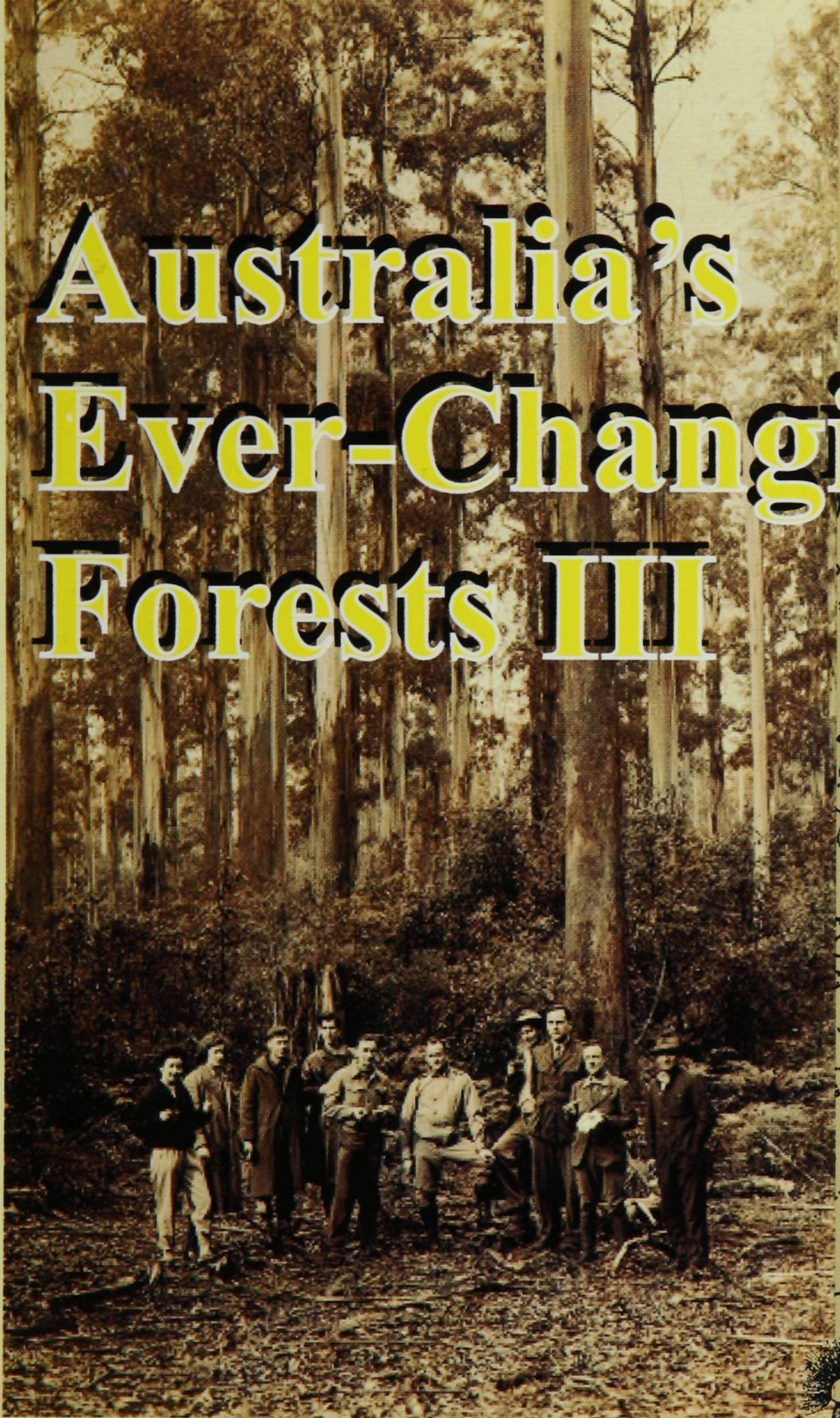
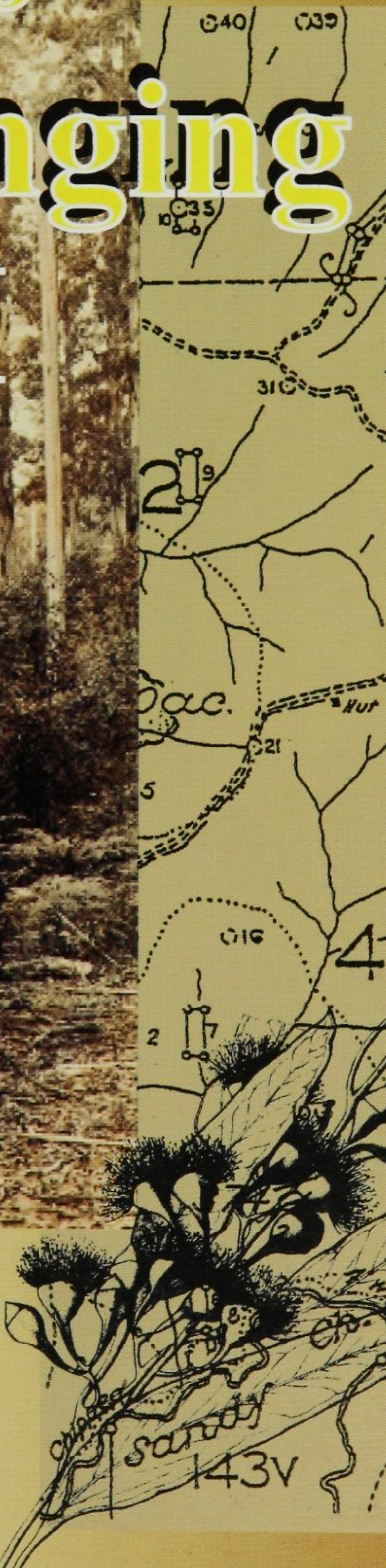
Australia's Ever-Changing Forests III





Proceedings of the Third National Conference on Australian Forest History

Edited by
John Dargavel

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Cover photo shows Melbourne University's Botany Part III class and postgraduate students in a mature mountain ash, *Eucalyptus regnans*, stand at Wallaby Creek, Yan Yean Catchment in the Victorian Central Highlands in 1947. The stand resulted from a fire c.1730 (see Chapter 13). From left to right: Fiona MacLennan, Jean Mathieson, John Fitzpatrick, Norman Endacott, Professor J.S. Turner, Jack Newey, Bob Oldham, John Brookes, Jim Willis, and an unidentified foreman from the Melbourne and Metropolitan Board of Works. *Photo*: late Professor E.J. Hartung.

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The authors

John C.G. Banks	Department of Forestry, School of Resource and Environmental Management, The Australian National University
Terry G. Birtles	Applied Geography, University of Canberra
Tim Bonyhady	Urban Research Program, Research School of Social Sciences, The Australian National University
M.J. Burns	Retired, Mt Macedon Nursery, Victoria
Pauline Curby	Professional Historian, Cronulla, New South Wales
John Dargavel	Urban Research Program, Research School of Social Sciences, The Australian National University
Moray Douglas	Retired Forester, Bairnsdale, Victoria
Norman Endacott	Retired Forester, Kalista, Victoria
Peter Evans	Light Railways Research Society of Australia
Tom Heinsohn	Environment and People, National Museum of Australia
Norman Houghton	Geelong Historical Records Centre
J. Donald Hughes	Department of History, University of Denver, USA
Keneth Jackson	Department of Economics, University of Auckland, New Zealand
Margaret Kowald	Queensland Department of Environment
Richard Lamb	Department of Architecture, University of Sydney

Ruth Lane	Environment and People, National Museum of Australia
Stephen M. Legg	Department of Geography and Environmental Science, Monash University
Jane Lennon	Heritage Consultant, Hamilton, Queensland
Daniel Lunney	National Parks and Wildlife Service, New South Wales
Damien Maloney	Department of Natural Resources, Queensland
Heather McRae	Professional Historian, Collingwood, Victoria
Jenny Mills	School of Social and Cultural Studies, Edith Cowan University
Chris Moon	National Parks and Wildlife Service, New South Wales (now Consultant, Coffs Harbour)
Colleen Morris	Department of Architecture, University of Sydney
Frank R. Moulds	Retired Forester, Mount Macedon, Victoria
Oliver Rackham	Corpus Christi College, Cambridge, UK
S.D. (Dennis) Richardson	Forest Consultant, Matueka, New Zealand
Michael Roche	Department of Geography, Massey University, New Zealand
Dale Sanders	School of Social and Cultural Studies, Edith Cowan University
Hilary Smith	Queensland Department of Natural Resources
Michael MacLellan Tracey	Department of Archeology and Anthropology, Faculty of Arts, The Australian National University
Kyle Weyburne	Department of Economics, University of Auckland, New Zealand (now Melbourne, Victoria)
Rebecca Williams	Queensland Department of Environment

Preface

Forest history has grown steadily in Australia since the first two national conferences were held in 1988 and 1992—in Canberra and Creswick respectively—and since their papers were published.[1] The first conference concentrated on papers reviewing major aspects of Australia's forest history, but also contained individual research papers. The second conference concentrated on research papers. Both reported the historical work being undertaken by public agencies. The subsequent growth in forest history occurred as a result of increased individual interest over a wide range of topics and as a result of greatly increased interest and funding by public agencies. The latter was largely due to the comprehensive regional assessments being conducted co-operatively by the Commonwealth and some State governments since 1991. The delineation of 'old-growth' forests became an important part of these assessments following the signing of the *National forest policy statement* in 1992.[2]

The third national conference, *Australia's Ever-Changing Forests III*, which was convened by the Australian Forest History Society at Jervis Bay, 24-27 November 1996, reflected these increasing interests, as can be seen from the papers to the conference which are presented in this volume. The selection of the theme of forest age, to which the first part of the conference was devoted, was stimulated by the attention being given to old-growth forests in the public arena. The very word 'old' commanded the attention of forest historians, as did 'growth' as capturing passing time, while the great but different values attached to such forests called for an examination of how their meanings evolved, all of which raised intriguing and more general questions. What are the various concepts of forest age? What do they mean in different sorts of forest? Is there a difference between the values attributed to forests and those attributed to trees? What values do Australians place on various ages and types of forest? How do they vary between people? How did forest age come to be so important?

A happy coincidence of interest between the Australian Heritage Commission, the Australian National University and the Australian Forest History Society enabled such questions to be explored widely. Six of the papers presented to the conference—Chapters 3,4,6,7,8 and 9 of this volume—formed part of a report prepared by the University for the Commission which has been published under the title of *The coming of age: forest age and heritage values.*[3] We are most grateful to the Commission for allowing versions of these papers to be included in this volume.

The first section of this volume explores concepts of forest age ranging from those expressed in the Greek and Latin classics of the ancient world to scientific measurements of tree age today. The second section examines aspects of forest age in Victoria, Queensland, New South Wales and Western Australia from the colonial period to the present. The question of the values placed on various ages and types of forest is considered in the third section. A variety of individual research papers have been placed in the following sections concerned with 'Using the forests' and 'Transforming the forest ecology'. Papers reporting the work of public agencies have been placed in the final section of the collection, 'Public history and methods'.

The conference was organised by Terry Birtles, John Dargavel and Sue Feary. It was held in the Commonwealth Territory of Jervis Bay with forest excursions to the National Botanic Gardens and to surrounding national parks and state forests in New South Wales. The Australian Forest History Society is most grateful to Mike Patrick of the Australian National Parks and Wildlife Service at Jervis Bay for making the Park Headquarters venue available for the conference, to Fred Howe for enabling the conference to visit the National Botanic Gardens and to Bruce Angus for guiding an excursion to Beecroft Peninsular. The conference and this publication was assisted by The Australian National University through the Urban Research Program in the Research School of Social Sciences, the Department of Forestry and the Centre for Resource and Environmental Studies.

I am most grateful to Sue Feary and Penny Handley for their assistance with editing the papers for publication, to Michael MacLellan Tracey for transforming the illustrations into digital images for publication and for designing the cover, and to McComas Taylor for his ready, cheerful advice.

John Dargavel
The Australian National University

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Concepts of forest age

Among all the varied productions with
which Nature has adorned the surface of the earth,
none awakens our sympathies, or interests, or imagination,
so powerfully as those venerable trees which have stood the
lapse of ages, silent witnesses of the successive generations of
man, whose destiny they bear so touching a resemblance,
alike in their budding, their prime and their decay.

Jacob George Strutt,
Sylva Britannica,
1826

1

Ancient forests: the idea of forest age in the Greek and Latin classics

J. Donald Hughes

Introduction

I invite you to join me on a search through the surviving writings of the ancient Greeks and Romans, and some of the Jews, for ideas about forest age. In contemporary modern discussions of forest management there are many mentions of 'old-growth forests','ancient forests', and what the US Forest Service calls 'late successional' forests.[1] Are these terms relatively new, or are there classical antecedents for the concepts they attempt to express, if not for the words themselves? At the outset, we must warn ourselves that, as in so many scientific endeavours, the result may be largely negative, and the path we will have to follow somewhat circuitous.

Our attempt, first of all, must be to discover what early writers said on the subject, and to postpone for the most part our critical tendency to ask whether they were right or wrong in their opinions. I would like to investigate just how many ancient forests there were, and where, and what happened to them in history. On another occasion, I hope to do so. But that is not my assignment for today. All scholarly essays must accept certain limitations, and mine is to deal with literary sources as a preface to the wider historical inquiry.

Age a characteristic of trees

The first observation we will make in our search is that in classical literature as in so many other places, it is hard to see the forest for the trees. Comments on the age of trees are much more prevalent than mentions of forest age. But we will begin with these comments, and proceed from the individual to the community.

A quality of trees that struck the minds of ancient writers was their longevity. When a prophet called Isaiah wants to emphasize the permanence of the future occupation of the holy city by the children of Israel, he says, 'Like the days of a tree shall the days of my people be.'[2] The Greeks and Romans were also amazed by how long some trees had lived. Pliny the Elder, first-century collector of natural history lore, notes that a wild olive tree in the marketplace at Megara had grown over the pieces of armor that brave warriors of the past had hung on it, so that the men who cut it down found greaves and helmets inside.[3]

Old trees

Several writers remark upon individual trees of great age. A search for the oldest tree mentioned in ancient literature might begin with the best documented examples and move backwards to trees of legendary antiquity. Theophrastus, the peripatetic student of Aristotle, wants the most dependable evidence he can find, most of the time. He opines that the plane trees which Dionysius the Elder had planted at Rhegium, although much thought of, had not attained great size in his own day. Since Dionysius died in 367 BCE, and Theophrastus wrote within about a decade of 300, those trees were about 70 or 80 years old, hardly record holders.[4]

Pliny, however, gives a list of trees of progressively greater age. An olive and myrtle planted by Scipio Africanus would have been about 260 years old.[5] A lotus tree existed in the sacred grove of Lucina, which was consecrated in 375 BCE, i.e. 445 years before Pliny's time, but the tree itself, he thinks, must be at least 500.[6] Seeking even more venerable examples, Pliny recalls a cypress as old as Rome itself that fell in Nero's day, 815 years after the founding of the city, and a nettle tree of Vulcan, planted by the founder Romulus and still growing in Pliny's day, 15 years after Nero.[7] But an oak[8] flourishing on the Vatican Hill was even older than the city.[9]

A plane tree at Delphi was reputedly planted by Agamemnon. That must have been before the Trojan War, since he was murdered as soon as he returned from it, more than 1200 years before Pliny.[10] Three oaks at Tivoli were as much as a generation older than the Trojan War.[11] Outdoing these examples is another mentioned both by Theophrastus and Pliny: the oaks on the tomb of Ilus, the hero who gave his name to Ilium (Troy), were reputed to have been planted there at the founding of that city, a date lost in antiquity.[12]

One might think that would end it, but the Jewish historian Josephus takes us even further back, recounting the story of the oak under which Abraham sat, called Ogyges. The Greek word *Ogygen* is a synonym for 'primeval,' or 'antediluvian.'[13] Near Hebron, he continues, is a terebinth that has been standing there 'from the Creation of the world until now.'[14] That obviously outdoes them all. The rings in such a tree would have settled the controversy concerning the date of Creation, perhaps, but there is no mention of annual rings in ancient literature. Theophrastus describes the rings but does not correlate them with yearly cycles. Even if the ancients had known about annual rings, however, they lacked increment borers and would have had to cut them down to count them.

Age and sacredness

For Greeks and Romans, age was linked with holiness. The older a tree, the more sacred it was likely to be. Theophrastus' list of famous long-lived trees is composed of trees linked with gods and heroes, including the olive Athena created on the Athenian Acropolis, Zeus' wild olive at Olympia from which the victors' crowns were cut, and the palm of the twins Apollo and Artemis on Delos, which had been grasped by Leto during her labour pangs at their birth.[15] In Rome, the Vestal Virgins hung their severed hair as offerings to the goddess in an ancient nettle tree.[16] Nero's stepfather, Caius Sallustius Passienus Crispus, fell in love with a beech tree that had been sacred to Diana 'from early times,'[17] and was observed not only to lie under it and pour wine on it, but to hug and kiss it as well.[18]

The image of a deity was often of wood, plain or carved[19] taken from a venerable tree sacred to the god or goddess. This was undoubtedly the case with the olive wood statue of Athena that the weavers of Athens provided with an embroidered robe every four years in the Panathenaic Festival. Jason's Argonauts, we are told, found 'a vine that grew in the forest, a tree exceeding old,'[20] so they cut it to be the sacred image of the mountain goddess.[21] It is clear that wood from an old tree was more appropriate than younger wood for this purpose.

Tree nymphs were 'of an age equal to their trees.'[22] Much longer-lived than mortals, they were not immortal, since they were born with their trees and died with them, too.[23] Woodmen had to be wary of lopping dryad-haunted trees with the axe, because nymphs often had friends among the gods who might work terrible vengeance on their killers. Not every tree dies when it is cut down, of course. Shoots can come from the stump, so that the tree grows anew.[24] Pliny knows of an oak ten metres around that had given birth, as it seemed, to a circle of ten daughter trees.[25] But 'is the shoot the same tree or a new one?' Theophrastus ponders.[26]

How does age affect trees?

Questions such as 'How does age affect trees?' and related ones are the subject of two portions of Theophrastus' writings on botany. In his descriptive work, *An Investigation Concerning Plants*, [27] he devotes a moderately long chapter[28] to longevity in trees; and in his physiological study, *Causal Phenomena in Plants*,[29] he provides another chapter[30] relating longevity to the bearing of fruit by trees. His comments on age in trees are, however, not limited to these passages. Pliny repeats a number of Theophrastus' observations and adds others he has collected.

Among Theophrastus' ideas are that older trees bear earlier in the year than younger ones, and mature all of their fruit;[31] however, that non-bearers live longer than bearers.[32] Pliny adds that almond trees and pears have their heaviest crops in old age, and, voicing a principle that may have some application among mature scholars as well, that older vines make better wine.[33] On the other hand, he adds that in all trees the bark becomes more wrinkled in old age.[34] Theophrastus quotes Democritus as saying that crooked trees live longer than straight ones, but adds, 'He is wrong.'[35]

Old trees shed leaves earlier than young ones, says Theophrastus, and leaves change their shape as a tree grows older.[36] Young trees sprout more.[37] The wood of older trees is inferior to that of younger ones as fuel. That of really old trees is especially bad, because it is dry and sputters as it burns; wood for charcoal should contain sap.[38] Pliny maintains that to be most useful for timber, trees should be neither very young nor very old.[39]

About roots there was a difference of opinion; Theophrastus says, 'Young plants root deeper and have longer roots than old ones.'[40] This is strange, because he also holds that older trees draw their food from a distance.[41] Pliny differs, noting that the roots of old trees can be very long.[42]

Firs produce pitch only when they are older, observes Theophrastus.[43] Among his ideas are that older trees hold out against sunscorch, but are liable to get grubby.[44]

A commonplace of many writers links age with size; in Arcadia, Pausanias tells us, he saw 'a grove of plane trees, most of which are hollow through age, and so huge that they actually picnic in the holes, and those who have a mind to do so sleep there as well.'[45]

Rapidity of ageing

So far we have been looking at the idea of age in individual trees. We come somewhat closer to our main subject, age in forests, when we examine our ancient natural historians' comments on longevity generally, and the rapidity of ageing, since these are considered to be characteristics that vary with types of trees. There is agreement that forest trees age very slowly,[46] and Theophrastus quotes woodmen as his authority for saying that wild trees are longer-lived than cultivated.[47] Fruit trees are held to be especially short-lived.[48] Trees growing in water are believed shorter-lived than those on dry land.[49]

Pliny asserts that the following trees 'do not experience decay and age: cypress, cedar, ebony, nettle-tree (lotus), box, yew, juniper, wild olive, cultivated olive; and of the remainder the slowest to age are the larch, oak, cork, chestnut, and walnut.' Palm, maple, and poplar age slowly.[50] Anyone with experience of trees would undoubtedly differ from the placement of some of these species on this list, particularly poplar, along with several others of the opinions quoted above, but our purpose here is to portray ancient opinion, not to correct it.

Human origins in forests

One of the most widely held beliefs about forests of the distant past connected them with the origin of human society. Forests existed even before people,[51] and constituted the supreme gift[52] bestowed by Earth on humankind.[53] Humans first lived in groves and woods.[54] Oaks first produced food for mortals and were the foster-mothers of the earliest folk in their 'destitute and savage state.'[55] In addition, forests were the teachers of humankind as they moved from one stage of culture to the next. Lucretius imagines that acorns dropping from oaks taught humans how to plant seeds,[56] and that the discovery of metallurgy happened when people discovered metals after forest fires had melted them from rocks.[57]

Old groves

One kind of forest often distinguished for its antiquity by ancient writers is the sacred grove, which could vary in size from a few trees to a wood several square miles in extent. These were protected because they were believed to be the residences of gods and spirits, and therefore had grown undisturbed for many years. Some authors believe that the age of trees in a grove was one of the factors that caused people to set it apart from ordinary land in the first place. 'Groves were the primordial temples of the gods,' maintains Pliny, 'By an ancient[58] religious ceremony, simple rural folk even today dedicate an outstanding tree to a deity; and we do not worship images gleaming with gold and ivory more than we do forests,[59] within their own silence.'[60] Seneca remarks, 'If you come upon a grove of old trees that have lifted up their crowns above the common height... you feel that there is a spirit in the place.'[61]

Sometimes an author will establish that a grove is very old by referring to archaeological evidence found within it. Diodorus of Sicily does this several times. He thinks a cypress grove at Cnossus on Crete is old because it contains the foundations of a house of Rhea 'which has been consecrated to her from ancient times.'[62] A forest near Panara with 'trees of every kind' he connects with a sanctuary of Zeus 'admired for its antiquity.'[63] The age of a palm forest in Arabia is shown by the fact that it contains an altar 'very old in years, bearing an inscription in ancient letters of unknown tongue.'

Its longevity may be contagious, since he remarks that the inhabitants are long-lived, too.[64] Animals were also protected in sacred groves and, it was said, achieved great age there: 'At the foot of the Atlas Mountain ... there are marvelous ... forests of the deepest, with the dense foliage of groves all shady and over-arched. And that ... is where elephants are said to resort in old age when heavy with years ... and they are regarded as sacred, under the care of ... the gods of the woods.'[65]

Anthropological evidence is offered by Procopius, who records that the Tzanoi, neighbours of the Armenians, worshipped groves as gods at a time when they lived as hunter-gatherers. Their forests remained impenetrable until Justinian conquered and Christianized them, felling trees to make space for roads, churches and fortresses.[66] More often an author will assert that a grove is very old because it has a mythological origin or association. Pindar refers to 'The most ancient grove[67] of the lords Aiakidai,' which would be at least as old as the Trojan War.[68] Pausanias reports that people say that a huge grove of planes on Mount Pontinus was dedicated by the daughters of Danaus, traditionally dated about 1425 BCE.[69] The grove of Colonus, described at length in Sophocles' play, *Oedipus at Colonus*, has many even earlier associations.[70] There are other instances of such claims of antiquity, too numerous to mention and of course impossible to verify.[71]

In many other cases, various words for 'old' and 'ancient' are used for groves without any specific association or indication of how long they might have been thought to exist. For example, Pausanias reports, 'On the Phliasian citadel is a grove of cypress trees and a sanctuary which from ancient times has been held to be particularly holy.'[72] Again, there are innumerable other examples.[73]

Occasionally one finds the idea that the sanctity of trees in a sacred grove preserves them from the effects of age. Speaking of the Grove of Aphrodite at Knidos, Lucian remarks that though the myrtle trees 'were old in years they were not withered or faded but, still in their youthful prime, swelled with fresh sprays.'[74]

The officials of Greek city-states and Roman municipalities promulgated laws to protect sacred groves and stationed guards to enforce them; inscriptions give ample evidence of this. As a result, the groves often contained old trees of remarkable size. They may not have been completely safe, since trees from groves were sometimes cut to make beams for use in temples. Regulations on the leasing of groves usually included replanting when trees were cut, but such requirements are closer to those governing sustainable yield rather than those intended to keep old-growth intact. Still, preservation was undoubtedly regarded as the rule and use as the exception.

Forest growth and succession

Theophrastus mentions the behavior of trees in association with each other in forests. 'Trees which are close together,' he says, 'grow and increase more in height, and so become unbranched, straight, and erect.'[75] Various tree species are 'good and bad neighbors' to each other, depending mainly on root structure.[76] He also notes that a forest may reestablish itself after a disaster: 'Where forests have been swept away by flood, the same trees grow afterwards.' And also, 'River floods encourage forest growth, as do heavy rains.'[77] These phenomena would of course depend on the forest species; he has failed to observe ecological succession.

Vanished forests

The idea that forests had existed in times gone by, but had been destroyed, is found in several of the classical authors. Lucretius recalls the clearing of forests for agriculture, saying that humans 'made the woods climb higher up the mountains, yielding the lowlands to be tilled and tended.'[78]

Others deduce that there must have been forests in places which were in contemporary times occupied by urban structures. 'There was a laurel grove[79] on the Aventine in Rome,' Pliny remembers.[80] Referring to Cyrene in Libya, Theophrastus says, 'There was a lot of sandarac[81] where now the city stands; roofs in ancient times[82] were made of it.'[83]

Strabo deplores the process of deforestation that he observed in his own day. 'Pisa [had]... timber for ship-building; in ancient times[84]... they utilized [it]... to meet perils... on the sea... but at the present time most of it is being used up on buildings at Rome, and also on the villas, now that people are devising palaces of Persian magnificence,' he laments.[85]

Primeval forests

Finally, there was a feeling of awe before what today might be called 'old-growth,' or 'ancient forests.' Virgil connects their antiquity with the mountain gods, singing of 'Old Father Apennine himself, with his roaring of quivering oaks.'[86] He also extols virgin forests, whose trees are 'unsown by mortal hand,' exclaiming, 'How fair the sight of ... fir trees, mountain born, and beauteous lands that owe no debt or wage to implement of man!'[87]

The age and extent of primeval forests on the edge of the known world genuinely excited admiration. 'If one thinks of the remote regions of the world and their inaccessible forests,' Pliny reflects, 'it is possible to believe that some trees have an immeasurable span of life.'[88] Not limiting himself to this generalization, he gives an example: 'In the northern region [of Germany] is the vast expanse of the Hercynian oak forest, untouched through the ages and coeval with the world, which surpasses all marvels by its nearly immortal destiny.'[89]

Conclusion

In a search through classical Greek and Latin texts, we have found references to age and ageing in individual trees, and in forests as well. The authors who gave the most attention to the subject knew that trees may change in appearance, configuration, and size as they get older. What they did not achieve is the concept of ecological succession; that is, that in ageing, the species composition and structure of a forest may change in characteristic ways. In seeking the roots of modern attitudes to late successional forests among the expressions of ancient minds, therefore, we must confess our failure to find much forest science worthy of the name. But we certainly find psychological antecedents. The admiration of venerable trees, the worship of antique god-filled groves, and the wonderment at endless, undying forests primeval that we find in the poets and philosophers have not disappeared. Expressed in other ways, they are among the motives for preservation of the remaining old-growth and opposition to logging of ancient forests that are still active today.

Notes

[1] United States Department of Agriculture, Forest Service, and US Department of the Interior, Bureau of Land Management. 1994. Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents Within the Range of the Northern Spotted Owl and Standards and Guidelines for Management of Habitat for Late-Successional and Old-Growth Forest Related Species Within the Range of the Northern Spotted Owl. US Government Printing Office (1994 - 589-111 / 00003 Region No. 10).
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[4] Theophrastus. Enquiry into Plants (HP) 4.5.6. Quotations throughout this paper are based on the Greek text and translation by Arthur Hort. 1916. Theophrastus, Enquiry into Plants. Loeb Classical Library, Cambridge and London: Harvard-Heinemann. Cf. Pliny 12.3, 7.
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[6] Pliny 16.85, 235
[7] Pliny 16.86, 236
[8] Ilex.
[9] Pliny 16.87, 237.
[10] Pliny 16.88, 238.
[11] Pliny 16.87, 237.
[12] Theophrastus HP 4.13.2; Pliny 16.88, 238.
[13] Josephus. Antiquities 1.10.4.
[14] Josephus. Wars 4.9.7, 533
[15] Theophrastus HP 4.13.2.
[16] Pliny 16.85, 235.
[17] Antiqua.
[18] Pliny 16.91, 242.
[19] xoanon.
[20] gerandryon.
[21] daimonos oureiês; Apollonius Rhodius. Argonautica 1.1117-23.
[22] Nonnos Dionysiaca 14.210-212.
[23] Homeric Hymn to Aphrodite 5.260-272.
[24] Theophrastus HP 2.7.2,3.
[25] Pliny 16.91, 242.
[26] Theophrastus HP 4.13.3
[27] Peri Phyton Historias.
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[31] Theophrastus CP 5.9.2.
[32] Theophrastus CP 2.11.1
[33] Pliny 16.51, 117.
[34] Pliny 16.55, 126, cf. Theophrastus HP 3.12.9.
[35] Theophrastus CP 2.11.7-9.
[36] Theophrastus HP 1.9.7; 1.10.1.
[37] Theophrastus CP 1.13.8.
[38] Theophrastus HP 5.9.1.
[39] Pliny 16.74, 192.

[40] Theophrastus HP 1.7.2.
[41] Theophrastus CP 5.9.2.
[42] Pliny 16.56, 130.
[43] Theophrastus HP 9.2.8.
[44] Theophrastus CP 5.9.2-3.
[45] Pausanias. Description of Greece 7.22.1. Quotations throughout this paper are based on the Greek text and translation by W.H.S. Jones. 1918. Pausanias, Description of Greece. Loeb Classical Library, Cambridge and London: Harvard-Heinemann.
[46] Pliny 16.51, 119.
[47] Theophrastus HP 4.13.1.
[48] Theophrastus HP 4.13.2; Pliny 16.90, 241
[49] Theophrastus HP 4.13.1, CP 2.11.1; Pliny 16.90, 241.
[50] Pliny 16.51, 119; 16.78, 212.
[51] Philostratus. Life of Apollonius, 8.18.
[52] Summumque munus.
[53] Pliny 12.1, 1.
[54] Lucretius. On the Nature of Things 5.955.
[55] Inopis ac ferae sortis, Pliny 16.1, 1.
[56] Lucretius 5.1360-62.
[57] Lucretius 5.1242.
[58] Priscoque.
[59] Lucos, groves.
[60] Pliny 12.2, 3.
[61] Seneca. Letters 4.12.3.
[62] Diodorus Siculus. Library 5.66.1.
[63] Diodorus Siculus 5.42.6–43.3, 5.44.5.
[64] Diodorus Siculus 3.42.2-5.
[65] Aelian. On Animals 7.2.
[66] Procopius. Buildings of Justinian 3.6.2.
[67] alsei palaitatô.
[68] Pindar. Nemean Odes 7.44-7.
[69] Pausanias 2.36.8-37.2.
[70] Sophocles. Oedipus at Colonus 11.54-61, 1593-7.
[71] Pausanias 4.1.6; 5.10.1; 8.11; 8.23.6; 8.38.5; 8.41.4; Strabo. Geography 14.1.27. etc.
[72] Pausanias 2.13.3–4.
[73] Pausanias 2.29.8; 3.22.8; Virgil. Aeneid 8.597 ff., etc.
[74] Lucian. Amores 12.
[75] Theophrastus HP 4.1.4.
[76] Theophrastus CP 3.10.3-8.
[77] Theophrastus HP 3.1.2,5,6.
[78] Lucretius 5.1370-71.
[79] Loretum.
[80] Pliny 15.40, 138.
[81] thyon.
[82] archaiôn.
[83] Theophrastus HP 5.3.7.
[84] palaion.
[85] Strabo. Geography5.2.5
[86] Virgil. Aeneid 12.701
[87] Virgil. Georgics 1.21-22; 2.437–42.
[88] Pliny 16.85, 234.
[89] Pliny 16.2, 6.

2

European ideas of the age of forests

Oliver Rackham

Europe is a glaciated continent. Even where it has not been covered with ice, most of it has been converted to tundra, or to steppe in southern Europe, several times over the last two million years. Forests can therefore seldom be more than 12,000 years old. No Holocene forest is exactly equivalent to the primeval forest of previous interglacial periods, because palaeolithic men had already altered the ecological balance.

Trees, of course, are living beings, not environment, and their history is not environmental history. Each species has its own agenda in life, and European trees have different agendas from Australian ones. Many of them are deciduous, shedding their leaves in the winter half of the year. In north Europe most trees are evergreen conifers. In middle latitudes (including England) most are deciduous broadleaves. In the Mediterranean south—in a climate resembling that of south-west Australia—most trees are evergreen broadleaves, but there are also winter-deciduous broadleaves and evergreen conifers.

European trees in general have more or less horizontal leaves, casting a denser shade than do eucalypts; they do not, however, produce chemicals which inhibit the vegetation under them. Adaptations to fire vary widely. Middle Europe, including England, is far less combustible than Australia, and most forests will not burn at all. Although Pyne (1991) claims that the importance of fire in England has been underestimated; nearly all his examples relate to non-forest fires. England has some fire-adapted plants (bracken, heather), but they are not trees, and forest fires are almost unknown. In the north fire is a major factor owing to the abundance of *Pinus sylvestris*, a fire-adapted tree; for example, many of the pinewoods of Scotland are a mosaic of different ages since fire. In the Mediterranean basin, where most of the vegetation, especially pines, is fire-adapted, fires are almost as important as in Australia.

When felled, many European trees sprout, to much the same degree as do most eucalypts (Rackham 1986). Most conifers lack this property. Browsing seems to be more important than in Australia. European trees are palatable to wild herbivores, especially deer, and to domestic livestock; this varies both with the tree and with the animal. Palatable trees in savanna, and often in forest, have their foliage ending at a sharply-defined browse-line at the height to which the particular animal can reach above ground (this is often seen with introduced trees in Australia). Some Mediterranean trees are highly adapted to coexist with browsing, much as Australian trees coexist with fire; these can persist for centuries in a bitten-down state (Rackham & Moody 1996).

Most European trees have better seed-dispersal mechanisms (by wind or birds) than most eucalypts. New forests readily spring up on abandoned farmland, as in North America. This property, too, varies from species to species, and some trees are poorly dispersed. Although a new forest may arise within decades, it may take centuries to acquire all the characteristic species. Most European trees have well-defined annual rings and are thus easy to date.

European cultural history

Europe has long been a continent of settled population and agriculture, extending back in the Mediterranean for half the Holocene. There is no defined date of discovery or settlement (except for islands such as Crete and Iceland), and usually no verifiable distinction between 'Aborigines' and 'settlers'. Some countries, such as England and Ireland, have had dense populations (by modern Australian standards) for at least 3000 years.

Europeans have devoted their landscape to agriculture, gardening, pasturage or woodcutting. They spent thousands of years cutting down trees with stone or metal tools, and digging up trees to create farmland. They have had less opportunity to influence the landscape by altering the fire regime, except in the far north and the Mediterranean basin where trees will burn and are fire-adapted.

In the early Holocene nearly all of Europe, except at high altitudes and in the driest areas, was covered with 'primeval' forest known as wildwood. Most non-forest land is the result of human activity. The present proportion of forest can vary from over half the land area, as in Finland, to less than two per cent, as in Ireland. Why some countries have more forest and others less is not well understood. In general the difference goes back before the earliest written records. The major deforestation of England, Scotland and Ireland took place more than 2000 years ago. The distinction between Italy, where forests were common, and Spain and Greece, where forests were rare, was as clear to Pliny (the ancient Roman naturalist) as it is today (Grove & Rackham 1998). England in 1086 A.D. had more forest than it has today, but less forest (in relation to its area) than France or Germany have now. Most European trees, except for most conifers, survive being cut down and sprout. This is the basis of <u>woodland</u> management by coppicing, which goes back at least 5000 years. Nearly all forests or <u>woodland</u> are 'umpteenth-growth', having been felled many times in their history.

By 1788 the English had long been used to trees and forests as a settled and permanent part of their cultural landscape (Rackham 1990). When describing the very different landscapes of Australia they used existing words but gave them new meanings. Their English meanings are summarised in Table 1. Most of the Australianisms seem to date from early in the colony's history, and are independent of American terminology. In this paper words like <u>woodland</u> are underlined to indicate that they are being used in the English, not Australian, sense.

Besides reducing the area of forest, and promoting woodcutting-adapted species in those forests that remained, human activities created new habitats for trees. Pasturage has greatly extended the area of savanna—cattle and sheep, to some extent, making up for the lack of wild beasts. There are also free-standing trees in hedges, parks, around settlements, and along roads.

The conversion of forest to non-forest is not a one-way process. Farmland, grassland and savanna have reverted to forest on many occasions. Most of the big wooded areas of medieval England contain archaeological evidence of settlement in earlier periods (e.g. Rackham 1989).

Table 1. Terms used in England which are different or unfamiliar to those in Australia

Term used in England	Meaning
Wildwood	Forest before human intervention
forest (small 'F')	Modern (not historic) term for land with continuous trees
Forest (capital 'F')	Historic term for a place of deer (often savanna with few trees or heath with none)
Woodland	Forest (in modern sense) as part of a cultural landscape
Wood-pasture (English) or savanna (American)	Scattered trees among non-forest vegetation
Coppice, copse	Forest which is frequently logged and grows again from sprouts
Scrub	Woodland in a young stage of development
Pollard	A tree (usually non-forest) which has its top repeatedly cut off (as can happen from natural causes or municipal engineers in Australia)
Grove	Small area of forest
Bush	Individual shrub or undershrub (not used for an area of land)
Wood (1)	Area of woodland surrounded by non-forest
Wood (2) (or equivalent in other European languages)	Stems less than 20 cm in diameter
Timber (or equivalent in other European languages)	Stems more than 20 cm in diameter
Maquis (French)	Trees reduced to the stature of shrubs
Phrygana (Greek) or *garrigue* (French)	Vegetation composed of undershrubs (which are not potential trees)

Wildwood and old-growth forest

Europeans know about the wildwood of the early Holocene chiefly from pollen analysis. It may not have been strictly wildwood. Palaeolithic men could have altered it in at least two ways. The elephants and other great tree-breaking beasts of previous interglacials were absent, probably because they had been exterminated. It is possible that the ability to sprout is an adaptation to browsing by great herbivores and not necessarily only an adaptation to fire, for many fireproof trees, such as *Tilia, Ulmus* and *Corylus,* are sprouters. The fire regime would probably have been altered in areas where fire was possible.

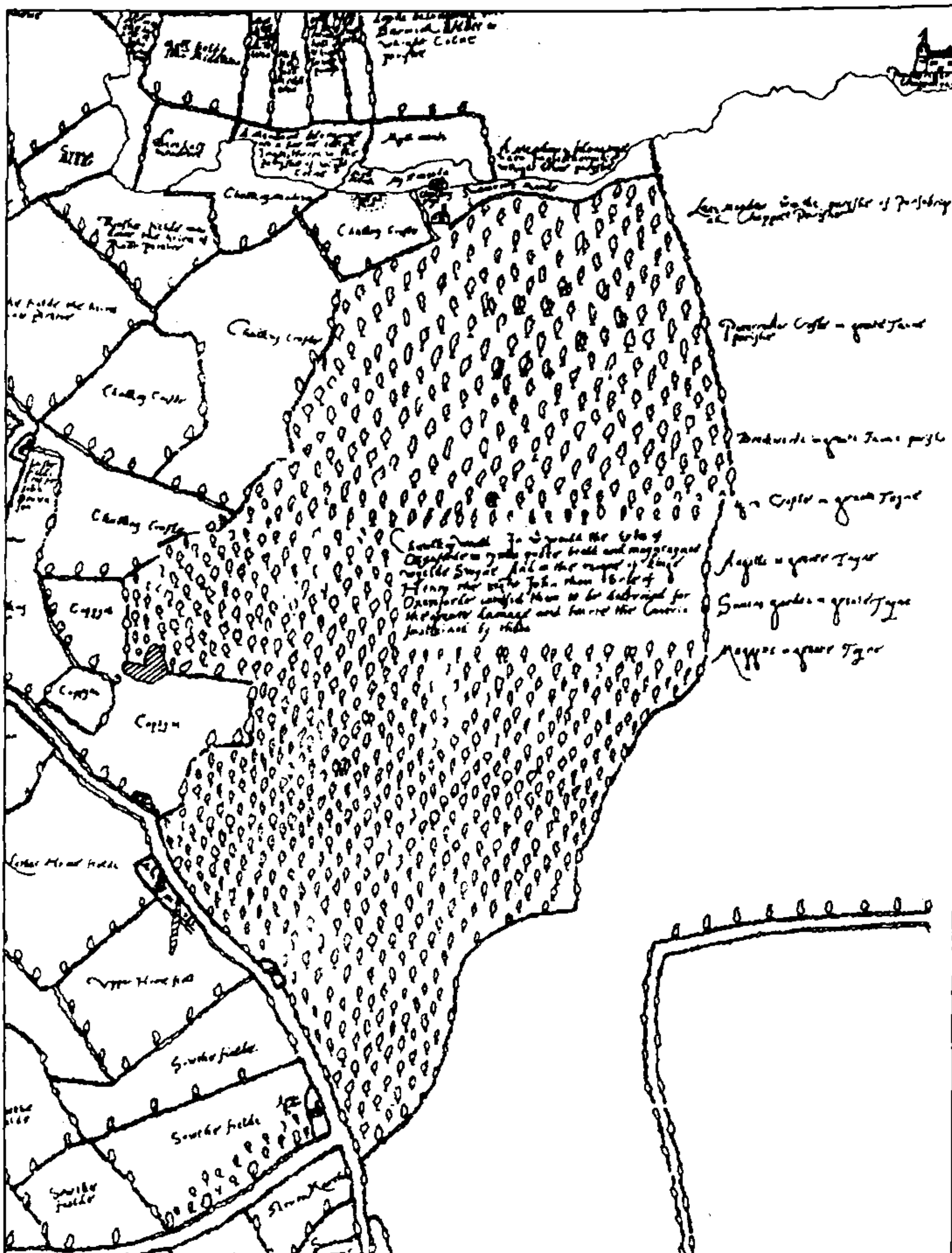

Figure 1A. Chalkney Wood, Earl's Colne, Essex, as mapped by Israel Amyce in 1598. The wood is about 2 kilometres long. A great earthwork runs all round the perimeter. *Source*: Traced from original in Essex Record Office

Figure 1B. Chalkney Wood, Earl's Colne, Essex, as photographed by a pilot of the German Air Force in 1940. Note the mosaic of different areas of regrowth since felling. *Source*:United States National Archives, Group 373, GX 10373F/1054/SK38.

Figure 2. Logging in the Bradfield Woods, west Suffolk. This scene has been repeated on this spot at intervals of about 10 years for at least seven centuries. The picture is of the variant known to academic writers as 'coppice-with-standards', in which the wood-producing trees have been felled but some trees have been left to grow on to timber size. *January 1980*

In a continent where civilisation has been pervasive for 6000 years, wildwood is most unlikely still to exist, and its existence is difficult to prove. Archaeological surveys often reveal signs of early settlement and agriculture even in areas which later were to be great forests. This is particularly true of areas where early civilisations produced monuments which are easily found even in forest, for example, the thousands of Iron Age forts (*nuraghes*) in Sardinia, or in countries such as England where archaeological study has been thorough. Elsewhere the apparent lack of archaeology in present forests may be merely because the dense vegetation hides all but the most conspicuous evidence. Even if people did not live in an area, they could have affected it at a distance by altering the browsing and fire regimes.

'Old-growth' is an American term not much used in Europe. In some European countries there are areas, usually of old trees, which are regarded as 'primæval forest' or 'virgin forest' and thought of as the equivalent of old-growth forest in other continents. Peterken (1996) gives a map of such areas. They are often not in remote or well-protected places, and their designation seldom depends on detailed knowlege of their history. Out of 264 sites, 112 are in Czechoslovakia, and none are in Britain, which suggests that the British have a narrower standard of designation than the Czechs or Slovaks. As Peterken points out, such 'old-growth forests' tend to have been designated by foresters, not ecologists. They are forests that for some reason have escaped the last 200 years or so of modern forestry. Many of them have been altered by activities other than forestry within the last two centuries, and what activities shaped them in the previous 5000 years is anyone's guess. As Peterken puts it, 'in most current usage the term ["virgin forest"] means little more than "old-growth unmanaged for at least several decades"'.

Figure 3. Scene in the Bradfield Woods (Figure 2) one year after felling. Among the regrowth is a dense stand of the herb *Euphorbia amygdaloides,* grown up from seed buried since the previous logging. *May 1987*

Pockets of wildwood, often too small to have attracted attention, may be expected to survive in particularly inaccessible places, even in densely-populated countries. Trees on cliffs and gorges escape browsing and burning, although woodcutting has often extended even here (Rackham & Moody 1996). Trees which are sensitive to browsing but not logging such as *Tilia,* or to burning but not logging such as *Cupressus,* may find refugia in such places.

Woodland in the cultural landscape

Looking for wildwood in Europe is chasing a might-have-been. Forests in reality are part of a cultural landscape, in which trees have come to terms with human behaviour. Europeans are settlers in other continents but Aborigines in their own. There is a history of centuries or millennia of conservation and management, especially in countries such as England where forest was rare.

Hayley Wood near Cambridge is a wood of 50 hectares surrounded by farmland. It is first described in A.D. 1252 in a survey of the Bishop of Ely's estates as *boscus de Heyle,* and its history can be traced in documents down the centuries to its present ownership by Cambridgeshire Wildlife Trust. A survey of 1356 says that it was supposed to be logged every seven years (Rackham 1975). Hayley is an example of Ancient Woodland. There are thousands of woods, typically of 5 to 100 hectares in extent, each with its own name, islanded among farmland, having permanent boundaries, and managed sustainably down the centuries (Figure 1). Although intensively logged (on a sustainable basis), they remain recognisable as natural vegetation; they are not plantations. Their plants and animals have come to terms with a management regime that has been relatively stable and has come to form part of the environment (Figures 2, 3).

Ancient woods are to be distinguished from the recent woodland which has sprung up on former farmland, heath, industrial sites, etc. It may take many centuries for such secondary woods to become assimilated to Ancient Woodland, although the latter often contains evidence of cultivation in the remote past. In England, Ancient Woodland is an official conservation designation, and English Nature has compiled a register of sites. Ancient woods can be identified not only from written records. The boundaries are fixed typically by banks and ditches, which defined the perimeter and made it easier to fence against browsing livestock. Other earthworks may subdivide the interior, marking former divisions of ownership; the labour invested in them demonstrates the importance then attached to woodland conservation. Changes of banks and ditches may mark areas added to or subtracted from the wood. Written records never tell the whole story: Gamlingay Wood, three kilometres from Hayley, is perhaps the best-documented wood in England, yet its archaeology reveals a complex history of which the documents know nothing.

Figure 4. Ancient coppice stool of *Cupressus sempervirens*, Eligias Gorge, Crete. This tree is one of the few conifers that sprout after felling. *July 1989*

The trees in ancient woods were expected to renew themselves by sprouting. This is mentioned several times in the Bible: 'And there shall come forth a rod out of the stock of Jesse, and a Branch shall grow out of his roots' (*Isaiah* **11** 1, 8th century B.C.). It is also alluded to in Roman and less often Greek authors (Rackham 1996).

Over the centuries these trees have developed massive permanent bases, up to five metres in diameter, recalling the ancient lignotubers of mallee eucalypts (Figure 4).

Many plants and animals are characteristic of Ancient Woodland. Some have poor powers of dispersal or establishment on new sites, such as lime, *Tilia cordata*. Others are adapted to the cycle of light shade and dense shade resulting from felling and regrowth, such as *Primula elatior* and *Euphorbia amygdaloides* (Figure 3) (Rackham 1990).

A source of evidence for woodland (and non-forest trees) in past centuries is the timber and wood contained in ancient buildings. These indicate the sizes, environments, and management of trees up to 800 years ago. Excavation of timber and wood in waterlogged sites indicates that woodland management in England goes back at least 5000 years.

Intermediates between forest and non-forest: hedges, savanna, maquis

Trees do not occur only in forests. Europe has trees in hedges, standing in fields, or scattered over the landscape in the form of savanna (roughly equivalent to Australian woodland).

Hedges

Rows of trees or shrubs along boundaries go back at least 2000 years; some individual hedges are more than a thousand years old. Boundaries in Australia seem not to turn into hedges as do those in Europe and North America. This may be because many European and American trees, unlike Australian, are dispersed by birds sitting on fences and excreting the seeds. (Hedges are less infrequent in West Australia.)

Maquis

Maquis consists of trees reduced to the form of shrubs by browsing, burning or woodcutting. Many Mediterranean oaks (*Quercus*) and other trees are adapted to living indefinitely as shrubs when circumstances require: they are roughly equivalent to the mallee species of *Eucalyptus.* Maquis is widespread in the less arid parts of southern Europe. It is often regarded as an artefact, as forest 'degraded' by human activity, but is really a long-standing ecosystem important in its own right.

Savanna

Savanna occurs in many European countries. It is now most widespread in southern Europe (Figure 5): the existence of savanna and maquis, as intermediates between forest and non-forest, makes measurements of forest area untrustworthy. Savanna has been overlooked by ecologists in the belief that it, too, is no more than 'degraded forest' unworthy of serious study. The story, however, is more complex than this. Much historic forest, and even wildwood, appears to have been in the nature of savanna, with non-shade-bearing herbaceous plants. In Europe, as in Australia, many present forests (including even some 'old-growth' forests) have the character of infilled savanna, with an old generation of big spreading trees now embedded in a crowded mass of younger trees.

Savanna was part of the medieval and earlier practice of wood-pasture, combining trees and browsing animals (Moreno 1990). Domestic livestock would eat the regrowth of felled trees and kill the palatable species. To prevent this, either logged areas were fenced to exclude animals until the new shoots were big enough not to be harmed, or it was the practice to pollard the trees, cutting them 2-4 metres above ground level so that the new shoots would be out of reach (Figure 5). Pollarding was used to provide successive crops of wood, or in some countries to yield leaves on which to feed cattle and sheep.

Figure 5. Savanna in the mountains of Fonni, Sardinia. The trees are ancient pollards of deciduous oak. Note the hollow trunks. *April 1992*

Areas of pollard trees usually took the form of savanna. Until the nineteenth century this was widespread in Europe. In the Age of Enlightenment it fell into decline, because of the fashion for disapproving of common-land and other multiple land-uses. Modern European forestry has almost always separated the growing of trees from pasturage, and has been particularly hostile to savanna. Savanna now survives mainly in countries such as England, Spain, Sardinia (Figures 5,6) and Greece, where modern forestry was late in developing and many areas escaped its influence.

Ancient trees

Many European trees are capable of living to several times the age at which they are 'mature' in the foresters' sense. Ancient trees have been venerated since Biblical times as picturesque objects and for their historical associations. Like deer, they play a part in native rites and ceremonies. They have been preserved as venerable features of later designed landscapes. They have names, and artists paint their portraits. If they are pollards (as most of them are) they are evidence of the history and use of the lands around them.

Recently it has been recognised that ancient trees are of unique value as habitats. A single ancient tree has rot-holes, red-rotted heartwood, dead limbs of various sizes, a hollow interior, old dry bark—a series of miniature ecosystems, each with its peculiar animals and plants, for which no amount of middle-aged trees are any use at all (e.g.

Harding & Rose 1986). Some of these habitats are enhanced by a history of pollarding (Figures 5,6).

Figure 6. Wood-pasture savanna, Staverton Park, Suffolk. The site was set up as a deer-farm in the twelfth century, and has kept its ancient trees. The middle tree, called the King's Oak, is probably at least 800 years old. *May 1979*

The occurrence of ancient forests is different from that of ancient trees. Ancient Woodland seldom contains old upstanding trees, but it does have the centuries-old permanent bases of trees that have been repeatedly felled. Old upstanding trees are normally in savanna and non-woodland situations, although infilling may have converted their sites to forest today. They are seldom relicts of former forests; indeed they often grew up as farmland trees, and may stand on archaeological features such as terrace-walls or stone-piles. Most trees live longest in adverse environments where their growth is slowed by infertile soils, pollarding, cold, or drought. They are not usually the biggest of their kind; very large trees are often comparatively young, having grown fast in a favourable environment.

In England wood-pasture was given a new lease of life in the eleventh century A.D. by the addition of deer to conventional livestock. Deer were kept as semi-domestic animals in parks (Figure 6) and Forests. These did not always contain trees, but where they did they were treated as savanna or wood-pasture. This began the characteristic English love of ancient trees, which continues in various forms until this day.

The fate of ancient trees is bound up with that of savanna. They are most numerous in England and Greece, where modern forestry was a late and incomplete development.

Conclusions

As in Australia, the age of a forest, the ages of the trees in it, and its age since last logging are three different things. The age of the forest as an ecosystem—the length of time since the site was something other than forest—may be much older than the oldest tree. Conversely, if the forest has grown out of savanna, it is possible for some of the trees to be older than the forest.

With trees that sprout, the age of the tree may be much older than the last time it was felled or burnt. Coppice stools and pollards, like lignotubers in Australia, may have outlived many cycles of felling or regrowth.

Centuries of woodcutting have produced stable ecosystems, of the greatest value both as cultural artefacts and as habitats for plants and animals. Felling is an integral part of these ecosystems, to the extent that lack of felling becomes a conservation problem. Many English woods for the last 70 years have suffered from too little logging; they are often in an excessively shady state.

This might be thought to give countenance to the theory that logging is beneficial to Australian forests and the creatures that dwell in them. There are, however, three important differences. First, European coppice-woods have come to terms with logging over scores of felling cycles and hundreds of years. Logging is a novelty in Australian forests, which are mostly in their second and third cycles and are unlikely to become fully adapted in the humanly foreseeable future. Second, in Europe, coppicing was preceded by drastic upheavals during the glaciations, which will have eliminated all the wildlife sensitive to disturbance. In Australia the effects of glaciation seem to have been less, so that disturbance-sensitive plants and animals, liable to be eliminated by logging, can be expected to survive to a greater extent than in Europe. Third, the effects of the logging cycle on shade are different. Australian trees tend to cast less shade than European trees in summer, and lack of felling does not normally result in excessive shade. However, the crowded sprout-growth of some eucalypts in the decades after logging produces a degree of shade seldom encountered in natural forests. This artificially dark, dense coppice phase may well be highly detrimental to ecosystems not adapted to it.

The importance of ancient trees in Europe has its parallels in Australia: here too it is important to prevent them from being tidied away in logging operations or 'stand improvement'. It is my impression, however, that there are some differences. In Europe ancient trees are usually protected from fire; in Australia they get burnt from time to time, which may affect their longevity and the habitats contained within them (e.g. rotten wood). Whether some eucalypts, like some oaks, can live for three or four times the average life-span of the species seems not to be known.

Savanna in Europe has declined through destruction by encroachment of farmland or forestry, and by infilling. Both of these have happened in Australia, although new savannas have been created by partial destruction of forest. In Australia as in Europe, there has been concern over decline of savanna trees and lack of replacement. To a European, a regrettable feature of many Australian savannas is the disappearance of the original grassland component. The trees may remain, but the ecosystem has lost its integrity where native grassland has been replaced by European grasses and weeds.

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3

Primeval forests in Australia

Tim Bonyhady

Sometimes they called it 'aboriginal'. Sometimes they called it 'old'. Sometimes they called it 'virgin'. More often than not they called it 'primeval'. That was how colonists generally characterized the forest which had survived European settlement more or less intact—and how Australians continued to characterize it through into the twentieth century. When this forest was felled, it became *A Primeval Clearing* as Arthur Streeton titled one of his paintings executed around 1888 at Gembrook in the Dandenong Ranges which shows a few dead trees in the foreground, a primitive hut in the middleground, then a wall of forest behind. The opening in the forest is manifestly new; a man holding an axe stands at the base of the biggest tree in the foreground; the clearing is only 'primeval' because of what is behind it.

What did colonists make of this forest? Most of them wanted it cleared 'entirely away'. They delighted, as Captain James Wallis's *Historical Account of New South Wales* put it in 1821, in how the 'primeval forest' could be 'changed from a mournful and desolate wilderness, into the cheerful village, the busy town, and the crowded city'.[1] Streeton's *Primeval Clearing* can be read as similarly celebratory. There is nothing to suggest that he was troubled by the destruction of the giant forest of the Dandenongs when he began painting in the 1880s. Rather his concern at the despoilation of Australia's forests developed only in the 1920s when, for example, he attacked the Victorian Forests Commission's plans to 'thin' the Cumberland Valley near Marysville because of how it would destroy the forest canopy, open the valley floor to 'strong sunlight and drying winds' and leave 'countless tons' of 'inflammable rubbish' littered through the 'once primeval forest'.[2]

Yet from at least the 1830s some colonists began looking very differently on Australia's old trees on account of their age. Although their work has long been forgotten – as early as 1920 the New South Wales Government Botanist, J.H. Maiden, claimed that there was only a 'scanty Australian literature' dealing with the rate of growth of eucalypts – some of Australia's leading colonial scientists began trying to determine the age of gum trees.[3] Insofar as they concluded that some species of eucalypts were very fast growing, colonists were delighted because of the 'industrial' implications for the eucalypt as a source of timber. When they concluded that the biggest eucalypts were hundreds, if not thousands, of years old, colonists began to argue that at least small stands of these trees should be protected. At least once, in 1889-90, the Victorian government was forced to abandon its plans to grant a timber concession near the Black Spur north-east of Melbourne partly because of the value colonists attached to this 'irreplaceable' forest.[4]

The age of the patriarchs

In the Old World everyone knew that each ring on a tree trunk indicated a year's growth and, to begin with, Australian colonists assumed that they could apply the same rule. Typical was the Tasmanian Governor Sir William Denison who in 1849 visited a shipbuilding yard at Oyster Cove where he saw two blue gums felled. One of these 'ordinary-sized' trees was 172 feet [52.4m] to its first branch; the other was 135 feet [41.1m]. According to Denison, both of these trees 'were from 270 to 300 years old, judging from the annual rings'. A decade later, when specimens of blue gum were exhibited at the Crystal Palace in London in 1859, the catalogue noted that 'from observations made on the annual rings of growth, it would appear to attain its full magnitude in about 300 years'.[5]

This view was probably orthodoxy among most colonists in 1875 when a Select Committee of the Tasmanian Legislative Assembly examined whether the export of native timber should be regulated so that foreign buyers could be confident of its quality. As if all eucalypts grew at the same rate, John Watson, an experienced timber merchant who had been in Tasmania for 43 years, testified that 'in Gum timber each year's growth has a ring for itself'. Watson declared that 'A gum tree takes three hundred years for its growth'. He had 'counted 280 rings in the timber'.[6]

The same view was maintained by the photographer Nicholas Caire who from the late 1870s through to the early 1900s did more than anyone to record Victoria's giant trees. One reason was their size: Caire took nationalist pride in the fact that the mountain ash were probably the tallest trees in the world eclipsing the sequoias of California. But the age of these trees was at least as important to him because he thought that they were probably the 'oldest inhabitants of the land'.[7] Caire's strongest reason for thinking Victoria's giant trees were of great age came from a mountain ash on the Black Spur north-east of Melbourne which was felled so that a section from it could be sent to the Paris Universal Exhibition of 1878. When a friend of his took 'the trouble of counting the rings from the core to the outer edge of the bark' of the stump of the tree, he found 1,200. Because he applied the standard old world rule of one ring for each year of growth, Caire concluded it was 'at least 1,200 years old' and that the mountain ash reached 1,200, if not 1,500 years, before decay and shrinkage set in.[8] Yet Caire at least occasionally imagined that the mountain ash were even older, influenced most likely by reports that the giant redwoods of the Sierra Nevada were up to 3,000 years old. Because the higher mountain ash were even taller than the biggest sequoias, Caire presumed that the 'patriarchs' of Victoria's 'older forests' must be even older. When an amateur naturalist David Boyle discovered a tree near Sassafras in the Dandenongs which he measured in 1888 at 466 feet (but which on remeasurement proved to be only 220 feet), Caire suggested in 1889 that this 'monster tree' might have withstood 'the shocks of time' for 3,500 years.[9]

The applicability of the European science of tree-dating to the eucalypts was questioned, however, already in 1853 by Governor Denison in a paper submitted to *Hooker's Journal of Botany* in which he provided detailed measurements of several big trees near Hobart including two which had been felled and proved to have 189 rings each. Denison explained that because 'the Gum-trees evidently make two shoots in the year, one in the autumn and another in the spring, the summer being an apparently dead time for them as regards growth', he suspected 'there might be a growth of two rings in the course of one year'. But after considering 'the size of these trees, and the rate of increase shown by dividing the number of rings by the radius in inches', Denison rejected this hypothesis. If the trees put on two rings a year, they would have grown quicker than Denison thought possible.[10]

This issue was taken up again in 1867 by the Reverend William Woolls, an Anglican clergyman-scientist, who concluded that tree rings provided little evidence of the age of Australian trees. One of his reasons was that, while these rings were 'clear enough in some of the younger trees of our forests', they were 'frequently obliterated and confused' in older trees and often did not exist at all because the trees became hollow. Woolls also drew on work done in Madras by Edward Green Balfour who had recognized that, while tree rings allowed for age to be calculated:

> with tolerable correctness in trees of temperate and cold climates, where during the winter there is a marked interruption to growth, and thus a line of demarcation is formed between the circles; ... in trees of warm climates, this mode of calculating age may lead to error.

Because of the irregularity of the seasons in Australia, particularly the occurrence of long droughts, Woolls declared it 'unlikely that calculations formed on the concentric circles of trees would lead to any solution of the problem regarding their longevity, even if other circumstances were favourable for such an investigation'.[11]

How then could the gum trees be dated? Woolls suggested that one possibility was to measure the rate at which different species put on girth and then extrapolate how long it would then take them to reach a given size. So he suggested that if:

> in some of the quickly-growing species, the diameter of the tree should be found to measure a foot [0.3m] in twenty years, then the same tree would require four hundred years to attain a diameter of twenty feet [6.1m] ... Or, again, if in some of the very hard and slowly growing species, 50 years should be required for the diameter of a foot, 300 years would be necessary to produce even the diameter of six feet [1.8m].

When Woolls applied this reasoning to ironbarks, he concluded that a tree just three feet [1.8m] in diameter could be 200 years old as an ironbark planted by Elizabeth Macarthur at Parramatta over 50 years before still had a diameter of only 1 foot [0.3m]. But Woolls also warned that his methodology was only useful while trees were growing. It applied to their youth and prime but not their old age and there was 'great obscurity in making any estimate of the period they may endure after they have passed the time of their perfect development'.[12]

For all this acute observation, Woolls was one of many colonists who could not stop himself assuming that the biggest trees had to be very old. Already in 1859 the catalogue accompanying the Tasmanian exhibits at the Crystal Palace had declared with no apparent justification that there was 'little doubt that trees of the Blue Gum now exist in Tasmanian forests which have witnessed the revolution of more than a thousand years'. Woolls did not go as far. But excited by reports from the Victorian Government Botanist, Ferdinand von Mueller, of giant mountain ash up to 480 feet [146.3m] high on the Black Spur, Woolls declared it 'impossible to believe that any trees could attain the astonishing height of 300 or 400 feet [91.4-146.3m] in less than several centuries'.[13]

Woolls was similarly unscientific a decade later when he delivered a paper on the 'Wonders of Australian Vegetation' to the Horticultural Society of New South Wales. So great was Woolls's enthusiasm for the eucalypts that he forgot his own earlier observations on the growth rates of different species of eucalypt which should have led him not to extrapolate from one species to another. Instead he proceeded to take the ironbarks at Parramatta as the basis for estimating the age of the mountain ash reported by Ferdinand von Mueller. Because he calculated that the ironbarks 'would not exceed a diameter of 6 feet [1.8m] in less than 200 or 300 years', he declared that a mountain ash 480 feet high [146.3m] or over 50 feet in girth [15.2m or 4.8m diameter] 'must be 1000 or 2000 years old'.[14]

Woolls's views about the great age of the eucalypts were implicitly supported by Mueller himself, although the great Victorian botanist was unusually unforthcoming with precise estimates of the age of these trees. Mueller seems to have first addressed this issue in a lecture at Melbourne's Industrial and Technological Museum in 1870s. Having described the 'marvellous' longevity of certain types of tree such as the cedars of Lebanon which he put at 2,500 years, British oaks which he thought reached 2,000 years and the giant redwoods which he believed attained only 1,100 years, Mueller declared: 'Here, in Victoria, the Native Beech and several Eucalyptus are veritable patriarchs of the forests, and of a far more venerable age than is generally supposed.'[15]

When Mueller returned to this issue a year later in another lecture at Melbourne's Industrial Museum, he declared that he had 'endeavoured to arrive at some idea of the real age of the larger trees'. But all he had to say was that 'a period of a quarter or even half a century must elapse before a solid plank, hardened by age', could be 'obtained from even a rapid growing eucalyptus tree'. So far as Victoria's oldest trees were concerned, he simply speculated that they might have 'stood already in youthful elegance, while yet the diprotodon—one of the megafauna which Mueller described as 'a wombat of the size of a buffalo'—was roaming over the forest ridges encircling Port Phillip Bay'.[16]

The Jesuit clergyman-scientist, Julian Tenison-Woods, put a radically different view of the gum tree's age in June 1878 in one of his most influential papers on 'Tasmanian Forests: Their Botany and Economical Value'. Within six months of delivering this paper to the Royal Society of New South Wales, Tenison-Woods was recording with suprise that it had attracted 'general attention' not just in Australia but in Europe and America. In April 1880 a reduced version of his paper dealing with the question of forest age was published in the English journal *Nature*.[17]

Tenison-Woods commenced his discussion by acknowledging that because of the size of Tasmania's eucalypts, one was 'inclined to attribute to them great antiquity'. But he announced that after trying to gather reliable information about the age of Tasmania's forests during almost three years on a 'missionary tour' of the colony, he had found no evidence to support this conclusion. His repeated questions had simply elicited 'mere guesses; from 200 to 300 years was the general reply'. In all he had found only two informants with useful empirical evidence about the rate at which trees put on rings and their observations suggested that Tasmania's eucalypts were of 'very rapid growth' and that even the largest were 'not of great age'.[18]

One of Tenison-Woods's informants was the owner of a big sawmill on the Huon, who felled a blue gum which his brother had planted 18 years before and found that it had 36 rings. His other informant was a farmer who cleared a paddock which had last had a crop on it 16 years before and reported that the biggest saplings had 33 rings.

Hence Tenison-Woods concluded that gum trees put on two rings of growth for each year. Because the sawmiller also seems to have reported that not one of the thousands of trees which had gone through his sawmill had more than 150 rings, while a 'very large proportion of ... serviceable timber' had just 100 rings, Tenison-Woods concluded 'the tallest trees of the forest, the giant timber of Tasmania, range from fifty to seventy five years old'.[19]

Tenison-Woods returned to this issue early in 1879 in one of his many scientific essays for the weekly *Australasian* in which he brought his work before a general audience. Rather than simply popularize what he had already told the Royal Society, Tenison-Woods both refined and generalized his conclusion. Unlike in his earlier paper, Tenison-Woods drew on a recent article in London's *Quarterly Review*, which suggested that lack of climatic extremes meant that tree rings in tropical countries were 'apt to be but faintly marked', while a 'cold snap' during the summer could 'divide the annual layer in two, and therefore be accounted as two years' growth'. Probably encouraged by these findings, Tenison-Woods announced that he was 'meeting with proof every day that two, and even three rings of growth are produced in the eucalypts in certain seasons, and that in times of extreme drought not even one is formed'.[20]

The problem with this new conclusion was that it implicitly cast doubt on Tenison-Woods's own earlier finding that Tasmania's tallest trees were just 75 years old. If trees sometimes formed no rings at all—and perhaps sometimes formed only one ring—there was no basis for dividing the number of rings by two. Moreover, as William Woolls had already recognized and Ferdinand von Mueller similarly noted in 1880 in his *Eucalyptographia*, identification of tree rings was itself not straightforward because 'the less regular intermediate rings between the annual layers of wood apt to be formed in the trees of the zone of evergreen vegetation, are easily mistaken for the results of a year's growth'.[21]

Tenison-Woods's conclusion that the biggest trees were just 75 years old was also too great a generalization as Woolls was quick to point out. In his *Lectures on the Vegetable Kingdom* published in 1879 and then in a paper to the Linnean Society of New South Wales in 1880, Woolls acknowledged that blue gums were particularly fast growing. He even accepted that one tree had 'attained 115 feet [35.0m] in seven years' and that in Tasmania they might assume 'gigantic proportions in less than a century'. But he insisted that such rapid growth did 'not apply to the species generally' and that 'the harder woods in the county of Cumberland' which he had observed for almost 50 years were 'slow in growth, and ...†centuries elapse before they reach their full proportions'.[22]

Nature and mammon

These very different views of the eucalypts' age of Australia's were not just a matter of arcane, scientific debate. They also underpinned very different views of what colonists should do with Australia's primeval forests. Those colonists who, like Tenison-Woods, believed that even the biggest, oldest trees were 75 years old at most, were inclined to see no reason to protect them from timber-getters. Those who, like Woolls, thought them the product of centuries of growth were much more inclined to argue that some of these forests should be preserved because, once they were destroyed, they could not be re-created.

Possibly the first colonist to suggest that Australia's big, old trees should be preserved was another Anglican clergyman-scientist, the Reverend W.B. Clarke, who arrived in Sydney in 1839 when much of the original native flora around the harbour had been cleared. The Austrian traveller Baron von Hugel recorded in 1834 how settlers in Sydney often removed 'every last trees round their homes'. This destruction made other settlers look more favourably on the trees which survived. In his first letter to his mother, written the day after he arrived in Sydney, Clarke observed of the few that remained around the harbour: 'These are old trees and I would not cut them down.'[23]

By 1870 Ferdinand von Mueller was calling for protection of some of Australia's old forests. In his lecture at Melbourne's Industrial Museum, Mueller declared 'Some feelings of veneration and reverence should also be evinced towards the native vegetation, where it displays its rarest and grandest forms'. According to Mueller, it was 'lamentable that in all Australia scarcely a single spot' had 'been secured for preserving some relics of its most ancient trees to convey to posterity an idea of the original features of our primeval forests'. While implicitly attaching most blame to government, Mueller also lambasted individual landholders for their 'vandalism' which he contrasted with the 'respect' for nature shown by the 'uncivilised inhabitants of many a tropical country'.[24]

When Mueller lectured at the Museum again a year later, he returned to this theme, contrasting his own success in 'saving many a venerable tree' under his control at Melbourne's Botanic Gardens with the fate of many old trees throughout the rest of Victoria which were 'sinking daily under our axes, often sacrificed unnecessarily'. Again the age of the eucalypts was a key part of Mueller's preservationist arguments as he asked, 'why should even the life of a plant be expended cruelly and wastefully, especially if, perhaps this very plant stood already in youthful elegance' when the diprotodon existed. Although he did not identify specific areas for protection, Mueller clearly wanted Victoria's 'primeval forests' preserved unless good reasons could be given for their destruction.[25]

John Smith, the foundation professor of chemistry at the University of Sydney, came to the same conclusion in 1871 after visiting the Mariposa Grove of giant sequoias in California which the United States government had protected seven years before. In his account of his travels, Smith recalled how on a visit to the Clarence River in northern New South Wales he had once measured a fig tree which 2 feet [0.6m] from the ground was 180 feet [54.9m] in girth and 6 feet [1.8m] from the ground had a girth of 118 feet [36.0m]. This tree had been felled soon after Smith measured it along with the rest of the Big Scrub along the Clarence. The contrast between what Americans had protected and Australians had destroyed led Smith to observe:

> In California, the Mariposa big-tree grove was made an inalienable reserve for public resort and recreation. Had our Government made a similar reserve of say a square mile on the Clarence, they might have preserved for the enjoyment of future generations some of the most wonderful productions of the vegetable kingdom, now hopelessly lost. It is still possible to secure a specimen of a forest of a very similar character ... in the district of Illawarra. I am not aware, however, that any such forest remains the property of the Government; but ... it is worth serious consideration whether some of it should not be bought back and carefully preserved for the common good. Once these aboriginal forests disappear no art can restore them.[26]

Yet when Australia's colonial governments began to enact laws to limit the cutting of native forests, they always sought to protect new growth by setting minimum size limits and ignored the old. For example, from 1870 regulations in Victoria prohibited the felling of all trees less than 18 inches in diameter but otherwise allowed splitters to fell an unlimited quantity of timber of any size and age in return for an annual licence fee of £5 and a royalty for sawmillers of 1 shilling for every thousand feet cut [2.4m^3]. The comparable regulations made in 1885 governing State Forests in New South Wales set different minimum girths for different species. While forest oak, *Casuarina*, had to be 2 feet 3 inches [0.7m], the minimum for red cedar was 9 feet [2.7m].[27]

Australia's first foresters supported this legislation because their overriding concern was to maximize timber production so that State Forests would yield the greatest possible financial return to the Crown. Typical was George Perrin who after working as Conservator for six years in South Australia, where organized forestry began in Australia, became Tasmania's first Conservator of Forests in 1886 and two years later assumed the position in Victoria. Time and again, Perrin emphasized that colonists needed all 'the old timber out'. He had 'no intention of keeping a single matured tree from the saw-miller'. When he first outlined his plans for reforming Victoria's State Forests in 1889, Perrin hoped to induce the sawmiller 'to take away old rejected trees and cut them up, by a reduction of the royalty charges on such trees'. But a year later he was arguing that sawmillers 'should be compelled to clear off every matured tree' from their concessions because 'every year it stands the tree is deteriorating through decay' and 'is simply occupying the ground to the detriment of its successors'.[28]

What did it mean for a tree to be 'mature'? Perhaps influenced by Julian Tenison-Woods's estimate that even the biggest trees were only 75 years old, Perrin generally identified a mature tree as between 30 and 35 years, although in evidence to Victoria's Royal Commission on Gold Mining in 1890, he declared 'the general life of the eucalyptus is from 30 to 35 years. But Perrin then made clear that he was equating 'life' with 'maturity'. According to the Conservator

> ... a eucalyptus planted now, in 30 to 35 years would become fit for the sawmill. If it is not cut down, every month it stands it is either rotting or deteriorating in some other way, and the sooner that tree is cut down the better. So we can arange for a rotation, and keep a large forest at from 30 to 35 years old.

Perrin's goal was to clear forest blocks of all such 'mature' trees and then close these areas 'for a rotation of years, say, 5, 10, 15 or 20, according to the growth of saplings upon the area at the time of abandonment'. his goal was to ensure that 'crops of trees' of uniform age and size were always coming on for the sawmillers.[29]

This approach to forest management finally became the stuff of politics in 1889 when the *Argus* revealed that Perrin had negotiated what he regarded as a model timber agreement – granting the Yea River Company exclusive rights over 5,000 acres [2023ha] of State Forest and 14,000 acres [5666ha] of adjoining land close to the Black Spur for 21 years with a right of renewal for another 21 years. Because the new company not only undertook to spend £100,000 on sawmills and tramways but also agreed to pay 2s 6d for every 1,000 superficial feet [3.0m^3] of timber which it felled, Perrin saw this agreement as a first step towards introducing a more general timber royalty. Perrin also believed that if logging were done by a single company it would be easier for his department 'to fix the responsibility of destroying saplings and immature timber'. The result would be both a proper financial return to the State and an end to indiscriminate logging by 'paling men' who left two-thirds of what they felled in the bush, often taking just one length of timber from trees 250 to 300 feet [76.2-91.4m] high. With manifest pride, Perrin informed his Minister that the new agreement marked 'an important epoch in the history of forest management in Victoria ... likely to result in a permanent revenue, conserve the forest and put a stop to the fearful and careless destruction going on everywhere'.[30]

When the Melbourne *Argus* revealed in November 1889 that Perrin had negotiated this agreement, there was 'an immediate explosion in Parliament'. Over the next two days it was debated twice in the Legislative Assembly. It was also the subject of a parliamentary inquiry and then another parliamentary debate in October 1890. In addition the agreement provoked a stream of editorials and articles in the press. As a result, the agreement did not proceed. The forests of the Black Spur were preserved from at least this threat but at the same time, Perrin's attempts to secure a better economic return from the forests were also stymied. When Victoria finally introduced a royalty on timber in the early 1900s, 'after strenuous opposition to change was experienced at every turn', it was the last jurisdiction to do so.[31]

Why was the Yea River Company agreement so controversial? One reason was that it was almost certainly illegal because the Victorian Crown Lands Act prohibited the Crown from granting a lease over a State Forest. But the agreement also offended both sides of politics on deeper philosophical grounds. The radical *Age* attacked the creation of monopolies in Victoria's forests as anti-democratic. The conservative *Argus*, which was the most influential advocate of environmental protection in Victoria in the late nineteenth century, argued that Perrin was wrong to try to turn the colony's forests into a source of profit to the Crown. It declared:

> The state does not wish to make a direct profit out of its timber. It is willing to dispose of trees as it disposes of coal or gold – in such manner as to promote general prosperity. The only reasonable stipulation should be that there must be a sufficient revenue from licenses to enable such a staff of inspectors and rangers to be maintained as is necessary to protect the forests and prevent spoliation ... the imposition of a royalty would not only be unnecessary for purposes of conservation, but would directly tend to increase the price of timber.[32]

The agreement was, however, most controversial on environmental grounds. A minor issue was that the government did not intend to require the Yea River Company to replant what it felled. The major ground of attack was that the mountain ash should not be logged at all. As the *Argus* put it in November 1889,

> The Black Spur forest is one of the beauty spots of the colony. Its magnificent timber, its sassafras and myrtle gullies, are only now beginning to be appreciated. Travellers who come ten thousand miles are charmed with the fairy spectacle which we have too much neglected. It would be nothing short of a crime now to hand over to the destroyer giant eucalypts and natural fern bowers, which could never be replaced.

This type of argument for protection of the forest was largely aesthetic. For example, the leader of the opposition James Munro declared it 'disgraceful to talk of destroying such a beautiful forest' which was 'one of the finest spots on the face of God's earth'. When the Minister for Lands John Dow interrupted and declared that the colony was 'not going to keep a forest for the sake of ornament', Munro responded by asking, 'Were they not? Were they going to destroy that forest ... surely they were not going to destroy every beauty spot in Victoria. Surely they would leave some parts of the colony for ornament'. According to Munro, the Black Spur 'ought to be reserved by Act of Parliament so that no-one should destroy it'.[33]

Not least, the *Argus* published 'A Plea for Beauty' by one of its occasional essayists, Edwin J. Hart, who identified Victoria's mountain forests as 'one of the few things of beauty' which colonists could point to with pride. While Hart acknowledged that it would be possible to turn the Black Spur into 'a perennial source of revenue' by replanting it with trees, he argued that 'deprived of its kings', the Black Spur 'would lose all distinctive feature and descend to a commonplace tree grown waste'. Not least, he questioned the type of civilisation which would engage in such destruction—reminding his readers that even the Goths and Vandals had revered the forest and would never have thought of clearing the Black Spur. As Hart put it, the barbarian had

> regarded the forest with a half affectionate, half superstitious veneration, and held his despoiling hand from its beauties. He deified the power of Nature, and enthroned his deities in the tree, the fountain, and the running stream ... In such woods as clothe the slopes and long ravines of the Black Spur, and plume the steep sides of high-crested Juliet, the barbarian would have seen a living temple, where we, or those who are supposed to represent us, see naught but an unproductive waste.[34]

The state of the forest was also a major issue as government argued that the area to be granted to the Yea River Company had already been worked over and hence was 'not really virgin forest, as had been stated'. To begin with, the Victorian Premier Duncan Gillies declared it 'had really been in the hands of the splitters ever since 1881' – a claim immediately disputed by James Munro who responded that 'only a small portion' had been worked in his way. In 1890 Perrin went further, claiming that 'the bulk of the land' proposed to be granted had 'been culled of its splitting timber over and over again for the past 30 years'.[35]

The age of the forest was even more of an issue as the government and its supporters argued that the mountain ash in the area were less than 40 years old because all the trees in the area had been killed by the bushfires of Black Thursday in 1851 and that, if they were not felled soon, all their timber would be wasted. Most notably, Jonas Levien, the prominent Geelong businessman who represented the seat of Barwon, ridiculed Munro's suggestion that 'the forests should be preserved as if they were something very sacred' when 'if they were locked up they would very quickly go to ruin'. While mountain ash grow rapidly, sometimes reaching 130 feet [39.6m] in 20 years, Levien claimed that they were of 'mushroom growth', reaching 300 feet [91.4m] within 35 years and then decaying just as rapidly. In similar fashion to Perrin, he declared that 'after 45 or 50 years' growth the timber would not improve.'[36]

Could Levien be correct? The *Argus* reckoned that even if the mountain ash grew as fast as he claimed and could be replaced in a generation, 35 years was too long 'for a beauty spot to remain as an object-lesson of greed and carelessness'. Hence it declared that even if mountain ash were as 'wonderfully recuperative' as Levien claimed, the Black Spur should not be subject to unrestricted logging and that any felling there 'should be done not for profit but to assist nature in her process of renewal'.[37] In any event Levien's argument was promptly rejected by several members of the Assembly who ridiculed the idea that a tree could grow 200 feet [60m] in 30 years. The *Argus* similarly declared it 'difficult to believe that the Black Spur giants, 75 feet in circumference [22.9m or 7.3m diameter] and hundreds of feet in height, could have attained their enormous proportions during the life of men ... still young'. Because it was sure that these trees were 'not likely to be replaced either in one generation or two', it argued that 'they should be preserved in common with the whole district'. According to the paper, the Black Spur was Victoria's 'wonderland—a spot to be held semi-sacred, inasmuch as it is nature's temple'. Neither the splitter nor the syndicate was to be considered for it was one place where colonists could not 'serve nature and mammon'.[38]

Notes

[1] James Wallis 1821. *An Historical Account of New South Wales*. London: Ackerman: 1; James Atkinson 1826. *An Account of the State of Agriculture and Grazing in New South Wales*. London: 90.

[2] *Argus*, 3 May 1929, p. 11. Tim Bonyhady 1993. A Different Streeton, *Art Monthly Australia* 61: 8-12. Compare Geoffrey Smith 1995. *Arthur Streeton 1867-1943*. Melbourne: National Gallery of Victoria: 24.

[3] J.H. Maiden 1922. *A Critical Revision of the Genus Eucalyptus*. Sydney: Spence, v.5: 244.

[4] *Argus*, 17 October 1890: 4.

[5] *Industrial Products of Tasmania exhibited at the Crystal Palace* 1859. Hobart: Bent: 10-11; Jospeh Milligan 1860. The Timber of Tasmania - Blue Gum. *The Technologist*, November: 101; William Denison 1870. *Varieties of Vice-Regal Life*. London: Longmans Green, v. 1: 114.

[6] Indigenous Timber: Report of the Select Committee 1875. *Journals of the House of Assembly*, v. 29: 6.

[7] N.J. Caire, Notes on the Giant Trees of Victoria, *Victorian Naturalist*, v. 21, 1904-5, p. 127.

[8] *Australasian*, 8 February 1908, p. 334; Caire, pp. 122-3.

[9] *Argus*, 30 January 1889, p. 8; 22 May 1889, p. 6; 6 June 1889, p. 8. See further Tim Bonyhady, The Giant Killers, *Sydney Morning Herald*, 3 February 1996, Spectrum p. 9.

[10] William Denison, Gum Trees of Van Diemen's Land, *Hooker's Journal of Botany*, v. 5, 1853, pp. 343-4.

[11] Woolls, *A*. 1867. *Contribution to the Flora of Australia*. Sydney: White: 221.

[12] Woolls, *A*. 1867. *Contribution to the Flora of Australia*: 220-2.

[13] *Industrial Products of Tasmania exhibited at the Crystal Palace*. 1859. Hobart: Bent: 10-11; Milligan: 101; William Woolls. *A Contribution to the Flora of Australia*: 220.

[14] William Woolls 1879. *Lectures on the Vegetable Kingdom*. Sydney: Fuller: 92.

[15] Ferdinand von Mueller 1870. *On the Application of Phytology to the Industrial Purposes of Life*. Melbourne: 7-8.

[16] Ferdinand von Mueller 1871. *Forest Culture in its Relation to Industrial Pursuits*. Melbourne: 18, 50.

[17] Julian Tenison-Woods 1878. Tasmanian Forests: Their Botany and Economical Value. *Journal of the Royal Society of New South Wales* 12: 17-28; *Australasian*, 28 December 1878, p. 806; *Nature* 1880. 21: 573-4.

[18] Tenison-Woods: 17, 21-2.

[19] Tenison-Woods: 22.

[20] *Quarterly Review*, v. 142, July 1876, esp. p. 79; *Australasian*, 22 February 1879, p. 230..

[21] Ferdinand von Mueller 1879-84. Eucalyptus Globulus. *Eucalyptographia*. Melbourne: Ferres.

[22] William Woolls. *Lectures on the Vegetable Kingdom*: 116; William Woolls 1880. Species of Eucalyptus of the County of Cumberland: Their Habitat and Uses. *Proceedings of the Linnean Society of New South Wales*. 5: 507-8.

[23] Elena Grainger 1982. *The Remarkable Reverend Clarke*. Melbourne: Oxford University Press: 76; Charles von Hugel (Trans. D. Clark) 1994. *New Holland Journal November 1833-October 1834*, Melbourne University Press: 275.

[24] Mueller. *On the Application of Phytology to the Industrial Purposes of Life:* 10-11.

[25] Mueller. *Forest Culture in its Relation to Industrial Pursuits*: 7, 15, 18, 50.

[26] John Smith 1872. *Wayfaring Notes (Second Series): A Holiday Tour Around the World*. Aberdeen: Brown: 302.

[27] State Forest and Timber Regulations 1885. *New South Wales Government Gazette*. 1: 166.

[28] *Argus*, 26 January 1889: 13, 28 January 1889:. 13; Woods and Forests of Tasmania: Report of the Conservator of Forests 1886-7. *Journals and Printed Papers of the Parliament of Tasmania*. 12: 9; Conservator of Forests for the Year ending 30th June 1890. *Victorian Parliamentary Papers* 4: 17-18; Report of the Royal Commission on Gold Mining. *Victorian Parliamentary Papers*. 5: 641, 643.

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[30] *Argus*, 21 November 1889, p. 7; 22 November 1889, pp. 6-7; *Age*, 21 November 1889, p. 4; *Victorian Parliamentary Debates*, v. 62, 1889, pp. 2443, 2483; v. 65, 1890, pp. 2114, 2120-1; Report from the Select Committee upon the Yea River Company, *Victorian Parliamentary Papers*, v. 1; Report of the Royal Commission on Gold Mining, *VPP*, 1890, v. 5, p. 643.

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4

Tree ages and ageing in yellow box

J.C.G. Banks

Introduction

Yellow box, *Eucalyptus melliodora* (Cunn. ex Schauer), is a one of the most widely distributed of the woodland eucalypts in south-eastern Australia, its principle occurrence in New South Wales on the tablelands and adjacent slopes west of the Great Dividing Range extends into adjacent lands in Victoria and Queensland where it is a common component of the *E. melliodora-E. blakelyi* alliance. These woodlands have been utilised for agriculture from the earliest days of settlement which began in the 1820s when squatters, following in the footsteps of the explorers Blaxland, Lawson and Wentworth, and Evans who had blazed the first access trail over the Blue Mountains in 1813 (McEwan 1979), began to move their flocks westward from the confines of the coastal plain to the tablelands near Bathurst. They soon spread west, south and north to occupy the extensive woodlands that lay before them. In selecting land, graziers were quick to recognise the value of yellow box as a reliable indicator of 'sweet country', the land carrying good native pasture (Lea-Scarlett 1968). Indeed, it was often the best land available consisting of undulating and easily accessible country with permanent water. It was well-treed and often referred to as park-like, providing shade and shelter from the hot summer sun for the expanding flocks of sheep and cattle herds. The soils were fertile although often shallow over-lying heavy clays.

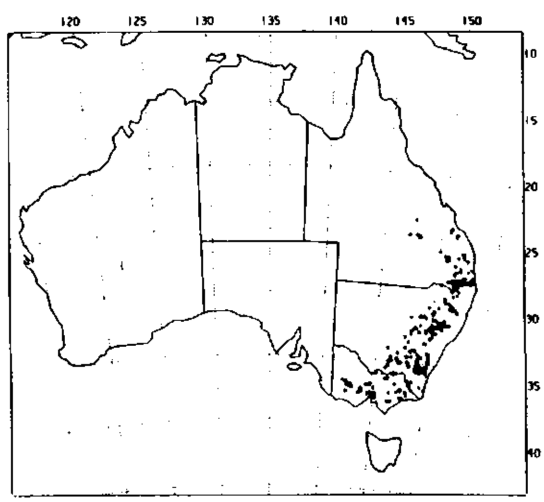

Figure 1. Distribution of yellow box (adapted from Boland and others 1990)

Most of the woodlands carrying yellow box have been utilised for grazing and to a lesser extent cropping for up to 175 years undergoing major ecological changes in the process so that today few stands resemble the original ones. The most profound changes have been the species composition of the native plant communities, the loss of top soil, and the extensive reduction of tree cover through the thinning out, usually by ring-barking, of the original trees to create open woodlands with scattered shade trees, and the loss of all or most trees in croplands. Grazing has suppressed tree seedlings while repeated cultivation has effectively eliminated regeneration. Often the last of the original stands are to be found along road easements and even these are at risk when roads are upgraded, widened and re-aligned. The result, inevitably, has been the fragmentation and 'thinning' of the woodlands with little or no tree regeneration. Tree populations have become smaller and are getting smaller still due to natural attrition as the trees get older, the death of weaker individuals and the absence of regeneration.

In order to rectify these losses, tree planting in rural Australia has taken on a new sense of urgency, particularly since the 'One billion tree' statement by the Commonwealth Government in 1990, and tree planting assistance programs through Greening Australia, Landcare and other organisations. Many of the trees being planted are native species. In New South Wales significant plantings are being made in the yellow box - red gum woodlands. Strategic plantings of yellow box and associated species will in time ameliorate deteriorating ecosystems by reducing salination and soil erosion, preserving and improving native ecosystems, enlarging wildlife habitats, adding to relict stands, preserving native ecosystems, and maintaining and enhancing landscape values. This comes at a critical time as many of the original trees, often left as isolated shade trees in the grazing lands, are slowly dying out, changing the landscapes for ever. This paper seeks to answer two questions: first, how old are yellow box woodlands trees, and second, what is the time frame for new plantings to resemble the mature trees?

Materials and methods

The Australian Capital Territory provided an ideal study site on the Southern Tablelands to answer these questions as it is located in the middle of typical yellow box-red gum woodlands which today are in various states of disturbance and periodic decline after some 170 years of settlement in the region. The sacrifice of woodland trees for new suburban developments in Canberra and Queanbeyan provided the opportunity to obtain bole cross-sections for tree age analyses. Yellow box trees which have been planted in Canberra over a long period provided a source of trees of known ages for non-destructive physiognomic study.

Tree ageing study

Bole cross-sections were salvaged in 1994 from trees being sacrificed in new housing developments in Jerrabomberra and Gungahlin with two samples coming from residential Garran and Theodore. From these trees, five samples with sound centres were sub-sampled to provide radial cross-sections for tree ring analysis and sound centre wood for radiocarbon dating. In addition a bole cross-section was collected from a 29 year old street tree in Garran which blew down in a windstorm in September 1996.

Tree physiognomic study

Four classes of trees representing a size/age series were sampled in spring 1996 to provide tree height, crown width and bole girth (measured at breast height over bark) data. The six youngest trees were saplings from 1990 plantings at the Namadgi National Park headquarters; 30 trees from 1967 plantings were sampled from the street and parkland trees in the suburbs of Garran, Hughes, Lyons and Chifley in the Woden Valley; and 30 trees from the 1932 planting in the median strip along Melbourne Avenue, Forrest were the oldest suitable trees of known age. The fourth category consisted of 31 mature and old-growth trees of unknown ages representative of the local pre-city woodland. These came from Australian National University campus in Acton (3), Uriarra Road (3), Melbourne Ave. in Forrest (2), Woden valley (8), Lanyon Station (5), Namadgi National Park headquarters (4), and Campbell, near the Pistol Club (6).

Results

Tree ages

Tree No. 65 provided a useful check as to the reliability of equating rings to years as its age was known independently, the tree was planted in 1967 as a street tree. A tree ring count on a basal cross-section matched the tree age of 29 years. False rings were sometimes difficult to identify and therefore tree ageing in this species using tree rings would not be precise. Tree ages were then estimated from tree ring counts for six of the mature trees (Table 1). For each tree sample tree rings were identified and counted to provide an estimated tree age. Mature tree ages ranged from 112 to 180 years.

Table 1 Tree ring counts (years) for mature yellow box trees

Tree no.	Cutting date	Locality	Latitude	Longitude	Girth (m)	Number of growth rings
31	10/1994	Theodore	35° 26′	149° 00′	4.50	170
32	10/1994	Garran	35° 20′	149° 08′	3.14	160
55	11/1994	Gungahlin	35° 12′	149° 08′	3.07	143
56	11/1994	Jerrabomberra	35° 27′	149° 11′	3.40	180
59	11/1994	Jerrabomberra	35° 27′	149° 11′	2.95	130
62	11/1994	Jerrabomberra	35° 27′	149° 11′	2.70	112
63	11/1994	Gungahlin	35° 13′	149° 08′	2.80	132
64	9/1996	Garran	35° 20′	149° 08′	1.10	29

Notes: Tree no. 31 - estimate of tree bole age in years; tree nos. 31-63 were sacrifice trees in new suburbs; tree No. 64 was a street tree planted in 1967

Ring widths were measured, but difficulties arose as to where the boundaries lay between some of the rings as they often displayed a sharp break between the early/latewood and a diffuse boundary between the late/earlywood raising the question of where the new seasons spring growth began. Ring widths were estimated and plotted (Figure 2). Ring widths did not appear to relate to seasonal conditions with respect to rainfall. For example, the ring for the drought year 1982/3 ring was one of the widest in the series. This suggested errors in defining the seasonal ring or other factors such as insect defoliation and supplementary garden watering may have influenced growth.

From the results of ring identification in tree no.65, the rings in six mature trees were assessed to provide age estimates and growth rates (Table 1). Ring counts were taken as estimates of tree bole ages since the tree rings were not always clear and distinct in the mature tree samples. These analyses provided ages from 112 to 180 years. These were taken as minimum tree ages as doubtful rings were assumed to be false rings and missing rings were an unknown quantity. For example, tree no.32 was much older than the ring count of 160 as cross-sections were incomplete and the outer 1.5 cm consisted of narrow indistinct rings which were not included in the age estimate. Ring widths were plotted as multiples of 10 rings, thus minimising errors from estimating each ring width (Figure 3). These data showed similar and uninterrupted growth rates in all trees, indicating that these mature trees had fully developed and undamaged crowns at time of sampling.

Table 2. Radiocarbon dates for centre wood from three mature yellow box trees.

Tree no.	ANU lab. code	Conventional age BP (years)	Tree age in 1994 and range	Inner ring date
31	9470	Modern, ie. post 1850	144 ± 30	1820 to 1880
32	9471	310	354 ± 40	1600 to 1680
59	10367	Modern, ie. post 1850	144 ± 30	1820 to 1880

Source: Data from Quaternary Dating Research Centre, ANU, Canberra

As a means of confirming the tree ages obtained from the ring counts, samples from the innermost solid wood from trees nos.31, 32 and 59 were submitted to the Quaternary Dating Research Centre, Australian National University, for radiocarbon dating. The results gave the inner rings of trees nos.31 and 59 a modern age of 1850 ±30 years. The estimates of age of 116-176 years old from this method may be compared to the estimates of 160 and 130 years from ring counts. The radiocarbon age for tree no. 32 of 354 ± 30 years was double the estimated ring count age estimate of 160. This large discrepancy could be explained in part by four narrow zones of decay which would account for a small number of rings. The major part of the discrepancy was accounted for by the numerous and extremely narrow and indistinct rings in the outer 1.5 cm of growth which were not included in the ring count assessment. The result confirmed that radial growth had been minimal over the last 100+ years.

Physiognomy of yellow box trees

Tree height, crown width, and bole girth data were analysed statistically and graphically to assess relationships of these characteristics between trees of known ages and with mature trees from the natural stands. All four tree classes were significantly different from each other for tree girth, height, crown width, crown silhouette (tree height x crown width), bole radius and crown radius, Table 3. The 1967 and 1932 cohorts were, as expected, the most similar. The mature trees were most dissimilar in girth and crown width, reflecting the continued increase in these attributes over time.

Graphically tree height vs bole girth (Figure 4) revealed a curvilinear relationship indicating that tree height reaches a 'ceiling' while the bole continues to expand in girth as the tree ages, although at a diminishing rate. The graph also shows that at least some of the planted trees had attained the mean height of mature trees. These mature trees had a mean height of 19.4 metres (range of 15-25 m) attained when trees had a girth of around 2.0 metres. Seventeen per cent of the 1932 trees and seven per cent of the 1967 trees had achieved a top height by 1996. The tree height data suggested that half mature tree height (10 m) could be achieved by age 20 years and the mean mature tree height (ie. 20 m) by 60-80 years. Early height growth can be quite rapid when trees are given favourable conditions. The heights of many of the 1967 trees overlapped those of the 1932 because most of the 1967 planting were street trees receiving some supplementary water and nutrients from residents gardens while the 1932 trees were from a medium strip planting and had no similar advantage.

Table 3. Mean and standard errors for yellow box trees in the different age/maturity classes. All tree categories were significantly different for all attributes.

Tree attribute Mean and (Standard Error)	1990	1967	1932	Mature
Girth (m)	0.30	1.22	1.63	2.86
	(0.06)	(0.05)	(0.05)	(0.12)
Height (m)	4.52	14.58	16.00	19.39
	(0.43)	(0.44)	(0.40)	(0.50)
Crown width (m)	2.60	9.20	11.48	19.78
	(0.39)	(0.45)	(0.34)	(0.65)
Crown silhouette =	12.29	133.88	185.21	384.37
height x width (m^2)	(2.49)	(9.50)	(8.62)	(17.03)
Bole radius squared	0.011	0.150	0.261	0.831
(m^2)	(0.039)	(0.011)	(0.015)	(0.080)
Crown radius squared	0.20	2.23	3.49	10.41
(m^2)	(0.058)	(0.241)	(0.026)	(0.0666)

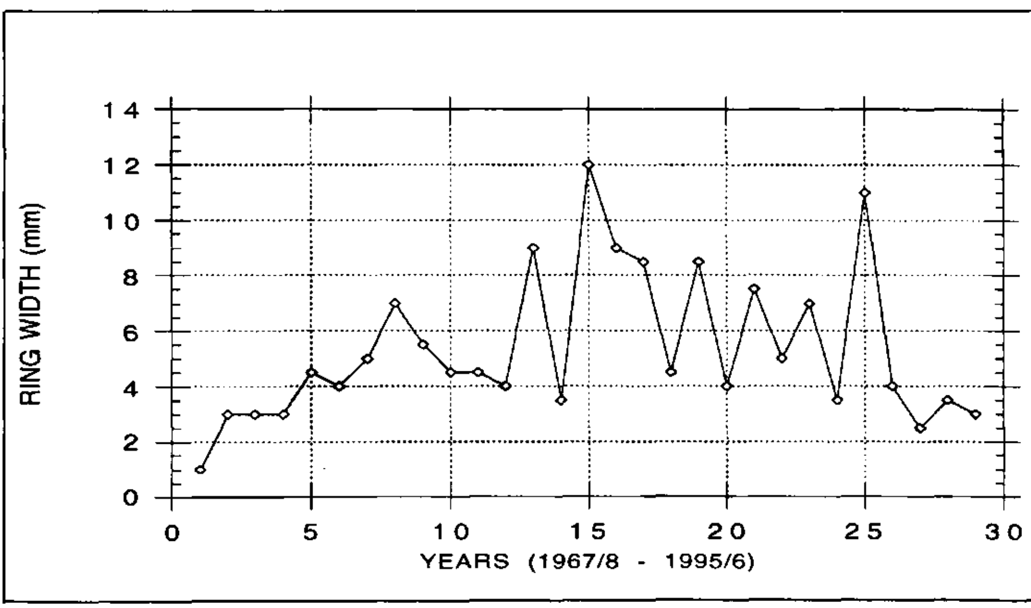

Figure 2. Plot of seasonal tree ring width for a yellow box tree planted in 1967 as a street tree in Garran ACT. The sample was cut from a windfall in September 1996.

Tree height vs crown width (Figure 4) revealed a similar relationship with crown width having the potential to continue to expand over time, doubling its size from around 15 to nearly 30 metres while tree height growth remained essentially stable. Some of the larger 1967 trees had crown widths larger than those of the 1932 trees. However, the mature trees were essentially distinct with wider crowns suggesting they were from a much older cohort of trees.

Tree height x crown width vs girth (Figure 6) showed a good relationship, with considerable overlap between age classes, in the planted trees but not in the mature trees suggesting that crown silhouette was not related to bole size in older trees. A similar pattern emerged with tree crown radius^2 vs bole radius^2 (Figure 5) indicating that cross-sectional area of the tree crown was not linked to basal area of the bole.

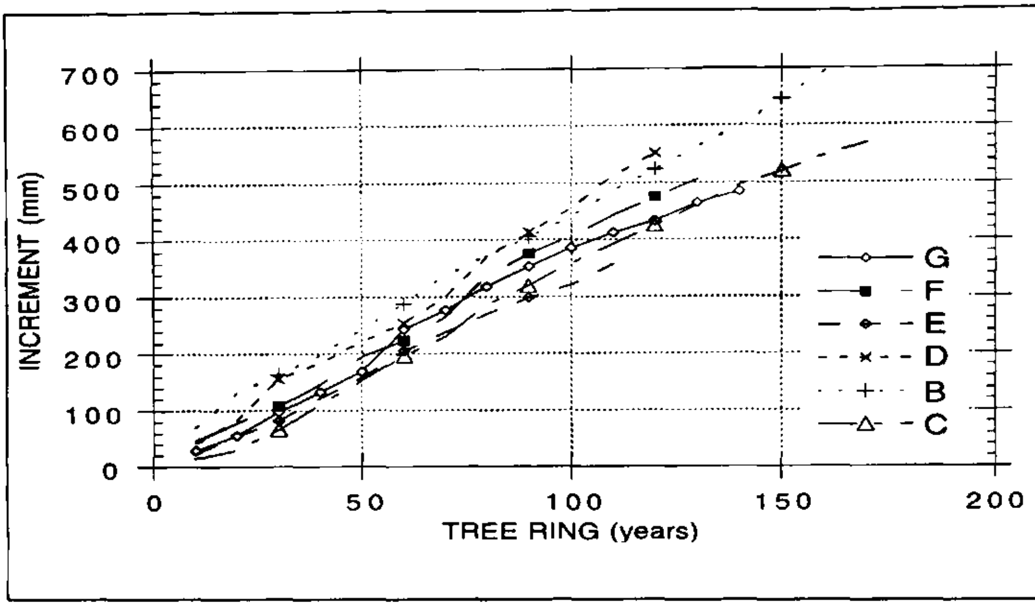

Figure 3. Graph of cumulative 10 tree ring increments in mature yellow box. Outermost increments not included as these were often indistinct.
(B = Tree 31, C = Tree 56, D = Tree 59, E = Tree 62, F = Tree 63, G = Tree 55)

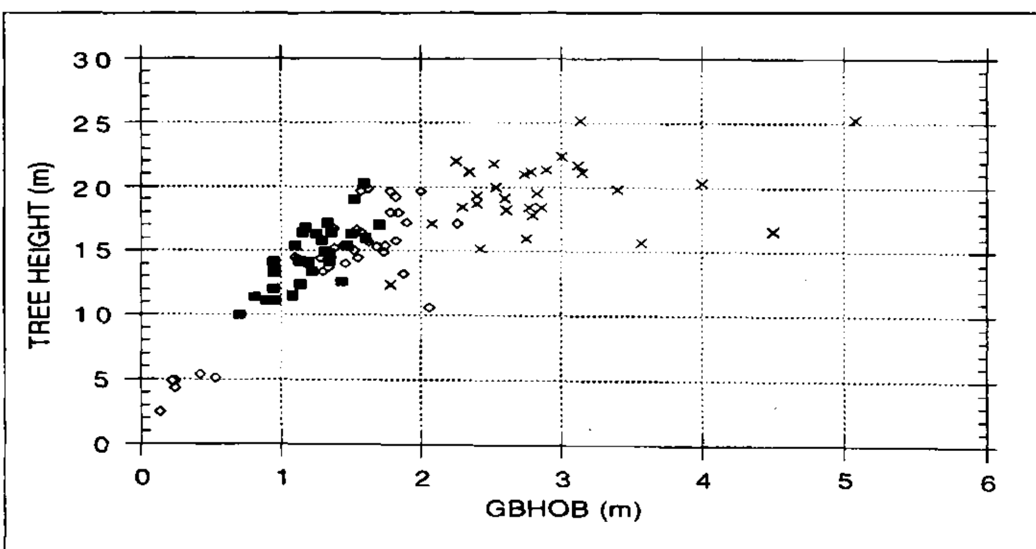

Figure 4. A scatter diagram illustrating the relationship of tree height to bole girth (GBHOB) for yellow box. Symbols represent (left to right) 6, 29, and 64 year old trees, and mature trees of unknown ages.

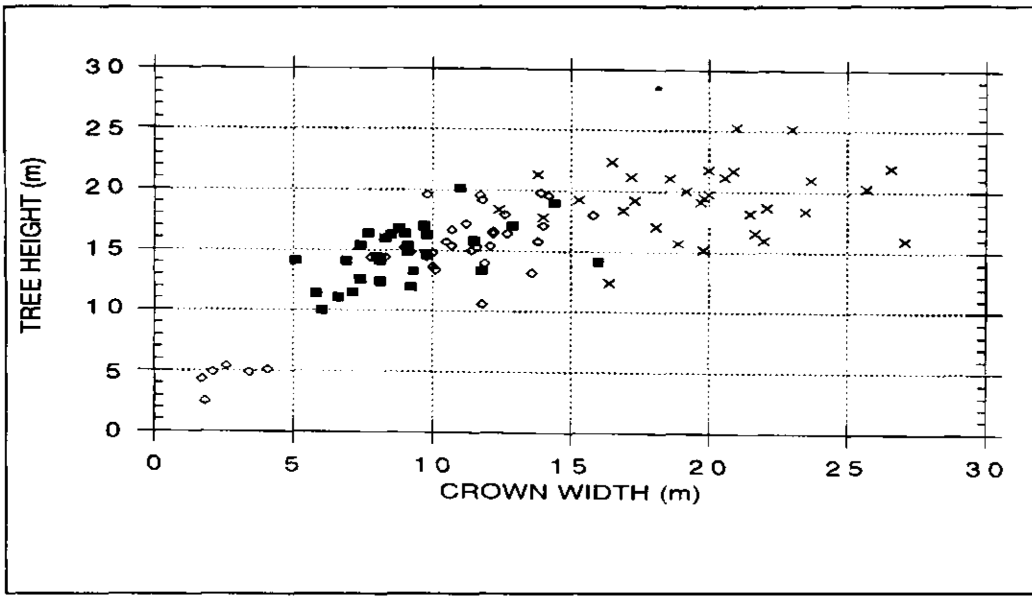

Figure 5. A scatter diagram illustrating the relationship of tree height to crown width (Symbols represent 6, 29, and 64 years old trees, and mature trees of unknown ages).

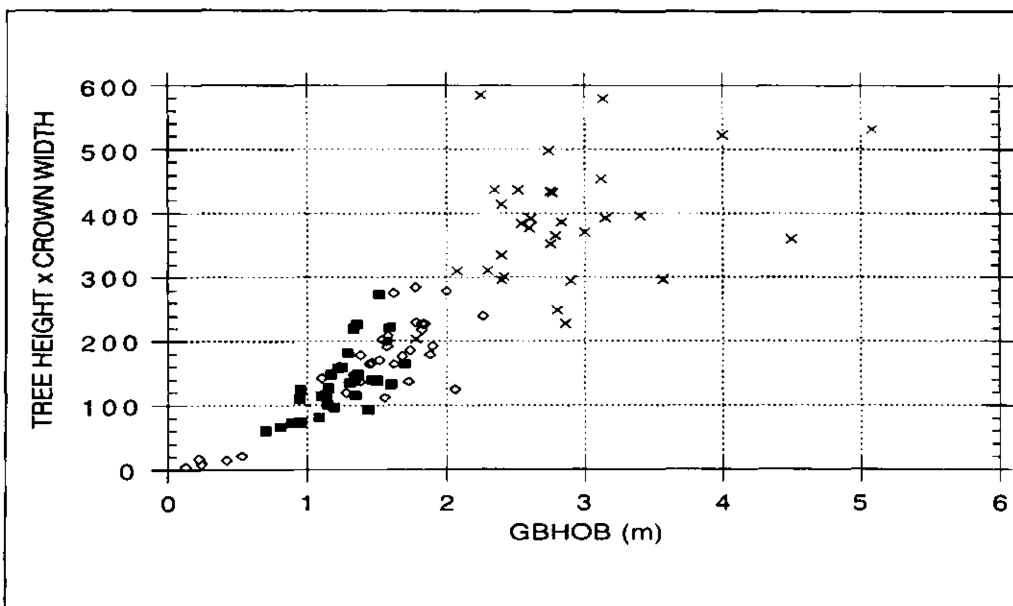

Figure 6. A scatter diagram illustrating the relationship between tree height x crown width vs bole girth (GBHOB). (Symbols represent 6, 29, and 64 years old trees and mature trees of unknown ages)

Discussion

Yellow box is an important component of the woodlands in south-eastern Australia and it is useful to comment on several aspects of ecosystem processes in these woodlands before considering the implications of the results.

The species and its environment

Yellow box is a rather majestic woodland tree, of medium-size to tall 15-30 metres in height and with a bole up to a 1.0 metre in diameter. It typically has a single trunk one third to one half tree height. The crown can be large and spreading and of medium to open density with pendulous branchlets. Its green or glaucous foliage is characteristically fine-textured, and bark persistence, colour and shedding pattern is variable. Indeed, trees in the same stand can appear to be from several different species with crowns varying from green to glaucous and the persistent bark from almost black to light-brown and extending from a short basal stocking to well above crown break. Nevertheless, flower and fruit characters are consistent for the species over its vast geographic range.

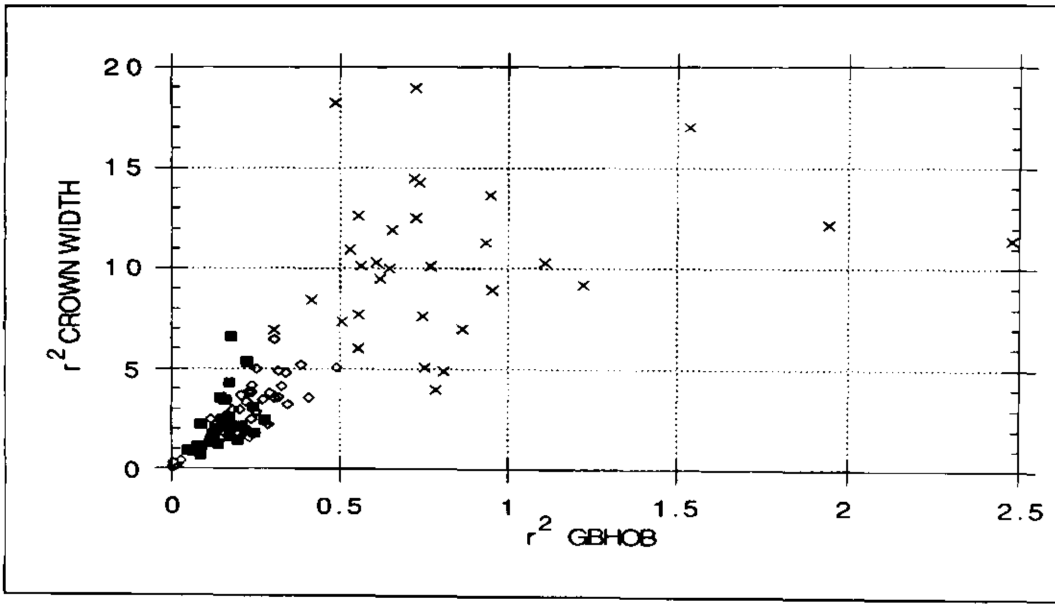

Figure 7. A scatter diagram illustrating the relationship of crown radius^2 vs bole radius^2 . (Symbols represent 6, 29, and 64 years old trees, and mature trees of unknown ages)

Yellow box was described in 1843 by the botanist Allan Cunningham who travelled through much of its geographic range on the tablelands and western slopes in New South Wales and adjacent Queensland between 1817-27 (McEwan 1979; Figure 1). It is appropriately named (from the Latin 'melleus' of honey, and 'odora' sweet or pleasant smelling) as it produces copious quantities of fine honey nectar keenly sought by apiarists (Hall and Brooker 1979). Taxonomically, it is rather separate and distinct from other eucalypts and, unlike many species, hybridisation is rare with only one example known from Murrundi in NSW where it occasionally hybridises with *E. albens*. This was originally described as *E. melliodora* var. *murrurundi* (Blakely 1934). Pryor and Johnston (1971) placed *E. melliodora* with *E. leucoxylon* and *E. sideroxylon* in the Series Melliodorae in their classification of the genus, while Hill in the *Flora of New South Wales* (Harden 1991) has retained the species in its entirety emphasising its unity and uniqueness in the genus.

Yellow box occurs over a latitudinal range of 24-38°S and is commonly found over an altitudinal range of 150-600 metres extending to higher altitudes in northern parts of its range. The mean annual rainfall is between 500-900 mm grading from winter to summer maximum from south to north, (Boland 1990). It withstands light frosts only, and treeless frost hollows occur in cooler parts of its range. It is often locally abundant on gentle slopes and foothills occurring on most rock types, except basaltic types. In southern New South Wales it is characteristic of the warmer, sub-humid areas of the tableland and is notably absent from the colder central Monaro, (Costin 1954).

Ecologically yellow box occurs in mixed species stands and is a major component of the *E. melliodora-E. blakelyi* alliance, being present as a dominant species in 7 of the 15 associations recognised by Costin (1954). Many tree species associate with it over its wide geographic range including apple box (*E. bridgesiana*), bundy (*E. goniocalyx*), grey box (*E. pilligaensis*), red box (*E. polyanthemos*), ribbon gum (*E viminalis*), white box (*E. albens*), various red gums including Blakely's red gum (*E. blakelyi*), brown stringybark (*E. baxteri*), red stringybark (*E. macrorhyncha*), and black cypress pine (*Callitris endlicheri*). Floristically the alliance is a rich one. On the southern tablelands of New South Wales it contains a large flora of some 239 species and varieties dominated by Australian and cosmopolitan species. This flora, not unexpectedly, is transitional between that of the adjacent dry sclerophyll forest and grasslands. The mature woodland takes on a parkland appearance. Structurally the upper stratum consists of widely spaced trees with rounded crowns having greater depth than bole length. The ground cover stratum is a continuous herbaceous sward consisting mostly of grasses subdivided into three strata characterised respectively by tall grasses, smaller grasses and forbs, and dwarf forbs (Costin 1954).

The dynamics of the pre-European woodlands

No large intact areas of undisturbed woodland containing yellow box remain today, all have been disturbed to a greater or lesser extent. However, it is possible from field observations to consider the dynamics of the tree strata in terms of tree loss and replacement. The trees, yellow box and its associates, occur in multi-age stands. This can be ascertained from the fact that no one environmental stress—fire, drought, disease outbreak or insect attack—kills the woodland trees over large areas. Rather individual trees decline and die from the effects of a multitude of environmental stresses imposed at intervals over time. Extended drought and windstorms are the most likely 'final factors' to cause the demise of individual trees. Since these woodlands are multi-aged only a few of the extant trees are susceptible to collapse at any one time thus ensuring persistence of the multi-aged structure. Tree losses create 'holes' in the woodland which are 'repaired' by regeneration quickly filling the gaps. This is known as gap phase replacement.

Fire imposes little direct impact on these woodland trees, although it can have several important indirect effects. This is because grass fuel loads ensure that woodland fires are of low intensity and tree crown and bole damage is limited. Yellow box has a thick bark, 2-3 cm on mature trees, which insulates the tree against fire damage and fire scarring seldom occurs. Fire scarring will occur when additional heavy fuel accumulates about the tree butt ensuring a hotter and longer lasting fire. This typically happens in over-mature trees when large branches break off from the crown. Fire scarring is unlikely to lead to tree collapse as the wood readily chars and structural integrity of the bole is maintained. Fire can indirectly affect the overwood by providing ash nutrients which can benefit the tree if there are suitable weather conditions.

Tree establishment occurs periodically in these woodlands, but only when the necessary conditions are achieved and in the right sequence: seed, a sterilised mineral soil seed bed, moisture and freedom from competition. Periodic fire events provide suitable seed bed conditions and over time, seedlings can accumulate in large numbers both beneath the tree crown and beyond. These seedlings fail to develop into saplings in the intact woodland because of the intense competition for resources by the established overstory. As a result they persist as 'low shrubs' being repeatedly droughted, grazed and mechanically damaged. Resprouting from a reservoir of bud tissue in the woody lignotuber ensures the persistence of these seedlings. Over time the accumulated seedlings constitute a significant 'lignotuberous seedling pool' waiting, as it were in the wings, to repair gaps as they appear in the overstory. When a gap occurs the suppression factor, the overstory tree, is no longer active and the established seedlings quickly respond to fill the space. More seedlings than can survive as trees compete for the newly created space, but eventually the best adapted and presumably fastest growing individual will replace the previous tree.

European use of the woodlands

The *E. melliodora-E. blakelyi* alliance contains some of the most valuable native pastures for sheep and cattle on the tablelands and many areas have been settled for over 170 years. The most important anthropogenic practices have been animal and plant introduction, ringbarking and clearing, and changes to the fire regime. These practices have had major impacts on these ecosystems and in particular on yellow box trees. In many areas the biodiversity of the original flora has declined. Over-grazing, the invasion of exotic plants, and soil erosion on a large scale have accelerated this decline. Ringbarking and clearing, combined with the loss of tree seedlings by rabbits and sheep and cattle have reduced the density of trees. Many residual trees are in a mature to over-mature condition and over the years without seedling regeneration the woodland is progressively regressing to a disclimax grassland. This process is accelerated by the harvesting of yellow box for fencing and farm timber, and in recent years increasingly for urban wood fires.

Today, many trees display gradual crown decline which is believed to be due to senescence of the root systems, (Middleton 1978). This rural dieback is often prominent where the original tree cover has been reduced, creating a more hostile environment to the remnant vegetation largely due to increased exposure resulting in physical damage, salination and increased application of fertilisers (Peck 1978; Greig and Devonshire 1981). Also the loss of crucial top soil has reduced the buffer against environmental stresses. Thus trees are dying prematurely as a result of increased stresses, new stresses and a greater frequency of environmental stresses.

The persistence and longevity of yellow box

A tree is an ideal form of life to attain great age. Its living tissues are repeatedly regenerated at short intervals with most living parts typically less than three years old, (Jacobs 1955). Old dead tissues support the new living tissues and in some cases protect them from damage and predation. Tree death comes about when one or more of the following occurs: the connecting linkage between the crown and roots is broken, the mechanical strength of the bole and/or roots fails, or access to adequate water and nutrients is no longer possible. Typically a combination of biological and environmental stresses bring an individual into decline until a single event finally kills it. Longevity depends largely on the ability of a tree to develop mechanisms to minimise the effects of environmental and biological stresses and to exist in an environment where such stresses are minimal. For example, thick bark insulates living tissues from fire, durable wood resists decay, and rejuvenating crowns recover from storm damage and insect defoliation. The eucalypts have evolved many such strategies but are not in the league of the world's longest living trees.

Data on the longevity of eucalypts remains limited. Old trees of the wet sclerophyll forest (Helms 1945; Lindsay 1939; Rayner 1992; Woodgate and others 1993; Banks 1994), and subalpine forest (Banks 1982), have been estimated at 400 years old. Some dry sclerophyll forest species, are at least 250-300 years old (Semple 1993). Mallee eucalypts typically reach about 100 years before becoming unstable and/or being destroyed by wildfire (Holland 1969), although their rootstocks may survive for hundreds or even thousands of years.

There have been no previous studies on tree ages in the temperate woodland eucalypts. In this study the maximum age for yellow box was the radiocarbon age for tree no. 32 of 400 years. This tree was in good condition and could have lived on for perhaps another 100 years. If so, then it puts these woodland trees amongst the oldest of the eucalypts. Additional indirect evidence for yellow box reaching considerable ages comes from an examination of the scar overgrowth on aboriginal canoe trees. One such yellow box from Lanyon property in the ACT bears the scars of bark removal by Aboriginals dating from at least the first half of last century, possibly earlier. The small amount of growth since scarring shows this trees slow growth, estimated at 1.5-2.0 cm, over the last 150-200 years. Older trees almost certainly exist in these woodlands as there are many large trees of similar physiognomy still extant. The species owes its longevity to its fire tolerance, having a durable wood, lack of major insect predation and fungal disease, and the capacity to rejuvenate its crown from epicormic bud tissue, an important attribute when the crowns of old trees begin to break up with the loss of both major and minor branches.

The loss of these ancient trees from the remnant woodland continues in what is referred to as 'rural dieback'. The causes of this attrition are multiple and complex but new and enhanced factors are contributory: stands may be progressively thinned out so that indivudal trees are left fully exposed to the effects wind and sun; the already shallow topsoil may be lost; and insect defoliation may increase. The tree bole ages for most of the sample trees were unexpectedly young, between 112 and 180 years. This placed their regeneration at before and during the early period of settlement last century and concurs with the fact that locally extensive and heavy woodland clearing occurred later in the eighteenth century and in this century by which time trees such as those sampled must have been seen as young vigorous trees suitable for retention as shade trees. For example in tree no. 31 from Theodore displayed rapid and prolonged growth for 150+ years. This tree had a ring age of 170 and a modern radiocarbon age, ie. 1950±30. It had a vigorous and youthful crown suggesting it was still growing rapidly when it died in 1993, almost certainly in response to changed soil levels associated with urban development. These data confirm that the species can reach a large size in a relatively short time span when growing under favourable conditions.

Opportunities for woodland recovery:

The integrity and long term survival of the *E. melliodora-E. blakelyi* woodland depends on the persistence of key species in semi-natural conditions. At present its survival as a species is not in doubt, but its fragmentation and changes to its demography place the ecosystem of which it is part at risk.

This paper has shown that yellow box seedlings established on yellow box sites that have not been degraded to the point where they can no longer support the species, and when given appropriate silvicultural treatment—pre-planting site preparation and follow up treatments in the early years after planting—has the potential to reach half tree height by their third decade and at full tree height in 60-80 years. They will be mature trees in the second half of next century.

Conclusion

In undisturbed stands yellow box populations are multi-aged with regeneration by gap phase replacement. The longevity of individual trees is equal to that of other eucalypts, and may be considerably more than 400 years. Many of the mature trees in local woodlands are between 100-200 years old. Dendrochronology has only limited application in this species as the tree rings can be indistinct, however in moderately fast growing trees the tree rings can provide estimates of tree ages.

The growth data from the physiognomic study of planted trees in the Canberra region encourages the expectation that yellow box has a future in these woodlands. With appropriate silvicultural practices, trees planted today can make a real contribution to maintaining the parkland character of the agricultural landscape and contribute to conserving and enlarging remnant stands.

Acknowledgments

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5

Growth rates: debating pathways for New Zealand forestry

Michael Roche

Establishing a context

The success of *Pinus radiata* and plantation forestry generally has tended to obscure the highly contested place of forestry in New Zealand in the late 19th and early 20th centuries as well as the sequence of abrupt government oscillations between promoting exotic afforestation over favouring sustained yield management of natural forests. Understanding these sudden policy shifts and episodes of vacillation on the part of politicians, public servants and scientists is not a straightforward task. Donald Worster (1990), the American environmental historian provides a useful framework in this regard when he identifies 'ecology', 'production' and 'empirical' as three layers of analysis. The scientific literature concerned with New Zealand's forest ecology is now extensive, though for the purposes of this paper it is pertinent to note the impact of biogeographical isolation and attendant vulnerability to introduced browsing animals. Worster's 'production' category in the New Zealand context was played as a particularly imperial variant aptly termed 'dominion capitalism' (Armstrong 1978). The purpose of this paper is to explore Worster's 'empirical' category in order to understand something of the intellectual context of various ideas, some conflicting, some in harmony about early forestry in New Zealand with a particular emphasis upon the role of ideas about indigenous forest growth rates.

In New Zealand three distinct 'knowledges' about forestry collided in the late 19th century through to the 1920s. These represent three different constituents of Worster's 'empirical' level and represent contrasting views of the nature and possibilities of forestry and its appropriate directions in New Zealand. The three knowledges may be termed 'official', 'popular' and—drawing on J. M. Powell's extensive work in natural resource appraisal and management in Australia (eg. Powell 1970; 1995)—'scientific'. The 'official' view of forestry was the bundle of (mis)understandings held by public servants, particularly those in the Department of Lands and Survey whose major efforts were dedicated to land settlement. 'Popular' views were those ideas circulating in the community at large. These are difficult to precisely define because they are 'common knowledge' and not written down, but there are some sources of evidence amongst the early popular agricultural writing and in newspaper accounts. Finally it is possible to identify scientific appraisals as a third type of knowledge about forestry. Much of this latter work was inductively based and not subjected to rigorous experimental valuation until the 1920s, however, it does constitute a distinctive view of forests and forestry directions. The comparative smallness of the New Zealand population also highlights the manner in which individuals can move easily (contradictions not withstanding) between different forest knowledges, for example, Edward Phillips Turner (Director of Forests 1928-1931) was formerly a senior public servant in the Lands Department and trained as a surveyor, but had a strong amateur interest in botany and forestry and was a member of lobby groups such as the New Zealand Forestry League. Foresters themselves are sometimes peculiarly positioned as public servants and hence experiencing an 'official' perspective but simultaneously being 'scientists' concerned with generating quite a different sort of knowledge.

A fairly small number of issues gained recurrent attention in the official, popular and scientific knowledges of forestry in New Zealand from the mid 19th century to the 1920s. They included: the *displacement concept*—a belief that the indigenous flora and fauna were giving way to stronger invading species; the *forest influences concept*—this attributed climatic modification to deforestation and afforestation, and was subsequently modified to emphasise flood protection; a *timber famine*—this was a persistent concern from the 1870s in New Zealand; and a *forest growth rates debate*—indigenous forest species were generally regarded as slow growing, although visiting foresters disagreed with this assessment. Each provided a rationale for forest management, but collectively and separately they won only slow acceptance because they appeared to conflict with the ethos of land settlement and, equally significantly, its economic importance to the Dominion.

The displacement concept

A number of 'forest management' systems directed towards timber extraction were adopted in New Zealand. These ranged from regulated use through timber licensing and reserves (1850s) to afforestation activity (1870s) and plans for rotational indigenous forestry (1920s). The displacement idea and subsequently timber famine concerns had the greatest impact. The notion of displacement of the indigenous flora by superior invading species suggested that the indigenous forests were doomed. In consequence stock grazing in forests, wind and fire damage were not regarded as significant causes of forest retreat. Displacement ideas inhibited exploration of the full potential of indigenous forest species. Management strategies at the time consisted of regulating the exploitation of the forest. Any concern for timber supplies in the future tended to be expressed in terms of afforestation proposals. This was to be undertaken with exotic species which performed well when introduced into the New Zealand environment. Only a few independent observers continued to champion the indigenous forest species with regard to replenishing timber supplies.

The forest influence concept

The forest influence concept provided a rationale for another type of forest reserve initially dedicated to 'climatic improvement'. A belief—found also in Australia and North America—that forests had a marked impact on the climate caused them to be regarded as more than as a source of timber. An expansion of this concept suggested that afforestation could actually restore the climate of a district; 'climatic amelioration' was a favoured phrase, and contributed to one type of forestry activity. Empirical investigation by the overseas scientific community of the forest influence question also caused a revision of ideas in New Zealand in the early 20th century. Flood protection and water conservation now received emphasis over climatic modification, but although the reasoning had altered, a stronger case for protection forests now existed (McKelvey 1995).

A timber famine
Fears of a timber famine were voiced soon after the beginnings of organized settlement in New Zealand and gradually gained momentum in scientific and official circles as the land was progressively deforested. The popular response was afforestation, which was received official support in the 1870s via the *Forest Trees Planting Encouragement Act*, 1872. In 1898, direct state involvement in afforestation began through the activities of the Forestry Branch of the Department of Lands and Survey. Scientific state forestry, as undertaken in Europe and India, emphasised the natural regeneration and harvesting of indigenous forests and was virtually unknown in New Zealand. Efforts at its introduction had been severely hampered by a clash of interests with land settlement goals. Scientific state forestry was not successfully introduced until the first decade of the twentieth century, when concern about a timber famine peaked and land settlement demands were largely satisfied.

Various official, popular and scientific views of forests, particularly those centring upon displacement ideas, forest influences, growth rates and a timber famine, provide significant insights into the forest history of New Zealand. However, some aspects of the initiation and demise of State forestry in the nineteenth century were the product of wider structural concerns. The substance of the *Forests Act* of 1874 advocated by Sir Julius Vogel was drawn from his personal observations, the advocacy of others, and a perusal of forestry literature. But in the wider context it may be viewed as part of Vogel's public works and immigration strategy. The Act was the product of his expansive financial designs; its emasculation was a result of the rejection of Vogel's bold borrowing and development policies and their replacement by financial restraint under Premier Harry Atkinson. This sequence of events was replayed by Vogel and Atkinson with the *State Forests Act* 1885.

A forest growth rates debate
The widespread official, popular and scientific view that the indigenous forests were slow growing was held in spite of an absence of comprehensive data. The implications were significant for the future direction of forest policy and management. Concurrently, exotic forest trees, notably pines and eucalypts, were found to grow rapidly in their new environment. In conjunction the difficulties of propagating and regenerating indigenous species and the apparent advantages of exotics led to early official efforts being directed towards afforestation incentive schemes. The efforts of the visiting British forester David Hutchins from 1915 to 1920 helped reverse official thinking and create conditions for implementing a scientific forestry programme. But L. MacIntosh Ellis, the Director of Forests (1920-28), calculated that demand would exceed the supply of available indigenous forest stocks by 1965 and took the bold step of embarking on 300,000 acre [121,000 ha] afforestation programme in 1925.

Growth rates in focus, 1880s-1920

The interest and enthusiasm for exotic afforestation stemmed from a positive factor: the encouraging results obtained from experimentation with exotic species, and a negative dimension: a belief that the indigenous forest flora, particularly kauri, was slow growing. The difficulties encountered in propagating indigenous forest species probably lent support to this view. Botanists, engineers, and foresters, each from a different perspective, and with diverse purposes, contributed to a debate over growth rates. In consequence, the 'scientific' view of the growth rates question altered, sometimes to extremes, with important implications for exotic afforestation and indigenous management strategies.

Initial opinion on the growth of indigenous forests stems from observations originally published in 1875 by Thomas Laslett, a Timber Inspector with the Admiralty, who made several visits to New Zealand in 1840-1843. Other contributions were made by Ferdinand Hochstetter (1867) and W N Blair (1876). Laslett judged the kauri to be, a 'slower growing tree than most firs and pines; it is slower even than the Pitch Pine of America, and makes only one inch [2.5 cm] of wood diameter in about six or seven years.' (Laslett, 1894, 389). He estimated that the 72 foot [23.6 m] circumference kauri at Mercury Bay to be 2000 years old. Hochstetter suggested that kauri of fifteen foot diameter was 700 to 800 years old and observed 10 to 12 annual growth rings to the inch [3.9-4.7 per cm]. Blair, an engineer, in a survey of the building materials of Otago, made estimates of the growth rates of indigenous forest trees in that region. Cedar, he believed, 'grows faster than most European timber trees' (Blair, 1876, 153). Miro, rimu and 'black birch', he also considered to be fast growing, while totara was described as a 'comparatively slow grower'. This survey was widely referred to and despite Blair's previously quoted observations was used to support the contention that the indigenous forest species were slow growing.

Toward the end of the 19th century, the view that indigenous forests were slow growing gained support. It is somewhat paradoxical that a prime contributor to this reappraisal was Thomas Kirk, the Chief Conservator of Forests (1886-89) and an eminent botanist who argued that 10 annual growth rings to the inch [3.9 per cm] was a 'fair average of a growing (kauri) timber' (Kirk, 1889, 144). He also referred to ring frequencies of up to 30 per inch [11.8 per cm] which led him to estimate the age of some specimens of kauri at 4000 years. Henry Matthews, the Chief Forester of the Lands and Survey Branch (ie. solely concerned with exotic afforestation), drawing on Kirk (1889), and Blair (1876) and some data from a plantation of native species in Thames for maturation times, posed the question:

> would the Forestry Department be justified in planting any ... (indigenous) trees with a view to providing for the wants of the future, when two or even three crops of exotic trees - such as oak, larch, spruce, Oregon Pine or eucalypt could be produced within the same period that one crop of native trees would take to reach maturity? (Matthews 1905: 78)

Not surprisingly Matthews saw only a limited role for indigenous afforestation.

The next contribution to the growth rates question was by Stewart (1905) who provided some statistics on indigenous trees known to have been planted in 1865, but more importantly by observation of ring counts of trees of known age, confirmed that kauri produced only one growth ring annually.

An investigation of major importance which overshadowed the previous studies appeared in 1913. Authored by Thomas Cheeseman, curator of the Auckland Museum, the paper entitled *The Age and Growth of Kauri* was specifically directed at the question of indigenous forest growth rates. He noted the tendency for exaggeration in human nature and concluded that this had happened in the case of the kauri where he suggested even 'careful writers' such as Kirk and Blair had assigned ages of over 4000 years and 3600 years respectively to large specimens, 'although neither gentleman appears to have counted the annual growth rings of even a single complete section' (Cheeseman 1913, 18). He ventured the opinion that a neglect of Laslett's work had produced 'from subsequent writers many rash and unsupported statements which otherwise would never have been made' (Cheeseman 1913: 10). Then he proceeded to attack Kirk's earlier work, claiming his assumptions were faulty and not supported by evidence. Specifically, Cheeseman argued that Kirk's two estimates of an average of 10 growth rings to the inch [3.9 per cm] for a five foot [1.6 m] diameter 300 year old tree and 30 growth rings to the inch [11.8 per cm] for a seven foot [2.3 m] diameter 1260 year old specimen were incompatible. Data collected by Cheeseman produced an average of 9.7 rings to the inch [3.8 per cm]. (In fact an arithmetical error occurred in the calculations and 8.5 rings to the inch [3.3 per cm] was more accurate). On this basis kauri trees dated by Kirk at 4320 and 3960 years were reassessed to be only 1398 and 1280 years respectively. That is to say, they grew more rapidly than Kirk believed.

In spite of demonstrating to his own satisfaction that kauri grew faster than had been previously thought, he still considered the species 'much slower than most trees of economic value' (Cheeseman 1913: 19) taking an average of 116 years to reach a two foot [0.6 m] diameter and 174 years for three feet [1 m]. 'Periods like these,' he concluded, 'are much too long to offer any hope of monetary returns from the planting of kauri, even if there were not other reasons to advance against such undertaking' (Cheeseman 1913: 19).

State exotic afforestation was thus apparently vindicated. But this view received a serious challenge from David Hutchins, who had extensive experience in South Africa and had only recently reported on Australian forestry. In an appendix to his Australian work he dealt with New Zealand (Hutchins 1916). As a consequence he was employed by the Government to report on the Dominion's forests. He argued that,

> Forestry in New Zealand has been entirely misjudged by the entirely erroneous idea that New Zealand native timber-trees grow more slowly than the ordinary timber-tree of other countries. (Hutchins 1916a: 301)

On these grounds, as well as using cost minimising arguments, Hutchins argued for indigenous management rather than afforestation as the solution to New Zealand's timber supply problems. In his subsequent report on New Zealand Forests, Hutchins (1919) expanded his arguments and lauded Cheeseman (1913) for dispelling the popular notion of the slow growth of kauri, dismissed Kirk (1889) as not understanding the true significance of his data, and insisted that Matthews (1905) had also misinterpreted his information. In Hutchins' opinion, the indigenous trees grew 'about twice as fast as European forest trees' (Hutchins 1919: 18).

Hutchins' views were not accepted unanimously. Ebenezer Maxwell (1919), a local afforestation advocate who established Taranaki Perpetual Forests Ltd in 1925 (see also Maxwell 1930), marshalled evidence in favour of faster growth of exotic species. The implication that Maxwell drew from his analysis was, 'that it would be an utterly hopeless undertaking to attempt to provide even a small portion of future needs in timber by growing native trees.' (Maxwell 1919: 372). Hutchins replied to Maxwell in 1920 claiming that he did not clearly distinguish between 'arborculture' (individual trees) and 'forestry' (mass trees). The former was concerned with unit growth per tree and the latter timber production per area. Hutchins did concede that there was a place for exotic plantations in New Zealand, because of the comparatively small area of forest and because some exotics showed 'an extraordinary rapid growth' (Hutchins

1920: 1) under local conditions. But he argued that Maxwell had compiled a diverse set of data, not all directly comparable because of variations in collection procedure. His major point, however, was that New Zealand forest trees *in situ* grew faster than European forestry trees in their own environment. In Hutchins' opinion the faster growth of some exotic species was not crucial:

> As long as there are no costs of planting plus interest on the native trees, it does not much matter if they do take considerably longer to produce their timber than costly and doubtful exotics. (Hutchins 1919: 4)

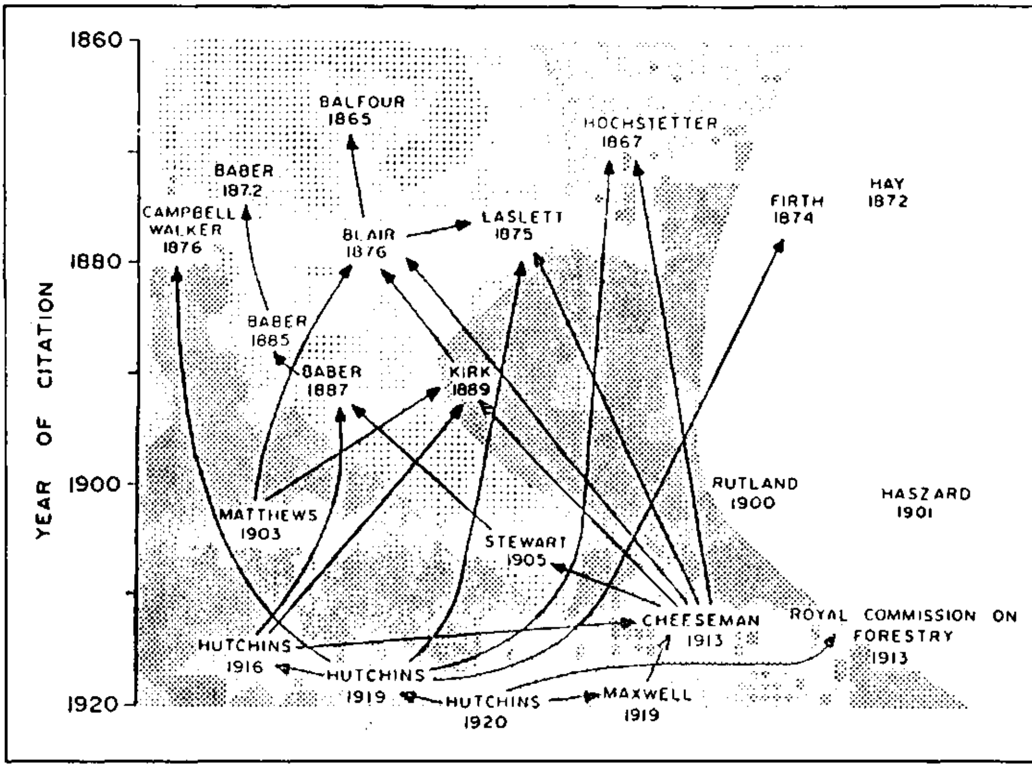

Figure 1. Citation network for the growth of indigeneous forests in New Zealand

Scientific opinion on the growth rates question vacillated over time and did not cease in 1920. The various contributions of foresters, engineers and botanists can to some extent be assessed through the use of a citation network. This is a diagram organised chronologically and indicating published papers cited subsequently. Garfield (1970) illustrated this approach with the example of Mendel's pioneering genetics paper and suggested that it helped to identify key individuals whose work had enduring impact in the field and helped to disprove myths about past influences. Usually cited publications dealing at least in part with the growth rates of native timber up to 1920 are depicted in Figure 1. Accepting that there are construction problems as nineteenth century citations were not streamlined and informal personal communication was frequent, some patterns still emerge.

The citation network clearly indicates that Laslett and Hochstetter's work was neglected in the nineteenth century. This oversight was perhaps the source of some of the confusion over indigenous growth raters. Laslett's volume was published in London and was probably not readily accessible in New Zealand. Instead, the standard reference was that by Blair (1876) who was less interested in growth rates than in the quality and attributes of the timber. Subsequent authors interpreted his data as showing that indigenous forest trees grow slowly. Cheeseman's (1913) paper emerges as a comprehensive review of the earlier published work and was in turn acknowledged as important by Hutchins (1916) and Maxwell (1919). The citation network also isolates engineers, botanists and foresters as three groups. The engineers in particular worked in isolation or cited work by others from their own field. In contrast, Cheeseman and Hutchins ventured more widely in their contributions. However, the foresters tone permeates Hutchins' writings; he favoured above all indigenous rotational forest management. Hutchins played a key part in subsequent developments leading to the establishment of an autonomous forests department.

State Forest Service growth rates research, 1920-30

Although McIntosh Ellis regarded himself as a practical man of action, he was aware of the importance of longer term research and forestry training programmes. Thus he directed efforts towards initiating a contract research programme and departmental scientific investigations of the indigenous forests. He was also in favour of the establishment of a School of Forestry to provide a source of trained graduates for the State Forest Service. In this way knowledge of the forest environment and State Forest Service expertise could be increased simultaneously.

The National Forest Inventory of 1921-1923 provided a basic check list of forest resources. From the first Ellis sought to obtain more detailed scientific information on indigenous regeneration and growth rates as this was essential information or implementing any system of sustained yield rotational forestry. In 1921 he wrote to the Commissioner, [i.e. Minister] of State Forests, Sir Francis Bell, arguing that in the past 'instead of searching for the key to nature's workshop', afforestation had been substituted as the solution to timber supply difficulties. In Ellis's opinion:

> ... unless and till the foresters are in possession of a working knowledge of the phenomena of Nature as regards the basic laws of growth of the native forests, you will have no managed forests, no regeneration and no future supplies'. (Ellis to Bell, 7 Sept. 1921, F6/1/13/1)

He remained exasperated by the difficulties in funding this research when indigenous forestry was a 'practical policy' and 'one that will pay its own way instead of calling for £40 000 000 if the indigenous forests are thrown overboard and exotic trees planted' (Ellis to Rhodes 19 Oct 1922, F6/1/13/1). Under difficult financial conditions, Ellis instigated departmental studies on a range of topics. These included plantings on an experimental station in Westland, sand dune stabilization work at Rangitikei, indigenous and exotic growth rate studies on a number of sample plots and underplanting of conifers in native forests. Important work on indigenous growth rates and regeneration was undertaken on a contract basis at Auckland and Canterbury University Colleges by the irascible William McGregor and Charles Foweracker and Frank Hutchinson.

Foweracker's Westland research showed 'the rimu is dying out where silver-pine is densest (which) seems to suggest that silver-pine is a successional forest following on rimu' (AJHR 1924, C3:10-11). Hutchinson (1926, 1927) completed a report on the forests of the Canterbury region, but by far the most important contribution was made by Leonard Cockayne, who had undertaken several botanical surveys for the Lands

Department in earlier years (AJHR 1907, C8A; 1908, C11; 1908, C14; 1909, C12) and published an important monograph on the vegetation of New Zealand in 1921. He was in no doubt as to the value of scientific study to forest management: 'If an accurate knowledge of any branch of New Zealand plant-ecology is of more importance for forestry than any other it will come from the study of succession.' (Cockayne 1928: 249) The concepts of community, succession, and climax were also used by North American forest managers. Scientific investigations greatly increased the knowledge about the indigenous New Zealand forests, but many questions remained unanswered.

Cockayne's work on the beech (*Nothofagus* spp.) forests was intended to provide the information required to manage them on a commercial basis. He argued that the beech were a 'climax plant-formation' of long persistence and self-replacing. By his calculation an 80-120 year rotation would be required for their management. This, he observed, was comparable with those in European forests. Cockayne, as had Hutchinson and Ellis, also favoured indigenous regeneration as an economical solution. However, other aspects of Cockayne's work may have played some part in convincing Ellis to shift to exotic afforestation as a solution to the timber supplies problem (Cockayne 1921, 1923). This reorientation had already taken place by the time that Cockayne's deliberations on the beech forests were published in 1926.

The research of Cockayne and others produced a detailed understanding couched in scientific language of New Zealand's forest environment. Ellis regarded this work as essential for sustained yield indigenous forest management. The official scientific appraisal of the environment now reached new heights of importance. Scientists possessed greater knowledge of the workings of the natural environment yet, somewhat paradoxically, this was obtained at the expense of its communicability to the official and popular sectors. Political decision makers now had to accept the recommendations of the forest scientists without the ability to critically evaluate them. However, political elements of decision-making remained ascendent, as for instance when timber exports were reintroduced despite Ellis's opposition in 1928 (Roche 1987)

Discussion

Growth rates were only one of a number of highly contested ideas about forests in New Zealand. Indeed, the growth rates arguably were not the dominant arena of official and scientific debate over forestry in the 1880s to 1910s although it did assume greater real importance under Ellis in the 1920s. Possibly, it remained more important in the 'popular' arena through the period. Growth rates were, however, an essential part of any broader forestry programme. The ebb and flow of knowledge about growth rates redefine the future of forestry in New Zealand in contrary ways: a belief in very slow indigenous growth rates initially directed attention towards exotic afforestation, the recognition that the growth rates of some indigenous forest species were comparable with selected European timber species helped open discussion about sustained yield indigenous forestry in the 1920s and the spectacular growth of exotic tree species enabled state afforestation to be seen as a means of meeting anticipated timber demands and winning time to allow the mechanism of indigenous forest regeneration to be understood. In this sense the growth rates debate on the early years of this century was of real significance to the eventual course of state forestry in New Zealand.

The interplay of various forestry knowledges at the empirical level is only one of the insights that can be traced from discussion over forest growth rates. Another link is that between Worster's 'empirical' and 'production' levels, for in the foresters' discussions about growth rates some of the ideas expressed are grounded in professional practices and principles that are ultimately anchored in a particular notion of the role of forestry in a national economy and the sort of social and economic conditions in which it will be pursued.

The impact of growth rates thinking in official and scientific spheres also cuts across the relationship between forestry science and Worster's 'production' category. In a selected fashion some aspects of this interrelationship have already been addressed by Gould (1962) and Raup (1964) who trace the connections between the emergence of sustained yield forestry in Western Europe (especially late 18th century Germany) and the historically specific social and environmental circumstances on which it is based. Lee (1984) summarises the conventional critique of sustained yield suggesting that the social practices embodied in sustained yield have been generally overlooked. This leads him to pose five research questions associated with sustained yield: Who were the social agents responsible for the development sustained yield and for whom did they act? Where, when and by what social agencies are sustained yields developed? What social function was pursued by developing sustained yield? Did sustained yield serve as a model for social-continuity? and How was sustained yield related to the major intellectual and ideological movements of the period?

The growth rates debate amongst officials in New Zealand takes place against a backdrop, as in the US where the basic assumptions of sustained yield, scarcity, stability, certainty and a closed economy were at best problematic and almost certainly ill-fitting. New Zealand was fifty per cent forest covered at the time of large scale European settlement in 1840, although this was reduced to about twenty-three per cent in 1900. The colonial economy, not without hiccups was geared towards growth, the 19th century colonial world of wood increasingly gave way to metals (and later plastics) in the 20th century, even wood based pulp and paper was not seriously discussed in New Zealand until the 1930s. New Zealand was not naturally endowed with a full range of merchantable hardwood species so that from the late nineteenth century, Australia provided timber for railway sleepers, telegraph poles and bridge timbers. The conventional criticism of sustained yield tends not to introduce growth rates into the analysis. When this is done, as in the New Zealand case, some additional insights emerge.

Appreciating that the indigenous forests were regarded by Land and Survey offcials as very slow growing, helps to reveal the urgency felt about timber famine concerns, i.e. it relates to the assumption about stability of supply. It also further explains why officials were so quick to advance exotic plantations as a solution to a projected timber famine. The resources that the State was putting into land development and agricultural expansion and an ideology of material progress also helps explain the restricted place given to forestry until the 1920s when the era of extensive agricultural expansion was drawing to a close.

Growth rates also offer some critical insights into foresters' thinking. Foresters had to work very hard to promote sustained yield in New Zealand not because it was seen as a form of social control (Lee's critique in the US case) but because the growth rates produced scenarios of managed forests with planting times of 500 years in some cases. To officials and many in the public this seemed a timespan that so transcends human timescales that it defies comprehension. The situation was exacerbated when the first National Forest Inventory (1921-23) produced data that pointed to timber demand exceeding supply by 1965 and concurrently the virtual exhaustion of timber supplies by the same date.

In these circumstances MacIntosh Ellis promoted a 121,000 hectare planting boom in 1925. Its objectives were to provide for the speedy creation of an exotic softwood timber resource to prevent the indigenous forests being exhausted and in so doing provide a respite for forestry scientists to come to grips with the mechanisms of forest regeneration in New Zealand with a view to implementing a sustained yield forestry programme. In all events some of the problems of indigenous forest management remained seemingly untraceable (only Cockayne's work on beech forests seemed to offer much hope, especially after the preservation interests secured sanctuary status for Waipoua kauri forest in 1952. Simultaneously the potential of fast growing exotics, particularly radiata pine seemed to offer new possibilities not restricted to local timber requirements, but as the basis of an internationally oriented pulp and paper industry and an export (log) and timber trade.

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Aspects of age in Australian States

A tree is an ideal form of life to attain great age. its living tissues are regenerated at short intervals. Most living parts are less than three years old. Living tissue more than ten years old is abnormal. The old dead tissues support the living ones and in some cases protect them. The proportion of crown to trunk decreases with size and the sheath of new wood becomes progressively thinner as the trunk increases in diameter. In the end the thinning of the sheath of new tissues would kill a tree, but most of them die from other causes before that happens.

M.R. Jacobs,
Growth Habits of the Eucalypts,
1955

6

Age and order in Victoria's forests

John Dargavel and Heather McRae

An ordered progression of age classes

An ordered progression of age classes in the so-called 'normal' forest is the ideal upon which the classical theories of forest management rest and to which many plans and efforts have been directed. If the amount of wood being cut from a forest, its 'yield', is to be regulated to a level which can be sustained in the long-term, order has to be imposed on both human disorder and natural variation. The ideal way of achieving this is simple; there must always be a proper amount of trees of each age, so that when the oldest are cut, there are slightly younger ones which grow to replace them in time for the next cut, and progressively younger ones still so that there are always new recruits to each class, the youngest class being regenerated on the space left by those felled. Much of the history of forestry is written as the struggle to transform real forests towards this ideal against the recalcitrance of people and turbulence of nature (e.g. Steen 1983). Even those who have criticised the ideal as unattainable and have sought to regulate yield over shorter times in a more pragmatic way have found the age structure of a forest to be an indispensable attribute (e.g. Clutter et al. 1983), while ecologists consider it a powerful indicator of ecological health. The 'managed forest' is therefore one in which age is directly or indirectly controlled. On these grounds one would expect that as forest management becomes more strongly established in a region, age would feature with increasing prominence in its records.

This paper briefly examines the forest record in Victoria (McRae 1994) to see what recognition age received as forestry evolved. Carron (1985) and Moulds (1991) have described this from the long arguments over the need for forest conservancy during the nineteenth century up to the *Forests Act* which established the administrative and professional framework of the Forests Commission in 1918. The new Commission affirmed the classic principles and set about assessing the forests and making formal plans for their management. Before reviewing how age featured in the record from the 1920s on, it is worth briefly noting some of the context in which classical forest management arose and how it was transmitted to Victoria. Only the German context is noted here (the French and Swiss contexts differed), but is particularly relevant given the strong German connection in Australian science (Home 1995).

The classic tradition and its transmission

In northern Europe, wood largely fueled industrialisation during the eighteenth and nineteenth centuries—thus contributing economically to the rise of Prussia and other states—while exports from the Baltic expanded even to remote Australia. The demands placed on the forests were so large that the old ways of haphazard cutting would not suffice, indeed if continued the forests would be exhausted and production would decline.

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	160
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)

In this situation, a deliberate, science-based, professional forestry was developed to manage the large estates, and in places the communal forests. It rested on a strongly-developed bureaucratic ordering of information through classification and quantification which had emerged during the second half of the eighteenth century (Lowood 1990) and was driven by the need to increase forest productivity. Silviculturally, productivity was increased by clear-felling the depleted forests of mixed ages and species and replacing them with uniform, even-aged crops, often of conifers. This replacement by younger, faster-growing trees was feasible because even the poorest of the old trees could be readily sold for fuel wood. Managerially, it required formal planning, the intellectual foundation for which was in the ideal of a sustained yield from the normal forest. Technically, the problem was to calculate the optimum 'rotation' age at which every stand of trees should finally be felled, but this required knowing the quantity of wood produced at various ages. Yield tables were painstakingly constructed which later served as exemplars for the British Empire (Table 1).

It was increasingly considered that the optimum rotation should be determined on economic principles which from 1849 could be applied by Faustmann's elegant solution for discounting the value of future crops to the present. To provide a professional cadre for the task, scientific education, well advanced in Germany generally, was extended to forestry with centres of forestry education being established in St Petersburg in 1803, Schemnitz 1808, Tharandt 1811, Warsaw 1816, Eberswalde/-Berlin 1821 and Nancy in France in 1824. Formal research followed as national forest experiment stations were set up in Germany in 1870, Austria 1874, Denmark and France 1882, and Switzerland 1888; by 1892 they were strong enough to form the International Union of Forest Research Organisations (IUFRO).

The imposition of order by clear-felling was rejected from the 1870s by some French and Swiss foresters—sometimes called the 'sylvan fundamentalists'—who developed silvicultural 'selection' systems to manage uneven-aged stands. They too sought to raise productivity but gave priority to ensuring forest health and maintaining soil fertility through keeping a mixture of ages and species in each stand. They ensured a sustained yield by measuring the trees periodically and felling only those which exceeded the number proper to each diameter class (Knuchel 1953, Troup 1952). Given the close relationship between diameter and age, they effectively controlled age while asserting a concept of 'forestry in harmony with nature' and rejecting large-scale, uniform, economically-driven enterprises.

The classic tradition was transmitted to India from the middle of the nineteenth century where it was transmuted into an imperial model which depended on the 'demarcation' of the best forest land, its reservation from clearing for agriculture, the dispossession of the original inhabitants, and management by a cadre of professionally trained foresters recruited at first largely from Germany. Vast areas had to be brought under 'systematic working' by the expatriate staff who were replaced periodically. To maintain continuity, 'working plans' were made for each forest according to a standardised format of two parts: 'Part I—Summary of facts on which proposals are based' and 'Part II—Future management discussed and prescribed' (D'Arcy 1898 [1891]). The imperial model, even to the detailed headings of its working plans, spread throughout the Empire. Wilhelm, later Sir William, Schlich (1840-1925) was a key figure in this. Trained as a German forester, he set up the system for working plan control in India and eventually rose to become Inspector-General of Forests. He moved to Britain and set up the Coopers Hill school, subsequently part of Oxford University, where most British foresters for the colonial and Indian forest services of the time were trained. He took his students to Germany to see orderly forest management at first hand and, with others, prepared and repeatedly revised a comprehensive, five-volume text, the Manual of Forestry (1889-1906) based on translations of German texts and his Indian experience. The eventual acceptance of the imperial model in Victoria followed the urging of imperial foresters: Vincent in 1887, Ribbentrop in 1895 and Hutchins in 1916, and the appointment in 1919 of Owen Jones—an Oxford graduate doubtless carrying the trusty Manual in his knapsack—as the first Chairman of the Forests Commission (Moulds 1991: 53). The working plans, and their successors, which were prepared in Victoria express both the classic ideal of sustained yield received in its transmuted form, and all the difficulties of managing real forests. This paper explores the considerable tensions between the ideal and the practice. It proceeds chronologically through three periods from the 1920s to the present. Plans for plantations are not discussed.

Era of classic working plans

The new Forests Commission recognised that ordering Victoria's forests would be a slow process partly due to the shortage of skilled staff which was only gradually eased by the four or five foresters who graduated from the School of Forestry at Creswick each year (Moulds 1991, 1993). It implicitly sought an ordered progression of age classes and viewed the existing condition of the forests as a major complication:

> 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).

However, exploring remote areas and battling against agricultural interests in the Parliament and the Lands Department to have the best areas reserved as state forests, as well as marking their boundaries and setting out sawmill licence areas were the first, most urgent tasks. An energetic programme of assessing the various types of forest with strip surveys was commenced about 1925 as a basis for preparing working plans. Considering the difficulties, progress was remarkable; in a decade, a quarter of the forests were placed under working plan control (Table 2). Very different types of forest necessitated different types of plan, discussed in what follows, although all followed the classic two-part template laid down by D'Arcy, a 1910 edition of whose work is believed to have been part of the Forests Commission's library. The plans were made for a period of about five years after which they were to be revised, as several of the early ones were. The Commission formally approved the plans over its seal, often issuing them with a strict instruction that they were to be adhered to.

Box-ironbark and messmate forests

The need to counter the devastation of the mixed-species forests around the goldfields in the second half of the nineteenth century had provided much of the early impetus to reserve state forests and establish Victorian forestry. Their durable box and ironbark timbers were economically important early in the twentieth century for railway sleepers, telegraph poles and, in the more accessible areas, for fuel wood, while messmate provided prime sawlogs. The 1935 Maryborough Working Plan, for example, noted that early cuttings in the 'open virgin forest' of red ironbark, grey box and yellow gum until the 1870s had resulted in dense seedling regeneration and some coppice growth. Later cutting had led to a dense coppice forest which produced mostly fuel wood and eucalyptus oil. Much the same was observed for the 1933 Ballarat and Creswick Working Plan where the 'virgin crop' of messmate and other species had been removed in the 1855-75 period and the succeeding seedling crop had been 'razed' so that the regrowth then present resulted from varying cuttings. It was intended that the better forests would be ultimately converted to high forest again, many of the box-ironbark areas would be managed on the two-layered coppice with standards system, and some would be used just for fuel wood. 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 were 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).

Table 2. State forest reserve and working plan areas

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			Mixed species	Sandon, Muckleford, Walmer
1931	1,893,186	182,357	Red gum Plantation areas Box-ironbark Ash, messmate, silvertop	Barmah and Shepparton Ovens, Bright, Aire V.,Stanley Rushworth Southern Baw Baw, Part Upper Yarra, Rubicon
1932	1,897,321	234,448	Box-ironbark	Heathcote, Scarsdale
1933			Messmate and mixed species Ash	Ballarat and Creswick Neerim boys camp
1934	1,899,154			
1935	1,922,031	263,619	Box-ironbark	Maryborough
1936	1,948,253	277,864	" "	Heathcote
1937		277,864		
1938	1,949,891	378,841	" "	Gladstone
1939	1,961,105	512,896		

Source: Forests Commission, Annual reports and Working plans

Clearly there was a long task ahead before an ordered progression of age classes could be established in a high forest. The coppice with standards system envisaged selecting a few of the best trees on each hectare, 'the standards', 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 [for the Conversion Working Circle].' Similarly while 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 relief funds.

Red gum forests
A detailed assessment of the important red gum forests along the River Murray made in 1929/30 provided the basis for a substantial Barmah and Shepparton Working Plan in 1931. The forests had been cut recklessly for sleepers and other products during the nineteenth century with virtually no control (Fahey 1988). The plan noted that 'stricter control has been exercised during the last 20 years' by imposing a minimum girth limit, below which red gum trees could not be felled, of 8 feet 6 inches [2.6 m girth or 82 cm diameter] measured at 5 feet [1.5 m] above the ground. The limit was relaxed in order to 'permit the removal of faulty and deteriorating timber'. However, the forest was far from meeting the normal ideal as it 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 by removing 'dead, dying and suppressed material' and by the 'sapringing of old, useless material [which] has commonly resulted in the establishment of advance growth, thus tending towards unevenaged stands'. With limited funds, 'the extension of such thinnings into the crowns, if only by the sapringing of subdominants useless for sleepers, has generally been considered to be economically impracticable'.

Bringing an ordered progression of age classes to such a forest was a formidable task and there was little to go on; there were no yield tables, no sample plots which could be remeasured and no records of growth. 'A definite effort [was] made to determine the age of certain stands and thus discover mean annual growth', but repeated selection fellings in the past, the pattern of intermittent regeneration, and slow growth in dense pole and sapling stands defeated the attempt. Over the river in Barham State Forest, the Forestry Commission of New South Wales had measured the growth of 23 trees for a period of 13 years and found that they had put on 0.24 inches [0.61 cm] of diameter growth a year on average. With some measurements from Gunbower forest where three increment plots had been established in 1928 (FCV file

68/791) and 'general observations', the rate of diameter growth on the best red gum sites was estimated (Table 3). A 30 inch [76 cm] tree was slightly smaller than the previous cutting limit but must have seemed satisfactory as an 80 year rotation was fixed in the plan. However, the basis of the estimates was so slender that the plan prudently prescribed that sample plots should be installed to make better information available for subsequent revisions.

Table 3. Estimates of diameter growth at breast height for red gum for the Barmah and Shepparton Working Plan 1931

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

Ash forests

It was, of course, the magnificent mountain ash forests in the Central Highlands, usually with messmate and silvertop on the lower slopes, which were the most important to the Commission. Sawmillers had forced their tramways into many areas, but the history of intermittent cutting and bushfires had created a complex patchwork which was difficult to map. Moreover, the cut-over areas frequently contained good trees which had been left because they were in inconvenient places or were too big on sites where horses did the snigging. The forests were difficult to assess, often growing on rugged country and always difficult to traverse. Systematic assessment started about 1928 and continued throughout the 1930s. Parallel lines were run through the forest at 10 chain [200 m] intervals along which the types of forest, density of scrub, rock formation, occurrence of regrowth and diameters of the merchantable timber trees were recorded so that detailed stand type maps could be drawn. Simple categories were used to describe the stands. For example, 'overmatured', 'matured', 'saplings' and 'seedlings' were used at Rubicon in 1928; and expanded to include 'immatured', 'young timber', and 'pole timber' at Royston. The diameter of every tree in sample plots, located along the assessment lines, was measured, their heights and the number of log lengths they contained estimated and their volume calculated. But 'proper volume and yield tables, constant bark percents, average rot percent, tables, etc. [which] would not only diminish the cumbersome reckoning considerably, but would also increase the accuracy of the computations to a high degree' were lacking. It all took an enormous effort in this type of forest.

While the mass of information enabled immediate logging operations to be scheduled in an orderly manner, how an ordered progression of age classes might be created in the classic manner was far less certain. The 1931 Southern Baw Baw Working Plan was the first attempt for the mountain forests, an endeavour which created 'an acute appreciation of the lack of definite knowledge ... [about] the silvics of our indigenous species'. There were four growth plots for messmate and silvertop, but none in ash. The best that the forester could do at the time was only, as he reported, '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, a comprehensive Rubicon Forest Working Plan was prepared by H.R. Gray, an Oxford-trained British forester recruited from the Sudan for the Australian Forestry School in 1927 (Carron 1985: 264). The forest, north of the Divide, included both the Rubicon and Royston Valleys and was both an expanding milling centre and a source of water for a hydro-electric scheme completed in 1928 (Evans 1994). Gray had the assessment reports to hand and concentrated on examining the regrowth from previous cutting, giving 'the virgin stand as a whole more cursory study'. Nevertheless, he and his students measured 23 alpine ash (also called woollybutt) stumps and counted the number of rings in each 2 inches [5 cm] of diameter growth estimating that the trees were approximately 135 years old, confirming the previous view that it was fairly young forest. He also performed a stem analysis from which he was able to construct an age-height curve to show that they reached a height of 200 feet [61 m] at age 135. He observed that dominants in the regrowth achieved half this height by 18 years (amended to 16 years in the copy of the report in the Australian Archives) and he thought that it should be possible to grow a 30 inch [76 cm] diameter tree by age 60, if the stands were thinned. He observed that 'faults appear to develop [in the timber] after about 80 to 90 years'.

Gray declared that 'it is obvious that the age and size of trees in the virgin stand is of no consequence' because clear-felling was the only practical silvicultural system. He set the rotation of the new crop provisionally at 60 years and envisaged that each major division of the forest, or 'felling series', would be converted into an ordered progression of age classes by felling the stands over the unexpired portion of the rotation which would be calculated from when felling started 20-25 years previously.

Fiery end to the classic era

Although there had been large bush fires before, and important ones in the ash forests in 1919 and 1926, there was nothing in either European theory or their own knowledge which could have prepared Victorian foresters for Black Friday, 1939. 'The experience of the past could not guide them to what might, and did, happen' as Royal Commissioner Leonard Stretton (1893-1967) wrote in his report on the fire which swept across the mountain forests, killing people and trees alike. The patient creation of an ordered progression of age classes which had been idealised in the plans forest by forest was also swept away by the wall of fire before classic forestry had hardly begun.

Era of relocation and reconstruction

The foresters and assessors quickly made a reconnaissance of the devastation and estimated that there were 2070 million super feet [6.2 million m^3] of logs in mountain ash and alpine ash trees which had been killed by the fire of which about one half could be salvaged (Forests Commission Annual Report 1938/39). A salvage plan was pursued energetically during the war (Moulds 1991: 84-8), but it was obvious that the mills would have to move to unburnt, hitherto unlogged forests afterwards. The assessors explored what were then remote, inaccessible alpine ash forests in the Alps and East Gippsland. Plans to drive roads into these areas and relocate much of the industry were made in the context of general plans for post-war reconstruction and an expansion of the national economy. Sawmilling centres were built in the 1950s at Heyfield, Mansfield, Ensay, Orbost, Cann River and several smaller places to meet the brisk demand for timber.

It is commonly asserted that logging in the new areas was allowed to proceed at a very rapid rate in the belief that the sawmills would be able to relocate into the central areas once the regrowth from the 1939 fires became old enough to be logged, perhaps when the trees were 50 to 60 years old. Our research does not enable us to say whether this was a formally articulated plan at the time or whether it is a post hoc rationalisation. The period was certainly driven more by pragmatism than the transmuted idealism of classical forestry. The point, however, is that the progression of age classes being created by fire and sawmill logging applied across the State, rather than within each individual forest.

The pulp and paper industry which had been started by Australian Paper Manufacturers Ltd in Gippsland in 1939 had planned to take three-quarters of its wood from the mountain forests including some of their regrowth (Wood Pulp Agreement Act 1936). The fire and its expansion in the 1950s meant that it had to use more mixed species wood from the foothill forests. To this end, the 1952 Boola Boola Working Plan was prepared to manage 50,000 acres [20,000 ha] of a nearby forest, mostly on a pulpwood rotation. 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 12 cunits per acre [84 m^3/ha] by the mean annual increment of 0.375 cunits per acre per year [2.6 m^3/ha/yr]. New methods of integrated logging were developed (Mann 1958) but a complete review of the pulp mill's resources was needed for a major expansion. The Commission's 1959 pulpwood survey used aerial photographs and ground inspections to map the forests within the mill's economic range by the age of the regrowth—largely determined by its fire history—and the slope of the ground. The two types of pulpwood resource—from mountain and alpine ash, and from foothill mixed species—were each divided into two age classes depending whether they were 'regrowth', defined as being under 60 years of age, or were 'mature' over that age. These categories reflected different pulping properties of the wood and were incorporated in the resulting Forests (Wood Pulp Agreement) Act 1961. The slope classes were needed to evaluate how much of the regrowth might be able to be thinned. The Act called for a formal, 10-year 'Plan of Operations' to be prepared, based on research, which was largely into the feasibility of thinning, conducted jointly by the Commission and the company.

While integrated pulpwood logging enabled new crops to be successfully regenerated on cut-over sites, the 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 regrowth in the mountain ash districts with the intention of starting cutting the regrowth from 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). Upper Yarra was an important district with stands from the earlier 1919 and 1926 fires which could be used first. A very detailed cutting plan (Upper Yarra Forest District Cutting Plan 1968-72, FCV file 68/735) also looked beyond its stated period, re-asserting 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 (Appendix 7).

Some attention was given to the mixed species and drier forests. An intensive 'Continuous Forest Inventory System' was installed in the Wombat Forest in 1964 and remeasured five years later (Smith 1973). The diameter increment was reported for each diameter and species class to show how the forest was changing, but it was still a two-tiered forest with an overwood of 80-85 years of age and an underwood of 20-25 years. Areas surrounding the Wombat Forest were considered in a 1976 report (FCV file 75/111) which for the Ballarat Forest District assumed an 80 year 'liquidation period' or rotation, being the time taken for regeneration to grow to merchantable size. It assessed the present standing sawlog volume at 96,000 cubic metres, assumed that the existing trees were growing at one per cent a year, and calculated the 'permissible cut' in the classic manner (Table 4).

Table 4. Example of permissible cut calculation, Ballarat Forest District, 1976

$$\text{Permissible cut} = \frac{\text{present sawlog volume + annual increment of uncut sawlogs}}{\text{liquidation period}}$$

$$= \frac{\text{96,000 cubic metres + (1 per cent per year x 96,000/2})}{\text{80 years}}$$

$$= \text{1,680 cubic metres per year}$$

Era of regional sustained yield

In 1982 a new reforming government was elected with a strong environmental platform of placing environmentally important forests in national parks and ensuring that the rest were managed in a sustainable manner, region by region. The Commission (1984) argued that a regional sustained yield was an elusive and impossible ideal in the face of fires and other likely changes which it listed region by region. It advocated a system of regulating the yields rather than following the normal forest ideal of an ordered system of age classes in each forest but it did not succeed in upsetting the Government's policy of applying the system regionally rather than across the State as a whole. The regions were of course many times larger than the individual forests which had been considered in the first era. Several incipient forest management problems also came to a head. The idea that the 1939 ash regrowth could be thinned to produce pulpwood from the 1960s and larger sawlogs from the 1970s had been tried and abandoned as impracticable on any scale, the sawlogs produced from the regrowth were not of as good a quality as expected, and the shift of sawmilling back from the Alps and East Gippsland to the Central Highlands had not happened. More importantly perhaps in the long term, was a change in the interpretation of the ideal of sustained yield. Rather than being just the yield of timber, it was all the uses and values of the forest which were to be sustained in a planned way.

The Government commissioned the University of Melbourne's Professor of Forest Science, Ian Ferguson, to examine the situation (1985) before it prepared an industry strategy (1986) which laid down, among other things, that the forests in each region were to be planned according to its ideals of economic viability in providing wood, environmental sensitivity, and sustainability for all values for future generations. To reassure an anxious industry, the government passed the *Forests (Timber Harvesting) Act* 1990 which mandated the minimum level of sawlog production which each of 15 'forest management area' plans had to ensure for the next 10 years. The first of the new plans covered the Otways and was completed in 1992 (Brinkman 1990, Dargavel and others 1995). One for East Gippsland was completed in 1995 while those for several other regions are in various stages of preparation. Each plan shows how the mandated level of sawlogs can be supplied and estimates what level of yields would be sustainable in the long-term; the cut in the Midlands area, for example, is likely to have to be reduced by 17 per cent after 10 years. An elaborate computer model aided the calculations for the Otways, but a traditional approach was used for the other areas. In Central Gippsland, for example:

> The long-term sustainable yield is calculated by multiplying the net available area of each forest type by the annual growth rate for the planned rotation length. Nominal rotation lengths vary from 60 years for eucalypt plantations, a minimum of 80 years for ash forests and between 80 and 120 years for mountain mixed and foothill mixed species forests respectively (Dept. of Conservation and Natural Resources 1993a).

Table 5 Growth assumed and rotation adopted, Central Forest Management Area

Species	Mean annual increment of sawlogs (m^3/ha/yr)	Rotation (years)
Alpine ash	2.5	80
Mountain ash	3.0	80
Shining gum	3.0	80
Messmate (high site quality)	1.2	100
" (low site quality)	0.8	100
Radiata pine plantations	15.0	35

Source: Dept. of Conservation and Natural Resources 1993b

The growth rates assumed and rotations adopted were tabulated as in the critical Central region, which included the Upper Yarra District, for example (Table 5). The rotation lengths listed in this era were longer than those listed in the 1930s and probably reflected a more realistic assessment of the time needed to grow a log of commercial size. For example, Gray's hope in 1931 that alpine ash logs could be grown in 60 years had depended on being able to thin the stands which was considered to be impracticable in the 1990s.

Our research has not investigated whether the rotations listed in the 1990s have a logical basis, but at first glance, they appear to us to be little more than arbitrary selections, justified more by repetition from plan to plan than by substantial analysis of growth, ecological or economic information. Their history indicates that they probably reflect the age at which final crop trees are expected to reach a merchantable size, or perhaps the age of maximum mean annual increment. They are notably far younger than the age of ecological maturity, which would be needed if silvicultural rather than preservationist means were to be used to sustain the environmental values.

In practice, the classic ideal of an ordered progression of age classes had to make way for two major considerations. First, the plans had to schedule logging from the stands in the real forests which were in far from the ideal normal condition. Different options for doing this had to be explored to find a way of spinning out the resources available to the industry in a way which would allow it to increase in future. Second, the requirement to sustain all the other uses and values of the forest had to be addressed. Some of these required taking parts of the forest, such as wildlife corridors and streamside protective strips, out of the wood production area, others required actions, such as opening or closing roads and tracks, quite unrelated to wood production. While classic forestry had at least provided a set of terms and concepts for thinking about sustained timber yield, there was no single set which could cover the sheer variety of other uses; the planners simply had to deal with the issues site-by-site. An ordered progression of age classes had been transmuted and transmitted to Australia but remained more a classic ideal than a real practice.

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7

Assessing Queensland's forests

John Dargavel and Damien Moloney

Introduction

Any assessment needs its subject to be clearly identified, the attributes of interest defined, their quantities measured and an overall valuation estimated. This is notably difficult for forests because of their extent, remoteness, variability, multiplicity of ecological and social functions, and dynamic nature. Moreover, their valuation commonly requires taking forecasts of their future condition into present account. In large forest organisations, standards have to be prescribed, and assessors trained so that assessments of different areas are comparable and can be aggregated. All this takes time, techniques, equipment, personnel and hard work. The cost has to be balanced against the value of the information gained and endeavours made to develop more efficient techniques. Conversely, what can be known about a forest, and which of its many functions can be valued is always conditioned by how far the difficulties of assessment can be dealt with at the time.

A series of assessments over time can gradually build knowledge about a particular forest, although changes to the forest or the attributes of interest can make previous assessments irrelevant. Earlier assessments may be lost, or may be too difficult or expensive to retrieve, especially if old maps and measurements have not been converted into an electronically-readable form. A current hazard is the loss of 'organisational memory' of the standards by which past work was performed. This chapter briefly describes the stages in which Queensland's crown forests have been assessed from the era of exploration and pioneering searches for timber, through an era of strip surveying, and an era of establishing a continuous forest inventory, to the present environmental era with its current old-growth and other surveys (see also Chapters 24 and 25). It shows that what was achieved in each era was conditioned by what had been done before, by the resources and technologies available, the organisational structure, and the values of interest.

Era of exploration and pioneering

Histories of the European exploration of Queensland and the extension of its pioneering frontier have described the journeys of early explorers like Oxley, Leichhardt and Dalrymple, and the progress of settlement in the nineteenth and early twentieth centuries (e.g. Bolton 1963, Johnston 1982, Roberts, 1924). It is sufficient here to make some general remarks about the period in terms of the requirements and difficulties of assessment.

Most obviously, identifying the features and resources of the vast landscapes was the prime task of exploration. The major rivers, plains and hills had to be found and their relative locations determined. It was a long process. For example, although Moreton Bay was assessed by Oxley in 1823, the major features of north Queensland were not reported until Dalrymple's expedition in 1873. Gradually, charts and maps were drawn, amended and improved. Land suitable for grazing, farming and growing sugar cane, or with the chance for gold, were the main attributes of interest. This was accompanied by scientific interest in the taxonomy of the biota, another long process started by Banks and followed in the 1820s by Cunningham, after whom hoop pine (*Araucaria cunninghamii*) was named. Knowledge gradually accumulated: Ferdinand Mueller made further collections while on Gregory's northern expedition in 1856, for example, and Government Botanists were appointed with a botanic garden and herbarium to support them. However, it was not until the turn of the century that the first flora of Queensland was published (Bailey 1899-1905). A standard guide which forest assessors could use for identifying the trees of the sub-tropical rainforests did not appear until 1929, and it was not until the 1951 edition that many tropical forest species were added (Francis 1929, 1951; further additions and amendments were made in 1970 and 1981 editions).

The explorers had an eye for timber, Oxley reporting hoop pine 'fit for the topmasts of large ships' (cited by Carron 1985: 96) and Dalrymple bringing samples of timber from north Queensland to Brisbane for examination. Apart from local use for the small colony, timber was valued as an export in the log or as rough-sawn timber for the Sydney market. This was mostly red cedar, although some 'Brisbane pine' (presumably hoop pine) had also found its way onto the Melbourne market by 1880 (Dargavel 1988). Queensland timbers were far less known internationally than those of the other colonies (Laslett 1875), but attempts were made to publicise the rich variety available by sending 'a magnificent, extensive and instructive collection of 200 varieties of timber' to the 1879 Sydney International Exhibition (Anon. 1881), and 449 varieties to the Colonial and Indian Exhibition of 1886 in London (Bailey 1886). In timber too, science was a long time coming, E.F.H. Swain issuing his text on timber properties in 1928.

While such official endeavours identified and mapped the major features, and sought to identify the trees and their timbers, it was the individual pastoralists, selectors, prospectors and timber cutters who, in seeking pastures, soils, minerals and timber trees, assessed the country on a smaller, informal scale for their immediate, personal interest. They traced the rivers and streams back into the hills, found where ridges ran and how routes could be pushed through broken country. They found trees they could sell and timbers they could use. Their valuations were pragmatic and quickly proved, or miserably disproved by experience. Importantly, they could assess the forests incrementally, finding enough timber for the next month or year, then seeking more.

The well-known case of the red cedar trade illustrates this two level process of assessment. It was an official exploration of the Hawkesbury River which found this valuable wood in 1790, but it was all the parties of cutters who searched it out, patch after patch, river by river up the coast. And when Dalrymple reported good timber on Queensland's north coast, it was the Freshney brothers and other timber-getters who quickly revealed its wealth on the Mossman and Daintree rivers (Bolton 1963: 76-7). The sawmilling industry, as it gradually developed in the 1860s and 1870s, continued this informal process of searching for its resources. However, large firms, like Hyne and Son (Johnston 1988) and Wilson Hart (Maryborough Chronicle 1988) which expanded rapidly from their Maryborough bases in the 1880s, needed to plan their future and justify their investments over much longer periods than the manual cutters or small sawmills had needed. Informal assessments, even by their own experienced timber-getters would not do, nor would the lack of adequate state forest reserves and a forest service to manage them. The widespread movement for forest conservancy, which had already begun in a small way in Queensland, was advocated more forcefully by R.M. Hyne and others to good effect.

Era of strip assessments

A Forestry Branch was set up in the Lands Department in 1900. The part-time Inspector of Forests reported in 1903 on the need to reserve 'young or mature timber' and prevent the cutting of 'young and undersized timber ... which if allowed to mature would be a valuable asset.' However, it was accessibility for logging, not growth potential, which was the attribute of interest, and the forests were classified, and implicitly valued, in accessible, difficult and non-accessible categories (Carron 1985: 98). Eventually in 1906, the *State Forests and National Parks Act* was passed and the Inspector, Philip MacMahon, was appointed as Director. MacMahon commenced an assessment of 1.5 million hectares of state forests and timber reserves to appraise their quality as well as quantity. The work was started about 1910 by one or more crews from 'Forest Valuation Camps' (Vanclay and others 1987). MacMahon died prematurely and was succeeded by N.W. Jolly who continued the assessment and in the words of E.F.H. Swain, his successor, 'pioneered the principle of sustained yield' (*Report of Director of Forests* 1918). While the principle may have entered the government mind, little could be done about it until the forests were located, and their timber stocks and growth rates determined.

It was not until 1920, when returning soldiers had been recruited to staff the Forest Service, that the era of extensive timber cruising could begin. Five forest survey camps and two cruising camps 'engaged in the important duty of demarkation [*sic*]' were set up and the next year a conference of forest survey officers was called to standardise their procedures (*Report of the Director of Forests* 1920, 1921). The term 'camps' was used to denote one or more survey crews, usually of three or four men, who lived in tented camps in the forests that they were surveying. The conference was chaired by Lieut. Reg Douglas, whose appointment as the 'Forest Topographer' highlights the priority that had to be given to mapping all the details of ridges and creeks which had only been known informally before. Corby Woods was Forest Topographer (1921-1928) and there may have been others. Three classes of survey were defined.

Class 1—Explore and investigate vacant Crown land

The most general surveys were designed to identify areas of the State which should be reserved as forest rather than being selected for agriculture. Doubtless, some areas could be dismissed fairly readily, but others were examined systematically by surveying parallel lines through the forest, probably at 40 chain (approx. 800 metre) intervals. This enabled the salient features of the landscape to be mapped and comments made on the nature of the forest. It could be remarkably tough work, as even official reports reveal:

> The Atherton forest survey party suffered from the disability of food shortage, due to the shipping strike, a severe drought for half the year, and abnormal rain for the other half, the impediment of the debris from the 1918 cyclone, the rough and broken nature of the country, and the difficulty of retaining survey hands. Nevertheless, 62 miles [103 km] of compass and chain and 55 miles [93 km] of compass and step survey were completed (*Report of the Director of Forests* 1920).

Class 2—Feature and assessment surveys of timber reserves and vacant Crown land

More detailed surveys were conducted in forests with commercial value to map the topography and estimate the quantity of the timber resource. Parallel strip lines were run through the forest at 20 chain [approx. 400 m] intervals and the diameter of every tree within one chain [20 m] either side of the centre line was measured, the number of nine foot [2.7 m] logs in each estimated and tallied in special survey books. The more detailed maps of the ridges, creeks, tracks and other features which resulted were commonly annotated with remarks about the species or their quality (Map 1). The survey book tallies were worked up, volumes of merchantable timber calculated, a fair copies of the field maps drawn and reports of the assessments prepared. The substantial camp and office work involved was reserved for the wet season or bad weather.

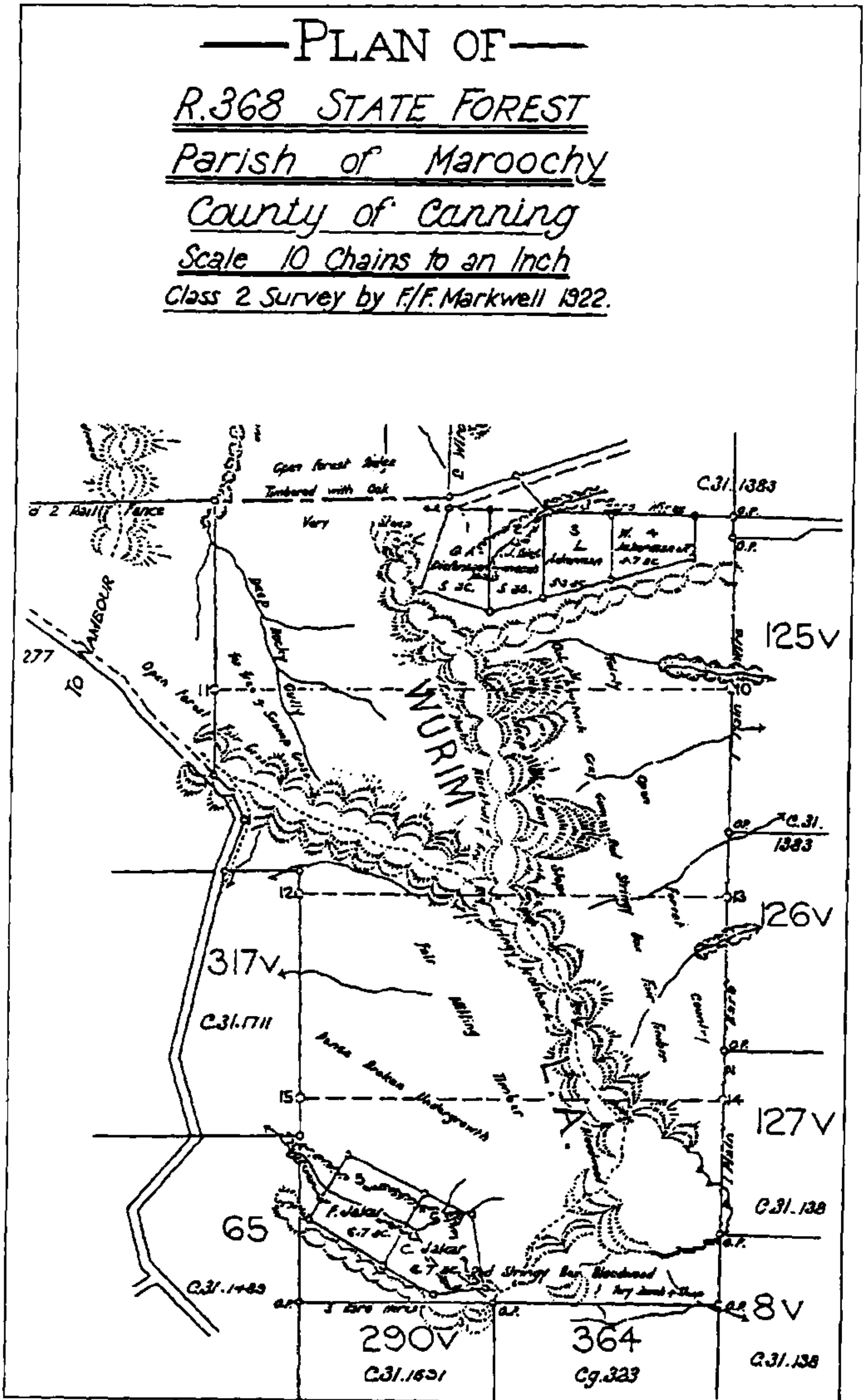
These surveys were used in two ways. If the forest was a valuable one, they provided evidence in support of a Forest Service case to have the land permanently reserved as state forest. If not, they provided an estimate of its timber value which an intending selector would have to pay.

Class 3—Valuation and organisation surveys of state forest

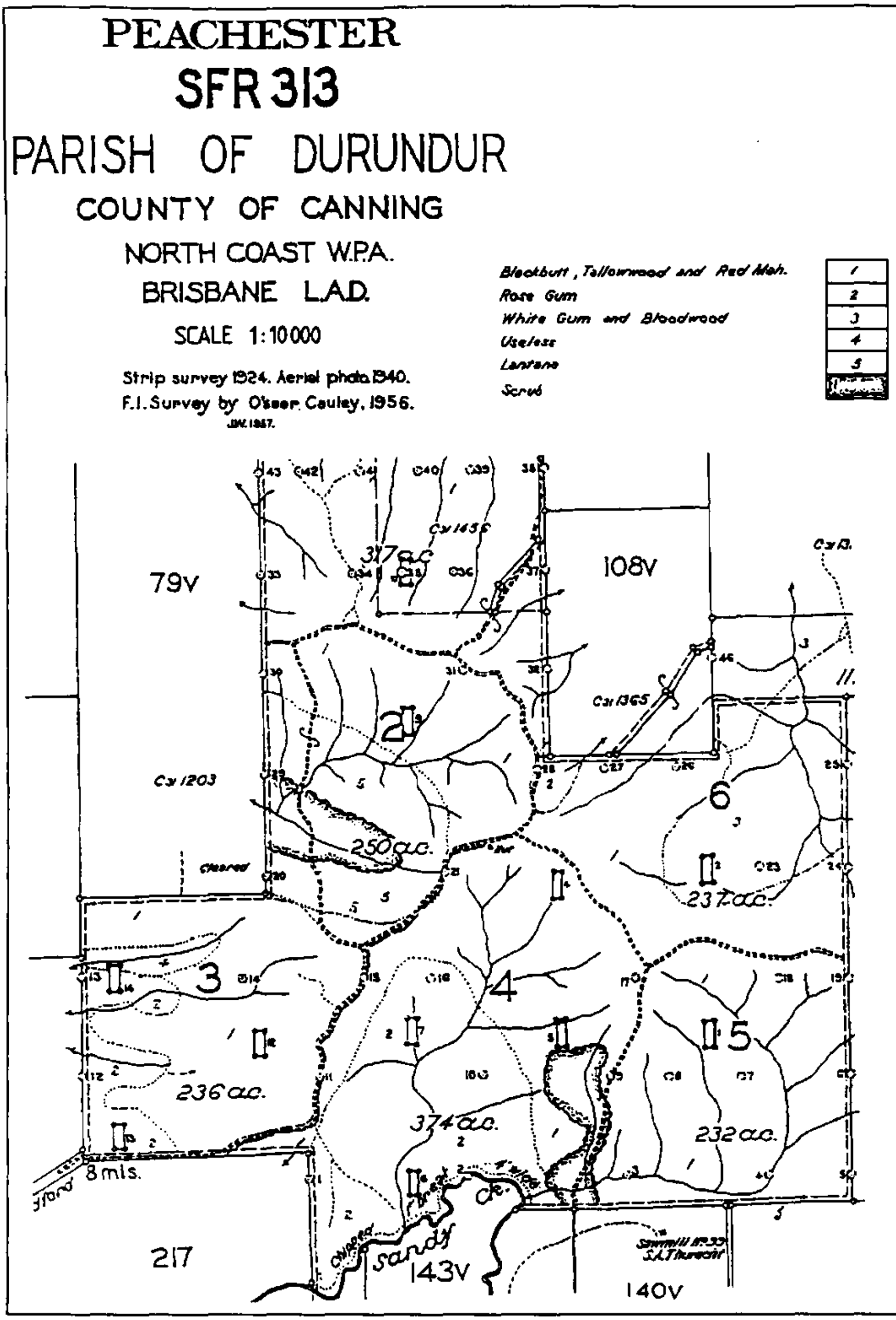
It was on state forest that the most intense surveys were conducted. These were conducted as strip assessments, as in the Class 2 surveys, but more intensely as the strip lines were closer together and the forest and topographic features were mapped mostly at a scale of 10 or 20 chains to 1 inch [1:7920 or 1:15,840]. Forest types were catego rised by their predominant commercial species. For example, a 1924 survey at Peachester recognised four groups of species as well as 'useless', 'lantana', and 'scrub' types whose boundaries appear to have been mapped in finer detail (Map 2). By 1926 a process of dividing the state forests into numbered compartments, typically of 100-200 hectares, surveying and marking their boundaries was well in hand.

As the plantation programme expanded in the 1930s, very detailed surveys were commenced which not only mapped their layout, mostly at a scale of 10 chains to the inch, but surveyed the contours of the land. The intensity and expense of these surveys highlights the greater importance attached to these young plantations than to native forests by the Forestry Department (created as a sub-department of the Lands Department). It was in the plantations that the Department was most obviously investing public funds and where their future growth and yield was uncertain. By comparison, the prosaic management of the native forests must have seemed less prone to scrutiny.

Taken together, these various classes of surveys demanded an enormous and increasing effort by the Department. A peak was reached in 1940/41, after which assessment stopped during World War II, except for one camp which operated in north Queensland making urgent estimates of kauri and other species to be used for aircraft construction. Some idea of the enormous effort demanded in this work can be gained from the areas summarised in Table 1.



Map 1. Maroochy State Forest (R368)—part only. Class 2 Survey by Forest Foreman Markwell in 1922 at a scale of 10 chains to 1 inch (1:7,920).



Map 2. Peachester State Forest (SFR 313)—part only. The map of the original strip survey was probably drawn at a scale of 10 or 20 chains to 1 inch (1:7,920 or 1:15,840). This map drawn by J.W. at a scale of 1:10,000 shows the large forest inventory plots installed by Overseer Cauley in 1956. The stand types shown are probably those mapped in 1924.

The 1940/41 annual report shows that the strip surveys sampled almost a quarter of a million hectares at an intensity which we estimate to be about 1:19. In that year, the crews traversed 863 kilometres of compass and chain lines, 6461 kilometres of strip surveys, and 380 kilometres of various traverses of scrub patches, tracks and roads—a total of 7704 kilometres almost all in straight lines up hill and down dale, across creeks and ridges, through thick vegetation and thin, and further than Burke and Wills had travelled eighty years earlier.

The assessments gradually extended the Department's knowledge of the forests until many, but not all, of the existing state forests and timber reserves had been covered by the 1940s. The knowledge was held not only in the bulging cabinets packed with detailed maps and quantitative reports, but also from the intimate experiences of those who had worked on them. In this sense, the earlier informal era of assessment was echoed in personal experience and organisational memory.

Table 1. Method and areas assessed in sample years, 1921 to 1941

	Explore and investigate *(Class 1)*	Feature and assessment surveys *(Class 2)*	Valuation & organisation surveys *(Class 3)*	Compartment & plantation surveys
Land tenure	Vacant Crown land	Timber reserves and vacant Crown land	State forest	State forest
Method	Line inspections	Strip survey, map features	Strip survey, map features	Boundary and contour surveys
Map scale	Not mapped	1:15,840 or 1:7,920	1:15,840	1:3,960 for plantations
Year		Area (ha)		
1921	268,838	37,272	23,976	
1926	208,876	2,388	23,949	22,044
1930	136,469	47,556	11,398	24,676
1935/36	4,160	23,621	23,006	60,015
1940/41	28,388	241,933 *	92,506 #	

* North Queensland for war effort; # Type and soil surveys. Dept. of Forests, *Annual reports*.

Era of air photo interpretation and continuous forest inventory

The first opportunity of improving strip assessment came when aerial photographs became more readily available after World War II. For the first time, foresters could see a representation of the forest as a whole without having to sketch how the creeks and stands ran between their survey lines, or traverse round every patch of rainforest, or 'scrub'. In many areas of north Queensland, military mapping had produced contour maps at a scale of 1 inch: 1 mile (1:63,360) which were of great help, and gradually the cartographers were able to extend the coverage. The Department was quick to take advantage of the war-time photos and in the 1950s started to commission some of their own.

Aerial photographs enabled the winding creeks and ridges to be mapped with much greater accuracy than had been possible from the strip surveys and it was not uncommon to find that the drainage pattern originally mapped needed substantial revision (L.T. Carron pers. comm.). However, their greatest advantage was in revealing the pattern of the forest stands. Their structure, rather than their species composition, could also be seen and it was remarkable what trained and experienced people could interpret. The categories appearing on the maps included: 'rain forest or scrub', 'scrubby forest', 'forest', 'rung'(ie. ring-barked), 'eucalypt regrowth-regeneration and saplings', 'eucalypt regrowth-poles', 'useless regrowth on former scrub lands (wattle, lantana, etc.)'. Their areas were neatly mapped, but species and quantities still had to be determined on the ground. The attributes of interest were still primarily the present timber resources and access to them, but interest in the future of the forest was reflected in the mapping of regrowth stands.

With aerial photo interpretation able to ease the task of identifying where the timber stands were, foresters could at last turn to the essential task for sustained yield management, that of monitoring the growth of the forest. A continuous forest inventory system, first developed in North America, was tried at Western Creek in 1941 and extended to some coastal hardwood areas in 1945 (Vanclay and others 1987). The Department instituted this class of assessment for state forests and installed a grid of quite large, one acre [0.4 ha], permanently marked plots in every 500 acres [200 ha] 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 class could be cut. In addition, individual tree measurements were made on some 'detailed yield' plots chosen to be 'representative of the average conditions of the major types' with the intention of providing more detailed growth information (Vanclay and others 1987).

Strip assessments still had to be undertaken in the 60 per cent of the state forests not covered by the continuous forest inventory, but the greatest work load related to the 'conversion of tenure' of public lands once the Bjelke-Petersen Government had passed its *Land Act* 1962 which enabled lessees of public land to apply for freehold, a process which gratified the government's rural support base while raising revenue. The assessments were of the Class 2 standard except for small patches of forest where every tree was measured. If the forest had enough high-quality timber, it might be recommended for reservation as state forest, otherwise the lessees were sent a description of the forest and an account, the amount of which they could contest in a Land Court. As much of the converted land was subsequently cleared, the forest assessors were put in the bizarre position of having to facilitate deforestation. They had always had some of this work, but the conversion 'boom' in the 1960s and 1970s was such that by 1984 the assessors had dealt with nearly 4000 applications and assessed 12.7 million hectares, more than three times the area of the state forests. The total amount of strip surveying both on state forests and for tenure conversions, reported in most of the Department's annual reports, shows an increase from an average of 1800 kilometres of strip lines assessed per year in the 1950s to 7400 kilometres in the 1960s and 5600 in the 1970s. Over 10,000 kilometres were assessed in each of the peak years of 1965 and 1967. Strip assessments continued as forested leases were still being converted to freehold in the 1990s and doubtless many were deforested.

There was a considerable amount of surveying of roads, plantation and compartment boundaries which was carried out in addition to measuring the inventory plots and strip surveying. The number of crews, or 'camps', increased until there were 36 to 37 at work in the peak years and over 180 people were employed in the forests with more needed to draw the maps (Table 2). Together they amounted to over nine per cent of the Department's entire workforce. With so many people and a high turnover, the need for training and standardisation was even more important than it had been for Lieut. Douglas. Young foresters fresh from their cadetships were put to the task and a three-year training course was started in the 1950s from which survey overseers graduated to good effect. Even with aerial photographs, where these were available, the work in the forest remained arduous and repetitive, although it became slightly more comfortable in the 1970s when caravans were bought to replace the tents. The Department produced a handbook (Queensland Forest Service 1962) which provided detailed instructions for conducting basic and strip surveys. It laid down how vegetation types were to be classified by tree species and how trees estimated along the strips were to be booked by four utilisation classes: 'mill logs and girders'; 'round timbers—poles, piles, house blocks'; 'sleeper trees'; and 'split posts'. All other 'useless' trees, it declared, were not to be booked.

Table 2. Assessment and mapping staff 1964/65

Grade	Number	Grade	Number
Foresters	11	Trainees	11
Forest surveyor	1	Men	120
Forest rangers	9		
Survey overseers	35	Total assessment staff	187
		Drafting Branch	19
		Total staff	206

Source: Dept. of Forestry, *Annual Report* 1964/65

Whereas the strip surveys were recorded in field books and their results worked up into tabulated reports of the condition of the forest at the time of assessment, the continuous forest inventory system demanded permanent plots so that growth rates could be determined. The network of per-manent and detailed yield plots was gradually extended to cover the most valuable forests and the plots were re-measured at approx-imately five-yearly intervals. The great amount of data generated by this form of assessment could only be processed effectively by computer programs which were developed from the 1960s. The combination of aerial photography with the plot-based inventory system during the 1950s and 1960s enabled the first calculations to be made of how much wood could be allowed to be cut from the state forests under the sustained-yield principles avowed by Jolly so many years before. Clearly timber was the attribute of interest during this era of expanded activity, but its primacy was not to last.

Environmental era

It was the environmental attributes of the forests which became of rapidly increasing interest from the early 1970s and the subject of public controversies and political conflicts over logging in the wet tropics, on Fraser Island and in many other regions

(Bonyhady 1993, Dargavel 1995, Mercer 1991, Taylor 1994). The history of their assessment is far more diverse than in the previous era as fauna, flora, aesthetic and other attributes had to be assessed, and as more agencies—most notably the Commonwealth's—and environmental and scientific bodies also undertook assessments, sometimes in cooperation with the Queensland Department of Forestry and sometimes independently. Most public attention in the environmental era was directed to the forest animals so that their assessment, and the impact of logging on their well-being became an important task. The numerous environmental disputes, inquiries, consultations and plans created seemingly insatiable demands on the Department's planning, assessment and mapping staff. A separate environmental unit was established and the number of people in the drafting office doubled. At the same time, Queensland was also subjected to the organisational restructures and staff reductions which affected all of Australia's forest services during the 1980s and 1990s. They added to the turmoil and diminished part of the organisational memory needed to retrieve the assessment legacy for the new issues. Nevertheless, existing assessment procedures were revised, new ones developed and new technologies deployed, which enabled some of the new assessments to be conducted in ways far more sophisticated than anything before.

Permanent plots

New parameters were added to those measured on the existing network of permanent plots. From the 1980s the crowns of the larger trees were classified in terms of their size position and leaf area. From 1993 the minimum size of tree recorded was reduced from 20 to 10 cm diameter, the amount of regeneration measured on sub-plots and soil information recorded. Reflecting the increased interest in vertebrate fauna, the presence and distribution of nesting hollows was recorded.

Fauna

Zoologists in the Forest Service carried out fauna surveys throughout the State from the mid-1960s and in 1969 began ground-breaking studies into rodent pest management in hoop pine plantations which were continued into the early 1970s. In 1975 the National Parks and Wildlife Service was created as an organisation separate from the Forest Service which had managed the national parks till then. The new service had to survey the fauna in the coastal lowlands of south-east Queensland, where large-scale clearing for the establishment of exotic pine plantations was occurring, as part of the environmental impact assessments required by the Commonwealth. In addition, detailed studies of indicator species, such as lorikeets and gliders were undertaken to measure the impacts of forest operations. These studies involved capturing and marking of large numbers of animals; the greater glider studies in particular involved detailed radio-tracking, utilising what was then fairly new technology for Australian zoologists.

By the early 1980s the spotlight on fauna had shifted to the wet forests of the Conondale Ranges due to public concern over the impact of logging there. A whole suite of studies was initiated to investigate the diversity of all vertebrate groups and the impacts of logging. The first paired-catchment study of fauna in Queensland was also set up to monitor the impacts of logging on two highly-restricted species of freshwater crayfish, then virtually unknown to biologists. In addition, a readily portable system—the Anabat detector—was developed for monitoring micro-bats by their ultra-sonic calls. It enabled zoologists to sample the occurrence of bats easily for the first time. The Conondale studies through the 1980s led on to Commonwealth funding during the 1990s (under the National Rainforest Conservation and Landcare Programs). Projects were undertaken in state forests on endangered, vulnerable and rare species (such as the black-breasted button-quail, yellow-bellied glider, micro-bats and marbled frogmouth) dependent, or partially so, on rainforest. Studies were also undertaken of the utility of wildlife corridors and remnant bushlands to fauna.

In the 1990s faunal studies diversified in scope and direction, primarily in response to the burgeoning number of laws and agreements that imposed major obligations to manage the forests in an environmentally sensitive way. The assessment and research program of the zoologists was diversified accordingly to provide increased information. Research, survey and monitoring in the 1990s became closely tied to the Comprehensive Regional Assessment process, ecologically sustainable development, farm forestry, forest health, the requirements of the *Nature Conservation Act* 1994 and the logging code of practice. A computerised system was set up as a major means of communicating information about flora and fauna to the relevant people.

Technologies

Of the new technologies, it was the images taken from space satellites in the 1980s that contrasted most spectacularly with those of the era of exploration. The features of the State which had been so patiently assembled area-by-area with such difficulty over more than a century were suddenly revealed together in each satellite pass. The images covered the country and their component bands could be manipulated to highlight particular features, such as forests. At last a consistent, comprehensive map of all the State's forests and woodlands, covering over 50 million hectares, could be made in a manner which could never have been achieved by the traditional mapping methods.

The new images added another level of knowledge about the forests, but it was the advent of geographic information systems (GIS) technology during the 1980s which opened up a remarkable means of bringing existing maps and various forms of data together. At first it was used as an efficient tool for storing and plotting mapped information and as a means of reducing the number of cartographers needed to draw, or revise the forest reserve maps with all their intricate detail of streams, ridges, tracks, and types of stands. However, the most powerful advance lay in the ability of these systems to overlay several different types of maps or other spatial information and produce new classifications of the forest landscape. Rainfall and temperature had long been measured in forest districts across the country and although it had been assiduously tabulated in forest working plans, it had rarely before had any bearing on how the forests were assessed or managed. The new systems enabled such data to be manipulated in statistical models by computers and combined with topographic, geologic or soil map information wherever available. The new classifications, or 'environmental domains' which could be generated were based, as far as possible, on a prior scientific understanding of the environmental processes at work. They were particularly suited to analysing the distribution of particular species and began to be applied from the mid 1980s (e.g. Nix 1986). Although the geographic information systems relied on maps and the vast legacy of data accumulated in museum collection records over a century or so, and in the forest assessment reports and maps, they had to be retrieved and converted to an electronic form. It was a use which could never have been envisaged when they were collected so that although many were used, others had to be discarded and many remain as a potentially rich source for historical studies. Computers, programs and the trained staff to operate the new systems and convert the old data had to be obtained so that it was not until the 1990s that they could be brought to bear on assessments regularly.

Wet tropical rainforests assessment

The rainforests of the wet tropics, which had been so laboriously assessed for their cabinet and other timbers for half a century, became the prime focus for assessing environmental attributes with the new technologies. Their eventual inscription on the World Heritage List in 1988 recognised the area for its evolutionary history, ecological and biological processes, natural phenomena and importance for the conservation of biological diversity. But assessing such attributes to determine where the boundaries of the area to be preserved should lie was a difficult task, especially given the politically fraught and harried atmosphere in which Queensland opposed the Commonwealth's nomination in the High Court. Each built its own computer-based geographic information system to support its case.

Queensland hurriedly developed its system from early in 1988 as a joint venture between its (then) Department of Forestry and Department of Environment and Conservation with assistance from other departments as required. Foresters, ecologists, cartographers and computer personnel combined to build a multi-layered system to cover the 894,000 hectares of the World Heritage Area. As the case developed, those giving evidence needed a variety of outputs to be plotted from the system. More data layers had to be added which imposed an enormous strain on the staff who also had to cope with increasing volumes of alpha-numeric data needed to describe the rare and threatened flora and fauna of the area. The scale and detail of the data from different sources required careful monitoring to ensure its accuracy. The work was greatly increased when the area to be studied was expanded to cover the whole biogeographical region of 2.6 million hectares. At the height of preparations for the case, the system contained over 30 layers of data which demanded massive storage capacity on the Government's computers. All the equipment and skills developed for this case provided a solid grounding for developing an integrated remote sensing and modelling system for Queensland's forests (Preston 1995) and for the recent old-growth assessment project (Chapter 25).

Meanwhile, the Commonwealth's Department of Environment commissioned a team at the Australian National University, led by Professor Henry Nix, to display the distribution of the various types of rainforest and their endemic species. The team built a computer model of the topography and climate with which it mapped appropriate environmental domains. It then hunted through herbarium and museum records to see where the plant and animal specimens which had been collected for well over a century had come from. The locations where many of the older specimens had been collected had not been recorded precisely enough, but many others were able to be incorporated into the model and the distributions essayed. The pace and style of the political decision-making led to the boundaries being set on the basis of various sources of information including Queensland's system and some of the early results from the Commonwealth's model. The model was subsequently improved to display the distribution of the rainforest animals (Nix and Switzer 1991). Both models proved exemplars for studies which were to follow on 'old-growth' forests, but by then the

National Forest Policy Statement (Australia, Council of Australian Governments 1992) had been signed and a more co-operative approach had been negotiated.

Persisting themes

The current old-growth assessment project (Chapter 26) with its multi-faceted surveys, advanced computer systems, published reports and political interest seems a world away from the collections of the early botanists or the assessments of timber men clambering through the forests to find another patch of workable logs. Yet some themes persist across the eras described in this paper which we wish to draw out as reflections on the nature of assessing forests.

First is the size and cost of the task. The sheer physical effort of traversing many thousands of kilometres in straight lines through the forests for fifty years stands out most sharply. Remarkable too was the endeavour to install and remeasure plots in a grid across the state forests. Although the effort required was eased somewhat as roads and tracks spread and was aided by aerial photography, the cost of timber assessment was substantial. The environmental era brought new attributes to be assessed, some of which, such as the flora and fauna surveys, also required direct observation in the forests. In spite of this, the total effort of observing the forests directly almost certainly declined from its peak in the 1960s. The marshalling of existing information and its manipulation in geographic information systems brought its own demands for equipment, staff and costs. The points to be made here are that assessment has always involved a substantial cost and that this has limited the amount which it was possible to know about the forests at any given time.

Second is the balance between permanence and transience. In each era some assessments add to the accumulating store of knowledge about the forests, while others are irretrievably lost. Accumulating specimens in herbariums and museums, spreading topographic and geological surveys, and long-term climatic records are examples of assessments which have the potential to increase knowledge about the forests permanently. The potential can not, however, always be reached because the costs of retrieval may be too high or because of inconsistencies or lack of precision in the original observations. At the other extreme, some assessments seem of only of passing interest, at least at the time. The first timber cutters needed no records of what they felled, nor have the records of assessments made on the 12.7 million hectares of forested land converted to freehold seemed of much value, although both might now prove useful to reconstruct Australia's ecological past. However, old assessments can provide a start for new sampling as in the case of the long-term yield plots in the wet tropics. Their measurement was discontinued when the area was placed on the World Heritage List and logging stopped, but have been started again to learn more about the dynamics of these forests. And it is clear that the measurements so patiently accumulated in the permanent plots for their original purpose of timber management proved an invaluable source of information in the most recent old-growth assessment undertaken for a very different purpose.

Somewhat related to the second theme, is the changing balance between direct personal observation and experience in the forests on one hand, and indirect and remote observation from aerial photographs and, at extreme, satellites on the other. The two can be seen as yielding knowledge at different levels of abstraction. The fallers testing the soundness of trees by their 'ring' to the axe, or the timber assessors measuring them, or the wildlife assessors releasing animals from the traps had an immediacy and personal depth to their observations of the forest. Yet the accumulation of indirect observations from the first theodolite triangulations to the latest satellite images provided a formal and stylised knowledge of the forest as a whole which was beyond the ken of individuals within it. Conversely, the indirect or remote observations only acquired their meaning from the forests directly observed. Yet the operators making the digital records on computers or manipulating them in geographic information systems may never have had any immediate or personal experiences of the trees or forest animals, except perhaps those gained on holidays.

Fourth is the inherent nature of the problems of sampling, interpolation and estimation with which each era had to deal. The early timber workers dealt with them informally, searching where they could and guessing what stands might be between until they could get to them. The strip survey system did so rigidly by observing along its lines, interpolating the run of creeks and ridges as best it could between them, and estimating the total quantity of timber from the sample measured. The continuous inventory system had a similarly rigid layout of plots and was used to estimate growth for the forest as a whole much as the strips had estimated its quantity. More difficult are animals which move or intangible aesthetic and heritage values which needed to be assessed in the environmental era. The heroic endeavours to incorporate the new information with that gathered in earlier eras for different purposes into geographic information systems could not escape the inherent problems. The most obvious one came from the reliability and scale of the original maps. Topographically these were rarely better than a scale of 1:63,360 or 1:100,000, while geological and soil maps were rarely better than 1:250,000. The climatic maps resulted from ingenious calculations made using continent-wide models with whatever long-term data were available from local weather stations. The distribution of the major tree species could be obtained from the strip and plot assessments, but the distribution of animals and plants often had to rely on irregular data, such as museum collection records. The manipulation and integration of such disparate sources of information made the best use of them, but the sophistication of the technique could not eliminate their innate uncertainties. As in every era, what could be known about the forests was conditioned by how far the difficulties of assessment could be dealt with at the time

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8

Bush, brush, forest and scrub

Pauline Curby

Introduction

This paper considers the values placed on some of the forests of the north coast of New South Wales, over the last hundred years. The first part is based on work undertaken on forests of the Dorrigo Plateau. The perspectives of a forest inspector from the 1880s and, from the 1890s, a grazier and a botanist are referred to; in the 1930s the attitudes of a range of different people to a specific Dorrigo forest are discussed. The way in which foresters valued, or devalued, certain types of forests in the period from the 1940s to the 1980s is also considered. Finally, the value ascribed to these forests in the 1990s is examined based on work in two forests north west of Dorrigo. What is of importance to most of the people concerned is connected with knowledge and use of the forest and, most importantly, with identification with a specific forest locality. These values are only implicitly related to forest age, a concept which is rarely explicitly articulated.

Forest history on the north coast began with what one could almost call a fixation with cedar. This was a purely economic focus with very little room for other values. Later when almost all the cedar had been logged there was a redirection of attention to a particular forest type. This was marked by a name change from the plain old 'brush' or, more commonly on the North Coast, 'scrub', to the much more evocative 'rainforest'. Ecology, biodiversity and aesthetics were some of the values articulated in the 1970s with regard to the north coast rainforests. Although forest age was implicit in these values it was not the key element that was expressed.

On the north coast an *explicit* concern for forest age only became apparent after the Wran Government's 1982 decision to stop most rainforest logging. It soon became obvious to the environmental movement that the protection of a forest type that had been already almost wiped out was a pyrrhic victory. In order to protect the remaining North Coast forests a broader definition of what was valued and worthy of retention was devised. Out of this came the more widespread use of the term 'wilderness' and the beginning of the use of the term 'old-growth'.

This paper is concerned with social history, not with etymology, although it is important to consider the context in which words are used. The words *Bush, Brush, Forest* and *Scrub* tell us a lot about how we perceive forests. The use of 'scrub' for rainforest, as in the 'Big Scrub', to describe the semi-tropical rainforest near Lismore, cleared for farms in the second half on the nineteenth century, is still sometimes used, especially by old timers. The word 'brush' was the term generally used, especially by foresters, for 'rainforest' until about 30 or 40 years ago. The first reference that I have found to 'rainforest' instead of 'brush' in the files of State Forests of New South Wales was in a 1958 report about Ellis State Forest in the Dorrigo Management Area. By August 1979, when protesters were lying in front of bulldozers at Terania Creek, the word was definitely part of our vocabulary. Lionel Gilbert's 1971 thesis provides a good reference to the historical use of botanical terms and refers to P.G. King's 1805 definition of 'brush' as 'a dark impenetrable thicket of plants and herbaceous shrubs'. He also notes the universal use of the word 'forest' to mean open forest and the importance of the presence of grass in this usage. This is something that has been picked up by recent commentators and, in my opinion, applied in a simplistic way to a variety of vegetation types.

The word 'wilderness' has a long history. The Helman report was important twenty years ago in popularising this term and pointing out the significance of its use in North America (Helman and others 1976). The report nominated twenty forest areas of New South Wales as wilderness areas which needed to be preserved. In the early 1990s I researched areas for State Forests of New South Wales which were either in or near to three of these: the Guy Fawkes, the Mann and the Washpool areas. The term 'wilderness' irked some north coast foresters and resulted in my being asked to write their 'European disturbance history'. To people whose families had grazed cattle there for sometimes for fifty or more years, and in some cases for three generations, and to those who had fossicked there during the depression, or who had brought loads of timber out with bullocks for local timber companies in the 1940s and 1950s, the areas were not 'wilderness' but simply 'bush'.

The beauty of the Dorrigo

I begin this paper with a quotation, written in 1950, that tells of one visitor's response to the forests of the Dorrigo Plateau as they were in 1892:

> It is beyond me to describe the beauty of the Dorrigo in its natural state—many thousands of acres of dense brush lands, rich in soil, with running streams of pure water in abundance, occasional waterfalls and ferneries. Orchids were beautiful and abundant. The timber was what took my fancy most—there was a magnificent wealth of cedar and other softwoods. The bird life filled the air with music one could never forget (Henderson 1950).

This was how Cunningham Henderson, a grazier from Coraki, remembered his first visit to the Dorrigo plateau. He was on his honeymoon, having married Marion McDougall in September of that year at Coraki. After the wedding they travelled to Bellingen to meet his wife's family. Here they borrowed horses from Marion's brother and rode up to the plateau where they stayed for two weeks. Another brother was overseer at the plantation where the Forestry Department was attempting to grow cedar. In the words of the bridegroom:

> Practically the whole of the cedar belts were thrown open for settlement at one pound per acre, with thousands of young cedar trees coming on and millions of seeds waiting their time for germination. The marketable trees were cut out and hauled to the nearest mill or market, the balance of the wonderful brush cut down and burnt to make grass. And so Nature's rich provision for mankind in that locality has been lost for ever.

> All through the Dorrigo the timber getters had cut tracks for miles and miles. These we followed on horseback. The freshness of it all was fascinating, the singing and whistling of birds, the perfumes from orchids and vegetation, the waterfalls; it was all grand and beyond description. We saw cedar butts lying for removal some day, up to 25 feet long and six feet in diameter. The lighter tops had already been taken (Henderson 1950).

Cunningham Henderson's memories of the Dorrigo plateau as it was in 1892 highlight some of the features that make it unique. He evoked the remoteness of the plateau which delayed white settlement; the natural beauty of the area which, even in 1892, attracted tourists; the wealth of timber ruthlessly exploited and the ham-fisted official attempts to replace it. His memories of his first visit there, recorded almost sixty years later, reflect the essence of the tragedy of settlement on the Dorrigo. The truth was even worse than Henderson recalls. In the eastern Dorrigo, in particular, not even the marketable timber found its way to the sawmills. It was often burnt due to a combination of circumstances. The despoiling of the Dorrigo plateau and the waste of the area's timber resources had been noted and deplored in the early years of the century. Henderson was not alone in regretting what had happened.

This exploitation was of course not unique. The Big Scrub on the Richmond River had been just as thoroughly plundered of cedar fifty years before Henderson's honeymoon and was almost completely cleared in the 1880s. The timing of the destruction on the Dorrigo in the early years of the century made the reaction to it boisterous. Australia had lost its innocence by the time Dorrigo was 'opened up'. The depression of the 1890s, followed by a lengthy drought and then the ravages of introduced plant and animal species had made some thinking people question contemporary modes of operation. In addition the fact that in the early years of the century New South Wales was importing timber, challenged the widespread belief that the state was endowed with unlimited supplies of timber. Although the loss of the forests, especially those that were aesthetically pleasing, was lamented, expressions of regret were almost always phrased in economic terms. Few commented on the destruction of the nation's ecological and botanical diversity.

The failed attempt to establish cedar plantations was one indication that the New South Wales government aimed, in the 1880s, to play a role in the management of the forest estate. Another was the creation of the first forest or timber reserves in New South Wales in 1871. Three were dedicated on the Dorrigo Plateau at this time: Glenfernie, Mt. Hyland and Dorrigo Forest Reserves. John Duff, New South Wales Inspector of Forests, described the latter which he visited in 1883 as a 'magnificent reserve'. His report outlined the different timber species that were found on the reserve and gave hints as to how they could be worked. At times he became lyrical at the beauty of the rainforest. For example, he noted that the lianas 'assist to form that peculiarly tropical and pleasing feature in the vegetation which is only seen in the jungle forests' (Duff 1883). This was, nevertheless, essentially a report concerned with timber rather than forests.

The botanist J. H. Maiden visited the reserve, where he spent 'a week under canvas', in December 1893. His account, published in the *Agricultural Gazette*, is an odd mixture of botanical information, purple passages about the scenery and practical advice on how to get there, where to stay and how much this would cost. In addition he indignantly refuted the ill-founded claims that a visitor to the Plateau would be bitten by snakes, sucked by leeches and attacked by ticks. In fact he observed that the two mosquitoes that he found in his tent had 'probably come up with my luggage' (Maiden, 1893). His observations make it clear, despite the depletion of cedar, how heavily timbered the plateau still was at this time. Ascending from the Bellinger along the new 'road', Maiden crossed Rocky Creek and described how the country on either side of the road:

> consists of almost impenetrable scrub ... [After] two or three miles of this road we suddenly enter one of the plains or meadows, and are fairly in the Dorrigo. The Dorrigo Forest Reserve consists for the most part of brush land, containing a great variety of timbers. Not a single species of Eucalyptus is found in it (Maiden 1893).

The Dorrigo Reserve was an extensive area to the west of Bielsdown Creek and so the present site of Dorrigo would, at this time, have been an isolated enclave, surrounded by dense rainforest. Maiden was enthralled by the trees and the variety of plant species that he found on the reserve. His greatest enthusiasm was reserved, however, for the scenery of the mountain forests. He captured the unique ambience of the cool, dank rainforest when he wrote:

> In the forest itself there is almost perpetual gloom. The trees are so close together, are so tall, and have such leafy tops, that unless one keeps on beaten tracks, along which the timber has usually been felled, one rarely sees the sky ... (Maiden 1893).

Maiden's appreciation of the beauty of the Dorrigo forests and his scientific interest in their botanical riches coexisted with a concern that their economic potential be exploited. He fretted that there was no demand for a 'single stick' of rosewood and was prepared to 'stake my reputation that this is a valuable timber'. This 'merchantable' species made, he informed his readers, 'excellent furniture'. There was no contradiction, from the perspective of the nineteenth century, in admiring the beauty of a forest, perhaps even loving and identifying with it and wanting to make money out of it. Totally destroying it was of course another thing altogether. But this is what happened. As the surrounding land was opened up for closer settlement and the town of Dorrigo grew in the early years of the twentieth century the rainforest of the reserve shrank and finally disappeared.

An appreciation of the beauty of the forests is a recurring theme in the history of the Dorrigo Plateau. This admiration was rarely enough, however, to stop a forest, if it were accessible, from being logged. The first very mild and unsuccessful protest against logging on the Dorrigo occurred in 1930. This was concerned with the aesthetic value of the area around Mount Campion that was, and still is, regarded by local people as a place of beauty. It was gazetted as a forest reserve in 1906 and was dedicated as Bielsdown State Forest in 1917. In 1930 the Dorrigo Chamber of Commerce protested to the Forestry Commission when it was about to be logged. They objected to Campion's Reserve, as they called it, being thrown open to timber-getters. The reserve, it was argued, was one of 'the beauty features of the Dorrigo'. The district forester replied that it had been logged for a number of years for pine and later coachwood and added, 'so far there is no visible difference in the aspect from the township, or in passing by from a scenic point of view'. He argued that as the area was not on the main tourist road it was unlikely to be visited much anyway. 'For beauty features', he wrote, 'Dorrigo is well catered for with the reserve for preservation of native flora ... from this expansive views are open to tourists', which was obviously enough for any little town to expect. The forester maintained that past logging had not spoilt the beauty of the forest and, with cavalier unconcern for the unique qualities of the reserve, suggested that if 'the area is heavily denuded of trees, planting can be undertaken' (SFNSW file 3892). Forest age was of no concern to this forester.

All local residents did not support the demand that the reserve be left in its 'natural state' and the Leigh Progress Association had in fact requested some years earlier that the area be 'thrown open for settlement'. The creation of Bielsdown State Forest in June 1917 had forestalled this and the Minister for Forests added his weight to the debate by stating that as 'state forests are created for the purpose of utilising as well as growing timber, timber-getting operations will be allowed so long as they do not conflict with forestry requirements' (SFNSW file 3892). Subsequently two timber-getters, Quinlan and Hamey, were issued with a brushwood cutting licence.

This debate indicates the different pressures that the Forestry Commission was subject to in the 1930s. The push for closer settlement was still present, although in this case it failed. Also unsuccessful was this early attempt to conserve a state forest from logging. The district forester obviously thought that the only factor worth considering was the visual impact of logging. There is no further correspondence from the Chamber of Commerce so it is not known whether this was also their prime concern. The players valued different aspects of the forest: the Chamber of Commerce appreciated the beauty of the forest; the forester and Quinlan and Hamey had their eyes on the timber; and the Leigh Progress Association valued the land for its agricultural potential. All over New South Wales there were people who shared this last idea, to whom every forest was a good farm going to waste.

Closer settlement

Pressure for closer settlement was a determining feature for at least a century. The mirage of thousands of happy families, contented and productive on small farms, posed the greatest threat to the forests of New South Wales. Although we may empathise with the progressive social and political position of those who wished to destroy the land monopoly of the capitalists and finance companies, we can now only deplore their ignorance of Australian ecology. For many of those who came to the Dorrigo after most of the good farm land had been alienated, the attempt to create farms from reluctant forest land proved to be a human and environmental tragedy. I traced the history of a number of blocks, now in state forests, that revealed a story of broken dreams and failed aspirations. One block, now in Clouds Creek State Forest was selected and forfeited four times within 22 years. When it was finally admitted, in the 1930s and 1940s, that blocks such as these were not good farm land, the Forestry Commission literally 'bought back the farm'. The main criteria for the Forestry Commission in acquiring these failed farms was that there was marketable timber, the land was accessible and it could be bought for a cheap price.

In the early 1950s, at around the time that Cunningham Henderson was writing his memoirs, assessors inspecting the forests of the Plateau noted that:

> Quite considerable areas outside state forest have been cleared on the Eastern Dorrigo for attempts at dairying and grazing by people apparently under the impression that the soils were as valuable as those further west (i.e. the red loams). Such attempts have mostly met with signal failure due to mineral deficiencies and somewhat more hilly land. The result has been a return of useless woody shrubs in many areas once cleared and great areas of dying brush both inside and outside state forests present a depressing sight (SFNSW report 219C).

The beauty of the Dorrigo had been tarnished by the tradition of placing purely economic value on the forests. No wonder that Cunningham Henderson wrote such purple prose about his honeymoon, when a trip to the Plateau in the 1950s presented the visitor with the sight of 'dying brush'. In 1979, K.T. Henderson was to write a useful thesis which examines the conflicting demands for closer settlement as opposed to forestry interests on the Dorrigo Plateau, a conflict between those who valued the forest for its timber and those who saw it as potential agricultural land going to waste.

Forest management

By the 1940s and 1950s there was less pressure on the Forestry Commission from those who saw the forests as potential farms. Equally destructive, however, was the desire within the Forestry Commission to 'improve' the forests. Forest age was of no concern. The only consideration of importance was whether or not a forest could be made productive. 'Class Three Surveys' to estimate the timber volume and producc topographic and contour maps with forest types marked were undertaken in Wild Cattle Creek State Forest in 1937, 1939 and 1940 (Forestry Commission, *Annual Report* 1945). This was part of a statewide survey of rainforests to locate areas suitable for hoop pine plantations. Rainforests, with all their diversity, were at this time regarded as of little value commercially, but hoop pine was in short supply having been selectively logged from them since the 1930s. Under the purely ulititarian management philosophy it was considered wise to replace rainforests with a single species from which revenue might be derived.

The survey of one part of the forest, Mobong Logging Area, in 1940 indicated that, after fifteen years of intensive logging, the southern part of this area was logged out, but the north was still 'virgin', obviously an old-growth forest. Three forest types were located in this survey. These were referred to as 'forest' (eucalypt).; 'scrub' (temperate rainforest). and 'bastard scrub' (SFNSW report 52). This last disparaging phrase probably referred to wet sclerophyll forest in transition to rainforest.

An assessment of all public lands was undertaken in the early 1950s in order to estimate the State's timber resources for the future. It was recommended that the:

> remaining isolated brush remnants on red soils in undulating topography could be cleared for primary production ... until more is known about brushwood regeneration, it may be safer to put this site [i.e 'commercial brush sites' in state forests] down for the growing of fast moving eucalypts and for exotic Pinus species (SFNSW report 219C).

The last suggestion, that exotic plantations be established, was not new. The Forestry Commission had, since 1919, a policy of establishing them to overcome a shortage of softwoods, being met at that time by imports. Despite numerous setbacks this policy continued in the pre-war years and was extended in the wake of the assessments of the 1950s and early 1960s. Between 1950 and 1970, 59 hectares of exotic pine was planted at Cascade and in 1958 a further 32 hectares at Welcome Flat Pine Plantation on the Dorrigo Plateau. Growth rates were not as great as those at plantations further south, and so those on the Dorrigo were not enlarged. A hoop pine plantation of 20 hectares was also established at Cascade in 1951 where the 'bastard scrub' had once grown. These projects were not extended primarily because they were regarded as too expensive. Hoop pine, for example, has to be grown for two years in a nursery and is very slow growing in the first year after being planted out.

The Washpool Wilderness and Willowie Scrub

By the 1970s, the Forestry Commission was getting increasingly out of step with changing community perceptions of the value of forests. The Forestry Commission's 1970s indigenous forest policy, for example, stated that 'mountain forests should be cut to the limit of economic accessibility' while coastal forests regenerated (Carron,1985). This policy clashed with the environmental movement that was growing more articulate and persuasive. Logging in the Washpool area that resulted from this policy was one of the catalysts that made the future of the state's forests a controversial issue.

An 'Investigatory Survey and Assessment' of Washpool State Forest had been completed in 1942 and 1943 in response to wartime conditions for additional timber supplies. The Desert Creek area was described as:

> steep, rough and broken, especially on the southern fall into Desert Creek from the Gibraltar Range. Internal accessibility is extremely difficult, roading and logging operations exceptionally hazardous and economically unsound (SFNSW report 153).

Despite this assessment of the area the report proposed that a road should go into Washpool State Forest. Nothing came of the proposals, probably because of lack of manpower caused by the enlistment of many forest workers in the armed forces rather than the improbability of their success with existing technology. It was not until the 1960s and 1970s that the first systematic exploitation of this forest began.

The Washpool area was identified in the Helman report in 1976 as a wilderness, worthy of preservation. No doubt in response to this report, in January 1977, Forestry Commission officers proposed a flora reserve be placed over a much smaller area of 5,692 hectares known as Willowie Scrub which took in part of Washpool State Forest, Moogem State Forest and Billilimbra State Forest. Forester T.C. Dawson described this as 'the largest untouched rainforest in the state'. He and his colleagues wished to preserve this area in its 'virgin condition' and rejected the suggestion that some selective logging could take place. It was argued that with this type of warm temperate rainforest 'even the most selective logging on occasions can cause considerable crown die back'. The concept of forest age, although not explicitly stated, had become important to some foresters. H. J. Hanson, the district forester at Coffs Harbour, was more concerned that 'the Commission's image and the credibility of officers in the district would be severely jeopardised if any logging took place' (SFNSW file 1003). Good public relations was obviously also an important consideration.

During the next three years there was extensive debate within the Forestry Commission on the future of the area. Although there was general agreement that it should not be logged it was more difficult to reach consensus on the mechanism for protecting the area. Local foresters and scientific officers wished to have it gazetted as a flora reserve and hence prevent future pressure from the timber industry to log the area. Head office officials, on the other hand, argued that there would be sufficient protection through the mechanism of the management plan. This disagreement within the Forestry Commission indicated that although some of its employees had been influenced by the environmental movement, official policy was still predominantly concerned with servicing the needs of the timber industry.

While the Forestry Commission was trying to decide what to do about Willowie Scrub they were overtaken by events. To the south, roading was proceeding in preparation for the logging of the Viper Creek area (within the Washpool Wilderness identified by Helman). Before this could proceed, however, the Forestry Commission was required in 1980 to undertake an Environmental Impact Statement concerning all proposed forest operations in the Washpool. While this was in progress in September 1980 the Forestry Commission decided to gazette the Willowie Scrub Flora Reserve. The motivation for this rearguard action was the realisation that if the area was not protected a far greater area would be 'lost' to the State's National Parks and Wildlife Service. This is what happened when, in October 1982, the New South Wales Government made all but the north and north east part of Washpool State Forest a national park. Although this was a large area it was not as comprehensive as that identified by Helman. Logging in the 1980s in the north of this area (in Washpool and Billilimbra State Forests). although enabling the Forestry Commission to honour their commitments to Big River Timbers Pty. Ltd., proved to be controversial.

Wilderness and the bush

The political clout of the environmental movement was evident in 1982 when the Wran Government banned 'general purpose' rainforest logging in New South Wales. Following this, the use of the more amorphous terms 'wilderness' and 'old-growth' to designate types of forest deemed worthy of preservation, indicated the widening scope of a popular movement. The nomination of areas within the Grafton and Dorrigo forestry districts as part of proposed wilderness areas indirectly led to my research in 1993.

Bob Williams, the district forester at Grafton, is a mild mannered man but he was clearly very annoyed by the use of the term 'wilderness' to describe some of his district. Bob, from years of dealing with graziers who had crown leases and other grazing tenures in the district, had picked up a little of the local history. He knew that this was an area that had a rich and interesting history going back to the earliest days of white settlement. He felt quite rightly that this history should be told. The area that we were concerned with had been part of a station called *Cunglebung*, said to mean the 'big valley'. My report began with the words:

> The area that is now Dalmorton State Forest first came to the attention of white people not because of its scenic beauty; valuable timber; grazing potential or mineral wealth, but because of its position. Located on one of the earliest routes between the Tablelands and the coast, the area was for many people not a destination but a route through which one passed travelling between Glen Innes and Grafton (Curby 1993).

Local people may not have known the exact details of this history but they knew that this was one of the earliest routes to the Tablelands and that it ran along the southern boundary of the proposed wilderness area.

South of this area, a section of Chaelundi State Forest, in the Dorrigo management area, was also a nominated wilderness area. I wrote a separate report on this area. Chaelundi State Forest is still largely undeveloped country, mostly accessible only on horseback or by four-wheel drive vehicle. The steep hills with hurtling slopes down to creeks and gullies and the patches of impenetrable vegetation may seem, to the casual observer, an area untouched by human hands. Like Dalmorton State Forest to the north, it has seen grazing, mining and logging certainly since the 1870s and perhaps earlier. In addition there has been, as yet undated, Aboriginal activity. The scant archaeological work done so far, which has uncovered a number of open artefact scatters, suggests that the Chandlers Creek area was certainly a transit route for the local Aboriginal people. My brief was to write the European disturbance history of these two forests.

Grazing

The European 'disturbance' or activity that had the longest history was grazing. To the people who knew, and know, this area intimately it was and is not *scrub* or *brush* or *forest* but simply *bush*. The whole area had been part of large pastoral holdings which after the *Crown Land Act* 1884 had formed part of the 'resumed area' of these stations. Despite changes in land tenure the forests were held for grazing as part of these holdings until the 1930s. Under the *Closer Settlement Act* 1937, stations such as *Marengo*, *Buccurumbi* and *Cunglebung*, were broken up into smaller leasehold areas in order to help share farmers and their sons acquire their own land. It was intended for people 'who have experience but who possess only limited capital'. The leases were balloted for and could be held in perpetuity, except for those in 'certain reservations' which were restricted to a term of 45 years. Jack Watters, the owner of a 'second or third rate dairy farm' near South Grafton was one of the successful ones and drew two Crown Leases. One of his sons, Keith, recalls that 'you were given five years to fence it and do some timber treatment [ring-barking]' (Curby 1993).

Noel MacDougall who drew a block argues that it was not a 'fair dinkum ballot'. He has always wondered how, if it were a ballot, his family, who held Marengo Station, managed to get four adjoining blocks and the Turnbulls, who held Buccarumbi Station, and their connections acquired almost all the rest. He maintains when Buccarumbi was cut up in 1938, the Turnbulls lost a lot of their domain but seem to have been compensated by 'getting some of MacDougall's land' (Curby 1994). The old term 'dummying' describes the practices of the late 1930s and early 1940s. Noel MacDougall considered it a legitimate tactic. He got a trusted employee, Joe Wheatley, to take up a block in 1946 because 'I had too much land'. Joe lived on it for him but he paid all the expenses. The theory was that no one person's land should exceed what was termed a 'home maintenance area' which MacDougall describes as an area that would carry 100 to 150 breeders. He maintains that 'not one block would carry that' (Curby 1994). The lease conditions demanded residence for five years and payment of rent or, in lieu of rent, improvements were to be effected. These improvements were to be 'of a permanent, fixed and substantial character exclusive of boundary fencing' and were to be equal to the rent payable.

Regular inspections of the leaseholds were held to ascertain whether or not these conditions were fulfilled. These reports indicate exactly what 'European disturbance' took place in the early years of the crown leases. This generally entailed the construction of fences, huts and yards and some ringbarking. They also show that 'dummying' was certainly a feature of this allocation of crown leases. It is interesting to note, however, that generally the 'dummies' did not last and that the man described by Noel MacDougall as the only independent person to get a block was also the only one of the original leaseholders from this ballot who still held the land in the early 1990s. This man was a tough old bushman called Peter Ellis who knew the area of his crown leases and the surrounding district like the back of his hand. At 82 years of age he could still put in a full day in the saddle and was just planning to buy another property when he died suddenly in April 1994 and was was buried near his home at Nymboida.

Mining

Mining had a short-lived impact on the area in the last decades of the nineteenth century. Dalmorton, located on one of the routes between the Clarence River and the Tablelands, became a mushroom goldrush town in the 1870s. The road which made the hamlet accessible to the hopeful miners, eventually became the main thoroughfare. Stories about mining and fossicking, which continued until the 1930s, are part of the folk lore of the district. There are still many open mine shafts.

Stories of a miner named Taylor (no one seems to remember his first name), are part of the local folklore. He and his family stayed in the locality for many years after the main mining activity had petered out and managed to make a living. They owned a small piece of freehold land in the vicinity of Cunglebung. Taylor never escaped the lure of gold. He was, according to leaseholder, Barry Adams,

> getting enough colours down Cunglebung Creek to get him through the depression. I can show you where he used to camp instead of walking home after he did his day's work. There was about three miles difference from where his family lived and where he worked (Curby 1993).

Mrs Emily Taylor's lonely grave site can be seen under an apple tree on their old freehold land. Her son Horace had a mail run from Dalmorton to the Mann River. He did the trip once a week, past the Blacksmith's Shop, following the Dinner Creek track, and stayed overnight at the old Cunglebung pub. The Cunglebung pub was probably a sly grog shop catering for the needs of the miners. Although there are records of numerous licensed hotels in Dalmorton and Buccarumbi in the 1870s when the gold fever was at its height, there is no record of one at Cunglebung. Keith Watters remembers a building adjoining the present Cunglebung hut when he first came to the area in the early 1940s. He believes this to have served as a hotel and recalls the 'pine board used for the bar and the gold counter were still there at that time'. The existing building was the sleeping quarters (Curby 1993). The legend of one unlucky miner, known as Mangey, who used to drink at the pub, is still told at Cunglebung. Mangey had been having a few drinks and was riding home to his hut up Wellington Creek. He was impaled on the low hanging branch of a tree and was found lifeless the next day by a passerby. His mates buried him on the point of the spur that comes onto Quarantine Point. The flat where he was killed has been known ever since as 'Mangey's Flat'. His grave was marked by a round post at each corner when old timer Jack Marsh showed Keith Watters the site in 1938. All trace of the unfortunate man's resting place has since disappeared.

Fossicking and small scale-mining also continued further south in Chandlers Creek until the depression of the 1930s. Peter Ellis remembered seeing 'a lot fossickers about in the bush in those days.' Horace Taylor, a reclusive man, was said to have a mine from which he ferreted out a steady supply of gold whenever he needed it. Tommy James, a retired Dorrigo stockman, recalls Bob Rhodes, the manager of Marengo Station, telling how he used to check on an old fossicker called Sid Powell when he was out mustering. Once, unable to find him at his usual spots, Rhodes searched his hut and found him dead inside. After the local policeman had been informed, old Sid was unceremoniously rolled up and buried down a mine shaft.

Timbergetting

Although most of these forests were officially 'unlogged' as far as the Forestry Commission was concerned, there had been incidental logging associated with the pastoral industry and selective logging for two species, cedar and hoop pine. In this remote inaccessible country bullocks were used long after they had been superseded elsewhere. There was a constant need for grass and water for the working bullocks until motor transport made them redundant. This was one of the reasons that the Cunglebung route, with plenty of both, was popular.

The first logging of the Cunglebung area, other than the early cedar getting, occurred during World War II. Doug Scott, at the age of fifteen, got his first job logging hoop pine there. V.B.Trapp & Co. of Coffs Harbour had, according to Doug, the job of supplying hoop pine under the *Essential Services Act* to the Armed Services. Doug was 'off-siding on a tractor'. The log hauling was done with winches; then a tractor took the log to where a truck could load it. This was, Doug recalls, 'virgin scrub. You couldn't cut a tree down unless it went six feet girth, chest high, and if you did you were in terrible trouble' (Curby 1993).

Although improved technology was to eventually make bullocks a thing of the past, the Adams family stuck with them until the 1950s. Barry Adams, son of bullocky Sid Adams and a big man in every sense of the word, has been associated with the timber industry and grazing since his early teens. Barry worked with bullocks until 1957 because as he says, 'all Adams were bullockies. It was in the blood' (Curby 1993). The slow moving bullocks gave their owners the time to learn about and observe the bush they worked in. This was a time when timber workers camped out in the forest for six week stretches. Doug Scott recalls how he came to town four times the first year. 'You didn't get bored. We did a bit of fossicking. Jack Marsh told us where to look, fossick, how to pan.' (Curby 1993).

Jack Marsh

Local people remember the names and stories associated with a place, so that they become part of the persona of a locality. Chaelundi State Forest will always, for me, be associated with the memory of Peter Ellis. For the people who know Dalmorton State Forest well such as Keith Watters, Barry Adams and Doug Scott the memory of Jack Marsh is synonymous with the locality. It is not the pastoralists or their families who are associated with *Cunglebung* but the name of this humble working man who spent about seventy years of his life there. Jack Marsh is still remembered as a yard and fence builder without equal. Keith Watters describes him as someone for whom 'near enough was not good enough; just right would hardly do'. He did the fencing right through from Cunglebung to Marengo Station and in 1936 built the stockyards, part of which are still at Cunglebung. He 'had to have a certain quality of timber or he wouldn't put it up. He worked by himself with a pair of draught horses to pull the timber' (Curby 1993). He is remembered as a semi-reclusive man who 'never went to town much' but who loved and understood the bush. He is said to have partly lived off the land but never exploited it. When he needed to be he was, according to Doug Scott, 'a damn good shot with a gun'. If fish weren't plentiful he fed them with 'a bit of roo meat hung over the water' (Curby 1993). Doug Scott remembers how, towards the end, he and Jack Watters had to coax Marsh into Doug's 'old bus' to get him to town for medical attention. He spent the remainder of his days with his sister in Grafton. Her grandchildren managed to teach the illiterate old bushman to read a few words and sign his own name before he died.

Local knowledge
There has been an uninterrupted history of grazing in Chaelundi and Dalmorton State Forests since at least the 1870s and most of the lease holders are the third generation of their family to follow grazing pursuits in the district. Their intimate knowledge of the country has been used at crucial stages in the history of the area. In 1938 Noel MacDougall escorted Forestry Commission inspectors around parts of what are now Marengo and Chaelundi State Forests. In the following year Bob Rhodes showed Department of Lands surveyors where the best places for camping reserves were. Presumably he showed them the camps then in use, many of them since the 1870s. In the early 1960s Peter Ellis assisted the Forestry Commission by indicating where the old roads and tracks were so these could be used for their road building program. Finally in 1993 they assisted me in researching the history of the area by consenting to be interviewed.

Conclusion

The value that rural people ascribe to these forests is certainly first and foremost economic. I have no wish to be sentimental but it also needs to be said that there are less tangible values that are just as important to them. These are tied up with an intimate knowledge of the 'bush' and its folk history.

Foresters move regularly and even if they do stay in a district for some years a lot of their time is spent in the office doing paper work. They have little chance of getting to know the forests as some of the local people do. When I am on a forestry project my first visit to the forest is not with the forester but perhaps with a long serving foreman or, more often, one of the lessees who knows the area well. As we drive around they tell me endless yarns about 'their place'. Some of this is trivia but much of it explains why they value the forest. It is a place that, if you run cattle, gives you a modest remuneration. This, usually rough winter grazing, may be enough, together with perhaps a small freehold area and yourself and partner working, to keep you in the cattle industry. It is also a place where you may set up a bush camp for the family in the school holidays. The kids can ride and learn the art of mustering. Adults can revive the skill of cooking with a camp oven and at night tell each other lies around the fire.

These intangibles are only by implication concerned with forest age. The values that are most deeply felt are difficult to articulate. They come from a long and intimate connection with a place, often over several generations, and are nurtured by a knowledge of the way in which they and their kind have interacted with the forest over time. It is my task as a historian to tell this story.

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Appendix: Summary of values placed on some of the forests of the north coast of New South Wales

Time	Place	Person	Values
1892 & 1950	Dorrigo Plateau	Grazier	Aesthetic (forest age implicit); economic/cedar
1880s	Dorrigo F.R.	Forest inspector	Aesthetic (age implicit); economic/rainforest timbers
1890s	Dorrigo F.R.	Botanist	Aesthetic (age implicit); scientific (forest age implicit); economic/rainforest timbers
1930s	Bielsdown State Forest	Dorrigo Chamber of Commerce	Aesthetic
		Local forester	Aesthetic/visual; economic/timber
		Timbergetters	Economic/ timber
		Leigh Progress Association	Economic/agricultural
1900-1940	Dorrigo Plateau	Farmers	Economic/agricultural
		Dept. of Lands	Economic/agricultural
		Forestry Commission	Economic/timber
1940s - 1970s	Dorrigo Plateau	Forestry Commission	Economic/timber
1976	Washpool	Academics	'Wilderness' (age implicit).
1970s - 1980s	Washpool	Local foresters and Research officers	'Wilderness'; 'virgin' (age implicit).
		District forester	Public image; economic/timber
		Forestry Commission Head Office.	Public image; economic/timber
1980s-1990s	Dalmorton & Chaelundi State Forests	Environmentalists	'Wilderness'; 'old-growth' (age explicit).
		Forestry Commission	Economic/timber and grazing
		District forester	Economic/timber and grazing; history (age implicit?).
		Lessees	Economic/grazing; history (age implicit?); sense of place; identification with a locality
1990s	Dalmorton & Chaelundi State Forests	Historian	History—empirical (esp. grazing, mining timbergetting)—predilection for 'history from below'; personal identificatio with a certain social class; economic/ commissioned history

9

Changing community concepts of age in the jarrah forest

Dale Sanders

Introduction

Community concepts of age in the jarrah forest have changed considerably since European occupation in 1829. According to Dell, Havel and Malajczuk (1989:401), 'the forest has been variously seen as the obstacle to travel, as a hindrance to agricultural development, as an endless source of timber, as an effective protection to water catchments and finally as a thing of value in its own right.' During the past 165 years the forest has been significantly transformed as the ancient spacious forest has been logged and transposed by younger thicker regrowth. This paper identifies the various land uses that have emerged in the forest, and charts the changing perceptions of the value placed on the age of this unique resource. Aboriginal valuations are not included because these warrant serious examination in their own right and are beyond the scope of this project.

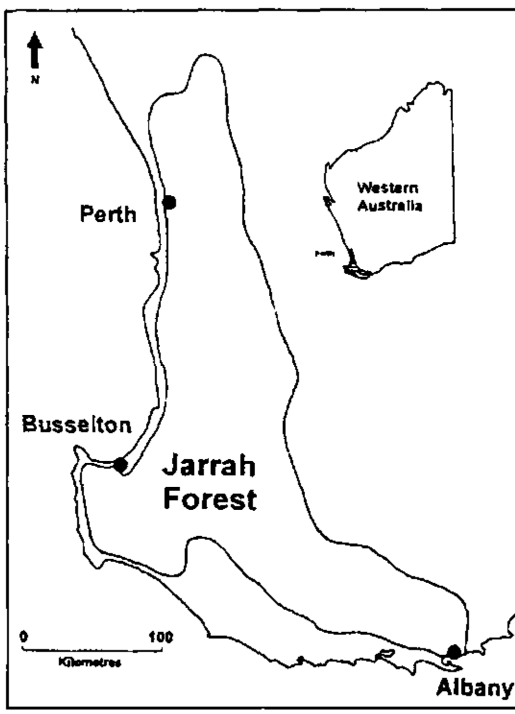

Figure 1. Location of the jarrah forest
Source: Jarvis 1986:70

Physical background

The jarrah forest is a unique ecosystem that has adapted over time to a fundamentally harsh physical environment. Although it was an important resource for Aboriginal people for thousands of years, it was only marginal to their economy, and had remained largely intact until the arrival of Europeans in the 1830s (Sanders 1995:1; Boutland 1988; Pearce 1988; Hammond 1980; Green 1984). The jarrah forest is located in the south-west of Western Australia, extending from Gingin 80km north of

Perth to Albany on the south coast, boarded by the Darling Scarp to the West and the wheatbelt to the east (Figure 1). Whilst jarrah is the dominant species in this forest, which is broadly classified as belonging to the broadleaved evergreen forests of Australia, numerous other trees and hundreds of species of understorey plants have all evolved in isolation in response to the local climate, topography, landforms and soils. Jarrah (*Eucalyptus marginata*) can range in stature from trees 56 metres high with trunks 2 metres in diameter to tall shrubs depending on geographical location. The species is extremely slow growing, averaging only one or two centimetres of diameter increment per decade. This contributes to the hardness of the timber and thus to its value as a natural resource (Dell and Havel 1989:1-3; Carbon 1982:225; Shea 1975:3). According to Abbott, Dell and Lonregan (1989:47), jarrah has a life cycle of between 500 and 1000 years with the tree reaching a mature height at 100 years, although its diameter continues to expand thereafter.

Early European settlers

Between the 1600s and 1800s Dutch and French navigators noted the blue smoky appearance of the forested hills of south-western Australia in their journals, however, the Jarrah forest was not comprehensively surveyed until after the establishment of the Swan River Colony in 1829 (Mills 1988:229). The magnificent tall timber of this region and its open park like appearance were initially used by Stirling as a selling point to attract settlers to the colony in the mistaken belief that the height and age of the trees corresponded with the fertility of the soils. However, clearing this timber with English axes was found to be nearly impossible. Instead the ancient trees were ringbarked and left to die and be burnt where they stood (Moore 1985:32). Although the myth linking the denseness of vegetation and soil fertility persisted for some time it was eventually discovered that these unique jarrah trees actually grew on extremely poor lateritic soils which could not sustain European crops. Jaggard (1985:136), reaffirms this stating, '... there is often an inverse relationship between tree size and soil fertility, especially among jarrah.' Thus the early settlers largely neglected the jarrah forest in the early and mid nineteenth century. Following changes to the land grant system in 1831 when land had to be sold for not less than 5 shillings per acre, nobody was interested in purchasing forest property which was difficult to clear by hand. The soils were infertile, there was limited transport available, and the settlers had to contend with poisonous plants and a perceived Aboriginal threat (Richards 1978;63).

Early land uses in the jarrah forest between the 1840s and the 1870s were small scale: pastoralism, sandalwood tracks, and limited intensive agriculture in the valleys. None of these activities involved close assessment of the age or regenerative capacity of jarrah. A system of annual pastoral licences on crown land which forbade the clearing of jarrah was introduced in the 1840s. Farmers developed a system of transhumance, running their livestock in the forest hills in response to pasture deficiencies which, much later were found to be due to a lack of trace elements on the coastal plain and winter flooding (Burvill 1979:10). Cutters began blazing tracks through the jarrah forest during the late 1840s in search of sandalwood which was located further east. Sandalwood, which was used for the manufacture of incense and was exported mainly to China, provided a major source of income for the struggling colony (Richards 1978:206; Statham 1988). Intensive agriculture was slow to develop in the jarrah forest due mainly to isolation and lack of transport, however by the 1860s a few small farms had been established in some of the more fertile river valleys such as Marrinup, where the soil was found to be particularly suitable for fruit and vines (Richards 1978:383).

The timber industry

The establishment of a large scale timber industry in the jarrah forest in the 1870s marks another change in attitude towards the age of the forest. Obviously the industry placed a high economic value on the older, larger and straight trees, and sought to exploit this largely untapped natural resource. Initially the industry was based on selective logging in suitable areas, rapidly expanding throughout the forest at the turn of the century until the inevitable exhaustion of the resource.

The first jarrah timber, then called 'Swan River mahogany', was cut largely by ex-convict pit sawyers in the forest surrounding the early settlements, providing strong durable jarrah timber for local construction. Although the first steam powered mill was introduced to the colony in 1833, it would be another 50 years before the necessary capital and infrastructure would enable the development of a large scale timber industry in Western Australia (Fall 1972:10). The industry began in the Vasse and Cannington regions where pit sawing operations, funded on a modest scale by Fremantle merchants were established in the 1850s. These operations were later upgraded to steam power, and by the 1890s the industry had expanded to cover most of the jarrah forest. Timber became one of the colony's largest earners of export income, supplying an increasing demand for railway sleepers, paving blocks and timber props for the South African mineral boom. This demand facilitated further rapid expansion of the industry which would continue until the 1950s (Robertson 1958:11-27).

Timber hewers were often the first people to move into these new areas of the forest, setting up mobile camps of up to 500 people and enjoying unlimited access to the forest until the *Forests Act* 1918 placed severe controls on their essentially wasteful methods of timber production (Mills 1988:276-277). There would have been a certain amount of prestige in felling the largest trees which were also the oldest. A number of companies also established permanent mills, private tramways, and in many cases, whole settlements in the central and southern jarrah forest. By the 1930s however, this network of mills and associated settlements was declining, primarily as a result of overcutting. New technology was gradually introduced into the industry from the 1920s and, following the Second World War, the industry became largely automated and centralised in a few large centres such as Jarrahdale, Dwellingup, Yarloop, Manjimup and the metropolitan area. In 1968 the felling strategy was changed from selective cutting to heavy cutting to reduce the risk of the spread of the jarrah dieback disease, *Phytophthora cinnamomi* (Forests Department n.d.:18). In recent times much controversy has emerged in regard to the timber industry's activities, particularly in old-growth forests.

Group settlement scheme

As previously mentioned, Western Australia was founded as an agricultural colony, and this ethos was to persist through the establishment of representative government in the 1870s and responsible government in the 1890s and beyond. Two Premiers who were particularly supportive of this concept were John Forrest (1890-1901) and James

Mitchell (1919-1924 and 1930-1933). Forrest initiated further agricultural settlement through the provision of infrastructure such as the gold fields pipeline and government railways. Mitchell is credited with devising a scheme which would increase immigration and agricultural expansion following the First World War. Mitchell's scheme involved placing groups of often inexperienced settlers on forest blocks scattered through the south west. According to Gabbedy (1988:41), 'Mitchell had no time for trees - in his view they were little more than obstacles to development'. This position placed Mitchell in direct conflict with his Conservator of Forests, Charles Lane Poole who had been appointed in 1916. The new Conservator, '...had made the government fully aware of the depredations on its forest wealth, the preservation of which, in his opinion, far out weighed in importance the needs of agricultural settlement and the return from it' Gabbedy (1988:83). Lane Poole was to resign as Conservator in 1921. The scheme continued to be implemented despite the many hardships experienced by these new settlers who struggled to clear the forest, and like many farmers before them were often forced to ringbark and burn the jarrah. The scheme was largely regarded an agricultural failure with many farmers simply walking off the land during the 1930s, although it did contribute to the clearing of many acres of forest for farming and the provision of essential infrastructure such as roads and railways.

Water and mining

Water conservation has always been an important issue in the jarrah forest, with an ever increasing demand from a constantly growing coastal population. The first small dams constructed were generally associated with the railways and timber industry. The first large dam in the jarrah forest was constructed at Mundaring to supply water for the goldfields at the turn of the century (Mills 1989:240). Dams on suitable rivers have been constructed continually throughout the jarrah forest with the dams located north of Dwellingup used for (human) water consumption whilst those to the south, with the exception of the new Harris River Dam near Collie, are predominantly for irrigation, in line with Water Authority policy (Department of Conservation and Land Management and Water Authority of Western Australian 1989:1). Although the construction of dams requires the inundation of a significant amount of jarrah forest, the need to conserve the surrounding forest in the catchment area was soon recognised, as the problems of salinity and siltation emerged. Restrictions on clearing in catchment areas were not introduced until the 1960s (Havel 1989:307).

Following successful exploration for bauxite in the jarrah forest in the late 1950s a 12,530 square kilometre mining lease in the northern jarrah forest was issued by the State government in 1961 (Alcoa n.d.:16). Mining continued to expand throughout the 1970s and 1980s with mine sites located at Jarrahdale, Huntley, Del Park, Willowdale and Mt Saddleback (Alcoa 1992:8). The mining process includes clear felling and removal of top soil, thus completely destroying the whole forest ecosystem in selected areas. By the late 1980s most of the jarrah forest was covered by mining leases with an open cut goldmine also being established at Boddington in 1987 (Bartle and Slessar 1989:373). Although these mining leases are extensive, only 10 percent of the jarrah forest soils contain sufficient ore for commercial extraction (Alcoa n.d.:15).

There has been much controversy surrounding the activities of the mining industry including their rehabilitation policies. Initially Tasmanian blue gums were favoured as the species to replant, although more recently, the mining companies have begun to re-establish jarrah on the mine sites (Schur 1986:4-47). The conservation movement which emerged in Western Australia during the late 1960s began to focus on the jarrah forest in the early 1970s primarily to protect the forest from this mining activity (Havel 1989:302).

Conservation

The debate regarding the use and management of Western Australia's forests began late last century with the reservation of state forests, which was in part a response to pressure for water conservation. This factor weighed with the first Conservator of Forests, John Ednie Brown (1896-1899), although his opinion of the jarrah forest was unenthusiastic as this quote clearly illustrates:

> Taken as a whole there is nothing particularly picturesque about the appearance of a Jarrah Tree or a forest of them. Indeed the general effect of the species en mass is dull, sombre and uninteresting to the eye (Ednie Brown 1896:2 cited by Mills 1989:229).

Ednie Brown was not replaced after his death in 1899 until 1916 (Jarvis 1986:69). The government also established a Forests Department in 1895 in response to concerns from the London Colonial Office and a Royal Commission in 1877 over the activities of the timber industry (Mills 1989:243). However, following these initiatives and implementation of controls in accordance with the 1918 Forest Act including the adoption of a policy of sustained yield and a system of tree marking by forestry officers in 1927, there appeared to be little further community interest in preserving the unique jarrah forest. It was generally considered to be adequately protected, until the conservation movement in the 1960s and the discovery of the jarrah dieback disease in 1965.

A conservation reserve was gazetted at North Dandalup in 1894 as a flora and fauna reserve in response to a petition from the Western Australian Natural History Society (Conservation Council of Western Australia 1980:50) This site was chosen as it was deemed the least economically viable area and unsuitable for agriculture due to the existence of poisonous plants rather than for its conservation value or to preserve it as an example of pre-European jarrah forest (Conservation Council of Western Australia 1980:52; Moore 1987:19). Within three years the reserve was under pressure from the expanding timber industry, by 1897 the area of the reserve was significantly reduced and by 1903 timber licences were being issued in the remainder of the reserve. Finally in 1911 it was formally returned by the government to timber production and in 1926 the remnants were incorporated into the state forest (Schmidt and Kimber 1985:22; the Department of Conservation and Land Management 1987:24)

During the late 1960s and early 1970s increased concern for the environment resulted in the establishment and growth of a number of conservation groups in Western Australia with the jarrah forest, and particularly old-growth forest emerging as an important issue in the mid 1970s as the last remaining accessible, pre-European forest was being felled (Schultz 1996). According to Havel (1989:312), there was a 'new perception of the intrinsic value of the forest, which generated not only an emotional reaction but also a strong political issue'. In response to this community concern, the government introduced the *Environmental Protection Act* and established the Environmental Protection Agency in December 1971 (Mills 1986:226). A

Conservation through Reserves Committee was also commissioned in 1972 to examine the feasibility of establishing more reserves in the jarrah forest.

Conservation groups were active in the jarrah forest, fighting to save not only the few remaining areas of pre-European forest, and focusing attention on the plight of old-growth forest, which had been selectively logged at the turn of the century (Schultz 1996). According to Dell and Havel (1989:401):

> Perhaps this is the outstanding part of the jarrah story, the ability of people in less than the lifetime of a tree to arrive at the recognition of values of the forest that transcend their own narrow interests.

As a result of the reorganisation of government departments in 1983, the Forests Department was absorbed into the Department of Conservation and Land Management, which appeared to provide more focus on conservation. However a growing controversy between this department and the Conservation Council of Western Australia and its affiliates has developed, with debate over the age of the forest emerging as an important issue. The Department of Conservation and Land Management (1996:3) suggests that jarrah 'rarely survive much longer than 300 years, and the majority of trees in old-growth stands are less than 200 years old.' The Conservation Council, however, argues that the trees will continue to grow up to 1,000 years old (Schultz 1996; Abbott and Christensen 1995). It would appear that a realistic assessment of the forests age and agreed definitions are required to solve this conflict.

Tourism and recreation

The jarrah forest has always been important for recreation for those who lived in or near it. Early examples of popular locations include John Forrest National Park near Perth and the Serpentine Falls (Havel 1989:297). It can be noted that as an interesting paradox that at the same time that the government was encouraging the removal of the forest, it was also included as an important stop on the touring itinerary of visiting royalty, such as the Prince of Wales in 1920 and the Duke of Gloucester in 1934. The use of the jarrah forest for tourism and recreation on a larger scale however, did not become popular until the late 1960s when people began to have more leisure time and desire to experience the forest as an escape from their predominantly urban environment. The venturing of large numbers of people into the forest for tourism and recreation in the 1960s marked a significant change in attitudes towards the forest resulting in further recognition of age and the need for conservation. During the past decade there has also been significant growth in 'eco-tourism' which has resulted in the identification and promotion of old-growth forest and ancient trees as tourist attractions. This relatively new industry in the forest places a commercial value on the age of the forest, which it advertises as providing a pleasing aesthetic and spiritual experience for local and overseas visitors.

Tourism in the jarrah forest at present is relatively small scale with most facilities ranging from walking trails, such as the Bibbulmun track which runs through the centre of the forest, to camp sites provided by the Department of Conservation and Land Management (Sanders 1994:122). New recreational attractions, such as the Dwellingup forest heritage centre and numerous guided walks that are offered closer to the city, also provide an educational component which may increase awareness of the age of this unique ecosystem in contrast to more exploitative activities, such as four-wheel driving. Whilst tourism and recreation in the forest enable contact with the environment, over-exploitation of this relatively new land use could lead to the destruction of sections of the valuable old-growth forest which is part of the State's heritage.

Forest management

By the mid 1970s the government adopted its present policy of multiple land use management and began establishing a system of management priority areas to deal with the many conflicting land uses now present in the forest. The system involves the allocation of primary or priority use in each land use area, with a range of largely compatible secondary and tertiary uses also permitted in these areas if they do not compromise the initial primary land use (Forests Department n.d.:22). Water production remains the first priority of this new system, however mining leases cover the entire jarrah forest and the *Mines Act* 1978 overrides the *Forestry Act* 1918 and the *Conservation and Land Management Act* 1984 (Calder 1980:170).

Conclusion

In conclusion, it can be seen that community attitudes in regard to age have altered considerably in response to the changing nature of interests in the jarrah forest over the past 165 years of European occupation. From an attitude of ambivalence displayed by the early agricultural settlers, to the high economic value placed on the ancient trees as a timber resource, to the emergence of the contemporary conservation ethos, the jarrah forest has undergone significant and often irreversible transformations which have resulted in the high value currently placed on the last remaining remnants of pre-European forest. In addition, a new debate has emerged, centring on the issue of the older regrowth forest—some of which is now 100 years old—which also comprises a significant part of Western Australia's natural and cultural heritage.

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10

Boranup forest: old-growth or regrowth?

Jenny Mills

Introduction

Boranup means the place of the male dingo in Aboriginal language (Towie 1982:3). The Boranup Karri Forest is a unique and very beautiful example of predominantly pure karri regeneration grown after clear felling in the 1890s. Part of the Western Australian State Forest 45, in the wine growing Augusta Margaret River Shire, it lies in two strips divided by a vast dune, the Boranup Sandpatch, and covers in all an area about ten kilometres long and four to six wide, north of Karridale. In a recent survey conducted on site by the Department of Conservation and Land Management, not one person out of about sixty interviewed realised that this forest was not 'old-growth'. (Neil Taylor 1996). In June 1993 the entire Boranup forest, which also includes mixed jarrah/marri stands and some coastal heath land, became part of the Leeuwin-Naturaliste National Park under the direction of the National Parks and Nature Conservation Authority.

Karri

The karri, *Eucalyptus diversicolor*, is one of the world's most durable hardwoods. It grows up to 90 metres tall and reaches its optimum height within 100 years. (Wheeler nd:24) Karri sheds its bark each year revealing multi coloured trunks of pink, orange and white hues. It flowers in spring and summer and needs a hot fire to set off seed release and an ash bed for regeneration (Wheeler n.d:24). Karri grows in competition with its own species towards the light (Mills 1986:198).

Botanist, Ferdinand von Mueller is believed to have given the karri its botanical classification referring to the light undersurface of the leaf. In his 1879 *Report on the Forest Resources of Western Australia* he compares the karri for height, girth and durability with the mountain ash of Victoria. He feels sure that once harbours are opened between King George Sound (Albany) and Cape Leeuwin, this native hardwood will become important to the lumber trade. He claims to have introduced the tree to Victoria and overseas, where its huge dimensions earned the name of *Eucalyptus colossea*. He comments that the karri is 'easily manageable in culture and of comparatively quick growth' (Mueller 1879:6)

Climate

The Boranup forest has a Mediterranean type climate with wet winters subject to fierce gales and some light summer rains. It lies on the western outlier of the main south west karri belt and is unusual in that it is situated on the Leeuwin-Naturaliste Ridge in which the underlying parent rock is Precambrian gneiss overlain by secondary limestone and aeolianite. In the karri forest the dominant soil is deep brown sand which is so free draining that there are no defined streams. (Boranup State Forest Working Plan 1976-80:16). This soil differs markedly from the rich loams of the karri forest further south.

Caves

Caves, cliff formations and sink holes abound in the area. The world famous caves are mostly on Crown reserves formerly administered by the West Australian Museum and the Augusta/ Margaret River Tourist Bureau in conjunction with speleological groups. Two caves to the west of the forest, Devil's Lair and Arumvale, are valuable archeological sites. Devil's Lair in particular shows evidence of human occupation in the area from 33,000 to 12,000 years ago. These early inhabitants used walk trails kept open by burning, and established a flake stone industry. They used grinding stones, kangaroo and wallaby incisors for tools and made a variety of stone and bone artifacts including beads (Christenson 1992:39-40). Vertebrate fossil remains discovered in the region include the Tasmania devil, the Tasmanian tiger and the koala among others (Leeuwin-Naturaliste Park Draft Management Plan 1987:30).

Forest history

European settlement came to Augusta at the mouth of the Blackwood River in the Leeuwin-Naturaliste region in the 1830s. Large pastoral leases were granted with freehold homestead blocks. Life was not easy in this remote, forested and inaccessible land. Soon settlers moved to the better more open grasslands of the Vasse near Busselton. Families such as the Bussells, Brockmans, and Ellis's retained coastal pastoral leases. The practice was to graze the cattle inland in winter then vary their diet by droving the stock to the coast through the forests in summer. The coastal grasses lacked essential trace elements which were provided by inland feeding. Like the Aboriginal people before them they fired the land to keep down undergrowth and encourage new young shoots. These men were stubborn and brave. In the case of the Ellis family, the women were much the same. Four unmarried Ellis sisters ran farms at East Augusta in the 1890s each holding their own stock brands (Ellis 1996).

Some of the early settlers like James Woodward Turner in the 1830s, and William Eldridge in 1875, tried exporting jarrah timber by sailing ships out of Augusta, but winter gales played havoc with this trade. Eldridge forfeited his large concession to the rich timber entrepreneur, Maurice Coleman Davies from Adelaide. In 1879 Davies began timber operations at Kudardup near Augusta carting timber by horse and tramline to his newly established port at Flinders Bay. He followed von Muellers' 1879 suggestion and looked for markets for karri for construction purposes. By 1882 the colonial government, granted him a concession of the whole of the timber on 46,000 acres [18,600 ha] for 42 years at a rent of £150 a year (Hamling 1969:41). Further pastoral leases including Turner's large grant and some freehold land were added to the Davies' forest estate.(Hamling 1969:41)

Davies, aided by six sons, established his empire. He built three more sawmills, Karridale, Boranup and Jarradene. Karridale was a large mill town with its own currency. It had a post and telegraph office, hospital, mill hall, library, sportsground and a racetrack. (Hamling 1969:47) The mills cut jarrah and karri timber destined for wood paving or for construction. It was exported overseas through the second port of Hamelin Bay.

Governments in the Australian colonies began to realise the need for professional forest management. In 1895 the West Australian government appointed its first conservator of forests, John Ednie Brown. He was an arboriculturalist, trained in Scotland and had already been conservator in New South Wales and South Australia. He visited Karridale and commented, in his 1896 report on the forests of Western Australia, that he was pleased with the 're-production' in the karri forest which had been denuded and cleared of its original mature crop. He found that 'twenty to thirty fine young trees have taken the place of every matured or large tree cut', and stated that this reforestation was:

> a valuable ocular demonstration without any assistance of what may be done in this way by nature if allowed to have its own way... in many places these young trees are over 40 ft [12 m] in height and from 8 ins to 12 ins [20-30 cm] in diameter, and if a little attention is paid to them in thinning, pruning etc., an excellent second crop would result.

He objected to the fact that mature trees were not cleared systematically, and that the fallers left some trees as a reserve for future orders. When felled later these old trees 'play terrible havoc among the young stuff' (Ednie Brown 1896:33). Ednie Brown proposed to regulate against this, but his death in 1899 meant that no action was taken. Meanwhile Davies's empire was incorporated into the Millars Karri and Jarrah Co. (1902) Ltd; an amalgamation of eight timber companies. The Karridale concession cut out in 1908, and M.C. Davies died in 1913. The Boranup forest was left to nature and the settlers burning their way to the coast.

Charles Edward Lane Poole, the next conservator, was appointed in 1916. He was a graduate of L'École Nationale des Eaux et Forêts at Nancy in France and a protégé of Sir David Hutchins, the author of *A discussion of Australian forestry* (1916), Lane Poole, introduced sophisticated forest management to Western Australia. His brief was to formulate a Forests Act and establish a Forests Department for Western Australia. Ironically, he answered to the Minister for Mines until the act was passed.

He became involved in forest classification in order to prepare ten-year working plans, which were intended to regulate the activities of the timber industry on State Forest and Crown Lands, calculate permissible intake and provide for a sustainable yield. (Forest Dept 69:25) Hardly off the ship in March 1916, Lane Poole explored the south-west forest and the Augusta area. He kept a comprehensive diary, commenting on the deserted town of Karridale and the fine karri regrowth nearby. He stayed the night at the Augusta pub and regretted not meeting the owner, Toby Ellis, 'a great card they say, but he was off mustering cattle.' He wrote 'all through the journey the country cried out for fire protection.' (Lane Poole 1916)

In October 1916, Lane Poole requested a surveyor from the Mines Department, L.J. Breen, to survey the Boranup Forest. Breen was instructed to choose, measure and label sample plots of known-aged karri for later reference. Forest Ranger, W. Donovan from a local farming family, was to guide him. Permission was given by the Millars' combine to cut sample trees for measurement in parts of the Boranup forest concession. Company manager, A J McNeil, also gave the names of some of the old Karridale hands who might be able to help with dating regrowth. These men were leaseholders who had worked for the mill as well as tending their stock. (CALM file map) There were some hitches for the expedition. A request to Busselton carriage hire owner, Percy Bignell, for 'a buggy and pair, the horses suitable for saddle' got the telegram response 'sorry unable to hire or procure for you horses almost extinct here.' (CALM file 8890F2401).

Breen reported before Christmas 1916 that the regrowth around Karridale which had begun in 1893-4 was now 'a good patch of young karri and fairly even' (CALM file 8890F2401). Forest regrowth covered less than half the original area. Some places where the big karri had been felled were quite clear. Ranger Donovan explained that the rubbish which accumulated under the big trees kept the forest floor damp and not prone to fire until the land was exposed by felling. Young saplings coming up through this rubbish were destroyed by the first fire to come through. No seed trees were left to generate new growth. In the original, more open spaces, which had been periodically cleared by fire, the young growth had a better start, and was not subject to such fierce fires. (CALM file 8890F2401)

Breen writes of a great karri log that he found on the forest floor in the Devil's Plantation area, burnt down about 1889. 'I measured the log at 40ft [12 m] from the butt, as 16ft [4.9 m] girth and at 128ft [39 m], 9ft [2.7 m]in girth. The place was damp and the log covered in moss.' He cut into it in several places and three inches [7.6 cm] from the surface found that the wood was 'green and sappy like a lately fallen tree'. He cut a sample at 40ft [12 m] and brought it home. Lane Poole put it in a forest museum he established as part of his department (CALM file 8890F2401).

The locals resented new government controls in the Boranup forest. Ranger Donovan was employed to protect the Boranup forest plots from wildfire. In November 1919 he wrote to the Forest Department wanting signs put on the karri experimental plots to inform local farmers about regrowth measuring, 'there is very few know anything about them, and just as likely as not to put a match to them,' he commented grimly (CALM file 8890F2401).

The *Forest Act* was passed in 1918 and a Trust Fund was set up for the regeneration of cut over forests into which three fifths of the Forest Department's net revenue was to be paid. (Kessell 1931:32). Lane Poole quarrelled with the State government over the Millars' combine leases and concessions which were not due to expire until 1931, and he resigned as conservator in 1921.

He was succeeded in 1923 by the 25 year-old Stephen Lackey Kessell, a graduate in forestry from Adelaide University and with a Diploma (with distinction) in forestry from Oxford. Kessell started work with the Forests Department in 1920. By 1921 he was Acting Conservator. He was an efficient organiser with great charm. According to American fire ecologist, Stephen Pyne, 'Kessel was one of the great figures in Australian forestry'. While most Australian foresters followed the North American model, and denounced controlled burning and sought the exclusion of fire from reserved forests, Kessell played a diplomatic role between the ideal and the practical. He recognised the undoubted value of fire for fuel reduction and silviculture. (Pyne 1991:277-8,298)

In a 1923 report, 'Hardwoods of Western Australia', he pointed to the possibility of a pulp industry based on karri. He outlined the progress of work being done by the West Australian Forest Products' Laboratory and noted that, 'this report is printed on paper manufactured from pulp consisting of 60% karri'. (Meyer 1985:56) This laboratory was established by Lane Poole in 1921 at the University of Western Australia. Experiments were carried out using karri for paper manufacture. The work was done by Isaac Boas, lecturer in chemistry at Perth Technical College, and his assistant Louis Benjamin. The laboratory moved to Melbourne in 1923 and in 1926 became a branch of the Council For Scientific and Industrial Research. (Schedvin 1987:104-5)

A report from forester A. Helms in October 1926, who had been delegated to work on the Boranup forest, alerted Kessell to the potential of this regrowth karri for paper manufacture. Helms wrote that:

> without hesitation I can say that this karri forest is one of the finest pieces of natural regeneration of the genus eucalyptus on the mainland of Australia and situated as it is adjacent to the Busselton Augusta railway, it is destined to become one of the most valuable forests in Australia. The growth and quality could be greatly accelerated by thinning and with the development of paper manufacture in Australia it may be possible to utilise thinnings and substantially reduce the period which must elapse before milling operations can commence. (CALM file 8777F2301)

Helms also suggested buying the land that Millars still held in the forest, and the planting of pine as an adjunct to a karri pulping enterprise. Kessell answered Helms quickly and positively. He asked for advice on the likelihood of excessive fire damage during the coming summer. Group Settlements were being established in the Margaret River area and he complained that the amount of settlement taking place in the district would make bushfires more prevalent (CALM file 8777F2301).

On the same day he wrote to the CSIR, asking for advice on establishing a pulping industry in the Boranup area, and how to attract investment. His queries were dealt with by his friend Louis Benjamin, now heading the CSIR Forest Products Division. The CSIR suggested that the karri mill might do best making bleached soda pulp for export. Then Kessell wrote to the Lands Department to secure Crown Land in the area, and later for permission to buy Millars' land. Before Christmas Kessell arranged for a topographical survey of the area to be conducted by Helms with three forestry students. By March 1927 the necessary field data was gathered and correlated. The total volume of wood available calculated from work done on 205 circular sample plots in the forest was 2,340,000 cubic feet [66,200 m^3]. Jarradene, once a Davies mill town in the middle of the Boranup Forest, was selected as a suitable mill site with a permanent spring for water (CALM file 8777F2301).

Benjamin estimated that the capital required was £50,000, and that such an industry would produce about £12,000 net a year if a backer could be found, but he thought that at present this was unlikely. Unfortunately successive state governments were more interested in agriculture than forestry and the first signs of the Great Depression would soon be apparent. Cutting his losses Kessell wrote a disappointed letter in April 1927, 'the trees are putting on satisfactory increment per annum and in consequence little will be lost by postponing silvicultural treatment for some time' (CALM file 8777F2301). The comprehensive Karri Working Plan was announced in 1927, and a Boranup Working Circle Plan was put into operation. Kessell's policy was to surround small areas of karri with a controlled fire and to have firebreaks around these coupes. The young trees could not stand any fire until they were fifteen years old (CALM file 21F0111). The Boranup State Forest was gazetted in 1929.

The Depression gave the West Australian Forest Department time to consolidate policy and implement a prescribed reduction in cut without too much hardship to the timber industry. (Forest Dept 69:38) There were no demands on Boranup. Pines were planted in the hope of a future joint pine/pulp karri industry although pine was more susceptible to fire and the complete stand was lost in 1945. (CALM file 21F0111) Later plantations were not successful.

The local Boranup leaseholders and farmers were beginning to adapt to forest regulations but there were always mavericks. Deputy Conservator, T.N. Stoate wrote to an irate Boranup forester, Louis Weston, saying that if the leaseholders went on burning without permission the police must be informed and the leaseholders' licences forfeited. Later in 1941 he wrote 'we have been twenty years trying to dispose of the bogey that action against incendiarism led to more fires'. (CALM file 21F0111)

By 1948 industry was encouraged back into the forest to dispose of thinnings and also to supply royalties to finance silviculture. Sawlogs were taken by F. Poland and in 1949 Cass Case Co established a mill and settlement in the forest. The mill cut poles for beer cases made in Perth. It closed in 1952. Fourteen men were employed in the enterprise and as at Karridale sixty years before, some were from original settler families, but some were more recent farmers with group settlement connections. The trees were felled in the bush and hauled to a bush landing by a Fordson Major 500 tractor. From there the logs were trucked to the mill (S. Bushby 1996). Pole timber was taken out by sawmillers in the 1960s, and in 1966 Monier, a local tile manufacturer, gained a contract for thinnings as tile battens. Later the State Electricity Commission contracted to take karri poles, but these had to be chemically treated in Bunbury before use. (CALM file 11525F3001)

West Australian fire policies changed in the 1950s from burning around protected forests to controlled burning inside the actual forests. It was found that too much accumulated litter remained as a fire risk in the protected forests. As this type of stronger controlled burn was increased in State Forests it was found that illicit burning by locals decreased, but it was not enough (Pyne 1991:331-2, 337). The summer of 1961 began dry and very hot. In January there were the notorious Dwellingup fires, and heatwave conditions prevailed with a cyclone in the north. On February 27 a farmer at Forest Grove near the Boranup forest started burning off. He did not have a licence to burn, nor did he inform the Forests Department of his intention. The fire was left over night and on March 1 winds took it into the forest. It jumped counter fires and spotted as it went. By March 3 it had spread in all directions and at lunchtime it destroyed the old Davies town of Karridale. (Royal Commission 1961:25) Sheila Bushby was living at Karridale. Her husband had gone 'up Boranup way' to fight the fire. She stayed in her farmhouse and waited for him to come home, but then they could not get out:

> It seemed to create its own wind, so much smoke and muck ... we threw water over each other ... you could hear your hair frizzle ... It burnt the church I was married in, the hospital I was born in and the hall we danced in. (S. Bushby 1996)

Fortunately there was no loss of life, and rain came the next day over a country covered in a pall of smoke. Fires in the Augusta Margaret River Shire at this time burnt out over 42,660 hectares, of that 24,443 hectares went in the Forest Grove fire. State Forest 45 was burnt over (Royal Commission 1961:57). A Royal Commission was held into the 1961 fires. Former Director General of the Commonwealth Forestry and Timber Bureau, G.J. Rodger, was chairman. He began his report with the diplomatic comment:

> Both forestry and agriculture regard the uncontrolled bushfire as a dreadful menace, but fire under control can be a tool of great economic value to both, and particularly to the settler. ... To avoid damaging the trees and regrowth, controlled burning needs to be carried out with great judgement on strategically located areas. (Royal Commission 1961:7) The report found that all the fires in early March in the area had been caused by settler burning. (Royal Commission 1961:26)

The 1961 fire resulted in severe damage to karri stands on the western half of the forest, but the remainder was only moderately damaged. There were 641 hectares of non damaged karri and 534 hectares of severely damaged trees. After the fire, karri regrowth sprouted in abundance, only to be choked off by scrub undergrowth. The foresters had to wait for more seed. The prescription for the severely damaged area was to maintain the seed trees until new seed developed in the recovering crowns. A regeneration burn followed, with hand planting if necessary. After this the seed trees could be salvaged. The new forest would be thinned at thirty, sixty and ninety years for wood production. Then the cycle of seed, burn and regenerate would begin again in this proven area. (CALM WP3/BSN). Two other fires followed in 1972 and 1974. These covered extensive areas and set back regeneration by either burning fuel on the ground prematurely or by causing regeneration before it was planned. This changed the intended layout of utilisation coupes. (Boranup State Forest Working Plan 1976-80:23)

North American environmental concepts of wilderness brought changes to Australian forest policy as early as 1958 when the newly formed Australian Academy of Science suggested that a committee be formed to look into Australian national parks and nature reserves. Thirteen years later the West Australian Government established an Environmental Protection Authority. In 1972 this authority set up a Conservation Through Reserves Committee (Carron 1986:171-7), and one of its first proposals in 1974 was that the Boranup forest area should become a national park and be managed by the Forests Department. (Boranup State Forest Working Plan 1976-80 Appendix 6.7.)

The proposed Boranup karri forest park was in varying states of regeneration, in places as much as eighty years old. Ironically at the same time the state's timber industry was involved in a highly criticised karri/marri woodchip venture encouraged by the Western Australian government as a means of regenerating the karri forests of the Manjimup/ Pemberton district. Forest policy now incorporated the need for multiple use. In 1976 the Forest Act 1918 was amended to give expression to this new philosophy. By the time the Boranup Working Plan 1976-80 was drafted, setting out long term management policies for the Boranup forest, it reflected these changed environmental objectives. The plan stated that the principal object of management was to maintain the karri forest as an important component in the landscape, for its historical associations, for recreation and scientific study. It explained that current logging operations in the forest were performing a needed function in the regeneration of the severely fire damaged forest, and by aiding essential thinning in other areas. When this operation was finished any future wood production would be an incidental by-product of management. (Boranup State Forest Working Plan 1976-80:1)

In March 1985 the Department of Conservation and Land Management replaced the Forests Department. the National Parks and Nature Conservation Authority was also placed within the new Department. In June 1993 the Boranup Management Priority Area including the caves reserves became incorporated into the already established Leeuwin-Naturaliste National Park.

Conclusion

The Western Australian Deferred Forest Assessment Draft Report states that the only definition for karri old-growth is 'virgin'. (DFA Draft Report 1995:25) The Boranup forest presents some significant issues in the application of this definition, since it does not qualify as 'old-growth' but has been deserving of conservation. By definition the Boranup Forest is not 'old-growth'. It is a product of settlement, imperial expansion, and intense fire. This forest is no more unique than the mountain ash of the East Coast. Both forests are dependent on a fire regime for their lives, and without it they will be suppressed by their understorey and new and different forests will emerge (Griffiths 1992:9-10). Forest management has to protect against this happening, and environmentalists with a preference for 'old-growth' need to recognise the importance of the living biota of the karri forest.

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Valuing the forests

It is not till a Tree is arriv'd to his perfect Age, and full vigor, that the Lord of the Forest should consult, or determine concerning a Felling. For there is certainly in Trees (as in all things else) a time of Increment, or growth: a Status or season when they are at their best (which is also that of a Felling) and a decrement or period when they decay.

John Evelyn, *Sylva*,
1664

11

Valuing old-growth forests: a product of time, culture or business ethics

Kyle Weyburne and Kenneth Jackson

Introduction

We all have our own views as to what constitutes value. Part of what sets these views comes from the background determined by our cultures, the times we live in and other factors more general than narrow commercial interests, such as market price. In Australia and New Zealand bodies such as the Australian Conservation Foundation have frequently adopted views about old-growth forests which are diametrically opposed to those seeking production logging opportunities. Some of the aims and objectives of such interest groups appear all but irreconcilable, although the use of rational analysis does suggest that some degree of middle ground can be found which is acceptable to most people within the society, even if the outcome does not fully satisfy either party. This paper examines the methods of determining what is acceptable, how it can be judged and then expressed. It explores the recent past experience of the East Gippsland forests in Victoria and the longer-run experience of the exploitation of the old-growth forest in New Zealand.

What follows is an exposition of various considerations involved in valuation. Individuals or firms may only undertake narrow financial appraisals of projects. At the community level partial analyses based on certain overriding considerations of what determines or defines value may be undertaken. However, more general consideration may be given to all forms of value through environmental impact analyses and the consideration of inter-generational sustainability. Details and examples of how values have been determined taken from the historical and contemporary experience of New Zealand and East Gippsland form the main body of the paper.

As a result of the study we conclude that the competing demands placed upon old-growth forests are reflected in the differences in attitude exhibited over time, by different interest groups within different societies in a manner which, whilst apparently difficult to resolve, do not present an impossible task.

Changing concepts of value over time: New Zealand

New Zealand and Australia have been physically separate for the past seventy million years or so, and the extent of their forest cover has fluctuated substantially due to climatic changes. At times the cover, particularly in Australia, has amounted to little more than isolated pockets in which the old ecosystems could attempt to survive and await lusher periods of growth. In more recent times these periods of contraction of the forest area have been enhanced as the result of human intervention, in terms of both clearing and significantly changing the make-up of the remaining forest. The intentional use of fire has been a significant factor in altering both the overall forest cover and the character of that cover.

Fire as a land management tool applied by human hand has only a short history in New Zealand but a longer one in Australia. It has produced major changes to the nature and scope of Australia's forest cover, as it has elsewhere in the world (Butlin 1994:94-5). By using fire and other management techniques, human beings have attempted to control the forest, which many have viewed as essentially a wild environment needing at least some taming. Such views became more explicit with the appearance of settled agriculture and pastoralism. This was partly the result of a larger number of people, but more particularly was the result of the integration into global markets following European colonisation. In this respect it is not so much the market for timber itself, but rather that for agricultural products, which resulted in increased competition for land use and little value being accorded to old-growth forests (Jackson 1991:238). The instant cash lure of the global market for agricultural products far outweighed the more intrinsic values of the old-growth forests while little or no market could be found for timber.

Various attempts to alter the commercial appreciation of the value of indigenous trees and to investigate their market potential have continued through to the present day, but afforestation with exotic species was seen as the way to proceed in New Zealand and elsewhere.

The concept of the value of the old-growth forest in New Zealand in the late nineteenth and early twentieth centuries is a pretty simple one. It viewed the forest as, at best, an apparently inexhaustible resource (Roche 1987:38) to, at worst, seeing it only as a barrier to the expansion of settlement. Effective use of the forest was seen as involving concepts of efficiency in terms of rates of clearance and the production of agricultural and more particularly pastoral products, largely for the British market.

Forests have been an important part of the New Zealand landscape and a contributor to economic activity ever since the start of human habitation, as well acting as a major physical constraint upon economic development. Maori methods of land management included the use of fire as a tool in shaping the environment to their purpose just as was the case in pre-European Australia. Also, as was the case in Australia, the scale of clearance for agricultural and pastoral land was far greater following the arrival of European settlers. The rate of clearance peaked in the late nineteenth and early twentieth centuries, when it reached levels comparable to those recorded more recently in Asia and Latin America. The role of old-growth forests was a subordinate one in a commercial sense (Jackson 1993).

During the late-nineteenth and early-twentieth century, much of the standing timber was regarded as having little if any commercial value, with large scale burning (Roche 1990:295) and few ascribed a value for conservation, scenic, existence or other reasons and most certainly not for anything approaching bio-diversity. Early calls dating back more than a century, of the need for alienation of the virgin forest in order to ensure conservation have their echoes in the current movements within the industry. We are now at the point at which cutting rights to the holdings of the

Forestry Corporation have been competed for in a vigorous manner by many private interests, both domestic and foreign, during much of 1996. Privatising or charging for access to the Conservation resource is clearly now far from unthinkable.

The value placed on old-growth forests has altered significantly since the nineteen twenties. Afforestation programmes, based on the planting of exotic species, principally pinus radiata, which currently provides the bulk of sawn timber supplies, have supplanted virgin forest sources, which now contribute significantly as commercial inputs only for chipping from the South Island beech forests. The remaining old-growth and regenerating bush is to be found in Conservation areas and on National Park land. Some of the conflicts between conservation and other uses of the forest remain, but the overwhelming source of sawn timber in New Zealand is now not provided by old-growth trees. The past scale of values has been altered and in many respects the battle lines regarding the forests are now drawn rather differently, with many who were previously critics of the Forest Service mentality being more concerned with defending its memory and its traditional role, rather than embracing the private ownership thrust of the current market reform programmes. In some respects the Forest Service underwent a pendulum swing in terms of its reputation. It was back in the resource conservation position it had traditionally held itself to be in since its foundation in 1921, but only since many now saw the alternative as even less responsive to conservation values and the Forest Service faced restructuring, corporatisation and privatisation.

Production forestry is now firmly commercially based with little evidence left of the conflict between the Forest Service and conservation interests. Many of the recent arguments as to forest value have been narrowly focused on the issue of whether the right price was obtained for the assets that were sold. In terms of the value of the sort of trees that once made up the old-growth forests amenity values, recreational, cultural and historical reasons for growing indigenous trees species are sometimes claimed, but usually only when straight commercial valuations seem insufficient. An example of this is to found in the discussion in a special review of forestry published last year (Macalister 1995, 32).

The role of government in forest policy making and the results for our appreciation of the value of old-growth forests has clearly altered over time in New Zealand. In the nineteenth century policy was mainly concerned with agricultural production and thus land clearance. Devices such as improvement leases which required clearance strengthened these concerns, as did subsidies for clearance, transport and other devices of agricultural and pastoral development. The bulk of the population were in favour of such actions, with few seeing any real need for concern at the rate of depletion. Timber royalties were low, if not non-existent and no attempt was made at constructing a rational market structure. The development of the Forest Service took the whole strategy away from any great reliance on market valuations and placed the emphasis on a more bureaucratic form of control and organisation which was primarily concerned with ensuring an adequate supply of sawn timber.

Valuing old-growth forests has proven to be problematic and eventually has become all but divorced from production forestry activities in the New Zealand case. Our valuing of scenic, cultural, recreational, and existence values for example are often related to old-growth forests with plantation forests providing the market driven values. Such is clearly not the situation in the second area considered in this paper, namely East Gippsland, where there has been a long running tension between the various possible sources of value generated by old-growth forests.

Spatial changes in value: East Gippsland

East Gippsland has a long history of logging activity, dating back to the middle of the nineteenth century. The goldrush era of the 1850s and 1860s initially prompted a demand for timber which was followed by the establishment of farming in the area with subsequent clearing of substantial proportions of forest cover, both as a prelude to settlement and as input into the general production process. The high degree of labour intensity and low degree of capital and technological capacity in the nineteenth century Australian logging industry ensured concentration on the very best examples of the most valuable of the eucalypt species. red ironbark, red gum, grey box and red box eucalypts were all selectively logged until they were extremely scarce in the accessible parts of East Gippsland.

By the 1930s species substitution was necessary to meet demand in the face of dwindling supplies. The impact of World War II saw timber consumption rise to record levels, with the post-war boom and immigration keeping up the pressure (Weyburne 1995:60).

Development of new roading access in order to increase timber supplies involved the further opening up of old-growth forest areas which had previously remained untouched. Clearfelling techniques replaced selective logging and a range of capital equipment—bulldozers, chainsaws and logging trucks—was brought to speed the process. By the 1950s East Gippsland had become Victoria's largest source of hardwood timber. The peak output was reached in the middle of the 1980s with an annual production figure of 370,000 cubic metres (Weyburne 1995:61).

In recent times more attention has been given to environmental values than was historically the case, with requirements now in place that potential sites of logging activities be checked for the presence of endangered species, as well for sites of special significance. Under this approach stream and rainforest buffer strips, special features and steep slopes can all interfere with loggers total freedom to undertake total clear-felling. Problems of a more general nature also emerge with respect to the value different individuals place upon these forest areas.

The Resource Assessment Commission Inquiry's nationally undertaken community attitudes survey of 1990 attempted to assess a dollar value for 130,000 hectares of National Estate Forest in south east New South Wales and East Gippsland. Two methods were adopted in attempting to determine the value of these forests. The first was a method based upon travel costs and actual expenditure upon them, which concluded that the estimated 106,000 visits recorded per year accounted for approximately $3.6 million in total expenditure. Working from this information the Inquiry estimated an entrance fee equivalent of $8.90 per visitor per annum (Resource Assessment Commission 1992, v.2B:u9-10).

An alternative method based on the principles of declared willingness to pay for the preservation of the National Estate area saw an average figure emerge of $22.00 with a high degree of variance, shown by the result that 50 per cent of respondents declared their willingness to pay amounts ranging from $43.50 upwards. Variations in declared values were positively correlated with income and negatively correlated with age (Resource Assessment Commission 1992, v2B:u13-14).

The conclusions drawn from this in the report, that existence and other non-use values exceed by a considerable margin direct use values associated with recreation and similar activities, are questionable. Comparing the two figures may be false in the sense that the first is based on actual expenditure, whilst the second relies on people's ability to conceptualise their potential expenditure and to report it accurately. For those on high incomes with a high desire for preservation, it is logical to declare high values in anticipation that this will then be provided publicly and at a relatively low private cost to them.

A similar dichotomy can be seen to operate spatially. In a 1993 study of the value assigned by people to forest preservation in East Gippsland, the major findings of that study were twofold: firstly that, based on contingent valuation survey methods, Victorians were found to accord preservation of the forest a value in excess of the current market value for sawn timber production and secondly, that the people living closest to the resource placed a lower value on preservation than did those in the rest of the state (Lockwood, Loomis and DeLacey 1993).

To the changes to be noted over time in the New Zealand case there are therefore changes or variations in value as related to income levels, to age and some which appear in a spatial sense, although all of these factors may overlap at times. Similarities in the impact of the various sources of differences in people's valuations are to be found in the degrees to which they perceive themselves likely to be affected by either costs or benefits. Those at a distance see little chance of direct loss of income from reducing forest production activities and gain at least existence benefits if nothing else.

The forest area of East Gippsland provides a heritage which dates back to the last Australian ice-age some 10,000 years ago, an example of the remnant pockets referred to earlier. In the modern era these forests have been said to represent the most diverse eucalypt region in Australia (Redwood 1994:60-2). Production activity in the forests have placed a real strain on the resource and brought into sharp focus the question of how the value of an old-growth forest should be judged.

The total mature rainforest in Australia is small in total area covered relative to the overall size of the landmass. The whole amount could fit into a circular area of just 160 kilometres, yet within its compass is contained half of all the plant species, one third of the mammals and birds and many of the reptiles insects and amphibians to be found in Australia. East Gippsland contains a significant amount of the total Victorian warm temperate rainforests, along with some cool temperate rainforest on the Errinundra Plateau (Woodgate and others 1994:45; Victoria, Department of Conservation and Environment 1991).

The existence values of this forest is considerable and could be said to justify the findings of Loomis and his co-authors. Since 1986 timber harvesting has been banned from areas falling within the Government definition of rainforest (Weyburne 1995:65). Conflict over this stance has occurred, however, with a discrepancy of substantial proportions to be seen in the official estimates of some 10,000 hectares of rainforest compared to the estimates produced by people such as David Bellamy and Peter Gell, which put the total at between 25,000 and 30,000 hectares (Weyburne 1995:67). Clearly there is a process of continuing debate here as to how to value the old-growth forests. Some see them as revenue earners in a commercial sense, others claim their existence value to be immeasurable. Over time attitudes to the forest have altered as the depletion has continued. Some of the higher valuation, however, may relate to rose tinted views of a romantic past. Judging previous generations from the current standpoint is fraught with difficulty, just as are contemporary arguments as to what should be bequeathed to future generations and at what opportunity cost.

Conclusions

Historically people paid little attention to the loss of the forests in New Zealand in the late-nineteenth and early-twentieth century period, because they felt complacent that the forest was inexhaustible and so implicitly undervalued it.

Government further undermined old-growth forests value by subsidising its removal, both directly and indirectly. In combination with the rapid entry of New Zealand into global pastoral markets, such attitudes ensured a rapid decline of the old-growth forests, essentially they were cleared to make way for further cash crop production with the emphasis placed upon short-run maximisation. Forests were not valued satisfactorily within the market system, nor were they valued very highly in a non-market sense. As time progressed, the value people accorded to forests increased. The reasons for the change are partly related to income levels, partly to changing tastes and partly because it was easy to claim to value something highly when they were safe in the knowledge that they would not be asked to bear the full cost of sustaining it or acquiring it.

Settlers in the period of early European settlement could disregard any social value since they were unlikely to ever have to pay for it and securing property rights to that value was difficult. By clearing land and running cattle and sheep they secured private returns, partly at public expense and very much at the expense of the natural capital stock, natural soil fertility and stability. There may also be a tendency for later generations to over state their claim to value what has been lost, since they too are unlikely to actually be asked to pay for its restoration in a direct sense. The costs of loss have been dissipated and made mysterious and therefore difficult to accurately estimate.

In the case of East Gippsland, there have been clearances for agricultural purposes, but there is also a stronger direct conflict between the timber industry and those who value old-growth Forests for products other than for its wood fibre, or more correctly for wood fibre's ability to be processed in a multiplicity of ways. The differences in values across space here match some of those differences previously observed across time. In some respects we can, however, investigate claimed values in the contemporary scene in ways which are not as readily available to us in the case of historical inquiry.

Contingent valuations are problematic, but they give us some clues as to how people perceive their valuing of natural assets such as old-growth forests. Keeping the valuations as accurate as possible is difficult and important, but not impossible.

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Cultural values in the assessment of old-growth forests

Richard Lamb and Colleen Morris

Introduction

Australia has few 'old-growth' forests remaining. This is related to the exploitation of native forests for timber, subsequent to the colonisation of Australia by people of European origin, rather than the management and establishment of sustainable resources of timber. The Australian built environment expanded rapidly in the past and is continuing to increase its timber demands. The building industry provided a great deal of this demand, and is dominated by the production of residential housing, most of which has a timber frame. This framing has been of hardwood timbers derived from selective logging of native forest, however these resources are being depleted, as indicated by the level of softwood imported into Australia and the capitalisation of softwood production in Australia itself (Holland and Holland 1995).

The ecological sustainability of native forests has become of concern because of the perception that they are under increasing threat due to the loss of representative forests, genetic resources, biodiversity refuges, and the less tangible aesthetic and symbolic attachments to nature (Beder 1993; Holland and Holland 1995). Thus the reservation and conservation of old-growth forests involves recognising and balancing multiple objectives (Dargavel 1995). But the definition of old-growth has been contentious (Resource Assessment Commission 1992) and has centred on the physical and ecological aspects, rather than taking account of the importance of cultural values and the potential of these to better define the objectives of their reservation. Recently there has been a call for increasing emphasis on the cultural values of forests—their historic, archaeological, aesthetic and symbolic values, for example—which indicates the potential for a richer interpretation of the values of forests to the community (Australian Heritage Commission 1994).

There is an extensive literature concerning human responses to landscapes and to forests in particular. Forests have been a rich field for research into the psychological and psychophysical aspects of landscape experience (Lamb 1994). There are many studies on preference and emotional response to the physical qualities of landscapes which are relevant to forests and also many studies on forests specifically. Various cognitive attributes have been identified as relating positively to the experience of the forest environment, such as 'making sense', 'involvement' and 'spaciousness' (Kaplan and Kaplan 1982; Herzog 1989). Content dimensions have also been identified, both cognitive (such as naturalness and scale), and physical (such as vegetation, water and topography (Purcell and Lamb 1984)).

Landscapes can also be thought to be, and to often also be composed of, cognitively definable places (Herzog 1984). That is, particular kinds of landscapes and specific locations within them may be identified and recognised as having meanings and expectations attached to them. The coding may differ within and between cultural groups (Purcell and Lamb 1984; Falchero, Lamb, Mainardi Peron and Purcell 1992; Watson, Roggenbuck and Williams 1991; Vining 1992) and be related to experience, background and to knowledge structures (Purcell 1992). Different levels of knowledge may differentiate the cognitive coding of particular landscapes for those with specific education and training from others without this background. Personal and working experience, implicit learning and repeated exposure to particular geographic areas are also implicated in creating different codings for individuals and sub-cultural groups.

Such research indicates one alternative explanation for the cultural construction of the meaning of the forest environment. It would be reasonable to surmise that those involved in forestry management may cognitively code forests, and old-growth forests in particular, in a way which differentiates them from other people. However, there is little evidence of whether old-growth forest could be considered to be a cognitive category. Other environments which could potentially be related to old-growth forests, such as wilderness, are recognised as having particular qualities (Hammitt 1982, Herzog 1984; Murray 1990). There is also anecdotal evidence that old-growth may be a construct (Worster 1995) which differs between community groups and 'specialists' such as forest ecologists. However, there has been little research attention paid to these differences and to whether they are evidence of different cognitive codings, or constructions of the meanings of forests, which may exist between the groups.

Other values also apply to forests, such as attitudes, beliefs, spiritual, symbolic and other meanings, which may of may not be based on direct experience, are less amenable to research and have received even less attention (Willers 1991). There is research on some values of wilderness, such as solitude and silence, (Hammitt 1982) and on the cultural values of forests to forest workers (Dunk 1994) but in general the spiritual and symbolic values of forests have not been the focus for research effort. Phenomenological and other qualitative methods are specially relevant (eg. Morse 1994, Murray 1990) to investigating these issues but have not often been employed. This may be because of the perceived lack of reliability and utility of the results, compared to the expectations of empirical research (Lamb 1994). The evidence derived from the little qualitative research carried out so far on forests is that it has the potential to provide a richer insight into forest values than has been provided so far by extensive empirical efforts.

The objective of the study reported in this chapter was to make a preliminary investigation of the values of old-growth forest, using qualitative research methods. The main aims were to establish whether there were identifiable values of forests generally and old-growth in particular. A secondary aim was to compare the values expressed by members of the group involved in forest management and a community group. This was designed to judge whether the values of forest might be shared by the two groups and, if not, to what degree there might be differences between them. This examination could help clarify the meaning of old-growth forest, which is necessary for its identification and reservation. It could also provide insights into the reasons for continuing debate between two of the main groups involved in the process. This was a pilot study which was intended to provide only a preliminary indication of the feasibility of conducting more detailed research.

Method

This investigation consisted of focused interviews conducted with forest specialist and community groups of people. The methodology is derived from phenomenological research (Lamb 1994; Morse 1994) and is aimed at discovering the cultural and personal dimensions of meanings in the environment. These meanings, or indications of them, can be found by analysing the content of narratives in which people are free to construct the answers to open-ended questions which focus their attention on related issues, but do not prescribe the form of the answers. Recently attempts have been made to combine the value of empirical and phenomenal methods in an innovative and enriching way where each informs the other (eg. Schroeder 1991). This pilot study attempted a similar combination, but only the phenomenological part of the study is discussed here. Focused interview was chosen because it was expected to be more efficient in time and effort terms than totally unstructured focus group discussions (Mackay 1993). Another reason for this choice was that the respondent groups for the pilot study could be anticipated to have already formed views at some level about old-growth forest and unstructured discussion would probably have been seen by the participants to be artificial and obscure.

Sample population

Two groups were used, forestry specialists and a community group, numbering 16 and 19 respondents respectively. The respondents were invited to participate by personal invitation, based on an initial list of 25 names in each case. The forest specialists came from government bodies such as the state forest and national parks services, and the community group from environmental groups, community organisations and sawmilling interests. Because of the pilot nature of the study it was decided not to equalise the two samples. In interpreting the content analysis it is therefore important to remember that these variations in group sizes may accentuate or reduce differences in content between groups.

Sample size

Compared to the kind of samples which would be required for statistical validity, the sample populations here are quite small. However, by contrast with empirical methods, there is little research to indicate what a valid cultural sample size might be for phenomenological research methods, as in this case. The 'intensity sampling' (Morse 1994) carried out in this study provides rich and complex information without any expectation of consistency or consensus. This is in contrast to more traditional research in which central tendencies (eg. averages) and limited variance (measurable consistency) are objectives. This means that there is no easy way in the present kind of research to establish the limits of variation. Small samples are appropriate in such studies and the sample sizes used here are considerably greater than those recommended by Morse (1994) as sufficient for valid interpretation. Notwithstanding this, the research presented here is of a pilot nature and should be interpreted with caution in the wider context.

'Question' selection

'Questions' were used to focus the discussion of issues. We put these in quotation marks to indicate that they were not used in a questionnaire format and simply provided the tenor and focus of discussion. The 'questions' were derived from three unstructured interviews carried out by the senior author with people unconnected to the old-growth forest project or any related work(an architectural academic, a teacher and a tradesperson). The transcripts were analysed, themes identified and used to derive the interview 'questions'.

Experiments

The two groups were interviewed separately. Each of the 'questions' was put in some form and all participants had the opportunity to respond. In most cases all of the respondents contributed on each. No control was exercised on the direction the discussion might take from that point. The responses were recorded and later transcribed. The tenor of each of the 'questions' asked was as follows:

1. 'Are there things about forests that are special to you?'
2. 'Are there special feelings that you have when you are in some forests?'
3. 'Are there special places where these feelings happen?'
4. 'Do you think other people would have the same feelings you do?'
5. 'Do you think that your training/background makes any difference to your reaction to particular forests?'
6. 'Do old-growth forests have special qualities to you?'
7. 'Do you have a 'mental picture' of what old-growth forest should be like?'
8. Alternative #1: (for specialist group): 'What do you think the 'mental picture' of old-growth forest that ordinary people might hold would be like?'

   Alternative #2: (for community group): 'What do you think the 'mental picture' of old-growth forest that specialists like foresters or biologists might hold would be like?'
9. 'The values of old-growth forest could turn out to be based on mythical or spiritual attachment to them. What is you reaction to that possibility?'
10. 'Do you think that disturbance changes the feeling you have about old-growth forest?'

Analysis

The interview transcripts were analysed for their content by the interviewers in two stages. The first stage identified main themes in a sample of the transcripts and the second stage used these to code the occurrences of the themes in the transcripts from the full set. Further themes were identified and added during coding. A large sample taken from the total data set indicated a close agreement between the coders. The results were in two forms: the first was as frequencies of occurrence of the themes identified, for each question. The second form was a sample of the words and phrases used by respondents which related to each theme. This chapter discusses the summary frequency data in quantitative and qualitative form, across all 'questions'.

Results and discussion

Content themes

Eight major themes were identified (A to H). The themes are not completely independent and aspects of some appear in other categories. The content of each is briefly described in Table 1.

Summary statistics

The results discussed in this chapter are for the summary data only. Eighty-four sub-themes were identified (Table 2). The three highest occurrences were for big trees (61), disturbance generally (46) and release from and alleviation of tension (40). There were more occurrences for the specialist group on most themes. There were results which differed between themes and between the two groups of respondents.

Table 1. Content of major themes

A	Spiritual values	References to the mystic or religious values of forests, or other spiritual values. It was not possible to establish a perfect distinction between these and symbolic values. Spiritual values were those judged to arise *within* a person. This could be independent of the experience of forests.
B	Aesthetic values	Specific references to aesthetic values, specific visual experiences, references to artistic or pictorial conceptions, or expressions of affective response to the appearance of forests.
C	Symbolic values	Symbolic values were taken as initiated *outside* the person; forests symbolise certain things to people which are beyond their simple appearance, (Cary 1993), or utilitarian use. The nature of the symbolism is a personal and/or cultural construction. The symbolic value of forests does not depend on the experience, but would be evoked by the forest where it was experienced.
D	Abstract values	Abstract concepts or constructs used to describe values of forests, often in scientific terms as 'models' of the environment; they do not depend on experience of forests.
E	Content	Identifiable parts of the physical and biological environment of forests, such as flora, fauna, physical changes caused by disturbance, water and understorey etc.
F	Use	The forest as a resource or as a setting for human use.
G	Personal experience	Beliefs and expressions of values relating to forests arising out of experience, education and varied interests.
H	Beliefs about others/expect ations	Beliefs about the feeling and attitudes of others, including perceptions of differences, lack of knowledge, grasp of reality and varied backgrounds.

Content

The content theme had 262 occurrences; 144 for the specialist group (averaging 9.6 each) and 118 for the community group (6.2) and was differentiated into the largest number of sub-themes; both groups referred to the same variety of elements. The results indicate that the category is detailed for both groups of respondents. However, it appears to be more important to specialists, who may have more detailed knowledge structures about the content of forests and a richer language to describe it.

There were elements which were common to both groups, but there were also differences on most elements, indicating that they do not share a common concept of forests in all circumstances. For example, big trees, tree parts/branches/hollows, epiphytes/moss/fungi/ferns, leaf litter/understorey and moist/damp were mentioned more often by specialists, whereas rainforest, regrowth/plantations, built structures, density/tangled and wildlife occurred more often for the community group. Disturbance occurred often for both, but specialists mentioned fire and logging whereas all but one community respondent did not, and intensity occurred more often for the community group. Built structures occurred for the community group only.

There was also evidence that the specialist concept of content is a more exclusive category than for the community group. The community group included built structures in narratives about content of forests and were less concerned about logging and fire as disturbances. They also frequently referred to regrowth/plantations and to rainforest in particular, as relevant forest types. Wildlife was an important content element, despite the fact that evidence of wildlife would often be difficult to discern. Specialists rarely mentioned wildlife, despite there being many specialist zoologists in the group. There was some evidence that they perceived other abstract elements, such as habitat and structure, as alternative themes which denote wildlife to them.

In terms of content, the specialists' concept of old-growth forest, appears to be a more differentiated, detailed and exclusive category than for the community group. The community's concept was more inclusive of different forest types, degrees and types of disturbance, was less sensitive to fire and logging disturbance, and was more influenced by rainforest as a relevant forest type. Wildlife was important, but, while discussed as a content element, this could be interpreted as being more symbolic than tangible.

Spiritual values

This category had 187 occurrences, 80 for specialists and 107 for the community with similar averages (5.0 and 5.6 for the two groups). It was highly differentiated, into 18 sub-themes. The sub-themes were a combination of emotional and cognitive expressions, with mystical and religious aspects. It was clear from the transcripts that these values are about the meanings of forests to people and do not depend on the finite experience of being in the forest. They are thus clearly differentiated from categories such as content, abstract values which are described by reference to content, use and personal experience. However, people sometimes illustrated the spiritual nature of forests by reference to specific experience and these occurrences were included in this category.

The theme was detailed for both groups and there was extensive commonality. However, there were some differences between groups. Sustaining/uplifting, safety/-security and privileged occurred more for specialists. Mother, loss/disappointment, amazement/humbleness, life support, lack of respect and related specific experiences occurred more for the community group. Two themes with negative emotional connotations, loss/disappointment (14 occurrences) and lack of respect (7) were expressed most by the community group These results confirm the issue of forests symbolising society's lack of respect for, or threats to, nature, which have been reported previously (Cary 1993).

Table 2 Summary of content of interviews by theme and sub-theme

	Theme	Sub-theme	Specialists (n= 16)	Non-specialists (n= 19)	Total (n=35)
A:	Spiritual values	Release/alleviate tension	19	21	40
		Specialness/valuing	10	11	21
		Sustaining/uplifting	10	1	11
		Connectedness/nature	10	11	21
		Safety/security	6	3	9
		Care (next generation)	0	3	3
		Home	0	2	2
		Mother	1	5	6
		Loss/disappointment	2	14	16
		Amazement/humbleness	4	8	12
		Spooky	2	3	5
		Excitement	1	0	1
		Life support	0	6	6
		Veneration (historic)	3	0	3
		Lack of respect	2	7	9
		Specific experiences/places	2	11	13
		Privileged	4	0	4
		Specific spiritual/religious	4	1	5
		Average occurrence	*5.0*	*5.6*	
B:	Aesthetic values	General	5	4	9
		Specific locations	8	7	15
		Vistas/views (in general)	9	2	11
		Beautiful/nice/attractive	5	2	7
		Composition/pictorial	5	2	7
		Enclosure/openness	3	3	6
		Dramatic/spectacular	2	0	2
		Silence	1	0	1
		Degrees of pleasure	1	0	1
		Sounds and smells	1	3	4
		Average occurrence	*2.5*	*1.2*	
C:	Symbolic values	Untouched/wilderness	17	9	26
		Awe/majesty	16	6	22
		Naturalness	11	7	18
		Constancy/unchanging	2	0	2
		Age/story/history	8	8	16
		Alive	1	1	2
		Balance	0	6	6
		Achievement/effort	7	2	9
		Health	2	6	8
		Cathedral	1	1	2
		Fear/repulsion	3	3	6
		Reservoir	1	3	4
		Fairytale/myth	3	0	3
		Average occurrence	*4.5*	*4.3*	

Table 2. (Cont.)

	Theme	Sub-theme	Specialists (n= 16)	Non-specialists (n= 19)	Total (n=35)
D:	Abstract values	Systems/processes/functions	14	11	25
		Populations/diversity	25	3	28
		Structure/habitat/biomass	6	3	9
		Resilience	5	4	9
		Scientific value	5	3	8
		Average occurrence	*3.7*	*1.3*	
E:	Content	Big trees, flora	41	20	61
		Vegetation types/rainforest	7	17	24
		Regrowth/plantations	0	5	5
		Tree parts/branching/hollows	6	0	6
		Epiphytes/moss/fungi/ferns	11	6	17
		Disturbance general	26	20	46
		Intensity	2	6	8
		Fire	5	0	5
		Weeds	5	4	9
		Logging	6	1	7
		Built structures	0	4	4
		Density/tangled	1	6	7
		Water	8	8	16
		Wildlife	3	12	15
		Rocks/features	1	3	4
		Growth stages	2	0	2
		Evidence of survival	2	0	2
		Leaf litter/understorey	8	2	10
		Moist/damp	7	2	9
		Fallen timber	3	2	5
		Average occurrence	*9.6*	*6.2*	
F:	Use	Recreation	0	2	2
		Timber products	0	5	5
		Education	0	1	1
		Average occurrence	*0*	*0.4*	
G:	Personal experience	General	3	8	11
		Discomforts/ticks/leeches	5	3	8
		Varied interests/attitudes	7	6	13
		Education	5	2	7
		Individual differences	1	2	3
		Distrust of the mythical	1	1	2
		Average occurrence	*1.4*	*1.2*	
H:	Beliefs about others	Ideal forest versus reality	7	3	10
		Individual differences	6	5	11
		Lack of knowledge	5	6	11
		Cultural differences	2	9	11
		Generation differences	0	5	5
		Varied backgrounds	6	9	15
		Same values as mine	3	2	5
		Fantasy forest	15	0	15
		Average occurrence	*2.8*	*2.1*	

The spiritual values were sometimes also related to specific places, which may indicate, as also concluded by Cary, that negative emotion may be more keenly felt or recalled when related to specific places. For the community group, there were many references to forests as a life support (not referred to by specialists) and very few to sustaining/uplifting spirituality.

The differences in spiritual values may be because specialists intellectualise their spiritual values and increasingly base them on qualities of forests, which they become aware of either through training or experience. That perspective could also incline them to hold positive spiritual values. That could explain the high level of sustaining/uplifting occurrences (10) compared to the community group (1). However, there is another possibility. Sustaining is a word which has particular meanings in ecological terms and in forestry in particular, which is different from the spiritual connotation. It is thus possible that sustaining/uplifting literally means different things to each group.

Symbolic values

The category had 124 occurrences, 72 for the specialist group (averaging 4.5 each) and 82 for the community group (4.3). It was differentiated into 13 sub-themes, half of which had occurrences of less than 5. The transcripts indicate that symbolic values are not dependent on finite experience, but when there is that experience, it would give rise to manifestations of that response in a person.

There were many shared values between the groups, but there were also differences. Untouched/wilderness, awe/majesty and achievement/effort were higher in occurrence for specialists, whereas balance was significant only to the community group. The importance of untouched/wilderness indicates that there was considerable equivalence of the meaning of wilderness with forests in general and old-growth in particular. Awe/majesty, naturalness, and age/story/history could also be thought of as related and had substantial frequencies of occurrence. However, for the specialists, naturalness and age/story/history could be not only symbolic values, but also be abstract intellectual qualities of forests, and be different from the same expressions used by the community group. In other words, the two groups could be using the same words to denote different meanings. Health and balance was important to the community group but not to specialists who may have expressed their own values in other terms, such as abstract values like diversity, structure and habitat.

Beliefs about others

This category had 84 occurrences, 44 from specialists (averaging 2.8 each) and 39 from the community group (2.1) and had 8 sub-themes. There was considerable consistency across groups. Overall only generation differences and same values as mine were of lower frequency, but there were differences between groups. Both groups appeared to appreciate the effect on perceptions of forests resulting from individual differences between people and varied backgrounds. For the community group, cultural differences and differences between generations were more common.

Specialists expressed two related themes more than the community group; ideal forest versus reality and fantasy forest. They generally believed that the community group had an unrealistic view of the forest, based on ideals and on fantasy, implying that this was not realistic. There were also other versions of this issue in the data. For example, achievement/effort was a significant symbolic value to specialists, (their own efforts and achievements in forests), the personal experience of (overcoming) discomforts like ticks and leeches were important, and privileged (to work in forests) was a spiritual value to them.

Aesthetic values

There were 63 occurrences for this theme, 40 for specialists (averaging 2.5 each) and 23 for the community group (1.2). Specialists referred to the theme more often, but the elements appear similar to those of the community group, with the exception of vistas/views and beautiful/nice/attractive. Specialists could generalise about aesthetic values and the qualities of pleasant locations to a greater degree than the community group. Perhaps the training of the specialist group in analysis and abstraction also influences that capacity in relation to expressing aesthetic values.

Abstract values

This had 79 occurrences, 55 for specialists (averaging 3.7 each) and 24 for the community group (1.3), indicating that abstraction is a familiar and widespread means of understanding the world for both, but particularly for the specialist group. The category was differentiated into 5 sub-themes. Systems/processes/functions and populations/diversity were most common, with structure/habitat/biomass, resilience and scientific value less common. The main difference between groups was with populations/diversity, with an occurrence of 25 for specialists against only 3 for the community group. This theme accounted for about half of the total of all the occurrences for the specialist group. The community group referred most often to systems. These references however were more generic, indicating a system view which was less technical and more symbolic than that of the specialist group. However, some specialists also indicated that the systems conception was also a symbolic value of forests to them.

Personal experience

There were 44 occurrences, 22 for each group, averaging 1.4 and 1.2 respectively. General references to experience (i.e. personal experience as a conception), discomforts like ticks and leeches, the importance of varied interests and attitudes and personal education were most common. The total number of elements for each were too low for any realistic interpretation of differences. There was an indication however, that the community group relied more on personal experience in general to inform their feelings about forests.

Use

The category surprisingly had only 8 occurrences. This indicates that the people were not considering the use of forests as a central issue, an unexpected result. A possible explanation is that the nature and focus of the pilot trial, which was known to participants to be on old-growth forest, created an environment in which questions of forest use did not easily arise. There may have been an implicit assumption that old-growth forest would be likely to be protected, even though many of the questions were about forests generally. However, there could be other reasons.

Discussion

The focused interview method provided rich and varied insights into the values held about forests and indications of differences between the respondent groups. The 'image' of forests which was most common to both groups was of big trees, rainforest, epiphytes, water, wildlife, leaf litter, diverse understorey and moistness. In the

Australian context, many forests, including old-growth forests, do not have all or even most of these qualities. Thus the results show, on one level, that both groups have an image of the 'ideal' forest which is equally unrealistic. However, the nature of the ideal forest was also different for the two groups.

Spiritual and symbolic values were important to both groups. Both referred to forests as places of special spiritual and symbolic value, often in terms of sacredness or as gifts. The source of the sanctity or gift giving was not specified. The community group relied more on personal experience and did not judge the 'reality' of forests to others as specialists did. The specialist view was more detailed in terms of forest content, exclusive and abstract. Many special qualities about forests to which they referred were knowledge-based, i.e. based on expert knowledge structures about forests, derived from training, probably from implicit learning within the forestry sub-culture, and from experience. Thus abstract conceptions were often claimed to be the 'evidence' or the 'facts' on which symbolic and spiritual values were based. Interestingly, the same abstract conceptions were often referred to as the basis of their understanding of old-growth.

The community view of forests was less detailed, more symbolic, more related to personal subjective experience, and more inclusive of disturbances. Special values of forests the community group referred to were more personal and emotive (home, mother, loss, life support) and more body-centred (alive, balance, health). For the community group, the 'facts' which supported their values of forests appeared to be grounded more in themselves, i.e. in their personal beliefs, whether these were 'correct' or not.

Old-growth forest was not mentioned by the community group as a special kind of place or a place which created special feelings. This can be interpreted as an indication that this group did not naturally distinguish old-growth from other forests and as evidence that old-growth was not a discrete cognitively coded environment to them. On the other hand, there appeared to be a definite cognitive code for old-growth forest for the specialist group. While there was evidence of a lack of consensus as to what the code signified, the specialists appeared to agree on the scientific principles on which the code appears to be based. One specialist candidly stated: 'old-growth is only an idea: it's not real.'

Most respondents agreed that many of the values of forests were mythical and spiritual, but specialists thought this unreliable, distinguishing the mythical and spiritual from other values. These were mostly abstract values or scientific 'facts'. Paradoxically, specialists appear at the same time to have a symbolic attachment to an unchanging, wilderness-like forest, whereas the community group appeared to have a more spiritual and symbolic attachment to forests generally, with wildlife an important element, and to have less difficulties with different versions of reality or 'truths', relating them to differences between people and experiences. They were more tolerant of changes, disturbances and variety in forests. Many mentions were made of the restorative powers of forests as places of peace and tranquillity, restoration of balance and refuges from pressures of every day life, where the cares of the world fall away and where emotional 'batteries can be recharged. This is a recurrent theme also in recent research on the restorative values of nature generally, which indicates that the effect may be widespread, physiologically mediated and not fully determined by cultural influences.

Two themes of practical value to the assessment of old-growth forests which were included in the focus of interviews were referred to very little, i.e. the concept of ecological maturity and the meaning of minimal disturbance. Where there was any mention of these, it appeared that neither was a naturally differentiated category. The categories seemed at best to be binary, i.e. either mature or not, or undisturbed or not. There was also an indication that both of the concepts were related to aesthetic notions.

Conclusion

The evidence here is that the meanings of forests were shared by both groups to a considerable extent and that old-growth forest is certainly a cultural construct. There were many references to the symbolic and spiritual values of forest (sacredness, refuge from harm, gifts (from above), venerable age and a sense of implicit tranquillity and knowledge) which were similar to classical conceptions referred to by Hughes (Chapter 1) in his workshop paper. Related to these were references to the mythic qualities of forests, for example, their association with folk heroes and other mythical figures, some classical and others more contemporary. The cultural construction of forests is clearly an area which has some elements which extend backward in time for a considerable distance.

The two groups shared the categories of values and some of the sub-themes, but there were larger differences between the groups than differences between the members of the groups, indicating that the two have different conceptions of old-growth. It is also clear that the content and abstract values themes, on which specialist opinion relies heavily, are not shared by many of the community group. The community group view is, however, no less 'real', despite the specialists' assessment of the unreality of it. It simply depends on other constructions of reality, including personal, emotional, symbolic and spiritual ones (Lamb 1994). These aspects of reality would be closely related to attitudes and behaviour towards forests, and as Cary (1993) points out, examining the nature and impact of symbolic beliefs on behaviour is a fruitful area of research. It is evident that further research of this kind would be valuable to the process of identification and reservation of old-growth forests.

The differences between the groups above probably accounts in part for the ongoing debate between forestry and community groups about the relationship between cultural and ecological values of forests. Such debates are common, where specialist and community values do not coincide (Lamb 1995). For the forest specialists, the ecological values of forests are 'facts' based on both abstract and specific knowledge structures (Purcell 1992) and these can be seen manifest in the content of forests. For the specialist, old-growth is a cognitively coded category which arises out of a combination of a sub-cultural construct of its meaning and salient experience. For the community group, the main difference from the specialist' conceptions is that the values of forests are subject to varying interpretations, beliefs, whether grounded or not, and to attitudes many of which are based purely on subjective experience.

The lack of evidence of a discrete cognitive coding of old-growth shared by the two groups may help to explain the continuing debate as to the process and basis of reservations. Several of the community group saw the concept of old-growth as not only artificial, but arbitrary. The lack of sharing of the concept of old-growth may be part of the reason that claims by forest specialists, that they are best suited to identify the ecological values, (and by implication the social values of old-growth forests also), fail to convince the community. There is evidence here that the community may consider that ecological values are not facts in their understanding, but are instead a social construction. This illustrates the distance which may exist between two different explanations of the same phenomenon, the values of old-growth forests. The community group indicated that looking harder in the forest will not discover the precise nature of old-growth forests as seems to be the preference of the specialists; it is necessary instead to look harder within people, where the meaning resides. What is occurring at present is that the specialist and community groups, while they use similar words for aspects of the meanings of forests, are not actually participating in communicating in the same domain (Lamb 1995). The social values of the forests differ substantially between the groups in some aspects.

The two central conceptions of old-growth identification and assessment, ecological maturity and minimal disturbance, which were of specific interest to the practical application of the data, were not referred to in detail by either group. Even focusing the discussion in this direction did not lead to any evidence that these were anything other than intellectual conceptions, as acknowledged by some specialists. There was indirect evidence that the specialist group, even though it shared detailed knowledge of the significance of the concepts, did not exhibit any consensus about them. One specialist candidly stated; 'old-growth is an idea: it isn't real'.

The trial indicated that social values of forests need to be taken into account in identifying and reserving forests. However, it also indicated that innovative ways of establishing communication and securing agreement are needed. This is because 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.

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13

In fealty to venerable forests

Norman Endacott

This paper presents the views and attitudes of Australian foresters towards forest age, and particularly, but not exclusively, towards old forests. I believe that they represent those of the majority of foresters in this country. The first part of the paper singles out and discredits the term 'old-growth forest'. It then presents the views of four older foresters and concludes by suggesting 'venerable forests' as a preferable term.

Old-growth forest

The term 'old-growth' originated in the Pacific north-west of Canada and the United States around the turn of the century. It was much used by woodsmen, timber workers and foresters to make the straightforward distinction in normal descriptive communication between two categories of coniferous forest, 'old-growth' and 'regrowth' or 'second growth'. The difference was plain to see and is still exemplified in the different quality grades of Douglas fir timber—called 'oregon' in Australia—coming from the two types of forest.

It was not until the the growth period of 'environmental awareness' in the late 1970s and 1980s that subtleties were brought into play and the forestry literature of the United States and Canada started to present its readers with earnest and erudite discussions, attempting to define old-growth forest (Society of American Foresters 1983; Gregg 1989; Hunter 1989; Bolgiarno 1989; Dargavel 1996; Chapter 25).

In Australia the term was known only to readers of American forestry and timber industry journals until the 1980s when it rapidly gained currency within the environmental debate and became an effective symbol or banner under which the preservation of native forests was fiercely advocated. As the Resource Assessment Commission noted, '... old-growth areas are high on the agenda of conservation groups seeking the cessation of logging' (Resource Assessment Commission 1992, v.1:56). The concept gathered momentum during the 1980s with two workshops being convened to define, refine and study it (Dyne 1992; National Parks and Wildlife Service of NSW 1993).

A further development occurred in Victoria in 1993 when the Department of Conservation and Environment carried out an extensive old-growth study for the East Gippsland Region with federal funding. Its objectives were to devise a working definition of old-growth forest and to identify those forests which qualified, thus paving the way for the East Gippsland Forest Management Area Plan and the foreshadowed Commonwealth-sponsored Regional Assessment. Its report lists the attributes which would reinforce each other to identify an old-growth forest (Woodgate and others 1994). One-fifth of the report is devoted to the vexing problem of defining old-growth forest. Sixteen alternative definitions obtained from a variety of sources are listed which give different and confusing variations on the theme. The list could be greatly expanded by using different permutations of attributes and subsets.

The debates in the old-growth workshops brought suggestions that some means of weighting the attributes should be devised so that rational judgments could be made as to how far down the scale the reservation process should go. The East Gippsland study must have had that in mind with a schematic graph which charts a scale of 'age' points along the x axis and 'disturbance' points along the y axis (Woodgate and others 1994: 62). However, it does not seem to have overtly pursued the idea further. Dyne made the significant comments to the Canberra workshop that perhaps old-growth is really a human construct made up of a diverse assembly of perceived attributes and that there is little unanimity as to which attributes to use (Dyne 1992). While this indicated that the workshops were merely wrestling with a concept, other contributors were adamant that forests could be classified as either old-growth or not old-growth. The twin attributes of 'disturbance' and 'naturalness' caused the greatest difficulties in the workshops. The disturbance criterion was watered down and a new category of 'negligibly disturbed forest' created which is almost equal in approval status to old-growth forest.

The East Gippsland study considered five defining attributes of old-growth. The structural attribute dealt mostly with aspects of the age of the overstorey and emphasised its alleged faunal implications. The *functional* attribute mostly dealt with ecology and biodiversity and seemed to adopt a 'philatelic' approach (Lennon 1988). The *contextual* attribute dealt with juxtaposition and compatibility with surrounding areas. The *intangible* attribute dealt mostly with spiritual, aesthetic and mystical qualities. Although the study set out the intangible values of four ecological vegetation classes quite expressively, it did not seem to know how to deal with them. The fifth attribute considered was the *presence or absence of evidence of past disturbance*. This aspect of the debate was interwoven with considerations of 'naturalness' and is tainted by dogma, superstition and misanthropic attitudes to human relationships with the forest. Linkages are claimed with the other four alleged attributes.

The Resource Assessment Commission suggested that the term old-growth forest should be reserved for only '*la crème de la crème*' of forests which exhibit an overwhelming array of age, ecological and intangible values (Resource Assessment Commission 1992: 150). It is also significant that the Ecologically Sustainable Development Working Group on Forest Use (1991:3) commented on the indecisive and conflicting definitions of old-growth forest. It rejected the term and adopted 'ecologically mature forest' in its report. 'Older-growth forest' was tried briefly in Victoria but quietly dropped. Suggestions have also been made that younger or middle-aged forest may need to be reserved for eventual graduation into the old-growth category.

George Baur, a forest ecologist and forester, introduced some refreshing views to the workshop debates (in Dyne 1992). Among other things, he rebuts dogmatic statements (e.g. Galvin 1989; Early 1990) that 'intensive forestry' is likely to severely compromise or even wipe out old-growth values, and that these values once lost will never be restored. He points to certain situations in New South Wales where clever management may permit harvesting to co-exist with high levels of old-growth values.

He also gives evidence that old-growth values can, given time, be restored following a period of severe perturbation. He sums up the old-growth debate by affirming that 'old-growth forest is as much an emotional concept as a physical state'. McIlroy filled a void in the Canberra workshop by stressing the importance of the cultural, aesthetic and spiritually uplifting benefits of forests (in Dyne 1992).

I suggest that it has been bad semantics and bad science to have invented, or copied from from America, a neo-technical term, to have elevated it to political importance as a land-use planning term and then to have gone to the forest in search of areas to match it; quite the reverse of what I consider to be the proper logical and scientific order of business. However, the old-grwoth debate, and espcially the East Gippsland study, raises a range of issues and focuses on many forest values previously neglected. This new recognition and emphasis stimualtes a new approach which I seek ot canvas in this paper.

A new approach to common ground: the 'venerable' forests

I turn my back on the term 'old-growth' forest and seek another adjective which focuses on the intangible attributes of forests of all ages. 'Venerable' is by far the most suitable as it is defined in relation to things—although not to persons—without reference to their age:

> **Venerable** 3. Of things: a. Worthy of, to be regarded with, religious reverence. b. Worthy of veneration or deep respect; deserving to be revered on account of noble qualities or associations. c. Fitted to excite feelings of veneration; impressive, august. (*Oxford English Dictionary* 1978)

When we leave the sequestered environment of a city or suburban life and revisit the forest for inspiration and enlightenment, we discover that so much written in the language of science and pseudo-science is excess baggage which we could well have left at home. During this all-too-brief sojourn in the forest, the scales fall from our eyes; we see that what is before us is not only the physical presence of trees, understorey, soil, streams and vistas of great beauty, but also a window through which we can perceive a fascinating dynamic biological continuum. We can seek out and identify the plant and faunal relationships hidden away in the trees. The forest has a past we can puzzle over, a beautiful and interesting present, and a future about which we can speculate, with varying degrees of expertise. We can imagine in our mind's eye the vigorous young forest as a mature one a century hence, or in a forest reserve, an eventual ancient forest. We can equally speculate on the future of the veteran forest surrounding us—for example, how long the tree species present can continue to dominate the site, with or without the perturbations of logging or fire.

Foresters' perspectives

Foresters as a class are not excluded from appreciating the non-commercial values of the forest which, while providing strong justification for some reservations, may still be found and enjoyed to varying degrees within a complex forest mosaic under genuine multiple-use forest management.

While lauding the beauties and wonder of the forest, as I am doing, one must acknowledge the corollary that some forests may be seen as pedestrian, repetitive and unexceptional, while others may have been damaged. Forests in a lamentable state after many years of selective, unregulated cutting and wildfires—like much of the coastal forest of East Gippsland or the Eden region before 1970—are unlikely to evoke the same pleasurable feelings in foresters as virgin forests or healthy productive ones under good management.

In this section I attempt to outline the attitudes of four Australian foresters (including myself) of mature age towards the forests they have encountered or managed in the past. Their views have been sought directly from them or gleaned from their published writings.

Roger Underwood (Western Australia)

Roger Underwood published an article entitled 'In praise of young trees' which sets out his attitudes to the age of forests (Underwood 1993). In the paper we can sense the appreciation and affection a forester has for the whole range of forest ages which he deals with in his day-to-day work. He quizzically remarks that society has become besotted with old trees and old forests, and can spare little admiration for vital young forests.

Underwood has a foot in both camps. He appreciates the 'interdependancies between old trees and their environment', and admires their dogged survival in the face of all the threats of fire, storm, insects and disease. He notes the 'gnarled and crusty beauty' of veteran trees. Yet he knows young forests well; some of them he either planted or officiated at their regeneration. He waxes lyrical about young forests, using the expressions: 'energy and vigour', 'freshness of the form and complexion', 'joyous optimism'.

He points to the special relationship that exists between a forester and the forest he or she helped bring into existence, maybe decades ago. He paints some Western Australian pictures for us: his childhood in the Swan Valley, and his early years as a young forester in the south-west karri forests. Trees and forests were always part of his life. He pays equal tribute to the contribution being made to our national well-being both by the young immature and mature forests in the production zones, and by the veteran trees and old stands within the reservation areas. In his article, Underwood was stimulated by Coleridge's 'Kubla Khan' when he wrote a vision for Australian forestry:

> So I write in praise of younger trees. I love them not simply for their youth and beauty, but for their promise and for the opportunity which they present. Together with the magnificent old-growth forests set aside for all time in our national parks and reserves, they can ensure that there will be something for every forest lover and user in the generations ahead, and in their establishment we can do something creative, positive and rewarding.
>
> So I do not weep that I will never see the trees I plant when they are old—no human can do this, the cycles simply do not match. On the contrary, I delight in 'my' young trees and I am grateful to them for enriching my life. After love and laughter, who could ask for more in that time between youth and crabbed age, than the opportunity to create something which is both beautiful and useful for the generations of the future.

Jim McKinty (Victoria)

McKinty starts a personal memoir (1996) with an account of the regrettable clearing of box/ironbark forests in north-east Victoria during the period 1860-1930. He gives his childhood memories of some of the relict patches of grey box, yellow box and red gum. The memoir records his entry to the Victorian School of Forestry at Creswick in 1934 and his observations of the long-term results of mindless forest exploitation during the Midlands goldrush years of the mid-nineteenth century.

Then the memoir progresses to the Central Highlands. Much of the mixed species forests had suffered many decades of selective exploitation and uncontrolled wildfire, and the result was forest degradation. The mountain ash forests, on the other hand, were in the early days of full-scale utilization when the 1939 fires struck. Before 1939 McKinty observed the existence of battle-scarred veterans of great age, girth and height; and post-1939, the vast expanse of dead 150-200 year old stags which were to dominate the landscape for the next half-century.

Moving on to the alpine ash forests further east, McKinty relates the 140 year age (in 1940) of many of these stands to the sightings of heavy smoke from the eastern mountains made by Bass and Flinders from the sea c.1800. He mentions riding through a magnificent park-like 200 year-old stand of alpine ash near Connors Plains with his Inspector, Reg Torbet, who exclaimed that: 'I feel like a British lord, riding through his woodlands!'. In his extensive forest assessment travels of the 1940s, he encountered stands of trees of extraordinary size: manna gum in the Barclay River and under Nunniong Plateau, red ironbark west of Buchan, yellow box in Broadbent Creek, and fuzzy box at Betebolong. Due to his initiatives, many of these exceptional stands were permanently reserved by the Forests Commission.

In his memoire, McInty enthuses about the Errinundra Forest, as the only substantial 'old-growth forest' in the true sense, remaining in Victoria. He mentions the intriguing subject of disjunct occurrences of certain eucalypt species, scattered over great distances in apparent random fashion, by a feckless Nature. While not grand or noble forests, they are truly old forests and inspire much thoughtful speculation and piecing together of the conventional wisdom on climate change and geological history. Despite his enormous respect and affection for old forests, McInty reveals his past preoccupation as a forester with the harvesting and silvicultural enhancement of native forests to increase their productivity of natural timber.

Tom Brabin (New South Wales, Tasmania and Victoria)

In a personal communication (Brabin 1996), Brabin expresses a love for forests of all ages. However, being a 'production forester' at heart, he has a special affection for the young, healthy, vigorous forest which promises so much for the future. He regularly escorts bus-loads and convoys of Melbourne Probus Clubs and other community groups to Toolangi. At certain stopping points in the mountain ash forests, he takes special delight in pointing out groups of surviving veteran ash trees of great girth and height, but moribund in appearance, and surrounded by 1939 regrowth—'vigorous and graceful, rearing their heads proudly, soaring up to the sky'. He points out to his parties the contribution each forest age class makes to the ecology and landscape beauty of the Central Highlands. The overmature and senescent trees—the 'lords of the forest'—provide a variety of nesting and refuge sites, and an aura of timelessness. The regeneration on logging coupes, the advanced logging regrowth and the middle-aged 1939 and older fire regrowth each provide its own selection of food and habitat for a range of fauna.

Norman Endacott (Victoria and south-west Pacific)

I can best express my own attitudes by making a short list of forests which I remember fondly. In Victoria, I must give first place to mountain ash in the Central Highlands. Figure 1 shows an image of a 217 year-old mountain ash forest; a noble species at its mature best. The description which comes immediately to mind is 'cathedral-like'.

Figure 1. Melbourne University's Botany III class with postgraduate students in mature mountain ash forest (*Eucalyptus regnans*), Wallaby Creek, Yan Yean Catchment, Victorian Central Highlands. The stand resulted from a fire c.1730. At the time of the photograph: age, approx. 217 years; average height, 71 metres; tallest height, 80 metres; average diameter at breast height, 4.0 metres. *Photo*: Late Professor E.J. Hartung, 1947.

Figure 2. Mature messmate stringybark forest (*E. obliqua*), Musk Creek, Wombat Forest. Stand resulting from clear felling in late nineteenth century. Approx. age 100 years; av. height 40 m; volume 230 m^3 /ha sawlogs and 130 m^3 /ha pulpwood. *Photo*: Aurora Studio, Hepburn Springs, Victoria.

I worked for many years with messmate stringybark in the Wombat Forest in the Victorian Midlands which was very heavily exploited during the gold rush period. Figure 2 shows a 100 year-old regrowth stand which fortuitously survived untouched by the post-war fellings applying generally to the Wombat Forest. The fact that this magnificent, high-yielding, valuable, and easily accessible stand was left intact in the face of forty years of cutting pressures, and without any reservation prescription, is difficult to explain.

Figure 3. Silver fir/spruce/beech forest in the communal forest of Boveresse, Val-de-Travers, Neuchâtel, Switzerland. *Photo*: John Dargavel

In Europe, the beech/silver fir/spuce forests managed under Biolley's classical selection system, which drew on the thinking of Gayer, Engler and Gurnaud in the nineteenth century, have provided an inspiration. Knuchel's definitive text book (1953) describes ongoing selection management in three communal forests in Switzerland (Figure 3). These highly productive and exquisitely beautiful European forests have experienced human manipulation and extremely intensive management at the skilled hands of French and Swiss foresters for more than a century. They provide a perspective on our 1990s old-growth forest debate. Instead of human manipulation being portrayed as a corrupting factor, it is here put on a pedestal.

The moist tropical rainforests of Malesia are typified by a great floral diversity, with random distribution and an absence of species, genus or family aggregation. (Richards 1952; Whitmore 1984). The three memorable forests mentioned here are those that depart from that norm in their tendency towards gregariousness and dominance. The *Araucaria* forests of the Bulolo/Wau area of Papua New Guinea were grand and noble forests at the mid-point of this century, rich in both ecological and human interest. In the 1950s a sustainable yield harvesting and reforestation regime was planned and started, but unfortunately no representative samples of these majestic virgin forests were reserved for posterity. Today there are only tiny fragments left (Idriess 1941; Downs 1980). The family *Dipterocarpaceae* has a unique place in forest ecology as it dominates the rainforests in a corner of the south-east Asian mainland and adjacent archipelagos. Most dipterocarp genera and species are notable for their emergent growth habit and gregarious distribution. The stature of the trees and the impressive forest formations overawe the forester and the ecologist (Wyatt-Smith 1959, 1963; Fox and Hepburn 1972). Only in Manus Island does the genus *Calophyllum* exhibit strong gregarious propensities. In Western Manus, there are 40,000 hectares of Calophyllum-dominated forest. There we see tall robust trees with columnar trunks of large girth, with broad crowns standing proud of the general canopy (Stevens 1974, 1980).

Apart from the ecology, the moist tropical forests of Malesia have presented their respective forestry departments with unusual opportunities for sustainable yield forest management, with prospects of success and with minimal degradation risk. The species are good ecological survivors, of gregarious tendency and dominant habit. They have a high commercial value and their gregarious distribution meant a high concentration of resource value. This has given the forester a highly profitable initial harvest which could have supported a vigorous, albeit expensive, forest management regimes. Such opportunities are rare in the tropics. However, to the best of my knowledge all of those opportunities seem to have been lost, and exploitative harvesting, solely for immediate economic reward, seems to have been the common outcome. (In fairness, I must state that the Bulolo project was executed for the first 30 years with due diligence, but then faltered and languished. Efforts are currently under way to rescue it). I am sad about how things have turned out, but I remember the beauty, the grandeur and the wonder of those forests, and I ponder on 'what might have been'.

Conclusion

The four foresters discussed earlier have an orientation towards responsible production forestry with a common thread through their attitudes which tacitly endorses the multiple use ethos. The attributes which foresters could attach to venerable forests can be seen against this background. A forester's taste may encompass forest stands of all ages. A venerable forest must have a high quality of management. Its intangible values include those of aesthetic beauty, spiritual or mystical quality. It may be of particular ecological or scientific interest, or present a particular challenge to forestry. A venerable forest may be of historical interest and involve past human interactions. And it may be of particular interest in the eye of the beholder. Foresters take special interest and pleasure in contemplating forests with which they have been associated in the past. If the outcome has been good, the pleasure is intense; if bad, they are distraught. It should be noted that an area under management for timber production may experience periods of trauma, but foresters look to the time when Nature's restorative processes will have re-created a forest which they can view with pleasure, pride and even veneration.

The old-growth philosophy regards human disturbance in a wholly negative light. However, there are others, including foresters, who think that any evidence of past human activity in the forest which takes us back through history is precious and should be cherished. Classical examples are known to millions of tourists who over the years have paid homage to the ancient forests of Britain (Rackham 1979), while the European fir/beech/spruce forests, mentioned earlier, are living, breathing, photosynthesizing testimonies to human skill and diligence over a long period. Even in Australia, with a much shorter time frame (relative to European occupation), any human artefacts such as old bridges, forest tramway formations, rusting relics of machinery and even the odd sawdust heap, are considered to add a spice of interest to the natural history which must always be our primary admiration. Jane Lennon (1988), for example, criticises '... the park management culture [which] tends to eradicate the memory and relics of past European uses in favour of an image of naturalness and primitiveness'. With relish, she produces a catalogue of last century's use by early settlers of the supposedly pristine eastern half of Wilson's Promontory.

The forest services have over the years undergone a transformation, largely induced by external pressures. For example, many a forester in youth carried out widespread felling or ring-barking of grossly defective or malformed veteran trees, where it was perceived that regeneration was being inhibited by their living presence. Such cavalier attitudes paid little regard to minimal requirements for faunal refuges. The areas treated were restricted by funding limitations rather than by moderating influences. In defence of those blinkered perceptions of the past, however, I would draw attention to the obvious silvicultural benefits which flow from such operations, and the comparatively poor state of many forests when they were never implemented.

Today the most august of the older forests are set asisde in statutory reserves, and other areas are placed within various cateogories of protection zones under management presciption. These prescribed areas are intermixed with the timber management zones, where the forester's management skills are given free rein. Even within these timber management zones, we will have much opportunity for veneration.

Foresters of the older generation, looking back from the vantage point of retirement, see the present day planning principles as a happy outcome; the answer to society's future requirements and an end to the current debilitating environmentalist versus forestry confrontation.

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14

Frontiers of green: pine plantations and local communities

Ruth Lane

> Since Forestry's been taking over land like Crown land, old school grounds and sports grounds and gold mining reserves—it's just by the way—that's taken with it. I don't know why. In some places they don't let them. Like at Argalong now the old school ground that's all pine. And several old schools that I know out Micalong way, that's pine.
>
> *Mike Garner* (Tape 062-3:7)

Figure 1. Sheila and Mark Garner at Tumorrama

This statement was made by Mark Garner, a descendent of one of the older landholding families at Tumorrama, in the Tumut region (Figure 2). His wife Sheila Garner agreed with him and articulated her sense of loss: 'You can't find your old school when you go out to Argalong now. It would have been nice to have left it as a picnic area or something. So that people could go back.'(Tape 062-3:7) Expressions of alienation and disenfranchisement such as these are common responses from local people to the expansion of pine plantations in the Tumut region of New South Wales. However, the Forestry Commission of New South Wales (now State Forests of NSW) was not always regarded with such antagonism. Understanding the relationship between the Commission and the local community requires some knowledge of the region's history.

This chapter explores the values of local knowledge and attachment to place in the context of dramatic change resulting from the expansion of softwood plantations in the Tumut region since the 1960s. The physical landscape has changed significantly and a community which was based predominantly on pastoral land use has been displaced by one of professionally trained foresters. Along with these changes has come a change in the knowledge base used to manage the country. I argue that something of value has been lost through this transition. The emotional ties of local people to specific places keep alive their knowledge of the history of land use prior to the pines, and may be useful to present and future land management. The change from pastoralism to pine plantations has effectively restarted the region's history from year zero. In this respect there is a parallel between this transition and the earlier and more traumatic transition from Aboriginal use and knowledge of the land to pastoralism.

The first pine plantations in the Tumut region were planted at the Red Hill and Billapooloola State Forests in 1928 and 1929 respectively (Grant 1989:163). These areas had been Crown reserves managed by the Forestry Commission as hardwood forests. After the Second World War the Forestry Commission placed an increasing proportion of resources into pine plantations as opposed to the preservation and management of native hardwood forests (see Figure 2).

The Forestry Commission gradually became a development agency promoting silviculture and gained more control over lands allocated to forestry purposes. It obtained increased funding for this more pro-active role through a series of agreements between Commonwealth and State governments between 1967 and 1978. These agreements allowed for the purchase of land, including pastoral land, for pine plantations (Grant 1989:159; Carron 1985:52). This meant that the Forestry Commission competed with pastoralists when properties came up for auction. Today much of the land above 600 metres elevation is covered by pine plantations managed by the Commission. This pattern is common to much of southern New South Wales.

The process by which the Forestry Commission acquired land for plantations often angered local people, particularly pastoralists. In 1959 the Commission acquired 20,000 hectares in the Tumut region, including both leasehold and alienated land (Carron 1985:25). This involved some resumptions of freehold land at Argalong. Although landholders were compensated they remained bitter about their lack of choice in the matter. There were no further resumptions. However landholders were prevented from converting leasehold to freehold in areas where the Commission wished to acquire land. The Commission was also able to out bid local farmers at land auctions in the district, making it difficult for smaller pastoral concerns to expand. Today, pine plantations in the Tumut district supply three large softwood processing plants which form the main industrial base of the region. The farming population continues to decline as pastoral holdings are replaced by pine plantations. People who remain on the land become increasingly isolated. Where once they had other families as neighbours, now they border plantations which are worked by people who commute from Tumut or other towns.

Fieldwork for the study reported in this paper was conducted between June 1991 and April 1993. The people who formed my main sources of information had lived most of their lives in the Tumut region, specifically in the localities of Tumorrama and Argalong. Some had never owned land, some were born into landholding families in the region and others had married into them. Most knew of the others interviewed or their families. They all felt very strongly about particular parts of the region, some steadfastly holding out against land use changes with which they disagreed. Their ages ranged from about sixty-five to eighty-three, and their childhoods and earliest memories spanned the years from 1920 to 1940.

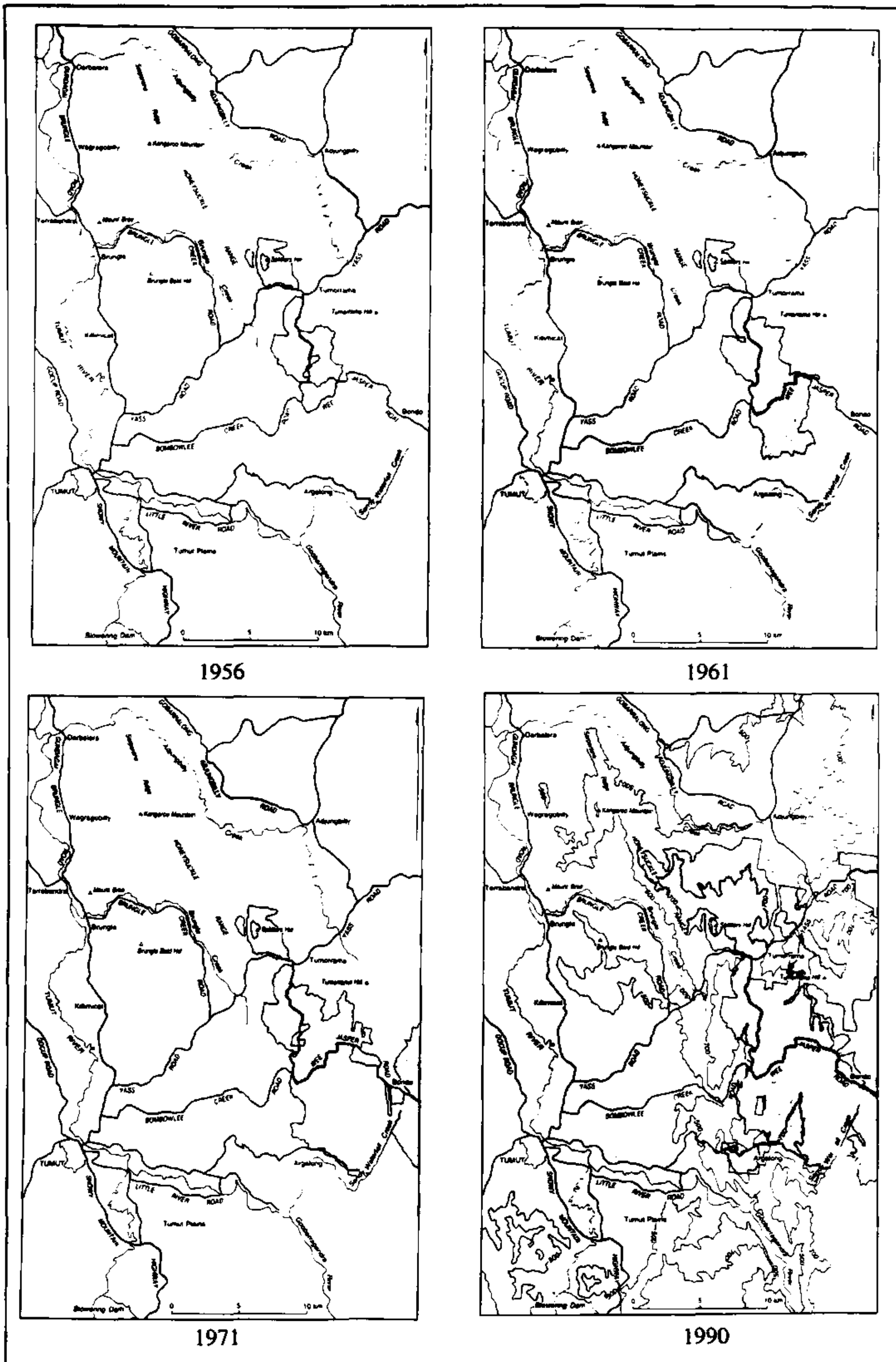

Figure 2. Spread of pine plantations over time

I detected a marked difference in the way people spoke about the Forestry Commission's activities prior to and after the Second World War. Prior to the War it was viewed as a public benefactor, protecting and managing native forests to maintain them as a resource for the future. Beryl Margules described a scheme for unemployed workers which operated in the late 1920s and was keen to show me where their living quarters had been at Red Hill and Billapooloola State Forests. These places were significant to her sense of the history of the district. Mark and Sheila Garner and Vince Bulger all described the labour that was put into the early pine plantations at Red Hill State Forest with a sense of deference.

The change in the focus of the Forestry Commission from native forests to pine plantations had the effect of decreasing the interactions between local people and the Commission. Beryl Margules' father owned a hardwood mill at Tumorrama. Her family had extensive dealings with Commission employees and was required to submit statistics of the native timber which passed through the mill.(Field notes BM 23/7/93:3).

Local people had less access to areas covered by pine plantations than to native forest reserves and the dictates of intensive cultivation meant that the Forestry Commission effectively had more control over the land than previously. It had been common practice for pastoralists to lease areas of native forest for grazing. For example Beryl Margules' father had paid £5 per year to lease land that was reserved as State Forest from 1925 to 1952. In pine plantations this was only an option for a brief period while trees were young. In the course of acquiring land at Tumorrama and Argalong, some areas that had previously been public lands became part of the Commission's holdings (as referred to in the interview segments from Mark and Sheila Garner). The Commission became more like a large private land holder with the primary aim of making profits from land. All this was in marked contrast to its earlier role as a protector of native forests for the public interest and to ensure a resource for future generations.

Of the two localities discussed here, Argalong has undergone the greatest transformation within living memory. Almost all the land which was once pasture is now planted to pine. For many people it is now unrecognisable. In 1992 a reunion was held for people who went to school at Argalong (Figure 3). Sheila Garner travelled to Argalong with her sisters to attend and was upset to find how unrecognisable the landscape had become since her childhood. She said: 'We had to ask the people where do we find the post office in there and where do we find the school and they said look for an elm tree in there or look for something else. It was just hopeless'. Jack Herlihy claimed that: 'the country that has changed, changed completely from the 1940s to after the Forestry Commission resumed it and planted it to such an extent that anybody of the old people that came back, they cannot recognise it' (Tapes 037-8:20).

Place names and memory

Naming and identifying features in the landscape gives the landscape symbolic meaning. It personalises the land and draws it into a social framework. People are connected in a more personal way with a familiar landscape where they can name many features. Place names serve as pegs on which memories of places, earlier times and events are suspended. In traditional Aboriginal societies, place names are part of dreaming stories that structure the relationships between people and country (Morphy

1995). While the place names related by my informants were drawn from an imposed rather than an indigenous cultural tradition, they were also important in structuring the relationship between people and country. This was revealed in the anger expressed at the erection of a road sign attributing the wrong name to Venables Creek at a crossing at Argalong. It was misnamed as Boggy Creek (Tapes TK 055-6:6-7; VB Field notes 5/8/93:6).

One of the common complaints about the spread of pine plantations was that named landmarks, once known to everyone in the district, had their names obliterated. Joan Kell articulated this in relation to a property called Black Andrew which had recently been purchased by the Forestry Commission:

> If someone spoke about Black Andrew, well the older people and the ones that pass it on, they'd know exactly where it is but now it's no more. And it'll probably be given just another name, a forestry number. Just a number now. (Tapes JK 053-4:14)

Once the names changed it was no longer possible to talk about the country in the way that they used to.

Hazel Herlihy explained that the Forestry Commission had named a new road at Argalong, 'Orang-utan Road'. Local men employed by the Commission had suggested this name as a joke. It was a name they called Bobby Glen, a mentally retarded man who had lived in the district and was so named because he walked bent over with his arms hanging down. Hazel thought the name was cruel and, along with others, lobbied the Commission to change the name of the road. They complied and it was renamed 'Bobby's Road' (Transcript HH 5/8/93:4). Jack Herlihy, however, still referred to it as Orang-utan Road (Tape 052 JH:9). This story reflects the relationship between old and new land managers at Argalong. The older forestry roads at Argalong have names that relate to the people who used to live there. This practice is less common in the newer plantations, a development which may reflect a distance that has emerged between local communities and the Commission. It was unlikely that anyone working on a particular pine plantation at the time of this study had personal ties with its site.

There may be a universal pattern in the social changes associated with any major new form of land use. In the Tumut region, pine plantations resembled a new kind of frontier. The country was renamed and its history restarted as though it had no past, just as the initial phase of European pastoralism involved a renaming of the country, an eradication of its Aboriginal names and the beginning of the 'history' of the region. Anthropologist, Deborah Bird Rose, describes a similar process in the transition from Aboriginal land to cattle ranches in the Northern Territory (Rose 1994).

Labour and memory

Another kind of story that was often recounted when people spoke about their memories of the country was one of physical labour or hardship. Like the journey stories, these also made reference to a physical experience of the country associated with former times. Physical work is one of the ways in which people change and are changed by their physical environment, and memories of labour can be very emotive. When Mark Garner spoke about his land at Tumorrama he referred to owning it and looking after it in the one breath: 'on the country that I looked after, I owned and looked after' (Tapes 037-8:1). He and Sheila Garner could rarely afford to employ people to work on the property so Mark did almost all the work himself, with some family assistance.

Figure 3. Jack Herlihy pointing out the old Argalong School ground.

Memories of labour were usually associated with particular forms of land use that my informants had been involved in and were often associated with memories of people they had worked with. Jack Herlihy spoke with pride of his work in clearing the country using 1920s model Fordson tractors for F.W. Hughes, a large pastoral company at Argalong. Vince Bulger, a local Koori, described the labour he put into clearing fallen timber on Red Hill Station while working there as a stockman in the 1940s and 1950s, and clearly enjoyed recalling stories about men he had worked with. Beryl Margules remembered helping her father to clear trees from a block of land now planted to pine. It upset Beryl that the marks of their labour had since been extinguished.

Some people also spoke about the physical labours of their ancestors in the country. Both Jack Herlihy and Mark Garner described with a sense of awe the labours of their pioneering ancestors in clearing the country. One of Jack Herlihy's complaints about the Forestry Commission and its impact on the landscape was the way that the marks of the labour of early European settlers in the country were extinguished: 'It's a sort of an automatic thing. There's no sentiment or any attachment to what the pioneers did in the early days. They've just completely wiped them altogether' (Tape 049:11). For similar reasons Tommy Kent was upset to find that one of the gold mine shafts at Argalong had been filled in. The old shaft was evidence of the labour of the miners who used to work it. His memories of life as a gold miner at Argalong in the 1930s and 1940s were very much memories of hardship and labour.

Resistance

There were many stories of resisting the authority of the Forestry Commission over land use at Argalong. Despite commonly expressed sentiments of powerlessness against authorities controlling land use, many of the people I spoke with had actively resisted authority or negotiated to achieve some concessions for their own land use interests. Jack Herlihy related a story about an elderly Argalong resident who pulled out pines that were planted under her telephone line:

> Mrs MacDonnell that you were reading about, she had a telephone line that came down through there, and the foreman on the Forestry he used to come down and plant little pines underneath, and she came down and she'd pull em out. They had a real war. Ma we used to call her, she was Ma to everybody, Ma kept pulling them out. This is where the phone line was up here. Old Bill'd come and put pine in here and she'd pull em out. (Tape 052:4)

The purchase of Red Hill Station by the Forestry Commission in 1986 formed a focus for local people's resentment towards pine plantations and their concern for the loss of a place they associated with the pastoral heritage of the region. Both heritage and environmental values were considered under threat. The local outcry, combined with lobbying by the Kiley's Run Preservation Society, achieved some concessions from the Commission. The catchment of one of the tributaries of Saw Mill Creek, which includes the historic homestead, will not be planted to pine. This area now forms a control catchment for a joint study between the Forestry Commission and the CSIRO examining the effects of the transition from pasture lands to pine plantations on catchment hydrology.

Arguments for reserves

Peter Read (1996:198-9), in his recent book, *Returning to nothing*, claims that:

> It is now time for environmental and heritage assessments to encompass these profound emotions ... The specialness of a place to an individual is not normally considered except where that individual is "of importance in Australia's natural or cultural history".

I support this appeal and also highlight some utilitarian values of such emotions, as the memories associated with places often contain very specific information about the history of particular places which may have uses for present and future land management.

There is now a recognition of the need to understand past Aboriginal land management practices, particularly in relation to fire regimes, and more attention is being paid to traditional Aboriginal knowledge of the environment (eg. Williams and Baines 1993). How much more knowledge could have been preserved if those who possessed it had been valued more? Each regime of land use entails a different perspective on the land and an awareness of different aspects of environmental change. With time, those involved in a new land use will acquire unique perspectives about the land and how it has been modified. I argue that we cannot afford to lose any knowledge about the country, even that which has developed over a single life span. The movement to more centralised land management which has occurred in the Tumut region highlights the need for tapping sources of local knowledge.

Mark Garner related stories passed on to him by older relatives which indicate that pastoralists assisted the process of incision by digging channels. This was a deliberate strategy to increase the area of valuable grazing land with rich alluvial soils. Mark outlined the process as it had been described to him–

> It was originally when my great great grandparents took all that land up, ... there was swamps, they weren't creeks, they were swamps and the water just flowed from for half a mile sort of thing in some places, flowed along through the grass. Well they dug the drains and because they couldn't graze them, cause there was too many stock getting bogged. And they dug these drains and to start the drain off they had a bullock team and they'd put the bullock team into the swamp and with dragging a log. And one set of bullocks had pulled the other set of bullocks or pull the team out of a bog and there was two teams and there was a chap there, I remember his name quite well, ah he died in the First World War, my father often used to talk about him. He was a bullock driver, the bullock team driver. And apparently he must have been something fantastic to get the bullocks through these bogs. And they'd hook long chains on and long pulleys and pull through an enormous amount of bog and eventually they got the water running and then they dug the channels with manpower.(Tapes 037-8 MG:2)

Jack Herlihy remembered a man called Joe Whiting who drained Little Sandy Creek at Argalong in the late 1920s or early 1930s by digging a channel with a shovel. According to Mark Garner, the creeks at Tumorrama remained much the same until recent years: 'And the channels were about three foot wide [1 m] and three foot deep. And they stayed like that for many many years until just recently.'(Tapes 037-8 MG:2-3) This agrees with the evidence from the Upper Murrumbidgee catchment indicating that channels have been stable for most of the twentieth century. However, Mark Garner then outlined a change in recent years which he attributed to the impact of pine plantations: 'But now since the Forestry got there those creeks are eroding and getting deeper and deeper' (Tapes 037-038 MG:2). These comments were complemented by other observations from Beryl Margules and Sheila Garner that the waterholes on Shaking Bog Creek and Adjungbilly Creek, where they used to swim and where Sheila taught her children to swim, have silted up (Figure 4).

Figure 4. Beryl Margules pointing to site of old waterhole on Shaking Bog Creek at Tumorrama where once she used to swim.

I could not locate any specific research about the impact on channels of a change from either pasture land or native forests to pine plantations, and so could not confirm or counter these claims. They do however, suggest that a closer study of the changes to creeks during this period may be warranted. Another aspect of the history of creeks was the intensive gold mining that took place in the 1850s and intermittently until the 1930s. Mark and Sheila Garner pointed out the site of the old 'Chinese Store' and had stories passed on to them about large numbers of Chinese miners camped along Shaking Bog Creek at Tumorrama.

Pines do not do well on soil that is very damp and problems also arise with soils high in nitrogen, which is often the case on pasture land improved with superphosphate and sub. clover. Vince Bulger had a good knowledge of which paddocks on the old Red Hill Station had been supered as he had played a role in this, spreading it while flying over the property in a Tiger Moth.

New frontier

The plantation maps used by foresters working on the pine plantations give the dates the most recent plantations were established and the names of current landholders. It is difficult to locate information about the first plantations and it seems that a knowledge of the country's history is not generally regarded as relevant to contemporary plantation management.

Many significant events in environmental history have never been recorded in any conventional sense. While it is clear that climate, vegetation, soils and watercourses have all changed over time it is often difficult to determine the extent of change, when the changes occurred, whether they took place slowly or suddenly, and what the consequences were. In the Tumut region the oldest systematic environmental record available is for rainfall but even this only dates back one hundred years. As environments are always changing, our sense of whether the current situation is 'normal' or 'abnormal' is purely dependent on an established record and is therefore an artefact of our historical perspective.

Some evidence for environmental change in the recent past may be found in local histories that document the rise and fall of regional industries related to different forms of land use. Environmental histories, such as Hancock's *Discovering Monaro* (1970) and Rolls' *A million wild acres* (1981), and more recently Seddon's *Searching for the Snowy* (1994), have drawn together evidence from historical and scientific sources to generate narratives accounting for environmental change since European occupation.

It is difficult to say whether pines or pastures are the more environmentally sustainable form of land use in the Tumut region. A local soil conservationist expressed the view that either form of land use was disastrous if poorly managed and that a well managed pine plantation was less damaging to topsoils than an overgrazed pasture (Jerry Ryan pers. comm.). There have been considerable improvements in plantation management since the 1970s. Contemporary management practices preserve patches of native vegetation along water courses and wetter areas and a rigorous Code of Logging Practice is now employed which aims to minimise land degradation and ensure safe working conditions (Forestry Commission of NSW 1984:19).

I argue the case for preserving places of significance to communities displaced by pine plantations. This would be one step towards acknowledging the prior history of the region; it could promote a better relationship between the Forestry Commission and the displaced community; assist in preserving memories of the history of land use; and assist in identifying aspects of the environment which have changed. If places such as old school grounds and mining sites were reserved and marked on plantation maps they might generate interest in the region's history among the new land managers. Since the first miners and pastoralists displaced Aboriginal land managers, this country has been progressively altered by gold miners, pastoralists and now pine plantations. Each time a new land use industry is imposed on the country, the knowledge base of previous occupants is devalued, and the country once again managed without a knowledge of its past. Perhaps this cycle can be changed.

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Using the forests

Saw-millers seem scarcely to have had fair play in Australia. By the tree enthusiast they have been looked on with disfavour as *destroying* the forest; while they were really improving it in the majority of cases, and it was only the want of a little "forest science" that has prevented them improving the forest greatly. Saw-milling is the only practical means of working and improving the indigenous forest.

D.E. Hutchins,
A Discussion of Australian Forestry,
1916.

15

Aboriginal use and rainforest clearing on the Atherton Tablelands before 1920

Terry G. Birtles

Introduction

Removal of rainforest from the Atherton Tablelands of north east Queensland as a 'pioneer' approach to 'taming' the environment this century constitutes only a tiny element of a global phenomenon which in the instance of European culture dates from clearance of the great woodlands of Europe for exposure of cultivable soils (Darby 1956). Sometimes associated with Eurocentric concepts of expansion into a 'new world' (Billington 1957; Perry 1963; Pike 1978), technical skills of axemanship and gun prowess retained in modern folklore served as tools of territorial conquest and landscape modification, not to mention cultural suppression associated with individual rights of possession by conquest. Equally significant were imperial attitudes of mind promoted through official documents and legal structures of authority. They blended with the accumulated cultural knowledge carried verbally and assembled from new experiences of first contact with strange places and the indigenous or 'native' people.

Concepts

Three concepts are important to this case study of the Atherton Tablelands, because they possess particular features of cultural bias which influenced European interpretations of north Queensland rainforest, with usage persisting until well into the twentieth century. In fact, the biogeographical classification, *tropical rainforest*, dating from Schimper's *Tropische Regenwald* (1898), has been adopted locally only as a post-1960s phenomenon of world heritage recognition.

The three concepts of *brush*, *scrub* and *jungle* used through much of the nineteenth century have been explored elsewhere (Birtles 1997). These appear to have been applied first to north Queensland by John Macgillivray FRGS who cruised the adjacent coast as part of a scientific survey from HMS *Rattlesnake* between 1847 and 1849. Landing at Rockingham Bay (Figure 1), a location established as a relatively safe place for armed seamen to replenish fresh water and collect firewood during hydrographic surveys, Macgillivray labelled the nearby rainforest as 'Indo-Australian flora', with taxonomic description as a wooded vegetation which 'in New South Wales would be called a *brush* or *scrub*, and in India a jungle' (Macgillivray 1852:88). At the time, New South Wales had not been reduced into separate colonies.

Brush appears to be the oldest term, used for the Illawarra lowlands south of Sydney in Surveyor General John Oxley's report of 1826 to describe the dense vegetation of vines, fig trees (*Ficus* spp.) and cabbage-tree palms (*Livistona australis*) which contained red cedar (*Toona australis*) logged from the 'Seven-mile Brush' near Kiama as one of the sources of the colony's first exportable timber resource (Jervis 1939:137; Jeans 1972:31). Otherwise, *brush* rated only as a nuisance to be cleared and burned before farming the land. For aesthetic reasons, the cabbage-tree palm and the Illawarra flame tree (*Brachychiton acerifolius*) were left to stand in meadows of introduced paspalum grass as stark relics of a lost landscape.

As cedar loggers and pit sawyers moved northwards from the Hawkesbury and Hunter valleys, the word *scrub* sometimes replaced *brush* as the preferred term (although *brush-hook* has remained in Queensland vocabulary to describe a curved slashing blade used to clear tracks through the undergrowth). *Scrub*, like New Zealand usage of *bush*, implied a dense barrier to the advance of European settlement and to some degree was interchangeable with *brush*, but application of *scrub* in Australia has never been reserved exclusively for rainforest. Rather, *vine scrub* has become the particular Queensland descriptor for tropical and subtropical rainforest, popularised in 1865 by Walter Hill, the government botanist, to emphasise the tangle of lawyer-vine (*Calamus* spp.) or 'bush-ropes' as an obstacle to human passage. Hill also promoted the prevailing belief that gigantic tree buttresses and the density of foliage indicated unusually high soil fertility. After inspecting the Tully River valley from Rockingham Bay during 1862 and 1865, Hill observed 'the peculiar density of scrub on each bank' and reported 'I have never witnessed in any of the colonies so dense or so luxuriant a growth of scrub trees and plants ... This fact alone testifies to the inherent richness of the soil' (Hill 1865:7).

The nature of *vine scrub* as a barrier was to prove a major reason for the tragedy of Edmund Kennedy's ill-fated expedition of 1848 (Birtles 1997; Beale 1870) farewelled from Rockingham Bay by Macgillivray, but this formidable impediment to European settlement received new meaning in 1873 when George Dalrymple led a government survey of the rainforest coast from Cardwell to the Endeavour River and described the vegetation as 'vine and lawyer' *jungle* (Dalrymple 1874:9).

The concept of *jungle* dates from British commercial links with India and by Dalrymple's day had acquired international application to refer to the invasion of cultivated land by tangled growth of inferior value (Birtles 1997; Boomgard 1988; Lian 1988). *Jungle* harboured all sorts of unseen dangers including marauders which emerged to stalk unwary prey. From the dark *jungle*, insidious mists spread out as the mysterious source of *jungle-fever* and tropical 'ague'(usually malaria). It was not until well into the twentieth century that mosquitoes were identified as virus carriers of malaria, dengue fever and encephalitis. Late nineteenth century interpretation of tropical coastal Queensland simply accepted Dalrymple's report of 'miasmic' influences as well as malevolent indigenous tribes skulking within a jungle which should be removed to expose the soil to coffee and sugar plantations under indentured Indian labour (Dalrymple 1874:17). Dalrymple claimed the heat and humidity as too extreme for 'white' civilisation.

European invasion

Dalrymple's report on the rainforest overlooked any notion of rights to be held by rainforest people. Dismissing them as ferocious but primitive and cannibalistic, Dalrymple gave no indication of any informed contact with them. Accompanied by a detachment of 'native police', it is not surprising that his party found camps to be deserted. From these he commandeered artefacts, including a mummified corpse, for a new museum in Brisbane, leaving 'some blankets and a tomahawk' as exchange (Dalrymple 1874:28).

Dalrymple's arrival at the Endeavour River, one day before the steamship bringing the first rush of gold prospectors, heralded the foundation of Cooktown on 25 October 1873. This boisterous camp grew to 4,000 people within six months. The stampede to the Palmer River diggings and then in 1876 to the Hodgkinson goldfield on the Mitchell headwaters, initiated many massacres of a 'copper-coloured race of natives who are fierce and warlike, very treacherous and have no more fear of a bullet than a spear' (*Queenslander*, 26 Nov 1873). Generally the miners and Chinese porters skirted and avoided the rainforest, with its margin of large stinging trees and nettles. However, Walter Hill, accompanying Dalrymple, had recognised extensive stands of cedar and kauri which subsequently attracted Cardwell loggers to the Mossman and Daintree valleys. By 1879, prime stands had also been removed illegally from Crown land near the Tully, Johnstone and Russell Rivers.

Large-scale 'scrub-felling' remained restrained, despite promotion of appropriate legislation for free selection (Qld, Dept. of Lands 1880; *Qld. Govt Gazette*, 19 August, 23 Sept 1882; Birtles 1982) and a cursory analysis of rainforest soils which proclaimed their suitability for intensive cultivation (Staiger 1882). Efforts to promote Cairns by opening a route along 'niggers' tracks through the rainforest were discouraged by the steep scarps and by skirmishes with the Aborigines (Birtles 1997; Collinson 1939:31-41; Pike 1978:331-8), until an 1880 discovery of a major stanniferous lode in the Wild River valley prompted Australia's first tin rush to the mining camp of Herberton.

Unlike gold, tin could not be converted immediately into cash or goods. Mining of ore-bearing lodes also required substantial capital investment on equipment and transport. The foundation of Herberton generated hope of a railway connection to the coast. At the same time, the adjacent rainforest of the Atherton Tablelands became threatened in its role as the last natural sanctuary for indigenous people. During 1881 and 1882, at least twelve pairs of pit sawyers operated within the northwest margins of this 'scrub' cutting no other timber than cedar (Fox 1923:334). Other logging camps were set up at Cedar Creek, a Wild River tributary south of Herberton.

Atherton Tablelands

The term *tablelands* has been applied by local usage since first European contact with the high country west of Port Douglas and Cairns, but with interchangeable usage which at times has taken in the headwaters of the Barron, Mitchell, Walsh and Tully Rivers, as part of a series of stepped surfaces characteristic of the faulted and uplifted landforms of this part of Queensland (Figure 1). This study is restricted to two plateaus with geographical limits taken to coincide with the steeper slopes of several marginal scarps, because these as well as the rainforest density proved to be obstacles to be scaled by European transport and they created the impression of a tabular form.

With the exception of watershed delineation of a northwestern boundary which proved to be the point of easiest European access, a scarp from 100 to 300 metres surrounds the two plateaus, with higher boundary relief as the Lamb Range and Bartle Frere (Queensland's highest peak, 1622 metres above sea level). The Evelyn Plateau (mean height of 975 metres above sea level and an area of 435 km^2) is higher and smaller than the Atherton Plateau (760 metres above sea level and an area of 710 km^2). An escarpment generally exceeding 200 metres divides the two plateaus as a prominent obstacle to east-west traffic.

Pollen analysis from volcanic craters lakes on the Atherton Plateau dates the rainforest as no more than 12,000 years old and linked to the most recent glacial period (Kershaw 1978, 1980) but many genera and species may have been lost through climatic change (Webb and Tracey 1981, Webb 1981). The western periphery of rainforest once coincided with the 1300 mm isohyet of mean annual rainfall as the margin of a dramatically drier rainshadow zone to the lee of coastal climatic influence. East of this apparently critical limit, mean annual rainfall remains in excess of the mean potential evapotranspiration moisture loss (Douglas 1966).

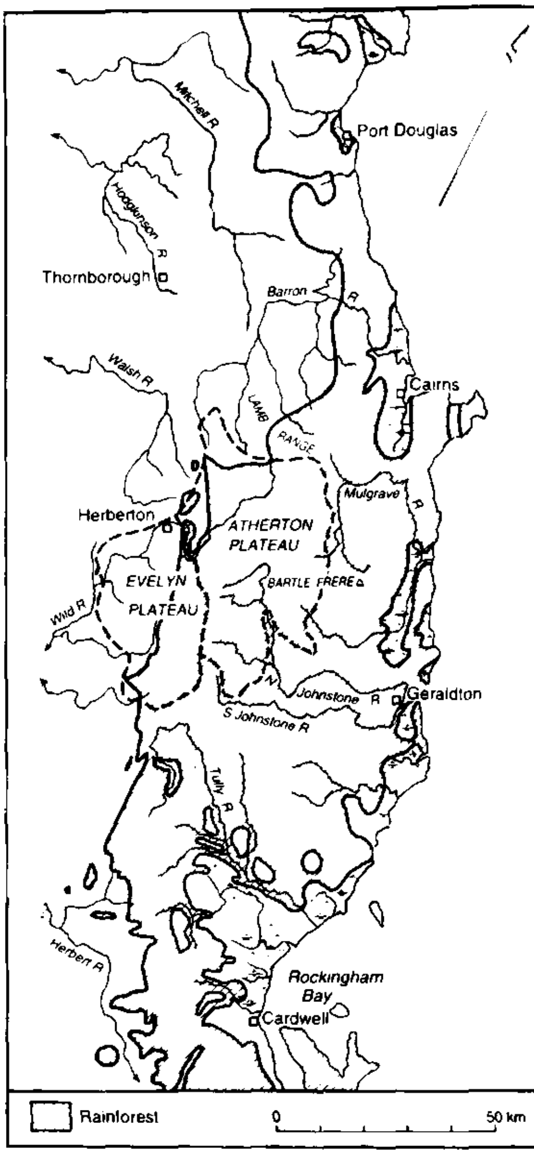

Figure 1. Pre-European distribution of tropical rainforest in the vicinity of the Atherton and Evelyn plateaus

Before rainforest removal, grassed enclaves of *Eucalyptus* known as 'forest pockets' held importance to the first European arrivals because these offered good camping grounds for tents and for grazing horses. Elsewhere, the density of 'scrub country' provided no pasture until it was cleared, burned and seeded. Other topographic variations were several rocky ridges and some substantial swamplands on both plateaus (Birtles 1982:82; Adam 1992:46-51,86-91).

Prior to European disturbance, the red-brown krasnozem soils of basaltic origin supported the largest species and densest cover, including emergent giant cedar, kauri and various forms of 'strangling' figs (*Ficus* spp.) reaching girth proportions rated bigger than on the coastal lowlands. The most gigantic were estimated as higher than '200 feet' with a width of up to 'four spars (four fathoms) of my arms around' (Mulligan 1877:395). Rainforest species also developed on a variety of less permeable red earths. Overall, the species distribution does not appear to have followed any uniform geographic pattern other than microtopography, with cedar and kauri stands more common near the main watercourses. Oral history suggests that the more observant European selectors rated this environment as extremely rich in biodiversity, although much of it was strange and considered economically useless, with the exception of such jungle fowl as scrub-turkeys (*Alectura lathami*), jungle hens (*Megapodius* spp.) and cassowaries (*Casuarius casuarius*) shot or captured as game.

The low light intensity of rainforest generated considerable negative European reaction. The gloom suggested a foreboding environment, especially after nightfall when total blackness reduced human vision to zero and when nocturnal creatures became noisily active, sometimes with weird calls and even screams. However, no species of Australian rainforest wildlife is a human predator despite nineteenth century European imagination of giant forms of wild cats, panthers, deadly spiders, man-eating snakes and plants.

An important European observation of the Atherton Tablelands which quickly found its way into local publicity has been identification of a healthy climate. The modifying effect of altitude provides respite from coastal heat, especially at night. The eastern escarpment, better known simply as 'the range', also functions as a buffer to the more violent coastal thunderstorms and high intensity cyclonic deluges. However, the persistence of drizzle became depressing to some, with a belief that the 'scrub' itself possessed an ability to attract a perpetual cover of cloud, mist and rain. Herberton, although higher, was rated 'more salubrious' (Mining Warden, Herberton 1888) arguably because of protection from the rainforest climate by granitic hills to the east and with poorer soils which such lush vegetation could not cross. Days were sunnier in Herberton with pleasant temperatures recorded. An assumption held that clearance of Atherton Tablelands 'scrub' would extend the climatic zone so favoured by Europeans. Summing up a distinction between tablelands and coastal rainforest, the first geologist's report on the tin mines in 1881 noted that 'the summit is clothed with forest or scrub, with a somewhat different vegetation from the (Mulgrave) valley below, and a considerable proportion of large cedar trees' (Tenison-Woods 1881:10).

Rainforest people

Interpretation of Aboriginal understanding of the Atherton Tablelands environment is based on non-Aboriginal records. No written or oral indigenous history is known. Nor is there any information of significance left from itinerant cedar getters, with the exception of an early photograph of a timber-getting scene reprinted in 1963 (in Bolton 1963:facing 18). This identifies the diminutive stature which several Europeans have regarded as a most distinctive characteristic of Atherton rainforest dwellers.

Similar written record in 1882 observed a contrast between the Warunga people of the Herbert valley grasslands and the slender build, receding chin and lack of facial or body hair amongst Giramay and Gulnay people who frequented the rainforest near the Tully River (Lumholtz 1889). Five years later, Archibald Meston expressed surprise over the short, wiry stature and unusually small hands and feet of the Yidinji people of the Bellenden Ker 'scrub' (Meston 1889a, 1889b). Christie Palmerston's close knowledge of the rainforest led him to remark that 'I have seen more bald-headed aborigines in these jungles than I have ever seen out of it' (Palmerston 1887:291). An anthropometric survey during the late 1930s classified rainforest dwellers as *negrito* but this term is no longer supported (Birdsell 1940; see also: Tindale and Birdsell 1940,1941; Tindale and Lindsay 1963; Macintosh and Larnach 1976). It is possible that the small, lithe stature might have been determined by constant tree-climbing and canopy foraging. Heavier body structures would not have been appropriate.

European observation has long commented upon the tree-climbing agility of the rainforest people plus 'their knowledge of how and when to gather products in the canopy of the forest, as well as detailed knowledge of how to eliminate the several poisonous alkaloids, saponins and other deleterious principles inherently or seasonally present in some of the foods' (Tindale 1976:14). Whereas tree-climbing skills were not unique to north Queensland, several sources support the conclusion that specialised environmental understanding of the rainforest gave its residents 'positive advantages over any invading or potentially usurping people from the grasslands of the west who might try to make entry into their domain' (Tindale 1976:14). Such knowledge, however, would become totally inadequate in the face of European culture committed to removal of the entire habitat.

Evidence of an extreme acuity of sight, smell and hearing amongst north Queensland rainforest dwellers has identified their ability to spot a python in a tree crown at 60 metres, a bee in flight at 25 metres or the detection of a distant tree kangaroo if it simply slapped a fly (Lumholtz 1888; Birtles 1976). By sniffing handfuls of soil, animals could be tracked. Minute scraps of material dropped by nesting bees were searched for carefully by gently blowing away leaves from near tree roots. Even the disturbance of tiny particles of moss from a rock provided a clue to the time and passage of different ground birds or animals. Possums were detected by their scent. As a complete antithesis of European rejection of rainforest as an unsafe place, these rainforest people held a superstition about a legendary monster related to the fearsome massed chorus of cicadas *outside* the rainforest (Lumholz 1889:202). These naked people also disliked heavy rain, preferring to remain warm and dry in their dwellings during downpours.

The first European contact with the northwestern perimeter of Atherton Tablelands rainforest, James Mulligan in 1877, reported upon the surprisingly high frequency of camps and well-established trails of people now identified as Ngadyan (Mulligan 1877; Birtles 1988:200).

The Atherton Tablelands rainforest habitat apparently supported a relatively high human population density but within three years prospectors following the same track to Herberton exterminated many of the Ngadyan people in an incident commemorated only by the naming of Bones Knob north of Atherton. Map reconstruction of some Ngadyan place localities and trails which existed in 1880 for the northwestern margins is based on the first charts by surveyors and contemporary reports. *Cur Cur* is now the site of the town of Atherton, to the south of Bones Knob. *Oonda* meant 'little swamp'. The crater lake shown as *Boonoobagolomee* has become known only as *Barrine*. Some Ngadyan trails tended to link the open forest pockets as preferred campsites, with one adopted for Robson's pack route to Cairns.

A pioneer European settler, J.W.Collinson, observed that the rainforest dwellers 'were inclined to avoid the open country', the preserve of more aggressive grassland hunting people, and at times of threat retreated into the 'scrub' as a refuge bounded by a most inhospitable barrier (Collinson 1939:60). Mulligan noted that the barrier of 'this scrub is full of prickly briers and vines of all description, stinging plant from which I suffer' (Mulligan 1877:395). The hooked briars are now identified as *Zizyphus* and fish-tail lawyer vine (*Calamus caryotoides*) or 'wait-awhile'—an apt description of its delaying ability if clothes or skin were not to be seriously ripped. The barrier of rainforest periphery proved to be particularly discouraging to horses and for this reason was avoided by Native Mounted Police who during 1880 established a camp south of Herberton at 'Nigger Creek', previously known to Aborigines as *Ae'araar* (Collinson 1939:64). Following the accepted practice of 'dispersion', these troopers became vigorous in demolition of Aboriginal communities west of the Wild River after the murder of three prospectors and incidents of cattle spearing. Near Cairns and in open areas of the Mulgrave valley, European settlers adopted a similar program of extermination by taking the law into their own hands as reprisal for thefts, but few ventured into 'scrub' perceived as the haven of 'lurking savages'. European imagery of giant, predatory 'myalls' resident in the 'scrub' dates from the disastrous Kennedy expedition (Birtles 1997).

Within the rainforest, different 'tribal' territories of the Atherton Tableland suggested in a police map issued in 1897 (Parry-Okeden 1893:3) show close correlation with a more recent map by Norman Tindale (Tindale 1974). Subsequent modification of the boundaries is based on linguistic differences as well as topographic features (Dixon 1966). Mulligan believed that seasonal migration explained empty camps of rainforest dwellers (Mulligan 1877:395) but it is likely that he was seen well in advance. His visit coincided with the wet season when most rainforest fruits would have attracted the indigenous people to the Atherton Tableland. The Ngadyan people would be less likely to frequent the coast at such a time when leeches, mosquitoes and scrub-itch mites could make lowland sojourns unpleasant despite the customary liberal body smearing with charcoal and possum or eel fat. The maps of territorial boundaries suggest only localised movement within the rainforest and it is probable that the Atherton Tablelands nut-eaters did not possess the sea-fishing and boat-building skills of their coastal neighbours—a conclusion supported by Palmerston's recognition of the need to change his Aboriginal guides when entering a different territory and Meston's contact with Yidindji of the Bellenden Ker range who had never visited the sea (Palmerston 1887:765-6; Meston 1889b:27).

Many Aboriginal paths linked semi-permanent camps, usually located in 'forest pockets' or at the rainforest margin and always close to permanent watercourses. However, other paths may have been trading routes (eg roads later adopted by Europeans as Clarke's road and the Elinjaa road to Towalla) or passed by sacred places such as the crater lakes, Mt. Quincan and Bromfield's Swamp, each of which held food resources. No record of the spiritual or totemic association is known and the only Aboriginal story from the Atherton Tablelands recorded by Europeans relates to a crater vent named Hypipamee, once known as *Maii-Iby-bummy*, where two broken-hearted gins, Koobri-yam and Iba-gnibummy, left their baby boys in a tree before leaping into the vent (Meston 1889b). Possibly such suicides occurred during the early 1880s as a despairing response to European arrival.

Aboriginal use of the rainforest

Some detail of pre-European use of the rainforest is available from the notes taken by Palmerston, Robert Johnstone and by a Norwegian zoologist, Carl Lumholtz, who chose to live with the people of the Tully valley near Cardwell for twelve months in 1882 and 1883 (Palmerston 1885-6; Johnstone 1903-4; Lumholtz 1889; Birtles 1967). In addition, extensive ethnological notes by Roth (1897,1898,1899,1901-6) and Mjoberg (1925) provide considerable insight into Atherton Tablelands indigenous culture. These sources are summarised below.

Figure 2. A mia mia under construction on a lawyer vine frame, Prior's Pocket, Atherton Tableland. Issued widely as a postcard entitled 'Atherton Blacks Shifting Camp' and published by Mjoberg in 1918. This photograph probably dates back to at least as early as 1898 and was taken on the site proposed for the Atherton school.

The rainforest environment supplied virtually all the resources for Aboriginal survival. *Mia mias* gave all-weather protection as thatched dwellings of broad leaves such as a palm or the wild banana (*Musa banksii*) woven on to a thatched framework of *Calamus* vine (Figure 2). Beyond the rainforest, grass provided an alternative but less secure thatch. *Mia mia* design served a different function to the hasty construction of a temporary *gunyah* of Aborigines further inland. Small cooking fires at the entrance to each *mia mia* were maintained during the night to provide smoke as protection from mosquitoes and were often covered from rain by a small leaf covered annex as part of the *mia mia* structure. *Mia mias* were not dismantled if people left the camp for any period but were left for future visits, unless burned because of the volume of insect infestation. Usually a drain around each *mia mia* diverted surface water flow. Fires were lit in the usual Aboriginal manner by firesticks, which on the Atherton Tablelands consisted of a flat, elongated piece of hardwood and a thin 'twirling rod' of *Calamus* cane. Blankets of possum skin or a cloth of beaten bark provided personal warmth. Apart from an occasional belt-rope for men to hold an implement or a necklace of twisted reed or berries for some women, no other garments were worn.

No photographic or written record notes any domestic animals (unlike grassland Aborigines to the west) until after European contact when camps became renowned for harbouring cats and scavenger dogs. Although the rainforest dwellers were hunters and food-gatherers, their foraging practices differed from those of the more open woodlands and plains where dog support may have been more necessary. There was no need for boomerangs. Spears may have been limited to fishing or small game as well as for dispute resolution.

The most common rainforest implement was a flat stone axe, with literally hundreds of basaltic axe-heads found once Europeans cleared the rainforest and began to cultivate the soil. These axe-heads were pecked and edge-ground, ranging in size from 8x10 centimetres to 15x18 centimetres and bound on to a hardened *Calamus* cane haft. Beeswax and various wood resins were used as glue to seal the binding. The axes were not appropriate to felling trees larger than saplings but were applied to the removal of bark, for digging drains or pit traps, for opening old logs for larvae, for chopping out plant roots such as *Alocasia macrorrhiza* and the base of swamp ferns, for cutting *Calamus* vine and for breaking apart insect nests, ground bird mounds and the hives of wild bees. Early European settlers recall that a feature of an Aboriginal rainforest camp was the almost continual sound of chopping as the axes were put to a variety of uses (Roth 1898).

Honey, a highly valued delicacy, was often mixed with water to reduce its pungency of taste. If not consumed immediately, honey was carried in a bark trough from which it was removed by chewed grass-stalk tufts dipped into the troughs. Another practice, also recorded in southern Queensland (Petrie 1904:79-80), was to soak the honey in chewed bark fibre carried in dilly bags. This fibre also provided the means of collecting honey directly from honeysuckle and other blossoms.

The main diet of Atherton Tablelands Aborigines consisted of 'cozzan' berries (Roth 1901a:11-13) and the young shoots of various species of *Calamus*, the nuts from such trees as *Cycas media* (known to the Aborigines as 'kunkee'), black bean (*Castanospermum australe*), walnut bean (*Endiandra palmerstoni* syn *Cryptocarya palmerstoni*), *Podocarpus pedunculata* fruit ('chupolla'), rootstocks of wild yam or 'chokora' (*Dioscorea* spp.) and 'kumbi' (*Colocasia macrorrhiza)*, freshwater reed tubers (*Typhu* spp.), kauri seeds, the young tops of palms, tree ferns and swamp ferns, and fruits from *Pothos, Piper, Capparis, Antidesma* and various fig trees (especially 'karpi' from *Ficus pleurocarpa* which also provided the bark pounded into blankets) (Roth 1901b). Some seeds, nuts, rootstocks and young stems contained actively poisonous alkaloids which the women removed by roasting or steaming, after which they were cut into chips with a snail shell or stone flake knife and then subjected to pounding, sifting, washing and a lengthy period of leaching and fermentation. A less toxic nut, not identified botanically and known only as 'coohoy', once found ankle-deep on the Atherton Tablelands in 'countless numbers' (possibly *Endiandra*), was simply roasted on coals, or crushed into a coffee-coloured meal. Palmerston in 1885 wrote:

> The aborigines usually chew kernals till they have sufficient dough to be cooked, flatten it out between two grass leaves and place it upon the embers until it bloats like self-raised flour. It must be nutritious, for these aborigines that live principally upon it are fat, agile fellows. (Palmerston 1885-6:265).

To reach the less accessible beehives, nuts and fruit of the rainforest canopy, knotted lengths of vine such as *Flagellaria indica* or *Calamus australis* were looped around the tree trunk which was then scaled to the first branch by a rapid series of upward springs. Sometimes the rope was held between the toes if the climber wished to pause and release both hands for investigating a tree hollow or nest or for chopping steps as foot-rests in a tree to be visited regularly. *Calamus* vine, as well as coiled grass, plaited human hair and bark fibre twine or 'kewan' (from *Castanospermum Gillivroei or Sterculia quadrifida)*, provided the materials for making fish and animal traps, nets and the baskets in which implements were kept, food supplies stored and young children carried (Roth 1901b). The design and decoration of sieve baskets woven in north Queensland rainforest appears to have been totally unlike the craftware of other Aborigines (Wolston and Colliver 1975). Bark water carriers, carved from the inner bark of *Calophyllum tomentosum* peeled off at the end of the wet season, were rendered waterproof by a lining of beeswax. Drinking water was often sweetened with various blossoms. Unidentified leaves held constantly in the lips may have served as a narcotic.

Surface traps, pit traps or netting snared a variety of meat sources, including ground birds, wild duck, bandicoots, tree kangaroos, wallabies and pademelons, marsupial cats, possums and various reptiles. Echidnas and goannas were trap-resistant and had to be caught by direct hunting. Flying foxes, parrots and small birds were trapped by smearing the roosting branches with sticky gum from fig trees. Captured game was killed immediately and the carcase thrown on a fire to singe off hair or feathers before gutting and then placement on coals for roasting. Usually individual portions of flesh were removed and eaten as soon as they were cooked. Birds eggs, frogs, leeches, the larvae of moths, beetles, wasps and other insects were consumed uncooked, but adult moths were roasted. Traps of rocks, sticks, cane-mesh or nets, as well as small dams, were constructed on the upper Barron and Wild rivers and their tributaries, particularly upstream from waterfalls, to catch fish, eels, tortoises and platypus. The bark of the mangosteen (*Garcinia cherryi*) applied as fish poison ('jo-coor') in any relatively calm pool yielded a return within a few hours. Other fish poisons from a range of rainforest tree species used by Yidindji people of the adjacent Mulgrave valley have been identified, together with record of considerable knowledge of medicinal and herbal properties probably shared with Ngadyan and other Atherton Tablelands dwellers (Covacevitch, Irvine and David 1988).

A particularly uncommon artefact, the 'mena' or 'oyurka', has been traced only to Atherton Tablelands culture (Kennedy 1961). Chipped from basalt as a T shape, the top bar of this tool was used with sand abrasive for polishing wooden implements, notably the flat-bladed, wooden clubs and large decorated shields carved from the barrel of fig trees or corkwood (*Erythine* spp.). For shield construction, wood to a thickness of 30 or 40 cm was removed by using the axes as wedges. By a process of repeated soaking and drying, the shield was then hardened before shaping and trimming with various stone scrapers. A live coal was applied for the manufacture of the handle, with the burnt wood chipped out with a sharp stick. After polishing with the 'mena' and application of beeswax coating, decoration with ochre, blood and white clay completed the product Figure 4). Similar shields have been reported from the rainforests of south Queensland, but with design and decorative variation. The function of the shield appears to have been restricted to personal protection from spears during the resolution of intertribal disputes. They gave no resistance to European bullets.

Figure 3. A group of Ngadyan people at a rainforest camp close to Prior's Pocket near Atherton. The photographer may have accompanied W.E.Roth in 1898 but this photograph was widely copied as a postcard entitled 'Niggers in the Scrub'

In common with other Australian Aboriginal initiation rituals, young men were marked with parallel chest and shoulder cicatrices formed by rubbing ash into incisions of the initiate's skin. Funeral rites led to smoking and partial mummification of the corpse. European eyewitnesses recall participants jostling to secure the precious fats released from the corpse, to be rubbed into the skin of celebrants as a source of spiritual strength. The heart, liver and lungs were ingested for identical reasons according to Palmerston's graphic eye-witness record (1885-6:433,467,491).

Following a period of mourning, the shrivelled remnant was cremated but with an occasional skull kept in the camp or carried in a dilly-bag.

Such rituals proved highly distasteful to European concepts of civilisation. An extremely unpleasant body odour, their unashamed nakedness and even the harbouring of head lice, not to mention defensive actions to survive, rendered the very existence of such people objectionable. The smell of their presence could upset cattle and would excite dogs. A widespread European reaction of the nineteenth century rejected all 'blacks' as a 'despised race' of 'vermin', with no rights to existence.

European assessment of the 'Atherton scrub'

Until 1880, a characteristic of European pioneer settlement in north Queensland was the absence of unwelcome interference by government officials other than imposition of mining licence laws, the enforcement of discriminatory legislation against incoming Chinese and a benevolent interpretation of law and order. The limited areas of agricultural land north of Bowen were selected and cleared as sugar cane estates, but goldfields markets had generated some demand for the small-scale cropping of maize (known as *corn* throughout Queensland) under a monopoly of Chinese tenant farmers working for absentee land speculators. Such Chinese market gardens, permissible under the Homestead Act of 1872, included eight hectares tended near Scrubby Creek on the Atherton Tablelands during 1882 as well as several allotments along the Wild River. These supplemented an inadequate pack supply of corn and vegetables from Cairns (Birtles 1982:39-41).

In Brisbane, a government aware of the rapid expansion of tin and silver mining west of Herberton, responded to the urgency of establishing northern settlement on a more secure economic basis and released Crown land near the coast as an expansion of the Settled District of the colony. Following a hasty survey, nearly 50,000 hectares of 'basaltic tableland' were also opened up for agricultural selection during 1882. The scheme invited selection before survey, which produced a haphazard cadastral layout, but with high prices set on 'scrub land' as an unsuccessful policy to discourage speculators. The quality of cedar stands guaranteed a good sale, with much interest expressed by prospectors who never occupied their selection but reaped profits from negotiations with the cedar cutters and from lease of the land to Chinese tenants. Government resumption of the Evelyn and Eve Linn West pastoral lands south of Herberton permitted Crown sale of most of the Evelyn Plateau rainforest between 1883 and 1884 as agricultural selections (Birtles 1982:41,82).

The effect was to stimulate a cedar logging industry which lacked access to a port. As the only market, pit sawn cedar boards were carted to western and northern mining camps where it was purchased at minimum price for house frames and weatherboards, for cedar shingles chipped for roofing, for shoring mine shafts and as pit props. Cedar boards were cheaper than any other building material because of high freight costs from the coast. Bullock teams took five weeks to complete the trip from Port Douglas to Herberton, with charges of between 25 and 50 pounds per ton. Virtually all building structures, including latrines, of Herberton, Thornborough, Irvinebank and Montalbion were built of cedar valued overseas as a prime cabinet wood. Pit sawyers at such locations as Martin's Camp, Mazlin's Camp, Prior's Pocket, Garland's Camp, the Millstream and Cedar Creek (now Ravenshoe) charged five shillings per hundred superficial feet for boards, but in a community short of ready cash, common agreement established that at least part of this charge could be paid in spirits, clothing and provisions. Kanaka axemen introduced from the coast were paid up to two pounds and ten shillings per month plus rations (Fox 1923:334).

Figure 4. Cedar logging operations on the Atherton Plateau, c.1882, showing Kanaka labourers and Aboriginal observers. Note use of sawn log sections as waggon wheels. *Photo*: Daintree Collection, Oxley Memorial Library.

The primary challenge was to find transport to a booming mineral and cedar export market. Tin could be smelted into ingots but movement to Port Douglas destroyed much of the profit and a third of the 1880s output relied on cheaper pack teams to Cairns. 'Strings' of up to one hundred mules could bring a combined load of ten tons to the wharf and became a frequent sight on Robson's track but mules could not carry planks easily (McGeehan 1950). Also, the London cedar market preferred logs which could be milled in England to controlled standards not possible by pit saw. This preference attracted the attention of Sydney timber exporters to the high grade cedar stands of the Atherton Tablelands. Contracts were drawn and wholesale cedar-felling commenced near the upper banks of the Barron River. Years later, Archibald Meston reflected on the resultant disaster:

> The most appalling waste of cedar was that on the Atherton country... When the town of Herberton first started, nearly all the timber came from the Atherton scrub. Red Cedar was most abundant, and the most easily obtained and cut, even the stables, closets, and fowlhouses being of what is now our rarest and most priceless timber. It was mostly cut by pit sawyers at Scrubby Creek, and charged at a pound per hundred feet at the pit, regardless of the cost of haulage to Herberton. In 1882, a young lawyer at Port Douglas, now of Bond Street, Sydney, drew an agreement whereby two timber-getters, Tom Thomas and Phil Garland were to cut three millions of feet of cedar [7080 m^3] for Captain Foulis and Blair of Melbourne. That was the first Atherton cedar to be cut for sending to the coast... Burns, Philp and

> Co. came into the cedar-cutting business and amongst them, about 15 to 20 million of feet [35,000-47,000 m^3]of red cedar were cut before all concerned knew how they were going to get a log of it to the coast. There was only one possible outlet, and that was down the Barron River in flood, an insane idea, considering the terrible rocky channels, the 500 feet [150 m] plunge on to solid rocks at Barron Falls, a further plunge of another 150 feet [45 m] on to more rocks and then that awful journey down the Barron Gorge to the open river. About a dozen logs came down in a state fit only for a pulp mill. All the rest of that magnificent cedar rotted in the Atherton scrub, except for about a million feet recovered by Captain Foulis and sent to Cairns by train. At least 15 millions of feet [35,000 m^3] were destroyed. I was living on the Barron all through that period, 1882 to 1889, and know the whole story so there is no mistake. (Meston 1923:51)

In the meantime, the apparent potential of further discoveries of tin, silver-lead and copper west of Herberton forced the Cabinet in Brisbane to plan railway construction from the coast. During 1882 and 1883, possible routes were surveyed from Port Douglas and Cairns, with assistance from Christie Palmerston. The colonial government had also noted the possibility of developing Mourilyan Harbour as the main port for north Queensland and land was reserved for a canal, rail or road link to the Johnstone River. Sub-Inspector Alexander Douglas of the Native Mounted Police, instructed to find a track from Mourilyan to Herberton, ran into heavy rains and malaria. He abandoned the venture after 28 days as 'impossible' once food supplies ran out (Pike 1984:68). The 'jungle', gorges and swiftly flowing streams to be crossed appeared impenetrable. Palmerston believed otherwise and in 1884 with financial assistance from Johnstone River selectors blazed a route which avoided steep grades and required no tunnels, but this information arrived too late. On 10 September, 1885, Cabinet approved railway construction from Cairns, largely because Trinity Bay appeared to be a safer harbour than Port Douglas. Yet, in engineering terms this was to become the most expensive railway in Queensland, requiring 15 tunnels and more than 90 bridges. It did not reach Herberton until 1910.

Railways and agricultural selection

News of a future railway inspired British investment in Herberton and Irvinebank tin mines, advertised as the 'Cornwall of Australia'. An immigration boom throughout the colony helped to boost the formation of an increasing number of mining camps. Herberton received municipal status and its residents proudly promoted display of the district's resources at colonial exhibitions. Here was a European climate in a land 'watered by scores of mountain streams', with the 'pure fresh air of a three thousand feet of altitude' and 'where blankets are a necessary covering throughout the year' (Ivimey 1889:141-7). Railway promotion forecast the prospect of 'twenty trains per week running for a hundred years' and a letter to a Brisbane editor about the future upper logging industry found its way into every north Queensland newspaper:

> The importance of the industry bears largely upon the decision... the Cairns route will tap country on the Upper Barron River comprising 1000 square miles of scrub, closely timbered with cedar, kauri, pine and other less known but, in many cases, valuable timbers. Roughly estimated, there are 6,000,000,000 feet [14 million m^3] of timber in these scrubs. From these scrubs 40,000,000 feet [94,000m^3] of timber could be shipped annually for the next 140 years (*Herberton Advertiser*, 23 April, 1884).

Such calculations as inspired guesswork were not backed by any careful survey of timber resources in the 'Atherton scrub' until 1889, leading to identification of valuable stands of seventy other species of rainforest timber (*Herberton Advertiser*, 27 June, 1890). Nor was any rigid control of logging actively applied other than instructions to not issue additional licences. New timber regulations under the Dutton Act (Crown Lands Act of 1884) merely increased royalties payable to the government for logging on Crown land (but not from freehold selections). However, the economic depression of the early 1890s terminated the most exploitative phase of cedar logging and led to an exodus of prospectors and selectors. Railway construction stopped at Mareeba (1893). The Atherton economy revived four years later in response to the London market which directed attention to Queensland cedar after failure of supplies of Cuban mahogany (*Swietenia*). From Atherton and Martintown, a traffic developed as horse and bullock teams dragged or carted cedar and kauri logs to the Mareeba railhead. Traction engines were imported to speed this delivery and by 1900 the Atherton Tablelands accounted for half of Queensland's cedar output and a third of the value of the colony's timber exports. Some giant logs were split apart by gelignite by railway staff to allow passage through Barron valley tunnels and in London buyers began to complain about the difficulty of selling logs too large for English mills. The size of export logs was curtailed after the arrival of a forest ranger in 1901 (Birtles 1982:48-52).

The abandonment of Atherton agricultural selections received comment during the Royal Commission on Land Settlement (1897). Rainforest clearing had exposed the crops to the activities of displaced insects, wallabies, bandicoots and ground birds and only five per cent of the freeholders had stayed. The only success, by Chinese maize-growers mear Atherton, produced Queensland's record yield per hectare in 1897, after several years of experimentation to control a maize blight found to be linked to wet season ripening. However, maize cobs also attracted Aboriginal thefts. A proposal to relocate other Queensland Aborigines to a reserve near Atherton was not well received. The Commission recommendations led to a new Land Act (1898) which extended the protection of Crown timber to all species, reclassified agricultural selections and, as a gift, transferred to the selector all rights to timber on an alienated selection as a means of financing land 'improvement' (a term which embraced 'scrub' removal). In October 1904, the Morgan ministry capitalised on the opportunity to raise revenue from land clearing by raising rail freight charges and by extending the royalty fees to all sawmill timber. By this time, a co-operative butter and bacon factory had opened in Cairns and the railway had reached Atherton.

Whereas railway extension speeded the delivery of logs to the coast it simultaneously exposed Atherton Tablelands agriculture to outside competition. The only alternative left to genuine selectors appeared to be dairying, with paspalum planted as the first introduced pasture. Amidst estimates in 1905 that room existed north of Townsville for four million 'white' Australians, public pressure for land to farm encouraged rural-oriented ministries to throw open to selection the steepest rainforest land throughout north Queensland. Group selection under the Closer Settlement Act of 1906 brought a swarm of new arrivals to Atherton railway station. Further concessions to attract selectors were included in the Land Act of 1910 and, from 1912, the Agricultural Bank provided liberal assistance. By 1914, agricultural selections of 'Atherton scrub' exceeded 110,000 hectares. The Discharged Soldiers' Settlement Act of 1917 abolished all Chinese tenancy and opened a further 60,000 hectares for 'white' farming, without any informed assessment of land capability, markets or economic prospects (Qld. Govt. Intelligence and Tourist Bureau 1918:15).

Further extension of the railway tracks as spur lines supported the establishment of additional timber mills, even though the government stopped cedar exports in 1909. Seasonal slumps in timber markets during the drier months coincided with the best time for burning, to create such selector impatience that most of the felled timber was put to fire. Ash content was believed to increase soil fertility. Apart from kauri, the most valued timber proved to be the bean tree (*Castanospermum australe*) because of its fire-resistance. For this reason, it became the selector preference for slab-fencing and slab hut construction. The extensive stands of high quality *Endiandra* trees, almost without exception, were destroyed by fire. The task of 'scrub clearing' followed the practice of nicking a deep cut in all trees for about half a hectare, then chopping one tree to topple the rest as a 'drive' of fallen logs oriented in one direction to assist burning. 'Grubbing' the soil after 'burning off' proved back-breaking and time-consuming. Stumps left to rot delayed ploughing for at least six years.

Queensland government promotion of selection prospects of the Atherton Tablelands during 1918 labelled this land as 'a veritable agriculturalists' Eldorado' and 'garden of Australia' with 'a healthy invigorating climate' and room for a future population of 100,000 (the numbers resident at the time amounted to 9000). Photographs of successful farms and the Atherton butter and bacon factory (relocated from Cairns) were supplemented by illustrations and commentary about 'the scenic splendours on the these Tablelands ... bewitching in their variety'. This prosaic propaganda added that:

> the country is naturally picturesque, but this is enhanced considerably by the existence of numerous waterfalls, a number of which are of imposing description. Many of the rivers are of noble proportions, while three of the lakes (Barrine, Eacham, and Newell) on the Atherton Tableland have features of great interest to the scientist and geologist. To those interested in the customs of the Australian blacks, the existence of two bora grounds demonstrates that the white rulers of the country have no desire to ruthlessly remove all traces of the scenes of the sacred ceremonies of the fast diminishing dusky sons of the soil. (Qld. Govt. Intelligence and Tourist Bureau 1918:3)

During the next decade, the government adhered to its perceived agrarian responsibility by proposing the opening of a further 155,000 hectares of rainforest between Tully and Cooktown.

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16

Archaeological evidence for a horse-drawn tramway at Bawley Point, NSW

Michael MacLellan Tracey

Introduction

Bawley Point is a rocky headland located on the New South Wales south coast midway between Ulladulla and Batemans Bay. The surrounding terrain is sparsely vegetated and swampy with some eucalypts thriving in small pockets of elevated land. Dominant species in the area include spotted gum (*Eucalyptus maculata*), bloodwood (*E. gummifera*), silvertop ash (*E. sieberi*) and turpentine (*Syncarpia glomulifera*) (Costermans 1981: Evans 1978:5). These species were exploited during early forest harvesting and archival research supports that a sawmill operated there between 1892 and 1922 (Tracey 1994). The archaeological remains of the sawmill are located directly below the ridgeline on the northern shore of Bawley Point approximately 300 metres north-west of the Termeil Trigonometric Station (MS428C).

Imported tradition and technology

Industrial archaeological sites are complex by their nature and may comprise several independent, interactive areas where specific functions were performed. A timber extraction operation is where timber felling, transportation, milling and shipment functions combine in an industrial undertaking that has an impact on the landscape.

Identifiers of past industrial endeavours, discarded tools, including derelict machinery or parts thereof, building foundations, decaying hulks of sunken vessels and earthworks often remain in the archaeological record as testament to technological change. To fully comprehend the change in a specific location it is necessary to consider a wide sphere of often very remote, although influential, events of technological change. Constant changes in applied technology, evidenced in the archaeological record, have been prompted by existing human need in response to environmental conditions. The evolution of a tramway system or railway is a complex process of invention and development according to the 'spirit of the times' (Rapp 1981:7). It represents the culmination of the combined skills of the inventor, craftsperson, engineer and labourer according to the prevailing sciences and engineering practices. Tramways continued to evolve in Britain, eventually changing to steam traction and steel rails, although the wooden tramway survived in marginal timber operations throughout Australia long after the change in occurred in Britain. The tramway at

Bawley Point remained a wooden, horse-drawn system from 1896 to 1916 and the archaeological remains provide a unique opportunity to study the applied technology of the era.

Tramways in Australia developed from the technology employed in Britain in the 18th and early 19th century which was imported by the early settlers. In the later half of the 16th century, crude railways employing horse-drawn wagons with wooden wheels and rails had been used in coal mining in England and western Europe (Daumas 1979:332-3). Tramways with rolling stock using both wooden and steel wheels on timber track had been in use in England c.1602 and an engraving, first published in 1752, illustrates a track system with carriages equipped with flanged wheels being pushed by people (Daumas 1979:332). Flanged cast iron wheels running on squared wooden runners fastened to sleepers with steel nails did not come into common use until 1790 (Snell 1973:2-5). The flanged wheel operates by employing a projecting rim or riser cast into the wheel to guide it along the tracks. The introduction and use of iron or steel rails enabled an economical, high-volume, reliable transportation method for both freight and passengers. In England, horse-drawn systems were gradually replaced with steam engines when Richard Trevithick, John Blenkinsop and William Hedley built and operated several steam locomotives from around 1797 to 1813. Trevithick built the first steam locomotive in 1804 for the Penydarren Iron Works in Wales. It was capable of hauling loads up to 25 tons, however, it was too heavy for the track and was converted to a stationary steam engine. Trevithick's engine inspired other engineers, such as Stephenson, to construct steam locomotives (Daumas 1979:338-339). Yet despite these revolutionary changes in motive power, horse-drawn tramways continued to be used and operated in industrial, mining, quarrying and even farming localities well into the nineteenth century. Despite their widespread use and importance in the industrial revolution in Britain, tramway systems have rarely been explored archaeologically (Jones 1987; Hughes 1990).

The early settlers of the Colony of New South Wales introduced a strong tradition of acquired technology, timber exploitation methods and knowledge of mechanised milling procedures and engineering practices (Pearson 1995). English railway design and innovation played a major role in early Australian tramway and railway history. The colony possessed a very limited manufacturing capacity, particularly for steel, and relied almost totally on England for imported raw material and manufactured goods. Cast iron railway wheels, axles and other line rolling stock infrastructure were imported from England. A horse-drawn tramway, based on the English inclined plane system, had been in service in the coal industry near Newcastle since the early 1830s. The tramway was used to transport coal from the pit face to the loading facility at the port (Pemberton 1986:31). Horse drawn tramways remained an efficient means of hauling heavy loads over short distances in the latter half the 1800s and early 1900s (Snell 1973:1-3). In the mid 1890s a wooden tramway operated at the wharf in Ulladulla. When first constructed, human labourers provided the motive power, and later, horses drew the loads (Longworth 1994:196-9, McAndrew 1995:70-71). This technology and transportation technique, once introduced into the timber industry in Australia, remained in widespread use until the advent of the internal combustion engine.

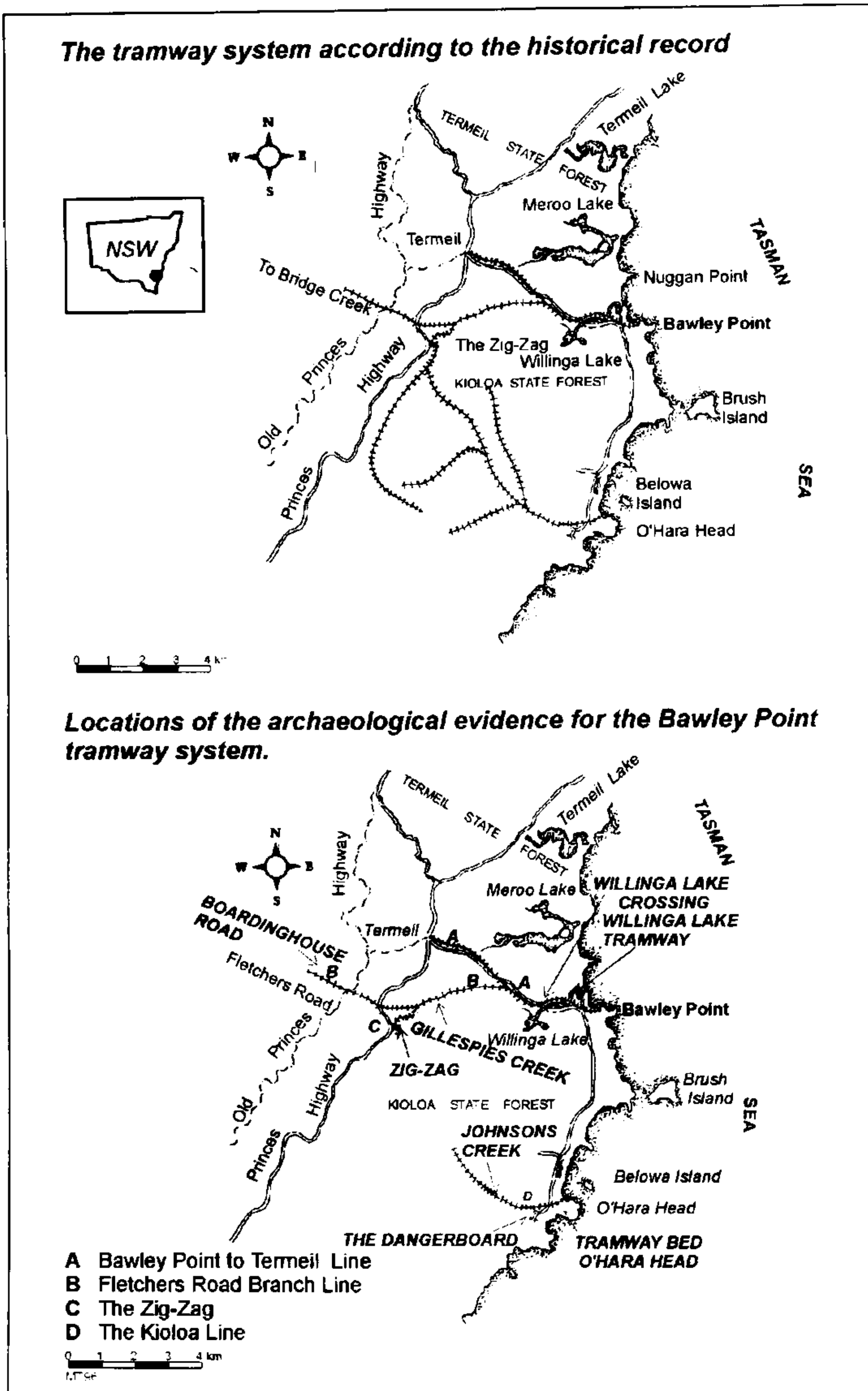


Figure 1. Maps comparing the historical record with the archaeological remains.

Tramway at Bawley Point.

The research discussed in this chapter was aimed at identifying and establishing the extent and significance of the archaeological remains that may illustrate the applied technology employed in a tramway system. According to historic sources the tramway had been used in conjunction with timber extraction operations in the Murramarang district on the south coast of New South Wales. Limited archaeological or historical research relating to the timber extraction industry in the area has been published. Local histories, such as *They Came to Murramarang* (Hamon 1994)—a welcome effort in collating such history—sympathetically include tales of the timber trade derived from local residents. However, the historical accuracy of such works is sometimes clouded by local folklore. Scarcity of archaeological research into historical methods of timber extraction is recognised, prompting the Australian Heritage Commission to comment that: 'To date there has been little systematic surveying of historic sites in forested areas. Forests have the potential to reveal a great deal more information about settlement in Australia and adaptation to the Australian forest environment' (*Heritage News* 1990:8).

While acknowledging the historical record, primary importance was accorded to identifying the impact and archaeological evidence of the construction of the tramway. Initial surveys also indicated that there may have been a contradiction between the archaeological evidence and the documented material. Several photographs and their inaccurate and ambiguous descriptions in published histories and the collections of the National Library of Australia led to confusion in the field (Hamon 1994:36).

Photographs are an excellent resource when identifying applied technology as 'the archaeologist of Australian industry cannot in any circumstances ignore the historical context of his site and the relevant written, oral or pictorial evidence' (Jack 1983). Although historians treat documents with 'selectivity and interpretation' and know well that the 'documents lie' McGowan (1995:5), exceptional care is required when using historical records, particularly photographs, to identify and describe archaeological sites and artefacts. For example, Jack (1987) describes the photograph of a dredge as 'Gold mining on the Turon, No date'. This and several other photographs of the same dredge were well described by the original photographer (Tilba Tilba Collection, National Library of Australia). It was built by William Clow, a timber miller of Wagonga for the Punkalla Gold Dredging Company in 1902 and its archaeological remains are in Simpson's Swamp on the south coast of New South Wales where it remained for the duration of its working life. The Turon Goldfield or the Turon River is over 450 kilometres north east of Simpson's Swamp. It is difficult to comprehend how the history of the two areas could be confused.

A second example is provided by a photograph of a bridge-crossing which is described variously in several publications as the tramway crossing at 'Willinga Lake', at 'Milton' and at 'Dermal Lake'. Hamon published an non-annotated version of the photograph and stated that it depicts: 'Horse team led by "old Prince" crossing the tramline bridge over Willinga Lake, c.1914' (Hamon 1994). Backhouse (1991:24) also published the photograph with the annotation on the print 'Log Hauling, Milton, New South Wales' and the caption 'Log Hauling about 1926.' These publications, written by local historians, state two conflicting dates twelve years apart, describe the location as Willinga Lake and Milton thirty kilometres apart and accredit the photograph to these respective areas. It was standard photographic practice to annotate the title, negative number or date of the photograph on the negative in Indian ink which then appears white on the developed print. In the case of this photograph it is possible that copying or retouching of the original has occurred (Tracey 1994:62). It is reasonable to assume that the person who marked it knew where it was taken. It is annotated as 'Milton' not Willinga Lake. A copy of the photograph archived in the National Library of Australia, has the description:

> Mr McKie Collection, National Library of Australia
> Milton / Timber Log Hauling (lent for copying August 1982).
> Date: Approx 1924-1925.
> Photo taken on Dermal Lake, Near Ballie Point near Milton on the South Coast of NSW.
>
> The horse teams [*sic*] on its way to the sawmill to Ballie Point. The fellow sitting on the first log was possibly Jack Backhouse. The leader of the team of horses had to be an outstanding horse with intelligence, good temper, able to stand a little bit of whip, cunning, not too free, one that will come to and gee off promptly, good hearing, placid and lovable.
>
> The bullock teams hauled the logs out of the steep hills to a dump. The mill laid a narrow gauge rail line into the bush (in this case about 5-7 miles). Then three bogey sets of train wheels were fixed up and the horse team would haul the logs from the dump to the mill at Ballie Point. The horses had to be hooked one ahead of the other to walk between the rail lines. Not used very widely as a method of hauling logs according to Mr. George Backhouse. There are no reins on the horses but they are driven by talking to them, lightly hitting them, at times cracking the whip. A good driver loves his horses and only hits them when they really deserve it.

The following issues raised in the description of this photograph are contentious and diminish its credibility:

- *1924-1925*—Bawley Point Mill was burnt down in 1922 and was not rebuilt.
- *Ballie Point*—The spelling may vary (Arnheim's Map uses Ball-y Point). Irrespective, it is not near Milton.
- *Dermal Lake*—Meant to be 'Termeil Lake'. A family by the surname Dermal operated a sawmill at Dermal Lake or as it was later to be known Termeil Lake. Termeil Lake is not near Milton but many kilometres south.
- *a narrow gauge*—The gauge was to be established from the archaeological evidence was 1.2 m (48") which is not considered narrow for a tramway.
- *train wheels*—bogie wheels were specially cast for forestry purposes.
- *not used very widely as a method of hauling logs*—This was a very common method of haulage which had been imported with the early settlers.

A second published photograph of horses on a tramway caused confusion when relied upon for site identification and direction for log haulage. Hamon (1994: 36) states it is at Kioloa and shows the photo with the horse team moving left to right, whereas in Ewin (1991:254) states it is at Termeil and has the team moving right to left. Ewin also states that jinkers are being hauled on the tramway whereas, although horses did haul under-slung jinkers, they never did so on a tramway; trolleys are hauled on tramways. This photograph has also been published in *Heritage News*

(1990:8) showing the horses moving right to left, with caption 'Termeil c.1900'. In Ewin's (1991:256) *Meet the Pioneers* a wooden framed poppet head constructed at a mining site at Nerrigundah in the Nerrigundah Division of the Southern Mining District NSW, is described as the Kioloa sawmill located at O'Hara Head (AR 1899:36). Further authority is inferred in the photograph by the identification of two workers on the site and specific dates are quoted that cannot be applied to the sawmill. Archaeological site descriptions derived from historians 'writing knowingly about places that they have never actually seen' must be accepted by the archaeologist and historian with caution (McGowan 1995:5).

Theories generated by archaeologists often stop at the high water mark ignoring the myriad of terrestrial artefacts lying on the seabed (Nayton 1992:17). '... to look landward and not seaward is a fundamental mistake, and that the criteria which allows such sites to be best understood can be either wet, or dry, or both in various proportions' (Hunter 1994:261).

Figure 2. The remains of one of 9 bogies located on the seabed at Bawley Point. Note the heavy crustacean and marine growth. *Photo*: Steve Harding 1995

Initially archaeological evidence located for the tramway at Bawley Point was very limited. However, a survey of the seabed near Bawley Point was conducted and artefacts were identified and recorded. These artefacts may represent elements of the earliest applied technologies and trade of the Colony of New South Wales (Jeffery 1987:17-19, 1993:1-6; Hunter 1994:262; Westerdhal 1994:265). The romance associated with shipwrecks attracts maritime research, and although wharves, jetties and lighthouses have attracted heritage conservation studies, there has been minimal intensive archaeological analysis of these remains. Discarded industrial components are often ignored (McCann 1994:92-99). Until the development of road systems and subsequent rail transport, the Colony of New South Wales was heavily dependent upon transport by sea, the maritime industries providing vital links for economic and cultural exchange (Bach 1976:3; Hannah 1986:29; MUDHS 1988:5). Milled timber was dispatched by ship and the Bawley Point sawmill had been located where moorings for ships were accessible and minimum handling of the finished sawn product was necessary (Hannah 1986:15).

Establishment of the timber industry at Murramarang

The first European settlement on the south coast of New South Wales was in the Milton district at Croobyar Creek in 1827 (Antill 1982:38; Bayley 1975:29; MUDHS 1988:5). Sydney Stephen, a barrister, applied to the Land Board in February 1828 and was granted land in March (Dixon [map] 1837). He gained possession in 1829 and named it 'Edgecumbe' (Brown: 1987; MUDHS 1988:5). William Carr, a fellow barrister, formed an association with Stephen, enabling the convicts assigned to Carr to begin to oversee the property now known as 'Murramarang.' Stephen eventually left the district for New Zealand after a prolonged dispute with Carr. Carr planned an expansion of his interests and in 1842 purchased 860 acres (348 hectares) at Kioloa. Despite its poor harbour he had argued, albeit unsuccessfully, for a village to be surveyed at Kioloa and by the time of his death in 1854 he owned 5340 acres (2161 hectares) from Kioloa to Bawley Point (Hamon 1994:21). He bequeathed his estate including Murramarang, the main property, to his widow Charlotte. Eventually the property was sold to William Yates and Evan Evans of Dapto and later it passed to John Evans who worked the area as a dairy farm (Tracey 1994).

Bawley Point, part of Evans' land holdings, was surveyed 16 October 1892 by Fred Arnheim. Noted on his plan was 'Sawmill in course of erection' (Spl91.4). This notation is the earliest official documentation relating to the Bawley Point sawmill. The mill and its tramway were built simultaneously and were in use by 1893. The editor of *The Ulladulla and Milton Times* (1893) described 'a crude light line of timber railway servicing Guy's Mill at Bawley Point.' Goodlet and Smith had built the Kioloa sawmill at O'Hara Head five kilometres south of Bawley Point in 1891 and about this time, Francis Guy Jnr., son of Francis Guy, who had sawmilling, mining and shipbuilding interests around Batemans Bay since 1870 commenced milling at Bawley Point (MUDHS 1979:4, 9-10).

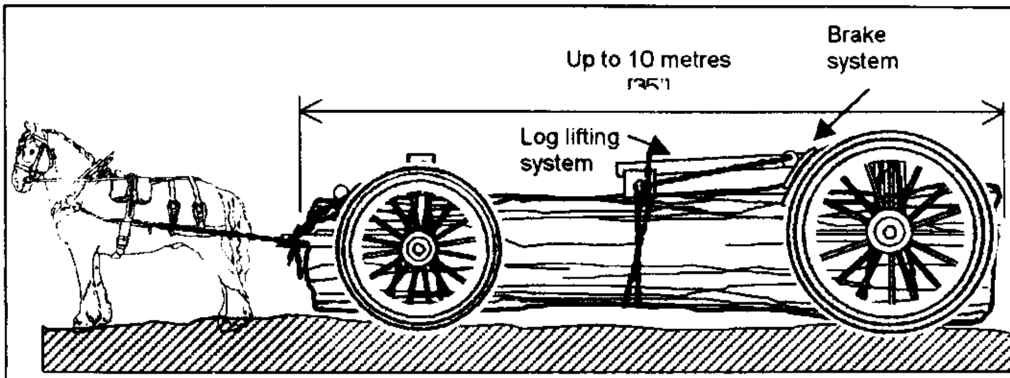
The 1890s depression detrimentally affected the south coast timber industry and operations ceased at the Kioloa sawmill after a boiler explosion in 1893. Guy's Bawley Point sawmill continued to function under duress. Ships which were vital for transportating the timber and delivering supplies were lost in 1895, 1896 and 1897 causing further shut downs. Despite the loss of his last schooner, *Gleaner*, Guy maintained operations until 1912 when he finally sold out to A. & E. Ellis of Sydney. Goodlet and Smith had withdrawn and sold their equipment from the Kioloa sawmill in 1898 (Brown 1987; Hamon 1994).

Sawmill handling process

A sawmill represented the final stage in the timber harvesting process. Rough cut logs were broken down into usable sizes and converted to sawn product before transportation or delivery to markets. The specific location of the Bawley Point sawmill on the coastal extreme made it reliant upon a tramway system to transport logs from the forests which were up to eight kilometres inland (Hannah 1986:15).

Although the land adjacent to Bawley Point is relatively flat and sparse, its timber resources around Termeil, Ingolds Knob and Cockwhy Ridge, southwest of the sawmill site, had major gradients. When the trees were felled, they were snigged usually by bullocks to loading areas where they were loaded onto tramway trolleys. Horse teams or individual horses hauled the trolleys directly to the sawmill, or to a point where freewheeling was possible (Hamon 1994:37-38; Tracey 1994:56).

Timber tramways generally required minimal capital investment and were constructed of wooden runners secured to wooden sleepers placed on the ground. Limited earthworks, such as cuttings and causeways, were required to maintain the required gradient of the tramway bed and few other expensive constructions, such as bridges, were necessary in the Murramarang area. By contrast, similar tramway systems in the ash forests of Victoria and the Waitakere Ranges and Mokai of New Zealand often required extensive engineering features, such as bridges and tunnels (Evans 1993; Griffiths 1992; Mahoney 1991:79; Lowe n.d:8-11).



Up to eight horses were harnessed single file or in pair depending on the size and weight of the log. Horses may have been used in the Bawley Point area instead of bullocks owing to the relatively level terrain.

Figure 3. A four wheeled under-slung jinker reconstructed according to the archaeological remains located, oral descriptions and historical photographs.

Limiting factors of a tramway system were the steepness of up-gradients, on which a team or individual horse could pull loads of between 1.2 and 8 tons, and the steepness and length of down-gradients which horses and trolleys, possibly with a brakeman, could negotiate. A gentle terrain was ideal to minimise these limitations and to enable the tramway bed to be constructed with relatively few curves. However, curves were utilised as a method of slowing trolleys. Tight curves lowered the speed of trolleys as they were freewheeled along the track. Steep inclines were negotiated in a tramway system by using a zig-zag configuration, thereby reducing the gradient. Long and steep downgrades could be negotiated by unhitching the horses and allowing the loaded trolley to freewheel down the slope with a brakeman controlling its descent (as had been practised in England's coal industry—Snell 1973:13). Other requirements for a tramway system were a fleet of bogies, trolleys, horses, their tack, shelter and feed.

Bullock teams snigged the logs in rugged country with steep inclines, valleys and gullies usually using under-slung jinkers or snigging skids (Tracey 1994:39-51), although horses were also used sometimes on relatively level terrain. It appears that tramways ran where gradients did not exceed approximately 10 degrees. Ridges, narrow valleys and gullies with gradients of approximately 20 degrees were worked by bullocks whose greater pulling power could sustain the loads on these inclines (Cannon 1985:9-15). The location of the sawmill at the lowest point in the cutting area and almost at sea level was used to take advantage of gravity for freewheeling trolleys on the tramway, for at least part of the way to the mill (Hamon 1994:37-38; Griffiths 1992:39; Evans 1994 pers. comm.; Lowe n.d:8-11).

Evidence for the tramway

The historical evidence for the Bawley Point tramway system comprises: an oral report and a 1:25,000 scale map annotated by Peter Scheele of Kioloa (EJLFA 1994), a conservation plan for the Edith and Joy London Foundation property at Kioloa (Titchen 1986), public record cadastral maps for the Parish of Kioloa (Map 44682) and the Parish of Termeil, a map published by Hamon (1994), and photographs in private and archival collections. Given the limitations of these sources, archaeological evidence was sought.

To establish the existence of the tramway system, it was important to assess the applied engineering features such as earthworks and bridges at the time of operation of the sawmills and isolate that period from later forest operations. Archaeological evidence for the tramway system was difficult to locate, given the ephemeral nature of the earthworks and that sleepers and runners may have been laid directly on the ground in some sections. Runners and sleepers had been removed when farms had been established along Reedy Creek immediately behind Bawley Point in the 1940s (Gillespie 1995 pers. comm.). The linear clearings were subsequently used for roads, and the tramway timbers were used elsewhere or in other tramways.

An estuarine lagoon, Willinga Lake, had to be crossed to gain access to Bawley Point. During a period of low water level, several runners and remains of bridge timbers were recorded. Many large lengths of timber, damaged by teredo worm, lay scattered about the shore of the lake. In the mud on the eastern bank lay lengths of timber 10 x 10 cm x 2.7 m [4" x 4" x 9'] with 9.5 mm [3/8"] diameter holes drilled at 46 cm [18"] centres along their lengths and 7.6 mm [3"] from the ends. Most holes were blocked with rust indicting the use of nails or spikes for the fixing of the runners and sleepers. However, no nails or spikes were found in the area. These lengths of drilled timber displayed characteristics of turpentine. They were in a better preserved condition than the larger timbers and had minimal teredo worm damage.

The bridge construction methods were similar to those interpreted from the remains of a tramway bridge approach at Johnsons Creek in the Kioloa sawmill system further to the south. Earthworks on the eastern bank next to the lake and in alignment with the timbers on the lake's edge provide evidence that this was the bridge crossing. Earth removed to a depth of 2.5 metres from a small quarry may have been used to infill an embankment for the track on the bridge approaches. The tramway bed, approximately 3.6 metres [12'] wide, curves away at this point and heads through a small cutting to a depth of 1.5 to 2 metres towards Bawley Point until it is truncated by the bitumen road at Shearwater Crescent (Tracey 1994:60). The tramway then ran along the ridge down to the mill. This area is now a housing development and no inghouse Road remains of the tramway bed have been located running parallel to the present graded road for half a kilometre. This section of the tramway branched away from the Stephens Creek spur line and ran west to the foot of the Cockwhy Ridge, continuing on to cross the Old Princes Highway, and on to Fletchers Road. Although there is no further evidence for the tramway beyond this point, it is considered that it did continue for approximately one kilometre along Fletchers Road towards Bridge Creek following the ridgeline.

The gradient of the tramway bed on the approach to Ingolds Knob varies from 10 to 15 degrees where freewheeling of trolleys is known to have been practised (Hamon 1994:37-38; MUDHS 198:33). Loaded trolleys rolled down the Boardinghouse to 18 Mile Peg Road until they reached the flatter land via Gillespies Creek behind Willinga Lake. Evidence exists for the tramway bed on the eastern side of the Princes Highway in the vicinity of Gillespies Creek. A linear clearing with associated earthworks is evident in the forest. Sections of turpentine runner complete with nails were reported to have been removed by the owner of the property to enable ploughing of the land and for safety purposes (Gillespie 1994; pers. comm.).

The bed for the tramway has been cut into the hillside to about 1 metre and up to 2 metres at various points to form a terrace and is approximately 3.5 to 4 metres in width. The earthworks on this section of tramway display similar construction methods to those at the zig-zag, Willinga Lake and Johnsons Creek. Roots of several spotted gums up to 1 metre in girth have grown over the terraces of the earthworks, thereby supporting the estimated date of construction for the tramway bed. This line provided access to the timber resource, mainly spotted gum, east of the Cockwhy Ridge and the turpentine at Gillespies Creek. Some timber was felled here for the construction of the *SS Douglas Mawson*, indicating that this section of tramway was in operation c.1914 (Antill 1982:323; Tracey 1996, Settree 1994 pers. comm.). This could also indicate that any quality timber closer to Bawley Point and Termeil had been previously cut out, supporting a statement in the historical record that there was a 'log shortage' (Hamon 1994:33).

Limited and mostly ephemeral archaeological evidence for the physical dimensions of the tramway was available in the form of earthworks and associated disused tramway beds. Contradictory remarks existed in the historical record as to the gauge, construction materials and types of equipment used for the tramway and its specific location in the field. It was important to the understanding of the operation to establish the gauge of the system, however, efforts to locate physical evidence in the terrestrial environment had not been successful. Once a tramway had served its purpose it was disposed of or disassembled for re-use. If the description 'though crude' is accepted, it may have been constructed with inferior quality material, such as spotted gum, which is prone to rapid decay in the damp environment of the forest. These processes are common to timber tramways (Evans 1994 pers. comm.) which 'are often very short lived affairs—built to serve a purpose and then abandoned. Consequently, despite all efforts of historians, some of them will never be traced.' (LRRSA 1974:5-6). Moreover, the snigging tracks and tramway beds were subject to forest regrowth and natural weathering, while some were destroyed when they were used much later by bulldozers and log trucks. During the course of the research described here, the archaeological integrity of sites, along with many artefacts, was lost when a section of the bed of the tramway at the Dangerboard on the Kioloa tramway system was destroyed by logging and the area surrounding the Bawley Point lost when a section of the bed of the tramway at the Dangerboard on the Kioloa tramway system was destroyed by logging and the area surrounding the Bawley Point sawmill was graded twice for use as a car park. Sites in this area must be considered under the threat of destruction from grading, logging, bushfire, flooding, storm surge and advanced rates of decay due to environmental conditions and infestation by teredo worm.

To establish the gauge of the tramway, it was necessary to locate a sleeper and measure the nail holes for fixing the runners. Sleepers could not be located and a decision was made to undertake a survey of the marine environment adjacent to the sawmill site at Bawley Point. There was a possibility that components of the tramway may have been dumped in the sea when milling operations ceased or if the equipment had been damaged beyond repair. Prior discussions with scuba divers had indicated that 'rusty lumps of metal' did indeed lie on the seabed (Harding 1994: pers. comm.).

A detailed marine survey revealed seven trolley bogies complete with wheels and axles, the wheels having seven spokes, a wide tyre, deep flanges and risers. The number of spokes in bogie wheels in general use varied from five to nine, depending on the manufacturer or the casting process (Houghton 1975:57). From the measurements of the artefacts on the seabed, the tramway was demonstrated to be of 4 ft gauge (measured between the inner wheel flanges—Figure 4).

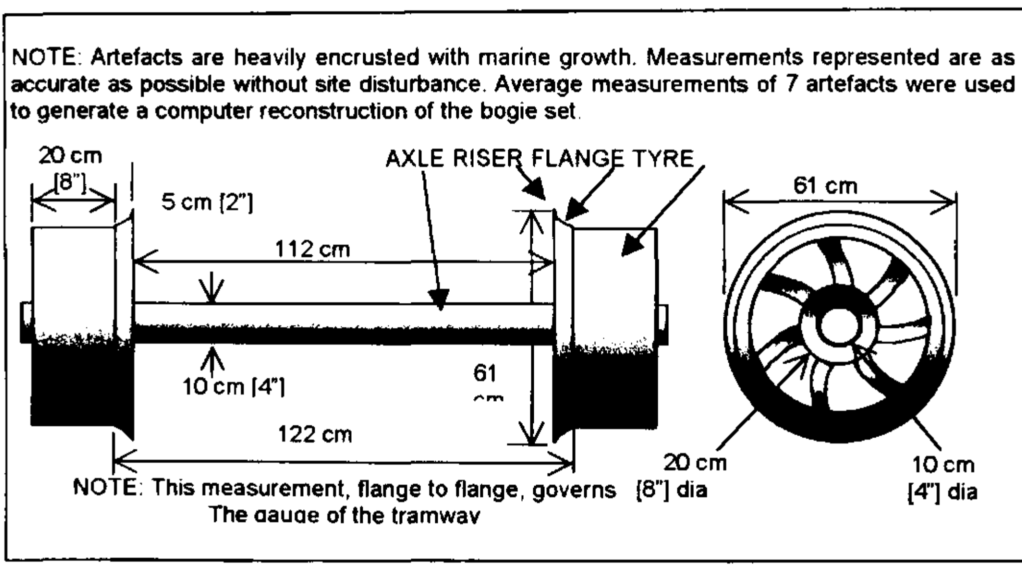


Figure 4. Reconstruction of bogie and axle derived from artefacts on the seabed

Intricate measurements were not possible to obtain owing to the concentration of marine growth. Measurements taken were wheel diameter 61 cm [24''], tyre width 20cm [8''] riser height 6 cm [2''], axle aperture 10.1 cm [4'']. Sleepers probably extended up to 30 cm [12"] on either side of the runners making each sleeper 1.8 metres [6'] in length. This measurement corrects the historical account from an unquoted source: 'The turpentine tracks were less than a metre wide' (MUDHS 1988:33).

The bogies are heavily encrusted with soft coral, plants and marine crustaceans. Most are partly buried in sand, which in this area is subject constant movement and re-deposition, adding to the difficulty of recording the artefacts. One bogie set displays on the tramway. Justifiable doubt remained that this discarded equipment may have come from another or later operation and the measurements of the bogies on the seabed had to be checked against physical evidence on the tramway bed to confirm the gauge of the system. The wheels were cast from chilled, possibly grey cast iron, using the sand casting process (Arnold 1989). The purpose of the curvature in the spokes in the wheel was to allow for expansion and contraction within the mould during casting thereby ensuring an even tyre and flange.

After the gauge of the bogies and the dimensions of the wheels had been established, further evidence on land in the form of a fractured segment of grey cast iron 15 x 10 x 2.5 cm (6 x 4 x 1") was recovered. This artefact was exposed on the lower eastern end of the sawmill site when this was graded for use as a car park (Tracey 1994). It has a curved outer face and was initially considered to be part of a cast container or cauldron. However, by estimating the radius of the curved section, the position of the spokes and the width of the object, and comparing these measurements to the wheels of the bogies on the seabed, it was concluded that it was a part of a bogie wheel. The curvature of the rim matched the 61 cm [24"] diameter, the material was the same and the raised section was similar to the inner radius that held the cast spokes.

During a severe storm, eight additional segments of cast iron were exposed at the edge of grading scree where the surface soil had been washed away. These were reassembled into the radius of the wheel diameter of 61 cm [24''] established from the wheels on the seabed. The initial artefact located fitted to another section of the casting. The wheel had been fractured in many places and the amount of rusting on the edge of the artefacts indicated that the fracturing did not occur during grading. It had probably failed during operation and been discarded. Although no evidence of the hub or bearing could be located, further indication of sub-surface ferrous metal was recorded electronically. The recovery of the hub and examination of the type of bearing cast or fitted into the hub would assist in identifying the period in which the casting was done. When the segments were assembled, they matched the measurements of the wheels on the seabed. Subsequently this area has been regraded and the remaining artefacts lost in the grader scree, including the suspected hub section.

The zig-zag

An interesting engineering feature of the tramway, the zig-zag, exists on the slopes of an extended ridgeline at Stephens Creek. It was constructed to enable horses to haul logs up a gentler slope than was possible in a direct ascent. The tramway bed continues to the top of 18 Mile Peg Road and on to join the Boardinghouse on the ridgeline. In initial surveys, attempts to locate this feature failed, owing to the dense forest cover, leaf litter and extensive disturbance of surrounding areas by later logging operations.

A 150 metre square section of the forest where the tramway was reported to have traversed was selected for survey and a search was instigated to locate any nails, sleepers, runners or parts thereof. Several extensive surface surveys had failed to locate any evidence of the tramway owing to the dense vegetation cover and forest litter. It was probable that sections of the tramway were disassembled when the timber cut out and were reused at other locations (Hamon 1994:109-110). Such actions would account for the minimal extant archaeological evidence for the tramway. Excavation was beyond the scope of the research at the time and any surface disturbance had to be account for the minimal extant archaeological evidence for the tramway. Excavation was beyond the scope of the research at the time and any surface disturbance had to be kept to a minimum. Despite extensive effort, the field survey failed to reveal any indication of nails used to secure the tramway runners to the sleepers along the bed of the tramway, although thousands would have been used. It is likely that the nails for the tramway were manufactured in the blacksmith's shop at the sawmill evidenced by the salvage of a nail heading tool (Bealer 1976:96-97). The aperture of the heading tool fitted all nails found on the tramway.

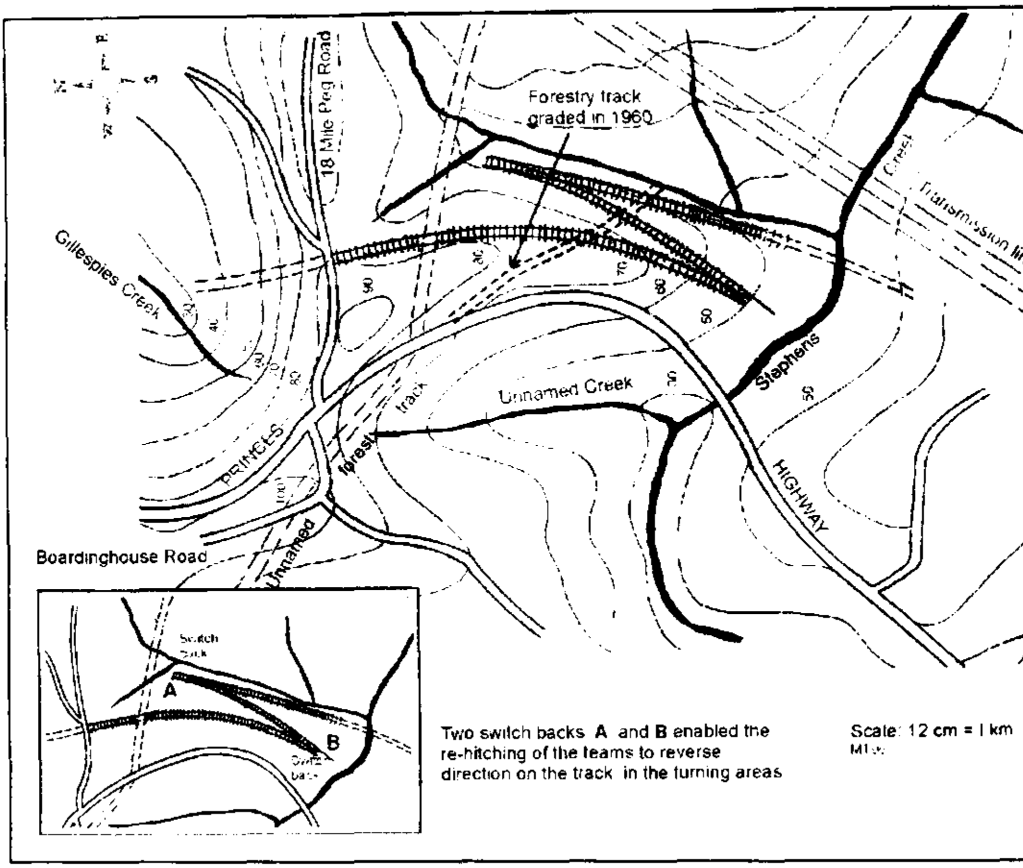


Figure 5. The zig-zag tramway at Stephens Creek. This historical engineering feature must be considered under threat from further forestry operations. It is unique on the southeast coast of NSW and worthy of heritage protection.

The fact that turpentine is difficult to burn makes it unlikely the runners were collected for firewood, or that the lack of remains could be attributed to the district's susceptibility to forest fires. Also, turpentine is resistant to insects and dry rot, characteristics which should have assisted its preservation in the archaeological record (Maiden 1889:89; Warren 1892).

Adopting the hypothesis that any metallic artefacts in these areas represented post-contact deposition, a metal detector was selected as the most non-destructive means by which to test the archaeological viability. A Compass Relic Magnum 6 Metal Detector fitted with a 200-mm coil was selected for its accurate metallic discrimination functions, depth of ground penetration, and adaptability to be altered for use in the marine environment. Only artefacts on the ground surface were recorded. If a sub-surface object was located, the detector was used to establish its approximate size, shape and metallic composition (ferrous or non-ferrous). No further investigation or disturbance of artefacts was undertaken. After scanning in a random pattern with this instrument for several hours a ferrous metal detection was recorded. A one meter square grid was set up in the area and systematically swept to reveal a similar reading approximately every 38 to 45 cm [15 to 18"]. According to the documentary sources the gauge of the tramway was less than 1 metre and it was thought that remains of nails would be found according to this description. A second parallel bearing was established by alignments of the detector's readings 1.2 m (48") to the west of the string line. Removal of leaf litter revealed timber runners with steel nails driven into them lying on the ground surface. The gauge of the tramway runners matched the measurements of the bogies on the seabed establishing 4 feet gauge tramway.

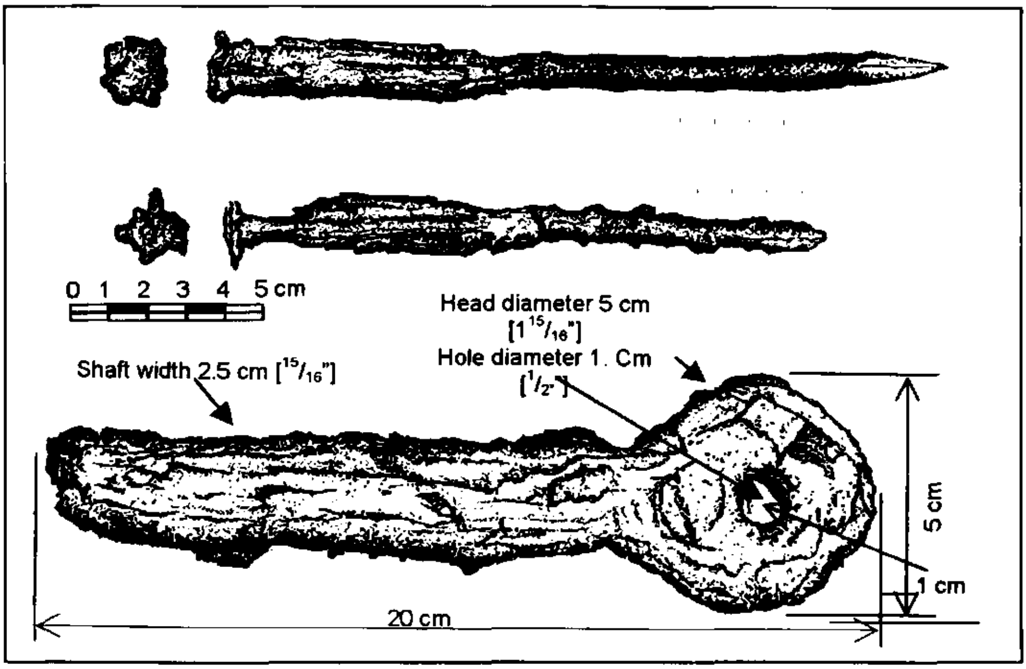


Figure 6: Nails and nail header tool from the tramway and blacksmith's shop.

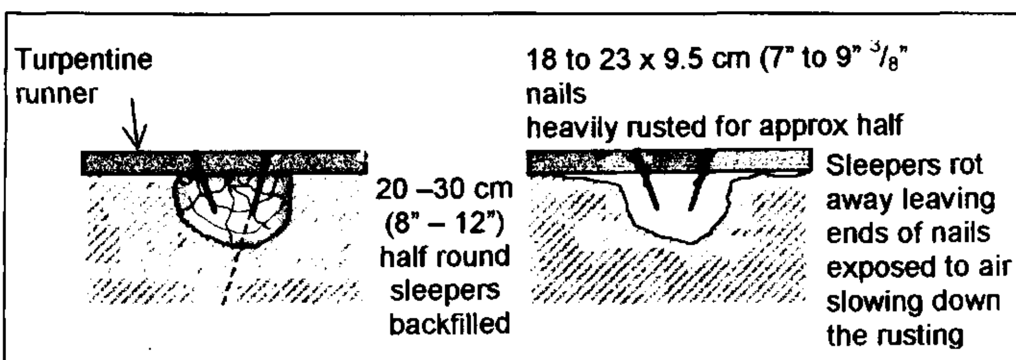


Figure 7: The rusting process evidenced on the nails provided an identifiable artefact that was used to locate the path of the tramway.

Depressions, 1.8 metres [6'] in length and at 46 cm [18"] spacings were present under the runners. Directly above each depression and in place in the runners, were two nails. Nail holes in the turpentine may have been pre-drilled to 9.5 mm [3/8"] because the nails may have bent when attempts were made to drive them into this very hard dense timber. The depressions were semi-circular, suggesting that the sleepers were half rounded, not squared, as had been reported. They were cut from spotted gum. Although spotted gum rots quickly on the ground, it is in abundant supply in the immediate vicinity and is soft enough when green, for a nail to be driven without pre-drilling. The repeated angle of the nails driven into the sleepers also indicates that the sleepers were half round.

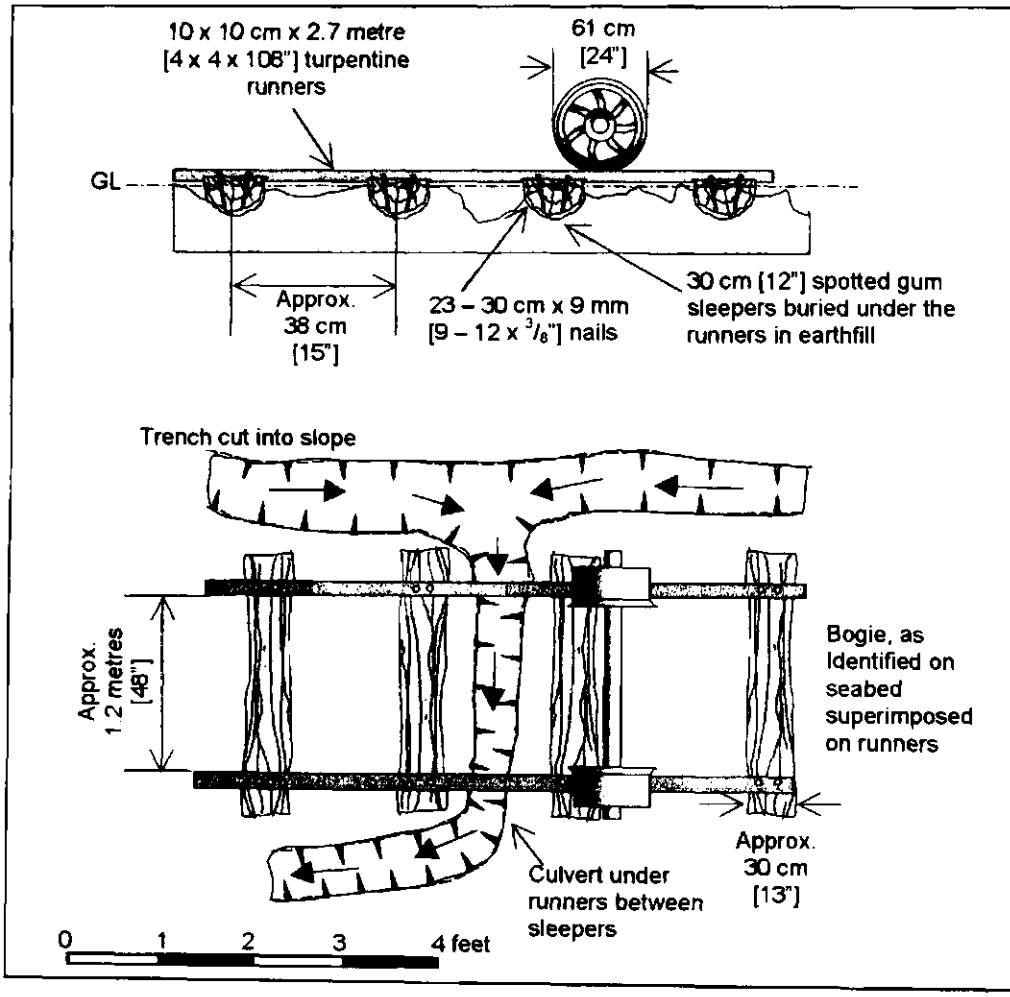


Figure 8. Details of the construction method of the tramway and drainage practices.

Further evidence to support that the sleepers had rotted away may be seen in the condition of the nails. All nails inspected had points and the upper section 10 cm [4"] was heavily rusted, whereas the lower section remained in good condition. Rusting resulted from moisture being retained by the turpentine timber accelerating corrosion on the head-end of the nail. When the sleeper had rotted, the steel would have been suspended in the cavity left by the decayed spotted gum. Exposed to the relatively dry air, this section of the nail would have been less susceptible to corrosion. This pattern was repeated at a bridge and approach at Johnsons Creek and Gillespies Creek. The evidence of this process could then be used as an indicator in the field to identify nails that had been used to affix tramway runners. In several sections, where earthworks cut into the slope, shallow depressions in addition to the sleeper depressions were located. These hollows, up to 30 cm [12"] deep, may have been drainage culverts, however, positive identification was not possible without considerable disturbance or excavation of the site.

Further use of the metal detector and marking of nail positions confirmed the direction of the runners and enabled a compass bearing to be taken. The direction of the switchback of the tramway was estimated by comparison with the angle of slope. Switch backs 9 to 12 metres [30-40'] long had been constructed at either end of each arm of the zig-zag. Point systems, drainage works, embankment earthworks and a small cutting were also identified.

The switch-backs were worked by a pivot runner or switch runner held into the sleeper by an 18 x 46 cm [$1^1/_2$" x 18"] steel pin that was manually pulled across the line. The horse teams would then have been unhitched and walked to the opposite end of the trolley, where it was then re-hitched. The length of the switchback would only allow for the length of the trolley, complete with log and horse, to be approximately twelve metres [40']. Allowing three metres [10'] for the horse and chain this leaves the average maximum length of the log to be approximately nine metres [30 feet]. This provided one limiting factor for this section of the line. A log of a maximum length of approximately nine metres [30'] only could be hauled on this section of tramway. The gradient of the slope in this location varies between 18 and 25 degrees although the maximum grade on the tramway bed of the zig-zag does not exceed 10 degrees.

Tramway line infrastructure

According to historical sources, the Bawley Point/Termeil tramway ran as a complete system for approximately 22 kilometres and was constructed of turpentine and spotted gum (MUDHS 1988; Hamon 1994:36-39). The timber runners were reported to be turpentine, *Syncarpia laurifolia*, which was obtained only north of Termeil and did not grow in the area traversed by the tramway (Titchen 1986). Approximately 44 kilometres of turpentine runners were required for the Bawley Point/Termeil system, representing a major capital investment including its haulage into the area.

The hardy properties of turpentine were known by the time of the construction of the tramway. It was being used in jetty and bridge pylons, as well as for tramway runners (Warren 1892:10). The field survey confirmed that turpentine grows south of Termeil and within the area served by the tramway. At 18 Mile Peg Road and Gillespies Creek mature turpentine trees are evident, however, they are *S. glomulifera* and not *S. laurifolia* (Costermans 1981; Blombery 1967:67). One tramway spur line may have been constructed primarily to exploit the turpentine and transport it to the remainder of the Bawley Point tramway under construction. Oral history maintained that sleepers measured 30.5 x 30.5 cm [12 x 12"] possibly split to 30.5 x 15.3 cm [12 x 6"] and were mounted with turpentine runners affixed with nails. Although this suggests the use of squared timber for the sleepers, it was contradicted by field investigations at the zig-zag which revealed that split round sleepers were used.

Trolleys

Early rolling stock used on the tramway consisted of four-wheeled trolleys with two sets of bogies per jinker and two jinkers per trolley (Evans 1994:34; Griffiths 1992:39; Winzenreid 1986:51). The trolleys were used in pairs and were spaced apart to suit the length of the logs, enabling them to be transported full length. A typical set of loaded bogies weighed 8 tons (Houghton 1980, LRRSA 1974; 5-6) The trolley unit had a short wheelbase, they were not sprung, and had deeply flanged wheels fitted to avoid derailments on uneven tracks (Mahoney 1991:79). Trolleys, with the logs chained securely, were connected by chain to an eyelet welded to a plate that was bolted to the wooden frame above the bogie axle. This enabled the trolleys when attached to the horse to negotiate bends on the tramway. Several plates and eyelets were located on the seabed. The nature of the bogie set, with wide 20 cm [8"] tyres were such that they would be very stable on timber runners by allowing a skewing movement over the surface of the runner to maintain stability (Griffiths 1992:150).

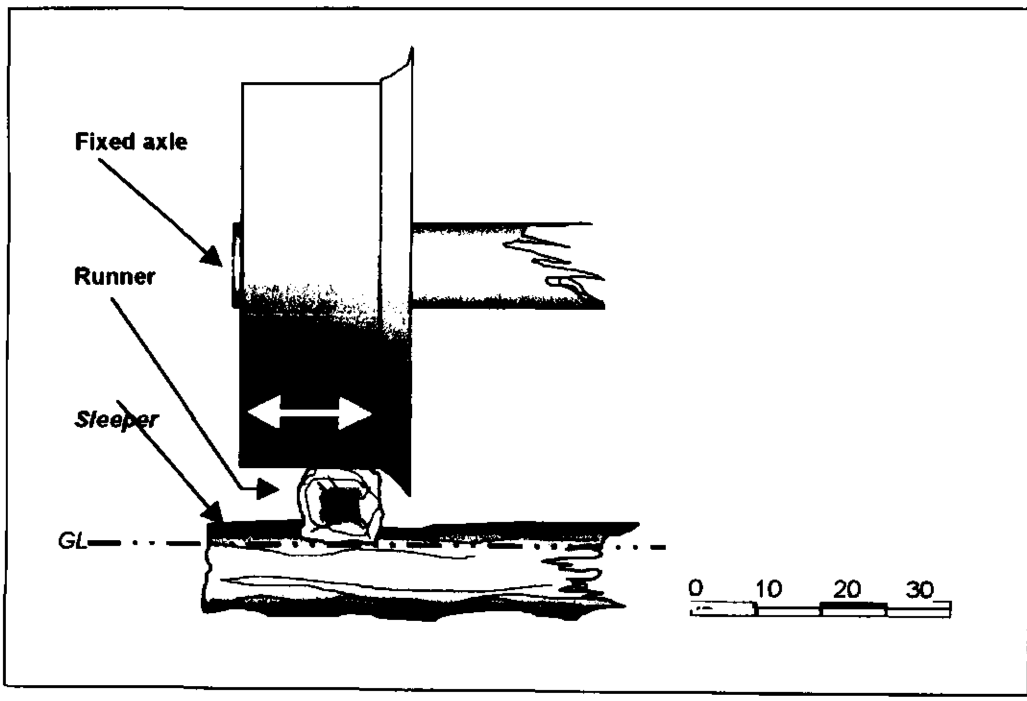


Figure 9: The wide bogie wheel allowed skewing of the bogie set over the wooden runners enabling freewheeling of trolleys to be practised.

Stability of the trolleys on the tramways would have been of paramount importance requiring a wide gauge line particularly during freewheeling. The horse team was detached, brakes applied and the jinkers pushed to freewheel downhill. Freewheeling of loaded wagons was employed with logs for the Bawley Point sawmill at Boarding-house Road and down the Dangerboard at Kioloa. Early settlers would have been aware of the inherent dangers associated with log transport, particularly where horses could be inadvertently killed while engaged in hauling loads down wooden tracks. The runners became very slippery in wet conditions (Evans 1994:15-17). Snell (1973:3) comments about events in 1754 in England: '... accidents were frequent. Steel and iron rails when wet get slippery enough, but wooden ones were far worse. Wagons "running a main" were a common site...' As stated by Hamon (1994:37) accidents were apparently common on the Dangerboard on the Kioloa tramway system.

Earthworks on a section of the tramway leading from Willinga Lake Crossing averaging 3.6 metre [12'] in width, allowed for a track of at least 1.2 m [4'] as well as a turning clearance for the log on the curved track. Some timber cutting operations in other areas may have employed horses hauling logs on steel rails (Houghton 1975:16, 30). No evidence for a steel rail tramway exists in the study area or in the district's historical record. However, a bogie located on the seabed, having only a 5 cm [2"] flange and an axle of 61 cm [2'] is consistent with the type used on steel to transport saw dust from the mill to the sawdust dump thirty metres east of the main building.

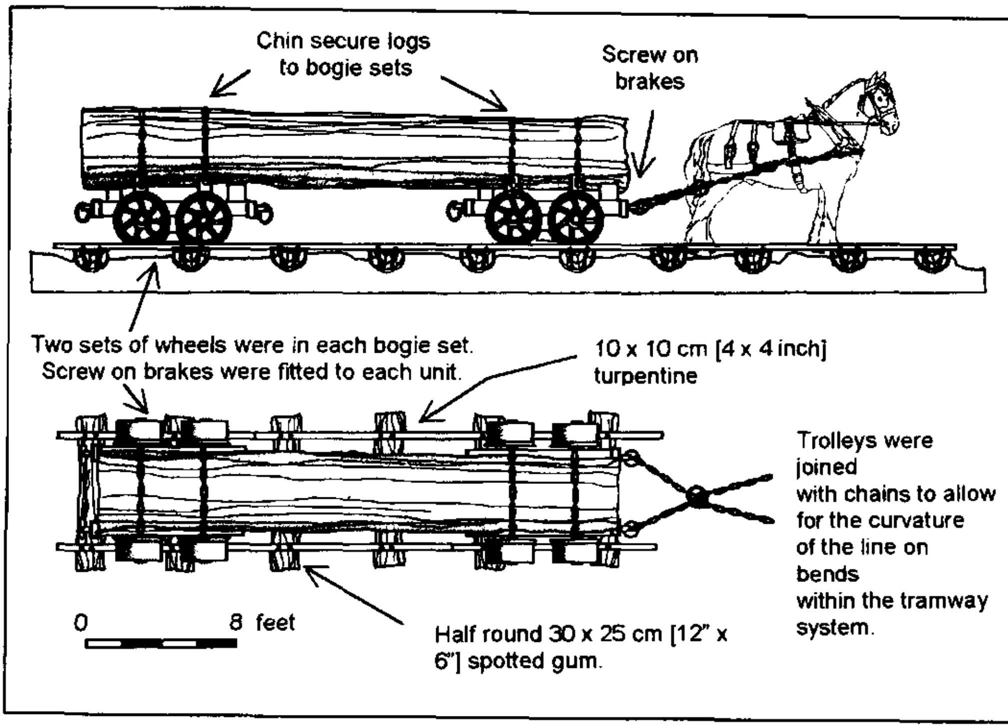


Figure 10. A typical trolley set reconstructed from the archaeological evidence.

Horses

No mention of the breed of horses at the Bawley Point sawmill is made in documented history. Photographs indicate that they were Shire horses or Clydesdales, or at least that these breeds were genetically dominant. The Clydesdale is an even-tempered, intelligent draught horse originally bred in Lanarkshire, Scotland, for drawing heavy loads. It had been imported as early as 1795 undertaking the arduous journey of over 16,000 miles in sailing vessels (Denholm 1979:102-106). A horse of 18 hands is capable of drawing up to 3 tons (Cannon 1985:9-13; Kennedy 1992; Wilcock 1976) and some argue that a single horse can haul up to 12 tons on a tramway (Snell 1973:7). Many articles or segments of horse harnesses and tack were found on a blacksmith's shop site adjacent to the main mill building. Large horseshoes of hand forged steel found on this site have calkins—steps on the ends of the shoe—to afford the draught horse sure footage. This artefactual evidence convincingly indicates that draft horses were employed in transporting logs to the sawmills.

Stables for the Bawley Point sawmill horses were situated on the north west bank of Willinga Lake on the western side of the tramway crossing. No relevant surface features could be observed as this area had been graded in the late 1960s. The site was examined with a metal detector however it revealed no evidence that could be attributed to the stables or their function. The site most likely to have been the stables is visible in the 1944 photograph although it had been graded for a small tree plantation by the time the 1972 photograph was taken (Collins 1994: pers. comm.; AP Run 13 NSW 2016\5117; J55\464 Map 277).

Conclusion

The terrestrial and maritime archaeological evidence supports the idea that a wooden tramway system operated between Bawley Point and Termeil. It was constructed at the same time as the sawmill and was not converted to steel rails. The bogies used were not altered or changed and no form of traction other than horses was employed. The dimensions and physical characteristics of the tramway were clearly established from the evidence as previously stated. Using this data and field measurements it was possible to produce computer reconstructions of rolling stock, bridging designs, loading areas and associated applied construction techniques described in historical texts. The archaeological evidence does correlate at certain common points on the composite map based on the historical documentation, however it does not fully support all the routes suggested by the various historical sources. Bawley Point to Termeil line carried logs and supplies through the Bawley Point hinterland, where gradients do not exceed 5-10 degrees. On the northern side of Willinga Lake the tramway crossed the lake via a wooden bridge then continued to the sawmill.

Boardinghouse branch line ran from the loading area and possible assembly point at Fletchers Road down the Boardinghouse to 18 Mile Peg Road with an initial steep (20 degree gradient descent) into Gillespies Creek to join the Bawley Point/Termeil line approximately 3.5 kilometres from Bawley Point. The historical record suggests 3 kilometres for this junction. The archaeological evidence supports the length of the Bawley Point tramway system to be approximately 13 kilometres

These sites are under threat of destruction and, if the comment by the Australian Heritage Commission in respect to forest histories and their importance to the understanding of settlement patterns within Australia is accepted, there is an urgent need for further research and recording of such tramway systems. A similar tramway operated at Kioloa mill at O'Hara Head south of Bawley Point, another at Pebbly Beach further south from O'Hara Head and at Bannisters Point near Ulldulla. At Jones Beach on Bannisters Point silica deposits were mined and transported for processing. Scant evidence, if any, exists for the operation of these tramways in the historical record and the ephemeral archaeological remains are under constant threats, similar to those at Bawley Point.

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17

Changing forestry perceptions at Mount Macedon, 1872-1995

F. R. Moulds and M. J. Burns

Nestling in and forming part of the Macedon Ranges in central Victoria are two very different 'icons' which have stood the test of time for different periods and which contribute diversity to the surrounding forests. The one surmounting the Macedon Ranges atop Mount Macedon, about 70 kilometres from Melbourne, in the midst of the Macedon Regional Park is the Mount Macedon Memorial Cross approximately 20 metres tall, lit at night and visible from Melbourne. It was constructed in the depression years of 1932-35 and entirely financed by one individual William Cameron, a resident of Mount Macedon who wanted to create an outstanding memorial to those Australians who died in World War I.

The other icon which had existed for much longer is the Macedon State Nursery at the southern base of Mount Macedon. It was established by the Victorian Government in 1872 to start a process of re-forestation following heavy cutting in the native forests in the 1860s and earlier for gold mining in Castlemaine and Bendigo, housing in the thriving metropolis of Melbourne, and later for railways.

These two forest-influenced enterprises have contributed much to the history of the region; the Cross, with its recent complete restoration following damage by lightning and wildfire is making a major tourism contribution; while the State Nursery has contributed approximately 25 million of a great variety of trees and shrubs distributed across the State over 125 years.

The developers of both enterprises were initially much more interested in exotic species than in native ones. In the Cross Reserve, William Cameron was able to take rhododendrons and other exotics from his extensive Mount Macedon garden and have his gardeners do the planting and maintenance. In the State Nursery, the regeneration and use of native species was little understood at first. The first report of the Superintendent of the Nursery in 1873 spoke of obtaining and growing 'the finest conifers and broad leaved trees from North America and Europe'. His plantings for the first few decades were almost entirely of an amazingly rich variety of exotics. The manner in which northern hemisphere seeds and plants were successfully brought through the tropics and introduced in this country is a great tribute to the early gardeners and nurserymen. The State Nursery, started in 1872, was not the first nursery in the Macedon area as there had been private nurseries since the 1850s each with extensive catalogues of, mostly, exotic shrubs and trees.

Figure 1. Original Memorial Cross with mature snow gums, *c.*1936

The Mount Macedon Cross, ever since its dedication in 1935 by the Premier of the day, Sir Stanley Argyle, deputising for the then Governor has attracted an increasing stream of visitors which now number over 220,000 each year, many of them from interstate and overseas. To reach the Cross along Cameron Drive from the main Mount Macedon Road, visitors drive through one of the most attractive parts of the Macedon Regional Park, with several popular picnic areas. They travel thorough a range of forest types in a relatively short distance, starting in messmate, stringybark and gum mixed eucalypt forest, then as they rise towards the summit though a small stand of mountain ash (*Eucalyptus regnans*), an extensive stand of alpine ash (*E. delegatensis*), followed by extensive stands of snow gum (*E. pauciflora*) near the summit. This is be the lowest elevation for extensive and well grown snow gums in Victoria.

The Regional Park is now being improved with re-planting of native species on sites which have not completely recovered and re-vegetated since the devastating Ash Wednesday fires of 1983. Within the Park, the separate War Memorial Reserve contains the remains of the original William Cameron gardens of exotic species which are now being restored. The Reserve was specially declared to be a War Memorial Reserve by the Premier of Victoria, the Hon. Jeff Kennett, on a visit to the site in April 1995. This was intended to lend support to the Appeal being conducted at that time by the Memorial Cross Trustees for funds to restore the dilapidated Cross and gardens.

Figure 2. The new Memorial Cross, 1995

Now the Cross has been restored successfully with a modern re-inforced concrete structure and well-restored terracing and rockwork, and as the new gardens are also taking shape, there is little doubt that the Cross and its environs will attract an ever-increasing number of visitors and will become a major tourist asset for Victoria. It is fortunate that the drive to the Cross passes through diverse range of native forest and associated vegetation which is a forestry experience in itself for the visitors.

State Nursery

The State Nursery component of this dual development in the Macedon Ranges region has been a highly unusual example of a continuous State enterprise over 125 years. As pointed out earlier, it started as a means of providing the necessary trees to begin a re-forestation program following extensive cutting in all the nearby forests for firewood, mining timbers, bridge and railway timbers, including sleepers and housing timber for the growing Melbourne. It was quickly into its stride with an active Superintendent on the job. A nursery was established and three houses built for the Superintendent and workers in the first couple of years. As also mentioned earlier, the emphasis was on exotics mainly because no one really understood the regeneration of native species but also because they were much more concerned to establish trees they knew and could expect to grow well in this environment.

An interesting development was the beginning of a dynasty of nursery managers and foresters. Macedon, particularly the State Nursery became the centre of training for early foresters in Victoria. They were mainly bushmen who were prepared to make a future life in the bush and were prepared to learn bush lore and nursery management, fire protection, road and track construction, and other similar ground work activities leading to a place in forest management. One of the earliest of this 'dynasty' line was that the of the Joseph Firth family.

Figure 2. Mount Macedon State Nursery
Source: Historic Places Section, Department of Natural Resources and Environment

Joseph Firth came to Australia from the Orkney Islands in Scotland in 1872. He landed in Rockhampton Queensland and after a few years found his way south to the Macedon area, where he worked, as a gardener in private gardens on Mount Macedon before getting a job in the State Nursery. He worked there from 1882, first as a curator and finally, after acting as Superintendent for 18 years, being appointed as Superintendent in 1900. He remained in that position until 1922 when he died after falling from his horse. Joseph Firth had 16 children from his three marriages, including four sons who carried on the forestry tradition for many years as professional foresters: James was Inspector of Forests in East Gippsland and became an acting Commissioner of Forests, George was a Forest Officer at Macedon until his retirement in 1960, Henry became a well-known District Forester at Creswick and Frankston, and Joseph, who began at Macedon, went on to become the Superintendent of the Hobart Pine Plantation.

The State Nursery under Joseph Firth's management became a model of nursery achievements. There were many references in the local and regional journals to the growth of trees and shrubs and the beautiful forest setting which Firth created. On his death, a local obituary read as follows:

> He had a deep knowledge of arboriculture and an intense love and enthusiasm for his work. For 37 years he sent out from the Nursery thousands of seedling trees, many of which have fulfilled their destiny and been hewn down, others are still in full and lusty life and others in various stages of their development. There is not a state school garden, nor probably a public garden in Victoria which does not contain trees over which he watched with fostering care and interest.

Other well-known foresters underwent their early training at the Macedon Nursery and surrounding forests included Josiah Semmens, D. Ingle, W. P. Freyer, Harvey, Jenkins, J. S. Parry, John Blair, Young, Dixon, Bailes, Brocklebank and Salmon.

The Nursery grew during the pre- and post-World War II periods to become one of the State's biggest. It also began to specialise in many native species of trees and shrubs when it was unfashionable or too difficult for smaller nurseries to do so. Members of the staff became proficient at gathering seed at the right times from special shrubs and trees in Macedon and other regions and at germinating and raising the seedlings. It still raised its share of the Department's own planting stock needs, such as radiata pine, other conifers and numerous eucalypts. It remained one of the main sources of farm trees for shade and shelter, and for local councils and road bodies for roadside plantings. The staff became recognised as well versed in the soil and climatic needs of the species they raised and their advice was widely sought in the planting season. During this period the Nursery became reasonably mechanised and modern water, fertilising and other systems were introduced.

Ash Wednesday fire

The situation of the State Nursery having an apparently secure place in the State's tree growing capacity and expertise, continued until 1983 when, on Ash Wednesday 16th February, a disastrous bushfire destroyed it and most of its buildings. The fire was responsible for the loss of about 500 homes in the Macedon locality as well as many more in other parts of Victoria. The destruction of the Nursery and its stock was so great that despite having one of the best years for the growth and quality of its nursery stock, only about one-third was able to be sold to the public.

The Memorial Cross on Mount Macedon was also swept by the fire and all the surrounding gardens and native vegetation, especially the alpine ash and snow gum, destroyed. The prolific natural regeneration of these two species that developed in subsequent years is a story in itself. With the help of the local black wattle, which developed 'by the million' from seed which had been in the ground for many years and which acted as a 'nurse' crop, the alpine ash and snow gum stands regrew and are now spectacular in appearance and cover the soil well. The wattles are now starting to die off, having done their job over the last 13 years.

A most interesting confluence of interest and genuine concern emerged after the 1983 fire which resulted in plans being simultaneously developed in several quarters for the replacement of both the Nursery and the Cross. However, there was a basic difference of approach in that there was no doubt the public was behind any move to restore the Cross and its surrounds, but the decision by the Department as to whether it should re-build the Nursery was not so clear-cut. As we have shown in our history of the Macedon State Nursery (Moulds and Burns 1997), there was a strong body of professional opinion that the Nursery should not be re-built on the grounds as there were four other State Nurseries and one in particular at Creswick only 100 kilometres away which could be expanded to provide all the services of Macedon. Needless to say with strong local support for its re-building and with the political arguments about local employment, especially of women, the matter took some time to resolve. In the end the Forests Commission with the support of its Minister decided on 1983, against most Departmental advice, to re-build and expand the Macedon State Nursery. The total cost was unlikely to be less than one million dollars especially if all modern equipment was to be installed to make the Nursery competitive and viable. The next four years was taken up with plans and counter-plans until a fine new Nursery was finally opened by the then Minister, Mrs Joan Kirner, on August 26th 1987.

Meanwhile on the top of the mountain overlooking the nursery, the Memorial Cross was still going through a black period. Several Departmental plans for the restoration of the gardens and the re-building of the Cross were prepared but the necessary Government funding was not forthcoming. It was not until 1994, when a new Government made the decisive move of appointing a Board of Trustees charged with the task of raising $750,000 to replace the Cross and gardens, that the situation took a decided turn for the better. That in fact became a success story. Within two years over $800,000 was raised and a new Cross erected and officially dedicated by the Governor of Victoria the Hon. Richard McGarvie AC on November 19th 1995. The gardens are still being restored.

To return to the Nursery, it began to take its previous place as a major tree and shrub producer with a capacity of approaching one million plants per year. It became one of the best equipped and most modern plant nurseries in the State. Unfortunately, as is so often the case, the wheel began to turn and a different side of the Nursery's future began to emerge. The Government of the day had some philosophic differences with its predecessor, which re-built the Nursery, and began to closely examine its reasons for being in the nursery business and in competition with private nurseries. It came to the conclusion, probably about 1992, that owning and operating state nurseries was not part of its core business. It therefore set about trying to sell them as going concerns. It succeeded in part, with other nurseries being sold, but for various reasons it found it difficult to attract a suitable purchaser for Macedon which ultimately closed down in 1995. The site, after nearly 125 years of activity and achievement, is now almost desolate.

It is sad to reflect on the success of one of Victoria's icons, and the sudden demise of the other; although not separated by more than a few kilometres, they have vastly different stories to tell.

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18

Refuge from fire: sawmill dugouts in Victoria

Peter Evans

On the Thursday afternoon, when they saw the fire was approaching ... two of us (myself, the wife of the foreman Harold Lorkin, and the wife of the engineer) refused to leave our husbands. The men who remained stopped work and excavated a dugout under a bank and put all their blankets and all available utensils filled with water inside. None of us slept that terrible hot night. The next morning, we could see the fire creeping nearer and nearer, so the men saturated the mill and all the stacks of sawn timber with water from the Ada River, but it was only like a narrow creek as it flowed by the mill. By lunch time they were still working and had not stopped for lunch, so I decided to take sandwiches and drinks down to them. There were only ten men, as all who wished to leave had been taken down the High Lead on the waggons the day before.

I had only walked a few yards down the wooden tramline to the mill, when a torch of burning bark fell at my feet and set the line alight. My husband called 'Run, run for your life into the dug-out'. I dropped the tea billies and food and ran. The men were still frantically soaking the mill. When they saw it was no use they were forced to come into the dug-out. How we lived through that dreadful inferno I shall never know. It was 113 degrees [F or 45°C] in Melbourne so you can imagine how awfully hot it was there as the worst fires in Australian history swept over us, sweeping sawmill, houses, horses, everything before it. I think, maybe, because it went so quickly, fanned by a terrific north wind behind it was the reason we survived. We two women were told to lie down on the ground whilst water was thrown over us, until the water reached boiling point and we could not drink it. Four men at a time stood at the small opening of the dug-out holding up soaking blankets until the blankets dried, caught alight and were swept from their hands in a few moments, then another four went forward to take their place. The Engineer went berserk and tried to take his wife outside and had to be quietened by knocking him unconscious to save his life.

The next morning, when the fire had gone taking our homes and all our possessions, we crawled out although our clothes were riddled by sparks which fell down through the small funnel the men had put in for a chimney and the men's hands were badly scorched by holding up the blankets. Strangely, no one was badly burned.

Ruby Lorkin has left us this graphic account of her experiences in the fire refuge dugout at the Ada No.2 mill in January 1939 (Lorkin 1984). It is one of only a few surviving accounts by a woman; the Royal Commission into the 1939 bushfires took evidence from men with only one exception. Without the protection afforded by the dugout at the Ada No.2 mill, all at this site would have undoubtedly lost their lives in this fire.

Fire is an immutable theme in the history of Victorian forests. Other writers have already explored the frequency and ecology of fire in these forests and it is not the intention of this paper to revisit the subject. Instead, this paper will concentrate on a specific cultural reaction to fire. Following the development of forest-based sawmilling, fire threatened not only the livelihood of sawmill inhabitants but their very survival. Most mills in the mountain forests were isolated and running from a fire was out of the question. The major cultural reaction to this threat was the fire refuge dugout, a common mid-twentieth century feature of the ash forests in Victoria but relatively rare elsewhere. The development and acceptance of the fire refuge dugout was a slow process influenced by several factors:resistance from sawmillers unwilling to bear the cost of construction and maintenance, hesitancy from bureaucrats unsure how best to advocate and implement the widespread adoption of dugouts, and pressure from sawmill workers eager to protect both themselves and their families. Each step forward in the process was triggered by a disastrous fire.

Military connection

The concept of the fire-refuge dugout, and certainly its name, dates back to the 1914-18 war when underground shelters were constructed to protect soldiers during bombardments. The word 'dug-out' was an important element in the lexicon of the Royal Engineers (Australian Army 1936) at the very time that the Forests Commission was attempting to pressure sawmillers into constructing dugouts at bush sawmills. Fire refuge dugouts followed the same general form as military dugouts except that the military gas curtain was replaced by a smoke filter made from blankets. That a connection between military and fire-refuge dugouts was perceived is alluded to in an exchange that took place at the 1939 Royal Commission:

> *Mr Slater* (appearing on behalf of the Forest Officer's Association):You might have had the experience that old soldiers had, that they would sooner be in the open than in a dugout when a raid was on. Is that your view?
>
> *Mr Gerraty* (Forests Inspector for the Central Division):The same thing applies in other places, where the mill hands got into the dams in the Rubicon area instead of into the dugouts. (Stretton 1939a:3:2130).

The 1926 fire

The first major disaster to turn public attention to the need to provide a refuge from fire at bush sawmills was the loss of fourteen lives at Worlley's mill at Mt Beenak in 1926. The mill settlement was typical of many of its time:isolated, hemmed in by scrub and connected with the outside world by a slender ribbon of wooden-railed tramway. (FCV 26/1482). The fourteen who died included a woman and three children (Hull 1983; *The Age, Sun News Pictorial*, 16 February 1926). This fire on 14 February 1926 earned the name of 'Black Sunday'. Following the fire, isolated suggestions were made that a 'dugout' could be useful for saving life in a bushfire, but the only specific action taken by the Forests Commission was to add one penny to the royalty on every hundred super feet of timber to provide additional funds for fire protection (FCV 28/430). This was primarily aimed at saving timber, not lives.

Forester J. W. Youl outlined plans for the construction of 'tunnels' as fire-refuges to the sawmillers of the Erica District in 1931, but was ignored (FCV 32/413).

The 1932 fire

Although miners in the mountain goldfields had very likely survived fires by retreating into their tunnels, the earliest recorded purpose-built fire-refuge was probably that constructed at another of Worlley's mills near Powelltown in the summer of 1931-32. Mindful of the fourteen people who had died nearby in the 1926 fire and of the thick scrub that had grown since that fire, several mill workers began to discuss the threat of fire as the height of summer approached early in 1932. There were no dams, rivers or clearings nearby in which refuge might be sought. Mill hands Ernie Berry, Ernie Stocks and Syd Woods decided the only thing to do was to go underground 'like a wombat'. A trench was started into the hillside once work had finished for the day. This work continued for about a week. The morning of Friday 5 February dawned hot and clear. Engine driver Bob Miller rose at 6.00 a.m. to re-light the mill boiler and discovered large clouds of thick smoke billowing over the ridge on which the mill was situated. Only a few men stayed at the mill each night as most of the workers lived in Powelltown nearby. The other four men still at the mill were quickly roused and sheets of corrugated iron hastily thrown over the top of the trench. The soil from the trench was shovelled over the iron and several kerosene tins of water dragged inside along with towels and blankets. A small hole the size of a wombat's hole was left at the entrance. No sooner had the five men entered the dugout when the fire roared over the mill site, destroying everything in its path. A wet blanket was used to cover the entrance and shield the men inside the dugout from the heat. Wet towels were used to cover their heads and enable them to breathe. This small dugout undoubtedly saved the lives of the occupants:Ernie Berry, Ernie Stocks, Syd Wood, Jack Jennings, and Bob Miller who were inside for about two hours (Ernie Stocks, Syd Wood typescript).

Official proposals for dugouts

Although those at Worlley's sawmill escaped death in 1932, six died at O'Shea and Bennett's mill near Erica where there was no such underground refuge (FCV 32/686). The first specific Forests Commission sponsored plan for a dugout appeared in May 1932 hard on the heels of the fire. The plan was put forward by Mervyn Ellis Bill, a Forests Engineer and Surveyor employed by the Forests Commission. He believed that thirty-six people had already needlessly lost their lives because no refuge from fire was provided at bush sawmills. He pointed out that fire escapes were provided by regulation at all city buildings, but that no law protected the inhabitants of a sawmill. His design included a tunnel with both downward and transverse deflections, underground piping and water sprinklers, hessian smoke filters and a steel-plated outer door. He believed that the door should point away from the north, the direction of the worst fires, as he had personal experience of seventy-five mile [120 km] per hour winds generated by a fire. Elaborate calculations were made of oxygen consumption and carbon dioxide generation. In most respects what he proposed has marked similarities to the 'modern' dugout except the downward-sloping entrance and the fixed door (FCV 32/1901). The downward-sloping entrance appears to have been an evolutionary dead-end, although one witness at the Stretton Royal Commission still believed that a downwards inclined tunnel was the safest because of the difficulty he experienced in trying to smoke wombats out of their tunnels (Stretton 1939a1:765-6).

Implementation

On 14 November 1932, the Forests Commissioners made the following minuted decision:'All sawmillers to construct efficient dugouts in close vicinity of all sawmills, particulars of such to be forwarded to the Commission'. This decision met immediate opposition. Chris Ingram, a sawmiller near Erica, stated that such an action would not only reflect badly on the industry, but that danger to life could be obviated without the construction of dugouts, and he demanded that the Commission receive a deputation on the subject (FCV 32/1901).

This protest was followed by official action on behalf of the sawmillers. Representatives of the Hardwood Millers' Association told the Victorian Cabinet in 1932 that there was no necessity for legislation governing dugouts to be enacted. They gave an undertaking that all members of their association would construct dugouts immediately (Evidence of Finton Gerraty at the inquest into fire-deaths at Rubicon and Matlock, *The Sun News Pictorial* 10/2/39). Subsequent events were to demonstrate the emptiness of that promise.

Despite the Hardwood Millers' promise, the Forests Commission pressed ahead, but the wording now changed from 'All sawmillers to construct efficient dugouts' to 'The Commission strongly advises you to construct efficient dugouts' and, somewhat loosely, defined the term dugout as 'any construction which will effectively give the required protection'. In these terms a circular letter with a tear-off strip to be returned was sent to all sawmillers late in 1932. The returns make interesting reading:some millers underlined the words 'strongly advise' and did nothing, George Worlley inserted the words 'when necessary' and also ignored the advice. Several millers pointed out that in the areas burnt by the fires earlier in the year there was now nothing to burn and also ignored the advice. Many did not reply at all. Only Jack Ezard replied that a dugout was being constructed but, as his No.1 mill occupied the same site as that of O'Shea and Bennett where the six fire-deaths had occurred in March 1932, he had good reason to do so.

The Forests Commission tried to force the issue again ahead of the 1933-34 fire season, once again sending a circular 'strongly advising' sawmillers to construct dugouts. This time it added a plea to the emotions:

> It is pointed out that on you does the preservation of the lives of your mill employees and their families largely depend, and unless suitable precautions are taken now it is quite possible that a disaster similar to those of 1926 and 1932 may occur. (FCV 32/1901).

This spurred one or two sawmillers into action, but the main body of mill owners still did nothing. Various excuses were offered:there was a motor road to the mill; there was a creek or swamp handy; there was a dam or water channel handy. Most did not seem to hold with the efficacy of dugouts. J.D. Walker replied 'we have a small dugout in the gully on the other side of the mill if anybody prefers it to the creek'. Arthur Mackie stated 'I don't hold with dugouts, my experience of fifty-odd years is that if a fire menaces you, you must fight fire with fire ... it is the men running away from fire that gets burned'. Oliver Menz replied 'I have no dugout here as it would be useless. It is not far to get out here and I am certain that if a fire is coming there will be no-one stop to get burnt'. Whether they objected to the cost of construction, saw the relatively temporary nature of mill sites as a justification for doing nothing, or just believed that the concept held no value, few sawmill owners installed dugouts (FCV 32/1901).

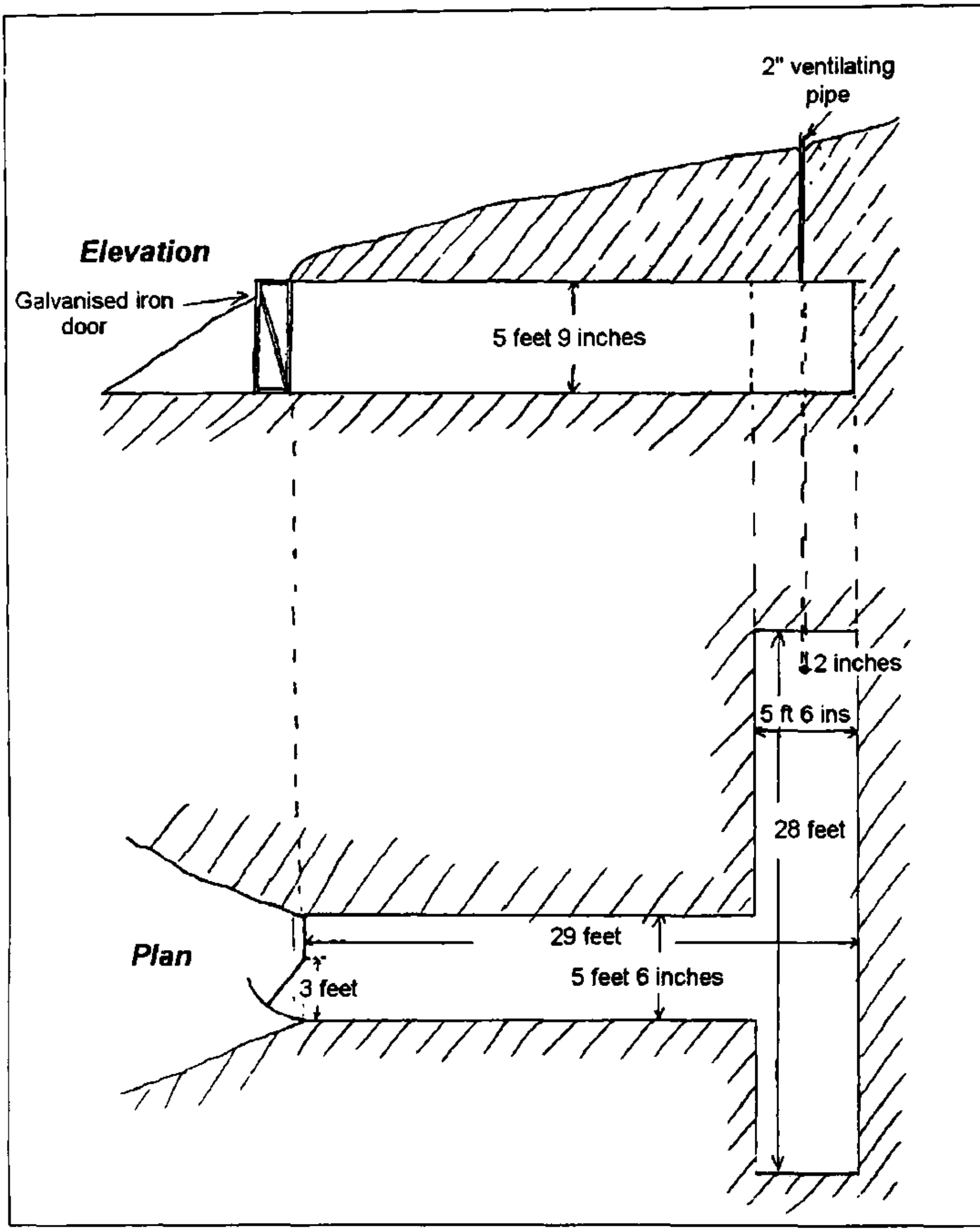

Figure 1. This dugout was constructed at Ezard's No.1 mill near Erica following the deaths of six men from fire at this mill site in 1932. With a safe place of refuge handy, the mill workers were able to stay at the site and save the mill from destruction in 1939. (FCV 40/280).

At the 1939 Royal Commission, Forests Commission Officers protested that they had done their best to get people to build dugouts, but that there was no power in the

Forests Act either to compel them or give them the right to do so. This was disputed by Judge Stretton, and documents produced at the Royal Commission proved that the Forests Commission was, at best, guilty of prevarication in this protest (Stretton 1939a3:2095-132).

Early in 1934, the Forests Commission had obtained an opinion from the Crown Solicitor as to its legal obligation if it inserted a clause in the Forest Regulations demanding the construction of dugouts. The Crown Solicitor replied that the Forests Commission could indeed insist on the construction of dugouts, but anyone getting into them must do so of their own volition so that the Forests Commission could not be held liable if a disaster occurred. The Crown Solicitor concluded that dugouts should be fitted with a sign warning people that they used the dugout at their own risk (FCV 34/1550). The Forests Commission may have indeed been caught between two evils:insisting on the construction of dugouts and then warning people against using them, or not insisting and merely encouraging the construction of dugouts in the hope of saving more lives.

Letters again went out at the start of the 1934-35 fire season 'strongly advising' the construction of dugouts. Forty-one-letters were sent out. Twenty-one replies were received and, for those sawmillers who neglected to reply, the Forests Commission had to rely on the previous year's reply for information. Over the two year period, ten sawmill managers had constructed dugouts and six stated that roads or creeks were available as escape routes or refuges. A total of twenty millers provided no information whatsoever on fire-protection for their employees (FCV 34/1550). Another appeal late in 1935 brought a similar response (FCV 35/404).

A small breakthrough was achieved in the Rubicon Forest the following year. Several meetings were held late in 1935 by members of the Australian Timber Workers Union at the Rubicon Forest mills, situated on the drier northern slopes of the Great Dividing Range. At these meetings, resolutions were passed requesting the construction of dugouts. The mill owners ignored the demand. The situation culminated in January 1936 in a public exchange of statements between two of the indirect participants, Commissioner W.W. Gay of the Forests Commission, and Mr Bodsworth, President of the Timber Workers Union. This resulted in a stern letter from the Forests Commission to the Rubicon mill owners virtually demanding that dugouts be built. In part, the letter read:

> In order to avoid any further unpleasantness between you and your employees and also undue embarrassment to the Commission, it is desirable that these dugouts be constructed immediately. It must be recognised that you, your employees and the Commission are interested in the Rubicon Reserve and it is most necessary that all work in harmony. I would point out that in the past, in the event of fire in this district, the men employed at the various mills have been to a very large extent, in fact almost wholly responsible for saving of the forest and also your mills. In the event of future fires the cooperation of the men is essential. This cooperation will be given all the more willingly if the men realised that the protection of the lives of their wives and children was considered by the millers, to the extent of providing this not very costly protection. I hope that there will be no further occasion to remind you of this matter, and that the necessary dugouts will be constructed. (FCV 36/288).

One month later, all eight of the mills in the Rubicon Forest had a dugout, although most were small and of rudimentary construction (Evans, 1994).

Another round of circulars was sent out at the start of the 1936-37 fire season. This time, the wording was stronger than before: 'Where considered necessary dugouts are to be constructed to provide retreats in case of danger'. This still did not persuade everyone. Forester Charles Elsey of Erica reported of one sawmiller:

> [He] has definitely intimated that he will not construct one and will contest every effort to force him to do so ..... [he] claims that it is degrading for people to cramp themselves in a hole in the ground. I believe that a dugout at this mill is absolutely essential. (FCV 36/288).

The 1939 fire

It is perhaps understandable that some sawmillers could not see the potential value of dugouts, which had not really been tested in a large fire. The period between 8 and 13 January 1939 provided all the testing anyone could ask for. It has not yet been possible to establish exactly how many dugouts were occupied during the 1939 fires, nor how many people survived in them. There is, however, substantial evidence to support the contention that the absence of a dugout at a sawmill or the decision not to use one vastly increased the chances that at least some of the mill inhabitants would be killed.

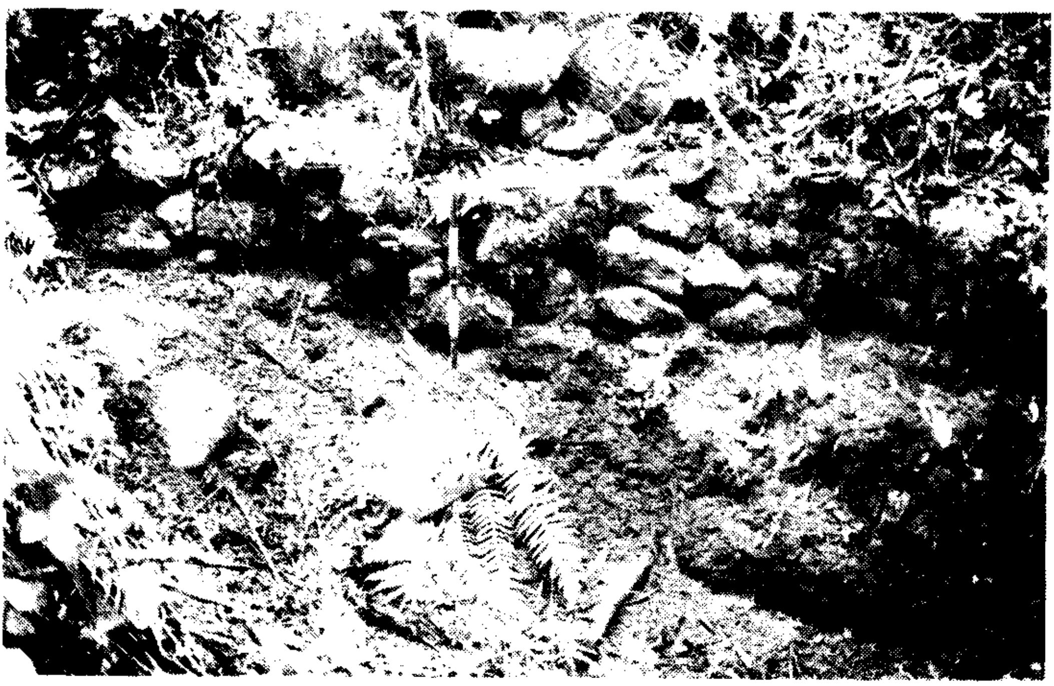

Figure 2. At the Ruoak No.3 mill in the Royston Valley, the mill hands filled the small dugout with furniture and fled. Four died. Some of the furniture is still embedded in the remains of the dugout today. *Photo: Peter Evans*

Despite the trouble taken by the mill workers to force the construction of dugouts in the Rubicon Forest, many decided not to trust them. At the Ruoak No.3 mill, workers crammed the dugout with their furniture and fled. The four slowest died (Stretton 1939a1:538,461-9). Some of their furniture is still there today, embedded in the collapsed remains of the dugout (Figure 2). On top of the Blue Range above the Ruoak No.2 mill, eight men attempted to save a lowering-gear winch by cutting a firebreak around it. The winch driver had begun the construction of a small dugout but, at the time of the fire, it was still incomplete (Stretton 1939a1:442-61; Ernie and Rose Le Brun, Ike Sims). All eight men died, and the winch was subsequently removed and never used again.

Figure 3. Several men survived the 1939 bushfires in this dugout at the Ruoak No.2 mill in the Rubicon Valley. The construction of the dugout resulted from pressure applied by the Timber Workers Union. Mill manager Frank Sims removes his saddle from the dugout following the fire. *Photo: Ike Sims*

Along the Acheron Way a small group of forest residents chose to abandon Feiglin's No.1 and No.2 mills, both of which had dugouts. Those who died were Frank Edwards, Kenneth Kerslake, Ellen Kerslake and Ruth Kerslake. Three quarry workers who accompanied them were also killed. Those who had left with plenty of time to spare, or who took to the dugouts, survived (Noble 1977:31-2; Sam Isaac, Keith Allan).

At both Britannia Creek and Matlock, Fred and Victor Yelland had used the defence of the availability of a brick house as an excuse not to build a dugout (FCV 34/1550). As a token gesture a small dugout was constructed at the Matlock mill, but was so poorly built that it had partially collapsed shortly after completion. When fire swept over the mill on 13 January 1939, Vera Maynard died when she was unable to escape from the brick house after it caught fire (Stretton 1939a1:763-73).

Just south of Yelland's mill was the mill of J.M. and C.V. Fitzpatrick. Fifteen men died and one survived. Fire protection at this mill was the subject of scathing criticism from Royal Commissioner Stretton. Scrub came right up to the borders of the mill and there was no dugout, despite 'requests' from Forest Officers that one should be constructed. The sole survivor, George Sellars, found a cleared spot, wrapped himself in a wet blanket, and waited for the fire to pass (Stretton 1939a3:770-1; Stretton 1939b:5). Sellars never fully recovered from his ordeal (Sam Isaac).

Only three people died in a dugout during the 1939 bushfires, but this may have more to do with social pressures than with any inherent drawback in the concept of the dugout. The dead were Ben Saxton, his wife Dorothy Saxton and a young mill worker named Michael Gorey. The Saxton brothers' mill was moved to Tanjil Bren in 1937 (Saxton, n.d.). The brothers, Ben, Jack, Wilbur and Eric had been born and raised not far from the site of the 1926 disaster at Worlley's mill. Their father, Alfred Saxton, believed that, had the inhabitants of Worlley's mill sought shelter in a mine tunnel nearby, none would have been killed. The Saxton brothers were therefore favourably disposed towards dugouts and had constructed two at the Tanjil Bren sawmill (Stretton 1939a2:1063-1063A).

The first and largest of these consisted of a long tunnel into the hillside with an entrance facing south. It was intended for the mill workers. As fire approached on 13 January 1939, Jack Saxton and thirty mill workers entered the larger dugout. At the height of the fire, the six men holding the wet blankets across the entrance had to be relieved every two minutes due to the intense heat. Two others were engaged in bringing water to the entrance to keep the blankets wet. There were sufficient men in the dugout to enable enough relays at the entrance for all to survive the fire relatively unscathed. In dugouts, there was apparently safety in numbers.

The second dugout was smaller and adjacent to the house occupied by mill manager Ben Saxton and his wife Dorothy. This dugout faced east. As the fire approached, Ben Saxton, Dorothy Saxton and a young timber worker named Michael Gorey entered the smaller dugout. When the worst of the fire had passed over, all three were found dead. Ben Saxton appeared to have sustained head injuries when the front of the dugout caught fire and collapsed, but the others appeared to have died from suffocation. There was still a supply of water in the dugout (*Narracan Shire Advocate*, 7 April 1939). Social pressure may have induced the mill manager and his wife to segregate themselves from the main body of workers and, if so, this probably resulted in their deaths. With only one other person for assistance, it is unlikely that they would ever have been able to effectively protect the entrance to the dugout. Just south of Tanjil Bren, paling splitter Frank Poynton, farmer Ben Rowley, his wife Agnes Rowley and their three children all perished for want of shelter from the fire.

Post-1939 dugouts

The 1939 fires demonstrated without doubt the efficacy of dugouts as a refuge from fire. Less than a week after the fires ended, the first sawmilling company applied for particulars for the construction of a dugout. Hayden Brothers of Barwon Downs were sent plans of Ezard's dugouts at Erica which had proved effective and had enabled the employees to save the mill without placing themselves in danger. By early 1940, Forest Officer Torbet was able to report that most millers were eager to construct dugouts, but that they wanted plans to indicate what to build. After fighting to have dugouts constructed for seven years, the Forests Commission still had no definite design for a dugout apart from the plan put forward by Mervyn Bill in 1932. Hurried consultations were sought with the Department of Mines and the Department of Health, and minimum requirements were drawn up (FCV 39/180). The Australian Timber Workers Union also took a hand, instructing their members not to accept employment at any mill unless the installation of a dugout was the first work carried out at the site (*The Argus*, 19 January 1939).

The *Forests Act* 1939 came into force in January 1940, and for the first time there were gazetted regulations to force sawmillers to construct dugouts. Dugouts had to be approved by a Mines Department Inspector, contain forty gallons of drinking water, electric torches with spare batteries and globes, sanitary pans with deodorants and a first-aid kit. A person in charge of the dugout had to be nominated and it was forbidden to use the dugout to store anything except the prescribed emergency equipment (*Government Gazette* 13, 31 January 1940).

Different designs for mill and winch dugouts were drawn up and despatched to sawmillers with a general time limit for construction of the end of September 1940. Specifications included the provision of ninety cubic feet of air and forty square feet of cooling surface (walls, floor and roof) for each person. They were designed to be occupied for six hours. The entrance frame to the dugout had to be made of metal, all timber had to be protected by three feet of earth or rocks, no air vents were allowed, and there had to be a traverse at the entrance. In 1948, the regulations were strengthened and the first-aid kit upgraded to include antibiotics. The location of dugouts was to be clearly indicated with a sign displaying the word 'DUGOUT' in black letters eight inches high on a yellow background. The basic design was adopted by the Country Roads Board, the Melbourne and Metropolitan Board of Works, the Forestry Commission of New South Wales and, eventually, by the Snowy Mountains Authority (FCV 40/280).

Even after the gradual withdrawal of sawmills from forest areas had begun, dugouts continued to be constructed at logging sites, forest work camps and road construction camps. The dugout became the universal cultural response to fire in Victorian forests, and no forest worker was far from one in the 1940s and 1950s. There are nearly 600 historic sawmill sites in or on the fringes of the Central Highland forests (Evans 1993a1:Appendix). If only one-third of these had dugouts there are at least two hundred sawmill dugout sites in these Ash forest areas. Add to this an estimated one hundred constructed for logging, work camp and roading purposes, and several at the bases of fire towers and in small forest towns and the wide distribution of this reaction to the threat of death by forest fire can be readily appreciated. However, the removal of most aspects of forest industry with the exception of logging operations to rural towns in the 1950s diminished the need for dugouts, and most were left to decay and collapse. Many were deliberately destroyed and only a few, mostly beside well-used forest roads, are now maintained. It is somewhat ironic that few of the post-1939 dugouts would have been tested by fire.

Dugouts today

With the absorption of the Forests Commission of Victoria into the Department of Conservation Forests and Lands in 1984 (Moulds 1991:210) the emphasis on maintenance of dugouts disappeared. There are now more dugouts maintained by Vic Roads and the residents of small forest townships than by the Department actually responsible for forests. Only one departmental dugout, that at Tanjil Bren, is regularly maintained. During a recent survey of historic fire sites in the Central Highland Forests it was discovered that a large and relatively intact former Melbourne Metropolitan Board of Works dugout at The Oaks near Matlock had been destroyed. At the time, logging operations were being conducted nearby. Officers from the Department of

Natural Resources and Environment (a successor to the Department of Conservation Forests and Lands) appear to have an ambivalent attitude to old dugouts. Some recognise them as having historic value, to others they are a management problem, and many have been deliberately destroyed during roading operations or to render them 'safer'. One report of a dugout as an historic site to the Historic Places Section of the Department notes with some displeasure that 'this dugout has claimed one bulldozer already'.

The fire refuge dugout was a mid-twentieth century phenomenon, a cultural reaction to the threat of fire in the mountain ash forests of Victoria. With few people living in the forest today, and with improved road networks, this threat has largely been ignored. With only a small number of dugouts now maintained, it is to be hoped that no forest traveller ever again has to seek safety underground.

Acknowledgment

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Ernie and Rose Le Brun, 12 August 1986. Residents of the Rubicon Forest in 1939 where Ernie was 'bush-boss' for the Rubicon Lumber and Tramway Company. Ernie was one of the last to see the eight men killed at the No.2 mill lowering gear on the Blue Range alive.

Norman 'Ike' Sims, 13 July 1992 and 19 September 1992. The late Ike Sims survived the 1939 bushfires immersed in the Rubicon River. His uncle was killed at the No.2 mill lowering gear on the Blue Range. Ike accompanied the writer on a visit to the Royston Valley fire-death sites in 1992 and pointed out the approximate positions in which the bodies lay.

Sam Isaac and Keith Allan, 21 July 1991 and 23 June 1995. Sam Isaac and Keith Allan worked at Feiglin's No.1 and No.2 mills both before and after the 1939 bushfires. Following the 1939 fires, Sam worked at the St Clair No.1 mill with George Sellars, the sole survivor from Fitzpatrick's mill.

Ernie Stocks, (date not recorded). Former timber worker Sam Isaac kindly supplied a cassette recording of an interview with the late Ernie Stocks. Ernie had worked at Worlley's mill at Beenak before the 1926 fires and was an occupant of the earliest recorded fire-refuge dugout in 1932.

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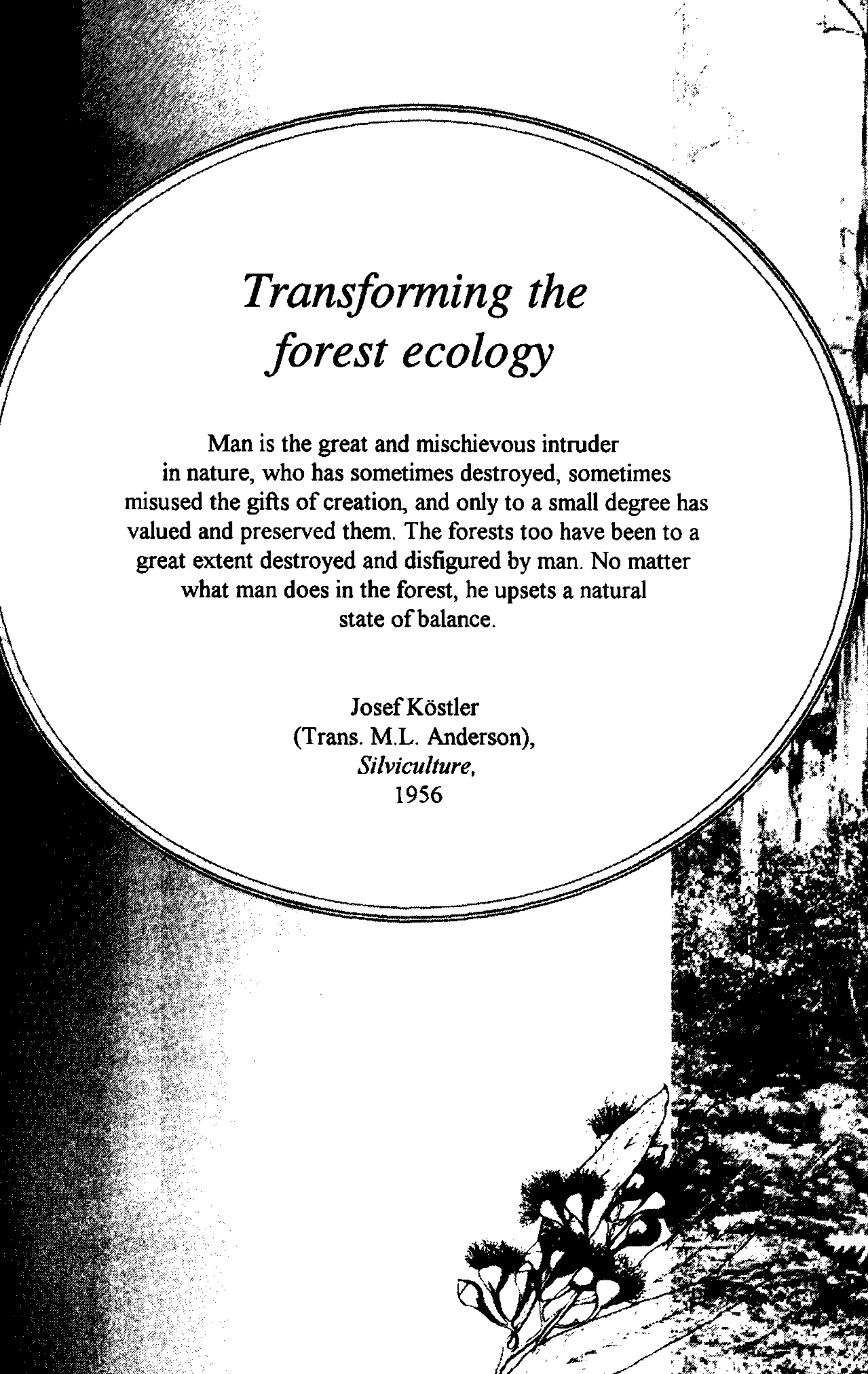
The Sun News Pictorial, *The Age* and the *Lilydale Express* for the week following the 1926 bushfires.

Wood, Syd. (n.d.) Bush Fire. Typescript regarding dugout built in 1932. Copy kindly supplied by Sam Isaac, who later worked with Ernie Stocks, one of the men who shared the dugout.



Transforming the forest ecology

Man is the great and mischievous intruder in nature, who has sometimes destroyed, sometimes misused the gifts of creation, and only to a small degree has valued and preserved them. The forests too have been to a great extent destroyed and disfigured by man. No matter what man does in the forest, he upsets a natural state of balance.

Josef Köstler
(Trans. M.L. Anderson),
Silviculture,
1956

19

Forests of East Gippsland before the Europeans

Moray Douglas

Introduction

Forests are constantly changing, affected by actions and incidents in the recent and distant past. It is difficult to capture their essence at any particular time, and now, some 160 years after the arrival of the Europeans, any interpretation of what they were like before that can only be speculative. It is made more difficult by the profound nature of the changes that they brought about.

East Gippsland was of course occupied. The Aboriginal people had been living there for possibly thousands of years. They made great use of the forests and managed them through the use of fire. The forests encountered by the Europeans were a product of their burning, combined with the natural incidence of fire. As Hope and Kirkpatrick (1988) pointed out, the nature of Australian vegetation is significantly affected by its fire history. Knowledge of that history would enable a better appreciation of the forests as they were at the time, however it has not been possible in this paper to consider it in any detail. Rather, some understanding of the nature of these forests has been gained through a study of the few records left by the early Europeans, relevant comments of later observers and more recent studies of trees and of the forests. There is a thread of 'sameness' which runs through the records and the comments which is significant in it revealing the consistency within the types of forest across the region and their stability over time.

The East Gippsland considered in this study is a very large region which extends from Maffra to Mallacoota and includes the Omeo District (Figure 1). It encompasses an area similar to that adopted for the history of land use in the region, *Land to pasture*, edited by Keith McCrae (1978).

Descriptions left by the first Europeans, 1798-1850

The early Europeans were primarily interested in areas with potential for grazing or settlement. The terms they used are coloured so: 'good forest' meant a timbered area with a good grassy ground cover, while 'poor forest' meant little grass. They did not relate to tree size, or their timber. 'Open forest' could mean widely spaced trees, or woodland, but it could also mean free of regrowth or scrub.

Vegetation descriptions invariably record whether the understorey was predominately grass or scrub, and the quality of the grass was often noted. Scrub could include young Eucalypt regrowth, shrubs or fern. The tree species were referred to in the broad groups of 'box', 'gum' and 'stringybark', each of which could cover a number of distinct Eucalypt species. Comments on the tree cover and the soil type, or quality, were sometimes recorded.

These early reports were made when the Aborigines were still following their traditional way of life, so that the forests they described were contingent on the burning regime of the time. However, the reports make very few references to fire or to recent burning, perhaps because it was so common as to be not worth noting.

The routes taken by these first Europeans covered a restricted area so that only limited early records of the vegetation are available, while for much of East Gippsland, particularly for the forested mountains, there are no records at all. George Bass was the first European to record his impressions of the vegetation of East Gippsland when, on his journey through Bass Strait, he landed at Wingan Inlet in 1797. His journal entry, includes the comments:

> The general productions are short deformed gum trees, the tea tree, some small shrubs and patches of an almost impenetrable underwood of small brush ground fern and vines. The foliage of the underwood is rich and green but the trees are far more dusky and brown than I have seen anywhere else. A luxuriant crop of grass may occasionally be found in the places where the underwood has thinned off but the soil is still the same. Where thick grass belly high and fern plants are growing together one might expect a better soil but it is only blackish sand like the rest. (Bladen 1895)

Further exploration by Bass led him to conclude that the poor soils continued further inland. On his return journey Bass put ashore further west at a place he described as nothing but dried-up swamps and sand hills. His adverse comments almost certainly dissuaded any early attempt at settlement.

It was 1835 before the next record was left. George McKillop, under instructions from Captain Hovell, explored the country between Maneroo (Monaro) and Westernport. He reached as far as Omeo (Greig 1912), noting that the country was very rugged and only partially suitable for grazing:

> except a small area about 5 mile square [3200 ha] called Lake Omeo, a little to the east of the Mitchell (Mitta Mitta) River where the land is nearly free from timber and the downs are covered with a most luxurious sward of kangaroo and other grasses.

He also described the Great Divide to the south, as a range of low scrubby hills.

The open nature of the Omeo Plains was commented on by John Pendergast, one of the squatters who took up a run there in 1836 (Pendergast 1968). He noted that open areas, bordered by scattered large gums, extended from the Mitta Mitta River through to Beloka. Blackwood and honeysuckle lined the northern slopes to Lake Omeo, while further north the gums were thicker and the area was known as the forest. But it was Angus McMillan who opened up East Gippsland to the squatters with his exploratory journey from Ensay to the Latrobe River. He later made some relevant comments on the vegetation through which he had passed. In May 1839 he travelled from Tubbut through open forest with kangaroo grass to the Snowy River. He encountered dense scrub along the range west of the Snowy River to Mt Mcleod. He then headed for Omeo, but the difficulties he met with were so severe, that the journey took him fourteen days (Cox 1973).

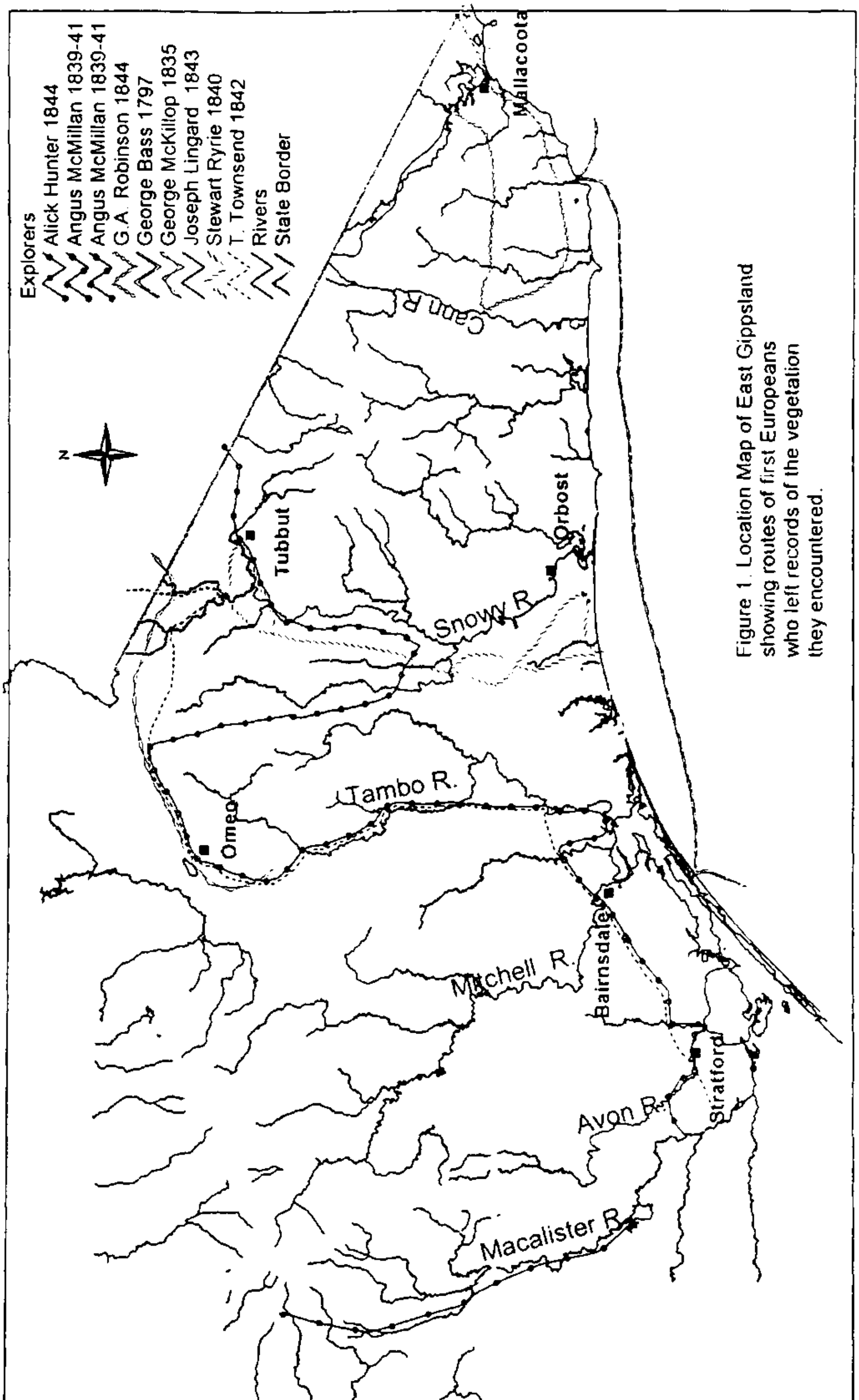


Figure 1. Location Map of East Gippsland showing routes of first Europeans who left records of the vegetation they encountered.

Six months later, travelling south from Ensay he struck thick scrub on the ranges and after 'a fearful journey of four days over some of the worst country I have seen', he eventually reached the Bruthen flats. McMillan had now arrived on the edge of the coastal plain. He described the next seven days journey as follows:

> On 15th. January camped on River Tambo and on 16th. started down the Tambo, the country we passed through was open forest, well grassed, timber consisting chiefly of red and white gum, box, he and she oak, and occasional wattle. Arrived at lake, north of lake beautiful open forest with grass up to stirrup irons swarming with kangaroos and emus. We then crossed the Nicholson high up. On 19th. January crossed the Mitchell and headed S. W. through fine open forest. She oak red and white gum for about 18 miles [29 km]. Camped at Chain of Ponds (Providence Ponds) then S.W. to lake. On 21st. travelled S.W. came to Avon after 4 miles [6.4 km] flowing through fine open forest. Followed it all day. Crossed it about 12 miles [19 km] from the mountains. The country around and beyond the place we crossed consisted of beautiful rich open plains which seemed to extend to the mountains. On the 22nd.we travelled S.W. across beautiful country consisting of fine open plains intersected by numerous belts of open forest extending to the lakes in the east and N.W. to the foot of the mountains. The Macalister was reached after travelling 10 miles [16 km]. (Bride 1898).

McMillan kept quiet about his discoveries, but Strezlecki, who followed shortly behind him, did publicise the rich pastures of the Gippsland plains, which led squatters to rush to the area. However, Strezlecki gave few other details of the vegetation he encountered in East Gippsland (1845).

In 1840 Stewart Ryrie was commissioned by the New South Wales Government to report on the squatting districts. He travelled from Tubbut to Buchan then through to the coast, west of the Snowy River entrance. He recorded in his journal (1840) that the box forests of the Deddick, Snowy and Buchan valleys were open and grassy, as were the tablelands of Gelantipy and Wulgulmerang. These had been missed by McMillan. Between the Buchan River and the coast, Ryrie crossed stony scrubby ranges, then passed through a thick tall forest of stringybark with some ironbark, an undergrowth of scrub and rushes, but no grass and with sandy soils. He found Ewings Morass covered in reeds, rushes and a little grass. Thick scrub and boggy creeks prevented him from reaching the mouth of the Snowy River. He returned to Buchan by a more easterly route which was timbered with box and gum, in addition to stringybark and ironbark and was freer from scrub, with a little grass. Later he crossed a level, thickly timbered, scrubby area of sandy soil (Tea tree Creek) before reaching Buchan. He returned to Tubbut via the Guttamurgh Creek valley which he noted as having good grass, and then travelled through open forest back to Tubbut. Ryrie also visited the far east coast the same year, noting the poor soils and scrubby vegetation found between Mallacoota and Genoa.

The next information on the vegetation of East Gippsland was recorded by a surveyor, T. Townsend. Surveyors were required to report on the nature of the country they traversed, including in their reports descriptions of the vegetation, soils, and other aspects which could help assess the suitability for settlement. By 1842 Gippsland was developing rapidly and Townsend was instructed to survey the now well-used road between Alberton and the Monaro. The road from the Avon River to Ensay generally followed McMillan's route and being only two years later, the notes recorded by Townsend on his survey plan (1842) greatly expand McMillan's comments and are a valuable guide to the pre-European vegetation. They confirm

McMillan's comments with respect to the better grassed areas, but with Townsend's closer attention to detail, the strong correlation between the presence of grass and the better soil types, often revealed by indicator species such as box or gum, is very apparent. Conversely, his notes indicate that scrub was invariably associated with poor soils, often sandy but sometimes barren, with stringybark as the indicator species. North from Ensay he made the pertinent observation that the grasses extended from the Tambo to the summit of the ranges on either side. He found the ranges above the Tongio Gap thickly wooded. He associated the poor scrubby forest on the north-west side of Splitters Range, around Mt Leinster and between the Limestone Creek and the Indgegoodbee River, with poor soil. Elsewhere he reported good grassy forest. His reference to 'thick scrub' at the top of the Sand Hill is his only reference to scrub density.

Alick Hunter in 1844 on his journey to Gippsland from Devils River, (Mansfield) noted that a great deal of scrub had grown up on the ridge in to the Barclay River, since his previous trip in 1841, indicating that the ridge must have been burnt not long prior to this earlier trip (Daley 1927). Later he observed grassy flats on the Barkly River, scrubby banks along the Macalister, and beautiful open, grassy hills around Licola.

East of the Snowy, there were only isolated settlements close to what would eventually be the New South Wales border, when in 1843, Joseph Lingard visited the southern Monaro, Wangarabelle, Genoa and Mallacoota seeking specimens and skins of animals. As well as notes on the fauna, Lingard (1846) made some relevant comments on the vegetation he encountered: South of Bondi (near the New South Wales-Victorian border) he noted trees of an 'incredible size' and found the forest too dense for his horse and cart. From Wangarabelle to Genoa he crossed grasstree flats and journeyed through a very thick forest with very large timber. Between Genoa and Mallacoota he had to cut a path through a thick growth of saplings, then travel across flats with tall trees, large dead logs and creeping vines, as well as areas of scrub and bog.

In 1844 George Robinson, the Protector of Aborigines, visited East Gippsland. He travelled through Omeo and down to the Snowy near the New South Wales border and recorded:

> Callitris from 4 to 5 ft. [3-3.6 m] in circumference grew amid shrubs of every kind. The country is well grassed and abounds with cattle, the soil varies from a rich black mould to a chocolate.

He then crossed over the Monaro and down to the coast at Twofold Bay. From there he travelled along the coast past Cape Howe and Mallacoota, to Cann River, then returned by an inland route to Genoa and Wallagaraugh. He observed that the ranges were thickly timbered and the country generally scrubby (Mackaness 1941).

The descriptions left by these early Europeans clearly depicted the open and grassy nature of the red gum and box forests of the plains and valleys, and the gum forests of the tablelands, while the stringybark forests of the foothills, the mountain forests and the coastal forests east of Lake Tyers were almost invariably found to have a scrubby understorey. Little can be deduced on the age of the trees or forest. The only comments on tree size were made by Lingard and these must be treated with caution as, in his comments on the fauna, he was prone to exaggeration.

Some indication of previous fire history can be gained from references to thick or dense scrub or saplings. Townsend's comments on thick scrub at the top of the sandhill, and McMillan's problems with scrub west of the Snowy and south of Ensay, point to those areas not having been burnt for some time, but it is not clear whether it was unburnt scrub between Mt Mcleod and Omeo, or early snow on the mountains which made that trip such an ordeal. Lingard's references to a thick growth of saplings point to a severe fire in the not too distant past. Ryrie's return route from the coast where there was less scrub and some grass may have been through a more recently burnt area, but also the presence of box may indicate that the soil was better. Hunter's remarks on the growth of scrub on the spur to the Barkly River since a previous trip, is the only comment which definitely points to a recent burn, though such burns may have been too common to be worth mentioning. Overall it is not possible to deduce the extent to which the forests had been affected by recent burning, but it seems that there were substantial areas which had not been burnt for some time.

By 1850 the squatters were very much in control of the area west of the Snowy River and the Aborigines had virtually ceased to follow their traditional way of life; the fire regime was significantly different, with indications that burning was much less frequent (Howitt 1890). Nevertheless, there were some later observations which are of value in understanding the pre-European forests.

Descriptions of the forests by later observers

Between 1849 and 1851 J. Wilkinson undertook surveys of the rivers from the Thomson to the Tambo. Wilkinson's (1849-51) notes on his survey plans indicate that the vegetation structure along all the lower courses of these rivers was very similar. The stream banks were normally scrubby, the alluvial flood plains often densely timbered and frequently scrubby, and the lower slopes of the valleys were usually open forests of box and gum which led back to scrubby stringybark ranges.

In the case of the Mitchell River, Wilkinson (1850) also wrote a report on his survey which gave additional information, particularly on the upper river. Above Glenaladale he noted that the banks were generally rocky and scrubby. Following the Dargo River he found an area of hilly open forest on decomposed granite before it ran through dense scrub above Spring Creek. Along the Wonnangatta River the banks were generally rock, then a series of narrow, densely timbered and scrubby flats, with some patches of open box or gum forests and scrubby ranges above. He surveyed to eight miles [13 km] above the Moroka junction where he found: 'the flats are densely scrubby with vast quantities of dead timber strewn over them.' Along the Wentworth River he noted:

> The Wentworth runs through rocky sterile country and its narrow valley is filled by a dense entangled scrub of myrtle, wattle, blackthorn, briar and difficult to penetrate. With the exception of poor stringybark forest about 2 miles [5 km] from its mouth, it doesn't contain any land suitable for pasture.

He also surveyed around the Gippsland Lakes from Eagle Point to the Avon River, with his notes further confirming the relationship between the soil and the nature of the forest and its understorey. In all his surveys his only reference to tree size was a reference to some big gums on the north side of the Mitchell below its junction with Boggy Creek

The Government Botanist, Ferdinand von Mueller made three expeditions into East Gippsland (von Mueller 1854-55). His reports dealt largely with the discovery of new species, but he did make some general comments on the vegetation which are of value. On his first expedition he reached the mouth of the Brodribb River in March 1854 where he noted the presence of rain forest. On his second expedition, in November 1854, he travelled from Stratford up the ranges of the Avon, which he described as barren, scrubby and in many places densely timbered. He crossed the Mitchell River and up the divide between the Dargo and Wentworth rivers and recorded:

> Proceeding along the Dargo which flows through some luxuriously grassed recesses of the mountains I advanced through difficult country to the Bogong range. A dense scrub and total absence of water on the Wentworth ranges rendering the progress tedious until I reached the dividing range towards the source of the Cobungra. Here open valleys give access to the central range in almost every direction and a profusion of grass attracts cattle in the summer months. The low scrubby underwood disappears with the stringybark and box eucalypts, the dwarf forests of mountain gum trees which replace them may be avoided and offer little obstruction to the traveller.

Alfred Howitt led the Government's Gippsland Prospecting Party No.2 in an exploration of the tributaries of the Mitchell River. In his report Howitt (1860-61) described the topography and made numerous references to the vegetation he passed through. He prospected the upper watershed of the Mitchell River, commencing his survey from Quag Munjie, McMillan's Dargo outstation. Howitt's comments on the vegetation of the lower Dargo River and Wentworth River valleys are in line with those of Wilkinson and Von Mueller. However, in the upper Dargo he did note the absence of scrub and the presence of grass under a forest of peppermint and stringybark. He also noted that on the Long Spur there were patches of a dense scrub of gum saplings, hop and prickly accacia, and from Basalt Nob:

> I obtained a view of the basin of the Mitchell, probably 20 to 30 miles across, it forms a triangle the apex of which is where the Mitchell runs past Castle Hill. The basin appears to be a tract of ranges of no great height, but covered with a dense scrub which has grown up after some great fire has destroyed the timber in the whole of this basin.

It is not possible to say with certainty when this fire was but it could have been about 1840, (when stands were established at Grant, Mt Ewan and Conglomerate Creek; see Appendix 1) and perhaps was responsible for the dense scrub and fallen dead timber reported by Wilkinson. The regrowth Howitt later noted at Mt Selwyn was almost certainly a result of the 1851 conflagration. He also noted (in the Upper Humphrey River) a dense stand of hop of an unusual size and thickness, indicating an area unburnt for many years. Howitt's only reference to large trees were those he noted south of Mt Birregun.

In 1864 McMillan (1865), who was in charge of the construction of a road from Omeo to the Jordon, confirmed Howitt's comments on the scrub along the Dargo-Crooked River Divide, noting too that between Omeo and Grant it was lightly timbered with good sound trees suitable for mining and other purposes.

A field geologist, Norman Taylor (1864), travelled extensively east of the Snowy River. Alhough his report made few references to the vegetation, he did comment on the extremely scrubby nature of most of the area, with the river flats of the Genoa and Cann rivers being the only exceptions. He noted the presence of 'Pheasant Scrub', an impenetrable wall of various shrubs growing to 10 feet [3 m] high, found on dry rocky northern slopes in the vicinity of Mt. Whittakers. On the climb up to Mt. Tingaringy, he observed patches of dense forests of tall straight wattles. Taylor's report is interesting in that the pheasant scrub and wattle patches are still found there today.

The comments made by Surveyor E.L.Bruce (1870) on the vegetation of the lower Snowy River, noted on his plan of survey, are of interest. He recorded that rainforest was found in a strip along the Brodribb, with patches at Corringle, Newmerella, Betebelong and the top of the flats at Jarrahmond. Most of the flats were grass or fern with a number of morasses, and the rainforest was quite limited in extent.

These reports generally confirm the earlier notes on the vegetation of the forests, with respect to the forest types carrying grass and those which were scrubby. This suggests that the undergrowth was relatively stable and not related to its immediate fire history. Howitt deduced the occurrence of severe fires in the upper Mitchell from the dense regrowth (gum scrub) he found, one of which could have related to pre-European times. The isolated references to tree size or age tell us little. Knowledge of tree size and age would greatly help in understanding the nature of these forests and fortunately some information is available both from later descriptions, and also from more recent studies of forests and trees, which compensates for the meagre references in the early reports.

The age of trees or stands at the time the Europeans arrived

Frederick D'A. Vincent (1887) provides the only known written report giving some details of the magnificent grey box forest which formerly extended from Swan Reach to Lake Tyers. He noted that, 'the trees run up to a height of 60-80 feet [18-24 m] without a branch with 10-14 feet [3-4.3 m] girth, as clean and as sraight as gun barrels'. These older trees, most probably established about 1750, were mixed with young trees of all ages and an understorey of grass.

In the late 1880s three separate accounts were given of the area between Cabbage Tree Creek and the Coast Range. James Stirling (1888) a geologist who inspected the area and reported on its suitability for settlement, refers to the difficulties that the large trees and jungle along the flats of the Glen Arte River and the McKenzie River would create when clearing for settlement. Also, when referring to the heads of the Brodribb, Bemm and Cann rivers on the south side of the Coast Range he commented:

> While it is patent that many of the great gums exeed 350 feet [107 m] I have not yet observed any of 400 feet [122 m], the tallest trees are not necessarily those of the greatest girth, I have certainly measured trees fully 40 feet [12 m] in circumference but as a rule the smaller trees had a circumference of 20-30 feet [6-9 m].

He also refers to sassafras at Mt Goonmirk with trees of 120-150 feet [36-46 m] with trunks 6 feet [1.8 m] in diameter. Edwin Merral (1887) in his visit to the same area referred to giant gums in the head of St Patricks Creek, in an otherwise wattle forest, and also to sassafras over 3 feet [0.9m] in diameter on the Coast Range. However he made no comments supporting Stirling on the immense size of the trees on the coast range. Neither did Baldwin Spencer (1889), whose only references to tree size, in his detailed report on the vegetation of this area, were his comments on the scrub of young gum trees on the lower ridges, huge white gums in the head of Cabbage Tree Creek, and lofty white gums in the head of the Errinundra. Stirlings account of tree size is certainly exaggerated, for though there were very large trees they would not have exeeded 300 feet [91m] and very few trees would have had the diameter referred to. He gives a very misleading impression of what the forest as a whole would have been like, as shown by the assessments of the area (Forests Commission 1930-70).

Overall these descriptions show that though there were some very large trees, that is, trees which could have been established before 1700, most of the trees were not noticeably large and so were probably established after 1750.

Howitt, in his paper on the 'Eucalypts of Gippsland' (1890), commented on the pervading presence of regrowth, but his only references to older trees, were to scattered gigantic dead alpine ash near Mt Wellington, large box in the upper Snowy valley and a few very large yellow box to be found in the Wellington and Macalister valleys. It is likely that these trees were established before 1750, but elsewhere, presumably most of the trees were smaller, and hence younger. Overall, Howitt concluded that the forests in pre-European times were more open than they were in 1890, ie. there was an absence of significant regrowth. He attributed the increase in density to the reduction in burning. His comments mostly relate to the box or gum, open forests or woodland, but he also referred to some mountain forests, though these latter areas had been severely burnt circa 1840 and, or 1851, and most likely it was the regrowth from these intense fires which had made these forests denser.

K.C. Rodgers (Wakefield 1970) and J.O. Holston (1939), who both had extensive experience in bush grazing at the beginning of the century, supported the original open nature of the tableland forests but proposed that the increase in their density, and that of the scrub, was due to the subsequent increase in the frequency and severity of fires. This was contrary to the more commonly held view that it was due to the reduction in fires.

In recent years a number of studies on and adjacent to the Errinundra plateau have determined tree ages (Griffin 1962; Piercy and Woodgate 1984; Barker 1991; Woodgate and others 1994; Chesterfield 1996). Some of the timber reconnaisances and assessments over wide areas of the commercially valuable forests (Forests Commission 1930-70), also provide information about age. Usually the trees were described as overmature, mature, immature or regrowth but in some cases estimates of tree age were given. In some assessments trees were felled and the rings counted to check their age, but generally the ages were deduced from the size of the trees and the condition of their crowns. As a rule, the age was estimated to the nearest 10 or 50 years, so that only rough estimates of the date of establishment are possible. Details of the studies and estimates are shown in Appendix 1. There are no age estimates available for the large areas of no commercial value.

Low elevation mixed species

Most of the stands were mature, often fire damaged. Few estimates of the age of these trees were given, (these species do not have reliable annual growth rings) but from the tree size it would seem that most would have established between 1800-1850, or later. In a study of silvertop, the oldest tree measured was found to have established in 1840 (Incoll 1974). Severely fire-damaged overmature trees were also found, more commonly in the sheltered gullies. Usually no attempt was made to age these trees but it is likely they would have originated before 1800.

Alpine ash
Large areas were killed by fire between 1851-1939, so information on the earlier forest is limited. Of the pre-1850 stands remaining, most were established between 1800-1840, with very limited older stands or trees, originating before 1750.

Mountain ash and shining gum
Most mountain ash stands were established between 1800-1840 with scattered, severely fire-damaged older trees before 1750. Stands of shining gum were established on the Errinundra plateau c. 1730, c.1760 or c.1800, while scattered trees of this age or older were found across its range. These trees were relatively free of fire damage.

High elevation mixed species
From the estimated ages and the run of sizes of assessed trees, most trees established between 1790-1840, though in the ranges east of the Snowy large, relatively undamaged, old overmature trees formed a significant proportion of the stands. Elsewhere these were less common and usually had suffered severe fire damage. Establishment dates, if given, were pre-1750, and it is likely that many of the largest trees over 3 m diameter were pre-1700. These larger trees occurred in the wetter mountain forests and to have reached this large size they presumably escaped severe fires early in their lives.

From these estimates of tree ages it is apparent that a substantial proportion of the trees in most forests originated between 1790 and 1840, i.e. they were regrowth or young trees at the time the Europeans arrived, though mature trees, i.e. established before 1750, also occurred. However the extent to which older trees were present cannot now be determined due to their subsequent destruction by fire. The Errinundra plateau and surrounds has been relatively free from fires and had a higher proportion of older trees, but even there, the predominant age of the tree stands, circa.1840, would have been from 40-110 years.

The nature of the forests when the Europeans arrived

The records provided by the first Europeans, the fragmentary comments of different observers from 1850 to 1890, together with the information which can be gleaned from the assessments and more recent studies, provide only very limited details. However these are sufficient to give an overall impression of the extent of tree cover, the size of the trees and the nature of the understorey.

Tree cover
East Gippsland was almost completely covered in forests, with only limited treeless areas including the Gippsland plains, the Omeo plains and the Bogong, Dargo, Nunniong and other small high plains, as well as isolated clearings, coastal heaths and grasstree plains.

As a rule the redgum and box of the lake margins and plains, the box of the inland valleys and the gum of the tablelands occurred as open forest. Often these forests would have been comprised of widely spaced trees, more correctly described as woodland. But some well stocked stands, particularly of redgum, occurred. These were able to support the timber industry for many years.

The mixed species forests of the coast and the foothills, together with the mountain forests, were almost invariably thickly or densely timbered, with only small areas lightly stocked with large trees. There were also small areas not dominated by eucalypts including patches of rainforest, silver wattle stands in the moister forests, and patches of wattle and other shrub species on some drier sites.

Tree size and age or maturity

There is little information available on tree size or age in the box and gum open forests or woodlands. The red gum forests had a substantial component of medium to large sized trees as evidenced by the extensive harvesting of saw logs and sleepers in later years. There are few references to very large trees, though this absence of comment may have meant that large open grown trees were too common to have been worth noting. The term 'open forest' which was almost invariably applied indicates that regrowth or recent regeneration was limited.

The low elevation mixed species forests were usually well or densely stocked.There would have been a range of tree sizes with a substantial proportion of immature stems, and a significant number of mature trees. Patches of regeneration would have been found and older, large trees would have occurred, but to what extent is not known.

Generally mountain ash occurred in even-aged mature, immature or regrowth stands, although two-aged stands were found as well as limited overmature stands near Mt Wellington and at Goonmirk Rocks. However large areas were burnt in severe fires from 1850 on, making it difficult to know what existed previously on substantial areas. Regrowth stands of alpine ash occurred extensively, older trees and stands were found, but subsequent severe fires have made it impossible to know their extent.

On the Errinundra Plateau and surrounds, mature stands of shining gum approximately 110 years old with younger, 40-80 years trees occurred, along with older overmature trees.

Most of the high elevation mixed species forests would have had a substantial proportion of immature trees or regrowth, but older trees, mature or overmature also occurred. In the mountain forests north of Orbost, the older trees were quite common, but elsewhere subsequent severe fires have made it hard to estimate their extent.

Understorey and grass

There were widespread comments on the presence or absence of grass by the early Europeans which pointed to a strong association between the forest type, soil type and the presence of grass. On the coastal plain east of the Tambo River good grass was associated with red gum and box forests, except for some small areas of sandy soils. Grass was also the dominant understorey on the fertile, box-covered lower slopes of inland valleys of the major rivers. Along the upper Snowy valley, and parts of the upper Tambo valley it extended well up the rugged slopes. The gum forests of the tableland areas were normally described as grassy, as were the granite soils of Dargo, Tubbut and the Reedy Creek (Ensay). The limestone soils of Buchan and Bindi were reported as having a good cover of grass under a tree cover of gum or box. There is only one report of grass in association with stringybark, and rarely was grass recorded in association with the coastal sandy soils. While a grassy understorey is promoted by burning, there were no references to recent fires which could indicate that its presence was a direct consequence of them. In fact, it appears to have persisted for many years in spite of the reduction in burning.

Understorey and scrub

The terms 'scrub' or 'scrubby' were very commonly used, embracing young eucalypt regrowth and all groundcover, including bracken fern, other than grass. Generally there was a close association between the forest type, the soil and the presence of scrub. The extensive coastal and foothill stringybark forests with their poor sandy or barren soils, and their understorey of shrubs and fern, were invariably descibed as scrubby, as were the wetter mountain forests and the banks and alluvial flood plains of streams, where, though the soils were often good, the understorey was dominated by the dry or wet sclerophyll shrubs and ferns common to these forests.

The recorded presence of scrub cannot be used as an indicator of fire history except when described as dense or thick when it indicated that it was some time since that area had been burnt; the very large hop scrub in the Humphrey River obviously meant that the area had remained unburnt much longer than other areas with hop scrub. The areas where McMillan struck problems, west of the Snowy and along the Tambo north of Bruthen, certainly had not been burnt for some time. Hunter's comment on the growth of scrub since a previous visit, and the fire referred to by Howitt in the upper Mitchell, are the only references which can specifically tie scrub growth to previous fires.

Conclusions

When the first Europeans arrived East Gippsland was completely covered in forest, except for a few relatively small areas of open plain. But this forest comprised two distinct parts.

Open forests or woodlands

The open forests or woodlands of redgum and box of the lakes margins and plains, the box woodlands of the inland valleys and the gum woodlands of the tablelands can be considered together. Their open nature and the grassy understorey invariably found within them resulted from the combination of a relatively dry climate, fertile soil and Aboriginal management through the fire regime which had been applied over centuries. The fires were frequent enough to inhibit the establishment of significant regrowth, but, with the exception of the Gippsland Plains, not to the extent of eliminating trees altogether. With some of the tableland forests, the open forests may also have indicated an absence of recent severe fires.

These forests were sufficiently stable to persist in this form for a considerable period of time after the arrival of the Europeans, in spite of an initial reduction in the use of fire. However, subsequent intensive use and clearing has almost completely destroyed the red gum and box forests, while much of the uncleared tableland forests have been substantially modified by the change in the fire regime, with first a decline, then an increase in the frequency and severity of fires, then more recently, a substantial decline.

Dense forests.

The dense forests of the foothills, mountains and coastal areas of the east generally comprised a range of tree sizes and ages. Most forests had a significant proportion of young trees but it cannot be said with certainty to what extent older, large trees were present. It is known that open stands of older trees occurred, but the extensive forests of very large old trees which drew people's attention to South Gippsland were not a feature of the forests of East Gippsland.

With the exception of some alpine ash stands, these forests almost invariably had an understorey of often dense scrub. On the drier sites, with stringybark as the indicator species this was primarily due to poor soil, but in the moister forests, scrub was normally found, even on areas of good soil. It is not clear what fire regime applied, but it appears that most areas were only burnt at infrequent intervals. Continual fires can increase the grass component even on poor soils, but the lack of reference to grass in association with stringybark would suggest that these areas were not burnt with the frequency necessary to achieve this. Certainly in the mountain forests the difficulties found in penetrating some areas points to a considerable time having elapsed since they were last burnt.

These forests too, have been substantially affected by clearing, by intensive timber utilisation, and by changes in the fire regime, but there are still substantial areas which would have changed very little from their pre-European condition.

East Gippsland

The forests the first Europeans found in East Gippsland were a product of the stable relationship the Aborigines had with the land, so that they probably had not changed significantly over hundreds of years. However, the 160 years of European settlement have had a tremendous impact on these forests; major changes are still occurring and it is likely to be many years yet before a similar stable relationship is established.

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Appendix: Summary of sources of age estimates

Year	Species	Location	Comments	Reference
1540	*Podocarpus lawrencii*	Goonmirk Rocks	Ring count 1 tree	Barker 1991
1620	*Eucalyptus denticulata*	Errinundra Plateau	Ring count 1 tree (approx. age)	Chesterfield 1996
c.1650	*E. delegatensis*	Errinundra Plateau	Est. age open stand, trees to 3.6 m diam.	FC Ass. Errinundra 1951
c.1650	HEMS	Errinundra Plateau	Est. age scattered very large trees	FC Ass. Errinundra 1951
1690	*E. sieberi*	Cobon	Dendochronology 1 tree.(approx. age)	Woodgate et al. 1994
<1690	*E. obliqua*	Bentley's Plain	Est. age open, damaged stand, trees to 1.2 m diam.	FC Ass. Nunniong 1941
<1690	*E. viminalis*	Little River	Est. age scattered trees to 3.6m diam.	FC Ass. Nunniong 1941
1700	*E. denticulata*	Errinundra Plateau	Ring count 1 tree (approx. age)	Chesterfield 1996
1700	*E. obliqua*	Nunnett	Est. age older trees in stand	FC Ass. Nunniong 1941
1720	*E. sieberi*	Cobon	Dendochronology 1 tree	Woodgate et al. 1994
1730	*Podocarpus lawrencii*	Goonmirk Rocks	Ring count of 1 tree in mixed forest	Barker 1991
1730	*E.denticulata*	Errinundra Plateau	Av. age in ring count of 4 trees	Chesterfield 1996
1730-60	*E.denticulata*	Errinundra Plateau	Dendrochronology of 21 trees	Piercy & Woodgate 1984
>1740	*E. delegatensis*	Black Range	Est. scattered remnant trees, 1.2-2.4m diam.	FC Ass. Nunniong 1941
1740	*E. delegatensis*	Campbells Ck.	Est. age older trees in stand	FC Ass. Nunniong 1941
1740-90	*E. delegatensis*	Barkly R. Watershed	Est age of scattered older trees	FC Reco. Barkly R. Watershed 1941
<1749	*E. regnans*	Basin Ck, Buchan	Est. age of older trees in two-age stand	FC Ass. The Basin. 1941
1740	*E. muelleriana*	Cabbage Tree Ck	Est. age older trees	FC Ass. Falls Ck. 1942
1760	*E. regnans*	Errinundra Plateau	Ring count 1 tree	Chesterfield 1996
1760	*Notelea ligustrina*	Errinundra Plateau	Ring count 1 tree	Chesterfield 1996
1770	*Elaecorpus holopetalus*	Errinundra Plateau	Ring count 1 tree	Chesterfield 1996
1770	*Accacia frigescans*	Errinundra Plateau	Ring count 1 tree	Chesterfield 1996
1780	*E. holopetalus*	Errinundra Plateau	Dendrochronology 21 trees	Piercy & Woodgate 1984
1780	*Atherospermum moschatum*	Errinundra Plateau	Dendrochronolgy 21 trees	Piercy & woodgate 1984
1780	*A. moschatum*	Errinundra Plateau	Ring count 1 tree	Chesterfield E. 1996
1780	*Kunzea ericoides*	Errinundra Plateau	Ring count 1 tree	Chesterfield E. 1996
1780	*E. delegatensis*	Nunett Ridge	Est. age of older trees	FC Reco. Nunnett Ridge 1957
1790	*E. cypellocarpa*	Basin Ck. Buchan	Est. age of older trees in two-age stand	FC Ass. The Basin 1941
1790	*E. obliqua*	Basin Ck Buchan	Est. age of older trees in two-age stand	FC Ass. The Basin 1941

Appendix: Summary of sources of age estimates (Cont.)

Year	Species	Location	Comments	Reference
1795	*E. denticulata*	Errinundra Plateau	Av. age by ring count of 4 trees	Chesterfield 1996
<1800	HEMS & LEMS	Various across East Gippsland	Est. age of scattered older trees in stands, more common in gullies	Personal observations by the author 1950-1980
1800	*E. obliqua*	Nunnett Ridge	Est. age predominant trees in stand	FC Reco. Nunnett Ridge 1957
1800	*E. denticulata*	Errinundra Plateau	Ring count 1 tree	Griffin 1962
1810	*E. radiata*	Errinundra Plateau	Ring count 1 tree	Griffin 1962
1810	*E. viminalis*	Errinundra Plateau	Ring count 1 tree	Griffin 1962
1820	*E. denticulata*	Errinundra Plateau	Ring count 1 tree	Chesterfield 1996
1820-40	*E. delegatensis*	Conglomerate Ck	Est. age mature stand	FC Reco. Bennison Plains 1940
1820-40	*E. delegatensis*	Little River	Est age younger trees, two-aged stand	FC Ass. Nunniong 1941
1820-40	*E. delegatensis*	Mt Ewan	Est. age mature stand	FC Reco. Dargo R. 1941
1820-50	*E. delegatensis*	Bentleys Plain	Est. ages vigorous mature stand	FC Ass. Nunniong 1941
1820	*E. sieberi*	Cobon	Dendrochronology 2 trees	Woodgate et. al. 1994
<1830	*E. delegatensis*	Grassy Spur, Wentworth R.	Est. age mature trees, open stand	FC Ass. Mt Baldhead 1931
<1830	*E. delegatensis*	New Rush Ck	Est age mature trees, multi-aged stand	FC Ass. Mt Baldhead 1931
1830	*E. regnans & E. viminalis*	Shady Ck	Est. age fire damaged stand	FC Reco. Shady Ck. 1947
1830	*E. regnans & E. viminalis*	Lwr. Haunted Stream	Est. age fire damaged stand	F.C.Reco. Haunted Stream 1947
1830	*E. regnans*	Old Sheepstation Ck	Est. age fire damaged stand	FC Reco. Haunted Stream 1947
1830	*E. fastigata*	Errinundra Plateau	Ring count 1 tree	Griffin 1962
<1840	*E. delegatensis*	Barkly R. Headwaters	Est. age mature trees	FC Reco. Barkly R. Heasdwtrs 1941
<1840	LEMS	Lake Tyers-Waygara	Est. age of remaining older trees	F.C. Compartment surv. Tyldsley <1937
1840	*E. sieberi*	Cabbage Tree Ck	Tree measured in growth study	Incoll 1974
1840	*E. regnans*	Chester Ck	Est. age mature stand	FC Reco. Chester Ck 1947
1840	*P. lawrencii & Acacia dealbata*	Goonmirk Rocks	Ring count of 2 trees	Barker 1991
1840	*E. regnans*	Grant	Est. age mature stand	F.C.Reco. Dargo 1941
1840	*E. obliqua*	Barkly R. Headwaters.	Est. age even-aged stand	FC Reco. Barkly R. Headwaters 1941
1840	*E. capitellata*	Cabbage Tree Ck	Est. age main stand	FC Ass. Falls Ck. 1942
1840-60	*E. globulus s.sp. bicostata*	Basin Ck, Buchan	Est. age of predominant trees	F.C.Ass. The Basin. 1942
<1850	LEMS	Bemm R. locality	Est. age of most trees in stands with a wide range of ages	F.C.Ass. Bemm R. areas. 1946-55

HEMS = High elevation mixed species: *E. viminalis, E. fastigata, E. obliqua, E. radiata*, etc.; LEMS = Low elevation mixed species: *E. globoidea, E. obliqua, E. capitellata, E. seiberi, E. cypellocarpa, E. Muelleriana;* FC Ass. = Forests Commission Assessment; FC Reco. = Forests Commission Reconnaisance

20

Flying foxes and their camps in the remnant rainforests of north-east New South Wales

Daniel Lunney and Chris Moon

Long years of bitter labour, the drought year's scanty gain,
The sport of chancy seasons, flood, fire and drought again,
The land of virgin forest, where none had turned a sod,
I cleared and made this garden, and won the smile of God.

(*A.E. Yarra*, 'The Clarence Pioneer', nineteenth century)

These rhyming couplets summarize much of the contemporary ethic that led to today's diminished heritage of flying foxes, the rainforest camps in which they breed and their food source, the flowering eucalypt and paperbark forests and the fruiting rainforest trees.

Introduction

Bellingen Island in the Bellinger valley, Susan Island in the Clarence valley, and sites at Booyong, Currie Park, Boatharbour and Maguires Creek in the Richmond valley are small rainforest remnants of five to twenty hectares that survived the almost complete clearing of lowland rainforest which began with the cedar cutters in the 1830s. These remnants are all regularly used as maternity camps by flying foxes (bats), particularly by the grey-headed flying fox (*Pteropus poliocephalus)*, but also by the little red flying fox (*P. scapulatus*) and the black flying fox (*P. alecto)*. The logging for rainforest timbers and the clearing of the valleys for farms took less than a century, and the rural scene evident today gives little clue to the once continuously forested valleys of rain-forest in the Bellinger valley, or to the swamp, rainforest and eucalypt forest in the Clarence and Richmond valleys. Clearing greatly reduced the number of locations for maternity camps in which the young bats are raised. The enormous reduction in coastal and sub-coastal swamp, rainforest and eucalypt forest also sharply reduced the food sources (flowers and fruit) for flying foxes so that the huge numbers of animals reported last century are no longer seen.

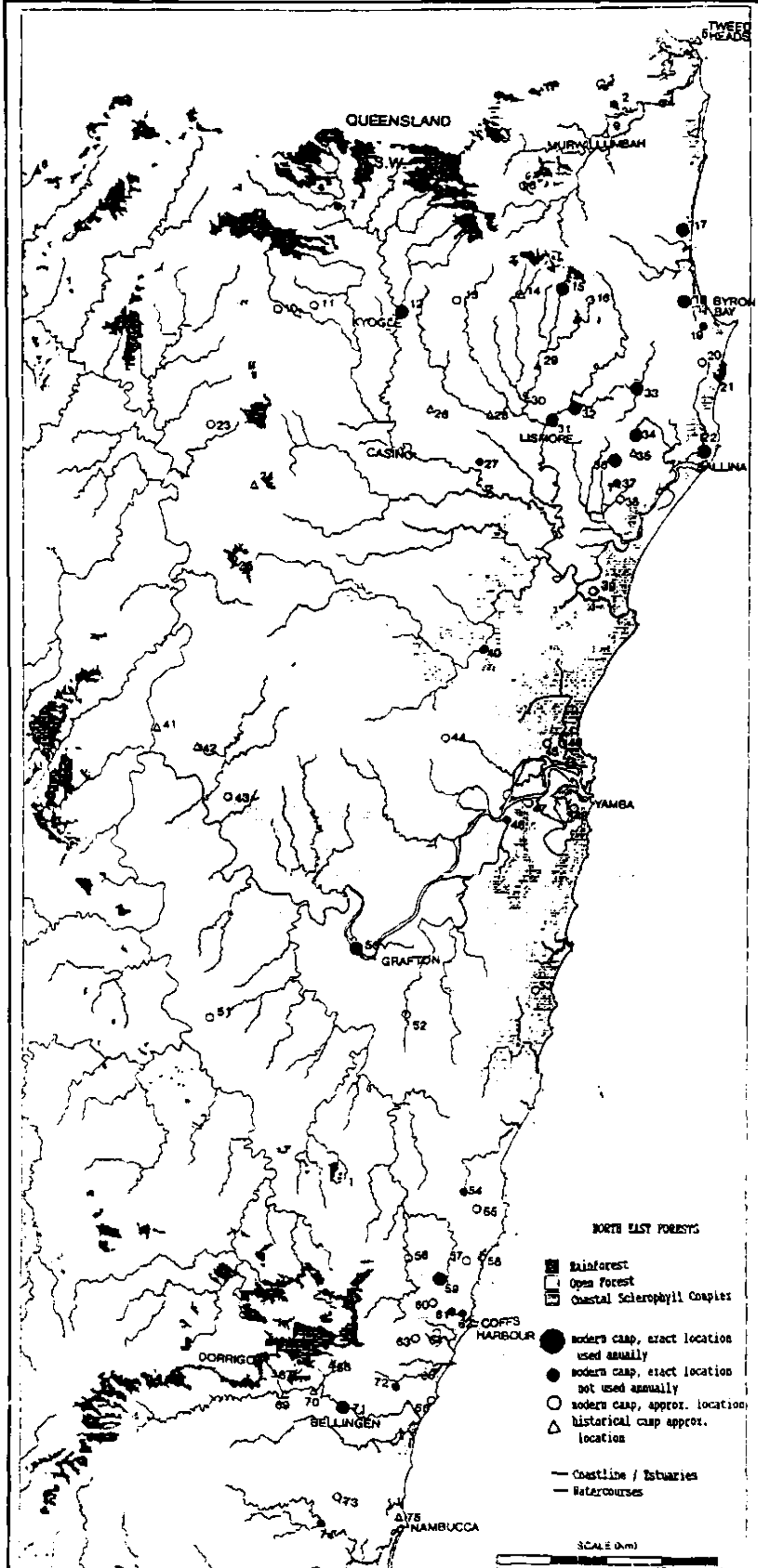
A perceived problem for the unique remnants of rainforest on the north coast is due to the large camps of flying foxes which are established each year. According to some sources, the canopy damage they cause threatens the integrity and viability of the remnants (A. Floyd pers. comm. 1988). At present there are no guidelines, so management will remain problematic until the ecology of flying foxes is better understood. Historically, the remnants have been neglected or managed for other values, such as recreation, and the bats have been regularly driven away. With legislative protection of flying foxes in 1986 (Lunney 1990), it was recognised that there was a management conflict between protecting the remnants as rainforests and protecting them as camps. Missing from this debate was adequate information on crucial aspects of flying fox ecology, other faunal values within the remnants, interactions between flying foxes and the floristic and structural characteristics of rainforest, and the cumulative impact of land-use practices which have brought the remnants to their present status. An additional dimension emerged in 1992 when the black flying fox was listed as an endangered species (Lunney and others 1996). It is now listed as threatened under the *Threatened Species Conservation Act* 1995.

It is not new to say that most rainforest was cleared last century (e.g. Planners North 1988; Adam 1987; Phillips 1991; Lott and Duggin 1993; Ryan and Stubbs 1996). It is new to attempt to chronicle and explain the losses through logging, clearing, grazing, burning, slashing and weed invasion, to quantify them, to date the loss of specific remnants, and to relate the sequence of loss to changes in the fauna, in this case flying foxes. Readily available information from files in government departments, working knowledge of local biologists, and general literature on the history of the remnants and their fauna, is scarce. A historical approach provides insight into the importance of particular locations for flying fox maternity camps, and this in turn underlines the necessity for specific management objectives for them. The study reported here complements the ecological work of Eby (1991), which focused on flying fox movements and the vital role they play in seed dispersal to sustain forest ecosystems. Flying foxes carry a lyssavirus, which is very similar to rabies (Tidemann and others 1997) so that it it is important to understand the ecology and behaviour of flying foxes for public health reasons (Lunney, Law and Baverstock 1996). The remnants of the once vast tracts of rainforest are equally deserving of special attention, research and conservation.

This study examines the impact of European settlement on flying foxes in order to assess the importance of the rainforest remnants as maternity camps, and to obtain the information necessary to establish guidelines for management. The study is site-based because we wanted to present specific options for protecting or managing them. We examined the century following settlement, rather than the last few years, because it was so crucial in shaping the landscape. An ecological history approach was essential to interpret how the bat populations used the forests, how they responded to changes in the valleys, and to assess the extent to which they depend on the remnants.

Methods

Four avenues of investigation were pursued. General land-use histories for the districts in which the sites occur were compiled, particularly those relating to early timber-getting, clearing, establishment and growth of agriculture, and distribution of flying fox food resources such a rainforest or tea-tree swamp. Historical information was gathered about flying foxes and histories were prepared for eight of the main camps. The authors also inspected camp sites regularly over the last nine years. Information was obtained from both written and oral sources. The former included: local histories, material kept by historical societies, files and maps kept in the Crown Lands Office at Grafton, by local governments and the National Parks and Wildlife Service.



1	Tomewin
2	Dulguigan
3	Brookes Lane
4	Stotts Island
5	Tweed Heads
6	Legume
7	Old Grevillea
8	Mount Warning
9	Murwillumbah
10	Toonumbar Dam
11	Peter Finn Creek
12	Kyogle
13	Cawongla
14	Nimbin
15	Terania Creek
16	Rocky Creek Dam
17	Nillinudgel
18	Myocum
19	Ewingsdale
20	Midgen Flat
21	Broken Head
22	Ballina
23	Bottle Creek
24	Mallanganee
25	Mount Pikapene
26	One-tree Farm
27	Clovass
28	Mason's Scrub
29	Keerrong
30	Blakebrook
31	Currie park
32	Boatharbour
33	Booyong
34	Maguires Creek
35	Duck Creek
36	Davis Scrub
37	Victoria Park
38	Wardell
39	Woodburn
40	Bungawalbin
41	Dumbudgery
42	Wave Hill
43	Fine Flower
44	Gibberangee
45	Woolbin Island
46	Esk River
47	East Maclean
48	Maclean
49	Yamba
50	Susan Island
51	Nymboida S
52	Glenugie Creek
53	Minnie Water
54	Bark Hut Road
55	Woolgoolga
56	Coramba
57	Orara East S
58	Moonee Beach
59	Bruxner Park
60	Red Hill
61	Shepherds Lane
62	Coffs Creek
63	Boambee
64	Symons avenue
65	Bonville
66	Bundagen
67	Rosewood River
68	Gleniffer
69	Thora
70	Gordonville
71	Bellingen Island
72	Valery
73	Bowraville
74	Bowraville Town
75	Nambucca

Figure 1. Locations of flying fox camps (most important—large closed circles)

The paucity of written records about native fauna reflects a concentration on what was created by development rather than on what was removed. However, interviews were conducted with present and former residents, owners, managers, trustees of remnants managed by Trusts, local naturalists and landowners who had responded to a 1988 questionnaire about flying foxes. People interviewed were generally asked: what they knew of past/present flying fox camps; how long the camp sites had been used, at what frequency, and in what numbers and species. They were also asked about adjacent land uses and changes (such as floods, fires, clearing, other uses and damage) which occurred in and adjacent to the flying fox camps, and actions taken against them.

The information collected is presented in what follows for each of the three river valleys in turn: the Bellinger, the Clarence and the Richmond.

Bellinger Valley

History of the Bellinger Valley:

The history and quotations noted in this section are drawn largely from a publication by the Bellinger Valley Historical Society (1978). The earliest description of the Valley was written by Macleay District Government Surveyor, Clement Hodgkinson, in 1841, the year of its European discovery. He reported that 'the brush contained the finest cedar and rosewood I have ever seen. The grassy forest flats were principally wooded by that species of eucalyptus called forest mahogany'. The following year the first ship carrying timber-getters entered the river. By 1845 2 million feet [4720 m^3] per year was being shipped out (*Sydney Morning Herald*, 11 Mar 1845). In addition, 'in the early days, millions of feet were also shamelessly wasted or destroyed because there [was] no control whatsoever in the industry'.

Also in 1842, the first settler arrived with a flock of sheep, followed two years later by the second with cattle. By 1849 all the land to near Boatharbour (now Bellingen) was sparsely settled. Rainforest was first cleared in Bellingen town in 1859, settlement began in 1861, and it was proclaimed a Village in 1887. Pioneer descendant, Leo McNally, recalls being told that in 1864, when his ancestors arrived, 'the Bellingen country was all thick dense scrub, and the only place you could see the sun was on the river bank'. The McNallys attempted to grow sugar cane around 1870 and built a crushing mill, but frosts killed the cane.

Up to this point the historical record does not mention flying foxes (N. Braithwaite pers. comm. 1988), but in 1878 settlement began at Thora, which is called 'Flying Fox Scrub' in the *North Coast Times* of 23 Aug 1889. During the 1880s land was cleared for farming which extended 30 miles [48 km] up the river, and to Brierfield and Gleniffer in the west and northwest. Large quantities of maize were grown, cedar getting was still providing employment, and gold and antimony were mined. The first Bellinger River Agricultural Show was held in 1881, and by 1889 the village had a bank, two blacksmiths, medical store, coach proprietor, saddlemaker, shipping firm, builder and contractor and a forest ranger.

These developments must be seen as having an early impact on the integrity of Bellingen Island, which formed a promontory on the south bank, adjacent to the village. Indeed, the island was still being used at this time as a stopping point for logs prior to their being rafted down river for export. Part of the island (now Portion 165) was reserved in 1887 as R3887 for Water Supply.

By the 1880s, the river was showing signs of shoaling (silting up) by the 1880s, probably by sediment from clearing and disturbance upstream. That North Bellingen had already been cleared and settled is apparent from Mr Kethel's recollections of the area in 1889: 'From the fringe of timber on the showground site at North Bellingen to Coffs Harbour, at that time, the whole area was one dense forest jungle, overrun with marsupials, snakes, dingoes and birds of all descriptions'.

By 1900 (the start of a two-year drought) all the arable valley country within 30 kilometres of Bellingen had been opened up. Main sources of income were maize, timber, pigs, fowl and cattle. The advent of dairying is given as 1905, although the first co-operative butter factory was opened in 1898, probably at Fernmount. Paspalum began to be widely planted for pasture, and the Gleniffer/Gordonville area was experiencing a boom. The rate of progress of Bellingen is described as accelerating after 1900. Thus, in 60 years, the present-day character of the Bellinger Valley had been established. Even the banks of the river had been largely cleared. Due to its reservation in 1900 and 1903, Bellingen Island was left as the sole remaining example of the once extensive alluvial lowland subtropical rainforest of the Bellinger Valley. The fauna of the valley existed only in the few remaining, fragmented areas of natural vegetation.

After 1916, much of the remaining forested area of the valley was dedicated as State Forest. During the 1960s many large areas of even-aged eucalypt plantations were established. Levee banks have now altered the flooding characteristics of the valley, with a consequent alteration in vegetation as moisture levels and soil fertility change slowly over time.

Flying foxes in the Bellinger valley

Thora—

The area now known as Thora contained a flying fox camp in rainforest by the river near the present bridge on Trunk Road 76. Flying Fox Scrub, as it was called (*North Coast Times* 23 Aug 1889), still contained a camp in 1926 (*Northern Coast Times* 24 Jan 1926), but the scrub has since been cleared and the camp has gone.

Glenifer, Gordonville, Bonville and Mylestom—

Another flying fox camp existed on Stony Creek at Gleniffer. A *battue*, or organised shooting expedition, was conducted against this camp in December 1901 (N. Braithwaite, pers. comm. 1988). The current landowner remembers that the number of bats fluctuated between years, depending on the flowering of native trees. The site was cut out, but not cleared, around 1910 (M. Adams, pers. comm. 1988) to create a rifle range for the Gleniffer-Raleigh Rifle Club. Adams suggests that the camp then moved to Gordonville for a few years, but had left there long before 1940. He also remembers a camp at Bonville, near Coffs Harbour. A report of a camp near Mylestom, at the mouth of the Bellinger River, has not been substantiated.

Rosewood Creek—

A large flying fox camp existed on Rosewood Creek, north of Thora, within what is now Dorrigo National Park (N. Braithwaite, pers. comm. 1988). While no establishment date is known, Mrs Elm of Thora visited the site in the 1920s and 1930s (pers. comm 1988). Trevor Joyce (pers. comm. 1988) recalls that the bats left this camp in 1959. Roy Rose, who lives east of Thora by the Bellinger River, recalls seeing large numbers of bats in the 1930s and 1940s flying up and down the river from the Rosewood Creek camp, but the numbers fell during the 1950s. He believes the bats used Bellingen Island for some years, but that the 1960s was generally quiet for bats. High numbers of bats have never returned to Rosewood Creek, or Roy Rose would have seen them passing his house. Nevertheless, the camp was used by some flying foxes from 1966, and probably earlier, and continued to be used as a camp site (N. Fenton, NPWS, pers. comm. 1988). The camp was a regular target for local shooters, and during one shoot in 1959 a big hail-storm frightened the bats out of their trees. The shooters caught a few and released them that night in the bar of the local hotel (T. Joyce, pers. comm. 1988).

Bellingen Island—
Norm Braithwaite recalls that raids by flying foxes on orchards were bad in the 1920s and 1930s, and he thinks that bats started using Bellingen Island as a camp sporadically during the mid-1920s. Another long-term resident (anon., pers. comm. 1989) believes that bats have used the island since at least the beginning of the century. He remembers attempts to scare the bats away by groups in boats who clapped oars and banged saucepan lids. Roy Rose recalls that bats used Bellingen Island for a few years during the 1950s, not much during the 1960s, but that the numbers of bats on Bellingen Island grew in the 1970s and have remained high, except for 1991-93, which were quiet years.

Two contemporary descriptions of the island, in October 1931 and April 1932, make no mention of flying foxes, canopy damage or flying fox smell, although they both go to some length to describe its features. One must conclude that bats were not there at the time, and certainly were not using the island in large numbers. Trevor Joyce clearly recalls bats using the island in 1947, and thinks they may have started using it earlier. By 1960 they were there in large numbers and the numbers increased dramatically during the 1960s. N. Braithwaite (pers. comm 1988) believed that by the late 1960s the Coffs Harbour Gun Club came down for a shoot. Bats have intermittently wintered on the island since the early 1970s, and by 1976 canopy damage, attributed to the flying foxes, had became significant

In 1981 the then Minister for Lands, A.R.L. Gordon, wrote to J.H. Brown, M.P. about a proposal to remove flying foxes from Bellingen Island, and arranged for the National Parks and Wildlife Service to advise the Council about it (Grafton Land Board Office File). Bat numbers increased from the mid-1980s and in 1984 the Council attempted to shoot the camp away, using bird cartridges (R. Cannon, pers. comm). The idea was again publicly canvassed by some aldermen in 1991, but not pursued. The discrepancy between some recollections, such as those of R. Rose and N. Braithwaite, is noted, but not resolved. Nevertheless, the conclusion can be drawn that the island has had a long history of use by flying foxes. Our regular observations over the last nine years, the most recent being in January 1997, confirm that it continues to support a flourishing camp of grey-headed flying foxes.

History of Bellingen Island

In its proposal to reserve Bellingen Island for recreation (16 Mar 1900) the Lands Department describes 'rich alluvial soil covered with dense brush', and notes that parts had 'soil washed away by floods ... now [it is] a shingle bed covered with small oaks and a little grass'. The island was reserved in two stages: in 1900 Reserve 30812 for Public Recreation and Preservation of Native Flora was notified, and in 1903 Reserve 36459 (from sale) and R. 36460 for Public Recreation and Preservation of Native Flora were notified (which replaced the 1887 reservation for Water Supply noted earlier) (Crown Lands Office, Grafton). Portion 165 (part of the present flying fox camp site) was described by Surveyor H.A. Evans in a report to the District Surveyors Office, Grafton on 28 Mar 1903:

> The land consists partly of a clear grassed patch on which are some shady weeping willows under which numbers of local residents spent a great many of the terribly hot afternoons experienced here last summer. The grassy patch is covered with water at every rise of a few feet in the creek and at date of survey of the portion, 1885, was dense brush, which has since gone in the floods and with it several feet of the surface.'
>
> The trustees of Reserve 30812 have within the last year spent a grant of £15 in fencing the west boundary of portions 167 and 168 and in removing lantana and noxious weeds from parts of portions 165 to 168, as well as in clearing paths across these lands to the shaded bathing places along the frontage of portions 166 and 168.
>
> They also spent more than £19 in bridging the water in the hollow running across portions 169 and 164, in cutting down the very high alluvial bank and making an approach to the bridge, and in placing a fence and gate across River Street between those portions. Subsequently, ... portions 166, 167 and 168 were offered for sale, but no buyers came forward.

A flood in 1908 is described in Lands Office files as changing the course of the river, but the change is not described. A wooden bridge, since replaced, was built in 1911. A weed problem existed on the island in the 1960s (N. Braithwaite, pers. comm. 1988). These activities demonstrate that by 1903 Bellingen Island was enduring recreation use, planting of exotic trees, growth of lantana and other noxious weeds, earth works, cattle grazing, flooding, and substantial loss of topsoil and vegetation. Its very existence today is due to a lack of interest by buyers a century ago, and to a recommendation by Evans in his report to refuse consent to clear and establish a market garden on the remaining portion. The western part of what is now Bellingen Island remained outside the reserve boundaries as freehold land on which cattle grazed until 1991 (Crown Lands Office).

Management of Reserve 30812 was vested in Bellingen Council, as Trustees, in 1923, and Reserves 36459 and 36460 were amalgamated with it in 1972 and transferred to Council control (Parish maps, Crown Lands Office, Grafton).

In the late 1920s and early 1930s a planting program was conducted on the Island, and included 500 azaleas, firewheel trees, *Stenocarpus sinuatus*, red apples, *Acmena brachyandra*, black beans, *Castanospermum australe* (slightly south of their natural range) and poinsettias (R. Macleay, pers. comm. 1988). An unsourced newspaper article (either *Northern Courier* or *Raleigh Sun*, 16 Oct 1931) describes the island and the improvements since Council assumed control. 'An access road has recently been built (River St.) and picnic tables erected.' The western end is described as 'clean grass and shady river oaks', and the '4 acres' [1.6 ha] of rainforest as 'still undisturbed ... enormous figs (4) whose girths in some cases measure 70 and 80 feet [21 and 24 m]. Beneath these the sun rarely penetrates ...'. A more graphic description is provided in a personal letter from a visitor to Bellingen which describes oranges and lemons growing wild on the island. The island is described as 'dense overhead, trees littered with staghorns, etc, of all descriptions, impossible to see the sun shining, and very wierd [sic] too, as no sound bar birds whistling, acorns dropping etc, and you cannot hear yourself walking as the ground is just a carpet of leaves inches thick in places and springy to walk on' (copy from Bellinger Valley Historical Society, 30 Apr

1932). The lack of mention of flying foxes in both sources, given the season and the obvious density of the canopy, suggests that the present camp had not been established in 1932, or was irregularly used.

In the next few years, dressing sheds and pit toilets were installed (Cathy Wood, pers. comm. 1988), and this is probably when regular slashing and other maintenance procedures were introduced.

The storms and record floods of 23 June 1950 battered the island and brought down a large casuarina tree across the north arm of the river which eventually caused it to silt up (N. Braithwaite, pers. comm. 1988). The subsequent flooding washed away most of the bridges, and two of the island's large figs came down then or shortly afterwards, creating large canopy gaps in the centre of the rainforest. As the north channel and swimming hole were silting up, bulldozers were used to keep the swimming hole open and there is evidence that a flood channel was cut south of the island, through the Reserve, which is now the present course of the river (Lands Department files). The north arm was finally left dry after a major flood in 1974, and now only flows in floods. The pattern of recreational use of the island changed after 1950, then a period of relative inactivity, or neglect, followed.

In 1984, regeneration work began in the rainforest remnant on Bellingen Island, slashing ceased, and Commonwealth Employment Program Funds were used to build walking tracks (R. Cannon, Bellingen Shire Council, pers. comm. 1988). Attempts were made to exclude cattle which, in the past, regularly strayed from the Reserve into the rainforest. The cattle were permanently removed in 1991.

The island flooded again in July 1985, and subsequent winds felled another fig, *Ficus macrophylla*, and a white booyong, *Argyrodendron trifoliatum*—both canopy trees (C. Wood, pers. comm. 1988). Another large she-oak came down in a storm in December 1986, followed by some maidens blushes, *Sloanea australis*, and the island flooded again in 1987, 1988 and 1989. The 1980 flood map of the Public Works Department classes the island as susceptible to a 1 in 20 year flood. The tree canopy on the island has now deteriorated to the extent that it is possible, for the first time, to see the town of Bellingen from the hill in North Bellingen behind the island. Norm Braithwaite attributes this to canopy damage by flying foxes, although tree-fall is sufficient to explain the openness of the canopy.

Clarence Valley

History of the Clarence Valley

The history and quotations noted in this section are drawn largely from a publication by the Clarence River Historical Society (1982). European discovery of the area that is now Grafton is attributed to Thomas Small, who sailed his schooner, the 'Susan', up the Big River, as the Clarence was then called, in 1830 with a party of sawyers. However, an escaped convict, Richard Craig, must have crossed the Clarence River between 1829 and 1831 on his flight from Moreton Bay to Port Macquarie,

Rainforest was never extensive in the Clarence valley (NPWS 1983, Maddocks 1840). It bordered the river for a long distance as a strip one or two kilometres wide, backed by extensive swamps and, on the elevated lands there were eucalypt forests. Unlike the Bellinger and Richmond valleys, the alluvial soils of the Clarence derive chiefly from sandstone and associated sedimentary parent material, rather than basic volcanic rock.

Within a very few years the area that was to become Grafton was being divided and settled. Cedar cutters' camps were recorded at Waterview (South Grafton) by Captain Butcher in 1838. Red cedar, and later other selected species, were cut out: 'the third boat that returned to Sydney from the river carried cedar' and much of the land was cleared and burnt for pasture. In January 1840, the first sheep, a flock of 800, were brought overland by Richard Craig from Port Macquarie via Ebor to Copmanhurst, which was apparently already cleared. Cattle soon followed. The first store opened in 1840, the first homestead was built (of cedar) in 1842, and in 1845, 700 bushels of wheat and 120 bushels of maize were shipped to Sydney. Ted Trudgeon says cedar was cut out to beyond 'The Falls' near Eatonsville (a few kilometres above Grafton) by 1841 (Trudgeon 1977).

Twelve hundred head of cattle were recorded at Waterview in 1848, and 1851 saw the first sale of town blocks in Grafton and South Grafton. By 1853, twenty houses existed in Grafton, and the land adjacent to the present vicarage was described as dense scrub. Thus within fifteen years of European discovery a thriving centre existed at Grafton, and a large number of stations had cleared and stocked large areas of the valley. Timber getting had opened the way for these activities. This initial settlement was followed by a period of continued rapid expansion. The Ramornie meat works opened in 1866, and was slaughtering 80 cattle a day by 1869. Sugar mills were built at Ulmara (1869), Southgate (1870), Chatsworth (no date) and Harwood (1874). It is estimated that there were some 650 hectares of sugar cane farms in the lower Clarence in the 1870s. Sugar production, cattle grazing and timber remain the three primary land uses in the lower Clarence River, as they have been for more than a century.

Flying foxes in the Clarence valley

Since rainforest on the Clarence River did not extend more than a few kilometers above Grafton, it is not surprising that no records of flying fox camps have been found upriver from Grafton until it is crossed by the Bruxner Highway. Ratcliffe (1931) refers to a camp at Mallanganee in the 1920s. One intriguing reference to flying foxes comes from an undated letter from Louis Chevalley to the late R.C. Law (Susan Island Trust), and describes 'the most terrible fire ever to occur in the Clarence region'. It burnt from the Rocky River (north and west of what is now Washpool National Park) right through to the coast at Evans Head, and caused so much destruction that 'many of the natives were reduced to living on flying foxes that abounded in the scrub on what is now called Wave Hill and in towards Dumbudgery'. The fire seems to have occurred around the late 1860s, and it may be guessed that the flying foxes were caught in their camps, as it would be difficult to catch these animals at night when they leave their camps. Wave Hill and Dumbudgery are old cattle stations between Grafton and Tabulam.

Susan Island—

Flying foxes have used Susan Island as a major maternity roost site, or camp, since at least 1870 (Wilcox 1870) and almost certainly since before European settlement. A reference exists to bats flying over Grafton around 1850 (*Sydney Mail* 23 Nov 1938). The *Daily Examiner* carried this notice in 1877:

> A great army of volunteers will leave the Corporation Wharf at 10.00 am, Wed. 7 November 1877 with a view to the total destruction of flying foxes. Every man to be armed with his own weapon, ammunition provided.

The location of the Susan Island flying fox camp given in 1926 is the same as it is today, although local people say that when little red flying foxes use the camp, its location sometimes varies. Bat numbers may have increased substantially after the 1930s (Law 1973).

Other camps—
Mrs Greaves (pers. comm. 1989) recalls a camp on Glenugie Creek (south of Grafton) in the 1950s, which was well known locally, and this suggests that the camp had existed for many years. Two unconfirmed reports of present camps in this area were received: one on Glenugie Creek just west of the Pacific Highway, the other on the eastern side of Glenugie Peak (Mount Elaine) in Glenugie State Forest.

Flying fox camps are reported on the lower Clarence at Woolbin Island, near the Esk River bridge, and at Maclean. The first two are not considered regular, significant camps. Bats have regularly roosted in the Maclean rainforest until 1986 when, after being driven away by Council and citizens concerned about canopy damage in the Reserve, the bats camped in a nearby gully for a few days, and then moved to a camp within a melaleuca forest a few kilometres east of the town, which they apparently continue to use (Dennis Milne, pers. comm. 1988). However, the little red flying fox continues to occupy the Maclean camp in the grounds of the local high school periodically.

Thus, it seems that Susan Island represents the major, traditional flying fox camp between the Richmond and Bellinger Rivers, augmented by a handful of smaller, less regular camps.

History of Susan Island
Having established the nature and extent of early land clearance and use, we can view what remains of the native habitat on Susan Island, which is a mobile, vegetated shoal in the river, as an isolated rainforest remnant, which only the mobile, flighted animals are able to colonise. It was probably chiefly rainforest, but there is evidence for koalas (Wilcox 1870) and eucalypt emergents, if not dry forest, on the downstream (i.e. younger) part of the island. Regular floods also bring exotic plants and animals (rats, foxes, mice). It was probably shorter in 1840 as increases in sediment caused by upstream land clearing have resulted in the island's growth in an easterly, downstream direction (Lands Department maps). It was covered in dense vegetation, principally of rainforest species, including cedar, figs, palms, *Livingstonia, Flindersia, Brachychiton, Melaleuca, Alstonia, Urtica, Grevillea* and *Eugenia (Acmena)*, as well as numerous unusual ferns, mosses and fungi (Wilcox 1870). Animal life was equally diverse, and included koalas, native cats, possums, gliders, flying foxes, pademelons and echidnas (*Clarence and Richmond Examiner*, 19 Apr 1870).

Aboriginal people would certainly have used Susan Island, as Wilson's Hill, in adjacent South Grafton, was a significant Aboriginal landmark. The island seems to have escaped the first wave of settlement, although it was logged for its cedar. Surveyor-General Maddocks (ca 1840) reports: 'The cedar generally is very abundant but too small for use, Tulip Wood is in abundance Rose Wood scarce there are several other woods but their qualities are unknown'. However, in the 1920s old cedar stumps were found under canopy gaps in the rainforest (D. Law, *Daily Examiner*, 26 Oct 1973).

It is known that goats roamed the island in 1870, yet in the same year congratulations were made by James Wilcox, naturalist, on the reservation of the island as a public recreation ground (*Clarence and Richmond Examiner,* 19 Apr 1870). Reservation was declared on 16 Jan 1907 (*Government Gazette*) although this did not preclude stock grazing.

We are fortunate to have a contemporary account by James Wilcox of the flora and fauna of Susan Island in 1870 (*Clarence and Richmond Examiner,* 19 Apr 1870), which can be compared to present day lists. As far as is known, this the only record of the early flora and fauna of a current north coast rainforest remnant that is in any way complete and authoritative, and from which we can do more than speculate on the impact on wildlife of land-use practices and European settlement.

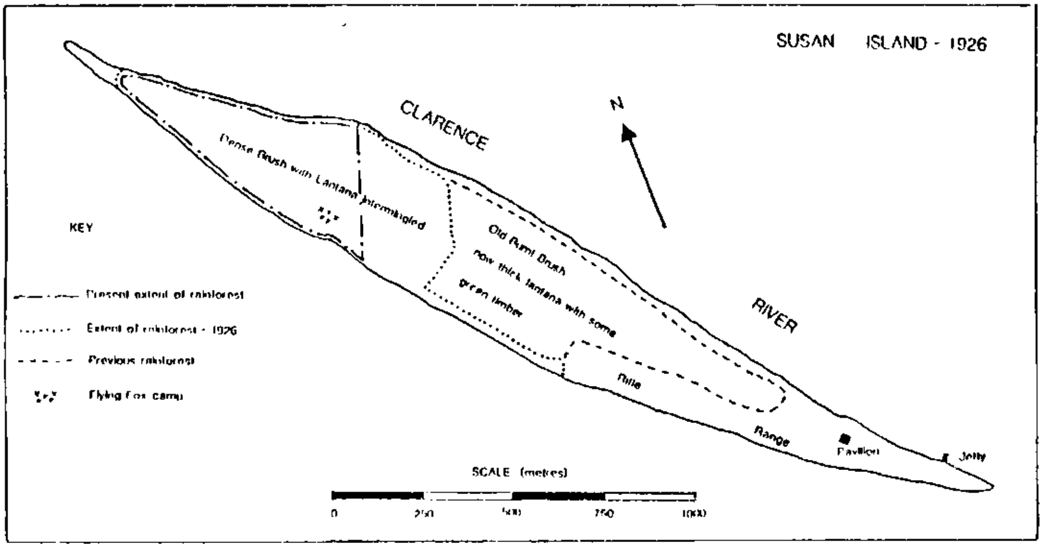


Figure 2. Susan Island, 1926. This 1926 map shows the progress of degradation of the Susan Island rainforest. The rifle range was kept clear for visibility, and the south-eastern end received heavy recreational use at this time. This end had many ornamental trees growing, a scout camp, telephone line, paths, tables and fireplaces. Cattle grazed the island by then. The mounds of the rifle range may still be located on the island. *Source*: Lands Department.

The early twentieth century was a busy and colourful period in the island's history, although the seeds were sown for many future problems. By 1914 the island was a recognised picnic, sports and playground. Travel from Grafton to South Grafton was by a free steam ferry which stopped at the Susan Island wharf if a bell was rung. Near the wharf (at the eastern end of the island) was a large shelter/dressing shed, with plenty of cubicles and toilets and a large verandah. Further up the island, on the highest spot, was a pavilion about 150 feet square [14 m^2], with a supper annex which was used for dancing and roller skating. There were large water tanks, and fireplaces, tables, chairs and toilets were distributed around the area. Full scale sporting programs were conducted there, including regattas, races and tug-o-wars, and it was also a popular social venue. The spit at the downstream end was ideal for swimming and sunbathing, and the rainforest, which covered 60 acres [24 ha] of the western half of the island, offered cool, pleasant walking trails and a fig tree over 100 feet [30 m] high. Thousands of flying foxes camped in the fig trees (presumably in the summer). (Bill Weiley, *Big River Express,* 6 Sep 1973 and the previous edition of the *Express*).

Figure 3. Susan Island, 1988, western end. Air photo shows the sharp line dividing the the grassy area with scattered trees from the 18 hectares of remnant rainforest which is a traditional maternity camp for flying foxes Photo: Sue Walker, NPWS.

Epiphytes were stolen from the island, so that it was denuded of these plants by about 1914 (B. Fahey, Susan Island Trust, pers. comm. 1988), although D.R. Law 1973) recalls 'Bird's nest ferns, orchids, staghorns and elkhorns were plentiful' in the 1920s. He also remembers 'pademelons, bandicoots, echidnas, wonga and several other types of ground pigeons, pittas and land rails etc. on the ground and birds too numerous to mention in the trees'. Of the human environment he writes: 'The revenue from the hundreds who visited it each week for picnics, swimming, bats, functions and family outings provided funds to build and maintain a bougainvillea-covered dance pavilion with a winding asphalt path lined with flowering shrubs to the wharf, bathing sheds, fire places, children's play areas, drinking water tanks, toilets etc. under the control of a caretaker'. The pavilion was moved from Elizabeth Island to Susan Island early this century.

The Susan Island Trust was established and had its first meeting on 16 Dec 1927. Its minutes are the source for much of the information in this section. The Grafton Rifle Club had a rifle range (1180 metres) facing west from the centre of the island (into the rainforest). The Trust formalised its establishment date as being on 1 Jan 1929, even though it is shown clearly on the 1926 map, Bill Weiley says it was there by 1914, and an unnamed, probably accurate, written source dates it as 1888 (Susan Island Trust, *Minutes*). The Scouts association applied to rent half an acre for a camp site on the island in July 1931.

Flying foxes continued to use the island throughout the 1920s, probably as a summer breeding camp. In 1931, 1000 of them were shot in an effort to drive them away. The Trust supplied the cartridges at a cost of one guinea. In February 1932 the wharf was repaired and improved, and a transmission line was installed across the western section of the island, the workers being given the instruction not to damage the forest. Certain weeds began to be a problem, and in July 1926 the Lands Department requested that lantana, tobacco bush and other weeds be removed. Tenders were called (*Examiner* 8 Aug 1936) which listed cockspur, castor oil plant, young stinging trees, thistles, nettles, burrs, and prickly pear as problem plants, in the area from the fence next to the rainforest to the rifle range. Attempts were made to control weeds over the next few years, principally by clearing, but 800 'lantana bugs' released in 1940 had no apparent effect. Over 200 bullocks were grazing on the island in 1938. While grazing leases had existed since about 1930, cattle were kept on the island, at least irregularly, since 1910 (B. Fahey, pers. comm. 1988).

Trees were planted by the Trust to beautify the island; the record lists 4 camphor laurels, 10 jacarandas, 6 poincianas and 4 figs in 1937, and 6 jacarandas and some bauhinia trees in 1941. A pagoda was built then, and planted with bougainvillea. Around this time, silt from dredging operations was being deposited in hollows on the Island.

The 1940s brought bad times to Susan Island. A number of scouts died in a boating accident, and it lost popularity. The ferry lost patronage, and eventually ceased operations after the road and rail bridge over the Clarence was completed in 1932. The advent of motor cars meant that people could go to the coast at Yamba instead. The grass grew long, and a wildfire swept the island, burning the pavilion down (*Daily Examiner*, 11 May 1944). A flood in 1945 brought a lot of debris. The weed problem worsened. In 1951 the Trust decided to fire the island to remove weeds, and in 1954 the use of 'Low Vol' spray was approved. Bathurst burr, lantana and prickly pear were still recorded as problems in the 1960s. Planting of up to 25 more trees was arranged in 1968.

Preservation of the remaining rainforest (now 16 hectares) was discussed by the Trust, following an inspection on 12 August 1970 by J.E. Betts, District Agronomist, Department of Agriculture. He describes the forest as 'being invaded by lantana, wild tobacco, castor oil, Convolvulus and White moth plant', and the remainder as 'pasture land growing mainly kikuyu and couch grass. There is scattered timber on this area. To me the main factor causing the degeneration of the forest is cattle grazing'. He recommended that a cross-island fence be built, and that a program of weed removal and planting of indigenous species be initiated (NPWS files). Fencing was approved by the Trust in 1974, but it was only partly successful. In 1977 the Trust authorised the National Parks and Wildlife Service to maintain and move the fence, and to supervise the exclusion of cattle from the rainforest, once dedication as a Nature Reserve was effected.

National Parks and Wildlife Service found no evidence in 1977 of any of the fauna described by Wilcox in 1870 and by Law in the 1920s, except for several hundred flying foxes. A second power line had crossed the north-west tip of the island, and a set of cattle yards had been built on the highest ground. A cattle crush and ramp were on the southern side and, on an artificial mound near the cattle yards, 'a small shed has been built to provide security for a small tractor, spraying equipment and weedicide'. It noted that drainage from the rainforest was being inhibited by a wall on the northern bank, the result of past dredging operations. The report recommended dedication as a Nature Reserve, revegetation and the provision of a few barbeques (NPWS files).

Susan Island became a Nature Reserve in 1982, and at the same time the Trustees decided to use eucalypts, in particular flooded gum and forest red gum, to help stabilise the banks on the eastern three-quarters of the island. The National Parks and Wildlife Service began a long-term project to rehabilitate the rainforest, commencing with the planting, in lantana-infested areas, of pioneer rainforest species native to the island. Local help was to be sought, and a triangular area was fenced for use by the Clarence Valley Reafforestation Society. Plans were made to deal with thistles and camphor laurels in 1984. A regeneration program is now under way. Cattle grazed and occasionally broke through the fences into the rainforest until the 1990s.

The Susan Island rainforest remnant of about 18 hectares is the single remaining example of lowland subtropical rainforest in this district. It is a traditional flying fox maternity camp which has ranged in size between 2,000 and 200,000 flying foxes. The ecological history of this site and its flying foxes are complementary and demonstrate that the history of one sheds much light on the history of the other.

Richmond Valley

History of the Richmond Valley

The history of the valley and quotations noted in this section are drawn largely from publications by the Richmond River Historical Society (1977, 1984). The history of the remaining six flying fox camps examined during this study are part of the history of the Richmond River Valley. Two, at Terania Creek and Billinudgel, were less affected by the land-use changes which followed settlement and are discussed separately; four are in remnants of the 'Big Scrub'.

The Big Scrub was the largest (75,000 hectare) continuous tract of subtropical rainforest in Australia but now consists of a handful of small, isolated, degraded patches which total about 556 hectares (Planners North 1988, Lott and Duggin 1993). Both Currie Park and Terania Creek are situated on the edge, or just outside, of the accepted extent of the Big Scrub. It is difficult to comprehend the scale and speed of the massive clearing and land alteration which removed the Big Scrub, particularly since it was done by hand and by a small number of determined individuals. Its history has been described elsewhere (Blackmore 1989; Planners North 1988; Lott and Duggin 1993), and a recent effort has reviewed historical sources to examine the possibility of constructing a pre-1750 vegetation map of the northeastern region (Ryan and Stubbs 1996).

The remainder of the Richmond valley is considered in two sections: the non-volcanic areas south and west of the Big Scrub, and the coastal plain. The former is primarily a history of grazing, the latter of growing sugar cane.

The Richmond River was known to Europeans following its discovery by Captain Rous in 1828. He sailed his boat 20 miles [32 km] upstream, and observed:

> The general outline of the neighbouring country appeared to be flat open forest on the western bank and thick jungle to the eastward with fine timber, and as you ascend the river, the tea-tree, mangrove and swamp oak give place to Moreton pines, cedar, yellow wood, palms and gumtree (Blackmore 1989).

A licence application was made for Runnymede, west of Lismore, in 1839 and the first settlers arrived with stock at Casino in 1840. Burnett's map of 1846 (copy at Lismore Museum) shows 'open rolling plains and pine ridges most suitable for grazing' west of the Big Scrub. The suitability of the country for grazing, and the relative ease of conversion of this land (compared to the impenetrable rainforest), meant that the valley was colonised first by squatters and their stock, and the Big Scrub was given a stay of execution. This does not mean it was untouched. The first party of timber getters, which included Joe Maguire, after whom Maguire's Creek was named, arrived on the Richmond in 1842 and began taking first red cedar and then hoop pine from the accessible areas of the Big Scrub, principally the river banks. A belt of cedar half to 1 mile [0.8-1.6 km] wide had existed from Casino to Coraki. This was soon gone. In 1860 alone, two million superfeet ($4700m^3$) of cedar came down Wilsons Creek from the Big Scrub.

The Government Gazette in 1848 lists the areas of the main stations of the Richmond Valley at the time. They total 128,723 hectares, and since there were also many smaller stations by then, the total area being grazed can be conservatively estimated at 150,000 hectares, twice the area of the Big Scrub and thus covering all the valley. A squatter's licence then required the settler, within six months, to occupy the run and graze stock on all of its outer boundaries. This condition was checked by the Commissioner for Crown Lands, so that government settlement policy actually accelerated the process of clearing and grazing. No record of the fauna of the valley was kept. By 1860 there were 23 stations in the valley occupying over 145,800 hectares of land and the population was around 1300, most of whom worked for the timber industry, which had been making inroads into the Big Scrub for almost twenty years (Blackmore 1989).

Following the Robertson Lands Acts of 1861, hundreds of selectors arrived on the Richmond, and the systematic removal of the Big Scrub began. First the trees were felled, the debris was burnt, then corn or sometimes grass was planted between the stumps. Purchasers were required to build a house, cultivate the land, erect fences and live there.

Boatharbour was settled at this time. The son of L.W. Geraghty, whose descendants still occupy the land adjacent to the southern boundary of the present Reserve, was born in 1867 on the land which his father had pioneered the previous year (Richmond River Historical Society, Boatharbour file).

Corn failed as a crop on the Richmond, but cedar and pine sustained the colonists through the 1870s, and sugar cane was planted widely in the Big Scrub. During the 1880s other timbers—notably blackbutts, ironbarks, tallowwoods and turpentines—were cut, and in the 1890s dairying became the dominant land use in the area that had been the Big Scrub. All the available arable land in the valley, including most of the

Big Scrub, had been alienated by the early 1880s (Blackmore 1989). Dairying remained the main industry on the volcanic soils until the 1960s, when land use diversified to include the growing of tropical fruits, macadamias and other crops. Grazing of beef cattle has remained the chief land use of the other parts of the Richmond.

The coastal plain, with its swamp forests and other coastal plant species, must have provided important roost and food resources for flying foxes and other fauna. This is now dominated by sugar cane, although not to the extent as in the Clarence and Tweed Rivers. Sugar mills were built at Coraki, Lismore and Mill Hill between 1869 and 1872. From 1880 to 1940 the Broadwater Mill organised drainage and reclamation schemes in the cane-growing district, and from 1886 supplied fertilisers. The industry grew rapidly after World War II and now occupies virtually every piece of suitable land on the Clarence, Richmond and Tweed rivers. Thus there has been more than a century of intensive land use and environmental modification of the coastal lands of the Richmond. The implications of this for aquatic and terrestrial flora and fauna cannot be assessed in detail because of the lack of pre-clearing records. Certainly flying fox activity must have been significantly altered by the sugar industry. Combined with the clearing of the rainforests and 150 years of timber removal, the habitat of these animals was almost obliterated.

Flying foxes in the Richmond valley

In their determination to clear the wild areas of the Richmond Valley, the pioneers did not keep records of fauna, or of vegetation except where commercial opportunities were concerned. Early records describe the 'scrub' as impenetrable, but containing such valuable timber trees as cedar, pine, rosewood, and other areas are described as grassy plain suitable for grazing and with some commercial hardwood timber. General references to fauna do little more for the wildlife historian than provide a taste of the hard information that so easily could have been written. An example is from the Jubilee Souvenir of the Methodist Church, which describes Duck Creek Mountain, now Alstonville, (n.d. cited by Crawford 1983) prior to the arrival of Europeans:

> The whole district was then covered with a dense and almost impenetrable jungle—trees, undergrowth and vines. Mammoth cedar, pine, beech, teak, bean, rosewood, cudgery, booyong and yellowwood with their enormous spurs; the parasitical fig, and numerous other trees in endless variety towered one hundred and fifty to two hundred feet in height. Fern, bangalow palm, climbing bamboo, treacherous lawyer-vine, and an amazing wealth of vegetation covered the banks of the creeks, and moist levels nearby, creating in places an impregnable labyrinth. Almost every little gully had its streamlet of clear, cold water, with only an occasional broken ray of sunshine falling upon it.
>
> This wilderness of scrub was the home of myriads of birds, many being of unsurpassable beauty. Here were great flocks of harsh-screaming white cockatoos, black cockatoos with their plaintive cry, parrots and pigeons in wonderful variety and countless numbers, laughing-jackasses, beautiful riflemen, dragoon, regent, satin and cat-birds, lyre-birds with their remarkable tails and mocking cries, coach-whips noted for their striking calls, bower-birds with their curious playgrounds, brush-turkeys, the builders of immense nests of heaped rubbish and leaves, pheasants, tollewongs and numerous others both large and small. Wonderful was the melody ringing through the bush on a spring morning from ten thousand birds' throats. Here also dwelt the bandicoot and the bush-rat, porcupine, the cunning goanna, the lizard and the treacherous snake.

> The stillness of the night was broken by the mournful howl of the dingo, the hoot of the mopoke, the laughing call of the o'possum, the dull thud of the paddymelon as he bounded along his well-beaten track, and by the shriek of the quarrelsome flying fox whose camp was in the swamp below or in the wild rocky gully on the side of the mountain.

Prior to clearing, the Big Scrub and its adjacent eucalypt forest probably contained the highest diversity of mammalian fauna in Australia (Frith 1977; Blackmore 1989). Given the range of vegetation types and topographic features of the Richmond valley, and its geographical position in a subtropical/temperate overlap zone (Planners North 1988), it would be fair to assume an equally high diversity and abundance of all vertebrate fauna. Certainly, with its vast, dense rainforests, coastal plain and access to hardwood forests as far as the Richmond Range with its still rich mammal fauna (Barker, Lunney and Bubela 1994), the valley must have been prime habitat for flying foxes. Robert Leycester Dawson, a grazier/naturalist living at Bentley, west of Lismore, described flying foxes in the area during the 1870s:

> They were literally in millions on the Richmond in the early days. There was a vast 'camp' at Blakebrook Brush, only a few miles from Lismore, and numerous other camps throughout the district.
>
> Let me describe an experience in October 1877. Early in the spring of that year, for some unknown reason, the flying foxes left Blakebrook and other camps apparently followed suit. They congregated in vast numbers in a brush on the range of hills a mile or so north of Saville's One Tree Farm.
>
> The Savilles said that when, after sunset, they rose from the brush to disperse on their nightly search for food, they darkened the sky like a great black cloud. I rode from Bentley to One Tree about three miles one evening under a ceaseless stream of flying foxes, the whole way, all flying east.
>
> Willie and John Saville and I decided to explore the camp and have a day's shooting amongst the denizens of it. When we entered the brushwood, every tree, bush and vine was loaded with the chattering noisy creatures, a great many were slaughtered, even although we only had a single barrel muzzle loading gun. It was easy to get them in line and kill five or six at a shot. At lunch time a brief thundershower came on, followed by bright sunshine, when all the flying foxes spread out their wings to dry. An unusual and really beautiful sight with the sun shining through their gauzy wings and lighting up the bright orange colour of their necks.
>
> We thought we had seen extra-ordinary numbers during the early hours of our visit, but in late afternoon, when our ammunition was nearly exhausted, we came on the main camp. It was a little valley, or saucer-like depression, in the hills, maybe between 250 to 300 yards across. This valley was a indescribable sight, just one seething mass of flying foxes! The tree-growth here was close and dense but stunted in height, and every bush, bramble, twig or vine was bent or dragged down towards the ground by the weight of clinging bodies.
>
> When we shouted or fired a shot, and the tens of thousands took to wing for a brief space, the noise of their wings and of their shrill chattering was such that we could scarcely hear ourselves speak. I am not exaggerating, indeed I have not command of language adequately to describe such an unforgettable scene, where the little animals were 'as the sand upon the sea shore for multitude'. Whether our raid was the cause I know not, but within a few weeks of it, this great camp broke up and dispersed, presumably to their own haunts, only a few thousand remaining behind for several years to come. One result of my experience was that it exploded 'travellers tales' I had heard as a boy to the effect that flying foxes cling to one

> another, the top ones, of course, being attached to a branch or twig. They don't cling to one another, on the day I have described I saw hundreds of festoons and suspended rows of the animals, apparently clinging to one another but when disturbed, it was obvious that they were really clinging to a vine or long thin branch, but so close together were their bodies packed that their means of suspension could not be seen until they took to flight.
>
> As every person knows who has seen a flying fox, besides the clinging claws on their feet, they have hooks at their wing points which are used for purposes of suspension and for climbing about amongst slender top branches of eucalyptus when sucking honey from the blossoms. *(Richmond River Historical Society Journal*, v.2)

One Tree Farm lies about nine kilometres north of Casino, next to Manifold Road. A number of points can be inferred from this account. From the description the bulk of the animals appear to have been the little red flying fox although the regular camp at Blakebrook (presumably the grey-headed flying fox) seems to have joined them. It also seems that the animals, flying south and east, may have been following waterways to the coastal and swamp forests south and east of Casino. The Big Scrub was largely cleared by this time.

Keerong, seventeen kilometres north of Lismore, contained a flying fox camp at the end of last century. In 1897 the name was changed from 'The Fox Ground' to Keerong (which was the local Wiyabal Aboriginal word for flying fox) (Richmond River Historical Sosciety, pers. comm.; Parkes 1978). In 1896 the Terania Creek Progress Association wrote 'to the Minister of Mines requesting ammunition to shoot the flying foxes as they were destroying the fruit' (Parkes 1978). 'The early selectors cut a lot of scrub in this valley around 1861, but even up to the 1920s a few inaccessible acres of rainforest remained' (Parkes 1978). Thus the camp seems to have been a traditional one which was driven away early this century. As Blakebrook was probably cleared earlier than this, it is possible that the bats moved camp from there to Keerong, and thence further up the valley, perhaps even to the present Terania Creek camp.

Another camp appears to have existed in the Nimbin area. Ratcliffe (1931) obtained information that numbers of bats in this camp were 'most prevalent before 1905', but gives no other details, except that a population decrease had also been experienced in a flying fox camp at Lismore. This may be evidence that the present Currie Park camp has been used by flying foxes since the early 1900s, but this has not been able to be verified.

Frank Gerraghty, a descendant of the original settlers of Boatharbour, recalls his father discussing flying foxes at Boatharbour, possibly as far back as the turn of the century, and remembers no time, from the 1920s on, when bats did not use Boatharbour as a camp. Ratcliffe (1931) also reports a camp at Mallanganee, about thirty kilometres west of Casino, which suffered high mortality due to heat stress around 1913. Another camp, on private land near Clovass, between Lismore and Casino, has been regularly used by the grey-headed flying fox since the 1940s, and probably for longer (J. Dockrill pers. comm. 1988), and received an invasion of the little red flying fox in early 1988.

Research during the late 1980s for this study and two related programs (Eby 1991; Lunney and Reid 1996) uncovered a large number of flying fox camps in the vicinity of the Richmond River. Many appear to be minor, occasional or temporary camps, not all have been accurately located or studied, and the history of their use by flying foxes is mostly unknown. Of those mentioned so far in this paper, Currie Park, Boatharbour, Clovass and Terania Creek are still in use. Others at Maguires Creek, Booyong and Billinudgel are described in further detail in this paper. A further sixteen recent or present camps are also shown on Figure 1 and other camps certainly exist.

The Kyogle area was not investigated in detail during this project. However, a number of camps have been reported there by A. Floyd, S. Gilmore and D. Charley, many without specific locations (a number are included in Figure 1). This contrasts with a comment by Ratcliffe that, despite records of activity over the border in Queensland, no camps were known in the area, and it appeared not to be used by bats as a gateway to and from New South Wales (Ratcliffe 1931).

Six flying fox camps in the Richmond Valley

Maguires Creek—

Little specific detail is available on historical land use in and around the five hectare Big Scrub remnant of subtropical rainforest on Maguire's Creek, approximately two kilometres north of Alstonville. The camp is principally on private land, and thus the local Ballina Council had the authority over land-use decisions. Consequently, departmental (e.g. the former Lands Department, now Department of Land and Water Conservation) records of past management do not exist, but its proximity to Alstonville allows a reasonably accurate history to be inferred from other records.

Joe Maguire, among the first cedar cutlers to reach the Richmond, was logging on Teven (now Maguires) Creek in the 1850s. Duck Mountain (at, and south of, Alstonville) was also being logged. As the major waterways were the first to be logged, we can suppose that Maguires Creek was logged then. Settlers first arrived in 1864 (Daley 1966), the first land selection in the area was in 1865, and others followed in 1867. Cedar and hoop pine were logged, and the remaining trees were felled and burnt. It is not known how this remnant came to survive in an otherwise chiefly denuded landscape. One settler (Crawford, arr. 1867) was a dairy farmer from the south coast (Trudgeon 1987) so it is likely that dairying was tried early in the settlement of Alstonville. The rainforest around Alstonville was being cleared by 1870 (Trudgeon 1977). Sugar cane was tried quite extensively in the area, around the 1870s, but failed due to poor management practices, frosts and economic factors.

The Alstonville plateau, including the Maguires Creek site, was the first area of substantial dairying in the Richmond. The first co-operative dairy factory on the Richmond was established at Wollongbar in 1889, as was a butter factory at Rous (Trudgeon 1987). In 1894 the Department of Agriculture began an Experimental Farm at Wollongbar, which aimed to help farmers use the Big Scrub land, trialling such crops as tea, coffee, arrowroot, and tropical and sub-tropical fruits, as well as various breeds of cattle (Trudgeon 1987). This set the scene for land use in the area for the twentieth century.

By 1909, 32,000 hectares of Rous County was under artificial grasses, presumably for grazing (Trudgeon 1987). This is almost half the original area of the Big Scrub, modified beyond recognition as a native Australian landscape, let alone an outstanding rainforest.

The Maguires Creek remnant was partially cleared, in 1986 or 1987, to make room for a blueberry farm. Privet began invading the site, which previously had only a slight weed problem (Planners North 1988). The consequent introduction of light, weeds, winds, and fertilizer runoff threatens the viability of this Big Scrub remnant.

From this history we can guess that the land surrounding this site, and probably the site itself, was logged in the 1850s to 1870s, cleared from the 1870s and grazed from the 1880s. It has probably been isolated for more than a century.

Currie Park—

Currie Park is a three hectare heavily disturbed subtropical rainforest remnant on the Wilsons River on the northern outskirts of Lismore. Its history, while short on specific detail, cannot be separated from the history of Lismore itself. Two other Big Scrub remnants in Lismore, Wilsons Park and Rotary Park, both occur in gullies. Currie Park and the Boatharbour Reserve (described in the following section) are the last two remnants of lowland alluvial sub-tropical rainforest of the Big Scrub. Flick (1935) describes the site in the 1870s thus:

> These flats in those days were very different to what they are today....timbered with almost impenetrable scrub. Curries Creek ran between the present [naturally grassed] high school flat [now Richmond River High School] and racecourse flat, the banks of which were also heavily timbered. The main river was also bordered on both sides with dense scrub.

In 1880 lands adjacent to Currie Park were privately owned, by J. Simes and J. Greenhalgh, a relative of Granny Greenhalgh—'the smartest cedar dealer on the Richmond' (Richmond River Historical Society, Currie Park file; Trudgeon 1977). Currie Park itself remained Crown Land, and was notified as a Reserve for Public Recreation and Preservation of Native Flora on 12 November 1898 (Crown Lands Office, Grafton). Lismore City Council has managed the Park as trustee since 1981. Ratcliffe (1931) mentions an apparent flying fox population decrease in a camp at Lismore and, while the location is not specified, no other flying fox camp is known in Lismore.

Lismore developed rapidly during the second half of the nineteenth century. Timber getters and squatters pioneered the area in the 1840s, it became a village in 1856, a municipality in 1879, and was the main business centre on the river by 1874, when the railway was opened. The population grew from 93 in 1871 to 992 in 1881, 2,925 in 1891 and 4,542 in 1901 (now about 35,000) (Trudgeon 1977). Currie Park's increasing isolation and neglect is reflected in these figures.

Scouts used Currie Park as a camping ground in the past, the land was leased for grazing until 1981, but grazing ceased only in 1986 (Property Officer, Lismore Council, pers. comm. 1988). Interviews with local residents, Lismore Turf Club staff and Lismore City Council's Parks and Gardens Supervisor revealed that very little historical information exists on Currie Park, that no fires or other major changes have occurred since the late 1960s, and that flying foxes have used the site each summer and most winters since at least the early 1970s (C. Peheny, pers. comm. 1988; A. Farmer, pers. comm. 1989). That one resident recalls travelling from Lismore to Boatharbour in the 1960s specifically to watch the flying foxes leave at dusk suggests that Currie Park was not a large or well-established camp at that time (N. Noble, pers. comm. 1988). The site floods readily and often, and experiences some frosts.

Gilmore (1982, NPWS files) describes the site thus: 'Apart from half a dozen or so large trees, the rest appear to have regrown subsequent to clearing, and is a good example of natural rainforest regeneration totalling 49 species'. Floristically the site is similar to Boatharbour, but less diverse (McKinney 1982, NPWS files, citing Gilmore). Regeneration work commenced in 1986, and was aimless at first, but then became a strategy of replanting in open areas to attempt to reduce the impact of flying foxes (M. Dunphy, pers. comm. 1988). This work went for only six months. The regenerators could not recall any stumps in the rainforest and, if it was cleared in the past, no record was found of such clearing. Any commercially usable trees would have been removed very early in the settlement period (1840s), and it is assumed that Reservation in 1898 would have prevented further logging.

In 1981 the Department of Agriculture, acting on Council advice, carried out a shoot to reduce the number of flying foxes at Currie Park and Boatharbour, with the usual lack of success (Property Officer, L.C.C. pers comm. 1988). Gilmore (1982, NPWS files) recorded grey-headed flying fox and black flying fox at Currie Park in 1982, and an estimated 200,000 bats were recorded there in October 1984 (NPWS file).

Planners North (1988) state that 'there is ... not enough water to sustain a rainforest in Lismore on flat land'. It appears that the supplemental water (Curries and Wilsons Creeks) and low-lying nature of the site provide a situation where rainforest (i.e. scrub) can be sustained, and as such this site is possibly unique in Lismore.

Boatharbour—

Much of the information in this section is drawn from Richmond River Historical Association's Boatharbour file. The present relatively good condition of the seventeen hectare subtropical rainforest remnant at Boatharbour belies its long history of disturbance. Boatharbour, on the Wilsons River/Bangalow Road, six kilometres north-east of Lismore, has been the site of intensive activity by Europeans since the first settlements on the Richmond. While the record is not specific, it can be assumed that Boatharbour was logged for cedar and hoop pine during the 1850s, if not earlier. The basis of this assumption is that the timber cutters arrived on the Richmond in 1842, and worked the river banks first because of the ease of access to, and transportation of, felled timber. Wilsons Creek was navigable as far as Boatharbour, permitting convenient access. Certainly it was logged during the 1860s—a patch of native pasture at nearby (2 km) Bexhill provided grazing for bullock teams used to haul logs to the rivers for floating to mills. Edmund Coleman worked the area for some years before moving to Lismore in 1862, and logging is reported in the area prior to the setting up of the first cedar dealing business in Lismore, probably in the mid 1850s (Trudgeon 1977).

Following the 1861 Robertson Land Act, settlement began at Boatharbour. L.W. Gerraghty (whose descendants provided information for this study) pioneered the Boatharbour area, and had a son there about 1867. Thus the isolation of this remnant began some 120 years ago. The area is described as 'thick scrub' in a 1857 survey of the area.

Early in the logging history of this area, a chain was tied across the river at Boatharbour to catch logs floated from further upstream, and a wharf was built for use by ships transporting timber out of the area. Peter Gerraghty (pers. comm. 1989) suggests that many of the current tracks in the reserve are old snigging (log-hauling) tracks from those days. As well as the wharf, the site contained loading facilities, a felling site and logging camp, and later a section to the north of the creek, west of the road, contained a milk separating station (Collins 1987). Frank Gerraghty (pers. comm. 1989) remembers that the whole area was devoid of trees in his childhood 1920s) and that present vegetation in paddocks and along creeks is regrowth. The Bryant family lived there in the 1870s and a bridge was built between 1883 and 1885 to replace the existing ford. The establishment of a cream depot at nearby Clunes (11 km) in 1892 reflects the conversion of the land in the district to exotic pasture and dairying by then (Trudgeon 1987).

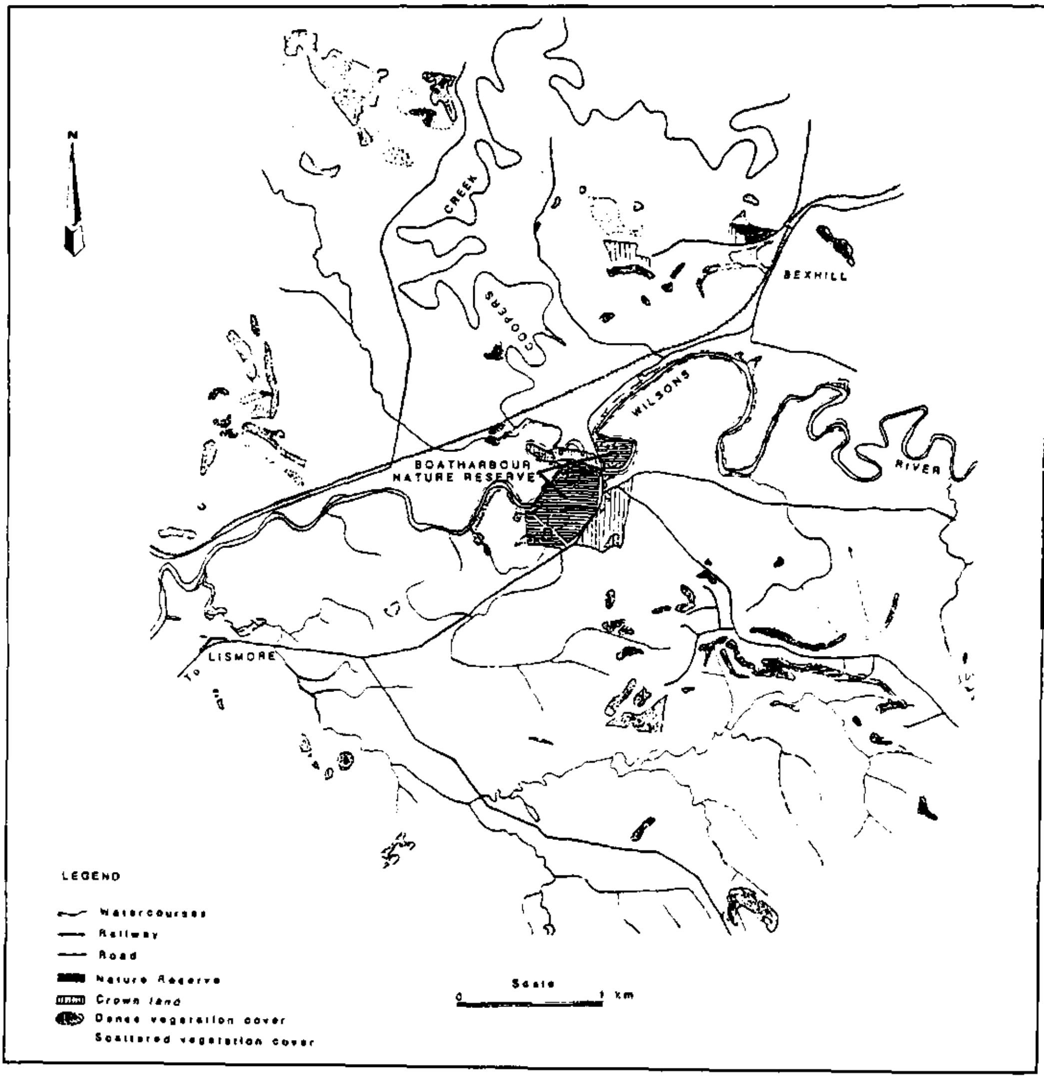


Figure 4. Map of the rainforest remnant at Boatharbour, showing its isolation in a landscape of forest fragments.

The site was reserved in three stages: R20643 for Access, notified 26 June 1894, R55748 from Sale for Public Recreation, Notified 20 October 1922, and R35856 from Sale and R35857 from Lease Generally for Public Recreation and Preservation of Native Flora, notified 18/3/1927 (Crown Lands Office, Grafton). A major aim of reservation was to protect the wharf.

Around 1920 a French family named Brault lived on the site in a four-wheeled, covered, horse-drawn wagon. Later they moved into one of the four houses on the west side of the Reserve. Three portions, three to four kilometres from the present reserve, were advertised for auction in 1926 and described as 'highly improved dairy farms'. We thus have a picture by the 1920s of an isolated, continuously used, rainforest remnant.

The Reserve has been managed recently for recreational use by the Lismore Lions Club which has sealed the access road, constructed a shelter and fireplaces, and kept the picnic area clean and tidy. National Parks and Wildlife Service and Lands Department officers inspected Boatharbour in 1981, noting cattle grazing and that the fence seemed to be permanently open (NPWS files). Gilmore (pers. comm. 1988) said that there had been much illegal grazing in the past, and that grazing was heavy until 1984, when the lease expired. Collins (1987) found no record of fire in the Reserve, but noted the presence of feral cats. He described vandalism as an extreme problem in the past, and stated that vagrants and alcoholics traditionally have used the site. Reserves 55748 and 35856 were gazetted as Boatharbour Nature Reserve on 13 November 1987, and the existing vehicular access was closed.

Flying fox use of Boatharbour as a camp may coincide with the final stages of the almost total destruction of the Big Scrub. Given the indifference of the pioneers and early settlers to keeping wildlife records, it is not surprising that no references to flying foxes at Boatharbour were found until Alex Floyd's Vegetation Inventory in 1977 (Floyd notes the presence of shotgun cartridges on the ground beneath the bats.)

Frank Gerraghty, born about 1915, is a direct descendant of the Gerraghtys who pioneered the area in the 1860s and recalls discussions with his father which indicate that flying foxes were always at Boatharbour (pers. comm. 1989). His father's memory would pre-date the turn of the century. His wife moved to Boatharbour in 1946, and was immediately astounded at the sight of bats turning the sky black each evening as they flew south from Boatharbour to feed. Frank used to earn 2d. per bat skull from the Pastures Protection Board during the 1920s. Frank's son Peter (pers. comm. 1989) recalled large numbers of bats at Boatharbour until the summer of 1969, when locals conducted a week-long shooting drive, or *battue*, against the bats. Numbers have been greatly reduced since then. A relative, Mrs Gerraghty at Bexhill, recalls an all-day *battue* in the early 1950s, which drove the bats away for a week (pers. comm. 1988). Lismore City Council and the Department of Agriculture organised a flying fox shoot at Boatharbour and Currie Park, using blanks, in 1981 (Property Officer, Lismore City Council, pers. comm. 1988). This action may have been effective, as both Peter and Frank Gerraghty commented on the reduced numbers of bats at Boatharbour in the 1980s. Flying foxes (200-500) were reported at Boatharbour in September 1986 (K. Parry Jones, NPWS files), 1987 (Planners North, 1988; Collins 1987) (c. 500) and 1988 (this study, grey-headed flying fox). About 200 black flying foxes, but no grey-headed ones, were present in June 1988.

Booyong Reserve—
While the clearing that isolated the thirteen hectare Booyong Flora and Recreation Reserve (R 62153 from Sale and R 62154 from Lease Generally for Preservation of Native Flora and Public Recreation) most likely occurred during the 1880s, the history of disturbance to this subtropical rainforest remnant goes back many more years (Figure 5). A tree which contained 33,000 superfeet (78 m^3) of marketable timber is recorded from the junction of Wilsons and Skinners Creeks (now the boundary of Booyong Reserve) in 1855 (Trudgeon 1977). A further report describes cedar-felling near Booyong and Skinners Creeks, apparently in the 1880s (Trudgeon 1977). We can suppose the area to have been well worked over for timber by 1890, by which time the land-use conversion to dairy farms was well under way.

In 1892 a meeting of dairy farmers was held at nearby (4 km) Clunes to establish a cream depot there for the district's produce (Trudgeon 1987). This led to the establishment of Norco, and suggests widespread clearing and pasture development in the district by then. Booyong town was also established in 1892, and has declined in size since its heyday earlier this century (E. Fiedler, pers. comm. 1988).

Figure 5. Big Scrub remnant at Booyong, 1988. *Photo*: Sue Walker, NPWS.

In 1930, local residents applied to the Government to have the land now known as Booyong Reserve set aside for recreation. In the same year the present playing area (south-east section of Reserve), which was similar rainforest to the remainder of the Reserve, was cleared and burnt off, and the timber was used to fuel the boilers at the Booyong Meat Co-operative (E. Fiedler). The area was reserved in 1930, and control granted to the present Trust in 1932 (NPWS file, E. Fiedler). Only its flood-prone position prevented this land being sold in the nineteenth century. The trustees fenced the reserve in 1934, and in 1936 a violent storm brought down many of the large trees, resulting in canopy gaps which still exist (E. Fiedler, pers. comm. 1988).

According to the Trustees, there have been no regeneration or weed control efforts in the Reserve, except for slashing along the fence line. In 1981 the Trustees informed the Crown Lands Office and National Parks and Wildlife Service staff that much of their income from grazing rentals was spent controlling Crofton weed, *Eupatorium adenophorum*, and that other weed problems were not considered significant. Cattle enter the rainforest reserve only very occasionally (E. Fiedler, pers. comm.) and Floyd (1977) states that the area appears relatively free of grazing. A storm in 1978 blew down some trees on the north-west side of the reserve (E. Fiedler, pers. comm.).

Flying foxes began to use Booyong as a camp site from about 1973, firstly as a small colony (c. 100 bats) near the creek, then moving to near the access gate in the early 1980s (E. Fiedler). Numbers increased from 1986, occupying trees along the present road frontage. There was some shooting of bats in the years after their arrival (E. Fiedler, pers. comm.) and they were still occasionally used for target practice in the 1980s (S. Gilmore, pers. comm. 1988). Floyd notes presence of the bats near Cudgerie Creek in 1977, and Gilmore reports that often some bats overwinter at the site, and that despite yearly fluctuations in numbers, the size of the camp appears to be increasing.

Terania Creek—

Specific detailed references to the subtropical rainforest of the Terania Creek flying fox camp site are not available in the literature as, historically, there were no features which distinguished this site from the valley generally. Historical references to Terania Creek probably apply to the lower reaches of the waterway, closer to Lismore. However, a general land-use history can be inferred from the available information.

We do know that Terania Creek was being logged for cedar and pine in 1848 (Trudgeon 1977), and that a flood in 1849 caused the creek to rise to twelve metres in one night. Such floods made logging far upstream worthwhile, as they enabled cut timber to be floated to sawmills and markets. A limitation on early logging was the availability of feed for the bullocks used to haul the logs to the waterways. Durroughby's grass, a natural grassy knoll some seventeen kilometres north of Lismore, was used by cedar-getters working on Terania and Coopers Creeks, five to ten kilometres away (Trudgeon 1977), so it was certainly possible to have logged Terania Creek up to and beyond the present flying fox camp in the 1850s. Daley (1966) shows a cedar camp called Terania Creek between 1842 and 1852, but locates it on Goolmangar Creek, about twelve kilometres north of Lismore. This may be a mapping error as the camp was most likely situated on Terania Creek near Keerong. Greenhalgh (in Trudgeon 1977) writes of cutting in Whian Whian in 1871, which was as far as, if not further than, the Terania Creek camp, and probably more difficult access. It is thus likely that the bat camp site was picked over for cedar and/or pine between 1850 and 1870, and could have suffered the ground disturbance of bullock teams and snigging.

The clearing of the flat areas along upper Terania Creek may have occurred around 1882, when the Nimbin area was opened up for settlement under the Robertson Land Act of 1861 (Trudgeon 1977). Some of this land had been already leased for cattle grazing, so that early disturbance by cattle at Terania Creek is also possible. The move to dairy farming happened soon after this time, and in 1913 a butter factory opened at The Channon, ten kilometres from the bat camp, to serve the dairy farms of Terania Creek (Trudgeon 1987).

The flying fox camp, located just within the vegetated edge of a partially cleared valley, was part of Whian Whian State Forest, probably from around 1920 to 1983. Although the basin was selectively logged from the 1940s to the 1960s, the northern half escaped the timber getters and remains virtually undisturbed (Milledge 1981).

However, the present rest area in Nightcap National Park was once used as a log dump, so that some logging may have occurred in or around the flying fox camp during this time (NPWS undated). Logging ceased in 1979, and the area was gazetted as Nightcap National Park in 1983. The history of flying fox use of this camp is unknown, but two species use the site in summer and it was an established camp by 1975 (H. Nicholson, pers. comm. 1988).

Billinudgel—

A detailed early history of this flying fox camp site is virtually unavailable because, being in a coastal swamp, it did not attract timber-getters or farmers, and it was not even suitable for growing sugar cane. Thus the area was bypassed in the local histories which have been collected for the more exploitable areas. Moreover in the 1980s, the area was owned by a development company based elsewhere, and was the subject of a land-use conflict. The owners were not accessible for information, nor necessarily inclined to provide it in possible contravention of their development interests. It also appears that there has been minimal human interference in the area until recently, as the highly unusual rainforest and swamp vegetation remains diverse, well-developed and relatively free of weeds.

That the area was settled by 1877 is evident from a notice in *The Northern Star*, 29 Jul 1876 (cited by Trudgeon 1977) which stated:

> I HEREBY CAUTION all parties not to remove or otherwise interfere with our CEDAR on BILLY NUDGEL CREEK or BRUNSWICK RIVER, branded J.B. star G.P. and W.W. JOHN O'NEIL and Co.

Billinudgel Creek flows through the flying fox camp, and is presently only a few kilometres long (its upper reaches have probably been modified or obliterated by the construction of the Pacific Highway at Yelgun), so that it can be inferred that: cedar grew in the vicinity; Europeans had searched the site for timber; the cedar had been earmarked (branded) for removal, and presumably was logged; and if the owners did not log the area, there was a strong likelihood someone else would, illegally. A map issued by the North Coast Steam Navigation Co. in 1904 includes Billinudgel, indicating it was a significant settlement by then (Trudgeon 1987). Alex Floyd, in a report to Byron Shire Council (date uncertain, probably early 1980s or prior to the Council's 1988 Local Environment Plan) noted hoop pine stumps to the east of the bat camp. He thought that a fire had been through the area 50-100 years ago, but that there had been very little disturbance for the last 40-50 years. Some adjacent areas were cleared, and cattle grazed early this century (R. Mazlen, pers. comm. 1988) but the immediate bat camp area was probably too wet for grazing.

The hydrology of the area has been modified in recent decades, probably in anticipation of development. Large drains and a number of artificial lakes were constructed by bulldozer in 1973, possibly resulting in a drop in water level and the death of some *Melaleucas* as the vegetation adjusted (R. Mazlen, pers. comm.). An embankment and access road runs in a north-south direction east of the bat site from New Brighton to Wooyung which, it would seem, must hinder drainage of those areas immediately west of the road. The area endured a severe cyclone in 1973/74 (R. Mazlan, pers. comm.).

In 1985 a number of 5-8 metre wide tracks were bulldozed into the area, including in the vicinity of the bat camp, and conservationists obtained an Interim Conservation

Order over the area (Total Environment Centre, 1987). This expired and zoning was 'deferred' in the Byron Shire Council Local Environment Plan 1988. Much of the immediate area, although not the flying fox camp, is now protected under State Environment Protection Policy 14 (Coastal Wetlands). Even this is controversial, as the company (Ocean Shores Development Corporation) obtained some amendments to the definition of these wetlands (Amendment 3, SEPP 14, Department of Planning).

The flying fox camp site, in a stand of Bangalow Palms, is used in winter and other times of the year by grey-headed and black flying foxes, but it is not known for how long it has been used. The land is now in the process of being purchased and dedicated by the National Parks and Wildlife Service.

Historical management of flying foxes and their camps

In 1889, following requests for help from thirty fruit-growing districts, the Minister for Mines and Agriculture determined to supply ammunition to groups to deal with the problem of 'numerous flying fox haunts, containing millions of animals, which eat the best fruit within twenty miles [32 km] of their camp'. These haunts we now recognise as the remnants of the once extensive subtropical rainforest of northeastern New South Wales. The Minister also determined to try dynamite as a means of shifting the bats from their camps. Explosives were found to be useless, and despite shooting 100,000 bats that year, at a cost of £1 per 150 bats, the ensuing report recommended the use of wire mesh to deal with the problem. Ratcliffe (1931), in his comprehensive study of flying foxes in Australia, came to much the same conclusion. Our historical study has revealed that traditionally used methods remain largely ineffective in dealing with the problems attributed to flying foxes.

This study has looked at land-use changes since settlement, records of flying fox activity and the historical uses of the actual sites of most of the significant present-day flying fox camps. A number of preliminary conclusions can be drawn which are relevant to current efforts to find solutions to the ongoing issue of managing flying foxes. The two major approaches have been to attempt to control flying foxes in their 'camps', where these are known and accessible, and to a lesser extent to control their impact within individual orchards. Camp-based approaches have included clearing of trees, shooting, explosives, poison gases and campaigns of noise and other disturbance. Shooting has traditionally been the most popular method. Orchard-based methods of control have included various, often ingenious, types of 'scarecrow', shooting, poisoning fruit and the use of physical barriers (i.e. nets). The latter is the one now recommended (Eby 1994).

Clearing all the trees in a flying fox camp effectively removes it. Sequential clearing of bat camp sites in the Bellinger valley around the turn of the century saw flying fox camps move from Thora to Gleniffer to Gordonville to Rosewood Creek to Bellingen Island—all within the one valley. In the Richmond valley prior to 1900 clearing seems to have pushed bat camps from Blakebrook to Keerong (which means flying fox in the local Aboriginal dialect) to Terania Creek. In these and other cases the bat camps remained within range of their native food supply and local orchards, so that the effect of clearing was not to solve the problem but only to relocate the camp.

Shooting has occurred periodically in all known camps, past and present. Bats have always been targets of shooters, and many people interviewed had shot bats, either as boys or as farmers protecting a crop. Most of the bat camps had shotgun shells on the ground, and it is not unusual to see bats fly overhead with holes in their wings. Loud noises, such as chopping wood or cracking a stock-whip, can upset a whole colony. Ratcliffe also mentions periodic *battues*. The camp at Boatharbour, near Lismore, has probably been shot at every year this century. Many of the shoots (e.g. Susan Island in 1877, Boatharbour in 1969, Currie Park and Boatharbour in 1981 and Maclean in 1986) were organised attempts to remove flying foxes permanently from the camps. However, the bats have usually returned to the sites, sometimes within hours and sometimes not for a number of years. Shooting has no meaningful effect on numbers of flying foxes, nor on the damage they may do to crops, and has not removed bats from the district. Other camp-based approaches have had, at best, limited effect and at worst have cost a lot of time and money (e.g. use of explosives), damaged the vegetation and not harmed a single bat.

An overriding constraint on camp-based approaches to flying fox control is the rarity and the importance of the ecological health of the remaining rainforest remnants where flying foxes make their camps. Such well-known and unique rainforest remnants as Bellingen Island, Susan Island, Boatharbour Nature Reserve and Booyong Reserve depend on the pollinating and seed-dispersing functions of flying foxes for their continued viability. Similarly, the restoration of rainforest through the region will continue to depend on the dispersal of rainforest seeds by flying foxes as they move from the camps examined in this study and their feeding sites.

A number of unconventional methods have been tried in the effort to keep bats out of individual orchards. Carpet snakes are said to be a deterrent in sufficient numbers; pruning flat the tops of the fruit trees makes it impossible for the bats to land; and a variety of offensive sounds, smells and sights (e.g. strobe lights, dead bats) were all reported to the study. Bats quickly learn to accept new or unusual events, and deterrents have only worked for short periods of time. Poisoning fruit subjects a small number of animals to a cruel death without providing a long-term, economic and practical solution to the problem of bat attacks on orchards.

At present, in accord with the initial decision to recognise flying foxes as protected species under the *National Parks and Wildlife Act* 1974, farmers may obtain a licence from the National Parks and Wildlife Service to shoot a limited number of bats within their orchards (Lunney 1990), although this has not been without its critics (Wahl 1994). In a year of good flowering of native hardwoods this appears to be an adequate solution, but in seasons when mass flowerings fail bats intensify their attacks on orchards.

While the historical record does not provide the empirical evidence needed to make direct comparisons between the past and the present, the few extant records of past flying fox activity give the impression of far greater numbers than are encountered today. Suggestions that flying fox numbers are increasing often do not consider the different behaviours of little red and grey-headed flying foxes, or the variations in bat behaviour that result from different seasonal and climatic conditions from year to year. In fact, the black flying fox became listed as a 'vulnerable and rare' species under the *National Parks and Wildlife Act* 1974 (Lunney and others 1996), which was modified to 'vulnerable' following the passage of the *Threatened Species Conservation Act* 1995.

Rather than attempt to eradicate these animals, as some people would like, we argue that it is more realistic and beneficial to be working to ensure their conservation as a major pollinator of our hardwood species and a major dispersal agent for many of our softwood species. In the long-term interest of resolving the problem, fruitgrowers should be advised to keep detailed records of all fruit bat activity of which they become aware, so that the information base exists to undertake realistic, informed, ecologically-based measures to protect orchards from attack.

Any approach which targets individual animals will have its effect only at the individual level. Thus, shooting of these flying foxes may help vent some frustration, but will never have a significant effect on populations. Indeed, one good breeding year for bats would negate the impact of any amount of shooting effort. We need to look beyond short-sighted methods of control which seek only to drive the bats a short distance away or to kill a few individuals. This approach only moves the animals to a new location within reach of the same food sources. A number of reports, particularly from Booyong, Boatharbour and Currie Park, mention the bats abandoning a site for a week to a month, then returning for the remainder of the season. Nelson (1965) comments on this, and correlates movement out of one site with arrival at other sites. An integrated and co-operative approach is needed which protects orchards and addresses the problems of the bats' dwindling supply of natural food.

The ecological history of these eight sites is a microcosm of the land-use changes to the region, particularly the low elevation strip along the coast that once carried the vast tracts of rainforest. The remnants are important in themselves and worth conserving on floristic criteria alone (Lott and Duggin 1993). This study identified for the first time the significance of the long-term use that flying foxes make of their camps, especially their maternity camps. The value of these camps to flying foxes and the mutually beneficial interactions between flying foxes and the trees of northeastern New South Wales demonstrates the need to care for both the camps and the flying foxes.

Acknowledgments

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21

Phantoms in the foliage: human influences on the rainforests of the New Guinea Archipelago

Tom Heinsohn

Introduction: Wallace's blind spot

The famous naturalist, Alfred Russel Wallace, although a co-author of the theory of evolution by natural selection, is most strongly remembered for proposing an imaginary line which divided the Asia-Pacific region into two distinct faunal areas, the 'Oriental' and the 'Australian'. After having spent eight years in the Malay Archipelago, and conducted long journeys through other equatorial regions, he is also remembered for his vivid descriptions of the tropics. In his book *Tropical Nature* (1878: 67-8), Wallace wrote of 'primeval forests' where he was overwhelmed by a 'vastness, a solemnity, a gloom, a sense of solitude and human insignificance'. He also writes of the Australian region marsupials as primitive mammals 'completely shut off from all competition with higher forms of life' (1878: 345).

This genre of sentiment regarding remnants of a primeval world, is echoed in the writings of the visiting English naturalist and lecturer, Joseph McCabe, who wrote an article which described continental Australia, at the heart of the Australian zoogeographic region, as 'a museum of primitive types' which presented 'a chapter from the middle ages of the Earth' (*The Lone Hand*, 1 Nov. 1910: 38-9).

Both the popular and the scientific literature, from last century to the present, are laden with statements about the pristine primordial forests of Australasia, which serve as living museums of ecosystems which stretch back to a prehuman prehistoric past. While this genre of views may be true to a degree in some areas, it tends to obscure the sometimes profound and often subtle human influences, which since prehistoric times have played a part in shaping the ecosystems of our region. Indeed, it is only in recent decades with advances in disciplines such as archaeology and palaeoecology, that the sciences and the humanities have gained a sense of the magnitude of prehistoric human impacts on Australasian ecosystems, and this has as yet, due to the low visibility of evidence, probably still been underestimated.

In relation to faunal history, Wallace was actually quite precocious for his time, in that he speculated that various 'Oriental' placental mammal species had been translocated by human agency into Celebes (Sulawesi), the Moluccas and Lesser Sunda islands of what we now call Eastern Indonesia or Wallacea, thus giving their zoogeography an anthropogenic skew. For example, in the 1869 edition of the *Malay Archipelago*, in relation to the zoogeography of the Moluccan Islands Wallace wrote:

> The land mammals [non-volant] are exceedingly few in number, only ten being yet known from the entire group...But even this exceeding poverty of terrestrial mammals does not at all represent the real poverty of the Moluccas in this class of animals; for, as we shall soon see, there is good reason to believe that several of the species have been introduced by man, either purposely or accidentally (Wallace 1869: 300).

Wallace then goes on to speculate how various wild placental mammals such the Celebes black ape, the Malay civet, the Rusa deer and a commensal shrew were probably introduced to various Moluccan islands by human agency. This includes speculation that the black ape, a common Malay pet on praus, became established on Bacan after some animals escaped from their owners; that the Malay civet, an animal which is traded live in cages as a source of civet for perfume, became established on Bacan and Buru after escaping or being liberated; and that the commensal shrew was translocated as an accidental stowaway in cargo. The Rusa deer, however, he regarded as having most definitely been deliberately introduced to various islands:

> Deer are often tamed and petted, and their flesh is so much esteemed by all Malays, that it is very natural that they should endeavour to introduce them into the remote islands in which they settled, and whose luxuriant forests seem so well adapted to their subsistence (Wallace 1869: 300).

In other parts of the *Malay Archipelago* Wallace also speculates how the long-tailed macaque may have been introduced to various Lesser Sunda islands by natives 'who often carry it about captive' (144); and how 'The deer [Rusa] may also have been introduced by man [to Timor], for the Malays often keep tame fawns' (Wallace 1869: 160). The introductions of some other placental mammals into Eastern Indonesia are recorded by Groves (1984; 1995), Glover (1986), Kitchener and others (1990), Flannery (1995b) and Heinsohn (1997c).

In general Wallace's eye appears well attuned to evidence of placental mammal translocation, however, when it came to evidence of marsupial mammal or ratite (emus and cassowaries) bird translocation, he appears to have a blind spot. It is speculated here, that this may have something to do with a subconscious Eurocentric bias against the less familiar Austral faunal elements such as marsupials, which were regarded as being further down the evolutionary scale, and less valuable to humans. For example, in relation to the Banda Islands in the Moluccas, Wallace has the following to say:

> The deer of the Moluccas and the pig have probably been introduced. A species of cuscus or Eastern opossum is also found at Banda, and this may be truly indigenous in the sense of *not* having been introduced by man. (Wallace 1869: 223)

What is curious about this statement is the fact that the Banda cuscuses, which include the common cuscus and the common spotted cuscus, are in all probability introduced (Flannery 1995; Menzies and Pernetta 1986) with their likely source being either other Moluccan islands or New Guinea and its continental satellites. Furthermore, in common with the rusa deer, both cuscuses (as in Wallace's time) are still considered a highly palatable game animal, are often kept as pets, sold in markets, and caged animals may be included in traditional trade cargoes. Despite this parallel, however, Wallace treats their island occurrences as natural. Similarly, the isolated population of the double-wattled cassowary, another essentially New Guinean species, on the large Moluccan island of Seram is also treated as being natural despite evidence of captive management and sea trading of this large and valuable meat and plume bearing bird (Wallace, 1869).

This trend of treating the less familiar Austral faunal elements as natural rather than introduced, is not confined to Wallace. When fellow British naturalist George Bennett described the essentially New Guinean dwarf cassowary found on the North Melanesian island of New Britain in 1857, he regarded its occurrence there as natural. This was despite evidence of pet keeping, captive management and sea trading by local natives (Bennett, 1860). Indeed, it has taken until recent decades for the impact of humans on the zoogeography of the marsupials and ratites to be more fully realised, largely owing to research stimulated by the Lapita Homeland Archaeological Project (Allen and Gosden 1991; Flannery and White 1991; Flannery and others 1988). Evidence for the possible translocation of a variety of marsupial mammals and flightless ratite birds in the Circum New Guinea Archipelago, is reviewed below. Due to the fact that some have regional distributions which do not appear out of place to the unquestioning eye, they are referred to as 'camouflaged exotics', which are a part of camouflaged human influences on the rainforest ecosystems of the Archipelago.

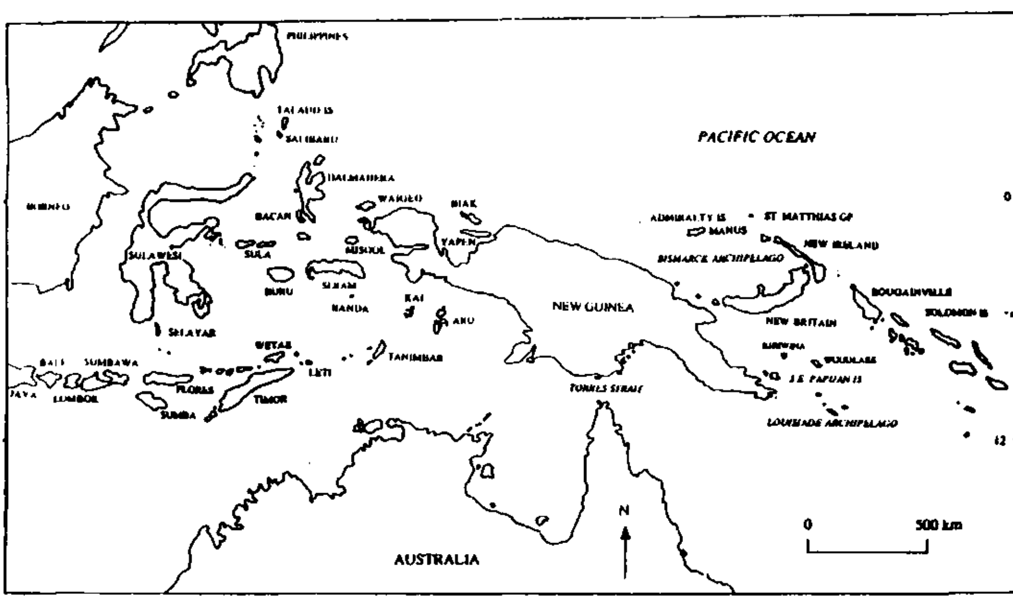

Figure 1. Map of the Circum New Guinea Archipelago

Study Area

The Circum New Guinea Archipelago is comprised of the Eastern (or 'Wallacean') Indonesian Islands and the Northern Melanesian Islands which flank the mega-island of New Guinea to the west and east respectively. Wallacea is comprised of the Moluccas (Maluku), the Sulawesi Archipelago and the Lesser Sundas; while the Northern Melanesian Islands are comprised of the Bismarck Archipelago and Solomon Islands. Some other New Guinea continental (land bridge) and non-continental satellite islands, which fall outside the formal boundaries of Wallacea or the Northern Melanesian Islands are also discussed. The dominant vegetation of the Circum New Guinea Archipelago is Malesian rainforest, although in places this is greatly disturbed or reduced in area due to human activity.

Method

Camouflaged human influences have been researched using a holistic environmental history which is broadly defined as a synergistic and strategic combination of history/anthropology, ecology/biogeography and archaeology/geology. A camouflaged human influence is a low visibility anthropogenic manifestation which mimics a natural phenomenon. It is argued that the synergism of holistic environmental history enables the unveiling of historiographically phantasmagorical human influences, such as camouflaged exotic species, which may go undetected if only a single disciplinary method were employed.

Figure 2. Double-wattled cassowary of Seram, Aru, New Guinea and north-east Queensland.

Evidence of ratite and marsupial translocation

Double-wattled cassowary

The double-wattled cassowary is principally a New Guinean species, but with satellite populations in northeast Queensland, on Aru Island and on the Central Moluccan island of Seram (Beehler and others 1986). The Australian and Aru populations are probably a by-product of the Torres Strait and Arafura Sea land bridges which connected both landmasses to New Guinea during the last ice age.

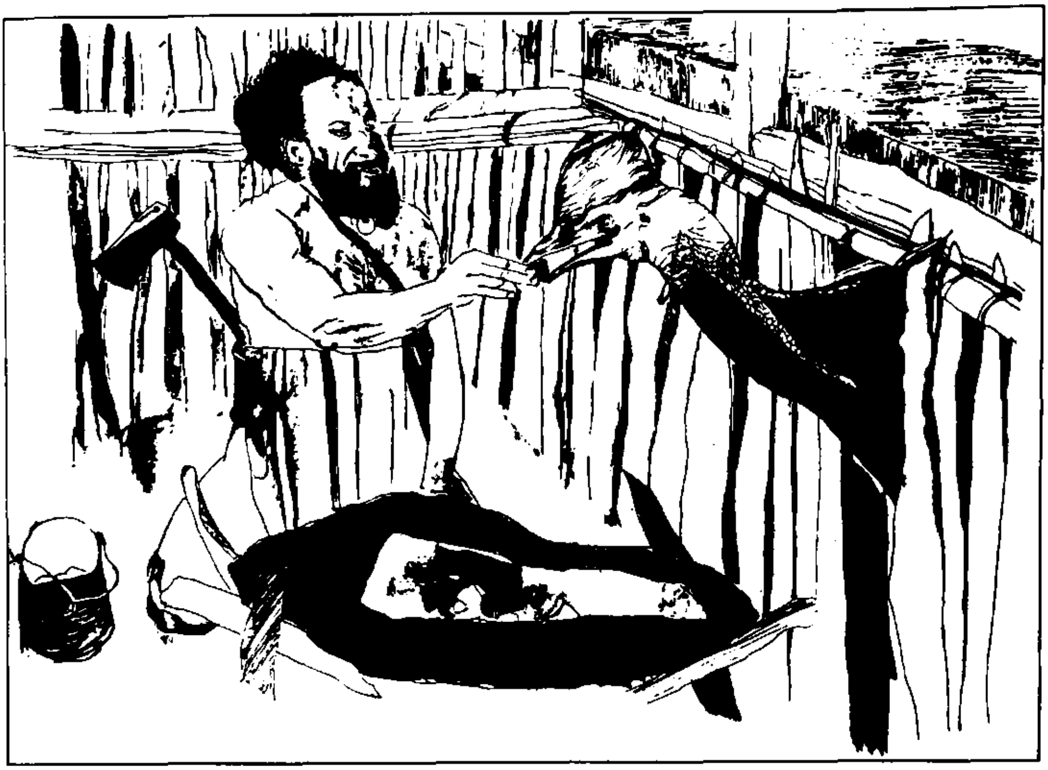

Figure 3. Captive management of wild cassowaries as practiced on the New Guinea mainland. *Artwork*: Robyn Barker

The Seram population is less easily accounted for, as that island has been separated from New Guinea by a deep, wide sea channel, and cassowaries, although capable swimmers, are not known for their ability to disperse across major sea barriers. It seems quite probable that the double-wattled cassowary was translocated into Seram from New Guinea or Aru by humans because all three of New Guinea's cassowary species—the double-wattled, single-wattled and dwarf cassowaries—are highly valued on the mainland, as meat, bone, claw, quill and plume-bearing ceremonial and trade animals, and because captured chicks are kept and reared to adulthood. As the Seram form does not differ greatly from mainland New Guinea or Aru forms, this may have occurred only a matter of centuries ago, or may have happened prehistorically via ancient Austronesian or Papuan seafarers (Iredale 1956; Rand and Gilliard 1967; White 1975; Heinsohn 1997). Evidence of sea trading in live double-wattled cassowary is provided by Newton (1893, 79):

> It [the type specimen of *Casuarius casuarius*] seems to be peculiar to the island of Ceram, and was made known to naturalists, as we learn from Clusius, in 1597, by the first Dutch expedition to the East Indies, when an example was brought from Banda, whither it had doubtless been conveyed from its native island [from Ceram by Maluku traders?].

Furthermore, from prehistoric to comparatively recent times, islands such as Seram and Banda were part of a series of trade networks which connected the Moluccas (Maluku) with western New Guinea and Aru. Some of these networks involved a trade in animal products (Swadling 1996).

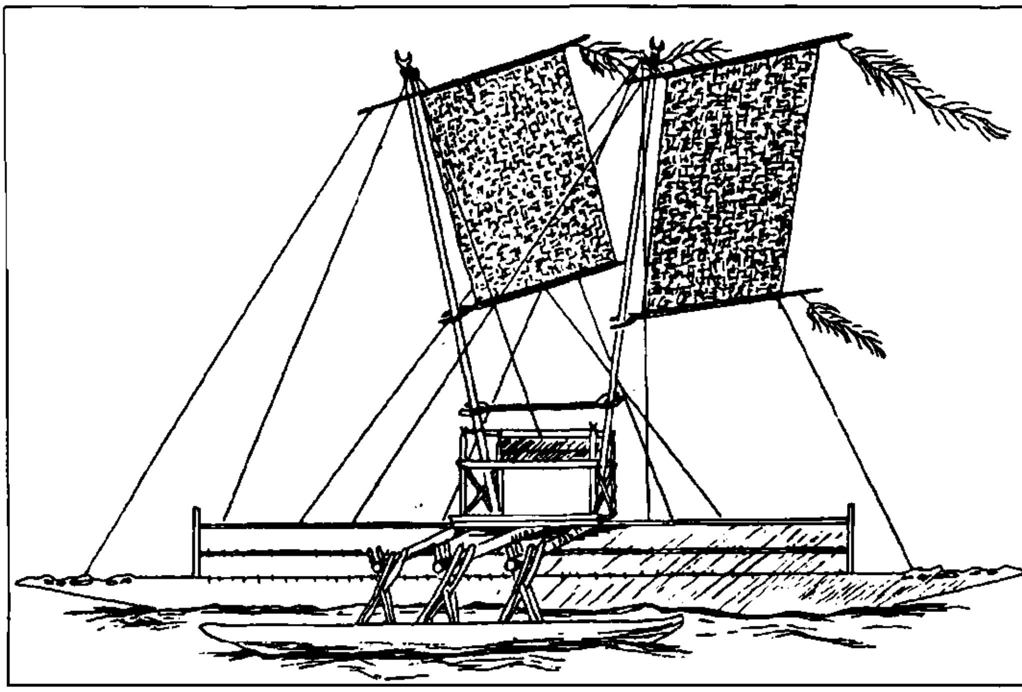

Figure 4. A Siassi sea-going sailing canoe of the type which linked New Britain and Umboi Island with the New Guinea mainland. These craft occasionally carried captive cassowaries and marsupials. *Artwork*: Robyn Barker

The dwarf cassowary

The dwarf cassowary, like the aforementioned species, is a principally New Guinean ratite. It has two offshore satellite populations, one on Yapen Island off the north coast of Irian Jaya, and the other on the large North Melanesian island of New Britain (Beehler and others 1986). The Yapen island population may be accounted for by the fact that Yapen is a land bridge island which was connected to New Guinea during the last ice age when sea levels were lower. New Britain, however, has been separated from New Guinea by a deep wide channel, and dwarf cassowaries, though capable swimmers, are not known for their ability to disperse across major sea barriers. Given that dwarf cassowaries are also highly valued, for the same reasons, and that captured chicks are also kept and raised to adulthood, it seems quite probable that it was translocated to New Britain via prehistoric human agency (Iredale 1956; Heinsohn 1997). Furthermore, as documented by Harding (1967) and Lilley (1986), New Britain has long been economically linked with the New Guinea mainland via ancient trading networks involving sea-going sailing canoes which sometimes carried animals as part of their cargo. Direct evidence of sea trading in live dwarf cassowaries is provided by Bennett (1860) who describes how in 1858, a young captive bird was brought by East New Britain natives to a vessel under the command of a Captain Devlin and offered for sale.

Figure 5. Common spotted cuscus of the eastern Indonesia, Papua New Guinea and Australia's Cape York Peninsula.

Common spotted cuscus

The common spotted cuscus is a large mostly nocturnal foliage and fruit eating tropical Phalangerid possum. The mainstay of its distribution is the lowland forests of New Guinea (and some of its continental satellites) up to about 1200m. However, it is also found on Australia's Cape York Peninsula; on Biak Island off Irian Jaya; in the St. Matthias Group and on New Ireland in the Northern Melanesian Archipelago; on the large islands of Buru, Seram (and its satellites) and Banda in the Central Moluccas; the Kai Islands in the South Moluccas; and on Selayer Island in the Sulawesi Archipelago (Laurie and Hill 1954; Carter and others 1945; George 1987; Menzies 1991; Strahan 1995; Flannery 1994, 1995a, 1995b; Heinsohn 1995).

While the Cape York Peninsula populations are probably a result of the Torres Strait land bridge, archaeological and ethnographic evidence indicates that the isolated Northern Melanesian populations in the St. Matthias Group and on New Ireland are introduced with New Guinea as the primary source area (Heinsohn 1995, 1997a, 1997b; Flannery and White 1991; Kirch 1988; Allen and Gosden 1991). Similarly, the isolated Selayar Island population is probably also due to human agency. Given that throughout much of its range the common spotted cuscus is valued as a meat and fur bearing game animal, is kept as a pet, and is carried live in water-craft for food or trade purposes, it seems likely that it may also have been either accidentally or deliberately introduced to some of the Moluccan Islands where it is found. Agitated captive common spotted cuscuses can be very good at forcing their way out of some of the flimsy wood, bamboo, vine or wire cages in which they are kept, or at making a break for it when being handled (pers. obs.).

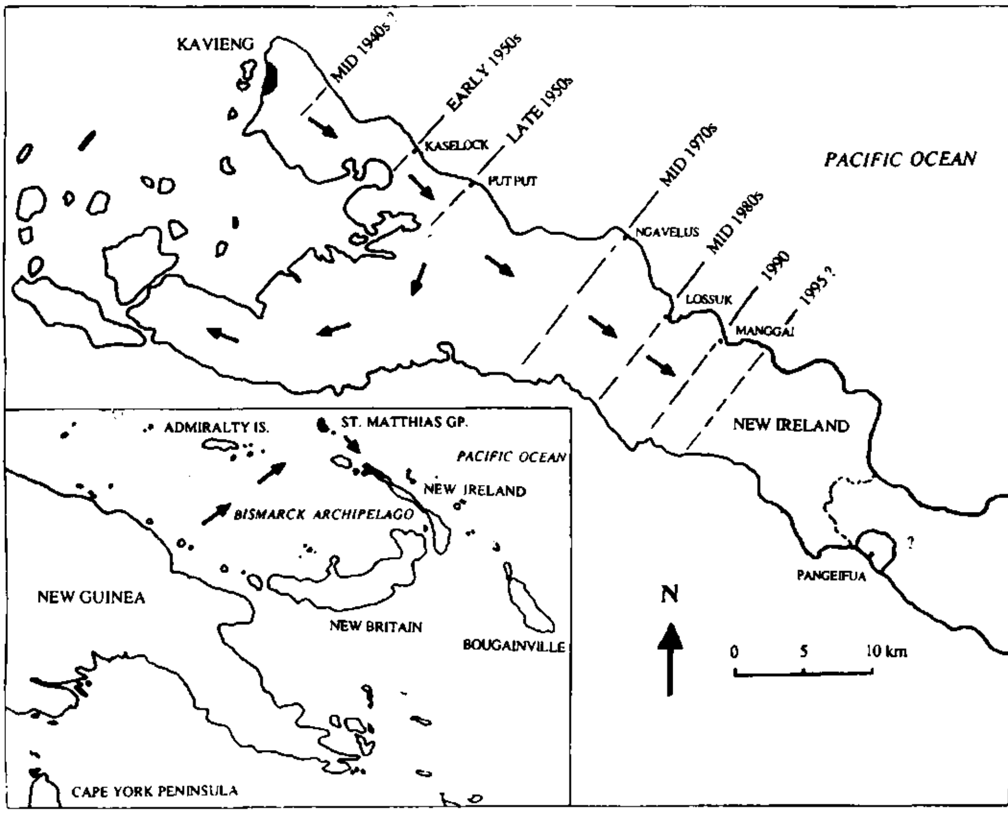

Figure 6. Map illustrating the anthropogenic spread of the common spotted cuscus (inset) and its subsequent invasion of New Ireland

On New Ireland, oral historical records indicate that the common spotted cuscus was introduced from the St. Matthias Group into the Kavieng area at the far northwestern end of the long narrow island sometime during the decade leading up to the commencement of the Second World War (Flannery and White 1991; Flannery 1994, 1995a, 1995b; Heinsohn 1993 and 1995). Since that time it has spread about 45 kilometres down the long narrow island and appears to be extending its range at a rate of about 0.8 kilometres a year (Heinsohn 1995).

Northern common cuscus

This nocturnal foliage and fruit eating Phalangerid possum has a very wide distribution which is centred on the lowland forests of New Guinea and its land-bridge satellites. Beyond New Guinea, it is found on Vokeo Is, Bagabag Is, Karkar Is, Long Is, Umboi Is, New Britain, Duke of York Is, New Ireland, Lavongai, Feni Group, Tanga Group, Lihir Group, Tabar Group and Djaul Is in the Bismarck Archipelago; throughout the Solomon Islands from Nissan to as far east as San Cristobal; on Sanana Is in the North Moluccas; on Buru, Seram (and satellites) and Banda in the Central Moluccas; Kai Is in the South Moluccas; and Timor, Leti Is and Wetar Is in the Lesser Sundas (Laurie and Hill 1954; Carter and others 1945; George 1987; Menzies 1991; Strahan 1995; Flannery 1994, 1995a, 1995b; Heinsohn 1995, 1997a).

Figure 7. Northern common cuscus of eastern Indonesia, Papua New Guinea and the Solomon Islands.

Archaeological evidence supports the theory that it was introduced into the Bismarck Archipelago, Solomon Islands and Timor prehistorically (Allen and Gosden 1991; Flannery and White 1991; Flannery and others 1988; Glover 1986). Given that throughout much of its range the northern common cuscus is valued as a meat-bearing game animal, kept as a pet, and carried live in water-craft for food or trade purposes, it seems likely that it may also have been either accidentally or deliberately introduced to some of the Moluccan Islands where it is found. Agitated captive northern common cuscuses due to their smaller size are reported to be even more adept than common spotted cuscuses at forcing their way out of some of the flimsy wood, bamboo, vine or wire cages in which they are kept (Lorex Martin, pers. comm. 1990).

Admiralty cuscus
The Admiralty cuscus, is only known from the Admiralty Islands, Hermit Islands, Ninigo Group and the Western Islands (Wuvulu Is) at the western end of the Bismarck Archipelago (Laurie and Hill 1954; Carter and others 1945; Flannery 1994, 1995b). Archaeological evidence supports the theory that it may have been introduced to Manus Island (Admiralty Is) prehistorically from an as yet unidentified source population, possibly somewhere at the western end of New Guinea (Tim Flannery pers. comm. 1990; Matthew Spriggs pers. comm. 1991).

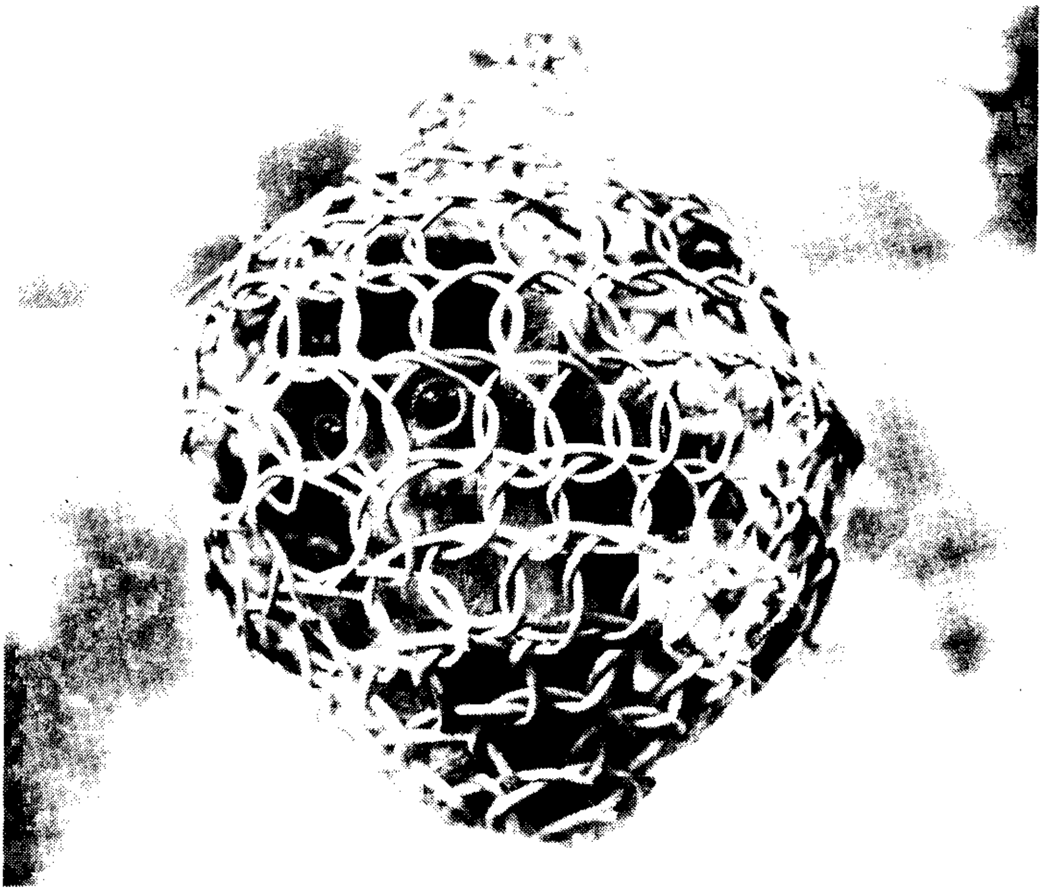

Figure 8. A captive juvenile Admiralty cuscus of the Manus Province archipelago, being offered for sale at Lorengau market, Manus Island, Papua New Guinea.

Given that it is a highly valued meat and fur bearing game species, and bound and caged animals are traded in market places and carried about in canoes, it seems likely that its distribution across a chain of widely dispersed oceanic islands (including atolls) is due to human agency. This is supported by numerous stories from local people who say that Manus Is satellites such as Bipi have been deliberately stocked with cuscuses, or may be restocked following local extinction from overhunting (Marsala of Lorengau, pers. comm. 1990; Father Matthias of Bundralis, pers. comm. 1990).

It is even possible that what Flannery (1994, 1995b) recognises as a distinct species endemic to the archipelagos of Papua New Guinea's Manus Province, is in fact an artefact of human translocation. That is, a distinct form resulting from a strong human induced founder effect and/or human-induced hybridization.

Woodlark cuscus

The Woodlark cuscus is endemic to Woodlark Island and some of its satellites in the Solomon Sea to the east of New Guinea. These include nearby Madau Island and the more distant Alcester Island (Laurie and Hill 1954; George 1987; Menzies 1991; Oxford University Expedition 1987; Smith 1989; Flannery 1994, 1995b). Given that the Woodlark cuscus is utilised by humans, Flannery (1994) states that the isolated but very similar population on Alcester Island 70 kilometres to the south, may have been translocated from Woodlark Island.

Bear cuscus
This very large mostly diurnal cuscus is endemic to the large eastern Indonesian island of Sulawesi, and some of its land bridge satellites (Laurie and Hill 1954; Carter and others 1945; Whitten and others 1987; Flannery 1994, 1995b) where it is has long been valued (by non-Moslems) as a meat bearing game animal. Captive individuals may also be kept as pets or fattened for eating, and caged or tethered animals are sometimes transported in water-craft. It is also found on Salebabu Island in the remote Talaud Group, where its disjunct distribution across a deep wide sea barrier, suggests that it may have been prehistorically introduced (Flannery 1994, 1995b; Heinsohn 1997a).

Sugar glider
The sugar glider is one of the most widely distributed of all marsupials, being found in Australia (and continental satellites such as Tasmania); New Guinea (and land bridge satellites); Vokeo Is, Blup Blup Is, Bam Is, Bagabag Is, Karkar Is, New Britain, Duke of York Is and Woodlark Is in the Northern Melanesian Archipelago; Halmahera Is, Bacan Is, Ternate Is, and Gebe Is in the North Moluccas; and Kai Is in the South Moluccas (Laurie and Hill 1954; Carter and others 1945; Menzies 1991; Strahan 1995; Flannery 1994, 1995a, 1995b). Given that the sugar glider is sometimes kept as a 'pocket pet' in the New Guinea Archipelago (pers. obs.) or may be an accidental stow-away in large clusters of bananas (Jim Menzies, pers. comm. 1990), it is possible that some of its island occurrences are due to human agency. Curiously, there is some equivocal historical evidence that the sugar glider may have been introduced into Tasmania in the middle part of the 19th century by European settlers who transported it from Victoria as a pocket pet (Gunn, 1851).

Matschie's tree-kangaroo
Matschie's tree-kangaroo is found on New Guinea's Huon Peninsula, on Umboi Is, and in the Mt. Agulupella area at the far western end of New Britain (Koopman 1979; Maynes 1989; Flannery and others 1996; Heinsohn 1997a). Given that tree-kangaroos are a highly valued meat and fur producing game animal, are kept as pets, traded live and may be transported over considerable distances it seems likely that the non-continental Umboi and New Britain populations may be due to human agency (Koopman 1979; Maynes 1989; Flannery, and others 1996). Furthermore, as documented by Harding (1967) and Lilley (1986) Umboi and New Britain, though separated from New Guinea by a deep wide sea channel, have long been economically linked with the mainland via ancient trading networks involving sea-going sailing canoes which sometimes carried animals as part of their cargo.

During fieldwork in New Ireland a story was collected regarding a Sepik woman who had been seen walking around Kavieng in New Ireland with a young pet tree-kangaroo sitting on her head and shoulders (Charles Tenakanai, pers. comm. 1990). Curiously, tree-kangaroos are not found in New Ireland, so it was most likely transported in from the New Guinea mainland. It was explained by Pino Martin (pers. comm 1990) a middle-aged Sepik hunter, that young animals are separated from their mothers after a hunt and often kept for a while as pets.

Northern pademelon

The northern pademelon wallaby is currently found in New Guinea (and some of its land bridge satellites) and also on Bagabag Is, Umboi Is, New Britain, New Ireland and Lavongai (Heinsohn 1997a; Laurie and Hill 1954; Carter and others 1945; Koopman 1979; Maynes 1989; Flannery 1995a, 1995b, 1992). Archaeological, historical and oral sources indicate that it was once also found on Buka Is in the North Solomons, and Feni Is, Tanga Is, Lihir Is, Tabar Is and Eloaue Is in New Ireland Province (Heinsohn 1997a; Flannery and White 1991; Flannery and others 1988, Egloff 1975). Archaeological evidence indicates that it was probably introduced to New Ireland about 7,000 years ago and Buka and Emirau subsequently (Flannery and White 1991; Flannery and others, 1988). Given that the northern pademelon is valued as a meat and fur producing game animal, may be kept as a pet, or transported in water-craft for food or trade purposes, it seems likely that much of its island distribution is due to human agency. During fieldwork in 1990, utilisation of the northern pademelon, including hunting, feasting and pet keeping was recorded in New Ireland (Heinsohn 1997a).

Dusky pademelon

The dusky pademelon is found in southern New Guinea, the continental Aru Islands and on the non-continental Kai Islands of the South Moluccas (Laurie and Hill 1954; Carter and others 1945; Maynes 1989; Flannery 1995a 1995b, 1992). Given that the Dusky Pademelon is a valued meat and fur bearing game animal, young animals are kept as pets, and captive individuals are sometimes transported live for food or trade purposes, the Kai Islands population may be due to human agency.

Dorcopsis wallaby

Several species of forest wallaby (*Dorcopsis spp.*) are to be found in New Guinea and some of its land bridge satellites (Laurie and Hill 1954; Menzies 1991; Flannery 1995a, 1995b). Archaeological evidence indicates that a further population of *Dorcopsis spp.* also once inhabited the North Moluccan island of Halmahera. According to Peter Bellwood (pers. comm., 1992) these may possibly have been brought in by human agency from New Guinea or one of its continental satellites. Forest Wallabies are, after all, valued as meat and fur producing game, young animals are sometimes kept as pets, and individuals may be transported considerable distances for trade pruposes.

Agile wallaby

The agile wallaby is a common inhabitant of tropical savannas and woodlands in Northern Australia (and some adjacent continental satellites), southern and south-eastern New Guinea and in a patchy distribution across some of the south-east Papuan islands (including Goodenough, Fergusson, Normanby and Kiriwina) (Laurie and Hill 1954; Carter and others 1945; Menzies 1991; Maynes 1989; Strahan 1995; Flannery 1995a, 1995b). While the trans-Torres Strait distribution is readily explained as a by-product of former ice age land bridges, the southeast Papuan island populations appear too patchy to be attributed to land bridges alone. Given that the agile wallaby is valued as a meat bearing game animal, is sometimes kept as a pet, and at times transported in water-craft for food, feast or trade purposes, it seems likely that at least part of its distribution is due to human agency. This is further supported by the fact that the islands of Southeast Papua and the New Guinea mainland have long been economically connected via trade networks involving sea-going sailing canoes (Malinowski 1922; Egloff 1979). Furthermore, in parts the agile wallaby's range, anthropogenic fire regimes help to maintain the savanna habitats in which it lives by preventing rainforest regeneration.

Common spiny bandicoot

The common spiny bandicoot is found in a variety of forest and open habitats on New Guinea and some adjacent land bridge islands. It is also found on Biak Is, Vokeo Is, Blup Blup Is, Karkar Is, Sakar I, Umboi Is, New Britain, Manus and Lou Is (Koopman 1979; Laurie and Hill 1954; Carter and others 1945; Menzies 1991; Flannery 1995a, 1995b). Archaeological evidence indicates that it may have been introduced to Manus Is (C. Williams as cited by Flannery 1995b; Matthew Spriggs pers. comm. 1994). Given that it is a valued game animal, which is sometimes captured live by traditional trapping devices and transported live for food or trade purposes (Alfred Kalenda of Lorengau, pers. comm. 1990), the common spiny bandicoot may also have been translocated by human agency to some of its other non-continental island occurrences.

Rufous spiny bandicoot

The rufous spiny bandicoot is found in New Guinea (and some of its adjacent land bridge satellites), on Australia's Cape York Peninsula, and on the Kai Islands in the South Moluccas (Laurie and Hill 1954; Carter and others 1945; Menzies 1991; Strahan 1995; Flannery 1995a, 1995b). Given that the rufous spiny bandicoot is a valued small game animal which is sometimes captured live, it is possible that it may have been translocated to the non-continental part of its distribution in the Kai Islands.

Impacts of introduced marsupials and ratites on rainforests

The most commonly cited human influences on the forests of the Circum New Guinea Archipelago from prehistoric times to the present, include: anthropogenic fire; clearing for agriculture; logging/resource extraction; and introduced weeds/exotic plants (Gressitt 1982; Whitten and others 1987; Dargavel and others 1988; Rosenbaum 1996; Holm and others 1977). A much less frequently cited human influence is the indirect impact of introduced placental herbivores such as browsing and grazing Rusa deer, or fossorial omnivores such as pigs which disturb the forest floor (Wildlife Division 1981; Downes 1972; Whitten and others 1987). A further indirect human influence on which there is virtually no literature for the Circum New Guinea Archipelago, is the impact of introduced marsupial herbivores and ratite bird seed dispersers. This strongly contrasts with New Zealand and to a lesser degree Australia, where the impact of marsupial herbivores, such as introduced brush-tailed possums and wallabies for the former (Wodzicki 1950; King 1990), and introduced satellite island populations of koalas and macropods for the latter (Lee and others 1990; Serena 1995) are well recorded.

Virtually the only comment on the impact of introduced marsupial herbivores on the forests of the Circum New Guinea Archipelago, is provided by the author (Heinsohn 1993), who describes the situation in New Ireland, where at one locality, individual flood plain trees, kwila (*Intsia bijuga)*, were found to be as much as 50 per cent defoliated due to browsing by the introduced common spotted cuscus and the introduced northern common cuscus. In other instances regrowth trees such as

Glochidion sp. and *Ficus sp.* growing at the boundary between rainforest and anthropogenic grassland were scorched and defoliated by a grass fire, but then prevented from re-foliating by cuscuses of both species which stripped them of their tender new leaf buds and young leaves. This apparently caused some trees and saplings which might otherwise have survived the fire to die of exhaustion (Heinsohn 1993).

It is concluded that in New Ireland, which received the northern common cuscus more than 10,000 years ago and the common spotted cuscus more than half a century ago (Flannery and White 1991; Heinsohn 1995), that these introduced possums have probably over time had a significant impact on the composition of the island's forests. The same is probably also true of other formerly mammalian folivore free Circum New Guinea islands which gained this class of herbivore via human agency. The role of introduced browsing and grazing macropods, such as Matschie's tree-kangaroo and the northern pademelon, is less certain, but the addition of any new herbivore to an ecosystem is likely to have some impact on the composition of plant communities. It is also speculated that the introduced double-wattled cassowary in Seram and the dwarf cassowarry in New Britain have also probably contributed to changes in forest composition due to their well documented role as seed dispersers.

Defining the nexus between nature and culture: a new synthetic theory

In order to make ancient human influences on biogeography and ecology more salient, it is necessary to break down some of the artificial boundaries between natural and cultural influences. This can be done by devising a new system of theory which links the two. Central to this is the concept of the 'ethno-tramp'. An ethno-tramp is a species of wild animal, which due to its economic value to humans has its geographic range either deliberately or accidentally expanded via human agency. Some clear examples in this study include the northern common and the common spotted cuscuses. An ethnotramp's relationship with humans is referred to as 'macro-mutualism' because although individuals may be preyed upon by humans, the species as a whole is enabled to be more successful and secure. This differs from commensal relationships, as exhibited between humans and some rats, in that both species (at the macro level) benefit. Furthermore, the scattered colonies of a species or taxa, which arise from translocation by human agency are referred to as an 'ethno-diaspora'.

A species which has a biogeographically suspicious distribution, but for which there is insufficient evidence to decide whether that distribution is due to human or natural influences, is referred to as a biogeographic 'phantom'. A clear example of a phantom in this study is provided by the sugar glider, which may or may not have been introduced by human agency to some of its island occurrences. At the extreme end of the scale is the 'camouflaged exotic', a human influence which goes unnoticed because a species' distribution appears natural. In the animal, plant and microbial world, there are probably more of these than we realise. A further cryptic phenomenon is that of the 'ethno-species' or 'ethno-race'. This is defined as an apparent island endemic, which is in reality, an artefact of translocation by humans. This may arise as a result of the source population becoming extinct or remaining undiscovered by science. Alternatively, it may also result from a strong human induced founder effect or human induced hybridization acting on the introduced island population—all of which may contribute to the creation of an apparently unique form. What Flannery (1994, 1995b) describes as the Admiralty cuscus, may in fact be an ethno-species.

Finally, the vast ecological experiment and biological frontier which is created when humans translocate a species or new genetic material is referred to as a 'meta-artefact'. Different types of meta-artefact include the 'archipelagic meta-artefact', the anthropogenic distribution of introduced species across chains of islands; and the 'invasion meta-artefact', which occurs when an introduced species has invaded or is invading a land mass. An example of an archipelagic meta-artefact is provided by the distributions of the introduced common spotted cuscus and northern common cuscus across the Circum New Guinea Archipelago; whereas, an example of an invasion meta-artefact is provided by the biological invasion of New Ireland by the introduced common spotted cuscus. A further type of meta-artefact is the 'extinction meta-artefact'. This is defined as the anthropogenic pattern of distribution of a species resulting from human induced local (or total) extinctions. An example from this study is provided by the contraction of the range of the northern pademelon in the island archipelagos of New Ireland Province, Papua New Guinea, which may be partly linked to the impact of Japanese occupation during World War II (Heinsohn 1997a).

Conclusion

While the rainforest ecosystems of the Circum New Guinea Archipelago are often viewed as pristine, it is likely that all of the non-continental cassowary and a significant proportion of the non-continental marsupial population are due to human agency. Further to this, it is also likely that these introduced marsupial and ratite populations have impacted to some degree on the composition of plant communities and (if the New Zealand model is applicable) possibly also on animal populations. The most striking effect is in the Northern Melanesian Islands (an area of low marsupial endemicity) where probably all non-continental ratites and most non-continental marsupials have been introduced. This compares with the Wallacean Islands of Eastern Indonesia where it is probable that all non-continental ratites and a significant proportion of the marsupial population (excluding the Sulawesi and Moluccan endemic marsupials) is due to human agency.

Some of our ancient forest history is well camouflaged and unless we keep a watchful eye for phantoms, that ancient cultural heritage and an opportunity for better understanding will remain hidden in the foliage.

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Appendix: List of common and scientific names of species

Common name	Scientific name
Admiralty cuscus	*Spilocuscus kraemeri*
Agile wallaby	*Macropus agilis*
Bear cuscus	*Ailurops ursinus*
Celebes black ape	*Macaca nigra*
Commensal shrew	*Sorex myosurus = Suncus murinus* ?
Common spiny bandicoot	*Echymipera kalubu*
Common spotted cuscus	*Spilocuscus maculatus*
Dorcopsis wallaby	*Dorcopsis sp.*
Double-wattled cassowary	*Casuarius casuarius,*
Dusky pademelon	*Thylogale brunii*
Dwarf cassowary	*Casuarius bennetti*
Long-tailed macaque	*Macaca fascicularis*
Malay civet	*Viverra tangalunga*
Matschie's tree-kangaroo	*Dendrolagus matschiei*
Northern common cuscus	*Phalanger orientalis*
Northern pademelon	*Thylogale browni*
Rufous spiny bandicoot	*Echymipera rufescens*
Rusa deer	*Cervus timorensis*
Single-wattled cassowary	*Casuarius unappendiculatus*
Sugar glider	*Petaurus breviceps*
Woodlark cuscus	*Phalanger lullulae*

22

Ecological democracy in New Zealand

S.D. Richardson

This paper argues that the history of forestry—which I define as the conscious management of forests—in New Zealand began when it was a *de facto* but undefined colony of New South Wales or, as Sinclair (1959) describes it, an Australian Frontier. I also preach a short sermon from the text of an anonymous advocate of colonisation, writing in 1830, who foresaw that the:

> ... intercourse of mankind may in time make the world one vast garden, in which all the blessings of a bounteous providence shall be naturalised as far as climate, or the science of man, can render those plants common to all, which were originally the property of a few. (Anon 1830: 422)

In view of our current preoccupation with the opposite extremes of naturism and clonal forestry, it is chastening to be reminded of New Zealand's early search for ecological democracy—which I define as equality of opportunity for all species, introduced and native—and diversity.

A unique ecosystem

Every ecosystem is unique but, to paraphrase George Orwell, some ecosystems are more unique than others. Few could dispute this claim with respect to New Zealand which has no native mammals, apart from an island bat, and in which to this day no product of the land entering commerce is derived from indigenous species.

New Zealand is placed in the Australian realm which is one of the 'six great realms' of life first described by Wallace (1905). But its fauna and flora are very different from those in other parts of Australasia and remained little changed by the activities of man before the rapid influx of European settlers following the Treaty of Waitangi in 1840—which effectively broke the dependency link with Australia. The Maori had brought dogs and rats, neither of which did much to help conserve the native fauna, but neither did they establish themselves in any great numbers. Captain Cook in his second and third visits in 1774 and 1779 brought plants and animals for food. And the sealers and whalers who operated off the New Zealand coast from 1779 to the early part of the nineteenth century made further introductions, primarily for food. Except for rats and pigs, their establishment was probably restricted to areas where settlement was attempted and it is doubtful whether any had significant effects on endemic populations. Most of them are unrecorded but there is an interesting suggestion that radiata pine—now perhaps the most important commercial timber species in the southern hemisphere—was introduced to New Zealand from California via Australia by sea-captains servicing the transportation of gold miners from, first, California to Australia and then from Australia to New Zealand. The signing of the Treaty of Waitangi led to quite remarkable introductions of animals and plants to a country characterised by a unique flora, no native mammals and birds that cannot fly. Within a short period, the survival and prosperity of New Zealanders, Maori and European alike, depended on these imports.

Introductions

Initially without any regard for pests and diseases which might be introduced on imported stocks, immigrants were urged to bring all manner of living things with them. Societies were established to 'acclimatise' such introductions and by 1870 more than 130 species of bird, 40 of fish and 50 kinds of mammal had been brought in (Wodzicki 1950). The success of sheep, cattle, deer, trout, fruit and vegetables is well known, but most of the unsuccessful introductions, which included elephants, camels and zebras, have been forgotten. And there are others, such as the Australian opossum which has damaged the native forest flora, and feral cats, rats and other predators which have wrought havoc on ground living birds.

But if it is the pasture grasses that have enabled the development of New Zealand, trees and shrubs played an important support role. In 1848 the New Zealand Company issued a colonial handbook advising intending colonists what to learn beforehand and 'what to buy for exportation'. More esoteric items included plaster casts of antiques from the British Museum, 'cricket apparatus', rooks in cages 'for the sake of the peculiarly English associations connected with them', a MacIntosh air bed (the Bishop of New Zealand once used one as a canoe, while on an expedition to the interior), game animals (uder which heading were included kangaroos and llamas) and acorns of cork oak. The variety of plants which settlers were enjoined to take with them was enormous and details are provided of packing in glazed frames 'fixed to the deck ... well out of the way of the sailors manoeuvres' and hermetically sealed against salt water; 'on the edge of the poop is the most the convenient place'.

Seeds suggested for import included wheat, barley, oats, rye, buckwheat, maize, turnips, swedes, mangold-wurzels, rape, tares, vetches, lucerne, peas, beans, linseed, caraway, coriander, clover and grasses. Quality was stressed with the advice that:

> As a general rule, whatever is useful in England will be as much so in New Zealand; and moreover, many plants that flourish in warmer countries, such as the south of France, Spain, Portugal, and Italy, may be expected to succeed in the Colony. [Of useful plants] fruit trees of all English kinds, ... forest trees of ditto, vine, olive and mulberry; lemon and orange; hop sets; etc. It is not easy to determine whether a parasitical plant like the mistletoe can be transported, either in seed or as a plant; but to a British colonist, the experiment of planting the symbol of the ancient Druids in the Britain of the south seas, should at least seem worth trying.

Quarantine legislation in New Zealand has a long if inconsistent history. The first enabling ordinance was enacted by the Legislative Council in 1842 (ten years after that in New South Wales) but, since no regulations followed, it was inoperative. Legislation was later introduced to disinfect human immigrants (following outbreaks of cholera in Europe in 1853 and 1854). It was not until 1881 that quarantine grounds for animals were proclaimed under the *Diseased Cattle Act*. The *Stock Act* of 1908 led to the strict controls which exist today. It covered everything from circus animals to manure (there were even New Zealand Inspectors of Manure in Australia and India). Plant controls date from 1894, following the appointment of the forest botanist, T.W. Kirk as official biologist.

I contend that forest management begins with species trials, so that the activities of the early European immigrants to New Zealand — who have earned the sobriquet of 'prodigious planters'— can be regarded as starting New Zealand forestry. The latitudinal spread of New Zealand opened the way for species, especially for trees and shrubs, from well beyond the range associated with the origins of the European settlers. Early lists included desert agaves, wet tropic *Albizzia*, camphor and *Cinchona* (quinine) trees as well as far northern conifers and heaths. Moreover, while most of the imports were suggested for economic reasons — even the pestilential gorse was imported because of its value for shelter, the immigrant planters were soon concerning themselves much more with ornamental than with utilitarian species. Arthur Ludlum, in the first volume of the *Transactions of the New Zealand Institute* in 1856 published a list of trees he had planted at Newry, Lower Hutt, since 1840. He had successfully established 84 conifers, including a juniper from Bermuda, 7 palms, 17 species of oak (Linnaeus described only 14), more than 50 camellias and a huge variety of rhododendrons. A horticulturist, Mason, in 1896 recorded the heights of over 300 species planted in the 1840's at Avalon and added another 230 to the list in 1903, although not all of these were trees.

Some of these pioneer plantings still survive and are recorded in Burstall and Sale's *Great Trees of New Zealand* (1984). One such planting has indeed grown from a cork oak acorn: which prompts the question of whether this particular species was ever seriously considered in New Zealand as an economic crop—as, for example, was the Mulberry tree as a host for silkworms. The New Zealand Forest Service (Forest Research Institute) reports, on which Burstall based his selection of great trees, record introductions of cork oak ranging from Northland to Canterbury. The first cork oaks planted in Auckland were introduced by the then Colonial Secretary, surgeon, explorer and botanist, Andrew Sinclair. Moreover, a very large tree at Morrinsville showed evidence of having had cork harvested from it.

If cork could have been produced in New Zealand, it would have made good sense. In the nineteenth century there were many applications for it other than for stoppering bottles and for which there were no cheap substitutes. It was used in fishing floats, fenders, gaskets, barrel bungs, buffers and for shoes; cork soles were indeed recommended by the New Zealand Company for footwear at sea. Much earlier, cork was used as insulation in bee hives and in the manufacture of life belts. When Camillus crossed the Tiber to the capital during the siege of Rome by the Gauls, he wore a 'life preserver of cork beneath his dress'. The ancient Egyptians made coffins of cork, lined with embalming resin, the Spanish used sheets of it as bedside mats, as linings in storehouses and, according to the renowned diarist and forester John Evelyn, inside leather cases 'wherein they put *flasqueras* with snow to refrigerate their wine'. The residues were used in tanning or charred to make 'Spanish black', for cosmetics and medicine. Again, according to Evelyn, 'the ashes drunk, stop the bloody flux'. By the end of the eighteenth century, cork was in short supply in southern Europe. Even in 1664, John Evelyn had expressed concern at the demand for platform-soled shoes resulting from ladies 'affecting or usurping an artificial eminency above men which nature has denied them'. His object was not to protect the chauvinist interests of males but the continued survival of the cork oak tree — a conservation role eventually played by artificial plastics.

Not all the early trials of trees in New Zealand were prompted by economics. An early publication in New Zealand forestry (Matthews 1905) appends a letter from Sir Truby King, founder of the Plunket system for caring for babies, describing species trials which he had himself carried out at Karitane to identify woody plants suitable for erosion control and the fixation of moving sand.

Conclusion

The anonymous commentator on colonisation, quoted at the start of this chapter, wrote, following a world-wide survey of timber trees and forests:

> As the commerce of mankind increases, the number of those valuable substances which we may secure to ourselves by cultivation will increase also; and at the same time, we shall diffuse our own vegetable production over the globe. In the gardens of New South Wales, the gardens of settlers are filled with plants which they cultivated in their native country. Colonisation universally produces this good. (Anon 1830)

Australians as well as New Zealanders have reason to be grateful for the bounteous introductions of the immigrants. Consequently it is of some concern to advocates of ecological democracy to learn of serious attempts to restrict bio-diversity through cloned forest plantations by the eradication of introduced genotypes, simply because they are 'foreign'. The accident of origin confers no intrinsic superiority.

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Public history and methods

Recognizing the impact of the present
on the past, we confront anew the paradox implicit
in preservation. Vestiges are saved to stave off decay,
destruction, and replacement and to keep an unspoiled
heritage. Yet preservation itself reveals that permanence is an
illusion. The more we save, the more aware we are that such
remains are continually altered and reinterpreted. We suspend
their erosion only to transform them in other ways.
And saviours of the past change it no less than
iconoclasts bent on its destruction.

David Lowenthal,
The Past is a Foreign Country,
1985.

23

Forestry and the policy process: Victoria and South Australia, 1870-1939

Stephen M. Legg

This chapter considers the evolution of public forestry during the 'custodial' era of the late nineteenth and early twentieth centuries when political pressure from all sides of the forestry debate forced governments throughout the New World to exercise greater control over the use and abuse of forests. Extensive systems of reserves supplying a wide range of forest products were established on public lands before the 1890s while, a few decades later, fledgling forest services applied increasingly intensive and sustainable methods of management. More restrictive regimes were introduced to regulate the human impact on forests on both public and, eventually, private lands, and the state gradually became active in forest products research, promotion and production—in part to build a foundation for the industrial forestry envisaged for the modern age, but more immediately to curb the worst excesses of forest destruction.

There remained in Australia, however, political cultures dominated by popular antagonism and official apathy toward forests. These attitudes were more typical of the earlier exploitive colonial period. This was despite the encouragement to forestry offered by institutional forces such as the push toward 'colonial socialism' and federalism from the late ninetenth century, and the imperial forestry movement in the early twentieth century. The reasons for this disregard included the inertia and conservatism inherent in the predominantly bi-cameral parliamentary political systems, along with the enormous power and influential position of those interests committed to maintaining the largely unregulated assault on the forests. Furthermore, the Australian Constitution (1901) ensured that control of public forests and other natural resources remained decentralised in the hands of the State governments. Progress in forest conservation was unlikely as long as large tracts of potentially-arable forested Crown lands remained unalienated. This was an ever-present challenge to the state in development-orientated capitalist societies in which social progress was pursued through rapid economic growth and the physical transformation of natural environments. In addition, there were well-founded fears that public forestry would threaten individual freedoms and increase production costs. The political response differed markedly throughout Australia, with the least- industrialised 'frontier States' of Tasmania, Western Australia and Queensland generally the most resistant to the introduction of modern forestry regimes.[1]

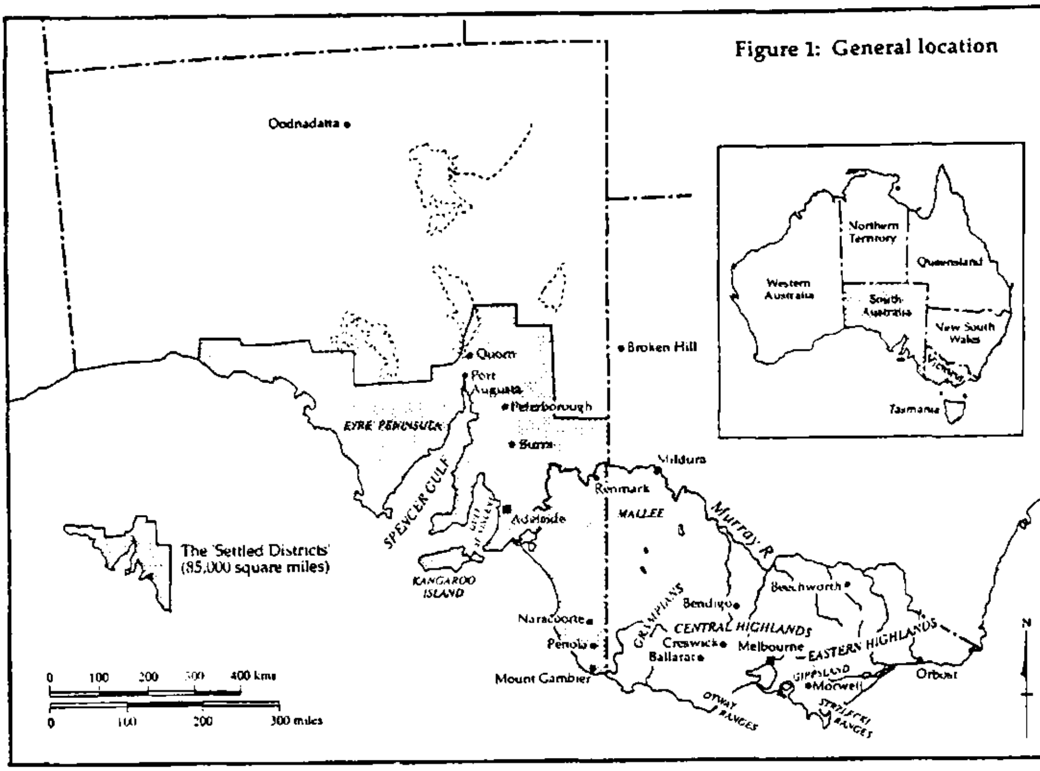

Figure 1: General location

Figure 1. General location

Nevertheless, forest conservation was advanced through a predominantly incremental, and episodic process of political opportunism, by convenient alignments comprising community-based conservation lobby groups, progressive parliamentarians, visionary bureaucrats, powerful newspaper editors, and large industrial capitalists. Indirectly by shaping the political agenda, and more directly by lobbying their parliamentary representatives, these capitalists demanded an increasingly reliable and standardised log output and were fearful of the continued loss of forest supplies to rapacious small-scale operators in the farming, grazing, alluvial-mining, and sawmilling industries. They were also wary of the timber merchants who generally opposed the development of sustainable domestic forestry in favour of continued imports, and with whom the industrial supporters of forest conservation maintained a precarious dependency. This was not merely a question of scale, even though forestry policy generally promoted the economies of large scale operations—there were just as many large operators and industries opposed to forest conservation. Sympathetic governments eventually voted increasing funds, staff, and political independence to the tiny forest services to implement these reforms.

The political struggle to gain control of the forests was long, complex and risky—earlier gains so painstakingly acquired were frequently dismissed at the stroke of a ministerial pen. The situation was exacerbated by the generally unstable, and occasionally chaotic, factional infighting typical of Australian parliaments during the study period. The party system expanded from the 1890s but, as late as the 1930s, was still subject to pragmatic realignments even amongst traditional enemies. This instability and uncertainty threatened the long planning horizons so essential for effective forest management.

Theoretical foundations and focus

The case study below comes from research undertaken for a doctoral dissertation comparing the historical geography of forestry in Victoria and South Australia during the formative years of government involvement, 1870-1939.[2] The commercial hardwood (primarily eucalypt) forests in the region clothed the cool, wet south-eastern parts of both States, although the densest forests grew on Victoria's coastal and central ranges which intercepted the moist south-westerly maritime airstream. These mountain forests remained bastions against encroachment of the agricultural frontier, although some of the bitterest struggles over forest use occurred in their dark recesses.[3] Despite being almost five times larger than its eastern neighbour, comparisons are simplified by the fact that Victoria is about the same size as South Australia's 'settled districts' which (lying in the southern, humid portion) were the principal setting for that colony's forestry efforts, albeit mainly with woodland species. To the north and west of the settled districts lay vast desert tracts devoid of large trees where the possibility of creating oases later proved an enticing challenge to the more zealous proponents of 'forest culture'.[4]

A comparative approach helped reduce the possibility of generalising from the particular, and Victoria and South Australia appealed for a number of reasons. These included the evolution of similar forestry policies and practices under extremely different natural environments, but almost identical political systems; the fact that the proponents of forest conservation had elevated the forestry debate to prominence on the political agenda in both colonies from the 1860s despite apparent differences in 'political culture', and the existence of significant differences in the two colony's economic history and economic geography. Thus, South Australians claimed a distinctive liberalism born of proud religious dissenters and independent Wakefieldian colonisers; and their economic and political power was far more centralised than in gold- and wool-rich Victoria.

Three interrelated historical-geographical themes were explored in the dissertation: the 'morphology' of spatial form (particularly the evolution of the reserve system), the ideas and contributions of individuals highlighted in 'biographical' analyses (especially key 'theoreticians and empiricists' such as parliamentarians, bureaucrats, scientists, lobbyists and editors) and most importantly, the political, economic and institutional forces stressed in 'societal' investigations.[5] A four-fold typology was used to classify the forest history literature on the basis of assumptions about the nature of history (philosophical pre-suppositions), attitudes to the role of the state, ideological stance, and political orientation, (Figure 2).[6] Detailed explanation lies beyond the scope of this paper, but a brief description of the two major approaches that informed both the dissertation and this case study is useful.

The first is the historical-cultural or, more precisely, 'Landscape Author' approach, fostered in the Australian context mainly by the geographer Joe Powell. In philosophical terms these works tend to be contextualist (disentangling the various strands that dominate particular events and places), with liberal ideologies, centrist political orientations, and elitist theories of the role of the state. As the term suggests, the focus is in interpreting human agency and its impact on the transformation of the landscape. The major exponents are historical geographers and environmental historians who have highlighted the ongoing dialogue between popular and official appraisals of societal demands and environmental realities as a core component of the broader learning sequence through which landscapes evolved.[7] They have stressed the contribution of various ideas, individuals and institutions in influencing the nature and direction of policy (a view tacitly supported by many proponents of the Orthodox approach—predominantly foresters re-interpreting their own history).

Approach to the History of Forestry	Radical Political Economy	Environmental Challenge	Landscape Author	Orthodox	Orthodox Response	Free Market
Philosophical Presuppositions	MECHANIST - CONTEXTUALIST - ORGANICIST - FORMIST					
Ideology	RADICAL - LIBERAL - CONSERVATIVE - ANARCHIST					
Political Orientation	LEFT - CENTRE - RIGHT					
Theory of the State	MARXIST - ELITIST - PLURALIST					

Figure 2. Historiographical approaches and philosophical presuppositions

Although many of the Landscape Author works deal explicitly with policy evolution, a more theoretical focus on political processes was taken, especially emphasising the role of parliament in general and politicians in particular, within the broad compass of theories of the role of the state. The latter paralleled many of the concerns of the proponents of Radical Political Economy, which became the study's second foundation. With its predominantly mechanist pre-suppositions (emphasising the primacy of capitalist regimes of accumulation or modes of production), radical ideology, leftist political orientation, and Marxist theories of the role of the state—advocates of this approach quite literally, in John Dargavel's words, interpret the forested landscape as being 'constructed in the image of capital'.[8] Many of these works (in common with the Environmental Challenge and, ironically, the Free Market approaches) have emphasised the extent to which policy evolved almost inexorably to meet the needs of capital or the market.

Given the mutually-exclusive categories used in the typology, it is not surprising that an easy assimilation of any of the six approaches to forest history is prevented by deep-rooted contradictions (for example over the agency/structure debate). But advances are possible, especially given the rich diversity within, and numerous links between, each 'approach'—in the latter case between the Free Market and Orthodox Response on one hand, and the Environmental Challenge and Radical Political Economy on the other. Moreover, unless the theories are applied in a strictly doctrinaire fashion, it is possible to reach some compromise. Thus, the non-Marxian political economy works by William Robbins demonstrate the enormous and inordinate influence of capital on US forestry policy without excluding precisely those features of human agency emphasised by the Landscape Authors.[9]

Upon the foundations of these two main approaches, my study tested the hypothesis that the state (or more precisely the interests that controlled it) selectively used and abused different types of knowledge to legitimise particular positions on forestry policy. This required a model of the political system found in both South Australia and Victoria, as well as a framework with which to examine the incorporation of knowledge in the policy process. These were modified from the works of the political scientists Peter Bachrach and Morton Baratz, and the sociologist Allan Schnaiberg, respectively.[10]

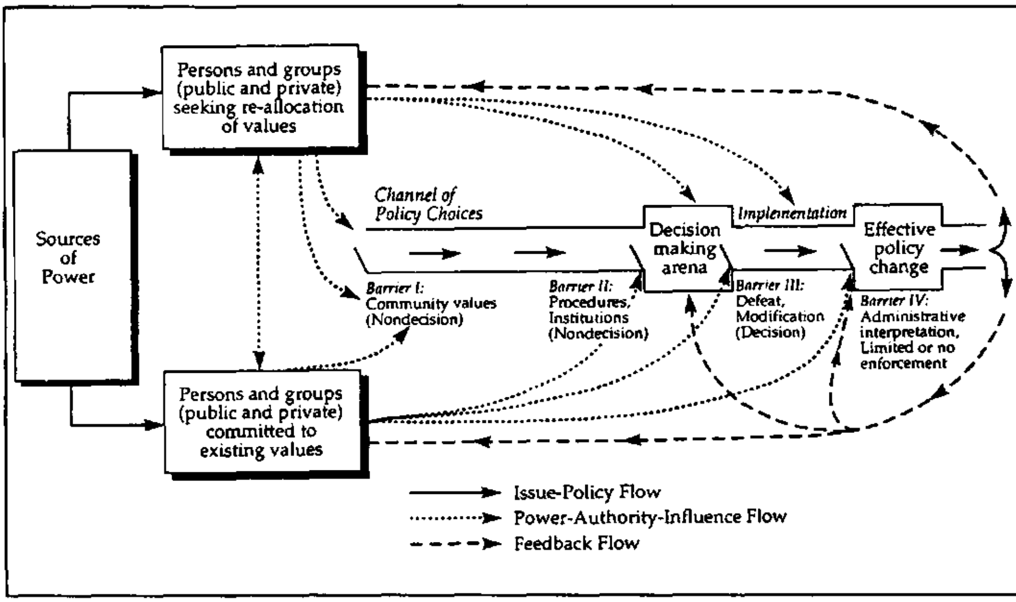

Figure 3. Model of the political system. *Source*: Bacharach and Baratz 1970:54.

Bachrach and Baratz's model of the democratic political system has four major components: the various sources of power in society; the particular pressure groups, individuals or classes who seek to either maintain or modify existing values; the channel of policy choices within which policy may eventually emerge, but which is subject to various barriers to innovation; and the heterogeneous flows of power, influence and information which link the different structures and stages in the process. Strong barriers limit new value orientations (i.e. specific political demands such as the call for forestry reforms) from ever becoming direct threats to the status quo. Ideological differences (barrier i) and administrative obstacles consisting of procedures, customs and organisational devices limiting access to government decision makers (barrier ii), can prevent the articulation of ideas so that they remain as 'non-decisions'. If ideas can be successfully raised onto the political agenda from the wider public discourse, then the 'decision-making arena' (the executive) is encountered. The merits of various proposals are aired and issues are resolved here, but new ideas are subject to modification or defeat (barrier iii). Even when policy change is forthcoming, legislation may be rendered ineffective at the implementation stage by administrative interpretation and the modification of enforcement (barrier iv). Thus, the political system includes three interdependent phases in the policy process: issues, decision making and implementation.

The feedback mechanisms shown in the model reveal the dynamics of the political system and suggest that authority and power can be redistributed amongst different groups. More specifically, the feedback mechanisms are, in effect, the political pathways through which we might envisage communities (or at least electorates) coming to terms with a whole range of realities under the 'learning system' favoured by historical geographers. Policy is, therefore, just one part of the process linking attitudes and behaviour in environmental management. It is the outcome of various factors influencing decisions, for 'resource management in the final analysis is a decision making process'.[11] Effective policy choices can result in the formation of new groups or the destruction of existing ones. They can undermine the currently predominant set of values, beliefs, and myths, as a result of which those who were initially change-seekers find themselves now cast in the role of status-quo defenders. Or an effective policy choice can result in modification of procedures and rituals, thereby easing change-seekers' future access to decision-making arenas and increasing the likelihood that decisions in their favour will be implemented.[12]

Ham and Hill help clarify Bachrach's and Baratz's model of the political system by defining three expressions of power exercised through public policy.[13] These are: the broader ideological influences which shape people's preferences so that neither overt nor covert conflicts begin; non-decisions, which are overt or covert actions to prevent the politicisation of current or potential issues; and, finally, policies which engender recognisable (overt) actions to achieve objectives.[14]

The first two expressions of power dominated, for example, the 1860s 'awakening' to forest conservation in Australia when a small band of influential academics, public servants and metropolitan newspaper editors first publicised concern about deforestation in Australia. They suggested a variety of benefits to be gained from the tree cover—but from a utilitarian stance, 'custodial' forestry's promise of sustainable use seemed to offer the best means of preserving some vestige of the sylvan heritage.[15] Following calls from both the Victorian press and parliament in October 1865, a system of Timber Reserves and State Forests was gradually introduced under the Land Acts, although the first set of regulations for the care, protection and management of State Forests was not gazetted until 1870.[16] Largely the work of Assistant Commissioner of Crown Lands and Survey, Clement Hodgkinson, these reservations may have been the first of their kind in Australia.[17] Provincial agitation forced the establishment of a few local Forest Boards from 1867, but these were unable to effectively control timber exploitation.

Although not strictly precipitated by the publication, in 1864, of George Perkins Marsh's *Man and Nature*, the work provided an intellectual foundation for the rise of conservationism.[18] Powell's analysis of an 'Australian awakening' in natural resource conservation suggests that greater recognition has to be given to the 1860s than has been allowed by mainstream forestry historians, who have concentrated more narrowly on institutional development.[19] This view is paralleled in Powell's later discussion of the Victorian press' coverage of the debate on the climatic influence of forests, in Wright's examinations of the Victorian Lands Department, and in Young's study of the economic history of timber exploitation in Victoria.[20]

Vear suggests that the awakening to forestry in South Australia came later, between 1870 and 1875, but it is clear from the Adelaide press that the public had been debating forestry for years.[21] Concern was first transformed into legislative action on forestry in New South Wales in the early 1870s, Tasmania in the 1880s and Western

Australia in the 1890s.[22] Frome's analysis of 'scientific activism' in the development of North American forestry and the excellent history of Canadian forestry by Gillis and Roach show that a similar awakening was occurring elsewhere during the late nineteenth century.[23] And Wootton's discussion of Britain's 'first generation of environmentalists' during the period 1860-1914 demonstrates that the rise of conservation as a social movement was not confined to the New World.[24]

The third expression of power requires the analysis of concrete decisions, and is the realm of Orthodox forestry history which focuses on changes to institutions and actual management practices. These changes generally appear at the end of the political process, but by that stage all three expressions of power operate contemporaneously. Of course, some policies may simply be a 'symbolic' statement designed to have a desired effect without ever being implemented, so there is much radical criticism of the assertion that policy without effective implementation was almost worthless.[25] Aucoin takes this further and distinguishes between policy which is stated, implied, perceived and done.[26] Each expression of power has a spatial impact, but historians and historical geographers have traditionally focused only on the positive landscape transformations that followed 'concrete decisions', rather than the negative impacts of the first two expressions of power which effectively maintained the status quo. For example, this enabled the continuation of rapid rates of forest clearance by postponing the implementation of adequate regulations or silvicultural treatment of native forests. For this reason, I believe that the various political economy approaches can offer some insight into the historical geography of natural resource management.

To examine the diverse arguments for and against forestry, and their influence on policy decisions from an 'information consumption' (sin model) perspective, we need to focus on parliament whose principal business was to introduce statute law to govern the community. Parliamentary bills were generally framed by key ministers (usually with advice from bureaucratic departmental heads) before the parliamentary draftsman was consulted to clarify formal details. But the choice of bill, the timing of its introduction, and the method of procedure (including the nature of supporting arguments and evidence), was generally made by the cabinet of the particular faction or party in government. It was the cabinet, and particularly the leader, who gauged the political agenda and the likely reception of the proposed legislation. Bills could be introduced in either Houses of Parliament, although 'money' bills (for the raising of money through taxation or the appropriation of money for government expenditure) were restricted to the Lower House.

Once introduced, bills proceeded by majority vote through four distinctive stages in each House, before being passed to the other House for the same procedure. At the first reading, the responsible Minister introduced the bill by establishing its context, purpose and justification. No debate was entered into. If the bill did not lapse, it proceeded to the second reading where the general principles of the measure were debated. If the bill was supported, it entered the Committee stage. There, the Chairman of Committees presided over the House (replacing the Speaker or President in the Lower and Upper Houses, respectively). At this stage, detailed debate occurred on the individual clauses of the bill and, upon majority vote, amendments might have been made. If the bill survived the Committee stage, the Presiding officer resumed the chair, and the bill was considered in its amended form. If the bill passed through all stages in the House in which it was initiated, and if it passed through all stages in the other House, it was presented to the Governor for Royal Assent. Only at that point could the bill become law as an Act of Parliament.[27] Finally, the new Act would be implemented through the relevant agency in the public service. At all stages in this time-consuming procedure, the various decision makers were informed by feedback flows of information. The policy cycle would be completed when the impact of the legislation (or its rejection) became, in turn, a significant issue on the political agenda.

Given its representative role, parliament held a strategic position at the interface between society and the environment, and was one of the foremost institutions responsible for attuning social needs and aspirations with 'natural resources'. Nevertheless, parliament often ignored or dismissed precisely those pieces of detailed information which were the product of the community 'coming to terms' with special requirements in diverse environments. 'Feedback' on environmental matters was limited by an overriding concern to develop the general (State-wide) legislative frameworks within which public or private land managers worked. It was often politically expedient to leave the detail to the bureaucrats, farmers or forest workers, knowing that geographical information could be incorporated at the grass-roots management level as long as the legislation was sufficiently flexible. Without that flexibility, amendments (or even a new Act) could always be considered in the future if sufficient pressure was mounted.

To clarify the reciprocal relations between the wider 'learning' system and public policy formation, we need to explore the input and reception of knowledge used in political debate. In terms of the model (Figure 3), this knowledge flowed through all of the components, and was vital to the process whereby the geography of each region was perceived and shaped. Few explicitly theoretical works have been attempted on this matter in conventional historical studies of environmental management, but where the hypotheses are discernible, two general approaches can be identified: 'error' and 'sin' models.[28]

Error models are favoured by policy analysts tracing the outflow or *production* of particular ideas from influential individuals or institutions. They assume that the policy-making process is rational, and that policy outcomes are largely inevitable (at least in the long term). Societal ignorance is seen as the principal reason for the accumulation of environmental 'bads', and it is expected that these errors will be corrected once new knowledge emerges.[29] There is an implicit faith that scientific progress occurs through an incremental 'development-by-accumulation' process which informs policy-makers. Consequently, the historians' task is to chronicle 'both these successive increments and the obstacles that have inhibited their accumulation'.[30] Studies of the impact of myth and misperception have encompassed error models to analyse the appropriateness of decisions, particularly where harsh environmental conditions have ultimately proved restrictive. Error models have been utilised extensively, but largely unwittingly, to explain reform movements and institutional development in most of the conservative histories of forestry—precisely because what are now cherished values are being defended. Error models tend to be teleological, because the very nature of what made 'rejected information' inappropriate (or 'in error') is judged on modern criteria.

By contrast, I favour a sin model. This portrays the policy process as an act of *consumption* which tends to legitimise existing political claims (i.e. 'persons and groups committed to exiting values' in Figure 3), and only slowly incorporates challenging new information. Societal ignorance persists not necessarily from a lack of knowledge, but rather because the political system ensures that certain types of information may be preferred. Thus, the political system influences both the input and reception of knowledge. Sin models can incorporate a variety of political theories derived from apparently conflicting ideologies and philosophies. Therefore they can deal with bourgeois views of parliaments and politicians as autonomous, powerful geographical agents, and can reveal conscious or semi-conscious choices by political and economic actors. Alternatively, they can encompass structuralist perspectives where the state holds little real power. And they can accommodate a variety of approaches to forestry history.

Sin models assume that the policy process is value-laden and that knowledge is, at least partly, ideological. This approach need not be teleological or presentist, because sin models facilitate a search for the contemporary values that determine the particular use or abuse of knowledge. They allow us to incorporate a 'historical-cultural' approach focusing on the emerging geography of forestry through 'the eyes of its creators, the people of the day'.[31] Therefore, without advocating an anthropocentric stance, we can pursue the prevailing development ideology of the study period by considering forests as human artefacts, thereby highlighting the extent to which forests 'became' a resource.[32]

Sin models offer a more realistic approach to long term policy evolution; not the least because they can encompass error models as well. In practice, however, the distinction between information consumption and production is sometimes obscure. First, there is the difficulty of assigning a source to publicly expressed opinions. Secondly, much of the information on forestry 'consumed' by parliament, bureaucracy or the press was not 'produced' with any specific application in mind—either because it was taken from the realm of pure science, or from apparently unrelated applied fields.

Finally, it is important to clarify the concept of knowledge used in the models above. Weaver, Jessop and Das differentiate between three dimensions of knowledge.[33] 'Personal' knowledge is experimental in nature, embodying our subjective internalised experiences; serving both as a stepping stone into the world of social relations through language, and as a basis for our particular philosophies and cosmologies. 'Sociological' knowledge is the social construction of reality, where facts are seen as values shaped by historical conditions, thereby determining our conception of appropriate social action under different circumstances. 'Positive' knowledge is information gained about the environment based on deductive reasoning, empirical observation and experimentation. Each dimension of knowledge represents the product of a specific form of consciousness and, it is posited, this results in different (non-universal) epistemological approaches to learning. As a geographic process, coming to terms with the environment will always involve varying mixtures of personal, sociological and positive knowledge. The infusion of the political process with 'positive' knowledge may assist a community in coming to terms with the environment, but rational policies may only emerge where the 'sociological' knowledge of the electorate, and perhaps the 'personal' knowledge of key legislators or bureaucrats is conducive.

Findings

The limited scope of this paper precludes a detailed narrative of forestry developments in the study region, let alone the morphological aspects i.e. the imprint on the landscape. Nevertheless, content analysis offers a useful overview of the timing, intensity and nature of the forestry debate.

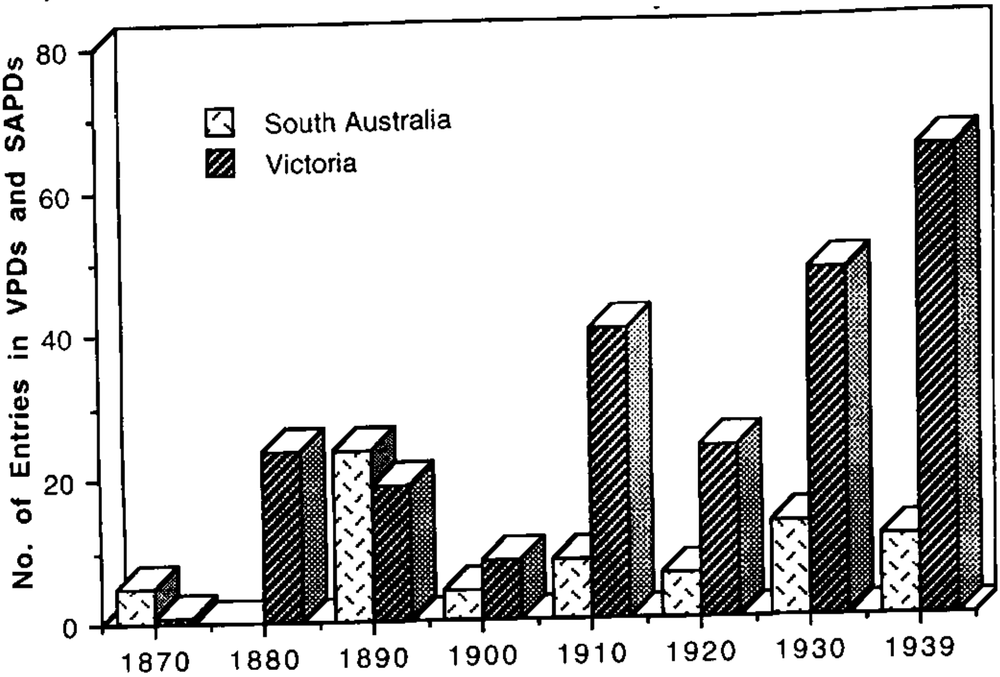

Figure 4. Forestry entries in South Australian and Victorian *Parliamentary Debates*, 1870-1939

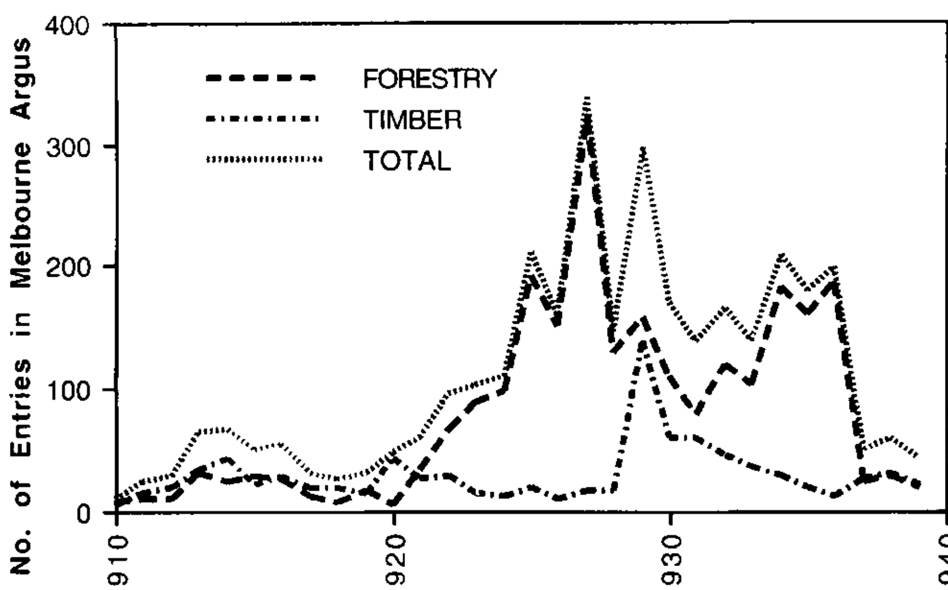

Figure 5. Coverage of forestry and timber issues in Melbourne *Argus* 1910-1939

Figure 4 reveals that forestry was firmly on the parliamentary agenda during the study period. Although the debate was episodic, due primarily to the same fluctuating political and economic forces in both States (e.g. depression, war, the push for closer settlement, the fortunes of the mining industry, the availability of public funding, and changing administrative fashions), the overall trend was of increasing attention. This was due, in part, to the elevation of forestry from the first two, to the third 'expression of power' noted above i.e. its increasing political legitimacy. These trends followed, and were often stimulated by, the promotion of forestry in the metropolitan press (Figure 5).

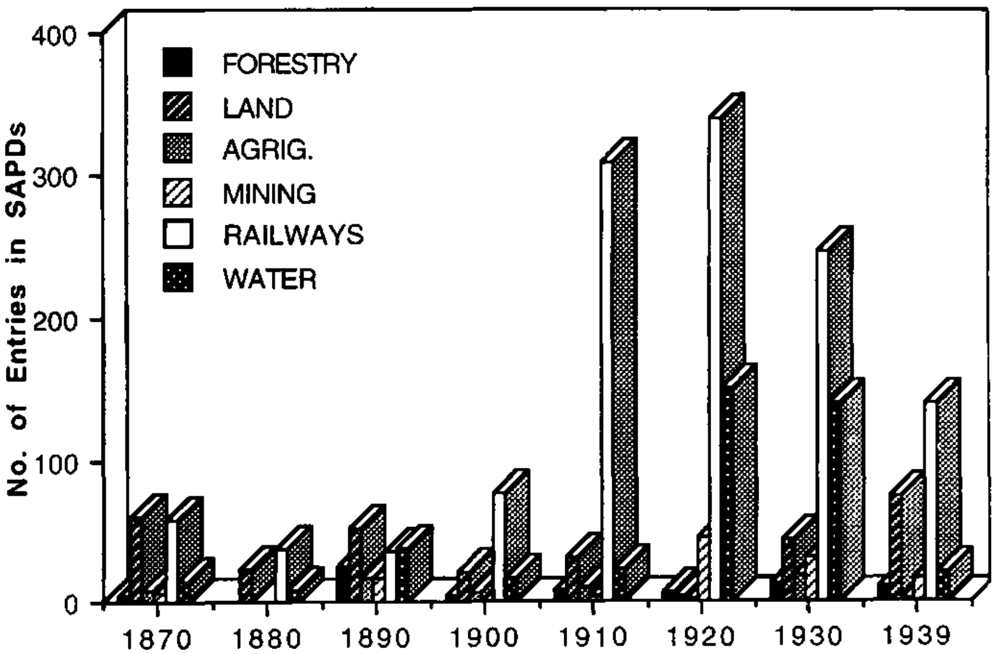

Figure 6. Subject entries in South Australian Parliamentary Debates 1870-1939

Figures 6 and 7 reveal something of the diversification of the debate, from the emphasis on timber production before the 1920s to a wider range of forest products and services e.g. water, soil and game management. These had been known since the beginning of the study period, but were only now gaining legitimacy. Pragmatic concerns were generally paramount, however, especially the supply of sleepers to the railways, pit props and fuel to the mining industry, and the continued bitter struggle to alienate forest reserves for settlement ('land' and 'agriculture' categories). The policy response (Figure 8) was equally episodic, although again the trend was of increasing parliamentary activity. All bills were considerably modified by the opponents of forestry, especially in the upper houses of parliament which were dominated by conservative pastoral and agricultural interests throughout the study period in both States. Even the apparent increase in the proportion of bills that were successfully enacted can be misleading, for in the Victorian Parliament the majority of the bills in the 1930s were introduced by governments who were antagonistic to, and were determined to destroy, many of the earlier gains in public forestry (especially in relation to fire restrictions, forest grazing, controls on local government in forested areas, and regulations reducing the alienation of reserves for farming, milling or mining purposes).

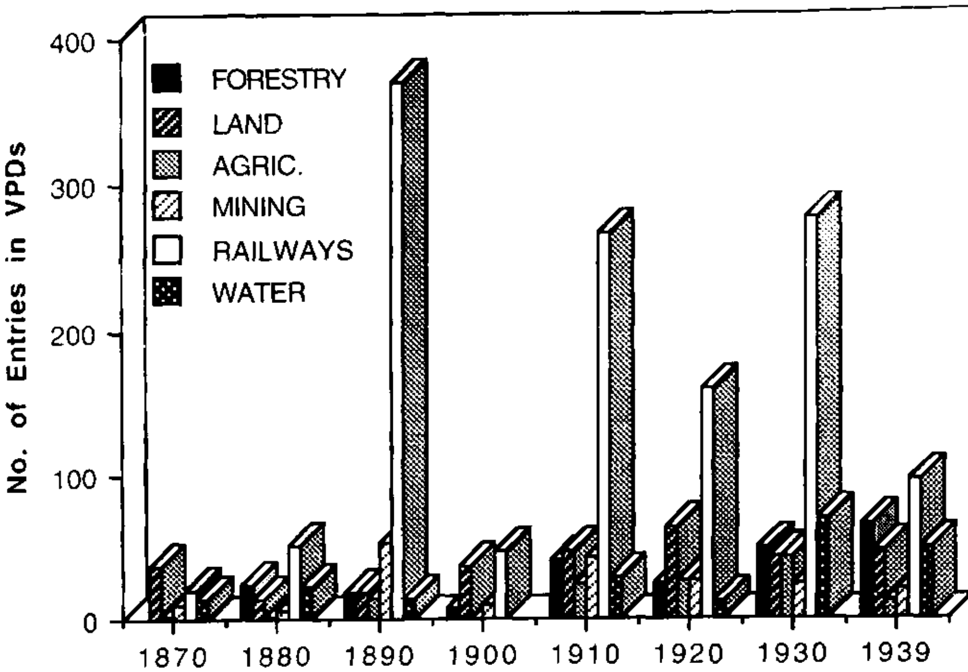

Figure 7. Subject entries in Victorian Parliamentary Debates 1870-1939

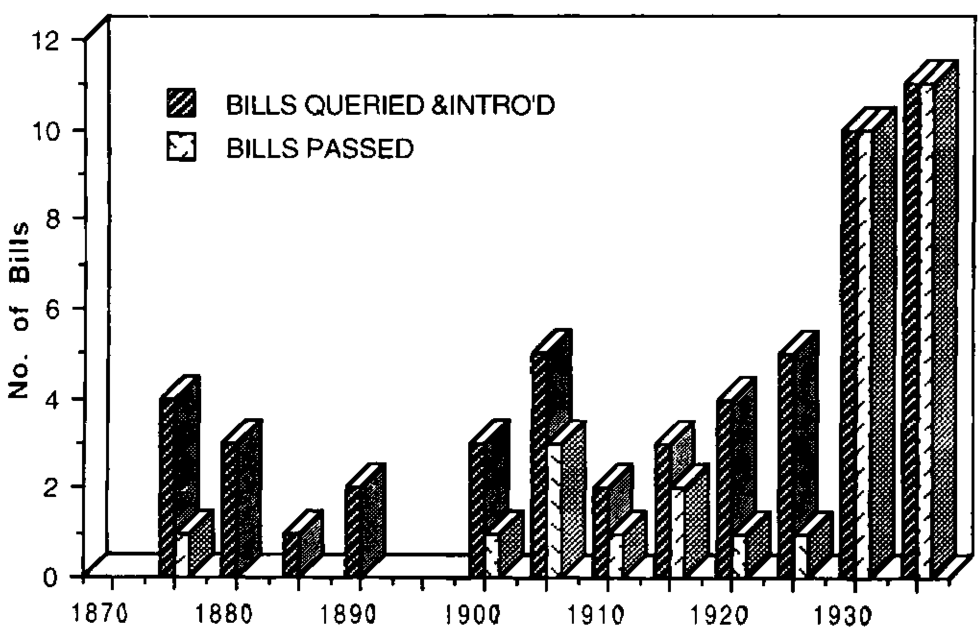

Figure 8. Passage of forestry bills in the Victorian Parliament 1870-1939

Forestry developed, in the broadest sense, through the actions of an interventionist, development-orientated, capitalist state. Obviously, the *role of the state* was determined by forces far removed from the confines of the forestry debate. Indeed, in both colonies, the foundations of independent state involvement in the management of natural resources had been laid during the 1850s and 1860s. The institutions that were developed there relied heavily on a wealth of experience of colonial management from throughout the British Empire, modified for the Australian experience. At least in the early stages (especially the 1870s), the administrative detail largely devolved to a few key public servants like South Australian Surveyor-General George Goyder and Victorian Assistant-Commissioner of Lands Clement Hodgkinson who were remarkably innovative and independent. But parliament always defined the limits of state intervention.

In general, there are at least three interrelated areas in which parliament contributed to the historical geography of forestry in Victoria and South Australia during the study period. In order of decreasing scope, but increasing detail, these were in shaping the political agenda on role of the state, the public interest, and policy. This had a profound effect upon the nature and direction of natural resource management, and in turn, on the evolution of the forested landscape. And in each area, we can discern the actions of parliament as an independent geographical agent separate from the individuals and institutions that influenced and implemented its legislation.

Parliament vested the Victorian and South Australian governments with the custody and 'improvement' of selected public forests along scientific lines so as to sustain the supply of forest products. In practice, this meant the production of timber and fuel for private enterprise in the building, mining, transport, chemical and cellulose-processing industries—for, in such 'newly settled regions', 'forest culture' was simply unprofitable. Few companies were able to compete with the government supply of timber for massive public undertakings such as railway construction, port development, street-paving, and the manufacture of wooden pipes for water and sewerage reticulation. Parliaments were careful, however, not to interfere unduly with major private markets, and so they gradually reduced government involvement in these politically-sensitive areas. The state's most contentious role in forestry was always in the regulation of forest use (both public and private). This persisted in one form or another despite continued challenges, if only because parliaments chose not to relinquish the revenue derived from the forests, and because control was essential to the reproduction of the living resource.

In all of the state functions there was an implicit recognition of a responsibility to the future—although inter-generational equity was almost always decided in favour of present needs. In addition to its primary economic function in forestry, the state also accepted a range of duties involving environmental protection or 'improvement', particularly where that related to increasing resource productivity (for example, of trees, soils and water) or security from natural hazards (for example, where afforestation was used to control droughts, floods and erosion). The parliament generally regarded forestry's environmental and economic imperatives as inseparable. More precisely, it acknowledged both the productive and protection orientation of forestry. Acclimatisation of valuable exotic tree species was one such case. Initially the exclusive domain of the Directors of the respective Botanic Gardens during the late nineteenth century (especially Victoria's energetic Baron Ferdinand von Mueller and South Australia's Richard Schomburgk), this responsibility was later transferred to the forest services to streamline administration. The marginalisation of the wheat industry in the late 1880s added impetus to the contribution of trees to economic diversification and the incorporation of more conservational land use methods. To an extent, this replaced the earlier emphasis on afforestation for 'landscape meteorology'.

'Beautification' was an important element of afforestation, but it was separated from mainstream forestry and became the province of Parks and Gardens agencies, and Roads administrations.

In both States, there was a growing parliamentary challenge to the environmental imperative in forestry policy. This occurred despite the rapid accumulation of scientific evidence on the protective and productive role of forests, and in sharp contrast to the growing demands for forest conservation (as deforestation and the degradation of primary forest increased). To some extent, this trend was inevitable as the market responded to forest destruction by increasing the value of the remaining scarce resources, and as representatives of the forest products industries became increasingly vociferous and powerful. More specifically, the increasing dominance of rural interests in both States ensured that the (once lauded) environmental services offered by forests were seen as a threat to future land development.

State intervention and centralisation grew as the public became more reliant upon, and less concerned by, the strictures of the Antipodean fashion for 'colonial socialism'. The brief experiment with 'local forest boards' in South Australia and Victoria during the early 1870s was initially supported by public servants and politicians alike, but ultimately the parliament redefined the acceptable degree of centralisation so as to ensure greater ministerial control over the Crown forests. In the most celebrated form of interventionism, the introduction of special 'franchise' legislation for specific long-term industrial joint-projects with APM and Cellulose Ltd in the late 1930s finally signalled a more serious parliamentary commitment to subsidising the forest products industry. Governments in both States had long promoted the development of industry by granting liberal concessions to forest users, but the joint ventures marked a new phase in 'industrial forestry'. This legislation coincided with a review of agricultural policy—especially in Victoria where the government's rationalisation of farming dramatically curtailed the excision of forests in marginal lands, and the introduction of more stringent bushfire controls reduced the impact of grazing in the forests. Modern forestry developed out of this more restrictive political environment.

During the study period, both parliaments rejected extremist positions on the role of the state. Plans for the complete privatisation of forest management proved as unwelcome as the suggested socialisation of private forest products industries. Periodic calls for socialisation came from radical trade unionists who wanted governments to act directly to protect workers and consumers from continued exploitation by capitalists. Before the 1920s, mainstream Labor legitimised this view as a calculated means of precipitating political confrontation, or as a temporary measure to assist the public in times of hardship (drought, war and depression). In South Australia during the early 1930s, Labor government initiatives in timber production and marketing promised a new era of socialisation in the forest products industry, but the experiments were soon dismantled by conservative governments. A few independent conservationists advocated socialisation as a method of slowing environmental damage because they believed that only public enterprise could be made to integrate ecological and economic considerations. But there was little support for either radical course. And the ideological gulf between them prevented any united front from these two tiny minorities. Both parliaments also resisted attempts at the federalisation of forestry administration during the inter-war period. This sprang from the traditional concern to protect States' rights over natural resource control, especially with its attendant revenue-raising potential. The issue over centralisation was stimulated by the

Commonwealth's decision to establish the national school of forestry in Canberra, rather than at Adelaide, Melbourne or Creswick. There was more sympathy however, for the C.S.I.R.'s national role in forest product research.

With such a broad consensus on the role of the state and the degree of centralisation, the political debate focused on intermediate questions of defining the *public interest.* There was never any serious suggestion that forestry should not encourage forest use—the preservationist argument was dismissed by forestry advocates and opponents alike. That was not surprising given the close links between the forest managers and forest industries. This was exemplified in Victoria by the disputes over closed catchment policies and by the convenient alliances between foresters and industry representatives like the National Forests Protection League. An even stronger link existed within the Australian Forests League in both States. The various hardwood sawmillers' associations in both Victoria and South Australia behaved opportunistically. Initially, they resisted government regulation but gradually became an important ally for the forestry cause, lobbying parliament for an end to excisions of valuable 'timber country' for agricultural purposes and encouraging forest product research that added value (such as advanced seasoning methods) or expanded markets (through product differentiation). Industry groups in the 'minor forest products' sectors—such as apiarists, charcoal burners, tanners, and eucalyptus distillers—had much less political influence, although their ideas were widely publicised in the press and conservation journals and this added legitimacy to the forestry lobby.

Despite the propaganda campaigns designed to promote a popular forest conscience, it was thought that only an economic revaluation of the forests was likely to give the forestry lobby sufficient political power to compete with its opponents. Forest ministers used the opportunity of the proposed joint ventures in industrial forestry in the 1930s to ridicule the preservationist stance as a barrier to development. And in both South Australia and Victoria, all of the forest conservators prioritised forest use over preservation i.e. they preferred a utilitarian rather than a 'silvacentric' approach to forest management. This emphasis derived in part from parliamentary influence on the selection criteria used for the appointment of new conservators, as well as from continual political pressure on forest service administration.

In parliament, the real debate centred on the issue of balancing 'development' amongst competing user groups. The forestry lobby had a well-founded faith that parliament could never achieve that end objectively—not even with the use of mutually-agreed scheduling for reserves by the Forests and Lands departments and the Governors in Council. Consequently, there were increasing demands for an independent commission that would protect the forest services from undue political influence.

Despite its obvious shortcomings, the Victorian Forests Department had shown the potential for a more serious approach to forestry. Substantial gains in forest revenue had been made under the 1907 Act, and the forest products industry was expanding despite the continued raids on the forests by the agricultural lobby. The Forests Commission was established in 1918 by a fortuitous political compromise after almost twenty years of campaigning. The parliament decided to seize the opportunities for repatriation presented by the impending end of the war, and although the mining industry had lost most of its influence on forestry policy, the new forest conservation lobby was able to turn the political tide.

In South Australia, by comparison, the timing was wrong. There was widespread support for the Woods and Forests Department between 1910 and 1925. In spite of

Southern MLC Reuben Mowbray's attacks on afforestation, forestry expanded, so governments continually rejected as unnecessary the few demands for an independent forests commission. The South Australian Forests League mounted a campaign against ministerial control of forestry during the late 1920s, but by that time Afforestation Minister Butterfield had dampened political opinion on the commercial prospects for forestry. In 1933 the Minister 'displaced' demands by reinstating an expert Forests Board—but this was largely to deal more effectively with the increasing complexity of industrial forestry.

Political opposition

Throughout the study period, there were at least four major groups which advocated the dismantling of much of the forestry system. This proved no real threat to the role of the state, because these groups generally favoured the retention of at least some small temporary timber reserves for local supply, and they all held contradictory views on government intervention—frequently demanding public assistance when their own interests were threatened. But they had an enormous influence upon contemporary conceptions of the public interest. In that regard they shaped the nature, timing and location of forest management.

First were the more extreme rural conservatives who were suspicious of experts, uneasy with science, and wary of any move toward a centralisation of control. They held that the forests were virtually inexhaustible and required little management other than periodic burning by 'practical men'. Secondly, there were the millers, splitters, hewers, wattle-bark gatherers, charcoal burners, and alluvial gold miners who equated public control with restricted timber supply and rising costs. These small capitalists were acutely aware of competition from the larger operators who could more easily cover increased government charges and who were more concerned with long term timber supply. In addition, there was competition from foreign suppliers, and from neighbouring Australian colonies and States. A third group of forestry opponents comprised the political representatives of the timber merchants who feared increasing competition from local sawmillers. The merchants promoted the notion that Australian timbers were inferior to their imported counterpart, and that exotic softwoods were ill-suited to local conditions. And they opposed the push for higher tariffs that might have offered greater protection to the suppliers of local timber. However, the most persistent and effective threat to forestry came from the agricultural lobby. The small farmers demanded the alienation of most permanent forests to expand arable land and reduce the forest cover used by native 'pest' species. Meanwhile their strongest political allies, the graziers, called for open access to forest reserves for their stock and the freedom to encourage the growth of grass by burning.

Internal conflicts between the opponents of forestry proved significant in the survival of both the reservation system and the forest services. Thus, at critical periods in policy development, political fallout occurred between the following: the grazing and farming lobbies over closer settlement; the smaller, more mobile forest products industries and their larger, more sedentary counterparts, over royalties; the alluvial and deep-lead miners, over the continuity of timber supply; rural municipalities, over competing visions of either an agricultural future based on forest removal, or an industrial future fuelled by a vigorous expansion of forestry; and politicians of various stripes trapped by the need to compromise in parliaments still dominated by factionalism.

The passionate arguments of the groups opposing forestry were due in part to a philosophical commitment to economic and political liberalism. For most conservative members, the forestry debate was always perceived as a clash between the state and the long-cherished rights of individuals to determine their own destiny. Generally, however, their concerns stemmed from a more practical self-interest. The forestry lobby was equally eclectic and opportunistic. It tended to regard state intervention less equivocally, being prepared to regulate private individuals and firms wherever it was deemed necessary in the 'national interest'.

In South Australia, the fortunes of the forestry movement fluctuated mainly with the political power of the agricultural improvers—for afforestation was seen principally as a means of ameliorating the State's harsh climate, and overcoming serious timber shortages in rural areas. Apart from the early struggle over the 'travelling stock routes', South Australia's large pastoralists remained an important ally to forest conservationists against the mutual threat from the advocates of closer settlement. After all, it is easy to forget that grazing (and to a lesser extent agricultural) leases dominated Woods and Forests Department revenue until just before the Great War. Few trees were lost by the alienation of the travelling stock routes, but the income lost might have been used to support more intensive management of the forest reserves. Non-timber uses were an important factor in the early acceptance of afforestation, but few landholders actually made use of the planting provisions of the early Acts. Given South Australia's limited native forest reserves, the free distribution of trees was widely welcomed, but it was the far-sighted expansion of exotic softwood plantations that ultimately provided the basis for a vast renewable resource. During the twentieth century, the expansion of mining at Broken Hill, fruit growing, and the particle-board industries proved vital to the campaigning of the forestry lobby.

In Victoria, rural interests (particularly the municipal and grazing lobbies) were far more antagonistic to forestry, in part because of a relative abundance of native forests, and also because the parliament did not exhibit the same degree of urban bias as its western neighbour. The corporate (deep-lead) gold-mining industry, wattle-tanning, and paper-making were of great significance to the development of forestry. Sawmillers and timber importers also had a considerable impact on policy. This is not to deny the irony that much of the forest destruction was precipitated by the very industries that were demanding longer-term solutions to their timber supply needs. Nor is it to champion the triumph of 'conservation through use'. After all, the political involvement of the forest products industry was designed to reduce competition for the forests that were its primary resource.

The short interval of management by local forest boards in the early 1870s was, in part, an attempt by forest users (especially miners and millers) to control their timber supplies more exclusively—free from concerns about the 'public interest'. And there is no doubt that the timing, direction, and stringency of forestry regulations were determined to a large extent by government trade-offs ('exchanges') against industry lobbying. The political pressure from industry, including the influence of widespread price-fixing from timber merchants, was enormous. The forests would have been significantly different—in extent, location, floristic diversity, age and size structure, were it not for the self-interested political involvement of the forest products industries.

By the 1890s, political parties were emerging from the maelstrom of parliamentary factions. Although a fixation on party titles is misleading, the broad distinction between the socialist line of the Labor parties and the liberal stance of the various conservative groups was apparent in their campaign rhetoric, and in their speeches from the opposition benches. Labor had a general sympathy for metropolitan interests and for the welfare of workers in the forest products industries, while the liberal parties aligned themselves with capital in regard to government regulation and labour disputes. In practice, however, both South Australian and Victorian Labor were populist, and conservative; while liberal and country parties were occasionally innovative in social legislation.

Neither of the major parties had a monopoly on any particular forestry *policy* initiative—although the limited experiments with socialisation by South Australian Labor governments should be acknowledged. Labor and the conservative parties were active at various times in different policy areas, and both would ignore or even reverse their positions when that course of action proved politically expedient. The parties representing rural interests were somewhat more predictable in their consistent opposition to most aspects of public forestry—a trend attributable as much to geography as any particular ideology or political philosophy. But internal conflict between grazing and farming interests, and the willingness of the country parties to temporarily align themselves with Labor (especially in Victoria) often confused the issue. And although generally united over key issues such as excisions, grazing and fire controls, individual variations continued in responses to particular clauses in forestry bills. Political instability fed and was fuelled by pork-barrelling, despite the growth of the party system. This continued localism contributed to the difficulties of forestry policy continuation, co-ordination and planning.

Regardless of the party in power, significant factors in parliamentary forestry initiatives included the commitment from a strong party leader with Cabinet solidarity, the necessary 'numbers' to carry an effective piece of legislation through both Houses, and opportune timing so that contentious changes could be legitimised. In a period of such remarkable political instability, these largely 'internal' factors were particularly important given the large number of occasions when unstable administrations were simply changed by realigning factions, without recourse to elections.

There is little evidence that differences in 'political culture' had electoral significance for forestry reforms. South Australia was the first of the two colonies to translate popular demands for forest conservation into effective legislation. But there was no systemic inducement to innovation, and the more liberal opportunities for parliamentary membership and voting for both Houses had little effect on the development of restrictive conditions governing the encouragement of tree planting on private land. Timing (with memories of devastating droughts still fresh), geography (with the push into the north gaining pace), and able individuals in both Houses to promote the reforms (Krichauff and Hodgkiss) were more important than political culture. In Victoria, the popular movement for forest conservation struggled against both the popular clamour for land (at a time when the parliament was a beacon of liberal reform) and entrenched capitalism (when her reputation for conservatism was well-deserved). In Victoria, agricultural improvement was equated with deforestation.

When there was adequate political will, even quite radical changes in policy could be initiated under existing legislation—as in the case of the continual raids on apparently 'permanent' State Forests; Turner's expansion of the Victorian forest reserves under the 1898 Land Act; Hill's expansion of softwood afforestation in South Australia during the early 1930s; Hill's and Whitford's experiments with socialised forestry during the same period; Victorian Premier Dunstan's reduction of unemployment relief funds and his opposition to stringent fire restrictions during the 1930s; and the pronounced geographical shifts in forestry in both States throughout the study period. Parliamentary support for or rejection of the policy directions of the various conservators proved another significant avenue for non-legislative political influence on forestry. All of the conservators were ridiculed mercilessly in parliament by forestry opponents. South Australia's Walter Gill (1890-1923) fared better than most. Victoria's Owen Jones (1919-1928) was vilified and pressured into resignation.

The relations between the forest service and the relevant minister received much attention in the parliament and press. The early forest departments were always hamstrung by their alignment with antagonistic (and invariably more powerful) ministries such as Lands, Agriculture, and to a lesser extent Mines. When independent forest ministries were established that portfolio was always amongst the most junior of cabinet positions, so that even sympathetic forest ministers generally had little power. Others were constrained by their commitment to other ministries, were in open conflict with their conservators, or were limited by Cabinet policy. Consequently, governments were able to maintain their attack on forestry despite the greater funding and apparent independence of the forest services.

Reviewing the models

It is important to make some tentative observations about the nature of the *political system* and the *policy-making process*. Bachrach's and Baratz's heuristic model proved a useful approximation of both. The political system became the major non-market forum for the struggle to revalue forests. Many of the proponents of forestry were able to influence community values (barrier i in Figure 3) through their effective manipulation of a sympathetic metropolitan press where a wide variety of arguments was presented. These arguments were gleaned from a range of specialist sources, with parliamentary debates and inquiries, conference proceedings and the scientific literature being regularly published. Major forestry proponents were also given access (occasionally contributing series on forests and forestry under pseudonyms), and editors maintained a concerted attack on parliamentary intransigence on forestry reform. The regional press, not surprisingly, was both more parochial and conservative—although the newspapers in the mining districts maintained their calls for forest conservation until the Great War. The forest conservation groups (especially through their affiliation with the Australian Natives Association) comprised thousands of individuals, but the general community had little interest in forestry. The targeting of schools to nurture a forestry conscience was an important development, but too frequently the changed attitudes were neither persistent, nor translated into action outside the schoolground or community plantation.

Institutional and procedural restrictions (barrier ii) limited access to the 'channel of policy choices' by those who sought to challenge existing values. Victoria's gerrymander and the power of the Legislative Council ensured the influence of rural and industrial interests respectively. In South Australia, the declining power of the pastoral lobby and the agricultural improvers in the older settled districts saw the erosion of support for forestry, as the agricultural frontier moved into the marginal lands of the north and as the closer settlement lobby demanded the intensification of farming.

Inside the parliamentary 'decision-making arena' (barrier iii) it was mainly economic interests who held sufficient power to influence parliamentary decisions when urban liberals, mining members and agricultural improvers occasionally 'had the numbers'. The same could be said of the proponents of afforestation in South Australia's South East in the 1920s and 1930s. The preservationists and other minorities, however, were generally dismissed—except when their views were used to support an argument (as was often the case with the explanatory 'first reading' of a bill which outlined both protective and productive aspects of forestry). Most often, radical views at all three levels (role of the state, public interest, and policy) were repressed by the forestry opponents—that is, relegated to 'non-decisions'. Of 49 major forestry bills examined, only South Australian MLA Friedrich Krichauff's early attempts at forest culture were significantly influenced by an environmental imperative, and none represented more than a modicum of liberal reform. Not surprisingly, none of the bills survived significant dilution from the original drafts of the forestry proponents.

Even where apparently stringent measures were enacted, there were many examples of political influence on administrative interpretation and a lack of enforcement (barrier iv). The excision of 'inalienable' State Forests, the transfer of permanent reserves to those of temporary status, the failure to exclude squatters, the ineffective impoundment of wandering stock, compromise on timber licences and royalties, the continuation of illegal cutting, the destruction of trees in competitors' concession areas, and the lax enforcement of fire controls, were some of the more noticeable policy shortcomings. Given the effective lines of communication in the forest services in both States, the 'feedback' from the rangers to the conservators on these problems was clear, regular and voluminous. But the conservators had considerable difficulties in penetrating, and ultimately influencing, the legislative process. And local magistrates were often loath to impose sufficient penalties to deter those tried for 'forest offences'.

Despite this, the policy-making process eventually created a comprehensive system of forest reserves and professional forest services to manage them. In the long term, the South Australian and Victorian landscapes bore testament, at a variety of scales, to the environmental and economic imperatives that the early advocates of forestry fought so hard to implement. This was achieved, in part, through reaction to the feedback on the various bills and acts being gradually fed into the policy-making channel. The input of a wide array of information seemed critical to the accumulation of a body of wisdom with which to legitimise policy decisions. Thus, the incorporation of what Schnaiberg describes as an 'error model' seems justified when investigating policy development. Historical geographers can fruitfully investigate the forested landscape, the forestry system, and the legislation that shaped them both, as an expression of a society coming to terms with its environment. In that regard it would be valuable to trace the evolution of environmental knowledge, and the contribution of those who 'produced' it.

Nevertheless, it would be naive to suggest that the tortuous delays in the achievement of those objectives were due principally to ignorance. This study has emphasised Parliament's selective use and abuse of information for a variety of political ends. This is not surprising given that parliamentarians acted as representatives of particular interests and value orientations, rather than as arbiters of the truth. In that sense, 'truth' had little meaning, for few members were swayed by the logic of opposing arguments in any parliamentary debate. Indeed, apart from attending to the mechanical aspects of introducing legislation, the Parliamentary Debates were too often merely a showcase for political opinion, or were used to legitimise (or sometimes cover) backroom deals—in other words, many of the political decisions were 'symbolic' or 'tokenistic'. There were a few notable converts to forestry by parliamentarians such as the graziers McLachlan, Cameron and Prendergast and the mining representatives Glass and Abbott. But in general, ignorance was a poor excuse when parliament could commission definitive evidence on forestry matters. In both States, the findings of Royal Commissions and Select Committees were regularly, and often correctly, dismissed as being politically biased.

Detailed evidence from the forest services, the forestry schools, forestry texts, relevant speeches, the press, lobby groups and committees of inquiry were all incorporated to legitimise arguments in the Parliamentary Debates, but there was obviously nothing inexorable about its acceptance. Opponents would often ignore this material when it suited them. Alternatively, they would present contradictory evidence, or dismiss the veracity of observations by an appeal to the wisdom of the common folk. Some of the technical issues continually disputed by different interest groups in parliament included the nature, extent and impact of deforestation; the meteorological effects of forests; the vigour and commercial value of different tree species; the effectiveness of seasoning; the validity and implications of an international 'timber famine'; the impact of forests on water quality and quantity; the role of forests in 'the erosion cycle'; the agricultural suitability of forest soils; the consequences of grazing; and the causes and effects of fire. These were quite apart from discussions of the value of different policy means and ends. Challenges to the veracity of the prevailing scientific wisdom were often precipitated by major droughts, floods or fires. Economic and social disturbances such as depression and war, or a downturn in the fortunes of farming, were also important. In such debates, the distinction between values and facts easily became blurred when the need arose.

Therefore, the 'knowledge consumption' approach represented by Schnaiberg's sin model seems particularly useful for examining how statute policy evolved from Parliament at any point in time. The policy-making process there was frequently 'incremental', opportunistic, subjective, and always highly selective. Alternatively, the more 'rational' process whereby the forest services developed their detailed management policies and administrative programmes owed far more to a logical system of scientific observation and trial and error—although political pressure always ensured the need for 'bluff and compromise' if public servants were to achieve optimum outcomes. The contribution of 'expert' public servants is more fruitfully examined through an error model that can trace the output and influence of particular ideas and evidence. The growth of research into forest products and the development of productive technologies were trends about which the forest service and parliament could at last agree on the value of science—although the parliamentary representatives of the timber merchants would frequently disagree.

Schnaiberg's portrayal of the policy-making process as either a sin or an error model has proven to be a false dichotomy. 'Official appraisals' of the forested environment in the study region always involved two, often conflicting, systems of learning. The forest services reflected the dominance of what was defined by Weaver, Jessop and Das as 'positive knowledge'. In sharp contrast, politicians were more concerned with applying their limited 'personal knowledge' to shape 'sociological knowledge' (in this case, the public interest).

Clearly, an underlying environmental determinism is also evident in the development of forestry in both South Australia and Victoria—a pattern influenced by the various biogeographical controls on forest growth. Nevertheless, it is difficult to underestimate the influence of theoreticians and empiricists in testing and 'designing' the landscape. This reflects the role of the forest services (from conservators to rangers), the common folk (including farmers, graziers, and timber workers) and the politicians who—no less than the others—were important in translating ideas into action. Thus, we can discern the influence of particular parliamentarians—forestry crusaders like South Australians Krichauff, Hodgkiss, Brooker, Vaughan, Verran, Senior, Peake, Reidy, Gunn, Petherick, Anthoney, Craigie, Butler, and the Victorians Bindon, Bosisto, Gaunson, Best, Turner, Tucker, Outtrim, McBride, Billson, Bailes, Hannah, Irvine, McLeod, Cain, Peacock, Eggleston and the impassioned McLachlan. The opponents of forestry had an even greater impact on the landscape, by accelerating deforestation through excisions or postponing the expansion of modern forestry practices—South Australians like Carr, Playford, Catt, Cockburn, Campbell, O'Laughlin, and Mowbray, and the Victorians Longmore, Richardson, Gillies, Patterson, Taverner, Beardmore, Everard, Dunstan and Lind.

Regional alignments of parliamentarians also had decisive impacts on the landscape. The proponents of afforestation in South Australia's northern lands, the Adelaide hills, and especially the South East became prominent in turn. In contrast, most opposition came from the northern lands as drought and depression forced farmers to seek the alienation of the few forest reserves there between the mid 1880s and the 1910s. In Victoria, the major forestry promoters were the mining members of the Central Highlands before the Great War, while notable opposition came (from the 1890s) from the farming lobby of the hill country of the Otway and Strzelecki Ranges and the foothills of the Eastern Highlands, and the graziers of the rugged ranges of East Gippsland and the north east. Political geography proved a critical influence on the forestry debate. South Australia's initial metropolitan dominance was gradually eroded by the push of the wheat frontier into the northern lands during the 1880s, but the inevitable retreat from the drought-prone north resulted in a more representative distribution. Victoria was dominated during the study period by an overwhelming rural gerrymander that influenced almost every aspect of forest policy until the end of the 1930s. It ensured that forestry bills were almost invariably passed during the 1930s—but generally to attack earlier gains by the forestry lobby.

By that time, the geographical re-orientation of forestry into optimal high rainfall areas in both States had been confirmed, the investment in plantation forestry at last seemed vindicated, and perhaps there would be a renewed role for science. The first giant industrial complexes of a new age of forest exploitation were being built as the memories of the hard-fought struggles of a bygone era were beginning to fade. And, as always, the geography of forestry was being shaped by a political debate which legitimised these changes.

Notes

[1] The two most authoritative overviews of Australian forestry are L. T. Carron, *A History of Forestry in Australia,* Australian National Univ. Press, 1985; and J. Dargavel, *Fashioning Australia's Forests,* Oxford Univ. Press, 1995. In Australia and the USA, policy innovations have generally varied according to economic, demographic and geographical factors—H. Nelson, 'Policy Innovation in the Australian States', *Politics,* 20, 1985, 77-88; J.W. Kingdon, *Congressmen's Voting Decisions,* Univ. of Michigan Press, 1989). Regardless of the geography, however, political resistance to radical change remained the norm—P Ellefson, *Forest Resources Policy: Process, Participants and Programs,* McGraw Hill, 1992, 224-6.

[2] S.M. Legg, 'Debating Forestry—An Historical Geography of Forestry Policy in Victoria and South Australia, 1870-1939', PhD thesis, Dept. of Geography and Environmental Science, Monash University, 1995.

[3] S.M. Legg, '*Arcadia and Abandonment?—The Evolution of the Rural Landscape in South Gippsland, 1870-1947*' , M.A. Thesis, Dept. of Geography and Environmental Science, Monash Univ., 1984; and Legg, 'Debating Forestry', ch. 8.

[4] The South Australian government's administration of the Northern Territory from 1863 to 1911 is not considered here.

[5] The threefold classification is used by R. Freestone, *Model Communities—The Garden City Movement in Australia,* Nelson, 1989, 3.

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Integrating cultural and natural heritage in Queensland

Margaret Kowald and Rebecca Williams

Introduction

Cultural heritage has been formally included in the suite of assessable forest values since the *National Forest Policy Statement* was signed in 1992. Historical and community-based cultural heritage assessments are being integrated with the scientifically-based flora and fauna assessments and with social and economic considerations. A Queensland Government (1993) policy to give the wood products industry using native forests greater planning certainty led to the project described in this paper being commenced in 1995. It was Queensland's first whole-of-government forest study to include cultural heritage values. The Departments of Environment, Natural Resources, and Primary Industries (Forestry) were directly involved and the Department of Families, Youth and Community Care was associated with the assessment of social and economic impacts.

The project was intended to provide a comprehensive regional assessment of five biogeographic regions (Figure 1) which would lead to a comprehensive, adequate and representative system of conservation reserves, sustainable forest management; and resource security. Studies were initiated to assess the cultural, social and natural environmental values and were designed to contribute to the selection of the reserve system, assist sustainable forest management and contribute to a regional forest agreement with the Commonwealth Government. Early in 1997 the two governments undertook to work towards such an agreement in ways which incorporate and supersede the Queensland process already started for the region.

This paper explores the integration of cultural and natural heritage by a multidisciplinary research team in the Queensland Department of Environment. The team consists of a team leader trained in forestry (Williams), a historian (Kowald), a zoologist, an ecologist, a geographic information systems specialist, an administration officer and four vegetation survey and mapping teams from the Queensland Herbarium. Issues associated with the immensity of the study area, differing methodological approaches, and limitations on the outcomes are discussed. Because of the initial emphasis of the project, this paper deals mainly with historic or post-contact cultural heritage and not with indigenous cultural heritage.

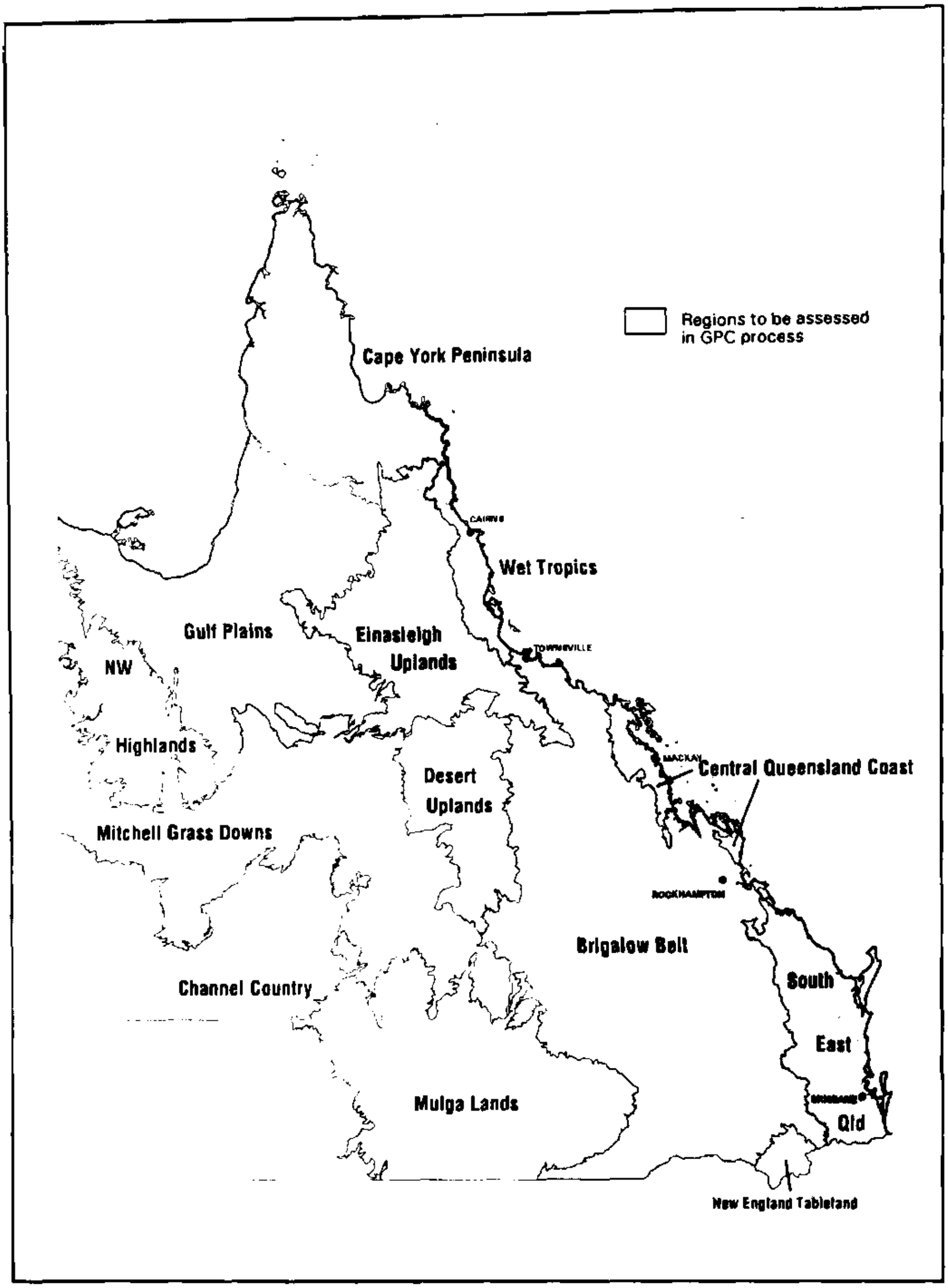

Figure 1. Queensland biogeographic regions showing regions to be assessed in the process for greater planning certainty for the forest industries

The South-east Queensland biogeographic region

The South-east Queensland bioregion covers 6.6 million hectares (Table 1). Its major physiographical features are a coastal plain, hills and ranges and the drainage basins of the Brisbane, Mary and Lower Burnett Rivers and the Barambah Creek. It has warm to hot summers and cool winters which contribute up to 30 per cent of the annual rainfall of 800-1500 mm/annum. Because the boundaries of the bioregion are based on natural rather than cultural elements, the study area does not reflect cultural variables such as the geographical extent of major historic themes or the boundaries of Aboriginal traditional owner groups. In addition, human history does not fall easily into 'forest' and 'non-forest' categories. Linkages can be made, however, in the fragmented nature of the forests as a consequence of the pattern and density of settlement.

Table 1. Forested areas in South-east Queensland compared to those in the East Gippsland and Central Highlands regions of Victoria

Land tenure and cover	South-east Queensland (ha)	East Gippsland (ha)	Central Highlands (ha)
Crown forested:			
State Forests	629,062		
Timber Reserves	22,234		
Protected Areas*	154,338		
Private forested	1,259,065		
Total forested	2,064,699	977,802	700,000
Total bioregion	6,568,372	1,216,685	1,200,000

* Includes: National Parks, National Parks Scientific, National Parks Aboriginal, National Parks Torres Strait Island, Conservation Parks, Resource Reserves, Nature Refuges, Co-ordinated Conservation Areas, Wilderness Area, World Heritage Management Areas, International Agreement Areas.

The abundance of timber in the region was one of the reasons for the choice of Moreton Bay for a convict settlement after Oxley's exploration of the Pine and Brisbane Rivers in 1823. Unlike other coastal regions, the initial process of occupation in the south-east was not from the main port. The lie of the land, influence of pastoralism, and the fifty mile [80 km] limit around the convict settlement of Moreton Bay meant that penetration was mostly by pastoral occupiers and their stock spilling over from the fertile Darling Downs. From 1842, however, when Brisbane became a free settlement and the fifty mile limit was abolished, pastoral occupation spread from Brisbane into the Fassifern Valley and as a northward thrust from the Tweed across the McPherson Range into the Currumbin valley area (Kowald 1996).

The development of Queensland depended on population growth which governments set out to achieve by policies which promoted land settlement. It became an unquestionable article of faith that the colony possessed a boundless area of land and an inexhaustible forest cover. Hoop pine, red and white cedar, black bean and beech as well as hardwoods were actively cut. There was little thought of timber harvesting before the heavily forested land was opened for selection. Great wastage occurred when timber which was felled, could not be removed because of poor transport facilities. Legislation in 1860 and 1868 provided conditions of occupation which included clearing and cultivation. The land was cleared for stock grazing and crops were planted. Dairying became established in the 1880s and resumptions of large holdings and Soldier Settlement legislation in the decades which followed resulted in further clearing of forest. There was difficulty in arguing for the retention of high quality forest stands when it was widely assumed that the best forests were on the best soils. The view prevailed that good land should be used for settlement and agriculture and that forestry should be confined to remote land. Furthermore, the Soldier Settlement schemes were based on the distorted views that Queensland was capable of supporting a large rural population and that a living could be obtained from small farms.

As rural areas declined, the pressure of population growth in the south-east increased. A broad scale regional planning process—the south-east Queensland 2001 project—resulted in a regional framework for managing growth in this most densely populated area of the state (Queensland Department of Housing, Local Government and Planning 1995). The framework included a principle that sites and traditions of cultural heritage significance should be identified and conserved. The work undertaken as part of the project described in this paper provides a way of partially addressing that principle.

While one third of the south-east Queensland bioregion is forested, it has immense pressures from urbanisation, which include a high demand of recreation, vandalism of places and associated interpretative material, and a scarcity of the ecosystems which originally existed in the flatter, more fertile parts. A significant body of public opinion now sees the public good as being served by preserving forests for values other than wood, namely for their social, natural and cultural values. These pressures coupled with the fragmented nature of the forested public estate increase the complexity of management required to achieve sustainability.

Aims and methods

The studies aim to assess the particular values of a forest, provide thematic layers for analysis of the conservation reserves, examine management implications and assist in the development of codes of practice and management prescriptions for sustainable forest management. For the analysis of conservation reserves, the assessments will allow forests to be ranked according to the principles of comprehensiveness, adequacy and representation, and to exhibit the attributes of: (i) diversity of regional ecosystems, fauna and flora species; (ii) presence of rare and threatened regional ecosystems, fauna and flora species and significant cultural heritage places; (iii) areas of endemism; and (iv) presence of populations of species or regional ecosystems considered to warrant protection due to spatial isolation, and limits of geographic and ecological ranges.

Regional ecosystems

Regional ecosystems are the primary surrogates for biodiversity used in conservation planning in Queensland. They are a function of vegetation, landform, geology and soils. Young (in prep) has described 120 regional ecosystems of which 86 are forest types. Further refinement of the descriptions and their extent is an expected outcome of this process. Pre-1750 and remnant regional ecosystem coverages can be obtained with regional ecosystems defined within the limits of the available data. A limiting factor is the incomplete coverages for both pre-1750 and remnant vegetation.

Vegetation survey and mapping followed the method outlined in Bean, Dilleward and Thompson (1994). Where vegetation polygons contain a mosaic of vegetation types, the spatial boundary of a regional ecosystem within the polygon may not be defined even though the areal extent of the type is known. Comparisons between the pre-1750 and remnant regional ecosystem coverages will be used to classify regional ecosystems as rare, endangered or vulnerable as outlined in the nationally agreed criteria.

Fauna

The fauna study to date (November 1996) has been a 'desktop' one using data on species distributions obtained from all major Australian museums, Queensland Government Departments, published data and databases (such as NatureSearch). A database of approximately one million entries has been erected which addresses the questions of which species have been recorded and where. There are other fields which allow the data to be filtered or referred to other original data. Among the filtering fields is an assessment of location error. Record validation for taxonomic and geocoding is a major process (McFarland 1996).

Taxonomic bias has arisen where species or groups such as birds have been intensively or selectively surveyed because they are relatively easy to identify. Spatial bias has occurred where specific habitats have been targeted, for example rainforest, or where locations are frequently visited, for example, popular campsites. Other limitations relate to the inclusion of incorrect records and incomplete information such as imprecise locations or lack of comments on the population size. Raw and transformed data will be used in the analysis. Attempting to assess species viability within a particular forest is beyond the scope of the project but is needed for sustainable forest management.

Flora

Assessment of the values at a species level was also a desktop operation. The analyses used point location records from the Queensland Herbarium (HERBRECS and CORVEG databases), Department of Environment regional office datasets (such as IBIS), departmental officers' datasets and other Queensland Government department databases.

The point location records were used to determine the location and extent of rare and threatened species as listed in the *Nature Conservation Act (Wildlife Regulations)* 1994, endemic flora, and flora at the limits of their distribution. The data was filtered to eliminate records over 50 years old, cultivated records and vague records.

As for the fauna records, the data was validated to standardise records to current taxonomy and to check the geocoding of the location. Historically, sampling bias has occurred due to surveys being carried out in specific locations or for particular species. Sampling bias can be partially compensated for by a number of standard techniques (Leverington and Dillewaard 1996). Disturbance was not included although it would have been beneficial to consider its influence on the species diversity had time and resources permitted an integrated study.

Cultural Heritage

A cultural heritage layer was introduced in the design of the conservation reserve system by the research and collation of a database of significant cultural heritage places and by associating it with the analysis of forest communities. There were no cultural heritage databases for the region which could be used within a geographic information systems. A historic data base is being developed through field work and desktop assessments.

Although the region is vast, the cultural heritage study had to examine the values present on all tenures for contextual comparison. Areas most likely to have high cultural heritage value—such as the Bunya Mountains, Scenic Rim, Maryborough, and Beerwah, for example—were targeted and places were recorded by categories and themes.

Information came from maps held in the Departments of Environment, Natural Resources, Primary Industries (Forestry), and the Queensland State Archives. Access was gained to local history publications and departmental reports. Unfortunately, the majority of the forestry departmental files are held in a warehouse and in local forestry offices rather than in the State Archives. Oral interviews with current and retired forestry personnel and people in the local community have been an effective source of information for the location of places. Community workshops in the regional forest assessment process will provide further assistance. Unlike the scientific techniques which assess the natural environment, the assessment of cultural values, especially social and aesthetic values, need to be carried out with extensive community participation.

Cultural heritage places were visited and records made of the type of place, its location (obtained from a global positioning system), a description, short history, the condition of the site and recommendations for future management. Photographs and information sources, both oral and written, are noted. Assessment is made against the *Australian Heritage Commission Act* 1975 and *Queensland Heritage Act* 1992, although more work needs to be done to establish and apply appropriate thresholds.

Table 2 Historic cultural heritage places in State Forests South-east Queensland Bioregion *(Results to November 1996)*

Place	No.	Place	No.
Bridge	3	Machinery	5
Building	6	Mine	5
Bullock wagon	3	Natural area	4
Cemetery	4	Railway	5
Charcoal pit	1	Road	8
Complex	5	Sawmill	10
Cultural landscape	3	Scenic landscape	10
Defence/war relic	3	Site	8
Ethnic settlement camp	1	Town	4
Feature protection area	2	Tramway	2
Fence	1	Tree	10
Fire tower	10	Trigonometric station	2
Helipad	2	Worker's camp	12
		Total number of historic places	*129*

Types of historic places which have been assessed include bridges, buildings, bullock wagons, cemeteries, charcoal pits, cultural landscapes, defence/war relics, ethnic settlement camps, explorer's routes/marked trees, fences, fire towers, helipads, machinery, mines, railways, roads, sawmills, scenic landscapes, towns, tramways, trees, trigonometric stations, and worker's camps (Table 2). Themes within these categories include the timber industry, recreation and tourism, community and settlements, communication, mining, education, military, water resource management and major events.

Although some discussions commenced with three Aboriginal organisations in the study area—Goolburri and Gurang Land Councils and FAIRA Aboriginal Corporation—detailed Aboriginal studies will start in 1997 with the regional forest agreement process. The proposed methodology for Aboriginal studies is for an agreement to be signed by the Government and the Aboriginal groups whereby traditional owner groups or Land Councils will undertake consultancies to identify and assess Aboriginal cultural heritage values. Issues to be addressed in the agreement include confidentiality of information, the required formats for the delivery of information, and future management of forested areas.

Places of indigenous cultural heritage significance may include archaeological sites such as artefact scatters, bora grounds, ceremonial areas, grinding grooves, living sites, middens, pathways, quarries and trees (carved, scarred). Places may also include landscapes, and landscape features which are integral to storylines and/or song cycles. Many such places explain the creation of life and the organisation of social responsibilities, and their exact meaning cannot be communicated for cultural and spiritual reasons. However, locations can be established through the recommended consultative procedure. Although the Department of Environment has a data base of Aboriginal places, they have not been recorded precisely enough to be displayed as a meaningful layer in a geographic information system and it will be necessary to determine their locations with a global positioning system. Some Aboriginal data from the Queensland Central Highlands which has been collected like this and does provide a meaningful layer in an information system (Godwin 1995).

Analysis

A grid-based analysis based on the Purdie-Bolton-Specht method will be used (Purdie 1987). It provides a structured, systematic method of identifying potential key areas for conservation using quantitative data. Potential key areas identify representative examples of the majority of ecosystems, locations of rare and endemic species, and significant cultural heritage sites. The analysis will indicate how well the existing reserve network captures the natural and cultural values of the region, and areas of greatest concentration of ecosystems that are not contained in the reserve network. This analysis removes the *ad hoc* process of selecting conservation reserves described by Pressey (1994).

The grid based method has the advantage that quantitative comparisons between different areas can be made relatively easily using the digital coverage of the thematic layers. It can incorporate a number of themes such as species diversity and significant historic cultural heritage sites. It has been used previously for the Channel Country (Wilson and Young 1990), East Gippsland (Australian Heritage Commission and Department of Conservation and Natural Resources, Victoria 1994a) and the Mulga Lands (Purdie 1986). It is likely that decision support systems will be used involving concepts such as irreplacability.

Results: thematic layers

Considerable progress has been made on the natural heritage thematic layers. The flora and fauna studies have concentrated on data validation, establishing agreed methods and initial analysis. Regional ecosystems have been mapped for parts of the bioregion and analysis will commence with the completion of the vegetation survey and mapping. The vegetation survey and mapping has led to the discovery of 13 new species and an average of 115 plant species have been recorded for the first time in each map sheet area.

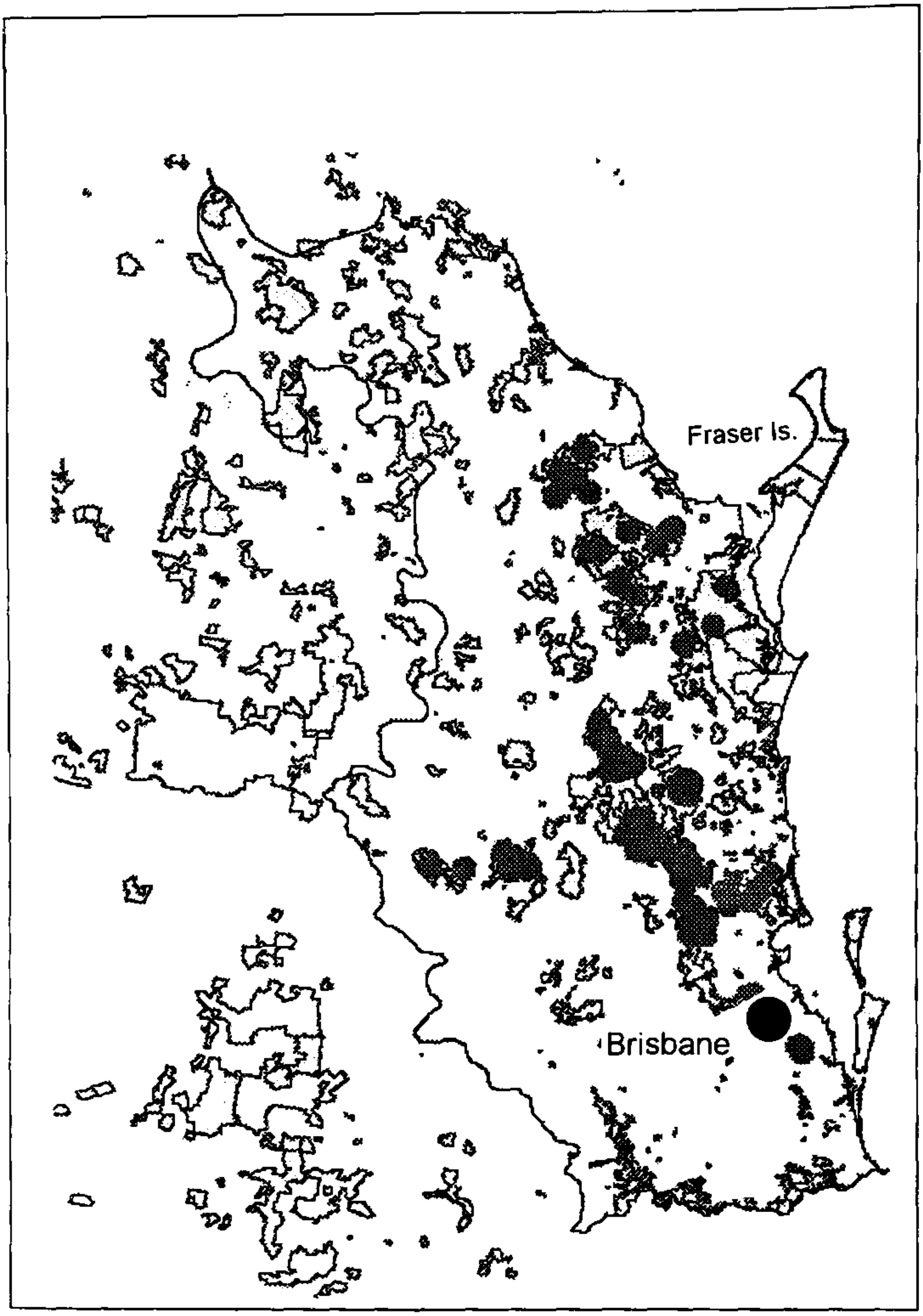

Figure 2. Historic cultural heritage sites in the South-east Queensland bioregion.

Cultural heritage forest studies in Queensland have been limited to historic heritage and have had to collect primary data; this has been a significant part of the project but has limited its rate of progress. A data audit (Jenkins 1995) and historical overview (Kowald 1996) provided the basis for the work. To date, 129 historic cultural heritage places have been visited, place reports completed and photographs taken (Table 2). The potential number of cultural heritage places is enormous. With an average of five historic places being identified in each State Forest and a total of 196 State Forests and 145 protected areas such as National Parks in the bioregion, there is potential for over 1,000 places. Figure 2 shows not only where historic cultural heritage work has been done (shaded area) but also the vast areas where fieldwork has not been undertaken. As well as highlighting these places as an information system layer, they are also marked on 1:50 000 maps. Places are marked as either a dot, a line for a road, tramway or railway, or a polygon for a cultural landscape or a mining area. Technology is playing a major role in both cultural and natural studies. The geographic informations system and related databases are enabling data to be stored, retrieved, combined and analysed in ways that were previously extremely time consuming and labour intensive.

In conjunction with this project, cultural heritage studies of specific State Forests have been undertaken by University students (University of Queensland and Department of Environment and Heritage 1995a, 1995b; Luxford 1995; Martin and Campbell 1996). A consultancy to study historical sawmills and tramways has commenced which will provide material not only for a conservation reserve system but also for cultural tourism. Sites can be included in self-guided forest drives and be the focus of recreational facilities.

Results: sustainable forest management

The bibliography and database prepared as part of the fauna study will contribute to species management through species profiles, management plans and an information system about wildlife. Management prescriptions for regional ecosystems and types of historic cultural heritage places are planned. The characteristic issues to be addressed in management prescriptions for types of historic cultural heritage places include fire, timber harvesting and visitation. Input into a draft code of practice for native forest timber production is ongoing. It is anticipated that the project studies will contribute to the development of codes of practice for minor forest products, recreation, and fire.

Discussion

Although the historic and indigenous cultural heritage layers are more limited than the larger natural heritage layers, they add a dimension to the overall understanding of forest values. The studies reported in this chapter are being complemented by the old-growth project, described in following chapter, in which historic data is actively being integrated into disturbance histories (Queensland Department of Natural Resources 1996). Thus, using historic data such as the burning regimes surrounding sawmills and bush towns, apparent anomalies in vegetation in otherwise environmentally similar localities may be explained.

The role cultural heritage values will play in the selection of the conservation reserve system will depend not only upon the ability of those values to be managed outside protected areas but also on the requirement for representative and unique values to be reserved. The integration of cultural and natural values in management regimes poses special challenges.

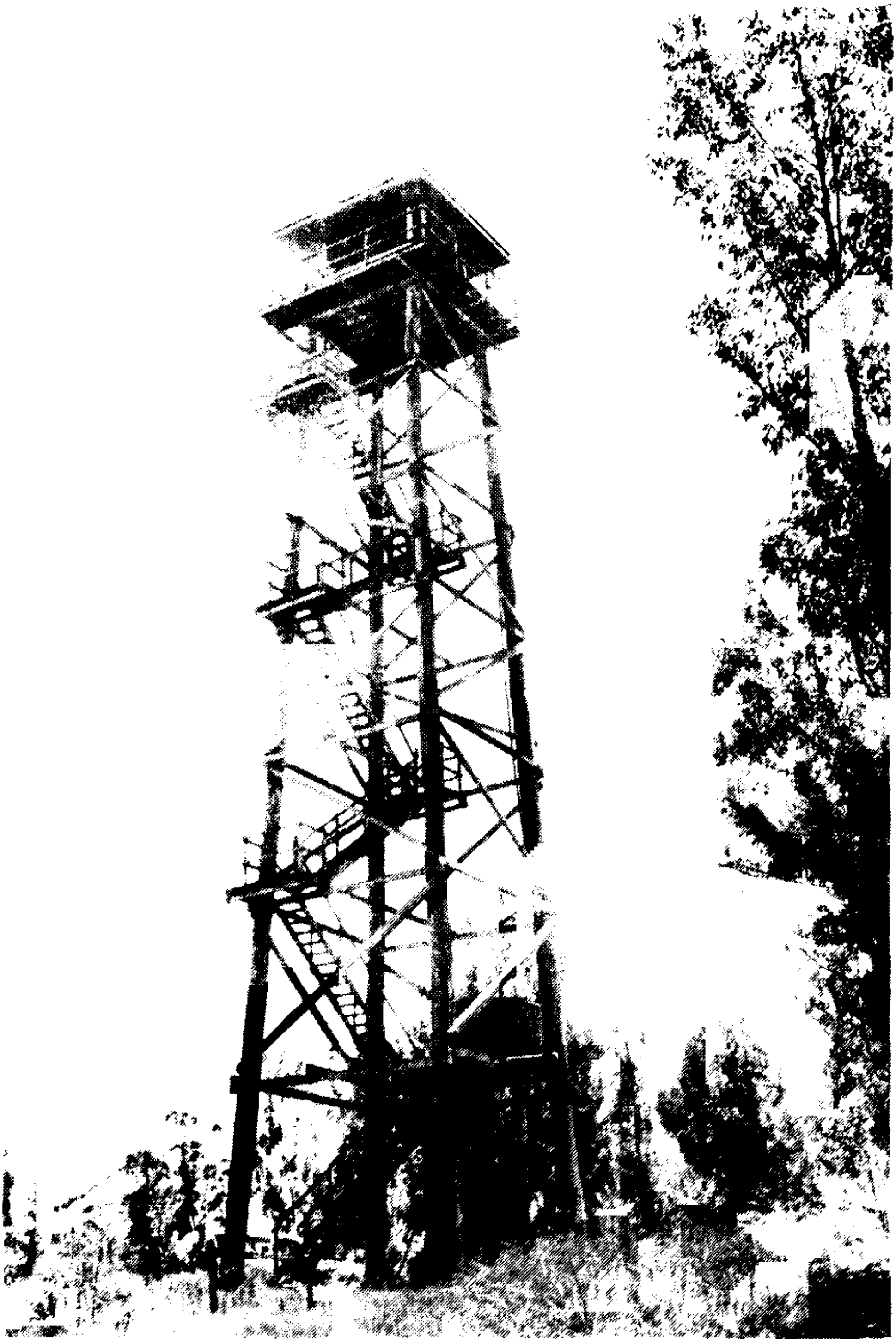

Figure 3. Sunday Creek fire tower, Jimna: built 1965. No longer required but of historic significance as one of the last four-legged wooden fire towers in Queensland. Painting to maintain it will cost $70,000, but who will pay? *Photo*: Margaret Kowald.

As stated in the Victorian studies: on the one hand, the emphasis on 'broad acre' issues in natural heritage management needs to be tempered by a recognition of points in the landscape with special cultural significance; while on the other hand, the generally broader scale of natural heritage management has great potential in terms of the conservation of expansive cultural elements or cultural landscapes (Australian Heritage Commission and Department of Conservation and Natural Resources, Victoria 1994: 34).

The cost of management is an issue which needs to be addressed. Conservation of historic cultural heritage places is not without implications for resource allocation and may be in conflict with conservation management of the natural values. Examples include a corduroy road which is actively eroding; alluvial gold and tin mines which may be leaching cyanide and contributing to watercourse sedimentation; $70,000 to paint a decommissioned fire tower which may be the last of its structural type (Figure 3); and, repair of an iron-roofed hut, now a 'smoko' shed, in a culturally appropriate way.

Conflict is most likely to be resolved when the significance of the historic cultural place is known in a bioregional context, when there are specific site management prescriptions, when the responsibility for management and maintenance of cultural heritage places is clearly defined, and when field staff have expertise in the recognition and assessment of cultural heritage places.

Queensland's forest studies clearly recognise forested areas as having both cultural and natural heritage significance. Past human activities have left landscapes and structures which are part of the region's cultural heritage. The challenge is to accommodate the differing methodological approaches of historic and indigenous cultural studies and to integrate and manage cultural and natural values both within and outside protected areas.

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Mapping disturbance for old-growth forest assessment in south-east Queensland

Hilary Smith and Damien Moloney

Introduction

The concept of 'old-growth' forest has become prominent in Australia and world-wide in the last decade reflecting an increased public awareness that such forests possess important conservation values such as faunal habitat, biodiversity and aesthetics due to their naturalness or low levels of disturbance. The Queensland Government has undertaken to conserve them and in 1995 established a project, jointly with the Commonwealth Government, to map them on all tenures throughout south-east Queensland. The aim of the project is to map a range of old-growth attributes which may or may not be included within existing forest conservation reserves. The project will cover thirteen map sheets (1:100,000 scale) as its first priority as these contain the majority of the moist forests in the biogeographic region (Chapter 24, Figure 1). It is using a combination of aerial photograph interpretation, ecological assessment, historical disturbance mapping and analysis. The remaining forty or so map sheets within the region will also be mapped for disturbance, but at a less detailed level. This paper focuses on the mapping and analysis of forest disturbance.

Definitions

Old-growth forest

The Queensland project accepted the Commonwealth definition of old-growth forest as 'ecologically mature forest where the effects of disturbance are now negligible' (JANIS 1996: 19). Within this context a major objective of the project is to develop a method to identify, measure and map the physical attributes of eucalypt-dominated old-growth forests. Their important characteristics include vegetation structure, composition and disturbance.

Disturbance

Forests, by virtue of their dynamic nature, are continually changing their structure and composition. It is widely recognised that under natural conditions disturbance plays a necessary role in the regeneration and maintenance of forest structure, function and species diversity (Brown 1992; Pickett and White 1985). Disturbance is both intrinsic and essential to the forest growth cycle (Brown 1992) but can also be a divergence from a natural state. Under 'natural' conditions, disturbance has a role in the regeneration and maintenance of species diversity in many vegetation types. In addition, the frequency, scale and intensity of disturbance have important consequences for forest condition. For example, if disturbance is frequent, old-growth forest may occupy only a small fraction of a landscape dominated by regenerating forests of different ages. Equally, where disturbance is of significant intensity, forests may exist in a permanently disturbed state or may be eliminated altogether. The question then arises as to whether a natural landscape in a particular time and place would exist as a mosaic of even-aged patches in various stages of succession, or whether it would be a more homogenous, even-aged, forest? In other words, does all of an old-growth forest have to be in an unquestionably climax state or can it be a good representation of trees in all growth stages?

In order to determine the effects of disturbances and to identify an old-growth forest, it is necessary to identify a reference condition. There are two possible ways of doing this: by defining a steady state expected to occur under optimal conditions (i.e. a potential state), or by accepting a pre-existing state (i.e. an actual state) regardless of the forest's dynamic status (Rykiel 1985). This is an important issue in the assessment of old-growth forests, and in fact of any type of ecosystem. While it would be ideal to identify the potential state (often given as pre-1750 or pre-European forest type) as a reference state, the reality is that only an actual state can now be identified and this is only possible where historical information is available.

If a reference state can be identified, then disturbance thresholds can potentially be determined. Thresholds are often considered to be discrete, binary and therefore relatively easy to study; either there is disturbance or there is not. However, in recovering from a disturbance, a forest retains degrees of its pre-disturbance ('natural'/'old-growth') attributes depending on the intensity, scale and nature of the disturbance which makes thresholds difficult to apply. If a disturbance, whether natural or unnatural, is so severe as to affect the natural processes of regeneration then it affects old-growth attributes. Disturbance levels, as opposed to thresholds, can be used with this in mind.

Determining disturbance levels requires an understanding of the ecological response of forests which varies according to the type of forest, its species and the type of disturbance. For example, wet sclerophyll and dry sclerophyll forests respond differently to grazing, particularly with regard to the structure and composition of the understorey, but their response is determined by their previous condition. Therefore, how disturbance levels are determined in various forest types varies according to the reference sites available and the information about disturbance.

Mapping disturbance

The various types of disturbance to the eucalypt-dominated native forests are being identified, mapped and analysed by the project in terms of the ecological consequences of disturbance rather than their social or economic causes. (Queensland Department of Natural Resources 1996). Hence an understanding of each type of disturbance and the ecological processes involved is being sought through literature review and historical research. The major types which have been identified as likely to affect the ecological attributes of old-growth are logging, grazing and fire. Secondary information is also collected to facilitate analysis and modeling. It includes agriculture and clearing (estimated from remotely sensed imagery); land tenure; sawmills, mines and quarries;

railways, roads and rivers; other stochastic events (cyclones, flood, drought) and dieback.

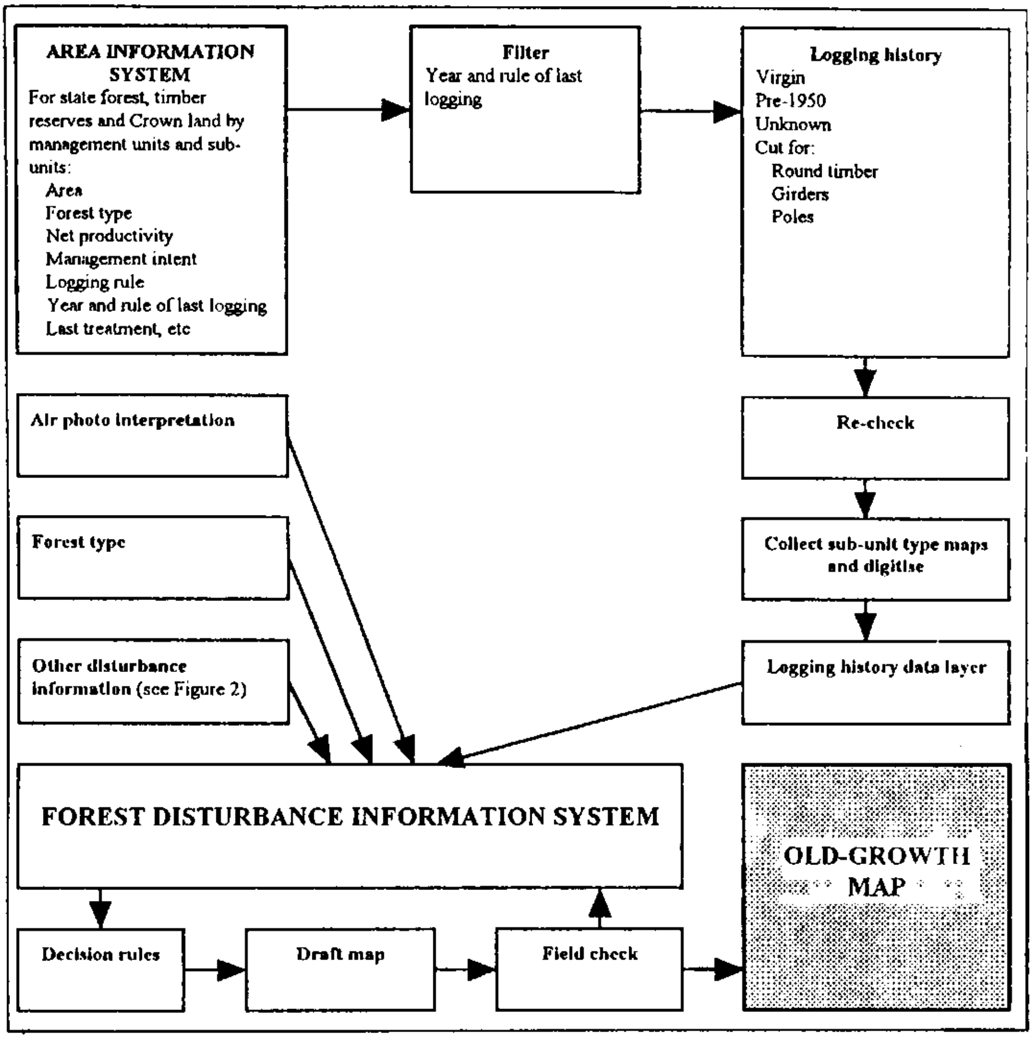

Figure 1. Schematic diagram for production of the logging history data layer

It is not within the scope of this paper to detail each data set being compiled in the study but it should be recognised that the primary shortcoming is the lack of accessible and available data in a digital form. The project is particularly dependent upon access to information held and updated by district forestry offices of the Department of Primary Industries. Although current information is available, historical information is often poorly archived. The majority of the time taken on disturbance history has been in spent collecting and converting hard copy data into a useable, digital format. Nevertheless, a number of data sets relating to the history of forest management and disturbance have been established for south-east Queensland.

Logging and silviculture

Logging and silvicultural treatment are considered to be the primary causes of disturbance. Information about them is held in various sources and forms (Chapter 7). Data for managing state forests, timber reserves and other Crown land is held in a computer-based area information system which stratifies the forest into management units and sub-units. These data cover broad administrative information, forest attributes for each stand (forest type, productivity, logging and treatment history) and events and activities which may affect forest structure.

For this project, information is collected and digitised at the sub-unit level where possible. It is then filtered to determine those areas which have specific logging histories as being: unlogged (virgin), last logged before 1950, selectively cut for poles, girders or round timber, or with an unknown logging history. This information is rechecked by forestry officers. Forest type maps, which spatially represent both forest type and logging history are then collected, digitised and amalgamated into one disturbance data layer which provides the detailed descriptive layer for the analysis and modeling of forest disturbances (Figure 1).

Grazing and treatment

In Australia, and particularly in Queensland, grazing has often been regarded as compatible with wood production. The grazing of Queensland's forests under the different tenures has important implications for their condition due to the different management activities permitted. The Department of Primary Industries manages approximately 4.5 million hectares of state forest and timber reserves. The *Forestry Act* 1959-1990 sets out the responsibilities, functions and powers of the Conservator of Forests for the sustainable management of state forests, including grazing. It also enables Stock Grazing Permits to be issued on state forests as leases for fixed terms not exceeding seven years. The Department of Lands issues Term Leases for grazing on Crown land. These account for 88 per cent of the grazed forest estate (2.77 million hectares) whereas Stock Grazing Permits account for only 12 per cent (Queensland, Forest Service 1991).

While there has been some debate about the virtues of opening forests to grazing, the agencies responsible for forest management in Queensland have maintained access to most forest types for grazing and related activities. In state forests grazing is managed according to a code of practices. These specify that grazing pressure must be below a level which is estimated according to the land's ability to maintain natural vegetation cover and soil stability. Possible adverse impacts of grazing on significant plant communities, fauna habitats and other forest uses are considered when leases are issued. While the significance of the impact of grazing on native forests is still being debated, it is increasingly argued that it is resulting in some degradation of the forest resource. Burning, poisoning, ringbarking and even extensive clearing are permitted in some forest types and this, in conjunction with the long term impact of browsing by cattle, has the potential to significantly affect both the composition and distribution of eucalypt-dominated forests of south-east Queensland.

Wildfire and prescribed burning

Fires have a major role in determining the composition, structure and function of Australia's eucalypt-dominated forests. In addition, decisions to suppress fires in order to protect old-growth qualities and timber values, or to promote fires in order to provide pasture for cattle, have consequences for forest development (Attiwill 1994). In the old-growth arena it is frequently debated as to whether a differentiation should be made between the ecological consequences of 'natural' wildfire and a managed fire regime. While wildfire has been included as a significant disturbance in other old-growth studies (see Woodgate and others 1994) Queensland rarely experiences large bushfires. This is because extremes of temperature and humidity are infrequent, especially in the coastal areas which support the greatest areas of forest. Thus the significance of wildfire as a disturbance for Queensland's forests is debatable. In this project, wildfires and prescribed burning are considered separately.

Wildfire is considered to be a particularly important disturbance to the growth stage characteristics and floristics of old-growth forest (Woodgate and others 1994). Wildfires maintain the ecological dynamics of regeneration and decline for most eucalypt species, whilst having the potential to physically affect morphological characteristics of growth stages. The time taken to recover from such a disturbance depends on the intensity and frequency of fire, and the type of vegetation type. However, the issue of 'naturalness' and the question of significance are pertinent in considering wildfire as a disturbance in old-growth forests.

Prescribed burns happen every three to four years in Queensland and are likely to be important in determining the structure of the forest. Fires of increased frequency and reduced intensity in 'good' controlled burns cause little damage to standing trees but they change the forest understorey. Some species of shrubs, for example, are likely to respond vigorously after a prescribed burn, while others might be heavily reduced (Lord 1994; Tolhurst 1994a; Hall 1994). Faunal populations are unlikely to be seriously affected by the burns because of their low speed and intensity but they are changed because their habitat is altered (Tolhurst 1994b). These undesirable effects are reduced by burning the forest in a mosaic pattern in which burnt sites are interspersed with unburnt ones which offer refuge for some species (Taylor 1994).

Fuel reduction burning as part of forest management strategies and controlled burning of forests by lessees for 'green pick' as cattle fodder, contribute significantly to the disturbance regimes experienced by forests in south-east Queensland. Due to the abundance of grazing and the frequency of burning, the relationship between grazing and fire cannot be overlooked as having possibly significant impacts on old-growth forest. Historical information about fire has been kept only sporadically, although some information is available for state forests and national parks. This limited information about the nature of each fire and the environmental conditions may help generate a picture of the frequency at which the forests of Queensland experience fire. In conjunction with other information being collected, areas of eucalypt forest which experience 'more frequent that usual' fire, and are therefore more significantly disturbed, are delineated.

Modeling and analysis

To facilitate the process of mapping and analysis, the information collected is being entered into a forest disturbance information system to promote analysis through a geographic information system and environmental modeling (Figure 2). The primary functions of this system are: data storage, the fluid integration of data layers, and the application of a single model to estimate disturbance parameters in areas where no direct data source is available (Gordon 1996). The disturbance information system acts as a repository for all information collected during the project and is used to determine relationships between disturbance information, aerial photograph interpretation and field validation. The outcomes of this process, in conjunction with other environmental variables are used to model, by prediction, the occurrence of old-growth forests in inaccessible areas.

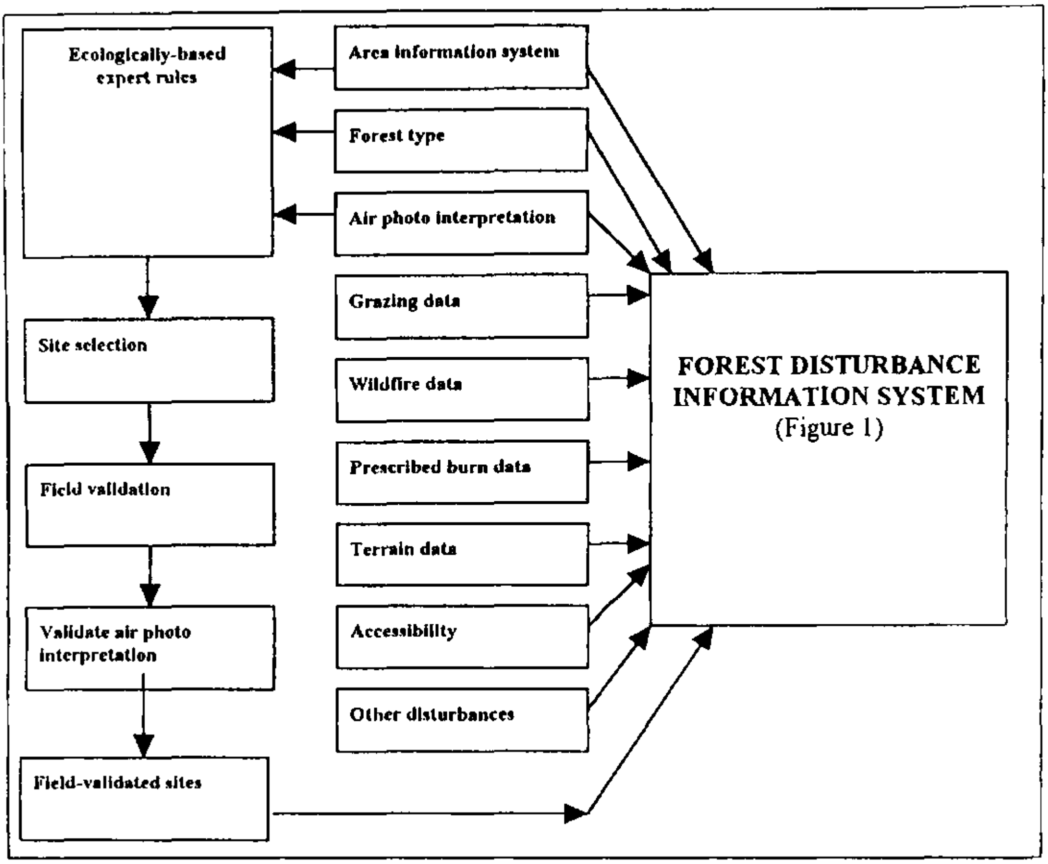

Figure 2. Schematic diagram of data analysis for old-growth forest mapping (modified from Gordon 1995)

Aerial photography

Aerial photographs (1:25,000 scale) covering forests on all land tenures of the study area are being interpreted to provide another primary data layer for the assessment process. Homogenous units of eucalypt-dominated forests are being delineated by similarities or differences in vegetation, disturbance type and intensity, growth stage, crown cover projection and other canopy attributes. Field studies are conducted to determine the accuracy of the interpretations. These, when combined with the disturbance information produce maps of areas which are considered likely to be old-growth forest.

Field studies

The ecological assessments and aerial photograph interpretations entered into the disturbance system are carefully validated. Ecological field studies have included measurements in temporary and permanent plots over a range of vegetation types, productivity classes and logging histories to assess the composition of forest in terms of growth stages. Observations to date indicate that in wet forest types unlogged forest contains higher proportions of senescent trees than in logged areas. However, this relationship was not as distinct in dry forests. From these studies the attributes which are directly measurable and useful in the delineation of old-growth forest have been found to include forest structure, growth stage of trees, crown cover projection and species composition.

Analysis of disturbance information

Studies on changes in forest condition due to disturbance have focused on the collection of baseline information. Analysis is continuing to examine the relationships between disturbances and other variables, including accessibility and forest type. It is anticipated that cross-validation of other data sets, particularly the aerial photograph interpretations will provide some insight into disturbance-canopy relationships. However, relationships between disturbance regimes and understorey characteristics will not be discernible from the aerial interpretations which focus on canopy attributes. Further investigation using alternative approaches, at a more detailed level, will be made.

It is important to recognise that analysis is more complex than examining a single disturbance event. Analysis can be further complicated by the nature of the properties of each disturbance. Further, for analysis to be valid, reference sites in which no disturbance has occurred must be identified. The challenge is to understand the impacts that disturbance regimes, both individually and in combination, have on all structural layers in eucalypt-dominated old-growth forests.

While it is not essential to recognise which impacts are associated with each disturbance type, the fact that they are often inter-connected means that the source of each impact is nevertheless important. The historical context in which the forests of Queensland have, and are being, utilised is therefore essential for a comprehensive understanding of existing forest condition. Therefore, thematic histories of forest use, for each district being studied are being compiled using both primary and secondary source information.

Conclusions

The aim of the south-east Queensland old-growth forest assessment project is to identify, assess and map eucalypt-dominated native forests which are ecologically mature and which have experienced disturbance the effects of which are now negligible. Determining the significance of various disturbance types has thus been a major component of the project, with a focus on the ecological impacts of these disturbances. The majority of time has been spent on information collection and conversion for analysis and modeling in a geographic information system. However, a new phase of investigation into the details of the characteristics of each disturbance type as they relate to ecological processes, and the ways that they can be interpreted has been started. Preliminary results are already highlighting relationships between disturbances and forest structure, particularly for wet sclerophyll forest types.

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Studies for the Western Forest Region of New South Wales

Jane Lennon

Reasons for the forest history studies

The Commonwealth and State governments are committed to undertake comprehensive regional assessments of Australia's forests in order to establish a comprehensive, adequate and representative system of conservation reserves from which to develop regional forest agreements. The Commonwealth's proposal specifies that fifteen per cent of the area which existed in 1750 of each vegetation type in each biogeographic region (as determined by the Australian Nature Conservation Agency) is to be reserved. State Forests of New South Wales decided to investigate the history of forest reserves in their Western Region as part of this assessment because very little has been written about land settlement there compared to the plethora of studies on the coastal belt or on cedar-getting. The investigation examined four areas of the surviving forests to see whether they existed in their present distribution and structure in 1750 and what influences since then had shaped their current distribution and structure. The area of forest to be reserved was to be calculated on the basis of the former extent of various forest types encompassing a suite of age-classes and would not assume that the pre-1750 forests were exclusively old-growth (JANIS 1996). It is important, therefore, to understand the processes of change operating in the forests and establish as detailed a chronology of impacts as is possible from a range of sources.

Subject areas chosen

There has been considerable clearing in the Western Region of New South Wales, particularly in the Central Division, since the arrival of Europeans and most of the surviving 'natural' vegetation is located in State Forests and National Parks. These forests, however, did not exist in their present distribution and form in 1750 and are often the result of regrowth, logging regimes and silvicultural treatment. Within the Western Region, which covers 75 per cent of the total land area of New South Wales, there are 396 State Forests covering a total area of 987,000 hectares. With the exception of the Pilliga, most of them are now small islands of forest surrounded by agricultural lands.

It was decided to concentrate the studies on the cypress pine and red gum forests. The cypress pine forests include most of the forests through the traditional wheatbelt of central western New South Wales, while the red gum forests of importance occur in the Deniliquin and Narrandera Districts along the major river systems including the Murray, Edward, Murrumbidgee and lower Darling Rivers.

Cypress pine-ironbark-box forests of the western plains
These forest types have been managed on a sustainable basis for timber production longer than most other forest types in New South Wales. From the early days of management in the 1880s, substantial silvicultural investments have been made to ensure the development of regeneration and to improve productivity. The condition of these forests has substantially changed under forest management from areas of open grassy woodland with scattered large trees and no regeneration, to forests of actively growing young trees.

These modified, managed forests are now perceived as having conservation values because most of this forest type outside the State Forests has been extensively cleared for agriculture. Many of the State Forests play a supplementary agricultural role through a long history of grazing.

Red gum forests of the riverine plains
These unique forests were extensively exploited from the 1860s during the riverboat era and have since regenerated. They have been managed since the early part of this century to produce a range of forest products, including sawlogs, railway sleepers, firewood, woodchips and landscape timbers, mainly for the Victorian market. In addition, grazing and apiculture are important commercial uses.

The ecologically sustainable management of these forests is closely linked to river flooding. The artificial regulation of river flows to satisfy competing demands for water for irrigation, domestic supplies (including Adelaide) and other requirements had an adverse impact on the growth and regeneration of the forests. Because the red gum forest grows on flood prone land, far less has been cleared in comparison to the forests through the wheatbelt. There is also a significant red gum resource on private property which is utilised by the timber industry. As the red gum forest is located adjacent to some of our major rivers and includes important wetlands, it has considerable values for conservation.

Organisation
A Technical Reference Group was established by Gary King (currently Acting General Manager Research for the State Forests of New South Wales) consisting of Jane Lennon, Les Carron, David Goldney and Sue Feary. Its task was to select the consultants, steer the project and comment on draft chapters. The four study areas, comprising fourteen forests, were selected in the two forest types for detailed examination, a brief was prepared and advertised, and consultants were chosen. The study areas are:

Pilliga forests cypress pine in the Baradine District
(Pilliga West SF No 267, Yarrigan SF No. 272, Euliga SF No. 810, Cumbil SF No. 812, and Merrwindi SF No 839)
Consultant: Elaine van Kempen.

Lachlan Valley cypress pine in the Forbes District
(Back Yamma SF No. 253, Euglo South SF No. 218, and Strathorn SF No. 238) Consultant: Mark Allen.

Murrumbidgee Valley cypress pine in the Narrandera District
(Gillenbah SF No. 1890, Matong SF No. 506, and Buckingbong SF No. 156)
Consultant: Pauline Curby.

Millewa red gum forests in the Deniliquin District
(Millewa SF No. 398, Gulpa Island SF No. 558, and Moira SF No. 576)
Consultant: Peter Donovan.

Methodology

For each forest area, the historians were asked to answer the following questions:

1. Did this forest exist in 1750?
2. If so, what was its condition, structure and floristic composition?
3. How have Aboriginal peoples modified this forest?
4. What has been the sequence of European and management use of this forest?
5. How has this created the forest and/or modified it caused forest reserve boundary alterations, changed forest utilisation in terms of products and technology.
6. How different is the 1996 forest to the 1750 one in terms of extent, distribution and composition?
7. Can the answers to these questions be extrapolated to other forests in the surrounding district?

To answer the questions, the historians were asked to examine the following agents of change for each forest: Aboriginal activities, early European descriptions by explorers, squatters, Crown Land Commissioners and land surveyors (why did they cut up the district into the patterns they did?); pastoralism, agricultural clearing; forest reservation, assessment, regulated use (or not); mining; fire; flood; drought; pest plagues and silvicultural management. Information on the agents of change was to be sought in the archival, documentary and oral sources listed in Table 1. These sources are located in Sydney, regional and district Forestry offices, and local towns and surrounding farms. People who have detailed knowledge of specific forests were to be sought out. The forests themselves are sources of evidence for what has happened to them and that evidence can be read in the trees, stumps and the remains of built structures for those with a ' seeing eye'.

Skills required and model studies

The consultants had to have a proven record in historical research, experience in the State archives, oral history and recording, refereed writing of history, and some expertise in natural systems so that they could synthesise information from many types of historical, biological and scientific sources and interpret the history of the forest under study. Where this expertise was lacking, they had to obtain specialist assistance to help them interpret the structural changes to the forest and understand the impacts of Aboriginal use on the forest under study. They had to be able to interpret maps, the landscape components of photographs and aerial photographs.

From their prior knowledge of interpreting documentary sources the historians had to be aware of the variation in terminology for describing the forests. Croft, Goldney and Cardale (1996) in their study of the pre-European vegetation of the central western region of New South Wales, urge caution in interpreting historical descriptions of density, species type and in drawing conclusions from areas of 'remnant vegetation'.

Table 1. Sources for forest history studies

Source	Type of Information
19th century surveyors' records, plans and field books	General descriptions of land and timber, pastoral property locations, track locations
Aerial Photos	Extent and distribution of forest cover.
Archived Lands Department records (pre-1916), indexes, registers and copies of correspondence	Surveyors' descriptions of use and conditions of reserves, recommendations for future use. Files relating to conditions of grazing leases. Forest Conservation Branch files (1882-1916).
Art: paintings, sketches	Impressions of the landscape.
Current or recent government records and reports, management plans and environmental impact statements	Current land use and generalised recent management of past land use.
Department of Agriculture	Pest plant and animal survey reports.
Forest Commission of New South Wales records (from 1916)	History of dedication and revocation of reserves. Use of reserves by lessees. Timber assessment reports. Silvicultural improvements. Fire reports. Maps of reserve and forest boundaries. Working plans. Dendrochronology studies.
Government Gazettes, Register of official and legal transactions with regard to land	Dates of land transactions, descriptions of land boundaries, size and location, names of owners and users.
Herbarium (Royal Botanic Gardens, Sydney)	Specimen collection notes; Ecological studies.
Interviews, oral history, personal recollections (Forestry Commission District offices; local residents)	Recent history, location information, regarding land use in recent times. Photographs.
Mines Department	Mining lease conditions reports
NSW National Parks and Wildlife, Australian Institute of Aboriginal and Torres Strait Islander Studies	Aboriginal occupation and land use studies; archaeological and anthropological surveys.
Parish and County maps	Pattern of land alienation over time, location of reserved crown land, location of transport routes.
Portion plans, surveyed plans of alienated Crown Land	Details of initial land tenure, dates of occupation. Nature of vegetation, soils, geological formations, built structures.
Royal Commission on Forestry in New South Wales (1908)	Evidence on existing condition of forests.
Secondary and contemporary sources, local histories, contemporary accounts (diaries, newspapers, poetry, prose)	Land use practices, working conditions and settlement histories.
State Rivers and Water Supply Department	Stream flow records. Channel and bank condition reports.
University Theses	History, anthropology and archaeology, botany, ecology, zoology, soil science, geomorphology.

Mark Allen has noted that the meanings of the terms 'forest', brush' and 'scrub' applied to the same forest area vary according to the reporter. For example, it is unclear whether Oxley, who had a gloomy view, and Cunningham, who was a botanist, used the terms synonymously. 'Forest' land certainly carried trees but also grass. Oxley and Cunningham described densely timbered lands as just that. Today's common usage of the term 'forest' appears to have evolved during the latter part of last century (Allen pers. comm.).

Forest history studies undertaken in Victoria by Charles Fahey (1987) and Anita Brady (1993) were recommended for model approaches as were New South Wales studies by Angela Rymer (1993) and Pauline Curby (1993). Some of these have been published in the proceedings of previous Australian forest history conferences.

Preliminary conclusions from the consultants' draft reports

All consultants submitted draft reports which showed that their trawling through the range of sources resulted in different frameworks in which to answer the questions posed. However, all are unanimous in their findings that the actual forests seen today did not exist in 1750, although Elaine van Kempen suggests that all the species present in 1750 in the Pilliga still remain though some of the grasses once common are now very rare. In the red gum forests a few ancient individual trees remain.

In the cypress forests, early European explorers observed that there was a mosaic of vegetation cover—open plains, brushes and scrubs, open and dense forests and myall plains—of varying sizes and density. This was a result of natural and Aboriginal burning which had checked the spread of pine scrub. Grazing hooves affected soil and grasses so that deep-rooted grasses were replaced by shallow-rooted ones. This made more moisture available for the pine which regenerated at densities of millions to the hectare. Pine does not thin itself naturally (unlike red gum) so that 'locked' stands resulted which required thinning by ringbarking to ensure better pole growth and understorey grasses. Forest reserves were set aside to ensure timber supplies and those initially gazetted had good pine trees, not scrub. These trees would have been about 150 years old, that is they grew from seedlings before 1750. Rabbits and sheep slowed regeneration in the 1890s so that any remnant big trees today are survivors of the 1880s. After myxomatosis and poisoning with 1080 drastically reduced the rabbit populations in the 1950s, regeneration came more plentifully and the old trees (from the 1880s) were again cut out to allow the younger to develop better.

The detailed studies of all 14 forests have revealed similar broad patterns, but each has differing patterns of species survival and density so that generalisations are not appropriate even by forest type. As Mark Allen (pers. comm.) has concluded:

> ... the species are natural enough, but the evolution of today's forest is not. A cycle which may naturally take 300 years or more without major interference is being compressed into a third of that period, and at the same time, across almost the whole of the forests, one species has been deliberately promoted to the detriment of others.

The forest ecosystem is dynamic and increasingly a cultural construct. To opt for the preservation of forests from a specific date like 1750 does not give a true picture of processes operating in and on the forest. To reconstruct the pattern and composition of forests existing in 1750, Oliver Rackham suggested that areas less than one hectare should be studied so as to see the species evolution without the effects of timber stand improvement.

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Personal communications from Mark Allen, Elaine van Kempen and Oliver Rackham.

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East Otway odyssey of rugged field work

Norman Houghton

In these days of satellite-aided, pin point navigation, CAD drafting systems and a host of modern aids to forest survey, it is opportune to reflect that there is still scope for human input: good old-fashioned, sweat-stained bush bashing. The accounts of some of the early forest surveyors are hair raising and one can only admire their courage, persistence and professionalism. I do not claim to be an explorer, professional surveyor, forester or botanist, but in the course of researching a history of sawmilling in the East Otway Ranges in Victoria I found that I had to teach myself some of their skills. I ambitiously set myself the task of identifying, mapping and chronicling every sawmill in the East Otways from 1849 to 1980, about 100 in all. This was an essential part of preparing to write a (forthcoming) forest and industrial history of the region. This chapter describes how the sawmill sites and tram routes were mapped by a field survey which turned out to be an odyssey of rugged field work involving 600 hours of bush walking over 3½ years from 1993 to 1996.

The survey was necessary due to incomplete or non-existent documentary records and the fallibility of human memory. The official files of sawmills on State Forest sites rarely give a complete picture, are sometimes in error and generally make no mention of the log lines. The maps in the files comprise parish plans that are without contour lines and show the heads of the rivers and creeks as imaginary squiggles. Translating this data onto a modern contour map produces hopeless results and geographical absurdities. Mills on private property scarcely leave much of an historical trail and a municipal rate book entry may be all there is. In addition I had numerous contradictions to contend with after sifting through the oral evidence provided by timber industry informants. A field survey was the only verifiable check as well as being the means to note and describe the mill sites and tram routes and determine the logging areas. In addition the tram routes are significant, but unrecorded, engineering achievements which deserve description and analysis.

Locating the sites

The mill sites were found using aerial photographs of the 1940s, file notes and sketch plans, parish plans and oral evidence provided by local farmers and retired mill workers. The tram routes were found using the above sources and mostly by walking out from the mill sites, traversing across slopes, or walking along the river and creek valleys and checking every side gully. Some routes were found by chance while walking in and out of the bush. As the survey unfolded I detected the underlying signature of each tram builder and used this to plot search strategies. Sanderson's trams almost never rose off the valley floors; Henry's log trams usually went high and took off from the valley floor on the off side of subsidiary creeks/gullies in herring bone fashion; Hayden's trams were either very high or very low and rarely cut across the face of a slope; Grant's trams went high and had minimal earthworks; while Mackie's trams had the weirdest grades and were likely to be found anywhere—high, low and in between.

The survey data along the tram routes were procured by pedometer, altimeter and marine sighting compass. The sighting compass permitted a hands-free determination of bearings. A prismatic compass was also carried but was only used for the long straight-line hikes into and out of the valleys.

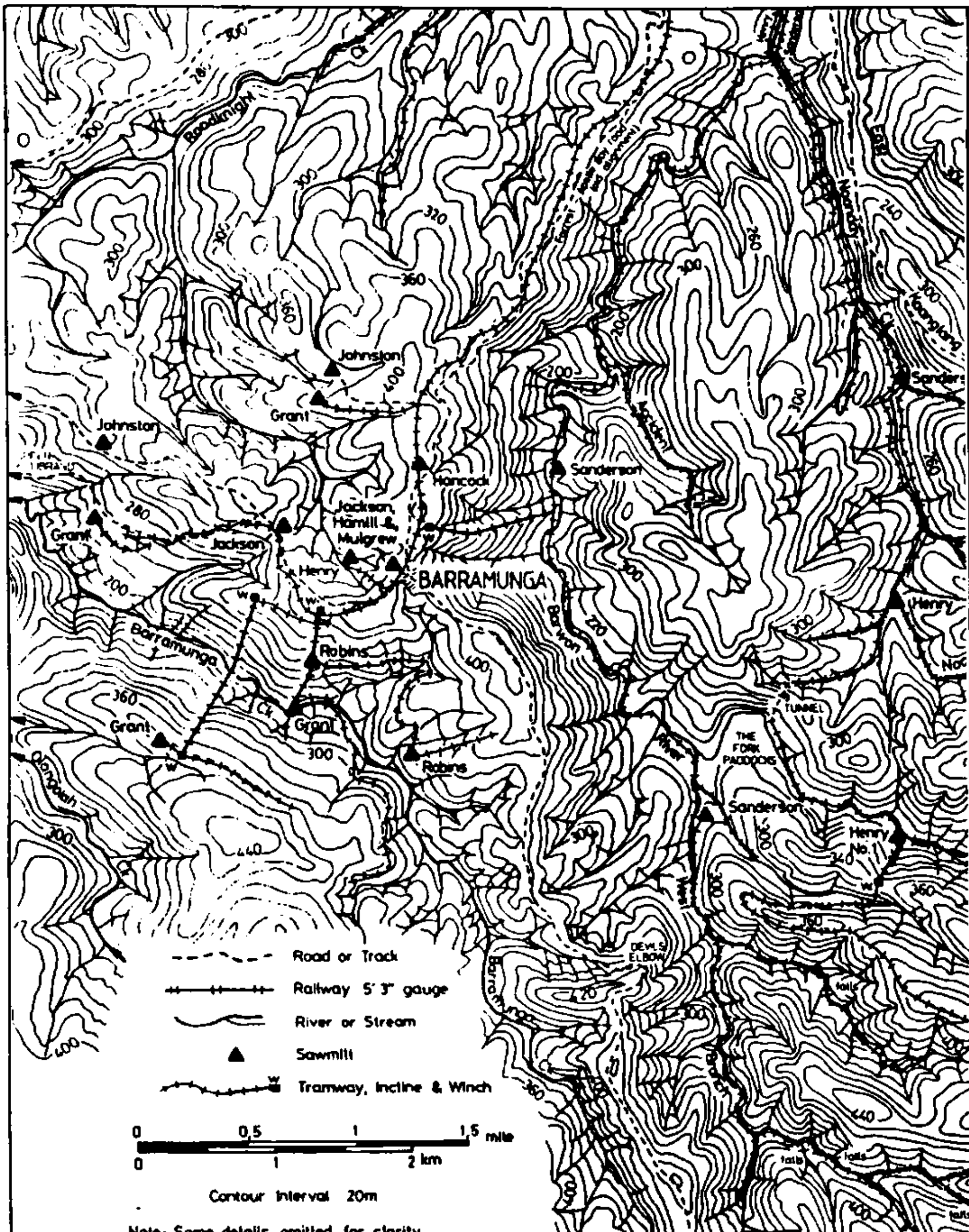
Details were plotted in pencil onto library catalogue cards which were just the right size to fit into pocket and palm. A base topographical map with all the main bearings pre-marked was carried. This map was a half A4 size photocopy coated with contact film to prevent disintegration in wet conditions. It rains two days out of every three in the Otways and in very wet weather it took about 1½ hours before the plot cards became so soggy that the pencil would not write on them; then it was time to head back.

After losing two pedometers I found I could do without by navigating with altimeter and plot cards. A filled plot card, both sides, equalled about 300 metres longitudinal distance and the altimeter told me how far up the slope or watercourse I was. Another dead reckoning device was listening for the sound of the watercourses. On a slope the sound persisted for one-quarter to one-third of the distance from the bottom. The angle of the slope and the type of vegetation were additional indicators of altitude.

Once I had located a tram route I followed it to the end, over and through dozens of fallen trees, patches of stinging nettles, wire grass, cut grass, dogwood and native mint, across foul dark gullies and slab-sided ravines either on bridge remains or on all fours, slipping down and crawling up through the black, stinking muck which invariably characterises these watercourses, and along river bottoms and boot-sinking mud flats, flicking off leeches and dodging snakes all the way. When the tram route vanished, it was a matter of scouting ahead in zig-zags or splashing along the river/creek beds until the formation reappeared. I did a lot of feeling with my feet sensing the level tramway underfoot in areas of dense ground cover. In really difficult areas I inched along the tram formation nudging the slightly indented uphill cut with one boot or the machete blade.

The tram routes ran up and down grades, through cuttings, around corners, into gully heads and doubled back until they suddenly stopped at a winch site, bridge site or landslide. I was not particularly concerned about getting lost as a result of what seemed like an aimless trek along earthworks as I usually knew in general terms where I was and had a general escape route pre-planned. If the tram route turned away from where I thought it would go and headed in the opposite direction I kept following it into the unknown and unplanned. I did not intend to come back a second time as it took so much effort to get anywhere at all.

When safely back home I translated the plot note details onto large sheets of paper and then superimposed this route onto the standard 1:25,000 scale Vic Maps for the area. Sometimes on the first trip into a strange locality I had very little idea of the permutations of the tram route so compiling the maps at home was a revelation. It was like driving a car forwards by looking backwards through the rear window. The Vic Maps are not ideal and are inferior to the old State Aerial Survey 1:31,680 series but the latter are scaled in imperial measurements and not useable. The Vic Maps tend to even out the contours on long facing slopes, do not take the gully and creek heads to their true sources, smooth out creek and river bends and show some logging roads in the incorrect positions.



Map 1. Sample of a completed map derived from the survey

Equipment

The surveying conditions can only be described as extreme. The mills and tram routes were built in unbelievably rough and wet terrain covered with thick bush. In order to get into and out of the bush without being torn to shreds by the vegetation, cracked on the skull by a falling branch or bitten by a snake, I developed a bush-bashing outfit to suit the conditions. It comprised a safety helmet, japara, welding gloves, overpants, heavy drill trousers, knee pads, two pairs of thick socks and a pair of gumboots fitted with climbing spurs. Accessories included a backpack with food, ground sheet, fire lighters, spare compass, dry shirt, and a camera. A whistle on a string hung around my neck. A webbing belt held a machete, waterbottle and umbrella, the latter to keep the rain off the plot cards.

Wear and tear on clothing and equipment was severe with a pair of trousers lasting about eight trips, and machetes, umbrellas and waterbottles frequently disappearing in heavy vegetation by being ripped away from the belt. I tried all sorts of trousers, even tear-proof ones, but none of them could withstand the pounding they received. The tear-proof trousers did not tear but they fretted and became thinner and thinner until a hole appeared. The japaras did not tear but the stitching around the hems and pockets gradually fretted away, the edges grew thin and the fabric split into shreds. The rubber boots got cut through by wire grass. Heavy leather boots may have gone the distance but a boot, sock and legging arrangement only catches leeches and does not offer much support or protection when kicking and smashing through obstacles. Not one piece of head gear, footwear, clothing or equipment—including a safety helmet, camera, altimeter, pedometer and climbing spurs—lasted the full survey. All were ripped, smashed, cut, torn, crushed, bent, ruined by water or lost and had to be replaced at least once; even the heavy leather gloves wore out or were sliced through by wire grass.

Operating procedure

My operating procedure was to drive into the bush on the main all-weather logging roads on top of the spurs and stop at a point or clearing where the vehicle could be easily seen. The stopping place was usually as close as I could get by road to the selected target for the day. Safety precautions involved leaving a marked map at home, parking the vehicle at an agreed spot, placing a marked map on the dashboard and advising my wife to ring for help if I had not reported back by a certain time. I did not go into the bush on days of strong winds or when lightning was visible. On occasions I drove to a proposed walking point but turned back immediately because of high winds. Lightning weather over the Otways is visible from Deans Marsh so if I saw the flashes by then I turned back. I came across the chilling results of lightning and fireball strikes on trees from time to time. These were powerful motivations to caution.

From the vehicle I headed into the bush on a straight line course, wherever practicable, over whatever frightful terrain was offering until meeting the tram. Straight line walking is the fastest means of travel provided one has sufficient leg strength and stamina. Coming out after a survey involved setting a compass bearing to the closest road or track and staggering up the slopes. I walked non-stop, never sitting down, and staying on my feet the whole time, mainly to outpace the leeches, to keep my perspiring body warm and to get as much done in the time limits I had set myself. I planned my walks to last four to five hours, which was enough physical punishment for anyone. A good average walking pace was 1.5 kilometres per hour but in the really tough sites, including climbing, the pace was 800 metres per hour. When my time was up I headed out. I walked by time, not distance, as the latter is an irrelevant measure in trackless bush.

I began my walks at dawn for several reasons. The mornings are cooler; if I found something of interest I could afford to dally over it and if I became disabled or was injured then rescuers would have some daylight left to initiate a search. On one occasion my planned exit route proved too tough due to horizontal scrub (progress was down to 100 metres per ten minutes) so I had to back-track and spent 9½ hours on my feet. If I had entered the bush later than I normally did then I would have been trapped by the coming nightfall and forced to spend the night in the bush.

Travail

The actual survey on the tram route was at a slow rate because of the obstacles and the pauses to take bearings and notes. A good day would result in about one kilometre of mapping, although some of the 'easier' sites resulted in three kilometres of mapping. Sometimes I thought I would never locate the site again when I broke off the plot as I was not exactly sure of where I was but I always managed to pick up where I left off. I would make a mental note of the type of vegetation and general lie of the land as I walked out because every main spur and side spur is different. Once at the top again I would mark a tree and begin my next walk from there.

I found it took almost the same time to go down a slope as up it. Going down was generally slow because of the need to pick a route and carefully watch where I was putting my feet in case I stepped into a hole or forked log and pitched forward, possibly breaking a leg. Sensing the true spine of a side spur on the downward leg was an art I never fully mastered. The true top wobbles all over the place and despite feeling with my feet, frequent stops and compass checks I occasionally walked off the top in the thick bush and ended up in a side gully awry of the main watercourse. This usually meant a hunched, hobble along an incredibly narrow, dark, foul smelling slot until coming to the targeted watercourse. Coming up the slope was only limited by my physical condition as picking a route was easy and since my eyes were closer to the ground than going downhill I did not need to concern myself with my feet. Climbing was just as much arm work as leg work from grabbing onto supports and leverage points.

The thick bush limited visibility to about 30 metres in any direction so it was always difficult to get a general sense of the terrain. I merely followed the compass bearings and kept my eyes glued to the ground looking for the tramway earthworks so I suppose visibility did not matter.

To descend the terrifyingly steep slopes near watercourses I lay on my stomach and slid down feet first, grabbing tufts of grass or ferns to steady myself. I did not use ropes or a pick and preferred hand holds and leg leverage. On one occasion I tried a rope and pick but found carrying them a nuisance and not worth the effort for the benefit.

For ascending slopes from the narrow gorges I walked upstream or downstream until coming to a reasonable bend where the inside slope is only 45 degrees. If saplings, ferns and grass were growing on the slope I judged it shallow enough to ascend; if nothing substantial was growing I did not attempt the slope and walked on to the next bend. The effort required to climb the slopes should not be underestimated.

To stagger and lurch up a 45 to 60 degree slope fully clothed, in heavy boots and with a pack, for up to fifty minutes pushing through thick vegetation, getting tangled in wiregrass, climbing over the smaller fallen trees, crawling under the larger ones, pushing through knee high ferns that refuse to part easily and grab one's legs and crunching through layers of bark fouling one's steps is no picnic.

The main after-effects were throbbing legs and a raised heart beat rate for twenty-four hours as well as leech bite itches for about three days. At the end of a year or so my legs ceased soreness after each walk but the raised heart beat remained. The leeches never gave up. To maintain fitness between walks I kept up a running programme two or three days per week. Despite this I came out of the bush after each walk completely exhausted, but my recovery rate became faster over time. I never quite reached the state where my legs refused to take another step but I got close a few times and occasionally, literally, fell out of the bush onto the logging tracks in an exhausted heap. I knew my limit was being reached when I had difficulty stepping over or brushing aside an obstacle just twenty centimetres off the ground. I did some gruelling crest-to-crest and return walks, emerging from the bush in a shuffling state of exhaustion on jellied legs. If I had any energy left on the way out I went looking for big trees or waterfalls or tried navigating by the sun and dead reckoning without using the compass.

I preferred walking in damp conditions as it aided body cooling and wet bush is not as sharp and crackly as dry bush. Not that I had much choice in the matter as the Otways are usually wet and much of my walking was in fog, mist and rain and occasional snow and hail. In the lower gullies every surface is wet and muddy all year round. I was soaking on the inside from perspiration and drenched on the outside from rain and damp vegetation so had to get used to walking in wet clothes for hours. I did not dare loosen or remove any of the protective clothing and found that continuous movement and exertion kept the damp clothing warm. I did not succumb to pneumonia, arthritis or dehydration so obviously I had the right approach.

Reflections

I found the bush to be a benign place as it protected me from the wind and sun and, if undisturbed by modern logging, held plenty of interest. I went into gullies and creeks where no-one has been for 60 years since the mills closed but I doubt if I went anywhere that someone has not been before. No matter where I set foot I found some evidence of human activity, even if only a piece of indeterminately shaped wood with the skeletal remains of a nail in it or a fragment of wire rope or a beer bottle or a snig track or a cut stump or ringbarked tree. I did not find any steam locos or log trucks still sitting on the rails, or mill huts intact nor anything else that popular myth says is resting in the bush. The sawmillers retrieved almost everything for re-use or sale as scrap. I found two boilers, three winches, a log on bogies and one intact tunnel and that is all.

Despite the general unpleasantness of the walking conditions, there were numerous magic moments; walking down the incline from Henry's No. 2 mill to the Barwon River along a narrow, razorback spur, clear of undergrowth and with views of the breathtaking slopes on either side; standing on the top of a spur in a howling rain storm watching the scudding clouds rush through the trees, which literally snatched the moisture from the clouds and caused great cascades of water to pour down the weather side of the trunks; trudging up the side of Mount Sabine, crunching through a carpet of hailstones, in clear weather until suddenly the sky turned black and whirling gusts of snowflakes blew in from the west; splashing up a watercourse and on rounding a bend finding a picturesque waterfall ahead; crawling into the tunnel along the Barwon River; navigating with pin point accuracy to Henry's No. 2 mill from the Benwerrin Road; being on a deeply entrenched tram route above a watercourse when the sun came out (not often); after hours of gut wrenching slog coming across a substantial relic such as a winch, log landing, bridge or perfectly preserved mill site earthworks.

In the end I got used to everything except the stomach churning sensation when first driving into the bush of wondering what foul surprises awaited me on that day's walk and whether any misfortune would befall me. Even the leeches became playthings. I overcame my fear of snakes; they could not harm me as I was completely wrapped up in protective gear. They left me alone and I merely stopped to observe them.

The walking was risky and dangerous. I had a few scares and close shaves including two free falls down steep slopes and a hit on the head by a small tree that toppled onto me. My clothing and helmet saved me from serious injury in all cases and not once was I disabled in any way, although I suffered bruising. I minimised the risks through thorough preparation of routes on paper, thinking about counter-measures, dressing appropriately, maintaining physical fitness and being extra cautious and careful in dubious situations. If necessary I turned back, tried another route or ducked for cover.

If I had objectively thought about the awful places I voluntarily walked into I should not have gone. If I had read any of the standard bush walking guides I would have stayed at home because I broke all the conventional rules. But in this case the rules did not apply. I created my own solutions to a special bush surveying project namely, walk alone, wrap up for protection, crash through on a straight line, keep moving, get in, get the job done, get out by the quickest route, walk to time not distance and, if in doubt or injured, walk uphill to safety. Walking alone initially was a necessity mainly because I could not find a fit companion prepared to accompany me week after week. I had a walking partner for several trips into the head of the West Barwon River to survey Henry's trams but that was all. Over time I found I preferred walking alone as I could set my own pace and make decisions that affected only myself. With few exceptions, at no time was I more than one hour of climbing from a logging track. If I had used conventional access i.e. walking down the logging tracks to the water courses and then proceeding along the valleys on the flat, I would have been hours and hours from help. If I had not taken to the side spurs I would have missed a number of tram routes as the junction points at river and creek level are not always detectable.

The wildest place of all is upper Mackie Creek beyond the Mackie No. 4 mill at the base of Mount Cowley, and this was the only area that frightened me to any extent. Every survey trip had a fright or two but upper Mackie Creek has a menacing atmosphere of wetness, gloom and unbelievably steep slopes and wiregrass that has to be experienced to comprehend its vicious, two metre high envelopment. The first trip so unnerved me that I stayed at creek level only long enough—twenty minutes—to locate the start of the incline to the Mackie No. 5 mill before bolting back up the slope to the Benwerrin Road. I 'hurried', if that is the word, up 1.2 kilometres of 1 in 4 slope in seventy minutes which was twenty minutes faster than I had gone down the slope! The next trip was tackled from Cowley Track and proved easier but the exit was punishing as I ran into a vast area of sapling and scrub regrowth and what should have been a fifty minute slog took ninety. The third trip was down cliff like slopes in incredibly wet undergrowth and I had a tree fall on me, apparently without ill effect at the time as I was wearing a safety helmet, but the headache arrived twenty-four hours later. The fourth trip to survey the eastern terminus of the main log line was undertaken with considerable trepidation but proved to be relatively uneventful apart from a whack in the face from a splintering, rotten branch. The exit involved a lineal climb of just 300 metres up an average 1:1.8 slope but it took forty minutes as I spent most of it inching up on my spreadeagled knees with my face buried in the dirt and my outstretched arms clutching at ground ferns to gain purchase.

Once I had safely negotiated upper Mackie Creek and all it had to throw at me, I felt I had truly conquered the East Otways. That was the last of the survey trips and I have not been back since. I had pushed my luck to the limit and the job was done.

Reference

Houghton, N. forthcoming. *Sawdust and Steam: a sawmilling history of the East Otway Ranges 1849-1980.*

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