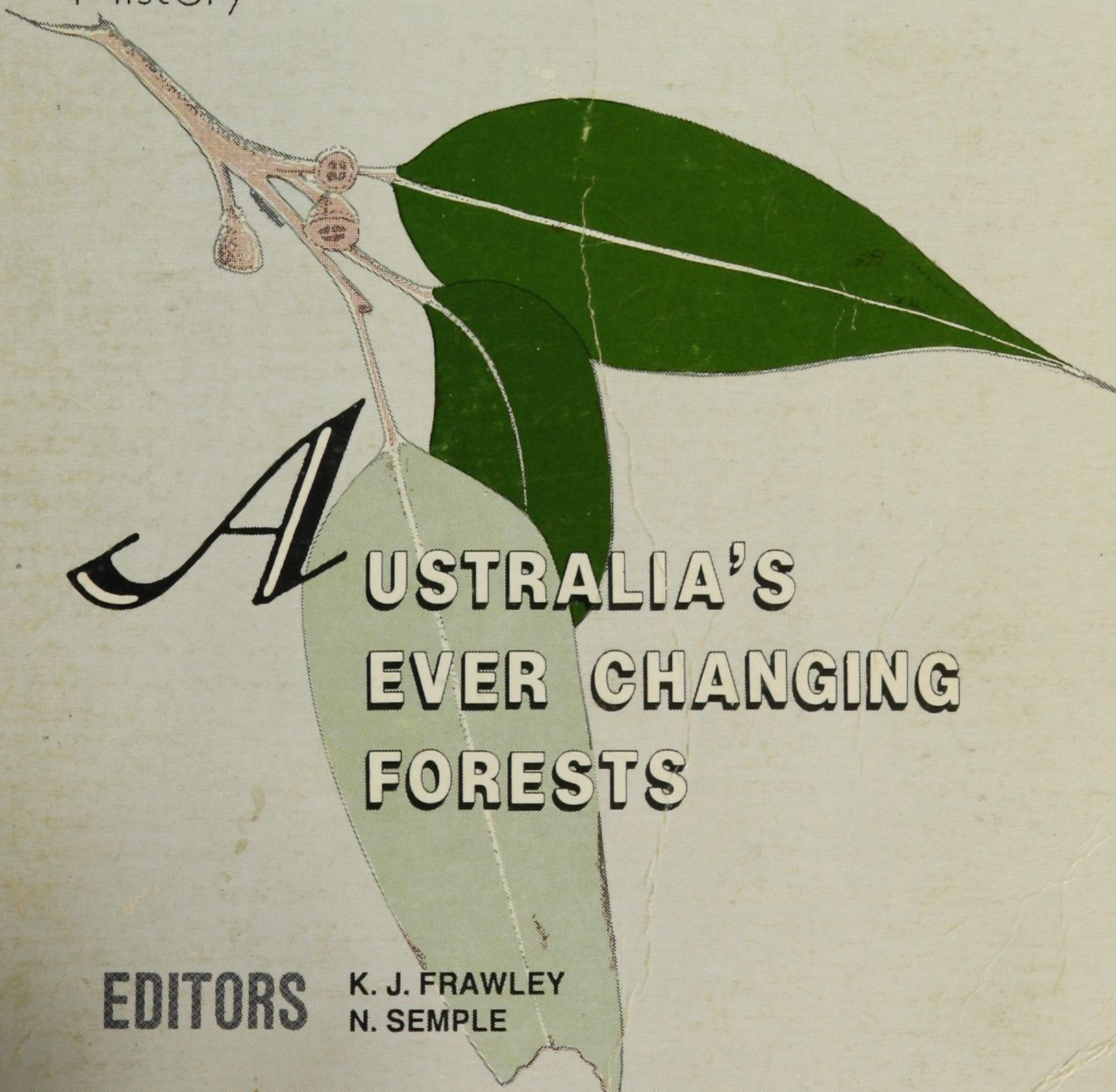
Proceedings of the First National Conference on Australian Forest History



AUSTRALIA'S EVER CHANGING FORESTS

EDITORS K. J. FRAWLEY
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Top left: Red cedar *(Toona australis),* Border Ranges, N S W
Top right: Eucalypt forest west from Mt Imlay, Eden, N S W
Bottom left: Rainforest remnant, Malanda, north Qld
Bottom right: Disused railway trestle bridge, Koetong, Vic. River red gum *(Eucalyptus camaldulensis)* timber

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edited by

Kevin J. Frawley and Noel M. Semple

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FOREWORD

There is currently a quickening interest in Australia's history - not only that of the brief period of European settlement, but also of the millenia of Aboriginal occupation, and the long geological past which provided the physical basis for the continent's unique flora and fauna. The unravelling of Australia's environmental history both before and after human settlement has taken an important place on the agenda of researchers in a range of disciplines and interests. In the wider community the wave of interest in Australian history was boosted by the bicentennial celebrations in 1988 which saw not only a flood of historical works, but also a heightened public debate about the nation's past including the effects on the environment of Aboriginal and European settlement. As part of this interest in Australian environmental history, it had been evident for some time that there was a scattered group of forest history researchers in Australia - in some instances, working close by but unaware of others with similar interests. What was now required was a means to unite this diverse group.

In this context, in 1987, a number of people with various interests in Australian forests and woodlands met at the Centre for Resource and Environmental Studies at the Australian National University to consider the formation of an Australian Forest History Society and sponsorship of an inaugural conference on Australian forest history in 1988. Following endorsement of the idea, a planning panel of John Dargavel (Centre for Resource and Environmental Studies), Kevin Frawley (Australian Defence Force Academy), and Charles Fahey (Department of Conservation, Forests and Lands, Victoria) took over the planning for the conference and associated field excursion in south-eastern Australia. The resultant conference was held at the Centre for Resource and Environmental Studies, 9 - 11 May 1988 with the field tour following.

This volume contains the papers presented at the conference with one additional review paper (Frawley: Conservation and National Parks). The proceedings testify to the broad range of interest in forest history in Australia - from biological scientists, anthropologists, geographers and foresters, but less so from historians (for national differences in this regard see Steen's paper). In structuring this first national conference on Australian forest history an expansive view was deliberately taken of the field and we hope that this volume encourages both other researchers and the maintenance of a broad multi-disciplinary interest. We support the conclusion of Hope and Kirkpatrick that there should be 'no trichotomy between paleoecology, ecology and post-settlement forest history when the results of past management or predictions for future forest change are being considered'.

A major goal of the conference was achieved in the resolution to form an Australian Forest History Society with the aim 'of advancing historical understanding of human interactions with Australian forest and woodland environments'. We hope that these proceedings provide inspiration for continuing and further research in this field, for there is much in this enquiry that is relevant to understanding not only the past but also today's conflicts and dilemmas in managing the remaining forests and woodlands.

CONTENTS

Public Forestry

Conservation and National Parks

Sources for Forest History

Forest History in North America

Appendix 1

Sub-tropical rainforest, northern N S W

ECOLOGICAL HISTORY

REVIEW PAPER :THE ECOLOGICAL HISTORY OF AUSTRALIAN FORESTS

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INTRODUCTION

The ecological possibilities or potentials of Australian vegetation have evolved under changing conditions and so reflect the vegetation history over all time scales. For large areas in the region we can postulate present-day controls but we have only a preliminary knowledge of distribution, very loosely correlated with general landscape, soils, climate and supposed disturbance regimes. There are, of course, much more detailed studies of selected forest communities which provide plenty of puzzles about the controls on individual tree species or species interactions. There are almost no long-term observations on actual community change or replacement. This, in part, arises from the massive ecological changes initiated by European settlement, which has changed the former Aboriginal controls irreversibly. The arrival of humans in Australia had already created new communities from species which evolved in pre-human times. It is thus necessary to garner clues from former distributions and unusual associations to provide a picture of the Australian regional forests. Our contention is that to understand the response of the ecology to short time historical processes such as felling, grazing by introduced animals, changed fire regimes and the spread of Phytophthora, we need to learn what responses were to past stresses and competition. This paper thus addresses the 'prehistory' of the Australian forests and reviews forest change on the evolutionary time scale at the level of the biome, on the adaptive time scale (the last 50 000 years or so) in terms of selected formations and alliances, and on the ecological or assortive time scale. The state of knowledge at each time scale is still deficient, so that the main effect is to throw up questions which can challenge present impressions of the direction, stability and resistance to change of individual forests. These impressions are very much influenced by ecological fashions derived elsewhere and by short-term observation; we know what forests should be doing but Australian forests often haven't read the same books as us. Their history can tell us what they have read (or more formally, what evolutional filters they have passed through).

There are massive gaps in knowledge that interfere with scientific and popular perceptions of Australian forests. Why do the intermediate stages of a plant succession grow to 100 m when the stable community is only 30 m high? Is the 25 m high single-stemmed forest of mallee species on Kangaroo Island an indication that mallee eucalypts evolved as normal trees? Why do some eucalypt species dominate forests over thousands of kilometres while many others are micro-endemic? Some of these questions are uniquely Australian. Their investigation is needed to improve the accuracy of our understanding of forest history at all time scales.

EVOLUTION OF AUSTRALIAN FOREST BIOMES

The details of the origins of the Australian flora have been reviewed recently by several authors and need only be briefly summarized (White, 1986; Barlow, 1981; 1986; Barker and Greenslade, 1982; Smith, 1982). The realization that Australia has been substantially isolated throughout the Tertiary and that it has experienced a dramatic climatic shift towards aridity, climatic variability and a wider range of temperatures led to a large number of papers exploring the implications for vegetation history (e.g. Beadle, 1981; Coleman, 1980; Hope, 1984; Johnson and Briggs, 1981; Kershaw, 1981; 1987; Specht, 1981; Steenis, 1979; Sluiter and Kershaw, 1982; Truswell and Harris, 1982).

Major influences on the Australian flora identified by these authors include its isolation when the Southern Ocean formed about 58 million years B.P. (Crook, 1981). We know more of the southern forests at this time than of those in northern Australia; a forest of mixed gymnosperms and hardwoods seems to have largely clothed Australia by the Eocene. This contained conifers, particularly podocarps, cypresses and araucarians, cycads such as Bowenia and families still prominent in the modern closed forest floras, such as Lauraceae, Cunoniaceae, Monimiaceae, Elaeocarpaceae, Myrtaceae, Sterculiaceae, Sapindaceae, Rutaceae and Proteaceae (Smith, 1982). Nothofagus 'brassii' was a prominent upland element from Eocene times. The forests were of tropical character in northern N.S.W. and central Australia (Truswell and Harris, 1982) and seem to have most resembled montane closed forests of New Guinea and Indonesia.

These 'Cinnamomum' forests are sometimes called 'Gondwanic', despite close taxonomic affinities at family level with tropical floras in the New and Old Worlds. It may well be that the Malesian and South American tropical forests should also be regarded as containing a large Gondwanic element which developed in the Cretaceous and was rafted to Laurasia by India and later South America. Many floristic similarities between Queensland forests and those of Malaysia (e.g. Eugenia/Syzygium, Elaeocarpus, Cinnamomum, Celtis, Macaranga, palms, Ilex, Citrus etc.) may represent sundered floras rather than later dispersal and invasion (e.g. Dransfield, 1981). This will probably remain controversial. Major elements not shared in the early Tertiary with Laurasia are some genera of southern gymnosperms, Casuarina (Gymnostoma), Nothofagus, Proteaceae, Eucryphiaceae and Pittosporaceae.

The vegetation reconstructions hint at widespread, relatively aseasonal, cloudy, wet conditions leading to mesophyll-microphyll (10-2 cm length) leaves and a rich variety of tree species of moderate stature (10-35 m). Clouds and drizzle lead to low evaporation and equable temperatures, and may have dampened seasonality. There was some differentiation of forest types into groups of thermal tolerance, ranging from <12°C in the south to >24°C in the north, as judged by Nix (1982) from leaf size and floristics.

The mechanism maintaining high rainfall, even in central Australia in the Palaeocene, is thought to be a generally higher sea-surface temperature and oceans that were warm from top to bottom. This would have resulted in a gradual thermal gradient south to Antarctica, rather than the steep thermal gradients found today. The southerly position generated westerly circulation and ocean evaporation fed the clouds and rain systems which crossed Australia. Recent climatic models suggest possible winter snow across the southern part of the continent, although other models suppose average temperatures slightly warmer, or 6-8°C warmer, than at present.

From the Eocene onwards, two influences on the climate became opposed. Since that time the drift of the Australian continent northwards into lower latitudes has brought greater radiation and warmth and subtropical high-pressure aridity. Meanwhile an ice cap had grown on Antarctica and this reached sea level by Miocene times. The consequent chilling of the oceans was gradual, but by the late Pliocene all deep ocean water had cooled to a few degrees and, outside the tropics, much colder surface waters then appeared as a result of this, with a severe temperature gradient around 45-55°C. Truswell and Harris (1982) identify several reversals in the general trend, with cooler, drier phases alternating with wetter ones from Oligocene times to the Pliocene. Nix (1982) considers that the three major thermal regimes were preserved through this time, with a substantial expansion of tropical macrotherm climates and cool microtherm climates at the expense of mesotherm. Although the two influences on mean temperature thus more or less balanced out, climatic change has been virtually continuous throughout the island history of Australia. The detailed history of Tertiary environmental change is still poorly known. It is clear from faunal evolution (Hope, 1982; Archer and Clayton, 1984) that the complex rainforests of the Miocene became broken up and changed through the Pliocene, and finally were disrupted and more or less relictual through the last million years or so of the Pleistocene.

The response of an isolated biota to environmental change is to evolve towards the new conditions. With continued environmental variability, there is selection for genotypic and phenotypic plasticity. Although long-term changes to extremes of cold, aridity and low rainfall reliability are of very great temporal magnitude, the flora has also adapted to increasingly rapid, cyclic climatic change as glacial-interglacial interchanges became increasingly established through the Pleistocene.

On the evolutional time scale the flora provides evidence of species radiation similar to that which characterizes most old oceanic islands. The taxa in Australia are classified by the distance that they have travelled from their ancestral forms. Almost all large families are botanically divided into two (or more) major groups. One group is well adapted to sclerophylly, often with leathery and reduced leaves, dry fruits, and various fire, drought or low-nutrient-adaptive features. The other group has soft leaves, fleshy fruits and an intolerance of fire. In some cases, the latter group includes more genera with tree species, while the former has many shrub and even herbaceous species. The major examples are: the division of the Myrtaceae into Leptospermoideae (Eucalyptus, Leptospermum, Melaleuca) and Myrtoideae (Eugenia, Syzygium etc.), the Rutaceae into xerophytic Rutoideae with three other subfamilies (Aurantioideae, Flindersioideae and Toddalioideae) (Morley and Toelken, 1983; Johnson and Briggs, 1981); and the Cupressaceae into Callitroideae and Cupressoideae. The more xerophytic groups (and genera) tend to be Australian endemics, while the genera in the moisture-adapted groups show the relationships to other moist areas in South America and Asia. They also quite clearly demonstrate a very old history in New Zealand, Australia, and have been regarded for this reason as Gondwanic, together with groups that have evolved no sclerophyllous representatives (e.g. Fagaceae, Elaeocarpaceae.

Work by Hill (summarized by Hill and Gibson, 1986) on plant macrofossils has been interpreted to demonstrate the gradual evolution of new species of Nothofagus, apparently due to the advent of colder conditions in Tasmania. The modern beech species N. cunninghamii is thus thought to be derived from an ancestral taxon apparently similar to N. moorei. However this example should make us extremely wary of labelling any existing species as 'Gondwanic', and no extant community can be regarded as reflecting conditions as they were in the early Palaeocene more than 50 million years B.P.

THE APPEARANCE OF AUSTRALIAN COMMUNITIES

It is questionable whether any major new tree species has evolved within the last 50 000 years or so in Australia. While many genera of sclerophyllous trees are clearly actively speciating (most spectacularly Eucalyptus and Acacia), microendemics are the major product; an unknown proportion of these will probably be quite old, and a few relictual. The appearance of 'modern' species and their contribution to 'modern' communities is very poorly known at present. Some species undoubtedly stretch back to at least the Miocene, but any estimate of when modern communities might have appeared really depends on evidence for 'modern' conditions.

It is possible to estimate that the biogeographic provinces of Australia were in place by the mid-Pleistocene, and that their boundaries have fluctuated in response to cycles in temperature and aridity since then. The two eastern provinces, Bassiana and Torresia, retain some biomes that resemble the late Tertiary forests, specifically the low-altitude and montane closed forests. All provinces have forest or woodland communities for which there is no fossil evidence, such as those dominated by Eucalyptus, Casuarina (sensu latu), deciduous vine forest and Acacia woodlands. All these are extremely diverse, with a curious mixture of widespread, relatively homogenous forest formations or alliances, often mixed with highly variable, disjunct or restricted forest types. Very pronounced disjunctions occur in various closed forest types and the wet Eucalyptus forests of Bassiana. The timing of the appearance of these disjunctions is not known in most cases; earlier speculation attempted to assign late Pleistocene or Holocene ages to most distributions, but this is now known to be wrong. For example the temperate closed forest disjunctions along the east coast and into Tasmania show no evidence of having changed substantially in the Holocene, and may reflect warmer and wetter interglacials more than 0.5 million years B.P. On the other hand, clear evidence for Nothofagus forest growing near Mt Kosciusko and presumably having good connections south, possibly across western Bass Strait, are established from macrofossils and pollen analysis at c. 35 000 years B.P.

At present, rather detailed information is available on ocean changes from the Pliocene to the present (Shackleton and Opdyke, 1973) and a reasonable knowledge of faunal changes make up for a relatively poor pollen record. Some evidence for cooler winters and the development of the alpine flora is known from the Pliocene, and the development of open-country browsers and grazers is apparent in fossil sites in central Australia from the Pliocene into the early Pleistocene (Archer and Clayton, 1984). Hitherto continuous sedimentary records, such as in the Latrobe Valley, Victoria, or from Lake George, N.S.W. (Kershaw et al., 1986) are afflicted by periods of oxidation and soil formation, which only end in the mid or late Pleistocene within the modern period of magnetic polarity, the Brunhes, which commenced c. 700 000.

The combined evidence implies a gradual strengthening of the glacial-interglacial cycles approximately every 100 million years with major ice-cap fluctuations affecting sea level indicating the final chilling of the deep oceans at 2.4 million years B.P. Although an open and probably semi-arid core developed in the Pleistocene, the periphery of the great sand dune swirl of central Australia was still actively expanding after 700 000 B.P., and may be still temporarily activated during the most arid times of glaciations. These seem to be those times of sea-level rise when warming land temperatures contrast with still-cold oceans to give great aridity.

Thus we can identify cyclic Pleistocene events in which cooling leads to increased effective moisture, despite some fall-off in total precipitation. Wet forest elements expand, particularly montane species such as tree ferns, beech and araucarians. Eventually, with low sea levels and sea-surface temperatures, cold conditions occur with widespread tree exclusion, and the development of grassland and open steppe. In many areas salinity is pronounced. Conditions become still more open as the effective moisture declines. Glaciation is replaced by periglaciation and aeolian landforms become common, possibly in response to drought. Inland areas then remain arid but receive more rain as the sea-surface temperature rises at the start of the Holocene. As the sea rises, the moister zone close to the coast migrates inland and sites there record very wet conditions from 8 000-4 000 B.P., followed by a slight reversion to drier conditions.

In this climatic change scenario it is important to note that the major climatic controls of temperature and water availability change in character, as well as absolutely, at any locality. Changes in precipitation and evaporation will affect growing season and the relative importance of topography. Thermal seasonality changes in line with orbital changes (Newell and Chiu, 1981) again impinging on seasonal growth and drought. Wind may have been an important control in southern Australia, where heaths were relatively widespread at times in glacial cycles (Chappell and Grindrod, 1983). Finally the reliability of rainfall and growing season temperatures is unknown, but may have fluctuated more widely than present. In summary, the present climates of the Holocene may be comparable to those of some previous interglacials, but the pleniglacial and interstadial climates, representing 90% of the time of the past two million years, were different, and may have no direct analogues in the present.

Two other considerations hinder the use of Pleistocene vegetation histories to tell us what conditions Australian forests are evolved to exploit or endure. Although pollen analyses stretching back beyond the last interglacial are very rare, it is possible to speculate that the record of the last pleniglacial (c. 25 000-10 000 B.P.) indicates a much greater reduction in forest cover than ever before, and significant animal and plant extinctions. Since ice extent in S-E. Australia and globally was not remarkably different to that experienced previously, other causes than degree of glaciation may need to be postulated.

The second consideration is the possibility that fire became more common after the arrival of humans, perhaps 50 000 years ago. Like climate, this possibility is very hard to assess because we can only guess what a truly 'natural' fire regime might have been like, and then balance against it regimes that may have consisted of more frequent but lower intensity fires, possibly deliberately lit in low fire-risk periods.

At the height of the last glacial, trees were excluded from about 85% of the Australian continent cold and aridity (Fig. 1). The altitudinal treeline was not only depressed compared to today, but had disintegrated in Bassiana, with open woodlands down to sea level. The great riparian red gum forests had abandoned the southern inland streams, due to frost and salinization; even the river Casuarina must have been absent from the uplands. In the eastern scarp and S.W. Australia, orographic rainfall maintained the closed and eucalypt forests in coastal enclaves, while in northern Australia the deciduous vine forests retreated to topographic refuges, and araucarian rainforest was pushed to near extinction. The localized ranges of some eucalypts along the coast and ranges may be explained as an effect of periodic isolation and migration. The disjunctions across Bass Strait, in the blue gum and ash groups as well as closed forest, indicate that cool periods allowed widespread, long-lived eucalypt forest to form connections which have since perished. The most recent time for these connections was possibly 50 000-35 000 B.P. when beech and eucalyptus forest were expanding in Tasmania (Colhoun et al., 1982) and at Lake George (Singh and Geissler, 1985) compared to the present. Disjunct occurrences of mallee at Gisborne and Eucalyptus alba and Callitris columellaris open forest at Tingaringy reflect former extensions of dry vegetation, preserved by poor soils or rainshadows. The most recent dry period [indicated by the western false mouse, Pseudomys orientalis,

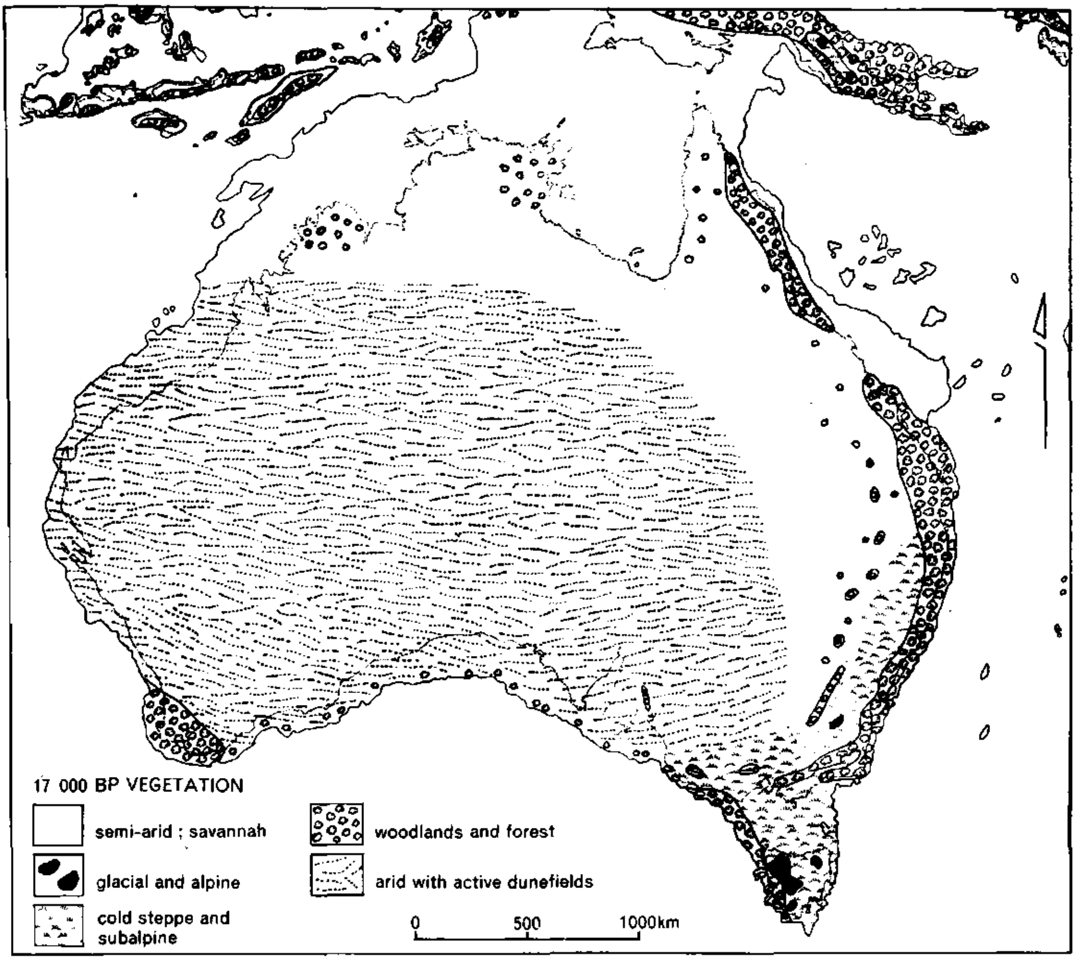

Fig.1 *Possible limits of Australian forest and woodland at the time of their greatest contraction about 17 000 years B.P.*

at Buchan (Hope, 1983)] when these range extensions might have been in place was 18 000-11 000 B.P. This is supported by an intrusion by dry fauna into south-western Victoria from 25 000-12 000 BP and by dates on dune activation in the mallee. However the disjunctions may be of much greater age.

The bulk of forests and woodlands have moved onto new ground and changed in composition over the last 10 000 years. The invasion of upland areas left relictual stands of snow gums in many low-altitude valleys; taxa which enjoy change seem to have thrived. A much more massive invasion of the semi-arid area by mallee, Callitris and various remarkable Acacia and Casuarina woodlands took place. Relictual stands of these forests can be found scattered in areas of eucalypt forest, perhaps representing the pre-Holocene range. Unlike some tropical and temperate eucalypt forests, which betray recent or continuing community formation, the semi-arid woodlands of Australia are remarkably homogenous and cover huge ranges. The box communities of the lower hillslopes, (E. melliodora - E. polyanthemos woodland) extend from the subtropics to Victoria. These woodlands now occupy areas which were above the Pleistocene tree line and so have migrated upwards and possibly inland as well, but their homogeneity perhaps reflects a maintained home range that did not alter much and in which gene flow was possible. Interestingly these box woodlands include microendemics in the grassland flora, such as Swainsona recta. These generally seasonal herbs are probably relictual from cold-adapted steppe grasslands, and survive only because the present woodland is so open.

In the tropics there is a recovery by closed forest and vine thicket when warmer oceans and wetter conditions prevail (Kershaw, 1985; Russell-Smith and Dunlop, 1983). The Holocene sees an expansion of closed forest of vagile (often bird dispersed) taxa onto floodplains and coastal sandsheets, and presumably the vine thickets spread out from refugia. There is some suggestion of larger trees and a greater variety of trees 7 000-4 000 years ago than at present, possibly suggesting still wetter conditions than present. It is certain that many patches of forest have declined fairly recently. These findings contradict the assumption that moist forests today are relatively restricted compared to those of glacial times. In fact, interglacials seem to have been the times of greatest expansion of lowland tropical forests, although that process is currently in reverse potential, being prevented by disturbance.

A vegetation history from Kangaroo Island (Clark, 1983) shows that the box woodlands of nearby Fleurieu Peninsula are an artefact, presumably of fire, because they are not so dense or tall as the forest on the uninhabited island, which had experienced wildfire every few centuries for a long time. This reminds us that continued disturbance and discouragement of long-lived taxa will allow elements of Pleistocene communities, such as tussock grassland or Acacia scrubs, to expand at the expense of forest. Thus grazing land and some overburnt areas are effectively being turned into an analogue of the open pleniglacial.

An important research area is the comparison of the penultimate glacial with that around 20 000 B.P. and of the last interglacial with the Holocene. Some preliminary evidence suggests that the last (or previous) interglacials saw much more widespread forests of non-eucalypts in almost all climatic regions. In the north this would have included the elements of bottle scrub, grading gradually to the south through taxa such as Geijera and Flindersia to Casuarina, Callitris and Pittosporum low forests in the more inland areas. In montane areas many species with good shade tolerance and stability may have competed. Candidates include gymnosperms, such as Araucaria and Phyllocladus, and species with wide tolerances such as Acacia melanoxylon.

In the glacial periods, similar plants which may have contributed to the vegetated landscape include Hymenanthera dentata, Astelia alpina, Casuarina nana, and Banksia marginata. Thus it is now possible to assemble at least the potential contributors to pre-human biomes, based on ecological plasticity and indications in the pollen record. However confirmation must await accurate macrofossil determinations. At present there is little to support the contention that eucalypt forests represent largely disclimax vegetation except the existence of many candidate species that could contribute to more stable biomes.

SHORT-TERM COMMUNITY DYNAMICS

Stability is a scale-related and time-related phenomenon that may be highly dependent on the absence or repeated occurrence of particular environmental perturbation patterns. The consistent occurrence of any particular forest species in both time and space depends on the satisfaction of the following set of conditions:

a) the existence of sufficient moisture, light and nutrients to allow establishment and growth to reproductive maturity;

b) the absence of lethal disturbances between establishment and reproductive maturity;

c) the opportunity for disseminules of the species to gain access to sites suitable for their establishment and survival.

The first condition describes an area within which the species must be confined. The disturbances of fire, frost, flood, famine and fatal competition/predation usually restrict the potential range, leaving unassailable gaps which are complemented by spaces disjunct from the origin of the taxon.

Forest species differ in their physical regeneration niches (e.g. Rogers and Westman, 1979), their ability to resist or encourage disturbance events (White, 1979), and their ability to disseminate their propagules (van der Pige, 1972). Some forms of disturbance may interact with species attributes in such a manner that there is a permanent or semi-permanent switch in species composition or dominance despite a continuity in the non-biologically dependent characteristics of the environment (Noble and Slatyer, 1980). Such disturbances can cause sharp boundaries within continuously varying forest, or between forest and non-forest communities. Other sharp boundaries often relate to abrupt changes in physical conditions, such as those associated with geological boundaries or sharp ridges. The latter type of sharp boundary tends to persist through time and environmental change while the former type is more probabilistic in its occurrence in time and space (Jackson, 1968).

The forest species that are most responsive to a purely physical environment are those that avoid competition with other species by either tolerating extreme physical conditions, like rock faces, or by occupying sites from which competition has been removed by a major disturbance. Such non-competitive species are usually extremely vagile if they occupy highly dispersed extreme environments such as cliffs. In the case of randomly occurring disturbances vagility is one possible characteristic. Species may also survive in the seed phase awaiting disturbance, or have characteristics that promote sufficient disturbance to ensure their perpetuation over their range. The longevity of some disturbance-dependents ensures their perpetuation in a low disturbance environment (Cullen, 1987).

Stress endurance in forest species is highly variable in type. Thus, Athrotaxis cupressoides will endure extremely low temperatures (Sakai et al., 1981), but is easily killed by fire (Kirkpatrick and Dickinson, 1984), while Eucalyptus globulus is easily killed by frost but readily endures most fire regimes (Kirkpatrick, 1975). There seem to be particular complexes of stress resistance. For example, shade and drought tolerance are often linked, and species that have a resilient response to fire also tend to be resilient to defoliation by other means. Species that are capable of surviving severe moisture stress or heavily shaded conditions rarely recover from defoliating disturbances at the level of the individual, although drought-resistant species are often resilient to such disturbances as populations.

Species that promote stresses tend to be those that best weather the stress they encourage. Casuarina stricta is highly drought-resistant and, if allowed to increase its biomass on sites in which it is mixed with eucalypts, will successfully compete for limited moisture (Withers and Ashton, 1977). Eucalypts are generally both highly flammable and highly fire-resistant (Dickinson and Kirkpatrick, 1985). Species that form closed canopies are often those that can germinate and establish in low light conditions (Howard, 1981; Read, 1985).

While colonizing species tend to be the most easily dispersed, many tree species characteristic of relatively stable forests are also highly vagile. For example, the rainforest flora of the relatively new coastal plain environment in the Northern Territory consists largely of such species, while the sandstone massifs each have their own distinctive flora containing many species with negligible dispersal ability (Russell-Smith and Dunlop, 1987).

In the southern part of Australia most tree species have wide ecological ranges or are buffered against environmental change within large genetic pools. Most of the species of the southern closed forest can be found as either trees or shrubs, and many extend to the alpine or treeless subalpine zones (Kirkpatrick, 1983). The widespread eucalypt subgenera have few internal absolute breeding barriers between species (Pryor, 1976) and genetic variation within species is normally considerable (e.g. Potts and Jackson, 1986). High genetic variability and high levels of density-dependent selection create species closely adapted to prevailing conditions (Barber, 1965). In northern Australia the eucalypts appear more genetically uniform within species and many exhibit effective vegetative propagation mechanisms (Lacey and Whelan, 1976), as well as a lesser tendency to promote fire, possibly because of its ubiquity (Bowman and Dunlop, 1986). Rainforest species are also usually confined to rainforest, although some broad-leaved trees are widespread within the grassy forest ecosystems (Taylor and Dunlop, 1986; Kirkpatrick et al., 1987). These latter trees rarely penetrate the rainforest, which has sharp boundaries with adjacent vegetation in most, but not all, situations (Tracey, 1982).

At the mature tree scale all Australian forests are changing over a time scale of decades to millenia, as, in mixed species forests, the same species is unlikely to occupy all the same sites in succeeding generations. Indeed, there is likely to be temporal complementarity between taxa, as each species has peculiar effects on the soil (Attiwell and Leeper, 1987) or topography (e.g. Thom et al., 1975) which present the inheritors of its sites with a different legacy than their predecessor. Some trees even reject their young as potential benefactors (Webb et al., 1967). At the forest scale there may be constancy of over-all composition, with deaths of individuals of any one species being compensated for by growth and establishment of other individuals. Most rainforest is thought to fit this mode, as does much forest dominated by dry-country taxa, such as Callitris. At the regional scale stability may result from a constant proportionality of areas covered by patch disturbances which are random in incidence (Henderson and Wilkins, 1975).

Despite some evidence of constancy of composition at the forest scale (e.g. Read and Hill, 1986; Cullen, 1987), there are strong indications that most Australian forests are unstable in their composition and dominance. The classical case is the maze of successional pathways through which forests potentially dominated by Eucalyptus regnans can progress or retrogress (Ashton, 1981a; 1981b), but examples can be cited from rainforest (e.g. Enright, 1982; Cullen and Kirkpatrick, 1988) as well as dry country communities (Withers and Ashton, 1977).

Thus, for each set of site conditions there is a range of possible forest types, depending on disturbance regime and temporal position within the regime. Not all possibilities are necessarily manifest, and not all changes following disturbance are unidirectional. Cyclic succession can take place at all scales, whether or not it is reinforced by exogenously or endogenously induced disturbance (e.g. Webb, 1958). However most of the change in Australian forests appears to be directional between disturbances, and does not usually involve relay floristics. Rather, after a brief appearance of disturbance annuals, the forest changes in the proportion of total biomass constituted by each of these species (Purdie and Slatyer, 1976; Purdie, 1977a; 1977b; Dickinson and Kirkpatrick, 1987). The most variable aspect of any forest tends to be its understorey. Understorey species often have shorter life spans than the dominants, occupy an environment the physical parameters of which are heavily influenced by the taller strata, and are often more exposed to disturbance than the dominants. Thus individual eucalypts will often persist while their understorey varies from grass to shrub to tree dominance and back again under the influence of fire and grazing regimes (Harrington et al., 1984). Nevertheless there are some situations in which the apparent dominants fall victim to the environmental modifications of the understorey species. The lethal effect of rainforest understories on high altitude Eucalyptus delegatensis provides one example (Ellis, 1985) while in drier areas understorey tree species survive droughts that kill eucalypts only where the understorey species have considerable biomass (Kirkpatrick and Marks, 1983).

Despite the prevailing dynamism of Australian forests at the tree, forest and regional scale, most forest species are highly resistant and resilient in response to disturbance or gradual environmental change. Many rainforest tree species will resprout or regenerate from seedlings after fire, and it may take many fires in a short time-span to completely exhaust their regenerative capacity. The dramatic changes in fire regimes documented for the subalpine forests of New South Wales have failed to seriously challenge the dominance of E. pauciflora (Adamson and Fox, 1982).

The longevity of most tree species is such that any long term environmental change may not be reflected in a change in forest type for centuries. The increase of predation of juvenile eucalypts that followed pastoral settlement of Australia is only now being reflected in the disappearance of native tree species from the landscape, and the Eucalyptus camaldulensis forest of the Murray River basin have yet to start to die out in response to the elimination of regenerating floods. Trees species are seldom more vulnerable than in their seedling stage, and it is the absence of suitable conditions at this stage that controls the incidence of species changes or forest elimination.

In some cases the time scale of forest successional processes may be such that there is little opportunity for them to run to completion within a period of constant environmental conditions. For example, Athrotaxis cupressoides and A. selaginoides can dominate a stage in the transition from bare ground to rainforest dominated by other taxa (Cullen, 1987; Cullen and Kirkpatrick, 1988), yet these species have a lifespan of millenia (Ogden, 1978). The interglacials of the Quaternary have consisted of only ten millenia each, and have been far from constant in their climates. The period required for soils to equilibrate with climate can also be measured in millenia, and many tree species appear to be sensitive to soil nutrient conditions (Gill, 1981). Dramatic changes in climate may create an invasionary dynamism. In the cases of tree species with relatively poor dispersal mechanisms, the process of invasion following the Pleistocene/Holocene climatic change may still be continuing (Kirkpatrick and Brown, 1984).

CONCLUSIONS

It will be obvious from this review that the history of Australian forests derived from ecological assessment and fossil analysis is still fragmentary. A general picture of forest change is known, against which individual stands may be assessed in terms of the following questions:

For what time scale might the stand have occupied the site?

Is it likely that the stand is stable under present conditions?

Is the present niche marginal or central for the stand association?

Has the stand community had a likely continuity through a great deal of time or is the community 'new'.

How long have disjunctions of taxa or the stand community existed?

Are there any components of the stand community that are unexpected or missing by reference to historical records?

These questions depend on the development of further answers to some more general research questions on the history of Australia's forests, which will require a combination of fossil, ecological and historical studies such as:

the nature of the communities which are ancestral to those of the present, and the conditions which produced change;

the effects of the arrival of humans and subsequent changes in settlement patterns on forest structure and floristics;

Have some communities repeatedly formed and been disintegrated by Pleistocene change? Have some been more or less stable? Are some quite novel?

What role have refuges played in preserving species and communities?

It is unlikely that better than speculative answers will be available for most of these questions, but their framing helps in the assessment of the effects of management options. Communities with rich and specialized component taxa, showing a high degree of similarity in stand composition and for which the fossil record indicates a high degree of stability through time and locality, may be relatively sensitive to disturbance and invasion, since the mechanisms to resist this will not have developed. 'New' communities may be intrinsically unstable in that the component taxa have not adapted to optimum performance and replacement strategies. In a third category are those communities which have apparently formed recently but which can be shown historically to have existed at periods in the past when conditions favoured the association of particular groups of taxa. These communities represent a different type of stability, in that the individual species are likely to be tolerant of a wide range of conditions, since they persist as components of more than one type of community. A well-known example is Eucalyptus pauciflora, which today forms low forests but appears in the Pleistocene to have been a relatively rare savannah tree in a widespread daisy and grass dominated steppe.

The major conclusion from our present state of knowledge is that Australia exemplifies a range of responses to environmental change that are different from those of the temperate Northern Hemisphere. In general, climatic change has not been so severe as to completely extinguish forest biomes. In the southern highlands, the communities and their component taxa have been selected for vagility by change severe enough to cause regional biome change and re-migration. To the north and inland, this effect was less severe and forests are instead more likely to show wide environmental tolerance, reflected as variation in species densities rather than major floristic breaks. Adaptation to climatic change and the great variability of the 'average' precipitation probably pre-adapted forests to withstand fire. Nevertheless, the advent of human-controlled fire seems to have shifted the structure of Australian forests towards more shrubby or short-lived taxa, and a relative decline in the non-sclerophyll components. We may thank this pre-selection for the relatively low level of plant species extinction in the late Pleistocene, and the preservation of regional variety in large genera. Australia is, at the continental scale, a rather marginal place for trees to grow. Thus the rich tree flora and bewildering variety of individual tree associations probably reflects a fair length of stability, or at least gradual change from an area favouring dense forest. We can contrast Australia with Canada, where a handful of tree species occupy a vast area of equivalently marginal tree habitat. Canada has experienced a scale of instability and continental area extinction and remigration that is missing from Australia. The genetic resource preserved in Australia gives us great potential for matching species to locality, if we can refrain from destroying the resource in favour of a few clonal taxa.

In addition to continued fossil work and ecological stand studies, the measurement of genetic variability and ecophysiological variability of taxa will add a new dimension to the assessment of forest histories. Fossil studies require much more detailed records of ecological change and these will come from refinements in pollen analysis, the development of other microfossil records, such as phytoliths, carbonized particles and diatoms. However work on macrofossil data and information on palaeoclimates must become more detailed. The shorter time scales require more attention to stand dynamics, utilizing tree rings where possible. All this work interacts with continuing taxonomic and distributional studies. In many ways, the collection of genetic, dendrochronological and ecological information from remaining 'natural' stands is the highest priority, given the rapidity with which forest is disappearing in Australia. Maybe these studies would be enhanced by detailed records of forest change in the historical period of European settlement. There should be no trichotomy between palaeoecology, ecology and post-settlement forest history when the results of past management or predictions for future forest change are being considered.

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REFERENCES

Adamson, D.A. and Fox, M.D., 1982 Change in Australasian vegetation since European settlement, in J.M.B. Smith (ed.) Australian Vegetation (Cambridge University Press, Melbourne): 152-76.

Archer, M. and Clayton, G., 1984 Vertebrate Zoogeography & Evolution in Australasia (Hesperian Press, Carlisle).

Ashton, D.H., 1981a Tall Open-Forests, in Groves, R.H. (ed.) Australian Vegetation (Cambridge University Press, Melbourne): 121-51.

Ashton, D.H., 1981b Fire in tall open-forests (wet sclerophyll forests), in Gill, A.M., Groves, R.H. and Noble, I.R. (eds.) Fire and the Australian Biota (Australian Academy of Science, Canberra).

Attiwell, P.M. and Leeper, G.W., 1981 Forest Soils and Nutrient Cycles (Melbourne University Press, Melbourne).

Barber, H.N., 1965 Selection in natural populations, Heredity 20: 551-72.

Barker, W.R. and Greenslade, P.J.M., 1982 Evolution of the Flora and Fauna of Arid Australia (Peacock, Adelaide).

Barlow, B.A., 1981 The Australian flora; its origin and evolution, in Flora of Australia 1: (A.G.P.S., Canberra).

Barlow, B.A., 1986 Flora and Fauna of Alpine Australasia (CSIRO, Melbourne and E.J. Brill, Leiden).

Beadle, N., 1981 Origins of the Australian angiosperm flora, pp. 407-426 in Keast, A. (ed.) Ecological Biogeography of Australia (Junk, Hague).

Bowman, D.M.J. and Dunlop, C.R., 1986 Vegetation pattern and environmental correlates in coastal forest of the Australian monsoon tropics, Vegetatio 65: 99-104.

Chappell, J.M.A. and Grindrod, A., 1983 Climanz: Late Climatic History of Australia, New Zealand and Surrounding Seas (Dept. of Biogeography & Geomorphology, ANU, Canberra).

Clark, R.L., 1983 Pollen and charcoal evidence for the effects of Aboriginal burning on the vegetation of Australia, Archaeology in Oceania 18: 32-37.

Coleman, P.J., 1980 Plate tectonics background to biogeographic development in the southwest Pacific over the last 100 million years, Palaeogeo. Palaeoclim. Palaeoecol. 31: 105-121.

Colhoun, E.A., van de Geer, G. and Mook, W.G., 1982 Stratigraphy, pollen analysis and palaeoclimatic interpretation of Pulbeena Swamp, Northwestern Tasmania, Quaternary Research 18: 108-126.

Crook, K.A.W., 1981 The break-up of the Australian-Antarctic segment of Gondwanaland, pp. 1-14 in Keast, A. (ed.) Ecological Biogeography of Australia (Junk, Hague).

Cullen, P.J., 1987 Regeneration patterns in populations of Athrotaxis selaginoides in Tasmania, J. Biogeogr. 14: 39-51.

Cullen, P.J. and Kirkpatrick, J.B., 1988 Studies of the ecology of Athrotaxis D. Don (Taxodiaceae) I. Regeneration patterns in populations of A. cupressoides, Aust. J. Bot.: in press.

Dickinson, K.J.M. and Kirkpatrick, J.B., 1985 The flammability and energy content of some important plant species and fuel components in the forests of southeastern Tasmania, J. Biogeogr. 12: 121-34.

Dickinson, K.J.M. and Kirkpatrick, J.B., 1987 The short term effects of clearfelling and slash-burning on the richness, diversity and relative abundance of higher plant species in two types of eucalypt forest on dolerite in Tasmania, Aust. J. Bot. 35: 601-16.

Dransfield, J., 1981 Palms and Wallace's line, pp. 43-56 in Whitmore, T.C. (ed.) Wallace's Line and Plate Tectonics (Clarendon, Oxford).

Ellis, 1985 The relationships among eucalypt forest, grassland and rainforest in a highland area in north-eastern Tasmania, Aust. J. Ecol, 10: 297-314.

Enright, N.J., 1982 The ecology of Araucaria species in New Guinea III. Population dynamics of sample stands, Aust. J. Ecol. 7: 227-237.

Gill, A.M., 1981 Patterns and processes in open-forests of Eucalyptus in southern Australia, in Groves, R.H. (ed.) Australian Vegetation (Cambridge University Press, Melbourne): 152-76.

Harrington, G.N., Wilson, A.D. and Young M.D., 1984 Management of Australia's Rangelands (CSIRO, Melbourne).

Henderson, W. and Wilkins, C.W., 1975 The interaction of bushfires and vegetation, Search 6: 130-3.

Hill, R. and Gibson, N., 1986 Macrofossil evidence for the evolution of the alpine and subalpine vegetation of Tasmania, pp. 205-217 in Barlow, B. (ed.) Flora and Fauna of Alpine Australasia (CSIRO, Melbourne and E.J. Brill, Leiden).

Hope, G.S., 1984 Australian environmental change: timing, directions, magnitudes and rates, pp. 681-689 in Martin, P.S. and Klein, R.G. (eds) Pleistocene Extinctions (Univ. Arizona Press, Tucson).

Hope, J.H., 1982 Late Cainozoic vertebrate faunas and the development of aridity in Australia, pp. 85-100 in Barker, W. and and Greenslade, P. (eds) Evolution of the Flora and Fauna of Arid Australia (Peacock, Adelaide).

Hope, J.H., 1983 The vertebrate record, 32, 25, 18 and 15 ka BP in east Gippsland, pp. 14, 36, 59, 79 in Chappell, J. and Grindrod, A. (eds) Climanz (ANU, Canberra).

Howard, T.M., 1981 Southern closed-forests, in Groves, R.H. (ed) Australian Vegetation (Cambridge University Press, Melbourne).

Jackson, W.D., 1968 Fire, air, water and earth - an elemental ecology of Tasmania, Proc. Ecol. Soc. Aust. 3: 9-16.

Johnson, L.A.S. and B. Briggs, 1981 Three old southern families - Myrtaceae, Proteaceae and Restionaceae, pp. 427-470 in Keast, A. (ed.) Ecological Biogeography in Australia (Junk, Hague).

Kershaw, A.P., 1981 Quaternary vegetation and environments, pp. 83-101 in Keast, A. (ed.) Ecological Biogeography of Australia (Junk, Hague).

Kershaw, A.P., 1985 An extended late Quaternary vegetation record from north-eastern Queensland and its implications for the seasonal tropics of Australia, Proc. Ecol. Soc. Aust. 13: 179-189.

Kershaw, A.P., 1987 A comparative history of the vegetation of south-eastern Australia and New Zealand, pp. 433-445 in Conacher, A. (ed.) Readings in Australian Geography (Institute of Aust. Geographers, Perth).

Kershaw, A.P., McEwan Mason, J.R., McKenzie, G.M., Strickland, K.M. and Wagstaff, B.E., 1986 Aspects of the development of cold-adapted flora and vegetation in the Cenozoic of southeastern mainland Australia, pp. 147-160 in Barlow, B. (ed.) Flora and Fauna of Alpine Australasia (CSIRO, Melbourne and E.J. Brill, Leiden).

Kirkpatrick, J.B., 1975 The natural distribution of *Eucalyptus globulus* Labill., Austr. Geog. 13: 22-35.

Kirkpatrick, J.B. and Marks, F., 1983 Observations on drought damage to some native plant species in eucalypt forests and woodlands near Hobart, Tasmania, Pap. Proc. Roy. Soc. Tasm. 119: 15-21.

Kirkpatrick, J.B., 1983 Treeless plant communities of the Tasmanian high country, Proc. Ecol. Soc. Aust. 12: 61-77.

Kirkpatrick, J.B. and Brown, M.J., 1984 Numerical analysis of Tasmanian higher plant endemism, Bot. J. Linn. Soc. Lond. 79: 165-83.

Kirkpatrick, J.B. and Dickinson, K.J.M., 1984 The impact of fire on Tasmanian alpine vegetation and soils, Aust. J. Bot. 32: 613-29.

Kirkpatrick, J.B., Bowman, D.M.J.S., Wilson, B.A. and Dickinson, K.J.M., 1987 A transect study of eucalypt forests and woodlands of a dissected sandstone and laterite plateau near Darwin, Northern Territory, Aust. J. Ecol. 12: 339-59.

Lacey, C.J. and Whelan, P.I., 1976 Observations on the ecological significance of vegetative reproduction in the Katherine-Darwin region of the Northern Territory, Aust. For. 39: 131-9.

Morley, B.D. and Toelken, H.R., 1983 Flowering Plants in Australia (Rigby, Sydney).

Newell, R.E. and Chiu, L.S., 1981 Climatic changes and variations: a geophysical problem, pp. 21-61 in Berger, A. (ed.) Climate Variations and Variability (Reidel, Dordrecht).

Noble, I.A. and Slatyer, R.O., 1980 The use of vital attributes to predict successional changes in plant communities subject to recurrent disturbances, Vegetatio 43: 5-21.

Nix, H.A., 1982 Environmental determinants of biogeography and evolution in Terra Australis, pp. 47-66 in Barker, W. and Greenslade, P. (eds) Evolution of the Flora and Fauna of Arid Australia (Peacock, Adelaide).

Ogden, J., 1978 Investigations of the dendrochronology of the genus Athrotaxis D. Don. (Taxodiaceae) in Tasmania, Tree Ring Bulletin 38: 1-13.

Pickett, S.T.A. and White, P.S., 1985 The Ecology of Natural Disturbance and Patch Dynamics (Academic Press, Orlando).

Potts, B.M. and Jackson, W.D., 1986 Evolutionary processes in the Tasmanian high country eucalypts, pp. 511-27 in B.A. Barlow (ed.) Flora and Fauna of Alpine Australasia (CSIRO, Melbourne).

Pryor, L.D., 1976 The Biology of Eucalypts (Arnold).

Purdie, R.W., 1977a Early stages of regeneration after burning in dry sclerophyll vegetation, I. Regeneration of the understorey by vegetative means, Aust. J. Bot. 25: 21-34.

Purdie, R.W., 1977b Early stages of regeneration after burning in dry sclerophyll vegetation, II. Regeneration by seed germination, Aust. J. Bot. 25: 35-46.

Purdie, R.W. and Slatyer, R.O., 1976 Vegetation succession after fire in sclerophyll woodland communities in south-eastern Australia, Aust. J. Ecol. 1: 223-36.

Read, J., 1985 Photosynthetic and growth responses to different light regimes of the major canopy species of Tasmanian cool temperate rainforest, Aust. J. Ecol. 10: 327-34.

Read, J. and Hill, R.S., 1985 Dynamics of Nothofagus-dominated rainforest on mainland Australia and lowland Tasmania, Vegetatio 63: 67-78.

Rogers, R.W. and Westman, W.E., 1979 Niche differentiation and maintainance of genetic identity in cohabiting Eucalyptus species, Aust. J. Ecol. 4: 429-39.

Russell-Smith, J. and Dunlop, C., 1983 The status of monsoon vine forests in the Northern Territory: a perspective, in Werren, G.L. and Kershaw, A.P. (eds) Past, Present & Future of Australian Rainforests (CSIRO, Brisbane).

Russell-Smith, J. and Dunlop, C., 1987 The status of monsoon vine thickets in the Northern Territory: a perspective, pp. 23-88 in Australian Heritage Commission The Rainforest Legacy (AGPS, Canberra).

Sakai, A., Paton, D.M. and Wardle, P., 1981 Freezing resistance of trees of the southern temperate zone: especially species of Australasia, Ecology 62: 563-70.

Shackleton, N.J. and Opdyke, N.D., 1973 Oxygen isotope and palaeomagnetic stratigraphy of Equatorial Pacific Core V28-238: oxygen isotope temperatures and ice volume on a 10^5-year and 10^6-year scale, Quat. Res. 3: 39-55.

Singh, G. and Geissler, E.A., 1985 Late Cainozoic history of vegetation, fire, lake levels and climate, at Lake George, New South Wales, Australia, Phil. Trans. Roy. Soc. Lond. B311: 379-447.

Sluiter, I.R. and Kershaw, A.P., 1982 The nature of late Tertiary vegetation in Australia, J. Biogeog. 8: 249-261.

Smith, J.M.B., 1982 A History of Australasian Vegetation (McGraw Hill, Sydney).

Specht, R.L., 1981 Major vegetation formations in Australia, pp. 161-297 in Keast, A. (ed.) Ecological Biogeography in Australia (Junk, Hague).

Steenis, C.G.G.J. van, 1979 Plant geography of East-Malaysia, Bot. J. Linn. Soc. 79: 97-178.

Taylor, J.A. and Dunlop, C.R., 1986 Plant communities of the wet-dry tropics of Australia: the Alligator Rivers region, Northern Territory, Proc. Ecol. Soc. Aust. 13: 83-127.

Thom, B.G., Wright, L.D. and Coleman, J.M., 1975 Mangrove ecology and deltaic-estuarine geomorphology: Cambridge Gulf-Ord River, Western Australia, J. Ecol. 63: 203-32.

Tracey, J.G., 1982 The Vegetation of the Humid Tropical Region of North Queensland (CSIRO, Melbourne).

Truswell, E.M. and Harris, W.K., 1982 The Cainozoic palaeobotanical record in arid Australia: fossil evidence for the origin of an arid-adapted flora, pp. 67-76 in Barber, W.R. and Greenslade, P.J. (eds) Evolution of the Flora and Fauna of Arid Australia (Peacock, Adelaide).

van der Pij, L., 1972 Principles of Dispersal in Higher Plants 2nd ed. (New York).

Wasson, R.J. and Clark, R.L., 1987 The Quaternary in Australia - past, present and future, BMR Report 282: 29-34.

Webb, L.J., 1958 Cyclones as an ecological factor in tropical lowland rainforest, north Queensland, Aust. J. Bot. 6: 220-8.

Webb, L.J., Tracey, J.G. and Haydock, K.P., 1967 A factor toxic to seedlings of the same species associated with living roots of the non-gregarious subtropical rainforest tree Grevillea robusta, J. Appl. Ecol. 4: 13-25.

White, M., 1986 The Greening of Gondwana (Reed, Sydney).

White, P.S., 1979 Pattern, process and natural disturbance in vegetation, Bot. Rev. 45: 229-99.

Withers, J. and Ashton, D.H., 1977 Studies in the status of unburnt Eucalyptus woodland at Ocean Grove, Victoria, I. The structure and regeneration, Aust. J. Bot. 25: 623-37.

AN ECOLOGICAL VIEW OF THE HISTORY OF LOGGING AND FIRE IN MUMBULLA STATE FOREST ON THE SOUTH COAST OF NEW SOUTH WALES

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INTRODUCTION

Near the coast in the Bega district of south-eastern New South Wales, Mumbulla State Forest is one of 25 state forests of the Eden Woodchip Agreement Area, which is managed under the Eden Native Forest Management Plan (Forestry Commission, 1982) (Fig. 1). The woodchip industry is a high intensity logging operation and, carried out in conjunction with sawlogging, gives rise to the commonly used term 'integrated logging': The industry has been the subject of continuous debate since its inception in 1969 (Lunney and Moon, 1987).

In 1977 the NSW Cabinet directed the National Parks and Wildlife Service to investigate and report on the long-term impact of integrated logging on fauna in the coastal forests of the Bega district. The study reported here investigated the fire and logging history of Mumbulla State Forest, which was the only forest being logged during the period of these investigations (1979-1984). This historical information was recognised to be essential in planning and interpreting our other ecological studies on the impact of logging (Lunney, 1983, 1987, 1989; Lunney and Ashby, 1987; Lunney and Barker, 1986 [a,b,c], 1987; Lunney and Leary, 1988, in press; Lunney and Moon, 1987; Lunney and O'Connell, 1989; Lunney et al., 1985, 1986, 1987, 1988, 1989 [a,b], in press [a,b]; Recher et al., 1981; Smith 1984, 1985, 1986, 1988).

The forested land of Australia has been modified, often drastically (Wells et al., 1984), and much of this occurred during the extensive colonisation phase of the 19th century. Land clearing, with the accompanying stocking of sheep and cattle and the invasion of exotic animal species, particularly rabbits and foxes, has had a major impact on native fauna throughout Australia (Calaby 1977; Frith, 1979). In the Bega District, which includes Mumbulla State Forest, native mammals have been adversely affected by the land-use changes and exotic species introduced since settlement in 1830 (Lunney and Leary, 1988). Many species of native mammals have undergone a dramatic reduction in population size and distribution, at least six species have become extinct, and others have become rare.

Understanding and documenting the effect of human activity on natural systems is crucial to the balanced management of forests. Decisions cannot be based on the current standing crop - rather, a detailed chronicle of past causes and present effects is essential in understanding rates and directions of change. This study was hindered

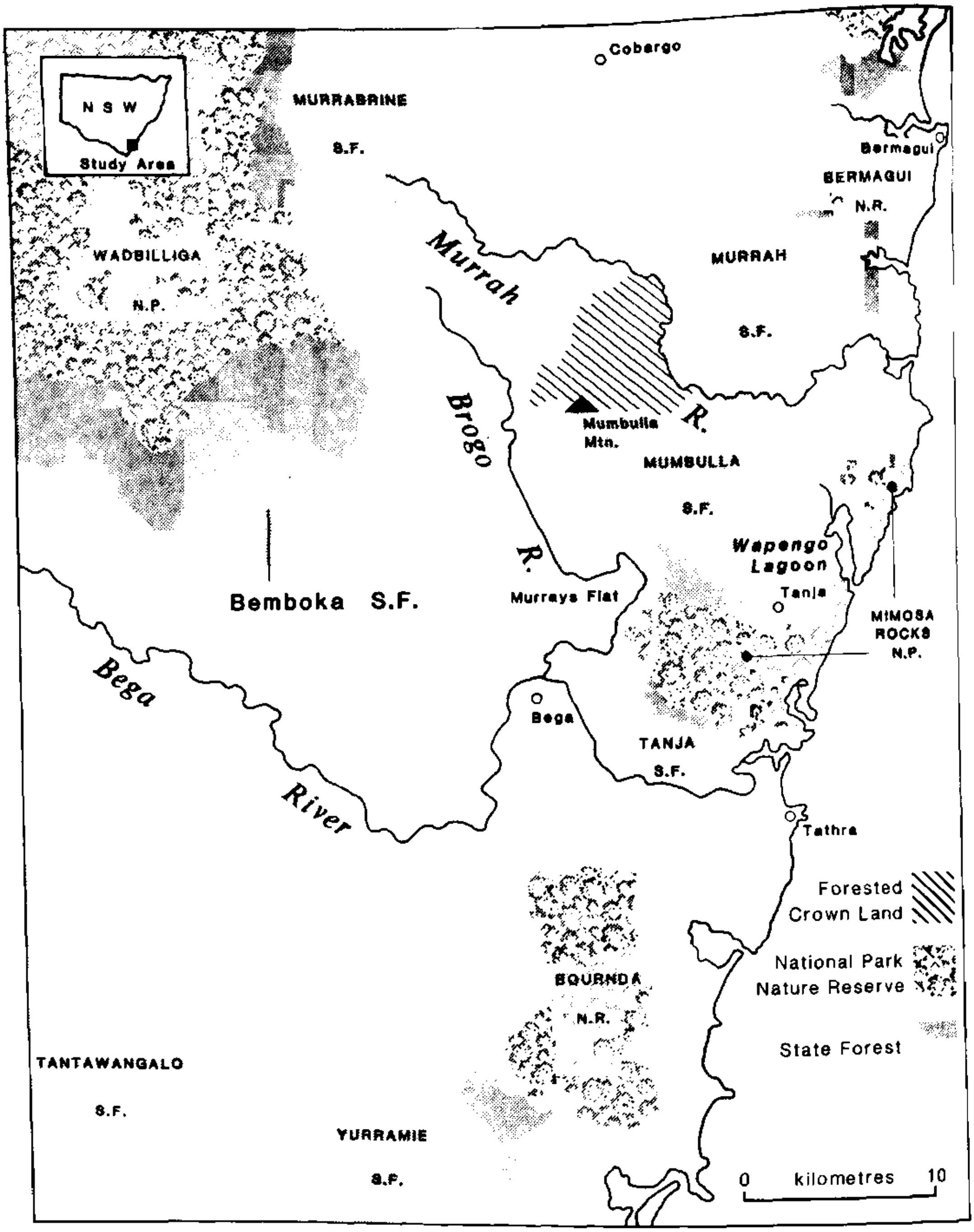


Fig. 1 *Location of Mumbulla State Forest, Bega district, NSW. Unshaded areas are freehold. The flat or undulating country of the Bega valley was cleared by about 1910 and is devoted to farming, particularly dairying. The State Forests, National Parks and Nature Reserves are on hilly country surrounding the valley*

by the paucity of records and was pieced together from seemingly unrelated fragments including old photos, cadastral maps, air photos, interviews, tree measurements, and contemporary forest records and wildlife studies.

The history of forestry in Australia is a new field of study and has recently been the subject of some major works (Carron, 1985; Hannah, 1986; Hudson and Henningham, 1986; Dargavel, 1988). The ecological history approach has yielded much of value both for British forests (e.g. Rackham, 1980, 1986; Peterken, 1981) and for our own faunal studies in the Bega District (e.g. Lunney and Leary, 1988; Lunney and Moon, 1987). The full history of Mumbulla State Forest would include its Aboriginal history (Egloff, 1981; Byrne, 1983; National Parks and Wildlife Service, 1983), but in this account we concentrate on the two most powerful causes of change to local forest ecosystems - logging and fire.

EARLY HISTORY

First settled in 1830, the forested valley country of the Bega district had been cleared by 1910 (Lunney and Leary, 1988) (Figure 2). Without the substantiation of early records, the contemporary view of the valley as it was last century is of open farmland with scattered trees. Land clearing, i.e. deforestation, was the major activity in the 19th century, although there was an increasing export trade, particularly the large-scale railway sleeper cutting industry. The area that is now Mumbulla State Forest received no specific mention in the historical records, although it can reasonably be presumed that sections of it were logged along with all the other accessible timbered country of the district. By 1917 all the arable land to the east and west of what became Mumbulla State Forest was cleared for farms, and the operation in the early 1890s of a mill at Tanja, adjacent to the forest, is evidence of commercial use of the timber from the immediate area (Figure 3). The survival of the area that became Mumbulla State Forest was a quirk of topography and soil quality and not of any early local interest in the conservation of original forest (Figures 4, 5 and 6).

Mumbulla State Forest was dedicated on 2 November 1917 with an area of 8 247 ha. Since then it has changed shape with seven additions and four revocations. By 1984 its size was 8 803 ha. The boundary changes are shown in Figure 7. This cadastral map can be interpreted with additional knowledge of land-use changes in the Bega valley and topographic maps. The portions marked out for freehold cover the flat country or gentle lower slopes of the Bega valley to the west and the arable area around Tanja to the east. The portions in the southern part of the forest still contain cleared land and houses. With its dedication as a state forest Mumbulla survived the last phase of initial colonisation and clearing. That this area has a future as a forest is due only to the recognition by the government in 1917 that forested land needed to be set aside and managed to retain its original values. As the boundary changes are comparatively small and on the edge of the forest, it can be considered to retain some pre-European features. The major dedication on the western edge of

Fig. 2 *Clearing of forest for farming in the 1890s - Brogo River on right, lower slopes of the escarpment leading to Mumbulla State Forest and Mimosa Rocks National Park (formerly Tanja State Forest) on left. Note standing dead trees killed by ringbarking, and forest on the upper slopes (Source: Bega Family Museum)*

Fig. 3 Gowing's Mill, Tanja, early 1880s. This scene suggests that logging, other than for railway sleepers, must have been extensive to support a mill of such size. The size of the logs indicates that large local trees were being milled. Forest in the immediate vicinity later became Tanja and Mumbulla State Forests (Source: Bega Family Museum)

Fig. 4 Contrast between the arable country of the Bega valley and the steep escarpment of the western edge of Mumbulla State Forest. Mumbulla Mountain - top left (D.L., 6/1982)

Fig. 5 South-eastern boundary of Mumbulla State Forest (upper left), Wapengo Lagoon (upper right), cleared land of Tanja area (foreground) (D.L., 6/1982)

Fig. 6 Hilly terrain of Mumbulla State Forest, looking W-N-W to Mumbulla Mountain (D.L., 3/1980)

the forest in 1972 took in the escarpment between the valley and the remainder of the forest.

THE FIRST OFFICIAL REPORT (1922)

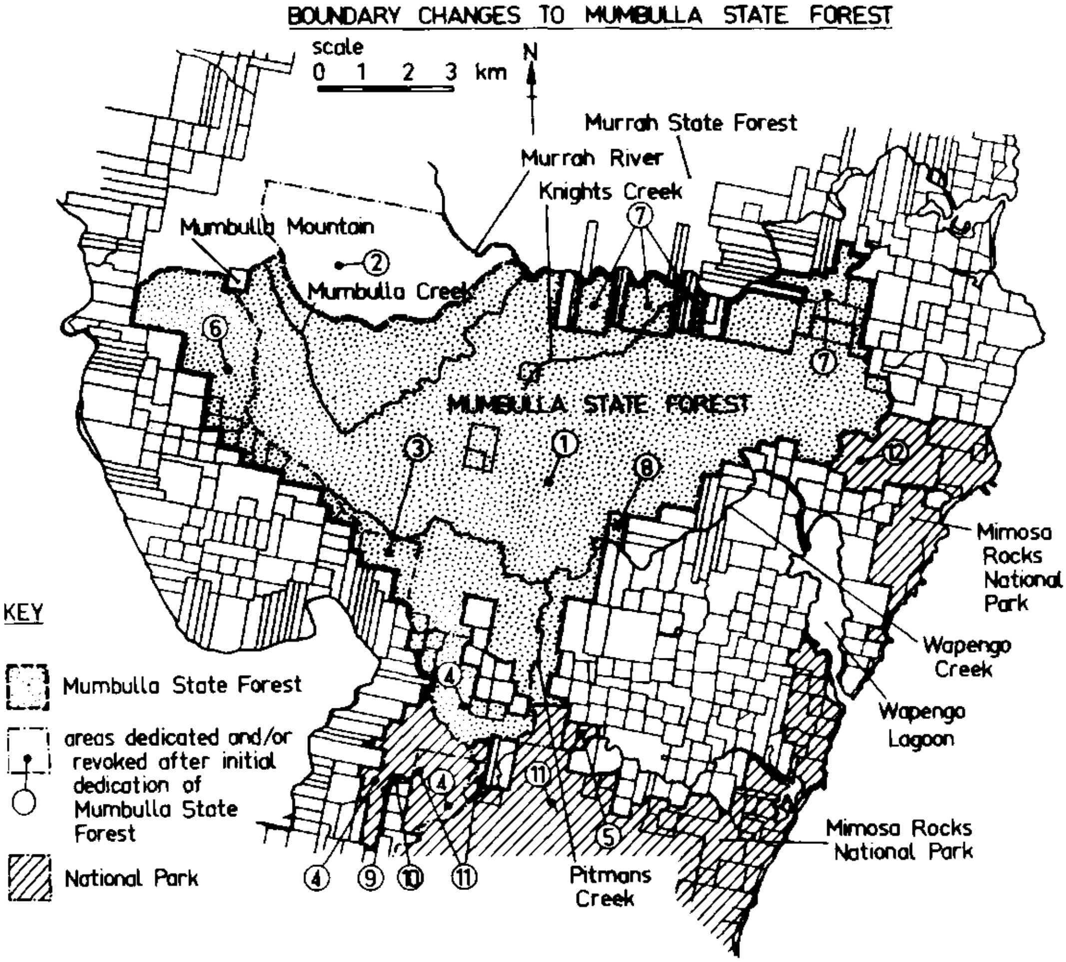
The earliest assessment of the forest was made in 1922 by Assessor L.O. Williams of the Forestry Commission of NSW (Williams, 1922). He subdivided it into 22 coupes (now called compartments) and estimated the mature and maturing timber yields per species for each coupe. He described the country as 'large and very hilly' and wrote: 'the bulk of the area is practically unexplored ... but road making will not present great difficulty when the need arises and the bulk of the area is exploitable'. He regarded the forest as 'very patchy as regards tree growth and composition but Stringy Bark, Woollybutt and Coast Ash are found generally over the whole area'. In addition to his appraisal of the whole forest Williams gave a coupe-by-coupe breakdown of species proportions. Such a detailed early record not only provides a valuable baseline for assessing change but also enables us to visualize the forest as it was in 1922. He drew up the following list of 'tree species found over the area in order of preponderance' (contemporary specific names are given in brackets):

Stringy Bark	(E. muelleriana, E. globoidea, E. agglomerata)	- 23%
Coast Ash	(E. sieberi)	- 20%
Woollybutt	(E. longifolia)	- 20%
Bangalay	(E. botryoides)	- 3%
Box	(E. bosistoana)	- 15%
Mountain Gum	(E. cypellocarpa)	- 3%
Iron Bark	(E. sideroxylon)	- 7%
Ribbon Gum	(E. smithii)	- 2%

A former forester of the Bermagui Forestry Office considered that Williams was reviewing only commercially useful species and potentially usable trees (D. Holmes, pers. comm. 1987), so a comparison with today's size-class distribution per species, based upon a comprehensive count, would not be valid. Nevertheless, when Williams' account is combined with his notes on management, a picture of the forest begins to emerge. Williams stated: 'Over the more accessible areas, sleeper operations have removed the bulk of the mature timber (Stringy Bark and Woollybutt), yet age-class representation is fair over the area generally'. He also stated: 'on the poorer soils (exposed ridge tops) dense stands of weedy sucker Coast Ash regrowth are found, as a result of firing'. The impression gained from Williams is that logging for railway sleepers had been the predominant activity for sufficient time to take most of the large trees, and thus the forest was, by 1922, primarily composed of small, immature trees. This shift in size-class distribution appears to have been compounded by fire, which created extensive regrowth.

Williams also remarked: 'Present demands of the area are limited to the supply of a few (railway) sleepers. These have been cut over the area of Coupes 1, 12 and 13. Previously, however, sleeper operations have been carried out over Coupes 8, 9, 10, 11, 14

Fig. 7 This cadastral map of Mumbulla State Forest and adjacent area, shows extensions and revocations since its original dedication on 2/11/1917. North of Mumbulla S.F. is the 12 207 ha Murrah S.F., to the immediate south and east is the 5 181 ha Mimosa Rocks N.P. That part of Mimosa Rocks N.P. which is south of Mumbulla S.F. includes the former Tanja West S.F. and most of a previously larger Tanja S.F. The town of Bega is south-west of Mumbulla S.F. Mumbulla S.F. is part of the coastal range forming an eastern rim to the Bega valley. The steep escarpment forming the western edge of the forest, and the 704 m Mumbulla Mountain in the north-west corner are clearly visible from Bega. The configuration of the western and eastern boundaries of the forest, where they abut the farm portions (depicted here in detail) reflect the limit of farming potential. The irregular and convoluted western edge of the portions is the Brogo River. Isolated portions within the forest were never cleared for farming, although there are cleared portions which still have houses and horses near the southern boundary of the forest in the Parish of Tanja to the west of Pitman's Creek



No.	DEDICATED / REVOKED	COUNTY	PARISH	AREA	TOTAL AREA
1	Ded 2-11-1917	Dampier		8243 4334	8243 4334
2	Rev 2-11-1923	Dampier		1163.4693	7079.9641
3	Ded. 25-3-1938	Dampier	Tanja	131.1179	7211.0820
4	Ded. 24-10-1958	Dampier	Tanja	987 4314	8198.5134
5	Ded. 10-2-1967	Dampier	Tanja	40 4685	8238 9819
6	Ded. 14-4-1972	Auckland	Mumbulla	845.7917	9084.7736
7	Ded. 14-11-1975	Dampier	Murrah	730.00	9814.7736
8	Ded. 6-1-1978	Dampier	Wapengo	28.3280	9843.1015
9	Rev. 7-9-1979	Dampier	Tanja	4.149	9838.9525
10	Ded. 3-10-1980	Dampier	Tanja	4.149	9843.1015
11	Rev. 30-10-1980	Dampier	Tanja	720.00	9123.1015
12	Rev. 29-4-1983	Dampier	Murrah Wapengo	320.00	8803.1015

and 15'. He concluded: 'Future operations should be confined to individual coupes in rotation and each coupe should be fully exploited'. This suggests that exploitation had been extensive and that active management was necessary to fully utilize each coupe, presumably to prevent the forest being picked over without consideration for the long-term effect on the timber resource.

Attached to Williams' report is a covering note written on 14 March 1922 by the district forester at Moruya. It states: 'On Compartments 8 to 14 sleeper operations have been in progress for a number of years, and some logs were cut thereon for the Wapengo sawmill (long since dismantled) about 1910-1912. A considerable number of sleepers were also cut a few years ago on compartments 1 and 2 where sleeper cutting is now in progress, and on these Compartments a few logs were recently obtained by the short-lived Mumbulla Timber Company. On the balance of the area, which has not been cut over, it might reasonably be expected that mature trees would predominate'.

It is possible to surmise from the consistency of these two reports that Mumbulla State Forest was part of the sleeper-cutting industry which was a major export industry of the district (Lunney and Leary, 1988) (Figure 8). The district forester's mention of Compartment 1, when added to Williams' nine, gives a total of 10 of 22 compartments 'cut over' for sleepers. Thus nearly half of the forest, mainly the southern and eastern parts, had been logged in an unregulated fashion for decades by individuals or small local mills. In contrast, the western half of the forest appears to have been relatively untouched prior to its dedication as a state forest. Sleeper cutting undoubtedly altered the size-class and tree quality composition of the forest by the preferential removal of the bigger trees as well as the less defective trees for sawlogs. However the Bega District Forester commented that as the largest trees were often not suitable for sawlogs, they were not felled (John Reynolds, pers. comm., 1987).

Although sleeper cutting was dominant, other logging was undertaken. For example, the Moruya district forester stated in 1922: 'Tanja mill now holds a special licence to obtain 10 000 feet of Sassafras logs on Coupe 13 ...'. This quote illustrates that rainforest species, confined to the edges of the major creeks, have been logged in the past even though they are untouched by the current operations.

It is clear that the forest was extensively utilized, and presumably altered, before adequate records were taken. The dearth of records leaves the information for the period from 1922 to 1953 dependent upon the memory and personal records of one retired forestry foreman.

THE DOWTON YEARS (1953-1976)

Mr Ernie Dowton, a Forestry Commission foreman from 1953 until his retirement in 1976, had worked in these coastal forests since his youth. His notes on individual coupes in Mumbulla and his

Fig. 8 *This photo, c. 1900, shows a sleeper cutting crew in the hilly coastal forest near Bega. Note the large size of the tree being cut into railway sleepers and the extent of clearing of forest in the background. The original photo bears the caption -* ***Tom White and workmen - Brogo Hill. Sleeper cutting. Around the turn of the century*** *- and could have been taken in Mumbulla S.F. (J. Caddy [former Forestry Commission foreman] pers. comm. to T.Leary, 1984)*

general recollections about the forest were relayed to us in November and December 1982 and formed the primary source of our interpretation of the management regime between the early 1950s and the commencement of woodchipping in 1977. Dowton remembers that in the last six months of his employment he wrote a compartment-by-compartment history of the forest. Extensive inquiries in 1982 and later years failed to locate the only copy. Fortunately, Dowton had kept the draft, written in 1971 (Dowton, 1971), and his memory covered the years 1971-1976.

The Bega district office's records were primarily limited to a map of the TSI (Timber Stand Improvement) undertaken by Dowton, with the years of treatment.

Sleeper-cutting

Dowton remembered that sleeper-cutting continued throughout the Depression and the war years. In about 1950 an untouched northern section of the forest was given to sleeper-cutters as a result of an arbitrary east-west boundary, while the southern cut-over section was allocated to sawloggers. Such neglectful management practices, according to Dowton, gave sleeper-cutters access to 'maiden bush' where they took high quality trees that should have been used for sawlogs. The sleeper-cutters, who had three camps each of two men near Lizard Road, north-east of the junction with Smith's Road, found the cutting so good that they did not move a '1/4 mile' (c. 400 m) from camp in a year. They were cutting '40 to 60 ft' (c.12-18 m) trees yielding up to 25 sleepers. They worked a '1 mile' (c. 1600 m) radius in five years. Sleeper cutting continued in this area until 1958 when a New Zealand sleeper contract terminated. The New Zealand railways required 7 ft (2.1 m) sleepers and took Silver-top Ash, whereas the NSW railways required 8 ft (2.4 m) sleepers but did not take Silver-top Ash until about 1952, preferring Ironbark, Box and Stringybarks, in that order.

Conspicuous during an inspection of the Smith's Rd - Lizard Rd intersection with Dowton in December 1982 was the 25 to 30-year-old stand of largely Silver-top Ash regrowth which became clearly visible after integrated logging operations in 1979-1981 took most of the surrounding tall trees. The integrated logging operation of a series of contiguous coupes in this locality in 1979-1982 was, in fact, specifically undertaken to release such regrowth. Indeed, support by Commission staff for integrated logging stems in part from the desire to remove old, uncommercial trees left from previous logging operations, to encourage regeneration, and to release advanced young straight trees to grow as potential sawlogs.

In 1956 sub-district forester Alan Perrott from Bermagui began tree-marking. Each tree was marked with an axe blaze and then stamped with a forestry brand. Since only marked trees could be taken this system was not popular with the fallers who, according to Dowton, preferred to select their own trees. In 1960 the sleeper cutters moved east to Bunga Pinch Road and took only smaller, twisted trees. Sleeper-cutting ceased in 1968.

Sawlogs

The management in the 1960s and most of the 1970s was for big sawlogs, often referred to as crown logging because the timber was taken from crown (i.e. government) land. Crown logging, most of which occurred in the early 1960s, took about 1 in 8 or 1 in 10 trees. In Dowton's view it was not as intensive as the current integrated operation. Ironbark, or mugga, was the most prized tree species and attracted the top royalty. Coastal Grey Box and the stringybarks were next in popularity and were used for bridge building by the Department of Main Roads and by County Councils for cross arms on telegraph poles. Silver-top Ash was not recognized as a sawmill timber until about 1962, when the H-Tree fire trail was made in the western part of the forest by the Clyde sawmill of Bermagui. In Dowton's view, royalties had been lost on Silver-top Ash because its value had not been recognized and it was sent to New Zealand for sleepers. Now it is used for sawmill timber and is one of the preferred tree species for woodpulp.

Timber Stand Improvement (TSI)

An intensive Timber Stand Improvement (TSI) operation was carried out under Dowton's supervision in 1 100 ha of Mumbulla State Forest from 1964 to 1973. It was more like clearfelling than selective logging and was undertaken to produce a forest of straight millable sawlogs. It extended east-west in a strip from the junction of Clarkes Road and the road to Mumbulla trig station in the western part of the forest, along T-Ridge Road to Whittles Road at the eastern edge of the forest. The TSI operation was carried out after salvage logging for usable timber and a burn to produce good regeneration (Figure 9). The operation commenced in the west in 1964 and finished in the east in 1973. The history of logging up to 1976 is shown in Figure 10.

Dowton's method was to clear 2-3 chains (c.40-60 m) from the road edge with a chainsaw while the crew carried out ring-barking downslope with axes. Dowton recalled that since some of the crew, such as unemployment relief workers, were unenthusiastic about the work, they ring-barked only the visible side which faced upslope. As a result, many of these trees survived and now provide valuable animal habitat. Other events explain the survival of large trees in some localities within the TSI area. A section off the southern side of T-

Fig. 9 A 15 y.o. regrowth stand in a gully after the TSI operation in the western part of Mumbulla S.F. (D.L., 6/1980)

Fig. 10 A large stump in the TSI area in the eastern part of Mumbulla S.F. in a gully to the west of the junction of Whittles Rd and T- Ridge Rd. Such stumps are positive but decaying evidence that this area once carried large trees. Trees of this size no longer occur in this part of the forest and are rare anywhere in the forest (D.L., 6/1980)

Ridge Road, 1.4 km east of Woollybutt Road, was earmarked to be clearfelled, but other work intervened and the trees were left for later falling which was never carried out. On Woollybutt Road crown logging was followed by salvage logging, but as certain parts did not receive the TSI treatment, some big trees remain.

By contrast, there are no big trees in some parts of the TSI area (Figure 11). At the eastern end of T-Ridge Road near Whittle's Road there was no salvage logging in about 1970 because crown logging by the Bega mill (now the Allen Taylor mill) had taken even the small trees to 3ft (0.9 m) centre girth. Again, examination of the logging map shows that there was no TSI treatment around the junction of Wapengo Creek with the tributary that forms the ford on T-Ridge Road, and current inspection showed this to be an area with few large trees. Dowton provided the most likely explanation for the absence of large trees. He remembered that in the late 1930s the families of two brothers, the Beckers, lived on this site and logged around it, probably taking the biggest trees.

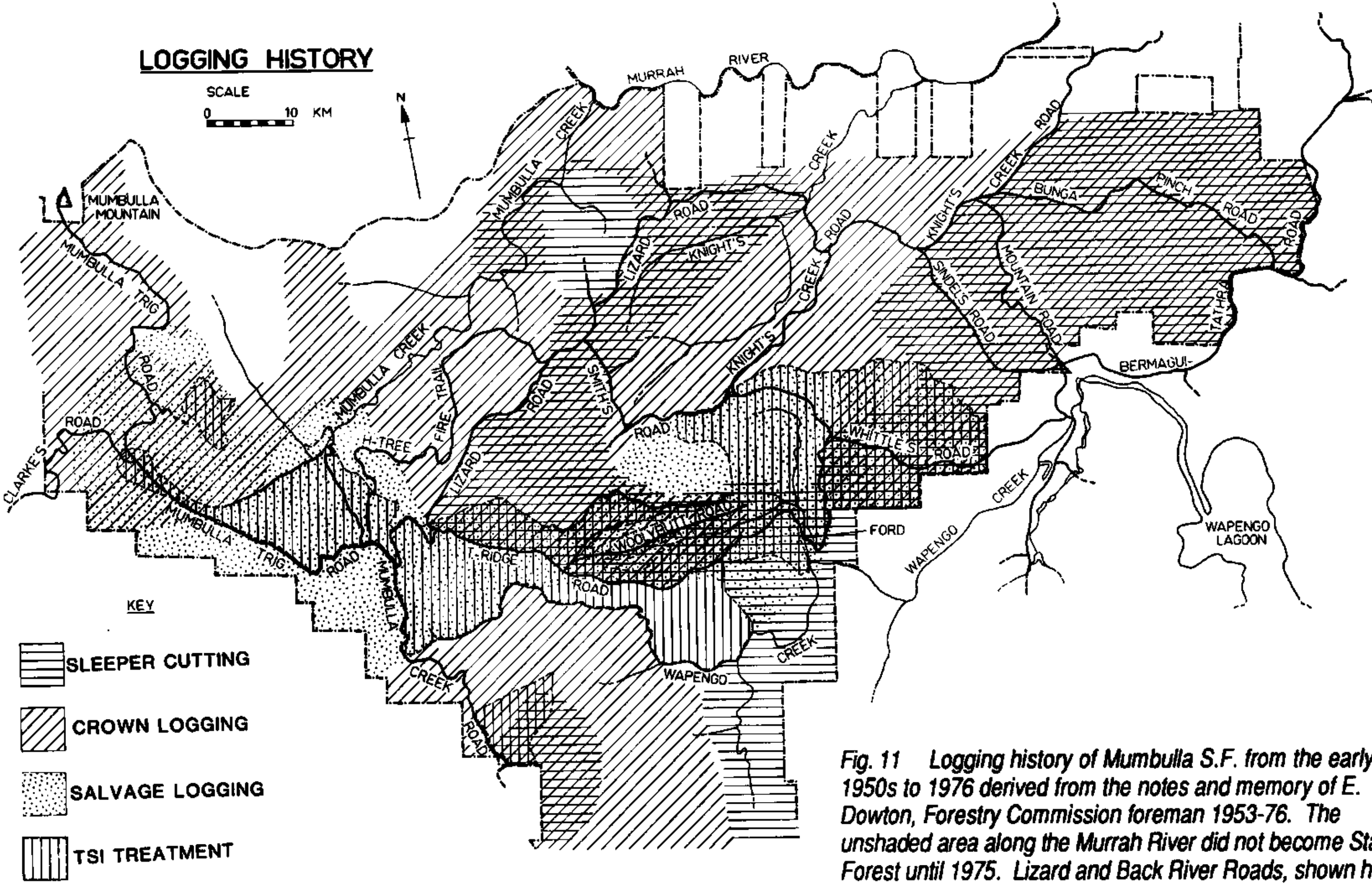


Fig. 11 Logging history of Mumbulla S.F. from the early 1950s to 1976 derived from the notes and memory of E. Dowton, Forestry Commission foreman 1953-76. The unshaded area along the Murrah River did not become State Forest until 1975. Lizard and Back River Roads, shown here to provide reference, were not built until the late 1970s and early 1980s respectively

Fig. 12 *A 14 y.o. stand of Silver-top Ash (Eucalyptus sieberi) at the western edge of T-Ridge Rd following selective logging in 1963, salvage logging in 1966, a fierce fire in 1968, and TSI treatment in 1968 (D.L., 1982)*

According to Dowton the TSI treatment sequence was affected by fire. In the area around T-Ridge Road about 0.5 km east of the junction with Lizard Road there was selective logging by the Clyde mill in 1963, salvage logging in 1966, fierce fire in 1968 and then TSI in late 1968. This was followed by rain in late December, with regeneration beginning in early 1969. Dowton vividly remembered someone remarking to him that it looked like a 'desert', and recalled his reply - 'Yeah, but not for long'. Dowton recollected that the seedlings of Silver-top Ash, each with two or four leaves, looked like 'a field of oats'. A striking stand of even-aged Silver-top Ash now stands there (Figure 12).

Fires

During his period as forest foreman Dowton had noted that some trees appeared to have been killed by fire, which he had estimated to date from the early 1940s. He thought these were likely to have been crown fires, i.e. high intensity fires that burn the crowns of trees. Dowton recalled that the big fire in the Bega district in 1952 had affected Mumbulla only lightly. This fire came via Murray's Flat, near Bega, moved along Dr George Mountain Road, then into the forest via T-Ridge Road. In 1968 a fierce crown fire burnt the western 2 km of T-Ridge Road but petered out at the ford on the T-Ridge Road at the tributary to Wapengo Creek. Dowton believed that this fire was deliberately lit from half a dozen points along Mumbulla Creek Road and T-Ridge Road. The fire history of the forest from the early 1940s to end of 1976 is shown in Figure 13.

Control burning has always been a regular occurrence in the forest. Dowton recalled that in the 1940s sleeper-cutters burnt along T-Ridge Road. Dowton himself control burnt regularly to form a fire break 2-3 chains (c.40-60 m) from the roadside. He carried this out only on ridges, and only in autumn so that breeding birds would not be affected.

Wildlife

Dowton recalled that there were plenty of goannas (Varanus varius) in Mumbulla, although Brown Snakes (Pseudonaja textilis) were very rare and Tiger Snakes (Notechis scutatus) were uncommon, mostly being found near Mumbulla Creek. (The scientific names have been added to cross-reference with Lunney and Barker, 1986 a,b, 1987). He remembered Death Adders (Acanthophis antarcticus) clearly for, on one occasion in 1968, when 18 unemployed drought-relief workers started work at the western end of the T-Ridge Road they saw six Death Adders. Six of the men did not return to work the next day because of fear of these snakes. Dowton remembers seeing Dingoes (Canis familiaris) around the Mumbulla Creek picnic area in the western part of the forest, but not further downstream. They were judged to be Dingoes because they were 'yellow animals with thick brush tails' and 'the dogs howled and the bitches yapped'. Occasionally he saw tiger cats, now called Spotted-tailed Quolls (Dasyurus maculatus), but never Koalas (Phascolarctos cinereus). By contrast, he remembered that Mumbulla had plenty of 'squirrels' Sugar Gliders (Petaurus breviceps), while Yellow-bellied Gliders (Petaurus australis) and 'black gliders' (Greater Gliders (Petaroides volans)) were less common, the latter living mostly in gullies in large old trees. Besides flying foxes (Pteropus - no species mentioned), Dowton remembered bats of two sizes - those slightly greater and those slightly smaller than a hand span. He said that these bats lived in small hollow trees such as box.

Dowton confirmed that there were only two gold mines in these coastal forests. As there are no natural caves in the forest these mines probably constitute the sole, and certainly the primary, roosts of two obligate cave-dwelling bats - the Common Bent-wing Bat (Miniopterus schriebersei) and the Eastern Horseshoe Bat (Rhinolophus megaphyllus). One mine was on Vimy Ridge in the adjacent Mimosa Rocks National Park in what was the former Tanja State Forest and the second mine was in Mumbulla State Forest near Knight's Creek Road between Lizard and T-Ridge Roads. Quarrying stopped at the beginning of World War II.

Dowton retires

In 1976 Dowton retired with a letter of high praise from the then Commissioner of Forests, Mr Jack Henry. He was subsequently

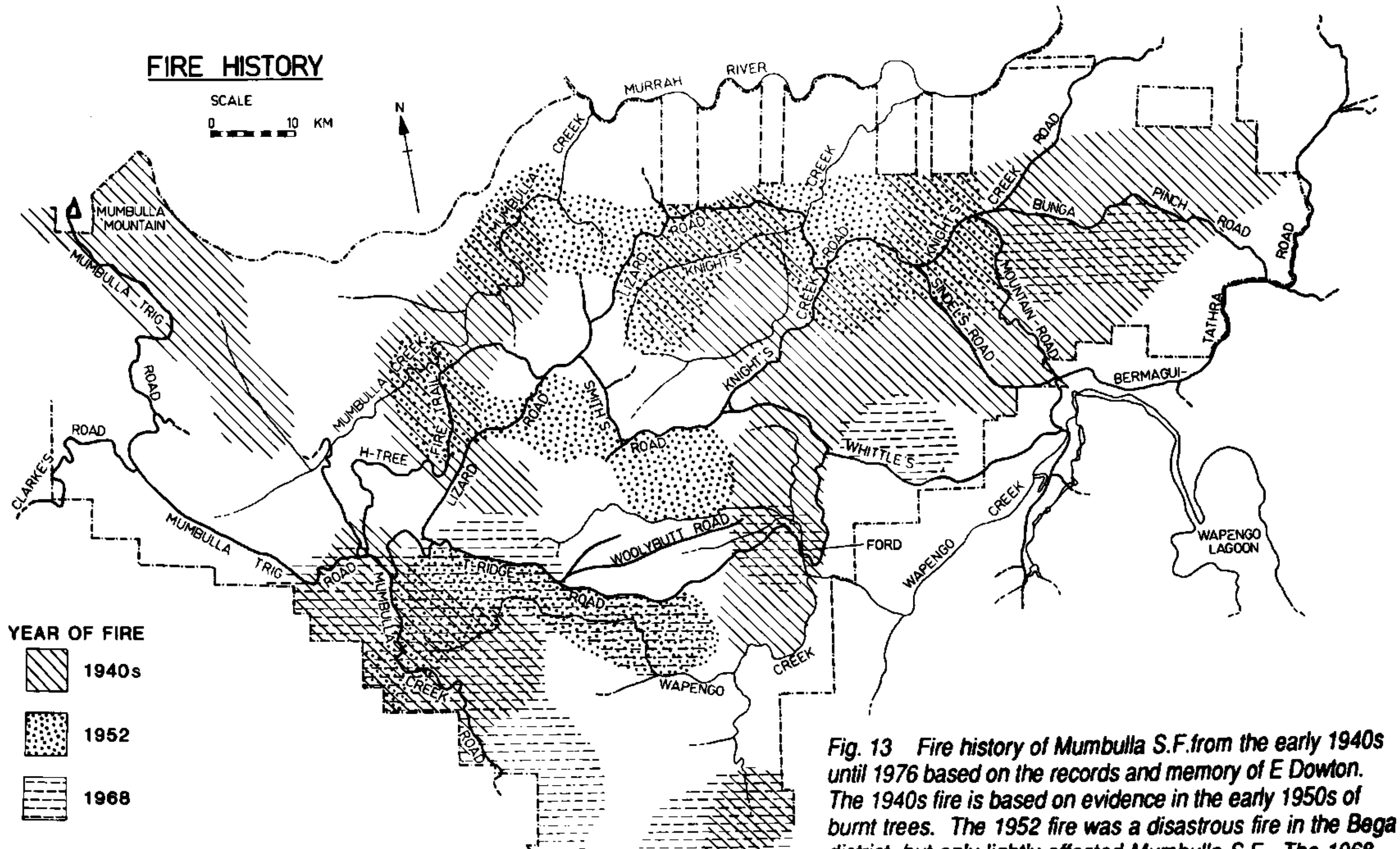


Fig. 13 Fire history of Mumbulla S.F. from the early 1940s until 1976 based on the records and memory of E Dowton. The 1940s fire is based on evidence in the early 1950s of burnt trees. The 1952 fire was a disastrous fire in the Bega district, but only lightly affected Mumbulla S.F. The 1968 fire was a crown fire confined to a small area of forest off the western edge of T- Ridge Rd

awarded the Imperial Service Medal for his contribution to forestry. As part of his work he had organized a major TSI operation and supervised extensive logging operations throughout the forest. From a contemporary viewpoint he was altering the forest with limited knowledge of the potential environmental impact and in the absence of environmental impact legislation. Yet his work demonstrated profound pleasure in, and knowledge of, Mumbulla as a forest, as evidenced particularly by his writing a compartment-by-compartment history. Dowton's ethic provides inspiration for future forest managers and those who are considering the land-use options for the forests of the region. As Dowton was retiring a controversial era of high-intensity logging was just beginning. A new industry, woodchipping, could now use most of the trees standing in the forest for chipping and exporting for pulping and papermaking. The modern challenge is to manage this industry to a standard that would merit another Imperial Service Medal by preserving the integrity of the forest for future generations to enjoy.

THE WOODCHIP ERA (1977-1982)

Logging

In late 1977 the integrated woodchip/sawlog operation began in Mumbulla State Forest under the logging regime outlined in the Eden Native Forest Management Plans (Forestry Commission, 1976, 1982). The TSI area and the area along Mumbulla Trig Road which was logged in the early 1970s were excluded from this operation. Compartment record sheets from the Bega district office of the Forestry Commission were the source of information on the sizes of coupes, logging sequence, and timber volumes taken. The years of logging these coupes are shown in Figure 14. The sizes and shapes of the coupes were not uniform. Coupes varied in size between 3.5 and 36.3 ha (x=12.41, s.e.=0.27, n=301). The boundaries of coupes were topographically determined. The lower boundaries were typically formed by gully lines or creeks. Ridges, which carried the logging roads, were in the centres of the coupes on small side ridges, or formed the upper boundaries on large ridges (Figures 15 and 16). Sniggers (tractors or bulldozers) drove down the slopes and hauled up newly cut trunks, leaving the crowns behind and causing disturbance to the ground cover. They did not cross the gully lines. This procedure was adopted as an erosion control measure, as was the placing of cross drains in the snigging tracks. On steep slopes some snigging was done by chain and wire rope and logs were winched or towed from a big tractor. The immediate impact of the logging sequence is shown in Figures 17 to 22.

The plan of management (Forestry Commission, 1982) requires that where the catchment exceeds 60 ha, or 40 ha in steep country, a 20 m filter strip be left along each side of the gully or creek. Trees may be felled from the outer 10 m strip, but heavy machinery may not enter this strip as it set aside primarily for hydrological purposes, e.g. erosion control. In addition, the planters of management provides for a set of wildlife corridors for the region. The corridors are at least 100 m wide, such as on either side of a creek, and are to remain unlogged. The maps detailing their position

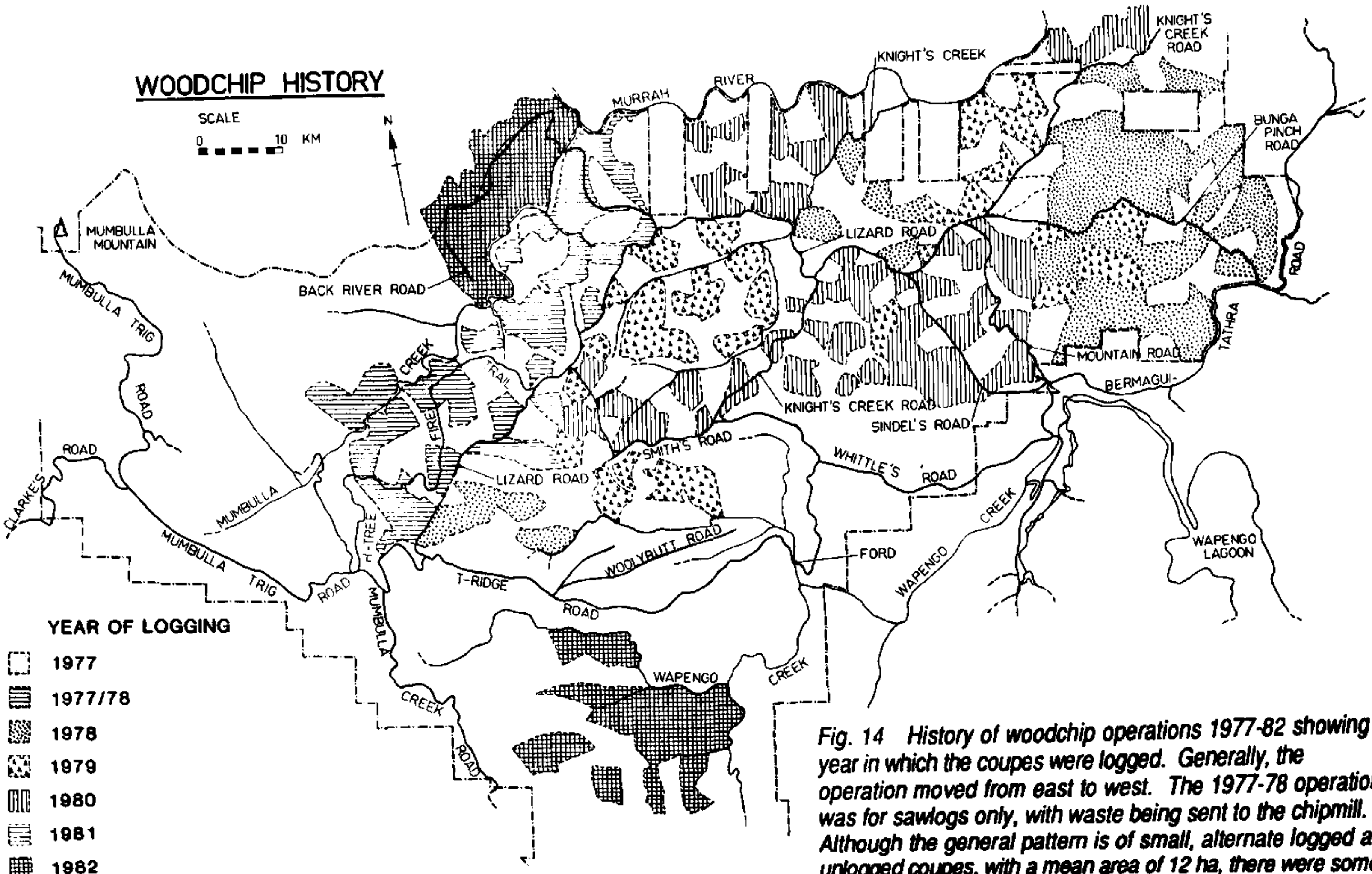


Fig. 14 History of woodchip operations 1977-82 showing year in which the coupes were logged. Generally, the operation moved from east to west. The 1977-78 operation was for sawlogs only, with waste being sent to the chipmill. Although the general pattern is of small, alternate logged and unlogged coupes, with a mean area of 12 ha, there were some areas, such as along Bunga Pinch Rd and Back River Rd, where many contiguous coupes were logged

Fig. 15 The pattern of small, alternate-coupe logging is shown here by a coupe logged in March 1979 and burnt in November 1980. Lizard Rd (see Fig. 14) is in upper right corner. Coupe is on a side ridge with log track into the coupe along the ridge line. A ripped log dump is the centre of the photo (D.L., 6/1982)

are available only in either the regional or district offices of the Forestry Commission, but a map (Appendix 20 in Harris-Daishowa 1986) shows where they occur, although it is not to scale. In Mumbulla State Forest the wildlife corridor covers the Murrah River. Owing to the particular topographic pattern of Mumbulla State Forest most creeks and gully lines do not have a 60 ha catchment, and so were logged or are destined to be logged, with the exception of the rainforest strips along Knight's Creek. By 1982 the first logging cycle was completed when the first set of alternate coupes had been logged. The management plan states that the unlogged coupes are to be logged 20 years after the initial set of coupes are logged. Thus this operation is expected to recommence in Mumbulla State Forest. The timing of the relogging of the initial set of coupes is not explicit. The Harris-Daishowa Draft Environmental Impact Statement (Harris-Daishowa, 1986) and the supplementary statement by the Forestry Commission (Forestry Commission, 1986) suggest that the next logging cycle may be delayed for as long as 80-150 years. Nonetheless, the current Plan of Management indicates that the relogging of the initial set of coupes will occur as soon as 40 years after the commencement of integrated logging operations.

The timber volume taken in 1977-1982 for both woodchips and sawlogs was 219 414 m^3 (Forestry Commission compartment record sheets), of which 177 214 m^3 of logs went to the chipmill and 42 200 m^3 of logs went to local sawmills. Thus, 81% of the timber went to

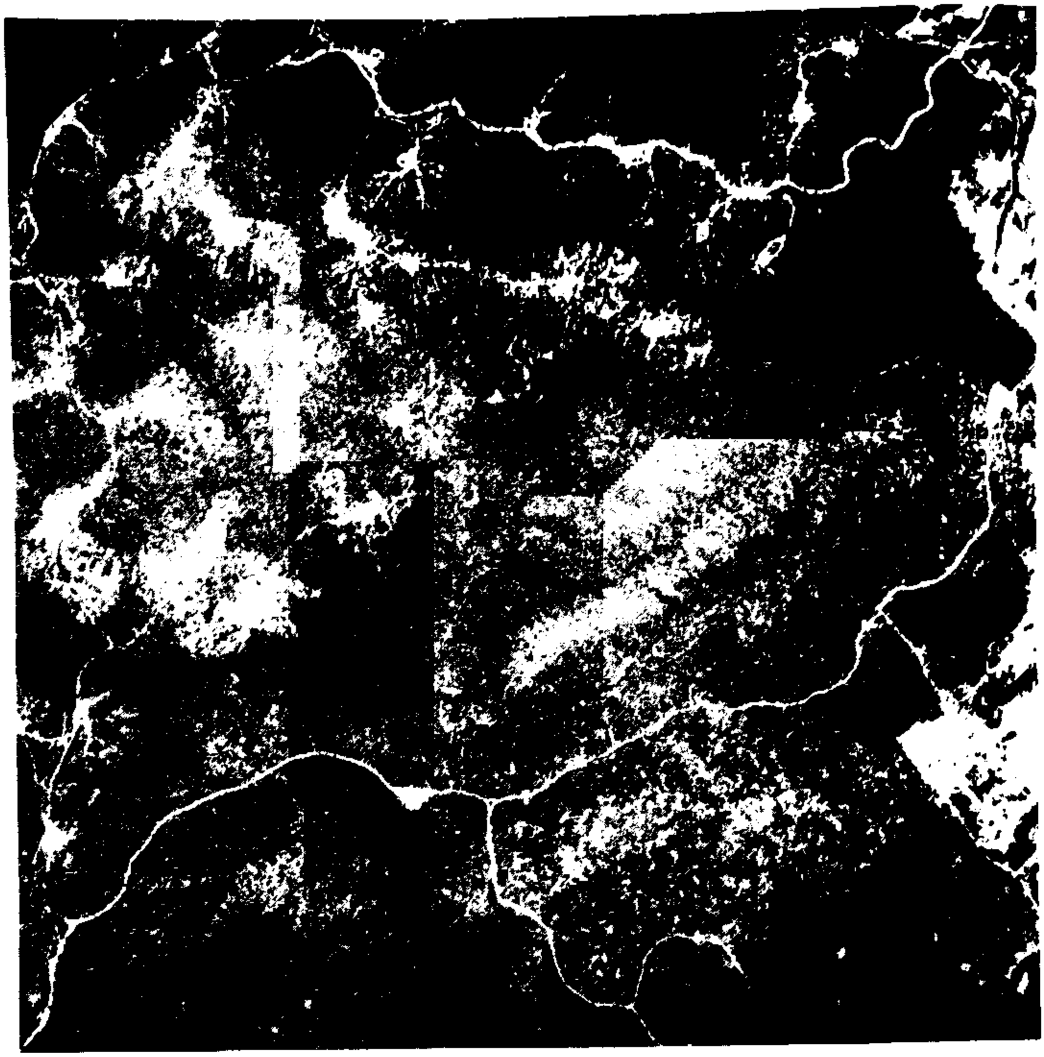


Fig. 16 Air photo taken immediately following the November 1980 fire showing the pattern of alternate coupes in upper left, farmland on far right, and 8-11 y.o. TSI through the middle. Roads (see Fig. 14): Sindel's (top); Knight's Creek (left); Smith's (far bottom left); T- Ridge Rd arcs across bottom past a 'borrow' (quarry for road making material); Whittle's Rd runs N-E to farmland. (Source: Forestry Comm. of NSW)

the chipmill near Eden and 19% went to local sawmills. (The compartment record sheets register logs to the chipmill in tonnes and logs to sawmills in m^3, so it was necessary to convert to the same unit for comparison. Conversion is 1 m^3 = 1.135 tonnes). The area logged in this operation was 2 817 ha, i.e. 31.4% of the forest. Of Harris-Daishowa's annual chipmill quote of 530 000 honnes derived from State Forests in the Agreement Area, Mumbulla State Forest, in its first logging cycle, provided an amount equal to 33% of one year's quota (Lunney and Moon, 1987).

A measure of the difference in species and size-class composition was carried out as part of wildlife studies in November

Fig. 17 An 'unlogged' gully i.e. area not logged during the integrated woodchip-sawlog operation. Location (see Fig. 14): due east of junction of Smith's Rd and Lizard Rd and due north of junction of Smith's Rd, Knight's Creek Rd and T-Ridge Rd. Compare: (i) pattern of light and shade, (ii) density of undergrowth, (iii) diversity of tree sizes, with subsequent photos. White lines are rope quadrats for a lizard census (D.L., 10/1980)

Fig. 18 Crowns of trees (Mountain Grey Gum - Eucalyptus cypellocarpa) in a recently logged gully about 4 km E-S-E of the junction of Smith's Rd and Lizard Rd. Note the openness of the remaining trees (D.L., 11/1980)

Fig. 19 Snig track winding down a long slope of a coupe that has just been logged. This coupe may be located on Fig. 14 just above the 'm' in Smith's Rd. Logging debris is conspicuous on either side of the snig track, as is the gross disturbance of the ground layer (D.L., 6/1980)

1982. The details are reported in Lunney (1987) and Lunney et al. (1989), and a summary is given in Table 1. This information shows that the gullies, with the larger trees, were logged much more intensively than the ridges and underwent an eleven-fold reduction in timber volume compared to a three-fold reduction for the ridges. Also there was a complete loss of large trees following the woodchip/sawlog operation, and most of the remaining medium-sized trees were stags, i.e. dead trees. In the TSI there was a proliferation of saplings. The effect of alteration to the vegetation on the wildlife has been reported in the studies listed in the introduction, and particularly in Lunney (1987), Lunney et al. (1987), Lunney et al. (1989), and Lunney et al. (in press b). The impact on wildlife was found to be significant and many species will remain affected because of the short (40-year) length of the current logging cycle, which does not allow sufficient recovery time for the habitat of many species. It was also concluded that the conservation of many species in this forest will depend on the amount of forest left unlogged, i.e. excluded from the second logging cycle. For forests yet to be logged in this woodchip-sawlog operation the opportunity for reserving unlogged areas, particularly large areas, is far greater.

Fig. 20 Ridge of a recently logged coupe. This coupe is on the N-W side of Knight's Creek Rd mid-way between its junction with Lizard Rd and Smith's Rd (Fig. 14). The open ground, lack of vegetation and sparseness of the remaining trees are evident. Much of the ground cover comes from logging debris. The open foreground provides a sharp contrast with the unlogged coupe on the background slope

Unlike records made to calculate royalties of trees taken to the sawmills, there were no records of the size or species of timber taken to the chipmill. Only tonnage is recorded for royalties and, since 81% of the timber was pulped, the pre-woodchip character of the forest cannot be determined. A comparison with the coupes currently unlogged for woodchips allows a picture of the pre-woodchipped forest to be made, but this opportunity will be lost by the year 2002 on current plans.

Fire

Fires are common in the district. Lunney and Leary (1988) found 13 major fires mentioned in the historical records between 1865 and 1980, yet none has been recorded in detail. Fox (1978) recorded and published the effects of the major December 1972 fire in Nadgee Nature Reserve, 80 km to the south of Mumbulla State Forest, because he recognised the importance of the information for managers and researchers. Mumbulla State Forest has its own fire history, which was largely unrecorded before 1980, yet fire remains a recurrent management problem.

Fig. 21 A log dump (1980) with a partly loaded log truck, front-end loaders, and a small heap of debarked logs ready for loading. Near Murrah River (Fig. 14) (D.L.)

Fig. 22 Coupe on western side of Smith's Rd (shown in photo)(see Fig. 14) logged 5/1980 photographed 5/1980. Remaining large trees are stags (dead trees) and live trees are small saplings. The openness of the forest from canopy to the ground is apparent. Although not clearfelling, the site shows an intensive logging operation where all potential sawlogs and pulpable timber was removed in a highly mechanized operation (D.L.)

Table 1: Comparison of the timber volume (m^3/ha) and the number of trees (all species combined) in 3 000 m^2 in four size classes in each of six major habitats in Mumbulla State Forest. The 3 000 m^2 consisted of six randomly located quadrats, each 10 x 50 m.

Size class (DBHOB) (cms)	Ridge or Gully	Number of trees Unlogged	Logged	TSI
0 - 20	R	54	31	155
	G	112	16	142
21 - 40	R	38	17	14
	G	23	5	10
41 - 60	R	15	4	0
	G	8	4	7
60 +	R	3	0	1
	G	15	0	0
TOTAL	R	110	52	170
	G	158	25	164
Timber volume m^3/ha	R	134	41	8
	G	258	24	188

Note:
(i) Timber volume (m^3/ha) was obtained by a formula which used both DBHOB and tree height (R. Bridges, Forestry Commission, Eden, pers. comm.).
(ii) TSI = Timber Stand Improvement.
(iii) DBHOB = diameter at breast height over bark.

On 18 November 1980 a fire began near the middle of Mumbulla State Forest and burnt 5 554 ha of forest and part of some adjacent farms (Forestry Commission, 1980). Its extent and intensity, shown in Figures 23 and 24, had a major impact on the forest and altered the course of our studies on the effect of logging on wildlife. In this paper we detail the 1980 Mumbulla fire both for the historical record and because of its ecological significance to wildlife.

In late October and early November 1980 a census was carried out to determine the effect of logging on reptiles (Lunney et al., in press b). The census finished on 15 November, the fire broke out on 18 November and with the forest still smouldering in early December, the census was repeated. In the late afternoon of 18 November, the fire started in what is locally called 'blow-up' conditions. The following details were obtained from the 'Individual Fire Report',

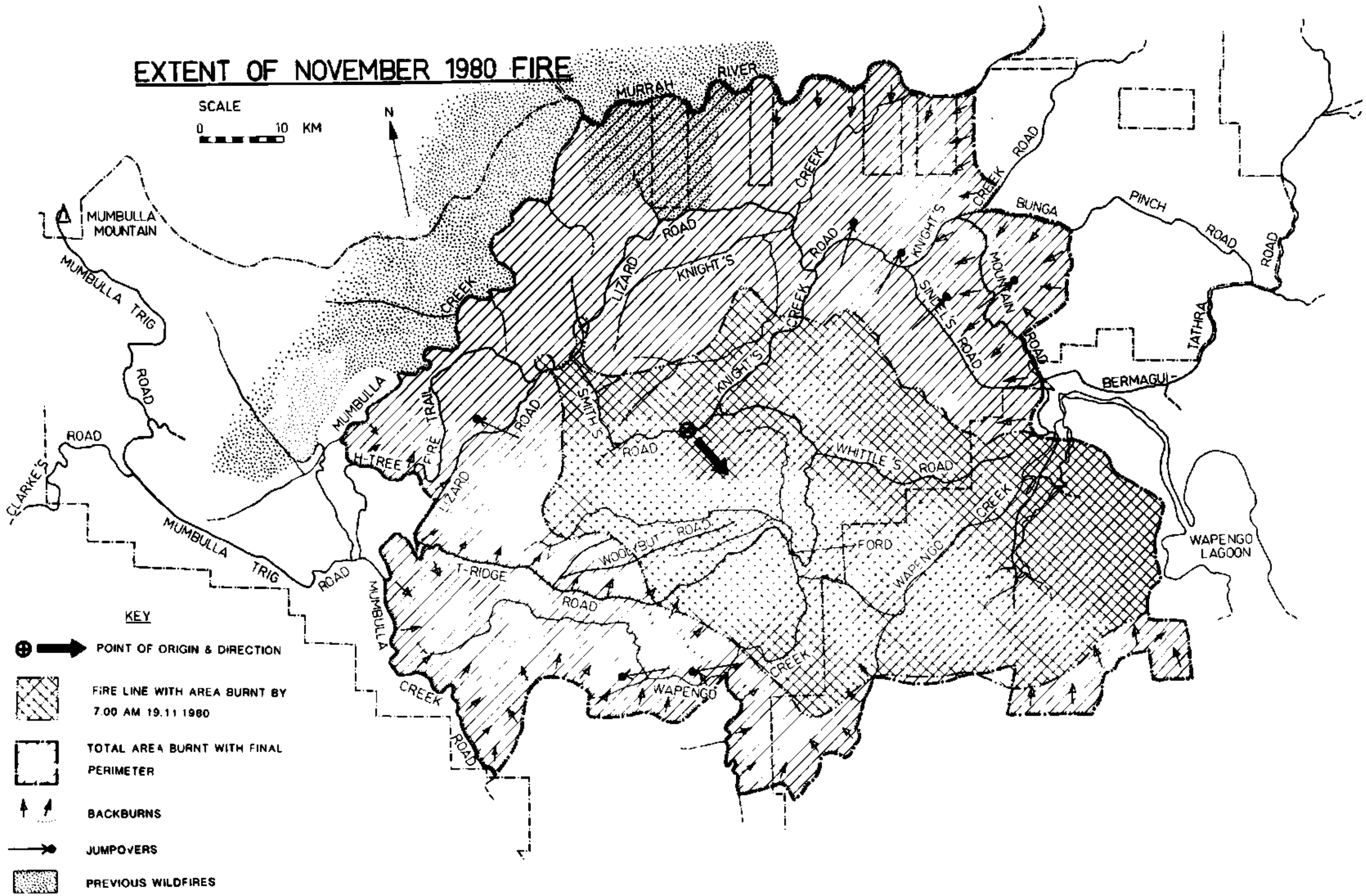


Fig. 23 *The extent of the fire which began in the late afternoon of 18/11/1980. The map shows the point of origin and direction, the area of initial burn (to 7 am, 19/11/1980), and the course of the fire, including back burns, jumpovers and area of total burn. An earlier fire in June-July 1980 on the northern edge of the forest is also shown (Source: Forestry Comm., NSW)*

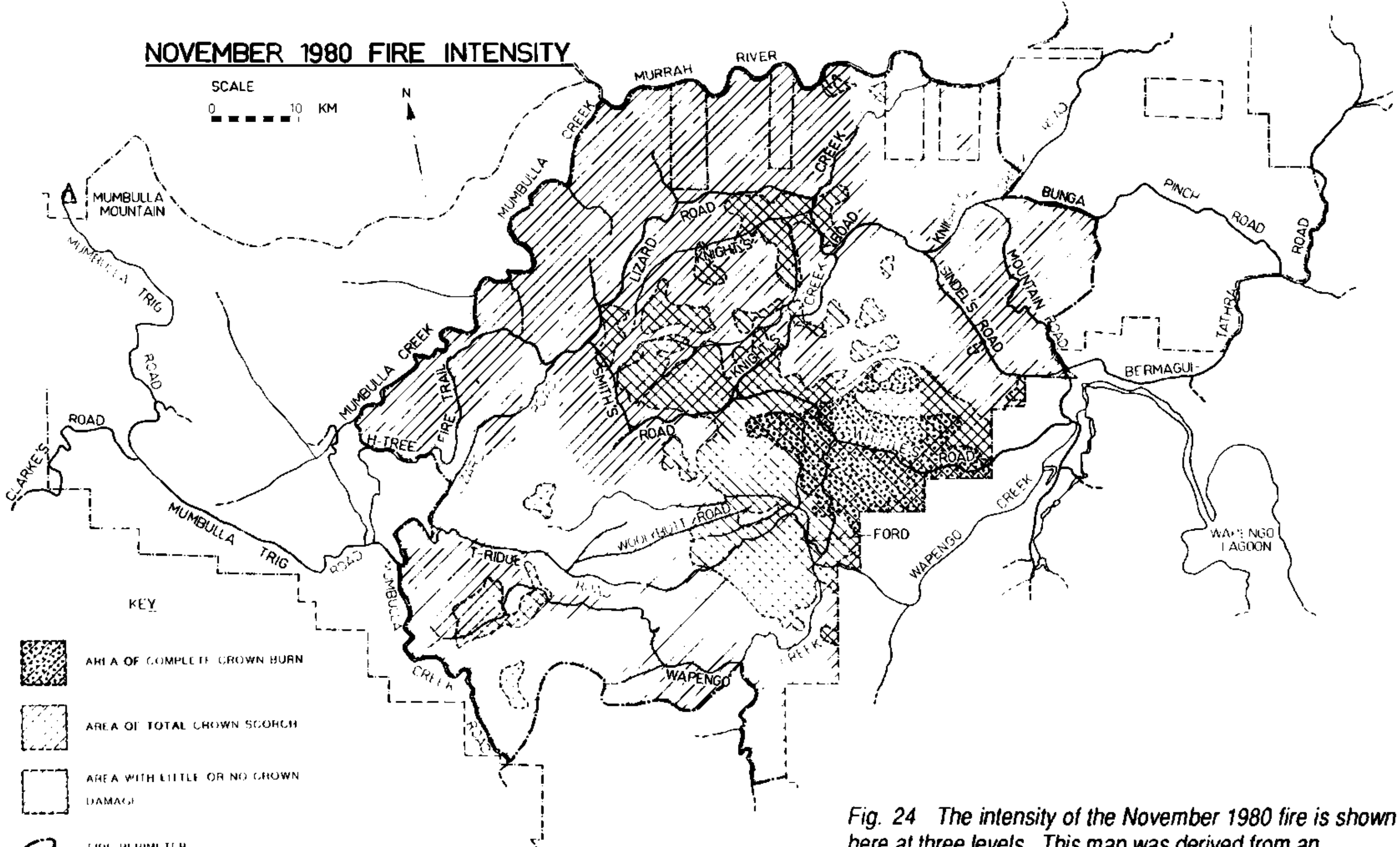


Fig. 24 The intensity of the November 1980 fire is shown here at three levels. This map was derived from an interpretation by Forestry Commission staff of air photos taken immediately after the fire (Source: Based on map prepared by Eden Regional Forestry Office)

map, and air photos prepared by the Bega district and Eden regional officers of the Forestry Commission, (Forestry Commission 1980).

At the time of the outbreak of the fire the Bega district had been drought-declared since the previous February. On the day of the fire a hot, dry wind was blowing at 90 km/hr from the north-west. The temperature was 41°C and the relative humidity was 15%. Further, the Commission report states that there were heavy fuel concentrations in the integrated logging and TSI areas. The cause of the fire, as stated in the Commission report, was: 'possible escape from bark heap but may have been deliberate arson. Evidence of ignition north of Lizard Road found on 19-11-80. Spots not consistent with natural spotting. Insufficient evidence to pursue matter further'. ('Spotting' is fire caused by airborne burning bark or leaves landing on unburnt forest and causing a fire outbreak). According to a Commission foreman, burning strips of Stringybark can carry fire for several kilometres (T. Sherwin, pers. comm., 1980). These burning incendiary torches are the bane of local firefighters, particularly when the wind changes direction and blows fire back across a firebreak.

The management practice in 1980 was to burn the heaps of bark and associated logging debris that was piled up by bulldozer on one edge of the log dump where logs are debarked and loaded onto trucks (Figure 25). These bark heaps are known to burn for as long as eighteen months, and we noted that some of the heaps were still glowing on 15 November, upwind of the point of origin marked on the map (Figure 23). It is easy to imagine high winds blowing sparks into the tinder-dry bush and thus starting a fire. Following the November 1980 fires (a fire started in a similar fashion, also on 18 November, in the Eden district), this practice ceased and bark was thereafter redistributed back onto the coupe. By the time fire crews could be contacted the fire was already extensive. With respect to damage, the fire report states that damage to private property was $48 000, but does not quantify timber losses. The changes to the forest following this fire are shown in Figures 26 to 30.

The available information on fire history shows that Mumbulla State Forest has experienced at least five fires in 40 years, each with a different pattern and intensity. A few parts of the forest have escaped fire, and some parts have burnt four times. Without adequate records of these fires the present condition of the forest is less easy to interpret. In order to provide more information about one of the most frequent and powerful influences on the forest, it is our view that the location, date and extent of all fires, including control burns, should be recorded, especially since the current plan of management contains a policy of allowing both pre- and post-logging control burning.

Wildlife

The large and conspicuous animals of the forest featured in Dowton's recollections and all of the species seen by Dowton were found during the National Parks and Wildlife Service studies (Lunney

Fig. 25
Burning bark heap in Mumbulla S.F. shortly after its ignition in June 1980. The size of these bark heaps, with dirt and log off-cuts, and their compaction, can keep them alight for up to 18 months - their cool, but thin and brittle, ash-dirt surface providing a dangerous cover to the hot coals below (D.L.)

Fig. 26 Burnt gully, two weeks after the fire in November 1980 - Smith's Rd in the background through unlogged forest. The leaves on the trees in this photo had been scorched and soon fell. The fire consumed litter and low vegetation (foreground) - some remnants of large logs remain. Reptile census work in progress (D.L.)

Fig. 27 The loss of ground cover from fire is apparent in this recently logged coupe marked out with reptile census plots. Intensity of fire was not sufficient to burn all vegetation such as large logs (D.L.)

Fig. 28 The impact of the fire in the TSI at the eastern end of the T- Ridge Rd (Fig. 14) is starkly shown by the complete loss of crowns in this 9 y.o. TSI stand. This area was in the path of the first 15 hours of the fire. All leaf litter and green vegetation was consumed (D.L., 12/1980)

Fig. 29 Regrowth 18 months post-fire in a gully logged in mid-1979. This coupe is near the eastern side of the tip of the north arm of Knight's Creek (Fig. 14). Unlogged gully in upper right corner. Burnt logs remain - as in mid-photo. Scat collection in progress for survey of habitat use by wallabies and wombats (D.L., 4/1982)

Fig. 30
Regrowth, 2 y. 8 mths post-fire, near site in Fig. 22. Wattles (Acacia spp.) and epicormic regrowth on eucalypts contribute much of the visible green regrowth , although in this area of forest there were 233 species of vascular plants 10 months after the fire (Lunney et al., 1989b)(D.L., 6/1983)

and Barker, 1986a,b, 1987). Our studies found 39 species of native mammals, 18 of reptiles, 10 of amphibians and 123 of birds in and near Mumbulla State Forest (Lunney and Barker 1986a,b, 1987; Smith, 1984). The design and interpretation of the Service's wildlife studies drew on the detailed historical information. For example, Smith (1984) concentrated on a comparison of the TSI and unlogged forest because he recognized that nearly all the forest would resemble the current TSI forest after the second logging cycle. Thus the avifauna of the current TSI stands gives an indication of the composition of the bird community of the forest in the early decades of the next century following the completion of the second cycle in 2002. Similarly, the mammal and reptile studies incorporated the TSI as a critical age-class because forests of the future would principally be young regenerating forests. Both tree-dwelling mammal species (Lunney, 1987) and ground-dwelling species (Lunney et al., 1987; Lunney and O'Connell, 1989) were found to be significantly different in the TSI compared to either unlogged or recently logged forest. Reptile species also showed a clear response to TSI, and the three commonest species were found to be comparatively rare because of the shading of the regrowth in the TSI (Lunney et al., in press b). However the mammal and reptile studies also concentrated on the immediate effects of logging because, within a period of five years (1977-1982), about one-third of the forest was transformed into the just-logged and then the recently-logged state. The results of the various studies showed that each age class presented different habitats to different species, and all species studied were found to be affected by logging and fire. Throughout the studies, part of the forest was classified as 'unlogged' in relation to recently woodchipped or TSI forest. However, it is recognized that 'unlogged' refers to forest with a logging history of sleeper-cutting and crown logging and thus represents a forest already modified from its pre-European condition.

With the second cycle there will be a much lower density of large trees and a greater density of small and medium-sized trees. This has important implications when it is considered that the numbers of many vertebrate species were related to the presence of large trees. For example, some species of bats (Lunney et al., 1985, 1988), possums and gliders (Lunney, 1987) and birds (Smith, 1984, 1985) were shown to be dependent on large or very large trees. While it was concluded in these studies that continued logging would create habitat inimical to their survival, it is also fair to conclude, on the basis of this forest history, that their populations would have been higher early last century than were recorded for the 'unlogged' coupes of the first logging cycle. Also, the large difference between the numbers of possums and gliders found in Mumbulla and Tanja Forests compared to those of the relatively untouched forests of the high country in the south-western part of the Eden region (Braithwaite, 1983) may not originally have been as great. As Mumbulla State Forest was already partially depleted of wildlife prior to woodchipping, a wildlife manager would need to consider not only the forest's pre-woodchip wildlife status, but also its pre-European wildlife status in any program of rehabilitation and setting aside of fauna refuges.

MANAGEMENT CONSIDERATIONS

At the onset of woodchipping in the Eden region in 1969 there was little ecological information on the forests of the region and no coherent picture against which to prepare a plan of management. It is not surprising, then, that the first plan was not produced until 1976 (Forestry Commission, 1976). Even the current plan (Forestry Commission, 1982) draws on very limited background information and the map of Mumbulla shows little more than the TSI area of the Dowton years.

Woodchipping may not be an industry that will run for many centuries, yet the forests of the region could be there in perpetuity, if managed properly. In 1997 Mumbulla State Forest is due for the second logging cycle for woodchips, and by 2002 all the currently unlogged alternate coupes will be logged. Thus the forest at that stage will primarily consist of coupes with 20-25 years regrowth, coupes with 0-5 years regrowth and TSI with 29-38 years regrowth. It will hardly resemble the forest as Dowton knew it upon his retirement in 1976. It is our view that representative parts throughout the forest should be set aside from the woodchip operations to retain samples of pre-woodchipped forest. These reserved areas will contain many values, such as for wildlife, and will be a benchmark for future managers and forest ecologists. We also strongly suggest that, since Mumbulla and other state forests of the region are being rapidly transformed by woodchipping without a detailed forest-by-forest account of logging and fire, there is an urgent need to record the pre-woodchip history and to better document the current timber taken. If such options for reservation and historical work are ignored, the value of the forests could be underestimated and their long-term potential, other than for woodchipping, would be diminished.

In the decade since the results of the Senate enquiry into woodchipping and the environment were published (Senate Standing Committee on Science and the Environment, 1977), inadequate progress has been made in addressing those ecological issues identified by the enquiry as matters for investigation. It is our view that a better ecological appreciation of all the forests of the region would be obtained by a careful chronological recording of their logging and fire history, and an evaluation of these effects from an ecological perspective. Environmental impact statements of forests should contain, or be based on, their detailed history because it is much harder to predict future impacts without knowing what affected them in the past. In Mumbulla State Forest we have made a start to indicate that such an approach is possible. Its value will become more apparent as the application of forest history becomes more sophisticated.

A forest in the British sense of the word was originally a place inhabited by the King's (or some other lord's) deer and was a legal term relating to special laws governing a tract of land (Rackham, 1980). The common terms referring to countryside with trees are 'woods' or 'woodland'. Of particular relevance to Australia are the British terms 'wildwood', i.e. post-glacial prehistoric woodland,

and 'ancient woods', i.e. those woods that came into existence before about 1700 (Rackham, 1980). Ancient woods may be primary, i.e. remnant wildwood, or secondary, e.g. previously farmland or moorland. Since it is difficult to prove that a wood is primary, the term 'ancient' is used. As recognized by Rackham (1980) and Peterken (1981), ancient woodland is a small and precious resource. From this British perspective, Mumbulla State Forest is an ancient woodland with pockets of wildwood, and although it may not be viewed locally as precious it will, in our judgment, be seen as such in future centuries. Its value will be further enhanced by continuing to record and publish its history, its current logging operations and its fires, and by including the historical viewpoint when considering future management options.

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REFERENCES

Braithwaite, L.W., 1983 Studies on the arboreal marsupial fauna of eucalypt forests being harvested for woodpulp at Eden, N.S.W. I. The species and distribution of animals, Aust. Wildl. Res. 10: 219-29.

Byrne, D., 1983 The Five Forests: An Archaeological and Anthropological Investigation (National Parks and Wildlife Service (N.S.W.) Sydney).

Calaby, J.H., 1977 Changing the face of the Continent, Aust. Nat. Hist. 19: 62-5.

Carron, L., 1985 A History of Forestry in Australia (ANU Press, Canberra).

Dargavel, J., (Ed.) 1988 Sawing, Selling and Sons (Centre for Resource and Environmental Studies, ANU, Canberra).

Dowton, E., 1971 Compartment Notes on Mumbulla State Forest Unpublished document. Original with Mr E. Dowton, copies with Forestry Commission Bega and National Parks and Wildlife Service Sydney.

Egloff, B.J., 1981 Mumbulla Mountain. An Anthropological and Archaeological Investigation, Occasional Paper No. 4., National Parks and Wildlife Service, Sydney.

Forestry Commission, 1976 Management Plan for South-East Hardwood, Pulpwood and Sawlog Management Area (Forestry Commission of NSW, Sydney).

Forestry Commission, 1980 Individual Fire Report Unpublished report. Bega Forestry Office. Copy with National Parks and Wildlife Service, Sydney.

Forestry Commission, 1982 Eden Native Forest Management Plan (Forestry Commission of NSW, Sydney).

Forestry Commission, 1986 Supplementary document to Harris-Daishowa (Australia) Pty. Ltd. Draft environmental impact statement for the Eden (NSW) export woodchip operation for the period 1989-2009. (Forestry Commission of NSW, Sydney).

Fox, A., 1978 The '72 fire of Nadgee Nature Reserve, Parks and Wildlife 2: 5-24.

Frith, H.J., 1979 Wildlife Conservation (2nd Ed.) (Angus and Robertson, Sydney).

Hannah, H., 1986 Forest Giants (Forestry Commission of NSW, Sydney).

Harris-Daishowa, 1986 Draft Environmental Impact Statement for the Eden (NSW) Export Woodchip Operation for the Period 1989-2009 (Harris-Daishowa Australia Pty Ltd, Eden).

Hudson, I., and Henningham, P., 1986 Gift of God - Friend of Man. A Story of the Timber Industry in New South Wales, 1788-1986 (Aust. For. Ind. J. Ltd., Sydney).

Lunney, D., 1983 Wildlife Research in the Five Forests, Forest and Timber 19: 18-19.

Lunney, D., 1987 Effects of logging, fire and drought on possums and gliders in the coastal forests near Bega, New South Wales, Aust. Wildl. Res. 14: 263-74.

Lunney, D., 1989 Kangaroos, wallabies and rat kangaroos: their past, present and future in the Woodchip Agreement Area of the Eden region, south-east New South Wales, in Grigg, G., Jarman, P. and Hume, I. (eds) Kangaroos, Wallabies and Rat Kangaroos (Surrey Beatty & Sons, Sydney) (in press).

Lunney, D. and Ashby, E., 1987 Population changes in Sminthopsis leucopus (Gray) (Marsupialia: Dasyuridae) and other small mammal species, in forest regenerating from logging and fire near Bega, NSW, Aust. Wildl. Res. 14: 275-84.

Lunney, D. and Barker, J., 1986a Survey of reptiles and amphibians of the coastal forests near Bega, NSW, Aust. Zool. 23: 41-49.

Lunney, D. and Barker, J., 1986b Mammals of the coastal forests near Bega, New South Wales. I. Survey, Aust. Zool. 23: 19-28.

Lunney, D. and Barker, J., 1986c The occurrence of the Golden-tipped bat Phoniscus papuensis (Dobson) (Chiroptera: Vespertilionidae) on the south coast of NSW, Aust. Mammal. 9: 57-8.

Lunney, D. and Barker, J., 1987 Mammals of the coastal forests near Bega, New South Wales. II. Annotated checklist, Aust. Zool. 23: 41-9.

Lunney, D. and Leary, T., 1988 The impact on native mammals of land-use changes and exotic species in the Bega District (New South Wales) since settlement, Aust. J. Ecol. 13: 67-92.

Lunney, D. and Leary, T., in press Movements of the White-footed Dunnart Sminthopsis leucopus (Marsupialia: Dasyuridae) in a logged, burnt forest near Bega on the south coast of New South Wales, Aust. Wildl. Res.

Lunney, D. and Moon, C., 1987 The Eden woodchip debate (1969-86), Search 18: 15-20.

Lunney, D. and O'Connell, M., 1989 Habitat selection by the Swamp Wallaby (Wallabia bicolor), the Red-necked Wallaby (Macropus rufogriseus) and the Common Wombat (Vombatus ursinus) in logged, burnt forest near Bega, New South Wales, Aust. Wildl. Res. (in press).

Lunney, D., Ashby, E., Grigg, J. and O'Connell, M., 1986 Food availability and habitat selection of Sminthopsis leucopus (Gray) (Marsupialia: Dasyuridae) in logged forest of south coastal NSW, Aust. Mammal. 9: 105-10.

Lunney, D., Ashby, E., Grigg, J. and O'Connell, M., in press (a) Diets of the Scinid lizards Lampropholis guichenoti (Dumeril and Bibron) and L. delicata (de Vis) in Mumbulla State Forest on the south coast of New South Wales, Aust. Wildl. Res.

Lunney, D., Barker, J. and Leary, T., 1988 Movements of banded bats (Microchiroptera: Vespertilionidae) in Mumbulla State Forest near Bega, New South Wales, Aust. Mammal. (in press).

Lunney, D., Barker, J. and Priddel, D., 1985 Movements and day roosts of the Chocolate-wattled Bat Chalinlobus morio (Gray) (Microchiroptera: Vespertilionidae) in a logged forest, Aust. Mammal. 8: 313-17.

Lunney, D., Barker, J., Priddel, D. and O'Connell, M., 1989a Roost selection by Gould's Long-eared Bat Myctophilus gouldi Tomes (Chiroptera: Vespertiliondae) in logged forest on the south coast of New South Wales, Aust. Wildl. Res. (in press).

Lunney, D., Cullis, B. and Eby, P., 1987 Effects of logging and fire on small mammals in Mumbulla State Forest, near Bega, New South Wales, Aust. Wildl. Res. 14: 163-81.

Lunney, D., Eby, P. and O'Connell, M., in press (b) Effects of logging, fire and drought on three species of lizards in Mumbulla State Forest on the south coast of New South Wales, Aust. J. Ecol.

Lunney, D., O'Connell, M., Saunders, J. and Forbes, S., 1989 (b) Habitat of the White-footed Dunnart Sminthopsis leucopus (Dasyuridae: Marsupialia) in a logged, burnt forest near Bega, New South Wales, Aust. J. Ecol. (in press).

National Parks and Wildlife Service, 1983 Biamanga Aboriginal Place - Management Plan (National Parks and Wildlife Service (N.S.W.), Sydney).

Peterken, G., 1981 Woodland Conservation and Management (Chapman and Hall, London).

Rackham, O., 1980 Ancient Woodland, its History, Vegetation and Uses in England (Edward Arnold, London).

Rackham, O., 1986 The History of the Countryside (J.M. Dent & Sons, London).

Recher, H.F., Lunney, D., Smith, P. and Rohan-Janes, W., 1981 Woodchips or wildlife? Aust. Nat. Hist. 20: 238-244.

Senate Standing Committee on Science and the Environment, 1977 Woodchips and the Environment (AGPS, Canberra).

Smith, P.J., 1984 The forest avifauna near Bega, New South Wales. I. Differences between forest types, Emu 84: 200-210.

Smith, P.J., 1985 Effects of intensive logging on birds in Eucalyptus forest near Bega, New South Wales, Emu 85: 15-21.

Smith, P.J., 1986 Woodchip Logging and Birds near Bega, New South Wales, in Keast, A., Recher, H.F., Ford, H. and Sanders, D. (eds), Birds of Eucalypt Forests and Woodlands: Ecology, Conservation and management (R.A.O.U., Surrey Beatty & Sons, Sydney): 259-271.

Smith, P.J., 1988 Changes in a forest bird community during a period of fire and drought near Bega, New South Wales, Aust. J. Ecol. (in press).

Wells, K., Wood, N. and Laut, P., 1984 Loss of Forests and Woodlands in Australia: A summary by state, based on rural Local Government Areas. CSIRO Division of Land and Water Resources Techn. Mem. 84/4 (CSIRO, Melbourne).

Williams, L.O., 1922 Report on Mumbulla State Forest No. 605. Unpublished report, Forestry Commission of NSW, Sydney (Also copy in NPWS files).

THE STATUS OF CASUARINACEAE IN AUSTRALIAN FORESTS

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INTRODUCTION

In Australia the genus Casuarina (sensu lato) is almost as ubiquitous as the two other important Australian genera, Acacia and Eucalyptus. In terms of number of species Casuarina is far less prolific than Acacia or Eucalyptus. However in ecological terms the genus occupies a much wider range than do either of these taxa.

The family Casuarinaceae occupies an isolated position in the flowering plants and no strong relationships to other taxa are apparent (Barlow, 1983). Johnson (1982) proposed that the family comprised four genera, Gymnostoma, mainly New Guinea and Malesia; Casuarina, Australia and the islands of the Indian and Pacific Oceans; Allocasuarina, Australia and 'genus C', Malesia. Whether making the distinction between Allocasuarina and Casuarina is necessary or useful is open to debate. In this paper I will restrict myself to the earlier nomenclature, as most of the published work from which I derive information was written before Johnson's views were published.

In prehistorical terms the first records of the Casuarinaceae occur in the early Tertiary (Martin, 1982), in the Palaeocene. However the taxon must have been present earlier, as there are reliable records from South America (Christophel, 1980), South Africa (Coetzee and Praglowski, 1984) and New Zealand (Campbell and Holden, 1984) in the Tertiary which are most easily explained by the Casuarinaceae being a Gondwanan family appearing sometime in the Cretaceous. The family has now become extinct in South America, New Zealand and South Africa. In all cases where macrofossil evidence is available the earliest records are of Gymnostoma types (e.g. Christophel, 1980) and it may be that Gymnostoma was the only taxon present outside Australia prior to the Miocene, while the development of Casuarina was an Australian phenomenon later in the Tertiary, with subsequent extension of taxa such as C. equisetifolia to more distant areas.

Singh and Geissler (1985) have proposed that Casuarina species rather than eucalypt species were the main dominants of sclerophyll forests before Aborigines arrived in Australia and increased the frequency of fires. This proposal is examined in relation to the ecology of species in the group.

Casuarina species are widespread in Australia and grow over a wide range of soil types and climatic zones. Many are shrubs which grow on extremely nutrient-poor soils. However, the tree species occur from quite nutrient-rich soils to nutrient-poor, deep sands.

In this paper only the tree species will be considered, with emphasis on taxa which grow in forest zones rather than the drier woodland areas.

Interest in the Casuarinaceae has been low in the past. However, more recently attention has been somewhat more focused on the members of the family because of the value of some species for planting in land reclamation, as wind breaks and for fuel wood plantations, especially in Third World countries. In addition the interest in nitrogen-fixing plants has spurred on research into the Casuarina-Frankia symbiosis and much of the earlier and recent work has been brought together in Midgley et al. (1983). However the interest in nitrogen fixation has not been paralleled by an interest in the general ecology of the group.

DISTRIBUTION OF THE FOREST SPECIES IN AUSTRALIA

The Casuarina species which form, or occur, in forests in Australia occupy a wide range of habitats, from saltmarshes, coastal sand dunes and coastal headlands through dry to quite wet open forests (particularly in the north and south-west). Towards the drier inland C. cristata, C. luehmannii and C. inophloia occur as dominants or codominants with other species in woodlands, while C. decaisneana in central Australia occupies the ostensibly driest sites of any Casuarina species.

As a first source for information on the distribution and ecological association of Casuarina species, Vegetation of Australia (Beadle, 1981) is most useful. In addition Boland et al. (1984) give fairly detailed descriptions of five species while the book Casuarinas: Nitrogen-fixing Trees for Adverse Sites, published by the National Academy Press, Washington also contains general information about a number of tree species.

Casuarina species vary in their importance in Australian forests depending on species and location. Importance is of course a relative term and can be considered in terms of height dominance or proportion of basal area. In almost all cases of forested areas Casuarina species are not the tallest trees. Most co-occurring eucalypts grow taller than casuarinas. However, in basal area terms, Casuarina species may be more important than associated species.

In the parts of Australia which can be deemed areas capable of supporting forest, only C. cunninghamiana can be considered to visually dominate the vegetation over an extensive range. It is the sole dominant in river valleys along the east coast and onto the western plains until Eucalyptus camaldulensis replaces it further inland. In lowland sheltered valleys east of the Great Dividing Range it is replaced by rainforest, while in less sheltered places and particularly where saline water becomes influential it is replaced by C. glauca. This latter species occurs around saltmarshes and in areas subject to seasonal waterlogging close to the east coast. In the west C. obesa tends to fulfil the role of both these previous species. Although it is likely that there is considerable ecotypic variation in salinity tolerance in C. obesa it tends to be ecologically most similar to C. glauca, perhaps because salinity levels in water bodies in Western Australia are generally higher than on the east coast.

Table 1 summarizes information about the main species discussed in this paper. Table 2 gives some idea of the variability in basal area proportion which Casuarina can comprise in various forests. In general, total basal area is low (below 15 m^2/ha) on rocky sites and on deep sand where Casuarina is over 40% and may be over 90% of the basal area. Soil pH values were variable between the sites which were studied and showed no clear pattern associated with total basal area or proportion of Casuarina on the site.

In terms of their habitat and range C. stricta and C. huegeliana seem to be sister species. C. huegeliana is usually dominant on shallow acidic soils, often over rock in the western part of the Western Australian wheatbelt, but may be found on deep sandy soils in the drier east. In contrast C. stricta occurs on a wide variety of rock types from basalt to granite and also calcarenite. This gives a wide range of pH and also encompasses a wide range of climatic zones. However in the wetter zones the species is likely to be common only on the sites which seem to be less favourable to potential competitors such as eucalypts, so that the species is found dominant on rocky, exposed headlands or coastal heaths on infertile duplex soils, or on high pH soil over calcarenite. On high nutrient sites in drier areas, such as the basalt plains, C. stricta may be dominant in places but is frequently subdominant to species like Eucalyptus viminalis.

Casuarina littoralis and C. fraseriana also seem to be a matched pair, although there are a number of differences such as the high fire resistance in C. fraseriana versus the lower resistance of C. littoralis. In Western Australia when growing with eucalypts C. fraseriana is an understorey tree. However on the sand plains such as the Swan coastal plain it may be codominant with Banksia species where eucalypts are small or absent. C. littoralis is almost always an understorey tree, subdominant to various eucalypt species. However in north Queensland, as in the case of C. stricta in Victoria, C. littoralis occurs in scrubs and shrublands on exposed sites (Turnbull, 1986). In the south it may sometimes become dominant in special situations (e.g. Withers and Ashton, 1977).

Casuarina decussata (south-western) and C. torulosa (north-eastern) may also be considered vicariants, at opposite ends of the continent, with a close similarity in form and restriction to fairly wet forests. Both are exclusively understorey species - C. decussata occurring in karri forest and C. torulosa associated with a wide range of eucalypt species at the wetter end of the open forest range.

Table 1 Fire and soil related factors in Casuarina

Taxon	Eastern or Western equivalent species	Noble & Slatyer (1980) strategy	Suckers or Sprouts without disturbance	Suckers or Sprouts after fire	Serontinous 'cone'	Soil Type
C.decussata	C. torulosa	UT or WT	-	+	+	Neutral soil Krasnozem-type
C.fraserianna	C.littoralis	WT or UT	-	+	-	Acidic to alkaline sand and ironstone
C.torulosa	C.decussata	UT or WT	-	+	+	Acidic duplex soils
C.littoralis	C.fraseriana	VT	-	+	+	Acidic duplex soils
C.stricta	C.huegeliana	VT	+	+	+	Acidic to alkaline clays, rocks or deep sands
C.huegeliana	C.stricta	CT	-	-	+	Acidic shallow soil over rock deep sand
C.obesa	C.glauca/ C.cunninghamiana	CT	+	-	+	Saline clays
C.glauca	C.obesa	VT	+	+	-	Saline clays
C.cunninghamiana	C.obesa	DT	-	-	-	Acidic sands to silty sands
C.equisetifolia	-	DT	+	-	-	Alkaline sands

Key to Symbols in Table 1:

U - plant can survive a disturbance by vegetative means and if mature at the time of the disturbance will remain reproductively mature.
W - plant can survive a disturbance by vegetative means as a mature individual which will remain reproductively mature.
V - plant can survive a disturbance by vegetative means but will need to grow for some time before it is able to reproduce.
C - plants can only regenerate from a short lived propagule pool after a disturbance.
D - plants are killed by a disturbance but have widely dispersed propagules.
T - plants can establish immediately after a disturbance and can continue to establish and grow as the community in which they grow matures.

Table 2 Proportion of <u>Casuarina</u> in forests

Site	Species	Total Basal Area (all species) m^2/ha	% Casuarina	Soil Type	PH A Horizon
Ocean Grove[2] (Woodland), Vic.	<u>C.stricta</u> <u>C.littoralis</u>	14.4	24.7	Duplex sandy loam over clay	5.1
Scrub[2]	<u>C.stricta</u> <u>C.littoralis</u>	15.7	27.7 38.9	Duplex sandy loam over clay	4.9
Carisbrook Ck. Otways, Vic.	<u>C.stricta</u>	16.5	92.9	Loam over arkosic sandstone	6.5
Wilsons Prom, Vic.	<u>C.stricta</u>	21.7	55.2	Sand over granite	7.5
Wilsons Prom, Vic.	<u>C.stricta</u>	23.4	69.8	Sand over granite	5.3
Yanakie, Vic.	<u>C.stricta</u>	8.3	44.1	Deep sand	9.3
Brisbane Ranges Vic.	<u>C.littoralis</u>	21.8	14.0	Duplex sandy loam over clay	5.9
Ashendon, WA[1]	<u>C.fraseriana</u>	31.0	6.5	Thin sand over ironstone	?
Dryandra, WA	<u>C.huegeliana</u>	14.4	91.3	Loamy sand over granite	?

1 Abbott (1984)
2 Withers and Ashton (1977)

ANATOMY AND WATER RELATIONS

The general morphology of Casuarina is clearly xeromorphic. The stomata occur in the sides of deep grooves along the long axes of the branchlets. On the sides of these grooves the stomata are very dense but in all cases single or forked hairs are also densely packed in the grooves, presumably enhancing the boundary layer effect. The branchlets are very sclerophyllous, having a foliage area (1/2 cylinder area) to weight ratio of 67.7 cm^2/g (juvenile) and 37.7 cm^2/g (adult) for foliage of C. stricta. In contrast a relatively drought-tolerant eucalypt E. goniocalyx has values of 100.3 and 53.7 respectively (Ashton et al., 1975).

The chlorophyllous tissue within the Casuarina branchlet occupies a zone between the edge of the groove and the central part of the ridge between two adjacent grooves. In many species a strand of sclerenchyma extends from the central cortical tissue into a 'T-shaped' structure at the ridge. This isolates the chlorenchyma on either side of the ridge. As is the case in many other Australian taxa there is virtually no spongy mesophyll and the intercellular space percentage is very low - another xeromorphic trait.

Cuticular transpiration in C. stricta from Mt Towrong (Victoria) is much lower than in eucalypt species from the same site (Ashton et al., 1975). Combined with the enclosed stomata low cuticular transpiration would seem to ensure very effective water conservation.

This was supported by field and experimental studies. In an examination of drought damage to trees on Mt Towrong it was found that in the four main species present the severity of drought damage was in the order of E. obliqua, E. radiata, E. goniocalyx and C. stricta from most to least damage. In fact C. stricta was not affected at all, despite growing on the most inhospitable, shallow soils (Ashton et al., 1975). The authors also considered that the associated experimental work on seedlings of the species involved supported the notion that 'from every point of view C. stricta seemed to be the best adapted species to drought'. Kirkpatrick and Backhouse, A.D., p. 63 state that C. stricta 'is probably the most drought-resistant tree species in Tasmania'. In a study of drought damage on dolerite soils near Hobart, Kirkpatrick and Marks (1985) determined that C. stricta as a shrub or tree was more drought-resistant than virtually all the other taxa in the study area. In its early growth C. stricta produces a much longer root than do co-occurring ecualypts, which is also a mechanism likely to help in drought resistance (Ashton et al., 1975).

There has been virtually no study of the water relations of Casuarina species in the field. Withers (1978b) compared the water potential of C. littoralis and E. ovata using a dew-point microvoltmeter. Despite taking measurements over seven weeks during summer in southern Victoria the trees were not under particularly strong water stress and there was no significant difference between the values for the two species. Water potential of C. littoralis was generally slightly lower than that of E. ovata and ranged from -1.7 to

-2.5 MPa over the seven-week period. On the shore of Lake Toolibin (Western Australia) C. huegeliana grows on deep sand soils (Froend et al., 1987). During winter water potential values were between 0 and -0.5 MPa on two study days, while in March (dry autumn) values fell to as low as -1.9 MPa at one site. C. obesa on more saline and waterlogged sites developed much more negative water potentials at the same time (down to -2.0 MPa on soils of 0.1% salinity). However neither species was particularly stressed. In comparison E. rudis growing on soils of 0.07% salinity showed very low vigour and minimum water potential in the middle of the day in March of approximately -2.3 MPa. On soils of higher salinity (0.27 - 0.3%) C. obesa showed considerably decreased vigour and water potentials in March ranged from approximately -2.1 to -2.9 MPa throughout the day, so these plants were considerably water-stressed. Even in winter the water potential values were below -1.0 MPa at all times from 700 to 1500 hours. From this study C. obesa is clearly more salt-tolerant than the eucalypt but does suffer water balance problems during dry times in soils of over 0.13% salinity.

As a comparison water-stressed eucalypts from a relatively dry area of Victoria developed water potentials down to -4.13 MPa (Myers and Neales, 1984) and Callitris columellaris, which has a similar foliage form to Casuarina and behaves rather similarly, may reach values of -6.58 MPa during a drought (Attiwell and Clayton-Green, 1984). Clearly C. obesa is damaged at much less severe water potentials than are some eucalypts and Callitris columellaris but there may also have been toxicity problems engendered by the saline soils at the Toolibin site.

CASUARINA, CALCAREOUS SOIL AND COMPETITION

There has been no formal study of the soil pH preferences of Casuarina species. However both C. fraseriana and C. stricta grow on soils derived from limestone or on calcareous sands. Since both these species also grow on very acidic soils there are likely to be physiological ecotypes; however this has not been tested. In rainfall zones where C. stricta is either not present on acid soils or is restricted to the understorey of eucalypt forests it is often the dominant species on alkaline soils, e.g. coastal western Victoria, Yanakie Peninsula (Victoria), Flinders Island (Tasmania). As eucalypt species are in general known not to be very tolerant of high pH soils (Pryor 1976) it may be that C. stricta has been able to survive in these special locations due to lack of competition from eucalypts. It is important to note that in Western Australia E. gomphocephala (tuart) is highly successful on south western coastal calcareous soils. C. fraseriana and tuart have overlapping ranges. In prime tuart areas C. fraseriana is not present in tuart forest despite the fact it does occur in adjacent jarrah forest on acid soils. However, towards the north in the drier end of the tuart range, near Perth, it is subdominant under tuart with Banksia species.

This aspect of competition is probably of importance in the interaction of all Casuarina species with other taxa. In a comparison of seedling growth rates between E. ovata, C. littoralis and Acacia pycnantha the relative growth rates for each species were not significantly different (Withers 1978) in one trial, but in another concerned with shading, the relative growth rate (RGR) of E. ovata was greater than that of the other two species and C. stricta (Withers, 1979a). In this case partial shading (30% full sun) increased the leaf RGR of the Acacia and Casuarina species, although total RGR was still lower than in full sun. However, in all cases of full sun conditions dry weight productivity was much less in Casuarina than for E. ovata or Acacia pycnantha.

The whole growth form and branchlet morphology of Casuarina leads to a slow rate of photosynthetic area production and hence it is likely to be a poor competitor for light when grown with species which rapidly produce broad leaves. Some Casuarina species may be able to cope with quite low light intensity and still maintain fairly normal growth rates. Casuarina cunninghamiana was only significantly affected by shading at a very low light intensity as shown in Figure 1. Growth was only significantly decreased at 5% of the control light level. In the study by Withers (1979a) it was shown that 30% shading for 9 months increased the height growth of C. stricta and C. littoralis seedlings while the dry weight of C. stricta decreased relative to the control, but there was no effect on C. littoralis. In contrast, the dry weight and height growth of E. ovata in the same experiment decreased markedly with respect to the control. In other growth trials (Withers, 1979b) the greater shade tolerance and slower growth rate of C. littoralis in relation to E. ovata was considered to be a major factor in the greater survival of C. littoralis seedlings in the Ocean Grove area of Victoria, under conditions of a dense grass sward or dense overstorey canopy.

FIRE RESISTANCE

The range of responses of Casuarina to fire is just as wide as that of the eucalypts.

Casuarina fraseriana is particularly fire-resistant, sprouting from epicormic buds after extremely fierce fires. Singh and Giessler (1984) noted that C. stricta will sprout from the base after fire and there is good evidence of this along the Otways coast (Victoria) where the extremely destructive 'Ash Wednesday' fires in 1983 destroyed stands of C. stricta facing the ocean. Most of these trees have now resprouted from their bases (Figure 2). The majority of shrub species (e.g. C. humilis, C. paludosa, C. nana) regenerate from basal lignotuber-type structures after the tops are burnt, but some tree species are fairly sensitive to fire. Within the tree group, as is shown in Table 1, there is a division between those with serotinous infructescences and those without. The forest species which grow with eucalypts (except C. fraseriana) display serotiny. C. littoralis, C. stricta, C. huegeliana and C. torulosa may shed seed throughout the year but always have a carry-over of seed in the canopy. However taxa such as C. cunninghamiana, C. cristata and C. equisetifolia all shed seeds soon after the 'cones' are mature. Most of the Casuarina (sensu stricto) group are not serotinous, but C. obesa retains 'cones' over several years and, although adults are killed after a fire, it has been

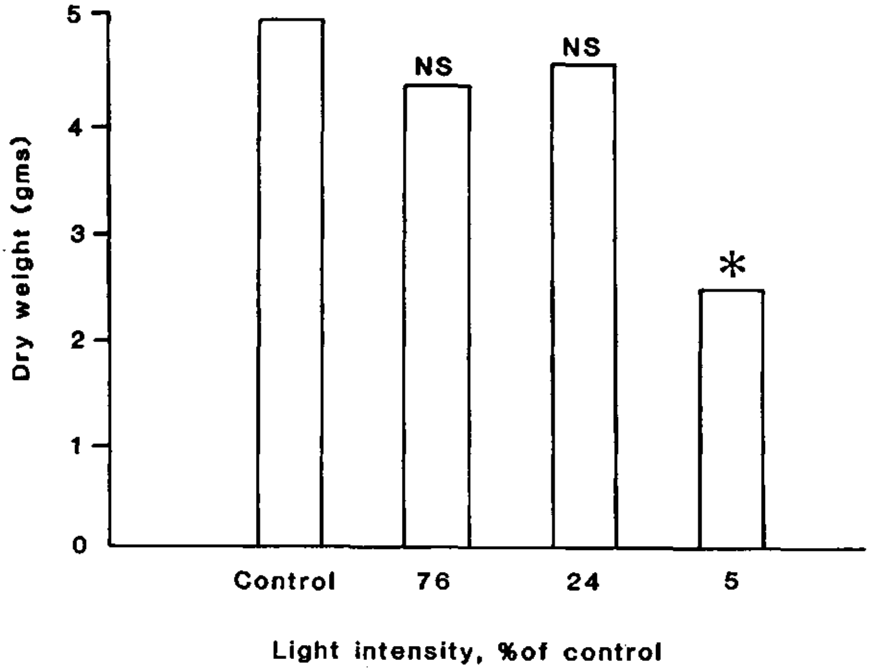


Fig. 1 *Shoot dry weight of Casuarina cunnninghamiana seedlings under different shading regimes (NS - not significant, * - significantly lower value [P< 0.01] based on a t-test)*

observed to regenerate prolifically from seed after a fire at Bindoon (Western Australia).

The vital attribute scheme of Noble and Slatyer (1980) can be applied to Casuarina species and a comparison made with the groupings apparent in the eucalypts. At least five groups can be recognised in Casuarina (Table 1) which have corresponding examples in Eucalyptus. The main difference in this context between the two taxa is that in general eucalypts can only establish for a short time after any disturbance and hence are 'I species' while Casuarina species can generally establish at any time after a disturbance (T species), even though many species establish more prolifically soon after a disturbance such as fire.

Most eucalypts are UI (e.g. E. obliqua) or VI (mallees) species - i.e. they store seed in capsules in the canopy and will regenerate vegetatively after a fire. The corresponding casuarinas are C. torulosa (UT) and C. stricta (VT). The abundance of C. torulosa in the understorey of many wetter northern forests is considered to be due to the frequency of fire (Beadle, 1981), which relaxes the competitive pressure on this species from rainforest species.

Less common in eucalypts are the WI (E. diversicolor) and CI (E. regnans, E. grandis) strategies. In the casuarinas C. fraseriana is WT or UT, while C. huegeliana is clearly a CT species being very fire sensitive.

Fig. 2 *Casuarina stricta regeneration (January 1988) from the base of stems killed in the 1983 Ash Wednesday fires on a slope facing the ocean at eastern view - Otways coast, Victoria*

Taxa such as C. cunninghamiana which are fire-sensitive and non-serotinous must be classed as DT types (widely dispersed seeds and establishment any time after a disturbance) as the only way they can enter an area after a disturbance is via-long distance dispersal. This strategy is very rare in eucalypts but is demonstrated by E. camaldulensis in the arid parts of Australia, where it is fire-sensitive, does not coppice after fire and is non-serotinous, but will establish seedlings at any time if there is sufficient water present.

Thus, far from being poorly adapted to fire, many Casuarina species are fire-resistant, coppicing after severe fires (Figures 2 and 3), or are dependent on fire to allow prolific establishment from seed (e.g. C. huegeliana). C. stricta is favoured by low-intensity fires which will reduce flammable eucalypt saplings to ground level while the less flammable growing tips of the Casuarina saplings often survive (Kirkpatrick, 1986). Certainly a number are fire-sensitive and do not seem to have any adaptation to fire. However these species occur in areas which are likely to be protected from fires, e.g. river valleys (C. cunninghamiana) and salt marshes (C. glauca) or where fuel build-up is low in arid areas (C. cristata). All Casuarina tree species seem to be able to establish seedlings (often not particularly abundantly) without disturbance. This seems to be related to their shade and drought tolerance.

Fig. 3 *Epicormic shoot growth on Casuarina fraseriana approximately six months after fire (Perth)*

POPULATION BIOLOGY

Seed Release

There are three main strategies for seed release in Casuarina:

1. Seed is stored in the infructescences 'cones' until the plant or branch dies, after which the bracteoles open to release the fruits. Many of the shrub species (e.g. C. humilis, C. paludosa, C. microstachya) have this strategy.

2. Seed is released annually, although perhaps over several months (e.g. C. fraseriana, C. equisetifolia).

3. Seed is released continually, although there may be peaks in release at some times of the year, but there is always carry-over of propagules in the canopy from year to year. Such taxa (e.g. C. stricta, C. huegeliana) often regenerate prolifically after fire because a heavy seed rain is produced.

Mass seeding after a disturbance such as fire is a common condition and has been considered as an adaptive trait to satiate seed predators, especially in eucalypts (Wellington and Noble, 1985b; O'Dowd and Gill, 1984). Ants, in particular, move Casuarina seeds; however this does not seem to be as important a limitation on stand establishment as is the case for eucalypts. Woolfrey (1985) found that removal of C. cunninghamiana seeds from caches was sporadic and at a low level (only 17% removed) while there was little harvesting of C. stricta and C. littoralis seeds (less than 40% seed removed) at a site where virtually all E. ovata, E. leucoxylon and Acacia pycnantha seeds were removed (Withers, 1978a). Seeds of C. fraseriana were less favoured by animals than seeds of E. marginata, E. calophylla and Banksia grandis in a Western Australian forest trial (Abbott, 1984).

Removal of competition is probably a more important factor in regeneration after fire. In C. huegeliana seedling regeneration is prolific on any disturbed soil near a fecund female, even if seed rain is sparse. In the case of this species its ability to also regenerate sporadically in a grassy sward is probably due to its high drought resistance.

Germination

In general Casuarina seeds germinate readily with a high viability as long as the seed is fresh, although some after-ripening of the seed may occur in some species (Turnbull and Martensz, 1983). However there can be quite a lot of variability in viability, as evidenced by the mixed success of germination trials conducted by Torrey (1983). It is reputed (Langkamp, 1987) that Casuarina (sensu stricto) species have higher temperature optima for germination than do Allocasuarina species. However, from the data in Turnbull and Martensz (1983), it would seem that the site of collection could have a lot to do with optimum temperature for germination. For example, C. cunninghamiana seed collected from the Australian Capital Territory germinated more rapidly at a low temperature than did seed of the same species from Queensland. Time to germinate at higher temperatures was the same for both collections.

The reaction to wetting of the fruit varies between species and is related to the structure of the fruit wall. Langkamp (1987) noted that the testa of Allocasuarina species is hard but this is not strictly true; often the endocarp is hard. The pericarp of the disseminule (a samara) has a thin outer exocarp over a mesocarp of inflated cells with walls that are spirally thickened (similarly to spiral thickening in tracheids, Figure 4). These spirals expand on contact with water so that water is held around the fruit through surface tension rather than in a mucilaginous gel as described by Torrey (1983). The composition of the spirals is not known, although it is likely to be cellulosic rather than 'elaborate polysaccharide' packaged within the seed as Torrey (1983) proposed. Whether the spiral cells swell or not depends on the physical integrity of the thin exocarp. In several species (e.g. C. huegeliana, C. stricta) the spirals are clearly visible between breaks in the exocarp and these propagules swell almost instantly on contact with water. However other seeds (e.g. C. obesa, C. cunninghamiana) have a more complete exocarp, so the spirals do not actually break through the exocarp, but it is

Fig. 4 *Scanning electron microscope photograph of a section of the fruit wall of* *Casuarina decussata* *(e - exocarp, m - spiral mesocarp cells, b - boney endocarp. Scale bar - 10 μ)*

clear that water does enter the spiral cell compartment and thus surrounds the seed. In the seeds which have a poorly intact exocarp, the expansion of the spiral cells seems to be a one-off occurrence so the disseminules may not be adapted to wetting and drying as, apparently, are some eucalypt seeds (e.g. E. sieberi, Gibson and Bacheland, 1986). However the expanded thread envelope is likely to provide a moister micro-environment than would occur around a propagule without this facility.

Germination studies in the laboratory are useful to establish the maximum likelihood of regeneration in the field. However establishment in the field is complicated by several factors which affect germination, e.g. allelopathic effects of live plants, or litter, predation or general tenderness of young seedlings.

Establishment and Population Structures

In seedling establishment field trials in southern Victoria, more C. littoralis and C. stricta seedlings emerged from sown seed than did those of two eucalypts in both eucalypt woodland and Casuarina scrub (Withers, 1978a). However, in jarrah forest in Western Australia, C. fraseriana seeds were less likely than seeds of two eucalypts and a banksia to produce seedlings, while Eucalyptus calophylla and Banksia grandis were most successful (Abbott, 1984). This was not due to seed predation, as C. fraseriana seeds were least attractive to predators and Abbott attributed the lack of success of C. fraseriana to drought. However C. fraseriana also had the lowest seed weight of the four species studied and on the very poor jarrah forest soils lack of nutrients in the early development phase would also be detrimental.

In C. cunninghamiana, which grows in monospecific stands along rivers, Woolfrey (1985) found that, despite seed fall being greatest under trees, establishment was fairly sparse. In glasshouse trials with different substrates, i.e. simulated litter over soil (such as occurs under adult trees), soil without litter, and filter paper, the best germination of seedlings was in soil with litter covering. However seeds watered with Casuarina litter leachate were poorest in germination success. There is probably a trade off in the field, where a thin litter layer would provide protection (safe sites) for seedlings, while a thicker layer would either prevent seeds reaching the ground, leaving them in a dry micro-environment, or produce a higher concentration of inhibitory substances if the seeds did reach the soil surface.

Woolfrey (1985) also investigated the population structure of C. cunninghamiana on the Murrumbidgee River near Canberra. The river valley is narrow and water levels fluctuate. C. cunninghamiana cover is patchy; dense groves are interspersed with more open stands. The summation of a survey of 22, ten-metre-wide transects perpendicular to the river showed that the overall population structure was a 'reverse J' type curve, which indicates continuous recruitment to the population.

The river valley is subject to floods and on a local scale seedling establishment is patchy. Young saplings are most prolific on cobble banks within or at the edge of the stream. It is reported that C. cunninghamiana produces suckers (National Research Council, 1984) and it could be considered that the dense banks of saplings along rivers are the result of suckering. However extensive excavation of dense regenerating stands in the Australian Capital Territory and on the south coast of New South Wales has not revealed any indication that the plants are suckers. Rather they seem to be the result of prolific seedling regeneration. In a glasshouse experiment Woolfrey (1985) found that seedlings on cobble substrate produced a greater biomass than seedlings grown on sand or mud. In addition cobbles may provide more stability than other substrates and enable C. cunninghamiana seedlings to survive floods. On the Shoalhaven River in lowland New South Wales seedling establishment at permanent plots was monitored over a winter to summer period. Seedlings which established in six-one-metre square plots were removed by floods on two occasions in 1984 and out of 14 plots no seedlings survived through to 1985, because of either flood or drought.

A phenomenon in C. cunninghamiana which may help resolve the question of suckering is that medium-sized trees which are toppled in floods may continue to grow, producing lines of trunks which are reiterated (in the sense of Halle, Oldeman and Tomlinson, 1978) laterals of the parent tree. If the parent trunk becomes buried, the line of trees appears to be the result of root suckering (Figure 5).

Fig. 5 *Prostrate Casuarina cunninghamiana showing reiteration of lateral branches, Murrumbidgee River, ACT*

Casuarina huegeliana has a quite different strategy from that of C. cunninghamiana. C. huegeliana is fire-sensitive, regenerates prolifically from seed if conditions are favourable and also establishes seedlings without disturbance.

After a fire at a site in Dryandra Forest (Western Australia) the density of two-year-old C. huegeliana saplings varied from 16 800 to 103 600 per ha. By contrast, in an adjacent unburnt area seedling density was only 500 per ha. As a comparison Wellington and Noble (1985a) found that after fire, recruitment of E. incrassata in the mallee in Victoria was at least 7 000 seedlings per ha while there were only 30 seedlings per ha on adjoining unburnt land.

Without disturbance, seedling establishment of C. huegeliana is much higher than in a mallee eucalypt but may be even higher than the 500 per ha when a localised high seed rain can provide prolific establishment in a small area (several m^2). In places at Dryandra mature female trees have fallen, perhaps because of wind and/or termite damage. Under the canopy of these fallen trees seedling establishment may be dense. Of 100 seedlings marked in spring 1987 only 3 remained alive after the dry summer of 1988. Despite this apparent lack of success this is sufficient survival to allow the establishment of the small groves of C. huegeliana which grow up amongst the dead unrotted limbs of some prostrate female trees in this area.

Size-class distribution of C. huegeliana stems from a granite site shows a pattern which can be interpreted in terms of continuous establishment up to a certain carrying capacity (approximately 2 000 trees per ha). After this, survival of seedlings can only occur when gaps form in the stand, so recruitment falls dramatically (Figure 6). At less densely stocked sites on duplex soil a few very old individuals are scattered amongst a new generation, which seems to have slowed recruitment in recent times (Figure 7).

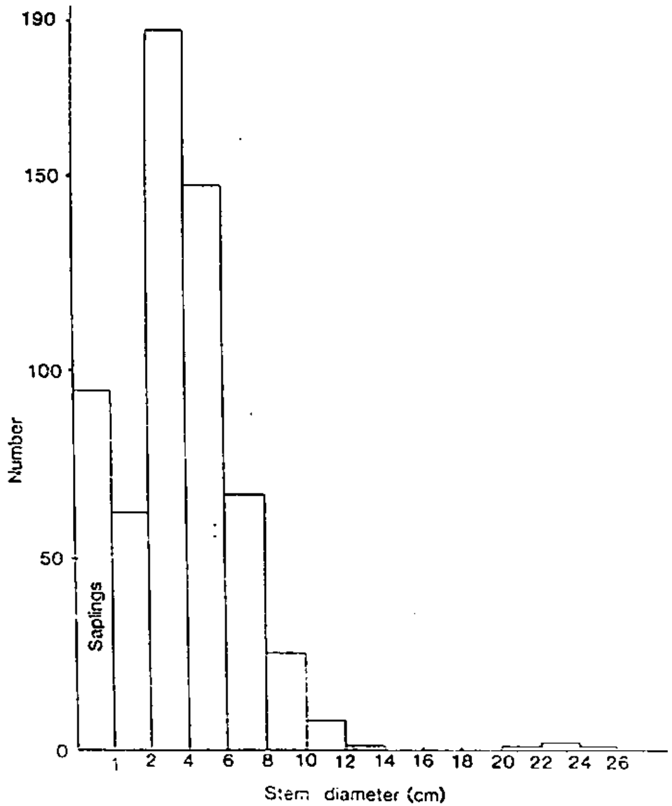
A size-class structure for C. huegeliana near Quairading (Western Australia) which had not been burnt for 63 years indicated continuous recruitment (Muir, 1985). However, of the younger stem classes, the smallest (0-2 cm) class had the highest proportion of dead stems, indicating that regeneration and survival were probably sporadic and that survival may depend on a sufficient number of wet years.

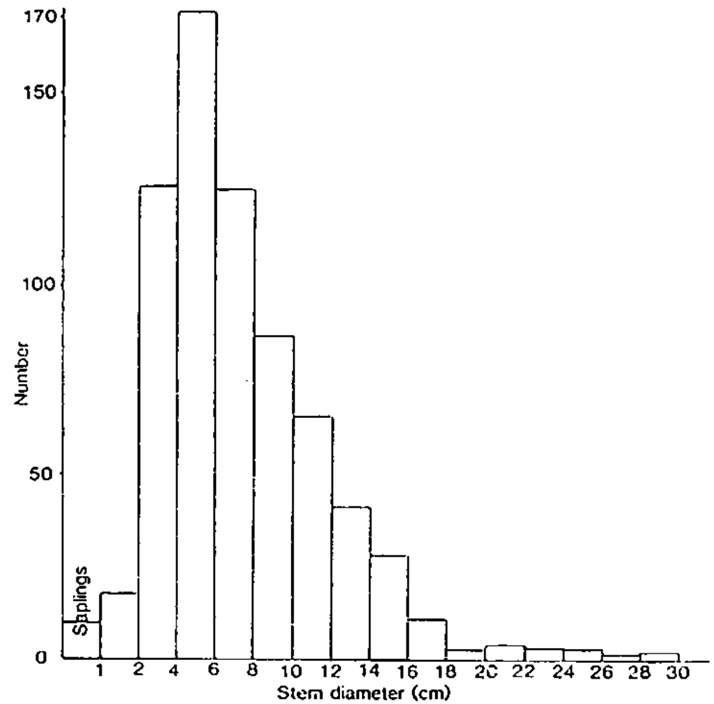
There has been little research on the dynamics of Casuarina populations, but there is a basis for defining patterns in different groups. The DT species, such as C. cunninghamiana, which grow in relatively fire-free areas are, like most species, sensitive to drought. In the case of C. cunninghamiana floods also prevent establishment. In other cases it has been suggested that saline conditions may depress germination of salt-tolerant species so that they recruit new seedlings only after heavy rainfall. Because the seedlings themselves are salt-tolerant, subsequent increase in soil salinity is not a problem (Clemens et al., 1983). The DT species may require special conditions for establishment but these conditions are more of the nature of normal environmental fluctuations than of disasters, such as fire.

In areas where fire is likely to be important the genus Casuarina is represented by species with various strategies. All species can establish at any time after a disturbance, owing mainly to the shade and drought tolerance of the seedlings.. In addition, the serotiny of the 'cones' in species which are killed by fire ensures a heavy seed rain and usually prolific regeneration after fire. A number of species also resprout after fire and so, like many eucalypts, can survive as adults as well as increasing by seedling establishment. In some cases (e.g. C. stricta) the foliage is much less flammable than that of eucalypts (Dickinson and Kirkpatrick, 1985) so in light fires the growing tips of young casuarinas may survive while similarly sized eucalypt saplings are burnt back to a lignotuber.

DISCUSSION

The Casuarinaceae has a long history in Australia - probably dating back to the Cretaceous. The first records have been confirmed, or are likely to be, of Gymnostoma-type taxa which now only grow in north Queensland and the islands north and east of Australia. Kemp





Size class structures of Casuarina huegeliana at Dryandra Forest Park (WA)

Fig. 6 On duplex soil

Fig. 7 On shallow loam soil over granite

(1981) considered that the first Casuarina (using the genus in its broad sense) may have been a rainforest associate and this is borne out to some extent by the types of fossils, such as Zamia pinnules, with which it is associated (e.g. Christophel, 1980).

The extant Gymnostoma species occur on various unstable areas such as river banks and volcanic blast areas or on nutrient-poor or alkaline soils (National Research Council, 1984). These would be considered adverse sites or sites subject to disturbance, where competition from rainforest species would be minimal allowing Gymnostoma to be dominant. It seems that Gymnostoma fulfils the role of a pioneer species and this may have been its role in the early Tertiary vegetation. For example at Anglesea (Victoria) it occurs towards the top of the sequence in fluviatile sediments rather than in the coal itself (Christophel, 1980).

Singh and Geissler (1985) suggested that Casuarina (presumably really referring to the Casuarinaceae) may be regarded as the 'first genus to constitute dominantly sclerophyll forest in Australia'. This may be correct because the first eucalypt records (Oligocene) post-date those of the first Casuarinaceae by many millions of years. However members of the Proteaceae such as the Banksia were present in the early Tertiary (Paleocene), were presumably sclerophyllous, and dominate Western Australian communities at present, so may also have been important sclerophyll taxa.

Due perhaps in part to its long history in Australia the Casuarinaceae has produced a variety of species adapted to many different environments - the only notable absence being from rainforests. The range of habitats occupied by Casuarina exceeds that of any other major genus in Australia.

The Casuarina species which grow in the forest zones of Australia at present generally occur as understorey plants. The exceptions are that on saline, alkaline or shallow soils, or sites which are generally unfavourable to other tree species, Casuarina may be a dominant. In river valleys the streamlined foliage of C. cunninghamiana may be an advantage in surviving floods. The morphology of Casuarina species means that they are poor competitors with broad-leaved species on good quality sites. However their drought and shade tolerance, which are general features of the taxa, ensure that on harsh sites they can become superior competitors to less resilient species such as eucalypts.

The ability of most species to regenerate under an overstorey canopy means that there may be continuous recruitment to populations in some areas. However where site quality is poor (such as where soils are shallow over rock) recruitment may become sporadic after a carrying capacity is reached, as new recruits can then only survive in gaps.

One of the main reasons for examining the ecology of Casuarina in Australia was to evaluate the thesis put forward by Singh and Geissler (1985) on the basis of data from Lake George (New South Wales). They described a scenario where Casuarina dominated the sclerophyll forests around Lake George from 4-7 million years ago until 195 000 BP, and implied that rainforest taxa were understorey components of this forest. They further claimed that after 195 000 BP Casuarina still dominated the region during interglacials until 25 000 years ago, but that the understorey was of a drier facies which allowed more widespread firing from lightning strikes. The upshot of their proposal is that firing by Aborigines was a major factor in changing the overall dominance in the forests around Lake George from Casuarina to Eucalyptus.

This whole scenario for Lake George is highly speculative. Although Casuarina pollen is abundant in parts of the core, most of it does not correspond to pollen produced by any living taxon. In their discussion Singh and Geissler concentrate mainly on the attributes of C. stricta in justifying their proposals. This is despite the fact that the main pollen type in the core is not of the C. stricta type and the ecology of the species which produced it is not likely to be known. Their thesis also relies on the assumption that casuarinas are fire-sensitive and it seems that this belief has grown from two sources:

(a) observations that some species are not adapted to fire (e.g. C. cunninghamiana); and

(b) the explanation that an apparent replacement of eucalypt woodland by Casuarina-dominated scrub at Ocean Grove in Victoria was due to the absence of fire over a long period.

Clearly, as has been emphasised, the first point is not universally true for the genus. The majority of Casuarina species are well-adapted to fire and many of them, particularly the heath species, are just as fire-requiring for regeneration as are species of Eycalyptus, Banksia, Hakea or Acacia. As to the second point, experiments at Ocean Grove concerning survival of seedlings on burnt plots did not show that eucalypts survived better than Casuarina on these sites, although the eucalypts themselves did survive better on burnt than on unburnt (control) plots (Withers, 1978a).

Other claims for the coincidence of vegetation change and Aboriginal firing have been made from a site in north Queensland, at Lynch's Crater (Kershaw, 1985). At this site the proposal is based on evidence of rainforest-to-sclerophyll transition and there is little argument that rainforest vegetation is likely to be restricted in extent by fire.

There is a danger of circular arguments developing in this question of vegetation and fire regime because it is very difficult to determine which changed first, the vegetation or the fire regime. Rainforest is resistant to burning, so charcoal values in sediments in rainforest areas will be low. If rainforest declines in extent, sclerophyll forest will replace it, hence burning and charcoal input to sediments should increase. However, which is the cause and which the effect? Is the charcoal record the result of the more flammable vegetation or is the sclerophyll vegetation the result of increased burning?

This circularity may be more easily resolved in areas like the Atherton Tableland where the pollen record is excellent. Lake George is a much more difficult site for which the interpretation of the sparse pollen data is equivocal.

Casuarina should not be seen as a fire-sensitive taxon. More useful proposals may be made by acknowledging the fact that Casuarina is generally very drought-tolerant. High Casuarina pollen values may indicate times of dry climate while eucalypt pollen may be indicative of wetter conditions in an area such as Lake George. Drier climate would lead to low productivity and lower incidence of fire, while during wetter times fuel loads would be higher, leading to higher charcoal input to sediments.

REFERENCES

Abbott, I., 1984 Emergence, early survival and growth of seedlings of six tree species in Mediterranean forest of Western Australia, Forest Ecol. Manag. 9: 51-66.

Ashton, D.H., Bond, H. and Morris, G.C., 1975 Drought damage on Mount Towrong, Victoria, Proc. Linn. Soc. 100: 44-69.

Attiwell, P.M. and Clayton-Greene, K.A., 1984 Studies of gas exchange and development in a subhumid woodland, J. Ecol. 72: 285-94.

Barlow, B.A. 1983 Casuarinas - a Taxonomic and Biogeographic Review, in Midgley, S.J., Turnbull, J.W. and Johnston, R.D. (eds), Casuarina Ecology Management and Utilization (CSIRO, Melbourne): 10-18.

Beadle, N.C.W., 1981 Vegetation of Australia (Cambridge Univ. Press, Cambridge).

Boland, D.J., Brooker, M.I.H., Chippendale, G.M., Hall, N., Hyland, B.P.M., Johnston, R.D., Kleinig, D.A. and Turner, T.D., 1984 Forest Trees of Australia (Thomas Nelson, CSIRO, Melbourne).

Campbell, J.D. and Holden, A.M., 1984 Miocene Casuarinacean fossils from Southland and Central Otago, New Zealand, N.Z. J. Bot. 22: 159-67.

Christophel, D.C, 1980 Occurrence of Casuarina megafossils in the Tertiary of south-eastern Australia, Aust. J. Bot. 28: 249-59.

Clemens, J., Campbell, L.C. and Nurisjah, S., 1983 Germination, growth and mineral ion concentration of Casuarina species under saline conditions, Aust. J. Bot. 31: 1-9.

Coetzee, J.A. and Praglowski, J., 1984 Pollen evidence for the occurrence of Casuarina and Myrica in the Tertiary of South Africa, Grana 23: 23-41.

Dickinson, K.J.M. and Kirkpatrick, J.B., 1985 The flammability and energy content of some important plant species and fuel components of the forests of south-eastern Tasmania, J. Biogeogr. 12: 121-34.

Froend, R.H., Heddle, E.M., Bell, D.T. and McComb, A.J., 1987 Effects of salinity and waterlogging on the vegetation of Lake Toolibin, Western Australia, Aust. J. Ecol. 12: 281-98.

Gibson, A. and Bacheland, E.P., 1986 Germination of Eucalyptus sieberi, L. Johnson seeds. I Response to substrate and atmospheric moisture, Tree Physiology 1: 57-65.

Halle, F., Oldeman, R.A.A. and Tomlinson, P.B., 1978 Tropical Trees and Forests: An Architectural Analysis (Springer Verlag, Berlin).

Johnson, L.A.S., 1982 Notes on Casuarinaceae II. J. Adelaide Bot. Gard. 6: 73-87.

Kemp, E.M., 1987 Pre-Quaternary Fire in Australia, in Gill, A.M., Groves, R.H. and Noble, I.R. (eds), Fire and the Australian Biota (Aust. Acad. Sci., Canberra): 3-21.

Kershaw, A.P., 1985 An extended late Quaternary vegetation record from north-eastern Queensland and its implications for the seasonal tropics of Australia, Proc. Ecol. Soc. Aust. 13: 179-89.

Kirkpatrick, J.B., 1986 The viability of bush in cities - ten years of change in an urban grassy woodland, Aust. J. Bot. 34: 691-708.

Kirkpatrick, J.B. and Backhouse, S., n.d. An Illustrated Guide to Tasmanian Native Trees (The authors, Hobart).

Langkamp, P.J., 1987 Germination of Australian Native Plant Seed (Inkata Press, Melbourne).

Martin, H.A., 1982 Changing Cenozoic barriers and the Australian paleobotanical record, Ann. Missouri. Bot. Gard. 69: 625-67.

Midgley, S.J., Turnbull, J.W. and Johnston, R.D. (eds), 1983 Casuarina Ecology Management and Utilization (CSIRO, Melbourne).

Muir, B.G., 1985 Fire Exclusion: a Baseline for Change in Ford, J. and Muir, B.G. (eds), Fire Ecology and Management in Western Australian Ecosystems (WAIT Environmental Studies Group Report No. 14: 119-28).

Myers, B.A. and Neales, T.F., 1984 Seasonal changes in the water relations of Eucalyptus behriana, F. Muell. and E. microcarpa (Maiden), Aust. J. Bot. 32: 495-510.

National Research Council, 1984 Casuarinas: Nitrogen-fixing Trees for Adverse Sites (Nat. Academy Press, Washington).

Noble, I.R. and Slatyer, R.O., 1980 The use of vital attributes to predict successional changes in plant communities subject to recurrent disturbances, Vegetatio 43: 5-21.

O'Dowd, D.J. and Gill, A.M., 1984 Predator satiation and site alteration following fire: Mass reproduction in Alpine Ash (Eucalyptus delegatensis) in south-eastern Australia, Ecology 65: 1 052-66.

Pryor, L.D., 1976, Biology of Eucalypts (Edward Arnold, London).

Singh, G. and Geissler, E.A., 1985 Late Cainozoic history of vegetation, fire lake levels and climate at Lake George, New South Wales, Australia, Phil. Trans. R. Soc. Lond. B, 311: 379-447.

Torrey, J.G., 1983 Root Development and Root Nodulation in Casuarina, in Midgley, S.J., Turnbull, J.W. and Johnston, R.D. (eds), Casuarina Ecology Management and Utilization (CSIRO, Melbourne): 180-92.

Turnbull, J.W. (ed.), 1986 Multipurpose Australian Trees and Shrubs Lesser Known Species for Fuelwood and Agroforestry (Aust. Centre for International Agricultural Research).

Turnbull, J.W. and Martensz, P.M., 1983 Seed Production, Collection and Germination in Casuarinaceae, in Midgley, S.J., Turnbull, J.W. and Johnston, R.D. (eds), Casuarina Ecology Management and Utilization (CSIRO, Melbourne): 126-32.

Wellington, A.B. and Noble, I.R., 1985a Post-fire recruitment and mortality in a population of the mallee Eucalyptus incrassata in semi-arid, south-eastern Australia, J. Ecol. 73: 645-56.

Wellington, A.B. and Noble, I.R., 1985b Seed dynamics and factors limiting recruitment of the mallee Eucalyptus incrassata in semi-arid south-eastern Australia, J. Ecol. 73: 657-66.

Withers, J.R., 1978a Studies on the status of unburnt Eucalyptus woodland at Ocean Grove, Victoria. II. The differential seedling establishment of Eucalyptus ovata Labill. and Casuarina littoralis Salisb., Aust. J. Bot. 26: 465-83.

Withers, J.R., 1978b Studies on the status of unburnt woodland at Ocean Grove, Victoria. III. Comparative water relations of the major tree species, Aust. J. Bot. 26: 819-35.

Withers, J.R., 1979a Studies on the status of unburnt woodland at Ocean Grove, Victoria. IV. The effect of shading on seedling establishment, Aust. J. Bot. 27: 47-66.

Withers, J.R., 1979b Studies on the status of unburnt _Eucalyptus_ woodland at Ocean Grove, Victoria. V. The interactive effects of droughting and shading on seedlings under competition, _Aust. J. Bot_. 27: 285-300.

Withers, J.R. and Ashton, D.H., 1977 Studies on the status of unburnt _Eucalyptus_ woodland at Ocean Grove, Victoria. I. The structure and regeneration, _Aust. J. Bot_. 25: 623-37.

Woolfrey, A.R., 1985 Factors affecting the distribution of _Casuarina cunninghamiana_ Miq.,Honours thesis, Botany Department, ANU.

INVASION OF AUSTRALIAN FORESTS BY ALIEN WOODY PLANTS

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PLANT INVASION OF FORESTS

Forests have been changing for their entire histories. Part of this change has been brought about by invasions by trees and shrubs which formerly were not constituents of those forests.

Natural invasions have been particularly rapid and widespread in geologically recent times during, and as a direct result of, the violent climatic fluctuations of the Quaternary period. It has been shown that forests have not achieved stability for periods longer than a few tree generations since the relatively abrupt ending of the last glacial interval about 10 000 years ago (e.g. Davis, 1976; Walker and Flenley, 1979). This may have been due in part to climatic instability; however a second reason is that after climatic change, woody plants have been extending their ranges at various rates, depending on their different dispersal mechanisms and abilities.

As well as occurring in response to changed climate, invasions have resulted from the occasional natural crossing of geographic barriers to dispersal. A few taxa of the great Malesian family of timber trees, Dipterocarpaceae, have crossed the straits from southeast Asia into the rainforests of New Guinea; one species of Rhododendron has made the further jump into Queensland. In the reverse direction, some Australian genera such as Eucalyptus, Melaleuca and Leptospermum have invaded a few areas of particular habitat in south-east Asia. By crossing the barriers to dispersal separating the continents these plants have invaded, and therefore changed, forests.

In recent times this originally natural process of forest change through biological invasion has been greatly facilitated and accelerated as barriers to plant dispersal have been broken down by people. Biological invasions are occurring today at an unprecedentedly rapid and accelerating rate. In most parts of the world movement of people and their chattels (including plants) has taken place on a large scale for many centuries or even millennia. This has been the case in Australia for only about two hundred years. Within this brief span, as transport became more advanced, opportunities for plants to cross the barriers into Australia increased rapidly (Wace, 1985). Many plants were deliberately brought, many others came as unknown and unintended passengers. There is now a vast reservoir of plants alien to this country growing in gardens, agricultural areas and elsewhere which can invade vegetation if it is within the species' dispersal range and if ecological conditions permit.

PLANT INVASION AND ECOLOGICAL STRATEGY

At least ten per cent of the wild Australian flora now consists of alien species and the number increases each year (Groves, 1986). The vast majority of these are plants which are well-adapted to exploiting sites of disturbance and in many cases are costly weeds for farmers. However they are not able to survive in closed vegetation so are of little concern to forest managers.

Such weeds are described by ecologists as ruderals (Grime, 1979). They require high levels of light and other resources (at least for the short time it takes them to complete their life-cycles) and produce numerous small seeds. They are well-adapted to rapid exploitation of situations in which resources are temporarily released by disturbance to the vegetation and those resources are not utilized by longer-lived, more competitive plants.

At the other end of the spectrum of ecological strategies are plants with opposite characteristics. These are the plants that provide the floristic ingredients that make up forests. They compete well and can survive at low levels of resource availability. Typically they grow slowly, have long life spans in which reproduction may be long delayed, and produce relatively few large seeds which are poorly dispersed (Grime, 1979). They do not have the characters that typify invaders (Newsome and Noble, 1986) nor do they invade substantially disturbed environments (Fox and Fox, 1986). Although such 'climax' strategy plants are not usually considered as invaders, very slow or delayed invasions would not yet be apparent. Many aliens with this strategy grow, as yet unnaturalized, in gardens and on farms and roadsides across Australia.

In Table 1 three ecological strategies are compared; ruderal and 'climax' plants are opposites, being adapted to frequent and very infrequent vegetation disturbance respectively, while nomads are an intermediate category of quick-growing woody plants (Smith, 1978) which succeed ruderals after forest destruction, forming the 'scabs of the forest' (van Steenis, 1958).

To describe a plant as 'naturalized' is to imply that it has become common as a wild plant in areas to which it is not native, without deliberate encouragement by people; however the term is variously applied and is open to differing interpretations. One definition (Wace, 1978) is of a plant 'that grows and reproduces for several generations at least, without the direct aid of man, outside its native range'. It is impossible by this definition for plants of 'climax' strategy such as forest trees, however well adapted they may be to local conditions, to have become naturalized in Australia, because insufficient time has elapsed since European settlement to permit the passage of several generations. Any alien tree species with a usual minimum reproductive age measured in decades can hardly be expected to have done more to invade an Australian environment than to produce a handful of offspring in the vicinity of planted parent trees.

Table 1: Some demographic features of plants with three ecological strategies

Strategy	Reproductive output	Minimum reproductive age	Maximum age	Time needed for ten generations
Ruderal	High	One-few years	One-several years	Decades
Nomad	Low-High	Few-several years	One-several decades	Decades/ centuries
'Climax'	Low	One-several decades	Centuries	Millennia

This is in striking contrast to a ruderal which may produce numerous, well-dispersed seeds after a lifespan of a single season and, therefore, have a population with a local history spanning as many generations as the number of years since its introduction.

Ruderals cannot invade forests to a significant degree, and alien 'climax' species have not yet had time to show that they can do so. However a few examples of plants with the intermediate nomad strategy show that forest invasion by woody plants can occur on an extensive and managerially worrisome scale. In time it is likely that further examples, ultimately including 'climax' species, will invade.

Forest invasion by alien woody plants of nomad or 'climax' strategy should be of great concern for several reasons.

1. Being large plants (unlike the herbaceous ruderals) they have a significant impact upon their invaded habitat, both visually and structurally, through shading and nutrient uptake, and by the production of large amounts of novel biomass materials (litter, foliage, seeds, etc.) which affect herbivore populations.

2. Because they are alien to the area they are less likely to have their vigour reduced by specialized, co-adapted pathogens and herbivores than the native species with which they are in competition; they therefore tend to become abundant and to threaten the survival of native species.

3. By invading forests they are becoming part of a vegetation in which the usual control techniques for unwanted plants are likely to be difficult to apply, and which involves disturbance to the environment in ways incompatible with management goals.

Examples of woody plants invading forests in south-eastern Australia include Cinnamomum camphora in moist forests between Brisbane and Newcastle; Chrysanthemoides monilifera in New South Wales coastal habitats (Weiss and Noble, 1984); Lantana camara in a range of moist, warm environments in coastal Queensland and northern New South Wales; Ligustrum lucidum and L. sinense widely along the coastal strip of New South Wales (Fox and Adamson, 1986); Pittosporum undulatum (an Australian native but not in that area) around Melbourne (Gleadow and Ashton, 1981); and Rubus fruticosus agg. in climatically moist parts of the entire region. All these examples are of species with fleshy fruits, whose seeds are dispersed by birds, especially currawongs, and also by mammals such as foxes and possums. Wind-dispersed Pinus species have also proved to be invasive in eucalypt forests near some plantations (Chilvers and Burdon, 1983). Many woody alien species are to be found in forest remnants in the vicinity of cities. This may represent the early stages of invasion from urban seed sources (Smith, 1985). It may also be due to local factors such as soil eutrophication (Clements, 1983) or disturbance. Less effective seed dispersal has probably retarded invasion by many otherwise well-adapted alien trees and shrubs.

BROOM ON BARRINGTON TOPS

In the remainder of this paper we consider an example of an alien shrub species, Cytisus scoparius (hereafter called by its common name, broom) invading eucalypt woodlands and other vegetation at Barrington Tops, New South Wales.

History

Broom (a native of western Europe) is a quick-growing, unarmed shrub in family Fabaceae. It has small, dark green, usually trifoliolate, deciduous leaves, and angled stems which are also green and photosynthetic when young. In late spring to summer, plants at least three years old produce numerous showy, yellow flowers, from which pods may develop, each containing up to twenty seeds or more. The seeds are hard-coated, 2.5-4 mm long, and after dispersal usually remain in the soil for several years before germinating.

Broom was introduced to Australia several times and for various reasons. The initial introduction was around 1800 after Governor King requested some broom seeds from Sir Joseph Banks, to be grown and used as a substitute for hops (King, 1798). Subsequent introductions were probably for use as garden shrubs for medicinal or ornamental purposes (Parsons, 1973; Kloot, 1987). There are presently at least twenty cultivars and hybrids of broom growing in Australia, several of which have been recorded as garden escapes in native bushland. Broom has been declared a noxious weed in many local government areas in south-eastern Australia.

In the 1840s broom was introduced to the grazing property 'Tomalla' at the northern end of the Barrington Tops plateau, where it was planted in the garden and possibly also as a hedge. It has since spread southwards along the plateau and currently occupies about 10 000 ha of private grazing land, state forest and national Park (Waterhouse, 1986, in press).

Recollections of long-time residents of the plateau suggest that broom had not spread far south of 'Tomalla' until the late 1940s; when plants were observed growing close to cattle watering points. Its distribution expanded during the 1950s and 1960s, probably associated with the proliferation of fire and logging trails across the plateau. The greatest expansion in distribution and density of broom has occurred since 1969 when the southern end of the plateau was dedicated as a national park. Factors which may have influenced the increase in broom since then include the following:

1. Cessation of seasonal grazing and annual burning in the national park and neighbouring state forests, which previously may have suppressed the number of broom plants and their reproductive capacity;

2. The accidental introduction of pigs in 1970 (followed by the deliberate release of more pigs by local hunters) which led to widespread soil disturbance, providing ideal seed-bed conditions for the establishment of broom;

3. Increased use of the plateau by recreational vehicles and bushwalkers, as well as the continuing presence of feral horses, all of which also provided ample seed dispersal opportunities.

<u>Impact and Control</u>

Dispersal of broom seeds in the area occurs at two scales. Intact seeds have been recovered from the dung of both feral horses and pigs, and these mammals (and no doubt also cattle in earlier days) clearly have the potential to disperse the seeds over several kilometres. Likewise the plant's conspicuous spread beside roads and trails leaves little doubt that seeds can also be transported, probably in mud, on vehicles and human footwear. On a more local scale, seeds are thrown up to three metres by violent dehiscence of the drying pod, and this leads to the expansion of broom stands at a rate of up to about one metre per year.

Dense thickets of broom up to three metres tall now occupy <u>Eucalyptus</u>-dominated woodlands and 'subalpine' grasslands where previously the shrub stratum was sparse or absent. Beneath the thickets both the species richness and the foliage protective cover of ground stratum plants are significantly reduced (Figure 1). There is also a substantial reduction in the number of regenerating <u>Eucalyptus</u> saplings (Figure 2). Shading (both by the broom canopy, and at ground level by a thick, broom-generated litter layer) is probably the major cause of these effects. Competition for nutrients, and allelopathic inhibition, may also be significant but have not been investigated. Major permanent changes to the vegetation may result if the infestation is long-term (Waterhouse, 1986, in press).

Attempts to control the broom have been unsatisfactory. Mechanical clearing using tractors was abandoned because of disturbance

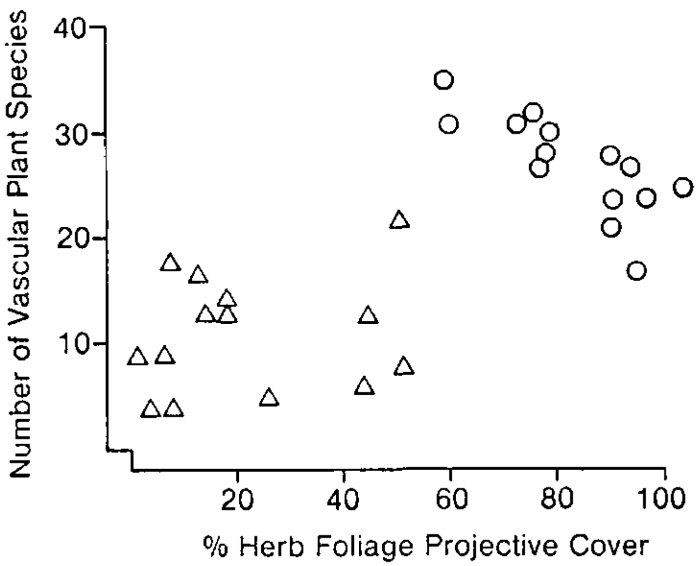

Fig. 1 *Per cent herb foliage projective cover and total number of vascular plant species recorded in five 1 m x 1 m quadrats at broom-infested and matched control sites in eucalypt dominated woodland (data: Waterhouse, in press)*

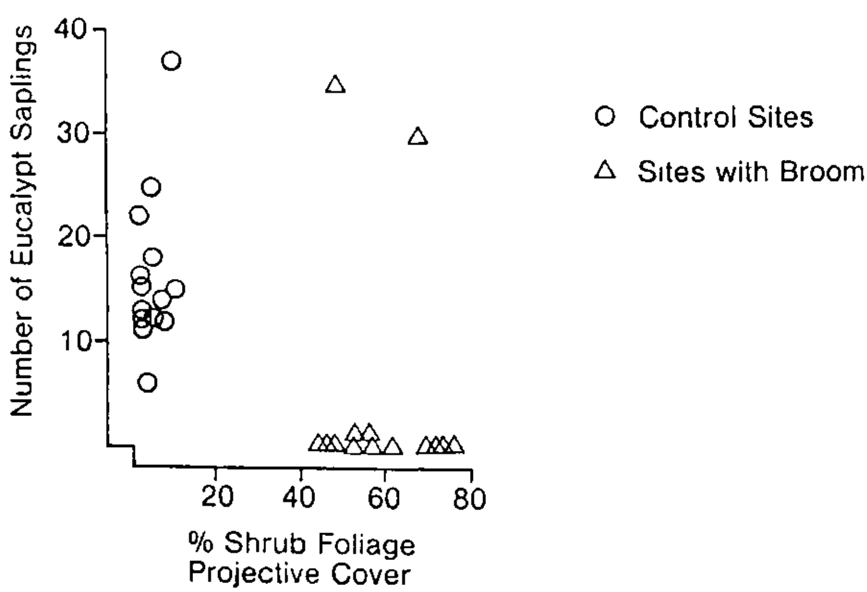

Fig. 2 *Per cent shrub foliage projective cover and number of eucalypt saplings recorded in 5 m x 5 m plots (data: Waterhouse, in press)*

to native vegetation and soil. Fire often failed to kill broom plants, and anyway could not be used systematically due to climatic conditions. Spraying with herbicides has been more successful, but killing broom plants by either chemical or physical means has led invariably to massive germination of a part of the long-lived soil seed bank. Stimulated by the Barrington Tops Broom Council (an informal group of local land managers and other interested persons) a research programme into possible biological control may soon be started.

Even where broom stands are accessible to spray machinery, and when economic constraints permit treatment with herbicide, the soil seed bank allows massive regrowth to occur. After any gross disturbance to stands of mature broom (including physical clearance, fire, herbicide treatment, and soil disturbance such as occurs during road works) the number of broom seedlings appearing is greatly in excess (until later self-thinning) of the former population.

Demography

Measurements of annual seed production and of the soil seed bank have been made in three stands of broom of different ages. Pods were collected and seeds counted on five plants at each site, the canopy dimensions of each bush also being recorded. Samples of litter, and of soil at 0-5 cm depth, were collected from three 0.2 m x 0.2 m or 0.3 m x 0.3 m plots at each site, and the seeds were later separated by sieving and counted. These continuing observations are made annually. In 1987 seeds were also collected from 1 m x 1 m litter traps at each site. Results to date are summarized in Table 2.

It is apparent from the data in Table 2 that most seeds contribute to the accumulating soil seed bank, which represents the bulk of the seed production of many years.

Data on plant growth and survival have also been collected annually at the three plots. Seedlings less than one year old, at each site and in every year, have been recorded at rates of 1-8 per square metre. While an annual count must miss many seedlings which appear and die between observations, it is clear that only a small proportion of seeds in the soil germinates in any year (at least without substantial disturbance).

Mortality of young broom plants in lightly shaded situations, at the edges of broom thickets (and presumably also in uninvaded eucalypt forest) is negligible. Plants are frequently browsed by macropods or horses, but until they are overtopped by neighbouring plants they resprout vigorously. Once the broom canopy closes, however, there is a progressive thinning of the population, and no recruitment of mature plants from seedlings. As they age, broom thickets therefore comprise progressively smaller numbers of larger individuals. Annual seed production per unit area remains effectively unchanged and the soil seed bank increases.

Table 2: Broom seeds produced, and present in the soil, per m² at three sites

Site: Relative broom age:	A Young	B Mature	C Old
Seeds counted on bushes-			
1986:	-	71	-
1987:	316	246	356
1988:	76	28	61
Seeds in litter traps-			
1987:	261	76	182
Seeds in soil-1987:			
Litter:	381	137	208
0-5 cm:	689	630	2992
Total :	1070	767	3200
Seeds in soil-1988:			
Litter:	500	283	200
0-5 cm:	1242	2709	3767
Total :	1742	2992	3967

In the oldest broom stand studied (where some broom plants are more than twenty years old) the plants are partly prostrate and commonly show signs of physical damage. The broom canopy is becoming discontinuous and native ground vegetation is less sparse than in younger, denser stands. However mortality of broom seedlings is still virtually total. It will be of considerable interest to continue monitoring this site in future, to see to what extent broom can replace itself after its first generation in the absence of allogenic disturbance.

DISCUSSION

As they invade new regions, plant species may be advantaged in competition with natives by not being accompanied by specialist herbivores and pathogens, leading to greater vegetative vigour, reproductive capacity and population growth.

The annual seed production and soil seed bank of three leguminous shrubs in Australia are compared in Table 3. *Acacia suaveolens* is native in the Sydney region. The other species are alien, *Mimosa pigra* being a Central American species now abundant east of Darwin. According to Auld and Myerscough (1986) about 47% of *A. suaveolens* seeds are destroyed by herbivores before dispersal. Although some unripe broom seeds are taken by crimson rosellas, predispersal seed predation is negligible in both the other species. It is clear from Table 3 that both alien species produce many more seeds than the native species.

Table 3: Annual seed production, and soil seed bank, for three leguminous shrubs in Australia. Values (means of several sites) are per m^2 except for Acacia suaveolens seed production which is per shrub. Population densities for reproductive shrubs of Cytisus scoparius and Mimosa pigra approximate one per m^2. A. suaveolens data from Auld (1986) and Auld and Myerscough (1986); M. pigra data from Lonsdale (1988) and Lonsdale, Harley and Gillett (1989).

	Annual production of intact seeds	Soil seed bank
Cytisus scoparius (Barrington Tops, NSW)	159	3339
Mimosa pigra (Adelaide River, NT)	9103	12 000
Acacia suaveolens (Sydney, NSW)	12	124

Most Mimosa pigra seeds germinate within a year (though some can persist for years, especially those deep in the soil); in the other cases most seeds remain in the soil seed bank for many years. When conditions (e.g. soil disturbance) stimulate germination, seedlings of alien species such as broom are likely to greatly outnumber those of native species present at the site. While not all native Acacia species appear to perform as poorly as this example, the native/alien contrast in seed production seems to be a general phenomenon. In New South Wales, where only the Acacia is native Chrysanthemoides monilifera seeds are much more abundant than those of Acacia longifolia in soil beneath vegetation with both genera. In South Africa, where only the Chrysanthemoides is native, the reverse is the case (Weiss and Milton, 1984, quoted by Newsome and Noble, 1986). Similarly, in a comparison of M. pigra stands in Australia (alien), Thailand (alien) and Mexico (native), seeds in each per m^2 of soil numbered 12 380, 12 610 and only 118 respectively (Lonsdale and Segura, 1987).

In the case of broom summarized above, high seed production combined with low seedling mortality in the early stages of site invasion accounts for its success and dramatic ecological impact on Barrington Tops. Its large, long-lived soil seed bank makes conventional control measures impractical. All these features can be attributed in large part to low levels of herbivore and pathogen activity. Unless such activity increases, for example as a result of successful biological control, the serious ecological impact of broom is likely to persist, and the species to continue to extend its range, far into the future.

CONCLUSION

Many alien woody plant species are present in Australia, even though most are not yet behaving invasively or are at only an early stage of naturalization. With time, some of them will invade forests. Their ecological strategies, involving long generation time and often poor dispersal ability which have so far delayed invasion, are likely also to include characteristics permitting establishment in competitive, relatively undisturbed forest environments.

Such plants, when they do invade forests, are likely to have substantial impacts. The example of broom at Barrington Tops shows that the invaded vegetation can be grossly altered, and that control by conventional means may be almost impossible.

Broom is typical of invading alien woody plants in having its vigour and reproductive capacity curbed much less by herbivores and pathogens than is the case for its native competitors. Herein lies a reason for its success, abundance and great impact. Restoration of an ecological balance between invading plants and their consumers, through the introduction or adaptation of herbivore and/or pathogen species, holds out some hope of partial eradication. However it is doubtful whether even such biological control can bring about total elimination. Permanent floristic change to Australian forests as a result of invasions appear inevitable.

REFERENCES

Auld, T.D., 1986 Population dynamics of the shrub Acacia suaveolens (Sm.) Willd.: dispersal and the dynamics of the soil seed-bank, Aust. J. Ecol. 11: 235-254.

Auld, T.D. and Myerscough, P.J., 1986 Population dynamics of the shrub Acacia suaveolens (Sm.) Willd.: seed production and predispersal seed predation, Aust. J. Ecol. 11: 219-234.

Chilvers, G.A. and Burdon, J.J., 1983 Further studies on a native Australian eucalypt forest invaded by exotic pines, Oecologia 59: 239-245.

Clements, A., 1983 Suburban development and resultant changes in the vegetation of the bushland of the northern Sydney region, Aust. J. Ecol. 8: 307-320.

Davis, M.B., 1976 Pleistocene biogeography of temperate deciduous forests, Geoscience and Man 13: 13-26.

Fox, M.D. and Adamson, D., 1986 The Ecology of Invasions, in Recher, H.F., Lunney, D. and Dunn, I. (eds), A Natural Legacy, Ecology in Australia (2nd Ed.) (Pergamon, Sydney): 235-255.

Fox, M.D. and Fox, B.J., 1986 The Susceptibility of Natural Communities to Invasion, in Groves, R.H. and Burdon, J.J. (eds), Ecology of Biological Invasions: an Australian Perspective (Aust. Acad. Sci., Canberra): 57-66.

Gleadow, R.M. and Ashton, D.H., 1981 Invasion by Pittosporum undulatum of the forests of central Victoria. 1. Invasion patterns and plant morphology, Aust. J. Bot. 29: 705-720.

Grime, J.P., 1979 Plant Strategies and Vegetation Processes (J. Wiley, Chichester).

Groves, R.H., 1986 Plant Invasions of Australia: an Overview, in Groves, R.H. and Burdon, J.J. (eds), Ecology of Biological Invasions: an Australian Perspective (Aust. Acad. Sci., Canberra): 137-149.

Kloot, P.M., 1987 The naturalized flora of South Australia, 4. Its manner of introduction, J. Adelaide Bot. Gard. 10: 223-240.

King, P.G., 1798 Historical Records of New South Wales 3: 497-594.

Lonsdale, W.M., 1988 Litterfall in an Australian population of Mimosa pigra, an invasive tropical shrub, J. Trop. Ecol. 4: (in press).

Lonsdale, W.M., Harley, K.L.S. and Gillett, J.D., 1989 Seed bank dynamics in Mimosa pigra, an invasive tropical shrub, J. App. Ecol. 25: (in press).

Lonsdale, W.M. and Segura, R., 1987 A demographic comparison of native and introduced populations of Mimosa pigra, Proc. 8th Australian Weeds Conf., (Council of Australian Weed Science Societies, Sydney): 163-166.

Newsome, A.E. and Noble, I.R., 1986 Ecological and Physiological Characters of Invading Species, in Groves, R.H. and Burdon, J.J. (eds), Ecology of Biological Invasions: an Australian Perspective (Aust. Acad. Sci., Canberra): 1-20.

Parsons, W.T., 1973 Noxious Weeds of Victoria (Inkata Press Melbourne).

Smith, J.M.B., 1978 Dispersal and Establishment of Plants, in Walker, D. and Guppy, J.C. (eds), Biology and Quaternary Environments (Aust. Acad. Sci., Canberra): 207-223.

Smith, J.M.B., 1985 Exotic trees and shrubs along a roadside transect between Sydney and Brisbane, Aust. Geographer 16: 264-271.

van Steenis, C.G.G.J., 1958 Rejuvenation as a Factor for Judging the Status of Vegetation Types: the biological nomad theory, in Proc. Kandy Symp.: Study of Tropical Vegetation. (UNESCO, Paris): 1-20.

Wace, N.M., 1978 Human Modification of the Natural Ranges of Plants and Animals, in Walker, D. and Guppy, J.C. (eds), Biology and Quaternary Environments (Aust. Acad. Sci., Canberra): 225-244.

Wace, N.M., 1985 Australia- the Isolated continent, in Gibbs, A.J. and Meischke, H.R.C. (eds), Pests and Parasites as Migrants (Cambridge University Press, Cambridge): 3-22.

Walker, D. and Flenley, J.R., 1979 Late Quaternary vegetation history of the Enga Province of upland Papua New Guinea, Phil. Trans. Roy. Soc. Lond. B, 286: 265-344.

Waterhouse, B.M., 1986 Cystisus scoparius (Broom) on Barrington Tops, Hons. thesis, Dept. Geography & Planning, Univ. New England, Armidale.

Waterhouse, B.M., in press Broom (Cytisus scoparius) at Barrington Tops, New South Wales, Aust. Geogr. Stud.

Weiss, P.M. and Milton, S., 1984 Chrysanthemoides monilifera and Acacia longifolia in Australia and South Africa, in Dell, B. (ed), Proc. 4th International Conference on Mediterranean Ecosystems, Bot. Dept., Univ. Western Australia, Nedlands: 159-160.

Weiss, P.W. and Noble, I.R., 1984 Status of coastal dune communities invaded by Chrysanthemoides monilifera, Aust. J. Ecol. 9: 93-98.

AUSTRALIA'S ARBOREAL MARSUPIAL FAUNA: PAST AND PRESENT

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INTRODUCTION

Arboreal marsupials spend most of their lives in trees and most are totally dependent on forests for habitat. Twenty-six species, representing six of the seventeen families of the Marsupialia (taxonomy following Walton, 1988), occur in Australia. These species include possums, gliders, cuscuses, tree kangaroos and the koala (see Table 1).

Study of this group is of intrinsic, ecological and economic importance. Most species are restricted in distribution to the tropical and temperate rain-forests, sclerophyll forests and woodlands of the eastern coastal margin of Australia. This geographic region also contains the majority of Australia's human population and supports most of its developmental and recreational activities, particularly in forested environments. As a consequence, conflicts arise between the maintenance of forest habitats for these fauna and the use of forests for other purposes. Conservation bodies such as the Australian Conservation Foundation now frequently use species of arboreal marsupials as the focus of their campaigns and to promote their objectives, both nationally and internationally.

Species of arboreal marsupials are maintained in captivity, both in Australia and overseas, for public display. Some, such as the koala, are of significant economic importance. They provide Australia with a source of international interest and are used to promote tourism.

Mean adult body-weight of individual species ranges from about 10 g in the little pigmy possum (Cercartetus lepidus) through 13 kg in Bennett's tree kangaroo (Dendrolagus bennettianus) which, excepting a few species of primates (i.e. monkeys), covers the range in body-size of all extant arboreal mammals. Many components of the life-history of members of this group are related allometrically to adult body-weight (Smith and Lee, 1984), thus providing opportunity for comparative evolutionary studies.

This paper considers the history of Australia's arboreal marsupial fauna, mainly over the last 200 years, and represents a selective summary from the perspective of Europeans. Four historical aspects are covered: Discovery and nomenclature, Exploitation, Ecological knowledge and Conservation.

Table 1 The nomenclature of species of arboreal marsupial occurring in Australia (following Walton,1988). Comments on cogeners are given where applicable. Note that <u>Dendrolagus</u> is included although Lee and Cockburn (1985) considered it to be scansorial

Family	Species	Describer	Common Name	Comments
Phascolarctidae				
	<u>Phascolarctos cinereus</u>	(Goldfuss,1817)	Koala	
Macropodidae				
	<u>Dendrolagus bennettianus</u>	De Vis,1887	Bennett's Tree-Kangaroo	Five other species of <u>Dendrolagus</u> in PNG* and Irian Jaya, Indonesia.
	<u>D.lumholtzi</u>	Collett,1884	Lumholtz's Tree-Kangaroo	
Phalangeridae				
	<u>Phalanger maculatus</u>	(Desmarest,1818)	Spotted Cuscus	Eight other species of <u>Phalanger</u> in PNG,Solomon Islands and Indonesia(from Sulawesi to Irian Jaya).
	<u>P. orientalis</u>	(Pallas,1766)	Grey Cuscus	
	<u>Trichosurus arnhemensis</u>	Collett,1897	Northern Brushtail Possum	
	<u>T. caninus</u>	(Ogilby,1836)	Mountain Brushtail Possum	
	<u>T.vulpecula</u>	(Kerr,1792)	Common Brushtail Possum	
	<u>Wyulda squamicaudata</u>	Alexander,1919	Scaly-tailed Possum	
Petauridae				
	<u>Dactylopsila trivirgata</u>	Gray,1858	Striped Possum	Two other species in PNG and

Table 1 (cont.)

Family	Species	Describer	Common Name	Comments
				Irian Jaya (including offshore islands).
	Gymnobelideus leadbeateri	M'Coy,1867	Leadbeater's Possum	
	Hemibelideus lemuroides	(Collett,1884)	Lemuroid Ringtail Possum	
	Petauroides volans	(Kerr,1792)	Greater Glider	
	Petaurus australis	Shaw,1791	Yellow-bellied Glider	One other species in PNG and Irian Jaya (including offshore islands)
	P. breviceps	Waterhouse,1839	Sugar Glider	
	P. norfolcensis	(Kerr,1792)	Squirrel Glider	
	Petropseudes dahli	(Collett,1895)	Rock Ringtail Possum	
	Pseudocheirus herbertensis	(Collett,1884)	Herbert River Ringtail Possum	Five other species in PNG and Irian Jaya (including Japen and Salawatti Islands).
	P.peregrinus	(Boddaert,1785)	Common Ringtail Possum	
	Pseudochirops archeri	(Collett,1884)	Green Ringtail Possum	Three other species in PNG and Irian Jaya (including Japen Island).

Table 1 (cont.)

Family	Species	Describer	Common Name	Comments
Burramyidae				
	Acrobates pygmaeus	(Shaw,1794)	Feathertail Glider	
	Cercartetus caudatus	(Milne-Edwards,1877)	Long-tailed Pigmy-Possum	
	C.concinnus	(Gould,1845)	Western Pigmy-Possum	
	C.lepidus	(Thomas,1888)	Little Pigmy-Possum	
	C.nanus	(Desmarest,1818)	Eastern Pigmy-Possum	
Tarsipedidae				
	Tarsipes rostratus	Gervais and Verreaux,1842	Honey-possum	

DISCOVERY AND NOMENCLATURE

Aborigines have been in Australia for at least 40 000 years (Stanbury, 1987). For most of this period they relied on hunting and gathering food for sustenance. Many tribes occupied forested areas and were well-acquainted with the arboreal marsupial fauna and their ways of life. The first record of the recognition of these fauna is a painting of the rock ringtail possum (Petropseudes dahli) done by Aborigines of the Arnhem Land plateau some 18 000 - 20 000 years ago (Chaloupka, 1984). Many other paintings of more recent age also depict these fauna. Possums, for example, are shown in cave paintings by Aborigines in the Cober pediplain of central western New South Wales (McCarthy, 1976). Similarly, possums are amongst many animals identified by the sign language of Aboriginal tribes living in north Queensland. This sign language has been handed down from generation to generation (Roth, 1908).

A manuscript apparently written about 1544 AD by Antonio Galvao, who was the Portuguese governor of the Moluccas at Ternate from 1536 to 1540, gives the first record of a marsupial from the Australasian region by a European. This was the arboreal grey cuscus (Phalanger orientalis). The local people called them 'kusus' (from which the common name, cuscus was probably derived) and ate them like rabbits, seasoned with spices (Calaby, 1984). Galvao's manuscript appeared less than fifty years after the first description of a New World opossum.

The first recorded sighting of a species of arboreal marsupial in Australia by Europeans appears to be that of the common ringtail possum (Pseudocheirus peregrinus). This species was collected from near the Endeavour River in north Queensland while the Endeavour was being repaired during the first voyage of James Cook to Australia in 1770. A 'possown' was shot at Adventure Bay, Tasmania while Furneaux spent a few days there during Cook's second voyage. On Cook's third voyage, the Resolution and the Discovery visited Adventure Bay and this time a good sketch and a specimen of a common ringtail possum were obtained.

The common name 'possum' appears to have been used first for the common ringtail possum during Cook's voyages to Australia, although the actual spelling of this name in his journals is different. Possum is an abbreviation of opossum, a name of Amerindian origin applied to American marsupials of the family Didelphidae.

Following Cook's exploration, P. P. King made four exploratory voyages around Australia. Surprisingly, only six species of mammal were collected during these voyages. These included a specimen of a feathertail glider (Acrobates pygmaeus) and the skeleton of a sugar glider (Petaurus breviceps), both of which are thought to be from the vicinity of Sydney.

It was not until the late eighteenth and early nineteenth centuries, following the arrival of the First Fleet, that the first systematic collections of Australian mammals, including species of arboreal marsupials, were made. These collections, however, were undertaken by French expeditions which included teams of naturalists. Specimens were preserved and subsequently deposited in the National Museum of Natural History in Paris, where they still remain.

By the mid-late nineteenth century, explorers and naturalists based in Australia were regularly collecting arboreal marsupials. Most of these specimens found their way into the British Museum, the museum of the Zoological Society of London and that of the Royal College of Surgeons. Most species were described during this period (Table 1). Interestingly, most of the describers did not visit Australia although several supported collectors in this country.

The process of collection, preservation and deposition of specimens in distant museums was not all 'plain sailing'. Many type specimens were subsequently lost and information on the locality of collection (type locality) of specimens was frequently incomplete or confused. The squirrel glider (Petaurus norfolcensis), for example, was so named because it was thought to have been collected from Norfolk Island. In fact the species does not occur on Norfolk Island and was probably collected in the vicinity of Sydney.

The first complete check-list of mammals recorded from Australia was not published until 1934 (Iredale and Troughton, 1934). This year (1988), some 444 years since a European first recorded a species of arboreal marsupial from the Australasian region and 118 years since a species was first reported from Australia, a second check-list of Australian mammals has been published (Walton, 1988). This catalogue details the nomenclature formally recognised for arboreal marsupials and other mammals of Australia in accordance with the 1985 edition of the International Code of Zoological Nomenclature. Information on the original publications in which names of species first appeared is included. The location, catalogue number(s) and status of primary type(s) are given whenever possible, as are type localities.

Today, the word 'possum' is used in various combinations of common names for four of the six families of arboreal marsupials in Australia. Strahan (1981) considers that, in the absence of truly vernacular names, many common names for this group have been coined in reference books over the years. As example he cites the feathertail glider which has been given various names in different books - pygmy flying-opossum, flying mouse, pygmy acrobates, feathertail, pygmy flying phalanger and pygmy glider - as well as the common name now recognised (Walton, 1988).

Many of the first European naturalists in Australia attempted to attach Aboriginal names to the animals they saw. This approach appears to have been frustrated, however, as these Aboriginal names tended to change from tribe to tribe. Thus, even in relatively small geographic areas, an animal could be known by several names. Probably as a consequence, only one name was adopted from Aboriginal languages for arboreal marsupials. Various Aboriginal tribes in the vicinity of

Sydney used several names (colah, colo, cullewine, koala, koolah, koolewong) to describe our most popular arboreal marsupial and one of these remains in use today. Early European settlers and explorers also called the koala (Phascolarctos cinereus) the native bear or native monkey (Strahan, 1981). I have often wondered if the name monkey gum which was applied to the species now known as mountain grey gum (Eucalyptus cypellocarpa), which occurs near Sydney, was given because koalas were frequently observed feeding in it.

One arboreal marsupial, Leadbeater's possum (Gymnobelideus leadbeateri), has been 'discovered' three times. This species was described in 1867 by Sir Frederick M. Coy, while foundation Professor of Natural Sciences at the University of Melbourne, from two specimens collected near the Bass River in Victoria. Two further specimens were collected 42 years later in 1909. These specimens, although unlabelled, were assumed to be from the same general locality as the earlier ones. Over the next few years the forests of the Bass River region were cleared completely. Leadbeater's possum was presumed extinct. In 1931 a fifth, previously overlooked, specimen was found in the collections of the National Museum of Victoria by C.W. Brazenor. This proved a significant discovery as the specimen was taken from the vicinity of Mt Wills, some 250 km north-east of the Bass River locality. At this time it also became clear to Brazenor that one of the unlabelled specimens collected in 1909 was actually from Tynong, about 40 km north of the Bass River locality. These events suggested that the geographic distribution of the species was wider than previously assumed. Extensive searches in the Victorian highlands ensued over a period of nearly 30 years but the animal remained unsighted. In 1960 it was listed as 'probably extinct' (Calaby, 1960). Amazingly, and accidentally, Leadbeater's Possum was rediscovered in the wild the next year near Marysville in the central highlands of Victoria (Wilkinson, 1961). Populations of this species are now known to be more widespread (Smith, 1982).

EXPLOITATION

Exploitation refers to the human use of animals. Limited data and reasoning suggest that Aborigines had an abundance of choices of fauna to exploit. This exploitation had primarily a direct and limited purpose; to feed relatively small groups of people in a short time. Storage of animal foods was minimal and there appears to have been no trade in this food (Thomson et al., 1987). Seven main groups of fauna were exploited, one of which was the 'possums'. This group was hunted throughout Australia, primarily for food but their skins were used for clothing in southern Australia (Wright, 1979) and to make fur string (Thomson et al., 1987). This string could be spun and was sometimes used to make a covering for the pubic region of the body. Mulvaney (1973) reports that the jaws of possums were sometimes used as tools.

Possums were generally captured by climbing trees and killing them or taking them alive (Petrie, 1904). It seems that young, newly-independent animals were taken most (Vanderwal and Horton, 1984), possibly because they were most readily caught and their meat was relatively tender to eat. Records exist of possums being smoked out of hollow trees (Thomson et al., 1987).

Koalas, particularly young animals, were valued as food by Aborigines and were vigorously pursued, once sighted (Home, 1808: Gould, 1863). The method of capture was probably similar to that used for possums. Home (1808) states that Aborigines climbed trees to capture them '... and either kill it with a tomahawk or take it alive'. Once detected, Aborigines could also knock koalas from trees by hurling heavy clubs at them (Gould, 1863). Clubs were hurled with precision.

The impact of Europeans on arboreal marsupials is well documented and has been significant. Species have been exploited principally for skins (fur) and sport. Some species, particularly the brushtail possum (Trichosurus vulpecula), have been poisoned for destroying cultivated crops, while several species have been captured for public display or scientific study. Animals may also have been taken for pet-meat.

The most significant exploitation of arboreal marsupials has been for fur. The brushtail possum and koala, in particular, were exploited around the turn of this century on a scale sufficient to bring them close to extinction (Thomson et al., 1987). In the late 1800s the export of skins of both species developed into an important industry. The fur of the brushtail possum was highly sought overseas and fetched high prices in Britain and the USA. In 1906, over four million skins were exported to markets in London and New York alone. There was some concern as early as 1900 that excessive hunting and trapping was threatening the survival of both species. Closed seasons for the brushtail possum were introduced in Queensland in 1907 but exploitation continued on a large scale. By the 1920s closed seasons had been introduced elsewhere but large numbers of possums were still being harvested. For example, a total of 11 701 skins were taken during a two-week open season in two New South Wales districts during 1926. Records for 1931-1932 indicate that over one million skins were exported from New South Wales (Thomson et al., 1987).

Exploitation of the koala followed a similar pattern to that of the brushtail possum although the numbers harvested were considerably lower. Nearly 60 000 skins were reported to have been traded in the Sydney markets in 1908. The number of koalas harvested continued to increase over the next decade and a half. By 1924 some two million skins were being exported (Thomson et al., 1987). During a short open season in Queensland in 1927, 584 738 skins were traded. Most harvesting of koalas had ceased by 1928.

Both species are now fully protected in continental Australia. Harvesting of the brushtail possum is still permitted in Tasmania. This is undertaken by licenced shooters during limited open seasons which are declared depending on the relative abundance of animals.

The ringtail possum and the mountain brushtail possum (Trichosurus caninus) were also harvested in considerable quantities earlier this century. Trade in ringtail possum skins peaked beween 1929 and 1938 during which period nearly four million were sold. Hunting declined after this period probably as a result of reduced market prices due to the relatively low quality of skins compared to other possums or to the reduced abundance of animals (H. J. Willims, pers. comm.). The mountain brushtail possum was hunted for its skin until 1963 when the last open season was declared in Victoria. Thomson et al.(1987) state that during this last (two-month) season some 900 000 possum skins were sold. Many of these were of the mountain brushtail possum.

ECOLOGICAL KNOWLEDGE

Compared to the majority of the Australian fauna the ecology of most mammals is very well known (Richardson, 1983). Within the mammals, the terrestrial kangaroos are probably the most studied. The ecology of the arboreal marsupials is also relatively well documented, particularly for those species from temperate forests. This knowledge is well covered by Strahan (1983), Smith and Hume (1984) and Lee and Cockburn (1985). Excellent popular accounts are given by Fleay's 1947 book Gliders of the Gum Trees and Russell's 1980 contribution Spotlight on Possums.

As with most other Australian mammals, most of the documented knowledge of the ecology of arboreal marsupials has been acquired over the past three decades. There are several reasons for this. Firstly, until recently, the people studying mammals in Australia had been relatively few and, generally, poorly funded and equipped. Calaby (1984) briefly described the formation and inaugural general meeting in 1959 of the Australian Mammal Society. The Society had 24 foundation members and at the first meeting 14 members were present and eight papers were read. Much of the recent knowledge has been acquired by State and Commonwealth government-funded individuals and research groups including postgraduate students, particularly Ph.D. students based at Australian universities. Many of these research positions are relatively new (also point three, below). Few people, for example, had the opportunity to undertake postgraduate studies until recently. The Ph.D. (Doctor of Philosophy) course was not offered at Australian universities until the mid-1950s. In contrast to the 1959 meeting, about 200 people attended the 1986 annual general meeting of the Australian Mammal Society and well over 60 papers were read. Secondly, arboreal marsupials are extremely difficult to observe or catch and study. With the exception of Bennett's tree kangaroo, all species are considered to be nocturnal and many typically utilise tree hollows or camouflaged areas for shelter during daylight. About one-third of the group are restricted to forests with closed canopies and several species spend most of their lives high in the forest canopy. Thirdly, and probably most importantly, impetus for much of the recent research on members of this group has arisen from widespread public and, as a consequence, political concern in the last few decades about the impact of forestry practices on these and other forest-dependent fauna (e.g. avifauna) (Tyndale-Biscoe and

Calaby, 1975; McIlroy, 1978). This concern led to a major redirection of funding within, or the provision of substantial additional funding to, existing government institutions. Further, private companies were also established to conduct research and review forestry practices. The overall effect was the creation of more research positions and the allocation of more research effort to these fauna.

Today, species of arboreal marsupials are known to occupy a variety of forest habitats - including tropical and temperate rain-forests, sclerophyll forests and woodlands. Within these habitats three main macro-niches are exploited: arboreal herbivore, arboreal gumivore and arboreal nectarivore. Most species probably have a minimum impact of their environment. However, some burramyids, petaurids and the honey possum (Tarsipes rostratus) may facilitate pollination, particularly in genera of the Myrtaceae and Proteaceae, while the koala and ringtail possum may defoliate trees to the extent that they die.

Some genera of this group (i.e. Dendrolagus, Phalanger, Pseudocheirus and Pseudochirops) have more species living outside than in Australia; principally in Papua New Guinea and Irian Jaya, Indonesia (Table 1).

Aspects of the ecology of arboreal marsupials investigated by researchers concern both academic and applied topics. Populations of the koala remained very low after its large-scale exploitation at the turn of this century. As a consequence, work was conducted on the relocation of surplus animals from breeding colonies as early as 1923, for example animals from colonies established on some islands off the mainland of Victoria (e.g. French Island) were relocated to mainland Victorian forests supporting potential habitat. A colony was also established on Kangaroo Island, South Australia, in 1923 and subsequent releases of surplus animals from this colony were made at eight localities on the mainland of that state (Robinson, 1978). Not all releases, however, were successful.

More recently, the brushtail possum has been used extensively for scientific study and, today, is probably the best 'understood' species of arboreal marsupial. Concentration of work on this species was due principally to its ease of capture and maintenance in captivity. Much work has also been conducted on introduced populations in New Zealand, where the brushtail is considered a pest and is also known to be a vector of bovine tuberculosis (Green, 1984).

Most applied research has, in one sense or another, addressed the potential effects of habitat manipulation or habitat removal, as in the case of clearfelling of forests for woodpulp, on resident populations of arboreal marsupials. Tyndale-Biscoe and Smith conducted research on the population dynamics and effect of habitat destruction on the greater glider (Petauroides (then Schoinobates) volans) in southern New South Wales in the mid-1960s (Tyndale-Biscoe and Smith, 1969). Later workers have attempted to quantify the habitat requirements (e.g. availability and use of food and shelter resources) of several species and how these requirements are affected by various land management practices (for examples see Smith and Hume, 1984). Population dynamics and rates of colonisation of some species of arboreal marsupials have been assessed in a few forest regions by comparing the number of animals in regrowth forests of different ages (but similar histories) to that of mature uncut forests (controls). Other researchers have investigated the applicability of the island biogeographic theory to 'terrestrial island' situations. This concerns the population density and number of species that forest fragments of varying sizes are able to sustain (at least in the short-term) (for a summary see Lee and Cockburn, 1985, Chapter 7). A few studies have also investigated the role (effectiveness) of corridors of native forest in linking distant, relatively large fragments of forest containing a favourable habitat for species. Research in most of these areas is still in its infancy and is continuing, albeit slowly due to current economic constraints. Norton (1986) summarises more fully these and other developments.

A very important point derived from the recent history of applied research is that the formulation and implementation of forestry practices have generally preceded the collection of scientific knowledge relevant to such decision-making processes. Further, often the gap in time between the implementation of such practices and the scientific assessment of their effect has been substantial. As a consequence, where practices have been demonstrated scientifically to be detrimental, the possibility of halting or reversing at least their immediate effect(s) has been low. A good example of this situation, in relation to arboreal marsupials, is demonstrated by the work of Braithwaite and co-researchers in the woodchip concession area near Eden, New South Wales (summarised in Braithwaite, 1986). With the co-operation of logging crews in the Eden forests, Braithwaite was able to obtain information about the species and numbers of possums and gliders these crews found during their operations. When these data were combined with a series of environmental measures recorded in the logged coupes important correlates of the quality of habitat of these fauna were derived. This knowledge, of course, was of academic importance to the specific area it was collected in because all of these forests had been cleared.

Concurrent with the increase in research effort on arboreal marsupials has been a gradual refinement in the methods used to capture and monitor free-ranging animals. As recently as the late 1960s, shooting and climbing trees to search hollows were two of the main ways of securing animals. More recently, aluminium cage traps used to capture terrestrial fauna have been modified to facilitate the capture of arboreal species. These traps are fastened to horizontal branches or are supported in a horizontal position, with the trap-door facing the trunk of the tree, by wooden ledges fastened to the tree trunk by nails. Nectarivorous species may be lured to near the trap by a honey solution which is sprayed in the vicinity of the trap. Traps are normally baited with a mixture of honey, peanut butter and rolled oats. Trappability of most species is improved if traps are located near feeding sites (e.g. the sap-sites of the yellow-bellied glider (*Petaurus australis*)).

Capture of the koala and greater glider has proved particularly difficult as both feed on foliage, usually high in the canopy. Thus it is difficult to lure them to a trap. The best way to capture a koala alive still remains that used by the Aborigines. That is, climb the tree! This procedure, however, has been refined with the use of an aluminium extension pole and lasso. Greater gliders provide more scope because they can volplane. Animals observed feeding near the end of a branch can be captured by shooting and breaking the branch, thus forcing them to glide to the ground.

Once captured, animals can be more easily identified by marking them with reflective tags so they can be observed at a distance using a spotlight and binoculars. More recently, new technology has allowed several species to be monitored using a radio-transmitter which is usually attached to a collar fitted around the animal's neck.

There have been several recent developments in counting species indirectly. For species, like the petaurids, that vocalise regularly and loudly, tape recordings of their calls can be played to 'call up' or elicit responses from previously undetected individuals. The presence of previously undetected species in a forest region can also be confirmed by the location and identification of their hair, skeletal remains, tracks or scats. For example, hairs or skeletal fragments may be collected from the regurgitated or faecal pellets of such predators as owls, feral dogs and foxes. The use of hair to identify species is outlined by Brunner and Coman (1974).

CONSERVATION

When Europeans began colonising the land around the beginning of the nineteenth century they considered the native forest fauna, like the bush itself, something to be mastered. By the turn of the twentieth century this attitude had changed somewhat and the conservation of fauna and the role of governments (after federation) in this process was recognised formally. For example, in outlining the policy of the Forestry Commission of New South Wales, the Forestry Act 1916 stated inter alia that one of the Commission's objectives was '... to conserve birds and animals thereon'. 'Thereon' referring to the state forests of New South Wales. For much of this century, however, the conservation of forest fauna received relatively low priority. Although many reserves and national parks were declared during this period, this was done with little knowledge of the suitability of most of these areas as habitat for fauna (T.W. Norton, unpublished data).

Serious scrutiny of the appropriateness of forestry management practices for the conservation of forest fauna, particularly forest-dependent species such as most arboreal marsupials, was generally lacking until the early 1970s. More recently, the adequacy of forest management practices, including those for the national 'system' of forest parks and reserves, and legislation to fulfil the objective of conserving forest fauna have received considerable attention and some revision. This process is continuing (Saunders et al., 1987). As alluded to earlier, the initial impetus for this re-appraisal was primarily due to the establishment and subsequent expansion of the export woodchip industry and the increase in forest areas used for plantations of exotic species. This impetus has been maintained and strengthened due to the recent and forthcoming negotiations between the Commonwealth Government and private companies for the renewal of export woodchip licences. Wilson (1987) summarises the developments in conservation in relation to Australian fauna, including arboreal marsupials.

The most serious constraint on the long-term conservation of most species of arboreal marsupials has been the significant reduction in, and modification of, native forest in Australia since settlement by Europeans (Table 2). Almost all of the native forests providing habitat for this group have been affected (Figure 1). Reduction in the total area of native forests is primarily the result of the spread of agriculture, urban developments and plantations of exotic trees. Modification of native forests is due principally to forestry practices and changes in fire frequency. Clearing of rainforest, in particular, has had a significant impact on a number of arboreal marsupials as this habitat is now limited in extent. About two-thirds to three-quarters of the rain-forest has been cleared since settlement. It now occupies only 0.2% of the mainland (Tracey, 1982).

Table 2: The area (km^2) and percentage of existing vegetation cover and vegetation cover modified since settlement by Europeans in three geographic regions (south-west, south-east, north-east) of Australia (modified from Laut et al., 1980).

	Geographic regions					
	South-west		South-east		North-east	
	km^2 (000)	%	km^2 (000)	%	km^2 (000)	%
Unmodified native vegetation	108	26	65	6	258	16
Modified by grazing or forestry	81	19	409	38	1009	63
Totally replaced by cultured vegetation	230	55	614	56	330	21

Another important feature of the clearing of native forests has been the types of forest cleared rather than the total area cleared. Many of the forest sites cleared were chosen on their suitability for agriculture. It now seems certain that many of these forests, particularly those in coastal eastern Australia, supported optimum habitat for several species of arboreal marsupials (Winter, 1984; Braithwaite, 1986; Norton, 1986). For example, the majority of the lowland eucalypt forests in south-eastern New South Wales which were dominated by forest red gum (*Eucalyptus tereticornis*) have been cleared. This eucalypt is one of the most preferred food trees of the koala. As a consequence the koala is now rare in this region.

Fig. 1 *Extent and degree of modification of vegetation cover since settlement by Europeans (map* ***b****) in relation to the broad geographic range of most pecies of arboreal marsupial (map* ***a****). Sources: (****a****) modified from Strahan (1983), (****b****) modified from Laut* *__et al__. (1980)*

Reduction and modification have also led to the significant fragmentation of native forests. As a consequence the habitat of arboreal marsupials has been fragmented further. The long-term effect of this remains speculative. Under natural conditions fragmentation prevents gene flow between distant populations. Small populations _per se_ may also be less resilient to immediate impacts like fire, cyclone, exposure to exotic disease and predation. Despite the obvious need, at least as early as 1970, to establish and monitor 'benchmark' research sites in fragmented and non-fragmented native forests, developments in this area have been slow (Suckling, 1982; Margules, 1985).

Some species of arboreal marsupials have adapted reasonably well to reduction and modification of their natural habitat. The brushtail possum, for example, has successfully colonised urban areas in coastal centres of south-eastern Australia. It has also been able to maintain small populations in farm land by sheltering in dwellings, hollow logs or rabbit burrows once most of the eucalypts have been cleared. The ringtail possum and sugar glider have also been recorded in built-up areas. Similarly, small populations of the koala have become established in some residential areas of the central east coast of Australia where their food requirements have been actively catered for. Nevertheless, most of the above populations remain susceptible to stress, disease and various forms of predation.

CONCLUSION

Arboreal marsupials in Australia have been exposed to human influence for at least 40 000 years. During most of this period the human impact on this group appears to have been negligible. In marked contrast, however, the impact since settlement by Europeans has been severe.

The most obvious impact on arboreal marsupials has been the large-scale clearing of native forests over the past 200 years. Combined with less intensive land management practices, this has led to a significant reduction in the geographic range of many species, as well as the modification, particularly in the form of fragmentation, of their known existing habitats. Scientific research to assess these impacts, however, was not forthcoming until very recently. This research is still in its infancy and is, at present, markedly constrained due to public-sector priorities and the prevailing economic conditions.

Despite this history, no species has recently become extinct and only one, Leadbeater's possum, is considered endangered. This generalized statement, however, is misleading. Firstly, there is the problem of definition. The taxonomic level usually considered in conservation, including current legislation, is the species. But the appropriateness of the use of this artificial category has yet to be adequately addressed. For example, the loss of a population of animals due to clearing of their habitat may be considered unimportant if the species is apparently well represented elsewhere. On the other hand, the loss of such a population may be biologically significant for the long-term viability of the species if it contained important genotypes which were not represented elsewhere (Winter, 1979; Ride and Wilson, 1982; Winter, 1984). Secondly, there is the widespread concern for the long-term effect of repeated cycles of modern, large-scale, intensive forestry practices on the arboreal marsupial fauna (Winter, 1984; Recher, 1985). Currently, there appears to be no scientifically rigorous method of assessing this effect in advance.

In conclusion, land management practices conducted over the past 200 years appear to have markedly limited the options available for the long-term management and conservation of wild populations of arboreal marsupials. The history of their exploitation, ecology and conservation demonstrates clearly that, given the opportunity, most species are relatively resilient to disturbance. The critical opportunity they require, of course, is the long-term maintenance of their remaining favourable habitat. If we choose to provide this opportunity then we conserve not only these fauna but entire forest ecosystems.

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This work is dedicated to Lila M Williams (1915-) and Louis Daniel Webb (1986-). To past endeavours and future ambitions.

REFERENCES

Braithwaite, L.W., 1986 Forests and fauna, Forests and Timber, 22: 23-36.

Brunner, H. and Coman, B.J., 1974 The identification of mammalian hair (Inkata Press, Melbourne).

Calaby, J.H., 1960 Australia's threatened animals, Oryx 5: 381-386.

Calaby, J.H., 1984 Foreword pp. iii-iv, in Smith, A.P. and Hume, I.D. (eds) Possums and Gliders (Surrey Beatty and Sons, Sydney).

Chaloupka, G., 1984 From paleoart to casual paintings, Northern Territory Museum of Arts and Sciences Monograph No. 1:60pp.

Fleay, D., 1947 Gliders of the Gum Trees (Bread and Cheese Club, Melbourne).

Gould, J., 1863 The Mammals of Australia (The Author, London).

Green, W.Q., 1984 A review of ecological studies relevant to management of the common brushtail possum, pp. 483-499, in

Smith, A.P. and Hume, I.D. (eds) Possums and Gliders (Surrey Beatty and Sons, Sydney).

Home, E., 1808 An account of some peculiarities in the anatomical structure of the wombat, Philosophical Transactions of the Royal Society of London 98: 308-312.

Iredale, T. and Troughton, E. le G., 1934 A check-list of the mammals recorded from Australia, Memoirs of the Australian Museum 6: 1-122.

Laut, P., Firth, D. and Paine, T.A., 1980 Provisional Environmental Regions of Australia (CSIRO, Melbourne) 2 vols.

Lee, A. K. and Cockburn, A., 1985 Evolutionary Ecology of Marsupials (Cambridge University Press, Cambridge).

McCarthy, F.D., 1976 Rock art of the Cober Pediplan in central western New South Wales, Australian Aboriginal Studies Research and Regional Studies No. 7 (Australian Institute of Aboriginal Studies, Canberra).

McIlroy, J.C., 1978 The effects of forestry practices on wildlife in Australia: a review, Australian Forestry 41: 78-94.

Margules, C.R., 1985 The Wog Wog habitat patch experiment: background, objectives, experimental design and sample strategy (CSIRO Division of Water and Land Resources, Canberra Technical Memorandum) 85/18.

Mulvaney, D.J., 1973 The Prehistory of Australia (Penguin, Melbourne).

Norton, T.W., 1986 Towards understanding the (eucalypt) forest dependent wildlife in south-eastern Australia, Tigerpaper (FAO, Bangkok) 13: 24-29.

Petrie, C.C. 1904 Tom Petrie's Reminiscences of Early Queensland (Watson Ferguson, Brisbane).

Recher, H.F., 1985 A diminishing resource: mature forest and its role in forest management, pp. 28-33 In Kikkawa, J. (ed.) Wildlife Management in the Forests and Forestry-controlled Lands in the Tropics and the Southern Hemisphere (University of Queensland, Brisbane).

Richardson, B.J., 1983 Identifying the Australian fauna: what remains to be done? Search 14: 320-323.

Ride, W.D.L. and Wilson, G.R., 1982 The conservation status of Australian mammals, pp. 27-44, in Groves, R.H. and Ride, W.D.L. (eds) Species at Risk: Research in Australia (Australian Academy of Science, Canberra).

Robinson, A.C., 1978 The koala in South Australia, pp. 132-143, in Bergin, T.J. (ed.) The Koala Proceedings of the Taronga Symposium (Zoological Parks Board of New South Wales, Sydney).

Roth, W.E., 1908 North Queensland ethnology, Records of the Australian Museum 7: 74-107.

Russell, R., 1980 Spotlight on Possums (Queensland University Press, Brisbane).

Saunders, D.A., Arnold, G.W., Burbridge, A.A. and Hopkins, A.J.M., 1987 Nature Conservation: the Role of Remnants of Native Vegetation (Surrey Beatty and Sons, Sydney).

Smith, A.P., 1982 Leadbeater's possum and its management, pp. 129-145 in Groves, R.H. and Ride, W.D.L. (eds) Species at Risk: Research in Australia (Australian Academy of Science, Canberra).

Smith, A.P., and Hume, I.D., 1984 Possums and Gliders (Surrey Beatty and Sons, Sydney).

Smith, A.P. and Lee, A.K., 1984 The evolution of strategies for survival and reproduction in possums and gliders, pp. 17-33 in Smith, A.P. and Hume, I.D. (eds) Possums and Gliders (Surrey Beatty and Sons, Sydney).

Stanbury, P.J., 1987 The discovery of the Australian fauna and the establishment of collections, pp. 202-226 in Dyne, G.R. and Walton, D.W. (eds) Fauna of Australia General Articles. (Australian Government Publishing Service, Canberra) Vol. 1A.

Strahan, R., 1981 A dictionary of Australian Mammal Names (Angus and Robertson, Sydney).

Strahan, R., 1983 The Australian Museum Complete Book of Australian Mammals (Angus and Robertson, Sydney).

Suckling, G.C., 1982 Value of reserved habitat for mammal conservation in plantations, Australian Forestry 45: 19-27.

Thomson, J.M., Long, J.L. and Horton, D.R., 1987 Human exploitation of and introductions to the Australian fauna, pp. 227-249 in Dyne, G.R. and Walton, D.W. (eds) Fauna of Australia General Articles (Australian Government Publishing Service, Canberra) Vol 1A.

Tracey, J.G. 1982 The Vegetation of the Humid Tropical Region of North Queensland (CSIRO, Melbourne).

Tyndale-Biscoe, C.H. and Calaby, J.H., 1975 Eucalypt forests as refuge for wildlife, Australian Forestry 38: 117-133.

Tyndale-Biscoe, C.H. and Smith, R.F.C., 1969 Studies on the marsupial glider Schoinobates volans (Kerr), III. Response to habitat destruction, Journal of Animal Ecology 38: 651-659.

Vanderwal, R. and Horton, D.R., 1984 Coastal south west Tasmania, Terra Australis 9: 137 pp.

Walton, D.W., 1988 Zoological Catalogue of Australia: Mammalia (Australian Government Publishing Service, Canberra) Vol. 5: 274pp.

Wilkinson, H.E., 1961 The rediscovery of Leadbeater's possum, Victorian Naturalist 79: 97-102.

Wilson, G.R., 1987 Cultural values, conservation and management legislation, pp. 250-265 in Dyne, G.R. and Walton, D.W. (eds) Fauna of Australia General Articles, (Australian Government Publishing Service, Canberra) 1A.

Winter, J.W., 1979 The status of endangered Australian Phalangeridae, Petauridae, Burramyidae, Tarsipedidae and the Koala, pp. 45-59 in Tyler, M.J. (ed.) The Status of Endangered Australasian Wildlife (Royal Society of South Australia, Adelaide).

Winter, J.W., 1984 Conservation studies of tropical rain-forest possums, pp. 469-481 in Smith, A.P. and Hume, I.D. (eds) Possums and Gliders (Surrey Beatty and Sons, Sydney).

Wright, R., 1979 A modicum of taste: Aboriginal cloaks and rugs, Australian Institute of Aboriginal Studies Newsletter 11: 51-58.

HUMAN ACTIVITY, FIRE AND CHANGE IN THE FOREST AT HOGSBACK PLAIN, SOUTHERN TASMANIA

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INTRODUCTION

The notion that past fires have profoundly affected characteristics of Australia's natural ecosystems seems now to be conventional wisdom. Almost certainly the frequency, extent and severity of fires across the country have been strongly influenced by the activities of its Aboriginal and European inhabitants.

Studies of post-fire recovery of vegetation and attempts to model community response to fire in Tasmanian forests (Gilbert, 1959; Jackson, 1965, 1968; Henderson and Wilkins, 1975; Mount, 1979; Noble and Slatyer, 1981; Brown and Podger, 1982) have not resolved competing theories about the effects which changes in fire frequency exert upon floristic composition, species dominance and stand structure.

The value of an historical approach to the analysis of vegetation change has been emphasised by Harper (1977). 'Vegetation is interpreted as a stage on the way to something. It might be more healthy and scientifically more sound to look more often backwards and search for the explanation of the present in the past, to explain systems in relation to their history rather than their goal.'

We have followed this approach in our study of the effects of repeated fire on the plant communities of an area of native vegetation around Hogsback in the cool temperate lowlands of southern Tasmania (Figs 1-4). A full account with details of methods, floristics and quantitative analyses is to be given elsewhere. Here we - (1) summarise the debate concerning the fire-stable or fire-labile nature of structural and floristic transitions between sedgeland and rainforest communities; (2) outline the principal findings of the Hogsback study and their relevance to the debate; (3) list the variety of quasi-historical methods used to derive fire histories for the Hogsback Plain; and (4) consider the comparative utility of quasi-historical and conventional historical records.

THE FIRE STABILITY DEBATE

The undisturbed vegetation of south-western Tasmania is a mosaic of forest, scrub and sedgeland. For how long this pattern has been stable is not clear. According to Mount (1979), in any given climatic regime the boundaries between the various native plant communities remain essentially stable in the presence of fire. Each

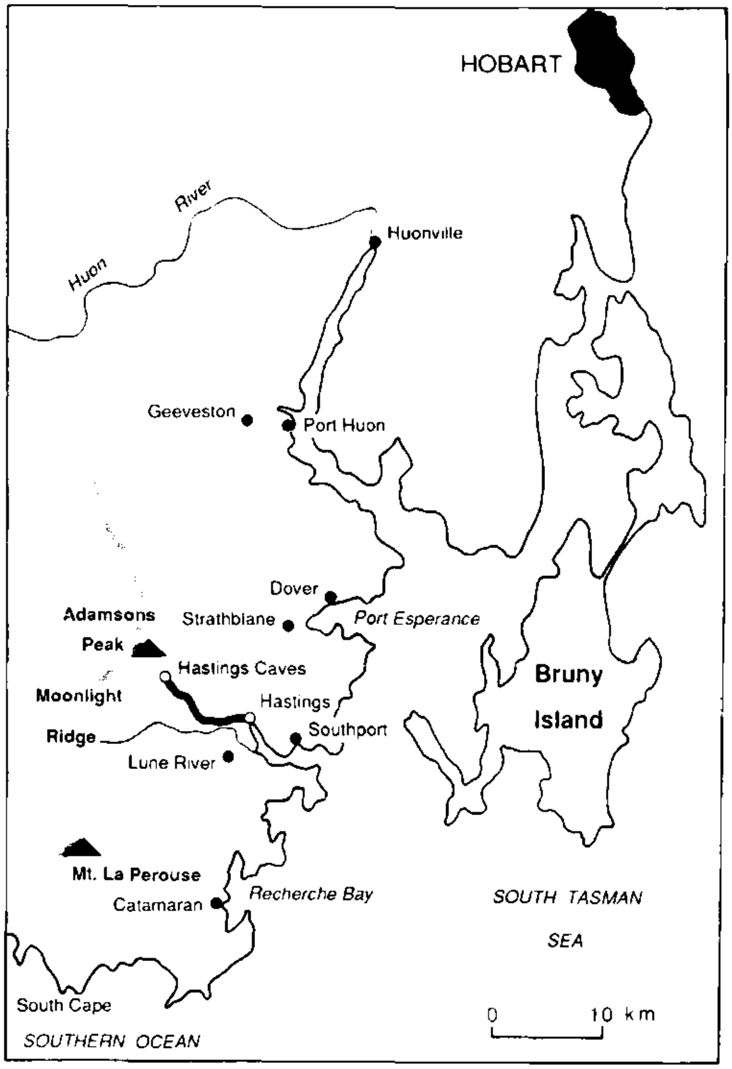

Fig. 1 *Sketch map of the southern forest region, Tasmania, with locations of the principal geographic features referred to in the text*

community has a typical fire-free interval, a consequence of differences in the rate of increase of fuels with time and differences in the flammability of the dominant species that characterise each community; the latter are peculiar to specific edaphic substrates. Mount's argument is echoed by Horton (1982), who argues that vegetation mosaics are determined by edaphic and topographic factors, and that fires burn the mosaics in such a way as to reinforce the environmentally determined pattern.

An alternative interpretation (Jackson, 1968) is based upon the premise that almost all of that part of the land surface of Tasmania which receives more than 50 mm of rainfall in each summer month is potentially capable of supporting rainforest. He argues that the present distribution and extent of the other vegetation types is very largely due to the effects of past fire. If fire frequencies are more or less constant the nature of the vegetation does not change appreciably. The result of an increase in fire frequency is to change the vegetation along a floristic continuum from rainforest toward sedgeland. With these floristic and structural changes there is an increase in flammability. This process of community displacement, which follows chance variation in fire frequency, and which can operate in either direction, has been referred to by Jackson as 'ecological drift'.

THE HOGSBACK STUDY

Physical setting

The Hogsback Plain is an area of low scrub and sedgeland c. 2 km x 2 km surrounded by tall scrub, tall-open forest, mixed-forest, and rainforest near Hastings (Figs 5, 6). The land systems of the region have been described by Davies (1988). The soils are a mosaic

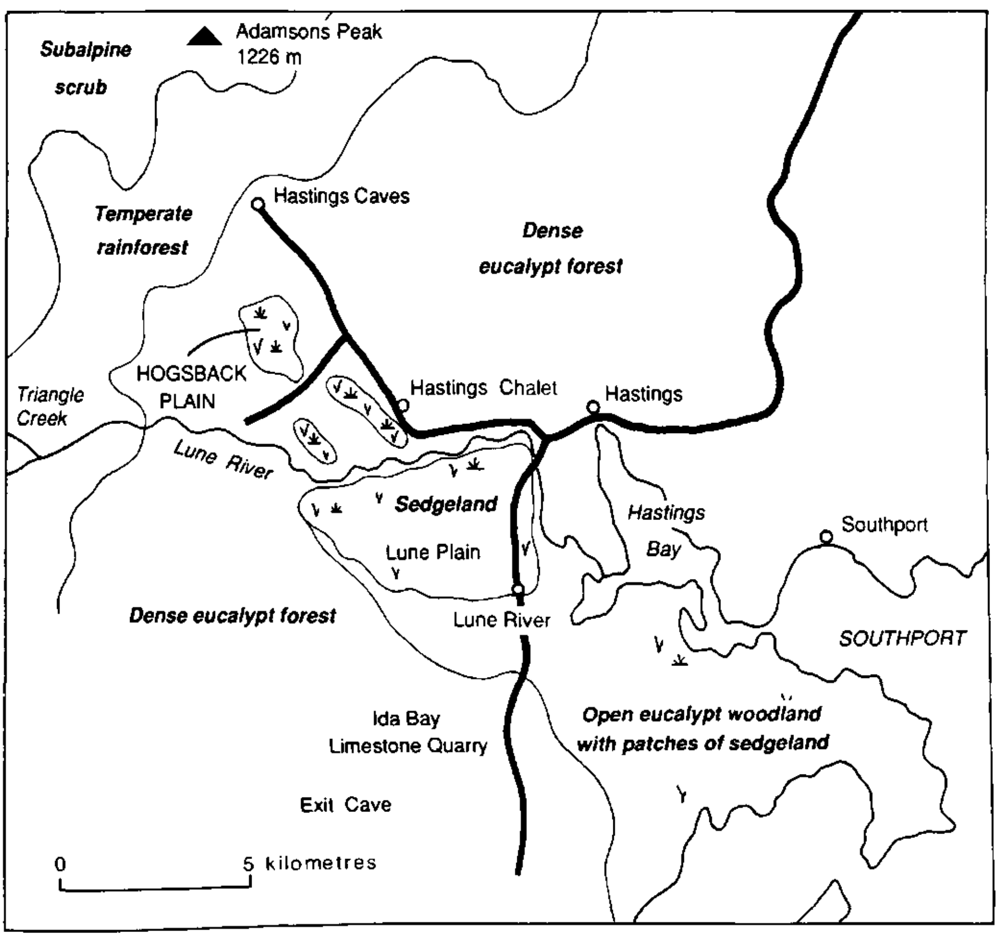

Fig. 2 Distribution of the principal vegetation types in the vicinity of the Hogsback Plain and their location relative to the coastal fringe and main routes of modern access

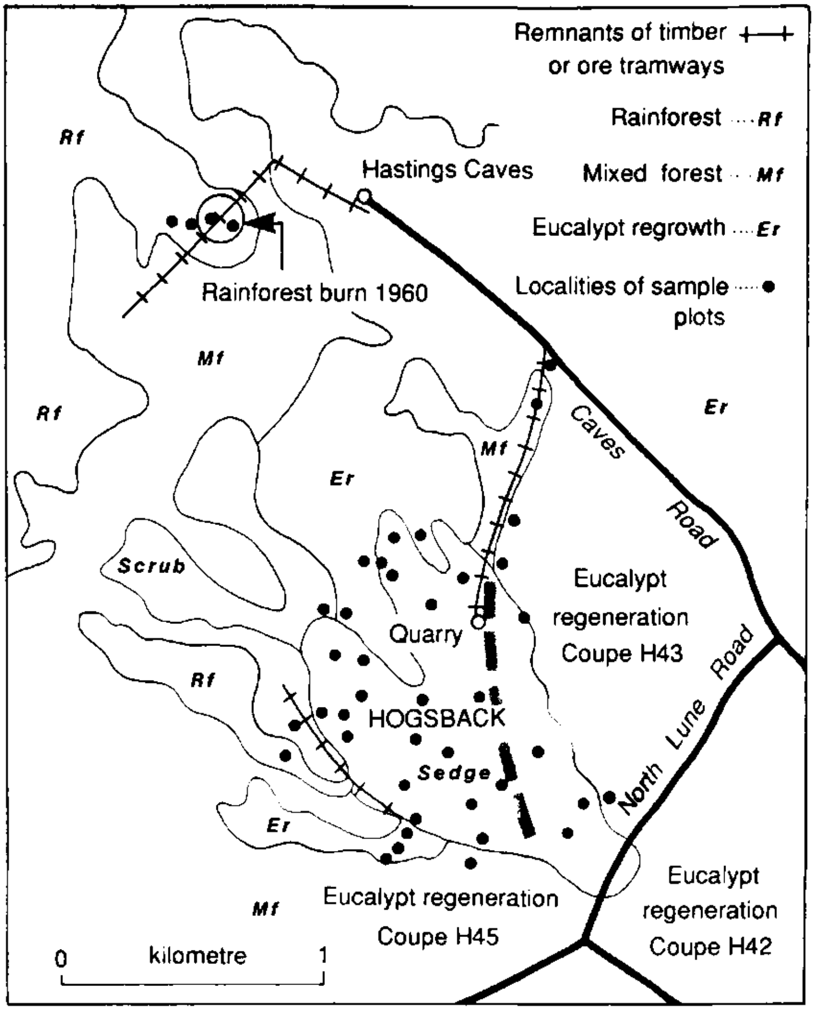

Fig. 3 Location of main groups of plots of the unpublished study of Podger, Brown and Bird, and the distribution of sedgeland, scrub, eucalypt regeneration , eucalypt regrowth originating prior to 1920, mixed forest of eucalypt over rainforest understorey originating more than 300 years ago, and Implicate rainforest

of well-aerated, red, fibrous peats and poorly-drained, black, muck peats together with mineral soils on quartzitic sandstones and alluvial deposits of the Lune River flood-plain and colluvial material from Adamsons Peak and Moonlight Ridge. Surrounding highly productive eucalypt forests are easily accessible from the coast and have a history of exploitation from the second half of the 19th century.

Historical background for the region

The lifespans of dominant individual plants now living in the various communities range from one to more than 600 years, covering the entire period of European settlement of Tasmania and more than 400 years of the final stages of Aboriginal occupation.

There can be little doubt that Aborigines travelled widely about, hunted in, and burned the vegetation of the southern forest region. There is abundant archaeological and ethno-historical evidence (Brown, 1986) that the coastal lowlands were occupied by significant Aboriginal populations well before and for sometime after European occupation of Tasmania. Signs of human activity and firing were recorded by Tasman in 1642 (Tasmanian Government, 1942, pp. 29-30). The mariners du Fresne in 1772, Furneaux in 1773, Bligh in 1788 and 1792, d'Entrecasteaux in 1792 and 1793, and Baudin in 1802 all recorded sighting smoke or fire (cited in Brown, 1986). Later Robinson (Plomley, 1966) made detailed observations on Aboriginal populations and their use of fire in southern Tasmania.

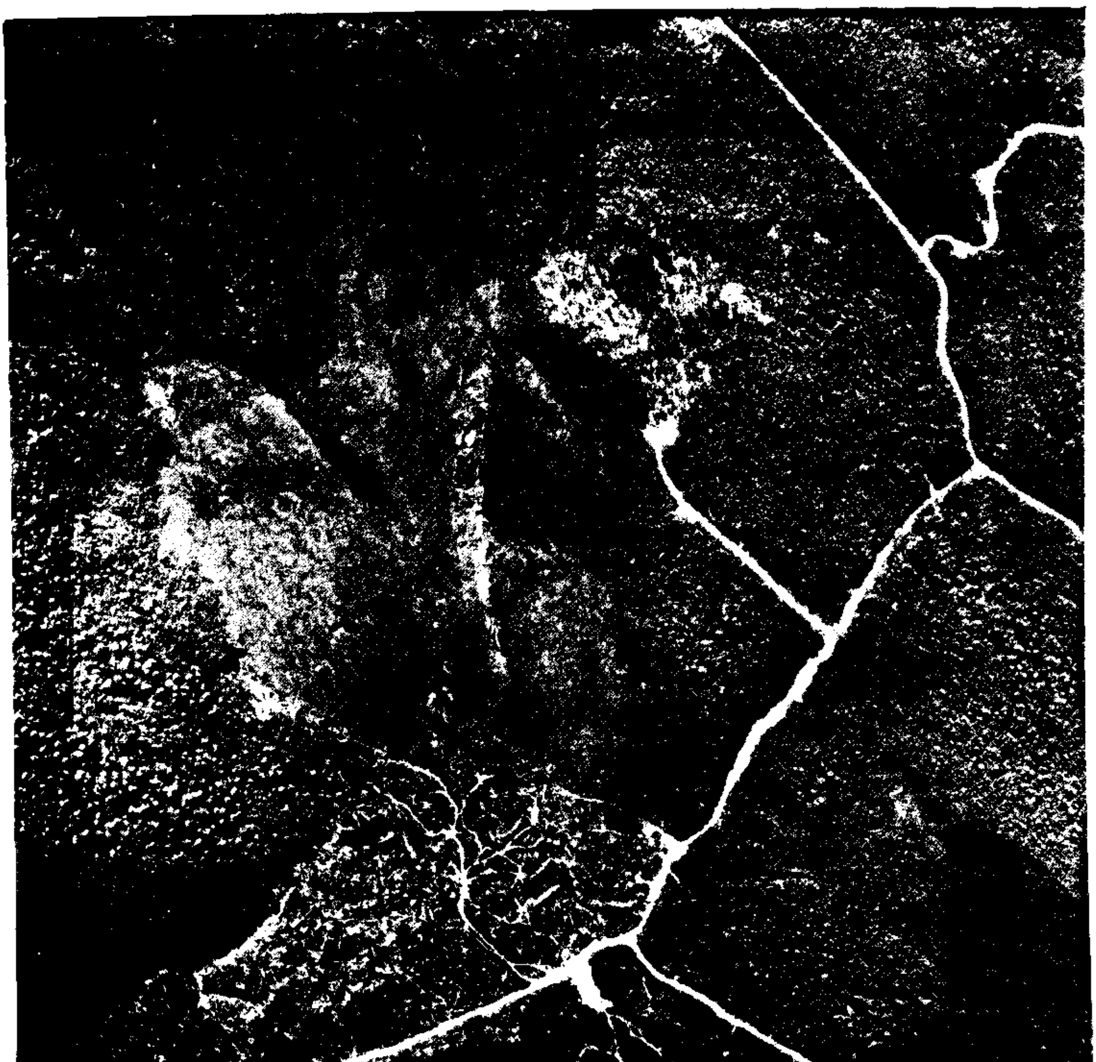

Fig. 4 *Aerial view of Hogsback ridge, plain and surrounds. Source: Lands Dept Private Forests M50 Run 6, flown 13/2/81. Scale 1 : 15 000. Key features are indicated on Fig. 3*

Fig. 5
View southward to regeneration coupe H45 from the south-western sector of the Hogsback Plain with standing dead Phyllocladus aspleniifolius stems amid Gymnoschoenus (button-grass) sedgeland

Fig. 6 View north-westward from the same point as Fig. 5 toward the scrub fringe and regrowth eucalypt forest with mixed forest and rainforest on the slopes of Moonlight Ridge

Fig. 7 J.W Beattie's photograph of hand felling a large stringybark. In this staged picture two axemen 'scarf' the face of the tree from shoes while two others prepare to put the back cut in with a cross-cut saw. Normally a team of two would fall a tree

The area south of Dover was first settled by bay whalers in the 1820s (Anon., 1973). Soon after, several coastal settlements were established to exploit the timber resources of the area (Fig. 7), a first shipment of 200 tons of logs being loaded at the Deep Hole at Southport for London in 1829. Early shingle-splitting (Fig. 8) and pitsawing were followed by the establishment of water-driven sawmills at Strathblane in 1856 and at Hastings in 1861. By 1866 there were nine sawmills at Hythe (Southport) and a population of 102 (Hammond and Rushton-Nuss, 1987). The first steam-powered mills began operating around 1874 and in 1881 the Hastings mill was converted to steam. Thereafter there were periods of boom and bust in sawmilling, with mills erected or relocated to many near-coastal locations. Initially the industry concentrated on the supply of construction timbers of large dimension to European markets (Fig. 9). With the growth of the apple industry a number of spot mills sprang up to supply boxwood. A major change in the character of the forest industry in the southern forests occurred in 1962 with the commissioning of the Australian Paper Manufacturers' mill at Port Huon to pulp and pelletise a mix of oldgrowth and regrowth eucalypt for carton manufacture. This revived logging in the areas of regrowth that regenerated between 1860 and the 1920s when old-growth easily accessible by animal and steam haulers (Figs 10, 11) had been cut out.

Although a number of local road trusts were appointed around the coastal settlements, it was not until 1876 that the Huon River was bridged at Huonville, and a coach road from Hobart first reached Port Esperance (Dover) around 1895 (MacNaughton, 1895). By 1915 a 'highway' was constructed from Dover to Hastings and onward to

Fig. 8 Fallers cross-cutting a large eucalypt for shingle splitting in bush that burned after the falling of the tree as indicated by the charred scarf in the foreground. Note the defoliated tree fern. Fires were used in conjunction with falling to improve access

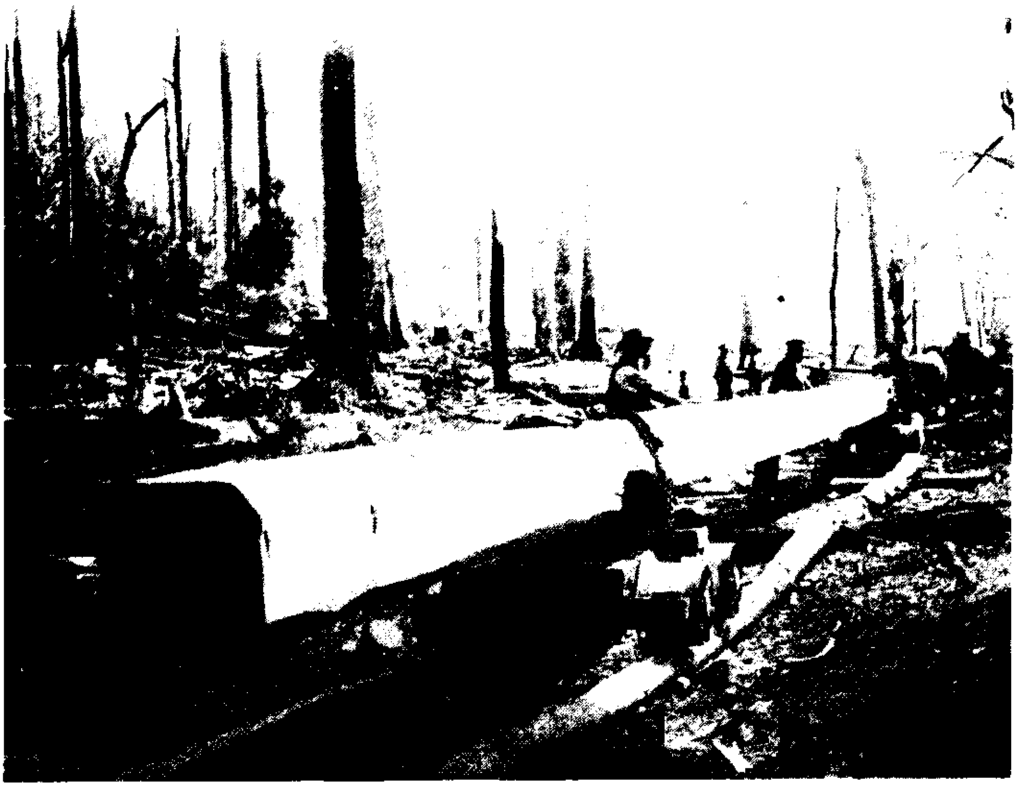

Fig. 9 Haulage of a broad-axe squared beam by a team of horses on a wooden railed tramway. Note that the surrounding bush has been severely burned. Such a degree of damage with many burnt-out tops is possible only after at least two hot fires

Ramsgate (Recherche). After the discovery of the hot springs at what is now Hastings Chalet and of the Hastings Caves in 1917, an access road was completed in 1938 (Anon., 1973) to service a small tourist industry. Earlier access to the caves had been by means of the Hastings tramway system which ran to the south-west and north of the Hogsback Plain.

Mining of deposits of coal near Catamaran and limestone at Ida Bay commenced around the turn of the century (Twelvetrees, 1915) but had little effect on the Hogsback Plain, where quartzite was mined briefly during World War II.

Principal findings of the Hogsback study

Analysis of floristic lists on 221 plots on the plain and surrounds using TWINSPAN (Hill, 1979) and detrended correspondence analysis (DCA) (Hill and Gauch, 1980) procedures indicate 14 recognisable plant communities along a continuum from sedgeland to rainforest on DCA axis 1. Evidence of prior occupation by rainforest species was found across the continuum in the form of both standing and fallen stems of Phyllocladus aspleniifolius and Agastachys odorata as well as living relics of fire-sprouts on large underground root stocks of Anodopetalum biglandulosum, a species not known to regenerate outside tall closed communities. Estimates of the period of occupation of the plain by the highly fire-sensitive Phyllocladus suggest a fire-free interval of more than 200 years prior to 1881. This last date of occupation was derived by pattern matching skeleton plots (Stokes and Smiley, 1968) of rings in dead trees on the plain with those of living Phyllocladus in unburned rainforest nearby. The latter cross-dated with a tree ring chronology of the same species on Bruny Island (La Marche et al., 1979). Supporting evidence was obtained by ring counts in dense stands of regenerated Eucalyptus obliqua in the immediate surrounds.

The larger Phyllocladus sampled near Hogsback were older than 450 years, but it is possible that some parts of the rainforest had not been burned for very much longer periods. Exploratory inspection of pollen and microcharcoal (Clark, pers. comm.) in a peat profile 1.2 m deep on shallow sandy soil over Ordovician sandstone beneath rainforest to the north-west of the plain suggests that there might not have been a fire on that site for more than 11 000 years. This is indicated by radiocarbon dating of macrocharcoal at the base of the profile and is consistent with Macphail's (1979) palynological analysis of cores from 'unnamed cirque' on Adamsons Peak.

Fig. 10 A wood-fired steam hauler used to snig logs to a landing for loading on waggons on a tramway. In this case the waggons are horse-drawn

Fig. 11 Log haulage by steam locomotive on a well constructed tramway with steel rail. Note the fire damage to the rainforest trees in the gully at right

In the open environment following burning, the forest sedge, Gahnia, and the fern, Gleichenia, increased in density: the plain would also have been moister due to reduction in on-site evapotranspiration and increase in run-off from the logged and burnt forests upslope. This has favoured the expansion of localised populations of the sedges and cord rushes. There is direct evidence of colonisation between 1978 and 1988 of former forest sites on mineral soils and red fibrous peats by Gymnoschoenus sphaerocephalus, a species more usually associated with poorly aerated black muck peats and their derivatives.

Fire histories since 1881 were constructed for each of the 221 plots using growth-ring counts on fire-sprouts and fire-callus of wounded stems. These indicated mean frequencies around 10 years for sedgeland and progressively longer intervals in other communities along the floristic continuum to rainforest. In sedgeland, as many as seven fire wounds of different age were recorded in the 64 years between 1914 and 1978 in relic Acacia melanoxylon while in tall eucalypt forest near the northern boundary of the plain, cross sections cut from eucalypt stumps left after selection felling in 1911 gave ring counts up to 410 years, suggesting that the remaining mixed forest overstorey might be near 500 years old.

A matrix of regressions was calculated for DCA scores against time since last fire and against several estimates of mean fire frequency. These showed high correlation between frequent firing and low DCA score on axis 1 (demonstrated independently to be the best discriminator of the floristic continuum).

A stripline survey of the occurrence of subfossil Agastachys and Phyllocladus on contiguous plots of 20 m x 20 m over 7 km of transect indicated that more than 60% of existing sedgeland on the plain had been occupied by low Implicate rainforest (terminology of Jarman et al., 1984) before 1881.

HISTORICAL EVIDENCE OF FIRE

The changing history of the principal causes of fires

Prior to human occupation of Tasmania, sometime before 23 000 B.P. (Kiernan et al., 1983), lightning strikes were probably the cause of almost all fires.

The widespread use of fire by Aborigines and its advantage to them in hunting, improved access, and domestic applications is well established in anthropological and ethnographical sources (Nicholson, 1981; Robinson in Plomley, 1966).

Four phases in the use of fire after European settlement can be recognised.

Between 1803 and 1935 fire was a vital tool for early settlers in land clearing, access, and mineral exploration. Much of this burning was done with little if any regard to its effects on neighbouring lands and perhaps more in anticipation of ancillary benefit. The Tasmanian Mail on 8/1/1898 observed:

> The recent devastating bushfires on the West Coast have not been utterly devoid of redeeming points. They have cleared away miles of almost impenetrable bush and scrub so that the prospector might now carry out his work with a tithe of the toil and trouble previously inseparable from hunting for lodes.

From 1935 restrictions on the use of fire gradually came into place, leading by the 1950s to the first considerable efforts at suppression of wildfires in state forests.

After the research of Gilbert (1959) and further joint work (Gilbert and Cunningham, 1972) on factors affecting the success of eucalypt regeneration in wetter forests, a program of slash burning and seeding was instituted around 1960 and was adopted across the state, becoming routine management practice. This was roughly contemporaneous with the development of a program of patterned fuel reduction burning on surrounding and less productive dry forest and sedgeland to act as firebreaks for the protection of commercial forest.

In the late 1970s a fourth phase began, essentially based on the third, but superimposing a strategy of burning for the maintenance of wildlife and floral habitat in shrub and sedgeland communities.

As a result of all these developments ignition due to deliberate human action or carelessness is now the predominant source of all fires. Some consider that lightning strikes are now a relatively insignificant cause of fires. Ingles (1987), for example, concluded that, of the area burned in state forests in the period 1979-84, less than 0.1% could be attributed to lightning ignition. This may be considerably less than the longer term average state-wide. In December 1981, 500 ha were burned on Mt Rufus by a fire seen to be ignited during an electrical storm (Tyson, pers. comm.). In two consecutive days of February 1989, 15 fires were sparked by lightning in southern Tasmania (Mount cited in the Mercury, 10/2/1989).

Sources of historical record of individual fires

A detailed account recorded firsthand by a competent observer is a rare commodity.

Newspaper reports concentrate on loss of life and property, tend not to be specific about area, and identify locality by district, nearest township, sawmills or other commercial property sometimes indicated only by the owner's name.

The following examples apply to the vicinity of the study area: the Mercury and the Tasmanian Mail for January and February 1898 contain extensive accounts of severe fires throughout the state. The Mercury for 3/1/1898 refers to fire burning on the mountains behind Ida Bay on 29/12/1897 and its spread for five miles on a two mile front, and on 8/1/1898 refers to 14 miles of fire from Catamaran to South Cape, the destruction of the Recherche tramway three miles into the bush, and the losses of Tyler's mill at Ida Bay and of Hay's mill at Hastings with its bush haulage engine and part of its tramway.

The Tasmanian Mail of 15/1/1898 reported that a large fire, thought to have originated on the La Perouse Range (Moonlight Ridge?) from a tourist fire, completely enveloped the ranges in black smoke on the 30/12/1897 and corroborates the report in the Mercury. Again on 12/2/1898 the Mercury reported that terrific bush fires were raging on 8/2/1898 in the Port Esperance (Dover) district. These sources of independent evidence are at best clearly circumstantial as to locality.

No comprehensive analysis of newspaper reports is available. However, Stuart Edgley (formerly Tasmanian Forestry Commission) has prepared an annotated list of southern forest localities burned in bad fire years to 1934 from newspaper records. This is filed in the library of the CSIRO Tasmanian Regional Laboratory, Hobart. P.J. Bowling's notebooks for 1955 record that Edgley searched the Mercury files for years regarded as bad fire years, checking October-March at first, but later deleting from consideration October, November and

March, and in the latest years, sometimes December. The searches for 1900-1909 were thorough but it is not clear which of those for the other years were abridged.

The most detailed and site-specific records encountered by us are those on file at the Tasmanian Forestry Commission (TFC). They are of several kinds and of varied reliability.

Deliberate burns for regeneration are almost always recorded in considerable detail.

Almost all the densely stocked regrowth originating before 1960 in the south arose following wildfire or fires lit for purposes other than regeneration. Since the introduction of pulpwood logging in 1962 the TFC has maintained a program of deliberate burning and seeding for regeneration (Gilbert and Cunningham, 1972). Records and maps for the Geeveston district indicate regeneration burns at places surrounding the plain in 1972, 1975 and 1977. The latest escaped and burned the southern end of the plain on 22/2/1977 (Richards pers. comm.). A second escape, which burned over almost the entire plain and entered eucalypt regeneration, mixed forest and rainforest at places in the surrounds, occurred on 27/2/1988 (Cheney, 1988).

Records of hazard reduction burning have not been kept routinely. No hazard reduction was conducted on the plain between 1977 and 1988. For the later part of that period this was to facilitate the study reported here. Prior to 1977 parts of the plain had been deliberately burned to reduce fuel (Richards, pers. comm.) but no record is available.

The TFC maintains records of wildfires for only those fires on which expenditure has been incurred in suppression; for even these the record may be incomplete. The number of preliminary reports is greater than the number of full reports on file and some years of record for the Southern Division were also lost in a fire at the Commission's Hobart office in 1984.

Only two fires in the vicinity of the Hogsback Plain were recorded for the period 1952-87. These were a fuel reduction burn of 120 acres on 28/11/1962, and a 4 acre fire in 'wet scrub' (i.e. Implicate rainforest) half a mile upstream of the junction of Triangle Creek and Lune River on 3/3/1952.

It is likely that operators of the silica quarry on the west face of the Hogsback would have periodically set fire to vegetation along the tramway connecting the quarry to Hastings Road to protect their equipment and the wooden footings of the tramway. Little information on the quarry's operation is available in the records of the Department of Mines (Allen, pers. comm.).

Hogsback Plain has been deliberately fired on a number of occasions by hunters (Richards, pers. comm.). One such fire, which was confined to the north-eastern quarter, burned sedgeland and eucalypt woodland on 4/11/1981 (Turnbull pers. comm.).

Aerial photographs covering the Hogsback area have been taken on nine occasions since 1947, seven in black-and-white and two in colour (Table 1). The photographs are of limited use for the compilation of fire history but contain evidence of human activity and vegetation distribution, damage and recovery which might provide circumstantial support for evidence from other sources. A comparison of the 1947 and 1961 photography for example indicates that the tongue of eucalypt forest along the creek in the central north-west of the plain and the scrub in the north-western forks (see Fig. 4) had increased in crown density and height between 1947 and 1961 and still further by the time of the 1981 photography. This evidence of improvement after 1947 in the stature of communities fringing the plain suggests that the major effects of increased fire frequency after 1881 had culminated sometime between 1947 and 1961, when the area of communities of low stature was at its greatest extent. There are two possible contributing factors. The earliest modern fires during the logging of oldgrowth in the second half of the 19th century and the early 20th century are just as likely to have originated in forest outside the plain as on the plain itself. Early logging methods relied on black powder splitting guns to reduce large logs to a size that could be handled by steam haulers and trams, all operations with attendant incendiary risks. In addition, weather conditions necessary for ignition and spread of fire in the forest, even the cutover, are likely to have been more extreme than weather on days selected by officers of the Forestry Commission for fuel reduction burning.

The photographs also provide some information on the development of access and of likely sources of ignition. The road to Hastings Caves is evident on the 1947 photographs as is the tram from the Caves road to the silica quarry. The 1961 photography indicates no other access or regrowth logging. This is first observable on the 1974-75 photographs with the North Lune Road completed and partial logging of coupes H45 to the south of the plain and H43 and H35 to the east.

Table 1 Aerial photograph cover of the Hogsback region

Year	Film	Scale	Location	Title
1947	BW	1:15,480	Forestry Commission	Adamson
1960/1	BW	1:40,000	Lands Dept	Picton Adamson S. Cape
1974/5	BW	1:40,000	Lands Dept	Hobart Area Census F448
1978	BW	1:50,000	Lands Dept	S.W. Resources F621
1979	BW	1:45,000	Lands Dept	S.W. Tasmania F617
1981	BW	1:15,000	Lands Dept	Private Forests M50
1982	BW	1:42,000	Lands Dept	S.W. Tasmania M142
1984	Col	1:20,000	Forestry Commission	S.E. Forestry M428
1987/8	Col	1:42,000	Lands Dept	S.W. Vegetation

A small fire, unrecorded in any other document, occurred post-1947 but prior to the photography of 16/2/1961 and is evident on the photographs as a patch of light-grey tone 1 cm south-west of the Hastings Caves car park area. It is located on part of the old tramway system, occurred in long unburned Implicate rainforest, and was independently dated by growth ring count of fire sprouts to the 1960-61 summer.

Quasi-historical method

From the early 1950s the TFC and the Commonwealth Forestry and Timber Bureau (F&TB) developed a joint program of yield and resource assessment in regrowth forests. The regrowth stands resulted from logging and wildfire in the period between 1860, when the first extensive sawmilling began, and the 1920s, when logging moved off the coastal plain and into the foothills of the southern ranges. P.J. Bowling (late F&TB) kept notebooks (filed CSIRO, Hobart) of transcribed discussions with old-timers concerning the history of logging and bushfires in the southern forests. These notes were used together with an historical survey to 1934 of the Mercury newspaper archives by S. Edgley and stem ring counts on understorey species such as Phebalium squameum and Pomaderris apetala (Bowling, 1954) to derive a 'chronology' for regeneration of fire-dependent (Gilbert, 1959) dense eucalypt stands. With this detail and checks by ring counts, assessors A.B. Mount, R. U'Ren and S. Edgley (TFC) prepared fire regeneration maps of parts of the southern forests. Mount's 1962 survey records fire years in 1898, 1906, 1914, 1926, 1934 and 1959 for the South Cape Bay to Southport Lagoon area. U'Ren and Edgely, working in the immediate vicinity of Hogsback in 1962, listed 1881, 1898, 1906, 1914, 1920 and 1934 and for south of the Lune River, 1898, 1906, 1912-15, 1926 and 1934.

In Table 2 fire dates determined in the course of the unpublished study are compared with those from both conventional and quasi-historical sources. There is considerable variety among the sources of these fires including lightning, arson, hazard reduction and escapes from regeneration burning.

DISCUSSION

Comparative utility of direct and historical methods

Information for use in the study of the ecological effects of fire must be precise at least as to locality and year of occurrence. Ideally it should contain information on season, fire intensity, and duration at specific localities (i.e. residence time). The most detailed studies of fire weather and fire behaviour - e.g. Foley (1947), Mount (1971) and the analysis of A. G. McArthur reported in Chambers and Brettingham-Moore (1967) - do not meet these requirements. Even the most severe conflagrations such as the extensive Savage River fire of 1982 leave a complex mosaic of defoliated, scorched , and unburned vegetation. This is due to the effects of variable terrain, atmospheric conditions, fuel and prior fire history on the spread of fire and its intensity. Unburned

Table 2 Years of fire records for the Hogsback Plain and surrounds

Determined (1) directly from counts of growth rings in the study of Podger et al., (2) by a combination of growth ring counts and historical search due to Bowling, Edgley, Mount, and U'Ren, (3) from the files of the Tasmanian Forestry Commission and The Mercury newspaper.

Decade beginning	Podger et al.	Bowling et al.	Historical Records
1880	1881	1881,82,84	1881
1890	1898	1894,98	1898
1900		1907,08	
1910	1914,17,18	1912,14,15,17	1914
1920	1922,23,24 26,27,28	1920,26	1922
1930	1930,31,32 35,37	1934,39	
1940	1941,42,43 45,47		1945
1950	1950,51,52 53,55,56 58,59	1951,56,59	1952
1960	1960,61,62 63,64,65 66,68	1961,66,67	1962,67
1970	1970,71,72 73,74,75 76,77		1977
1980	1980,81,88		1981,88

patches of a few square metres are not uncommon in quite extensive burns on flat sedgeland and constitute a potential source of error in dating fires many years later (cf. the years obtained by ring count on discrete areas of a frequently burned plain in Table 2 with the data obtained from nearby forest by forest inventory assessors).

For these reasons and for its imprecision most of the conventional historical record is seldom reliable enough to test for ecological hypotheses. At best it may provide circumstantial support for an hypothesis or a warning signal that data obtained more directly need checking.

Relevance of the findings to the debate

Together these sources indicate the following history. Some 400 or more years ago the Hogsback Plain and its immediate surrounds were swept by fire. The present cohort of giant eucalypts regenerated at that time. On what is now the plain a stunted Implicate rainforest burned. Many plants of Agastachys survived by resprouting and developed as multiple-stemmed clumps up to 8 m in height. As the community developed, Phyllocladus colonised from seed sources in unburned rainforest on the lower slopes of Moonlight Ridge. This phase lasted until c. 1881, when extensive fires associated with timber exploitation and greater human access became a frequent feature, burning various parts of the plain and its surrounds at various times. The result of this change in fire frequency from 200 years or more before 1880 to an average around ten years has resulted in the displacement of forest by sedgeland or 'ecological drift' in less than 100 years.

This first report of a quantitative demonstration of ecological drift, albeit in an essentially infertile environment, does not establish the ubiquity of the process even for the dominantly oligotrophic wetlands of the south-west. Forests on more fertile sites might be expected to be more strongly buffered against such change.

Resolution of an apparent anomaly

The direction of change in fire frequency at Hogsback, which followed the displacement of Aborigines by disease and deportation and the subsequent utilisation of the region's resources by Europeans, stands in direct contrast to that reported by Ellis (1964) and Ellis and Thomas (1989) for the north-eastern highlands and is prima facie surprising. The Hogsback plain is near sea level, within five km of an abundant waterfowl habitat and less than ten km from a widely utilised marine resource. Yet Hogsback seems not to have been exploited between c. 1680 and the extinction of Aborigines in the area around 1834, an interval for which there is considerable ethnographical record of their presence and their use of fire. For the much cooler highlands of the north-east around 700 m elevation and more than 40 km south of substantial sources of waterfowl and shellfish, Ellis (1964) suggests more frequent and extensive burning during Aboriginal occupation than after (see also Ellis and Thomas, 1989). Explanation of regional or even local differences of this kind might be found in analyses of interactions between terrain, substrate fertility, and both historic and prehistoric dispositions of the concentration of human populations as they influence sources of ignition, spread of fire, food or material resource available for capture or utilisation, and its ease of exploitation.

This question is not amenable to direct examination as the historical record of ethnographical and anthropological observation is sparse and lacks specific detail (Horton, 1982; Bowman and Brown, 1986). There are similar problems in the use of evidence from palynological and charcoal analysis (Clark, 1983) though these should prove valuable in expanding our understanding of vegetation changes between the beginnings of the present interglacial and c. 1600 A.D. These methods are unlikely however to help us understand the role of man in those changes (Clark, 1983).

CONCLUSION

Detailed studies in other regions and localities will be necessary before a soundly based history of fire, man, and change over the entire range of vegetation types in Tasmania can be written (cf. Bowman and Brown, 1986).

Such studies will require the use of both direct and indirect methods and of necessity will involve extrapolation. The direct methods of dating vegetation will inevitably contain an element of error due to the need to handle large numbers of samples. Because evidence of earlier burning has often been obliterated by subsequent fires, it will be necessary to obtain evidence by direct dating from the neighbourhood areas. The circumstantial support that might be expected from historical records is almost invariably fragmentary and imprecise - mainly because of the difficulty and cost of mapping numerous fires.

Importantly, there is little if any prospect that historical records will provide a sound basis for examining the critical influence of variation in fire intensity. Direct evidence is very rapidly lost, so that studies of the effects of intensity will need to be based on post-mortem determinations for very recent fires or direct inspection of future fires involving repeated observation over considerable time. Despite these limitations, anatomical and historical methods, provided caution is exercised to avoid circular argument, should provide a much more complete appreciation of the history of fire in the forest than any single method alone.

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REFERENCES

Allen, P., pers. comm. Mines Dept, Hobart.

Anon., 1973 Back to Dover, Saturday Dec. 22 - Sunday Dec. 23, 1973. Huon Newspaper Co., Franklin, (held in Tasmaniana Section, State Library, Hobart).

Bowling, P.J., 1954 Use of scrub species in age determination. Inst. Foresters Aust. Newsletter: 10(1).

Bowman, D.J.M.S. and Brown, M.J., 1986 Bushfires in Tasmania: a botanical approach to anthropological questions. Archaeology in Oceania 21: 166-171.

Brown, S., 1986 Aboriginal archaeological resources in southeast Tasmania. Nat Parks & Wildlife Serv. Tas., Occ. Pap. 12.

Brown, M.J. and Podger, F.D., 1982 Floristics and fire regimes of a vegetation sequence from sedgeland-heath to rainforest at Bathurst Harbour, Tasmania. Aust. J. Bot. 30: 659-76.

Chambers, D.M. and Brettingham-Moore, C.G., 1967 The bushfire disaster of 7th February, 1967. Report to Tasmanian Parliament. Govt Printer, Tasmania.

Cheney, N.P., 1988 A review of the preparation for and practice of regeneration burning in Tasmania. CSIRO National Bushfire Res. Unit, Canberra, 32 pp. + app.

Clark, R.L., pers. comm. University of Liverpool, U.K.

Clark, R.L., 1983 Pollen and charcoal evidence for the effects of aboriginal burning on the vegetation of Australia. Archaeology in Oceania 18: 32-37.

Davies, J., 1988 Land systems for Tasmania, Region 6: South, East and Midlands. Lands Dept, Hobart.

Ellis, R.C., 1964 Dieback of alpine ash in north-eastern Tasmania. Aust. For. 28: 79-90.

Ellis, R.C. and Thomas, I. 1989 Presettlement and postsettlement vegetational change and probable Aboriginal influence in a highland forested area in Tasmania. (This volume).

Foley, J.C., 1947 A study of meteorological conditions associated with bush and grass fires and fire protection strategy in Australia. Bull. 38, Bureau of Meteorology, Aust.

Gilbert, J.M., 1959 Forest succession in the Florentine Valley, Tasmania. Pap. Proc. Roy. Soc. Tas. 93: 129-51.

Gilbert, J.M. and Cunningham, T.M., 1972 Regeneration of harvested forests. I State forests in Tasmania. Appita 26: 43-45.

Hammond, D. and Rushton-Nuss, A., 1987 Franklin - Settlement in the Huon. Southern Holdings Pty Ltd, Hobart: 99 pp.

Harper, J.L., 1977 The population biology of plants. Acad. Press, London.

Henderson, W. and Wilkins, C.W., 1975 The interaction of bushfires and vegetation. Search 6: 130-133.

Hill, M.O., 1979 TWINSPAN - a Fortran program for arranging multivariate data in an ordered two-way table by classification of the individuals and attributes. Sect. of Ecol. and Systematics, Cornell Univ. Ithaca.

Hill, M.O. and Gauch, H.G., 1980 Detrended correspondence analysis, an improved ordination technique. Vegetatio 42: 47-58.

Horton, D.R., 1982 The burning question: Aborigines, fire and Australian ecosystems. Mankind 13: 237-251.

Ingles, A., 1987 Fire - background information additional to the E.I.S. on Tasmanian woodchip exports beyond 1988. Working Paper 2. TFC, Hobart.

Jackson, W.D., 1965 Vegetation. In J.L. Davies (ed.) Atlas of Tasmania. Lands and Surveys Dept, Hobart, pp. 30-37.

Jackson, W.D., 1968 Fire, air, water and earth - an elemental ecology of Tasmania. Proc. Ecol. Soc. Aust. 3: 9-16.

Jarman, S.J., Brown, M.J. and Kantvilas, G., 1984 Rainforest in Tasmania. Nat. Parks & Wildlife Serv., Tas. 201 pp.

Kiernan, K., Jones, R. and Ranson, D., 1983 New evidence from Fraser Cave for glacial age man in south-west Tasmania. Nature 301: 28.

La Marche, V.C., Holmes, R.L., Dunwiddie, P.W. and Drew, L.G., 1979 Tree-ring chronologies of the southern hemisphere. 4. Australia. Chron. Series V, Lab. Tree-ring Research, Univ. Arizona, Tucson, Az.

MacNaughton, R.E., 1895 Through apple-land. Pall Mall Magazine, Feb. 1895, (held in Tasmaniana, State Library Hobart).

McPhail, M.K., 1979 Vegetation and climates in southern Tasmania since the last glaciation. Quart. Res. 11: 306-14.

Mount, A.B., pers. comm. TFC, Hobart.

Mount, A.B., 1971 Seventh of February - a day of extreme fire weather. Unpubl. doc. TFC, Hobart.

Mount, A.B., 1979 Natural regeneration processes in Tasmanian forests. Search 10(5): 180- 186.

Nicholson, P.H., 1981 Fire and the Australian Aborigine - an enigma. Pp. 55-76 in A.M. Gill et al., (eds). Fire and the Australian Biota. Aust. Acad. Sci., Canberra, 582 pp.

Noble, I.R. and Slatyer, R.O., 1981 Concepts and models of succession in vascular plant communities subject to recurrent fire. Pp. 311-335 in A.M. Gill et al., (eds) Fire and the Australian Biota. Aust. Acad. Sci., Canberra, 582 pp.

Plomley, N.J.B. (ed.), 1966 Friendly mission: the Tasmanian journals and papers of George Augustus Robinson, 1829-1834. Tas. Historical Res. Assoc., Hobart.

Richards, G., pers. comm. TFC, Dover, Tas.

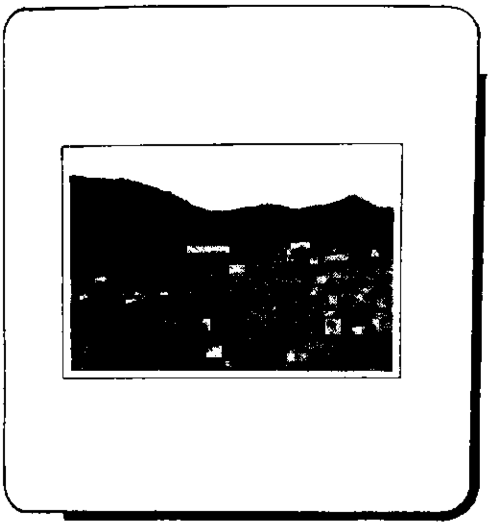
Stokes, M.A. and Smiley, T.L., 1968 Tree-ring dating. Univ. Chicago Press, Chicago. 73 pp.

Tasmanian Government, 1942 The discovery of Tasmania 1642. Selections from Dr J.E. Heeres' translations of Tasman's Journal from August to December, 1642. Orig. publ. F. Muller, 1898.

Turnbull, C.R.A., pers. comm. CSIRO Div. Forestry and Forest Prod., Hobart, Tas.

Twelvetrees, W.H., 1915 The Catamaran and Strathblane coal fields and coal and limestone of Ida Bay (southern Tasmania). Geological Surv. Bull. 20, Govt Printer Hobart.

Tyson, R.G., pers. comm. Dept of Lands, Parks & Wildlife, Hobart.



Nursery Swamp, aboriginal archaeological site, montane valley bordered by wet sclerophyll forest, A C T

FORESTS AND ABORIGINAL SOCIETY

REVIEW PAPER : FORESTS AND ABORIGINAL SOCIETY

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INTRODUCTION

This discussion on forests and Aboriginal society aims to bring to the attention of foresters the fact that the forests they now manage had a previous history of Aboriginal occupation, use and management. There is a long and changing history of human interactions with our forests, about which something is known, but which has rarely been viewed as management or forestry. In this paper I argue that there were many different types of 'Aboriginal forestry' - a term which embraces the many different practices of Aborigines in forest and woodland ecosystems in Australia. For this paper I have reviewed literature from botany, anthropology, archaeology and forestry to determine what is now known about the use and management of some of our major forest and woodland types, particularly during the last 5000 years (the mid to late Holocene period). This review of the literature is directed at providing an overview of Aboriginal patterns of use and management, which may at times seem, to specialists, to represent their own disciplines superficially.

A discussion of Aboriginal forestry must of necessity look at forestry in the broad sense expressed by the Society of American Foresters as:

> The science, the art and practise of managing and using for human benefit the natural resources that occur on and in association with forest lands (Ford-Robertson et al., 1971).

There is no doubt that Australian Aborigines used the forests for their benefit. However the questions we have to address if Aboriginal use is to be considered as forestry are: Were forest ecosystems purposefully managed? If so, why? And were these practices based on a conscious knowledge of effects?

In this paper I attempt to answer these questions by discussing Aboriginal forestry in the context of the development of Aboriginal resource management strategies during the mid to late Holocene, and then by reviewing some of the literature dealing with traditional Aboriginal use and management of forests. The first general section is followed by more specific detail on some of our major forest and woodland environments.

CONCEPTIONS AND PRECONCEPTIONS OF ABORIGINAL SOCIETY

Most early European settlers and archaeologists saw Aboriginal people as primitives living from hand to mouth. Aboriginals were seen as parasites on the land (Meggitt, 1964; Elkin, 1954) because they appeared to only use the resources of the land without 'working it' or managing it is any way. Yet according to Mulvaney:

> Evidence to refute such notions has always been available to those who watched traditional Aboriginal food-producing activities or read explorers' journals with critical understanding. The blinkers of prejudice and preconcpetion are so effective that Aboriginal society has been condemned for being unproductive, aimless and nomadic (Mulvaney, 1987: 87).

Such views are based on the traditional dichotomy between hunter-gatherers and farmers. Hunter-gatherers are assumed to live in small groups, move around a lot and live on foraged foods, while farmers live in large groups, are sedentary and support this lifestyle by a combination of social stratification and intensive production of food and other material goods. Many writers now argue that there is no such clear distinction between hunter-gatherers and farmers, that observed differences are clinal rather than dichotomous (Lourandos, 1985; Flood, 1983; Hallam, 1975; Hynes and Chase, 1982; Rindos, 1980). It has been suggested, however, that such a view was a very convenient one for the British colonists, because it abrogated any moral sense that they might otherwise have held that the land was owned by the Aborigines (Jones, 1980).

THE MID TO LATE HOLOCENE DEVELOPMENT OF RESOURCE MANAGEMENT STRATEGIES

During the mid to late Holocene (5 000 - 4 000 years B.P.) many groups of Australian Aboriginals are believed to have undergone something akin to the 'neolithic revolution' in Europe (Hallam, 1975; Flood, 1983; Lourandos, 1985; Mulvaney, 1987). The changes in Aboriginal society which occurred during this period are central to this discussion because one of the major changes which occurred during the late Holocene was the development of techniques to manage particularly food resources intensively in order to supply a growing, semi-sedentary population (Lourandos, 1985; Flood, 1983). Flood neatly summed up the changes during the Holocene as:

> A remarkably consistent pattern ... emerged ... in south-eastern Australia during the last few thousand years. The major happenings seem to be the adoption of small composite tools, an increase in intensity of occupation (with more sites, artefacts and people), the spread of people into harsh environments with few or no earlier inhabitants, and the harvesting or management of special foods linked with the holding of ceremonies and extension of social network (p.212).

The increase in 'intensity' of occupation reflects the findings of numerous archaeologists who have noted that a great majority of Aboriginal sites in Australia are less than 4000 years old. For example in inland southern New South Wales only one site out of seven is over 4000 years old (Mulvaney, 1987); on the southern coast of N.S.W. only one site in two or three is over 5000 years old. (Hughes and Lampert, 1982), while in the Western District of Victoria all sites excavated so far have been less than 3500 years old (Flood, 1983: 207; Ross, 1981). This evidence suggests that much of Australia was only occupied with any intensity during the last 5000 years, and points to a rapid increase in population during this phase. Associated with this increasing population was an expansion into harsher areas, and an increase in ceremonial activity. Flood notes:

> There is a close link between the holding of lengthy ceremonies and the management of food resources. As a society becomes more complex, it increases its demands on the economy; a more intensive social system is linked to more intensive food management (Flood, 1983: 208).

The ability to manage food resources, whether by increasing production, or making the supply more reliable, enabled a semi-sedentary way of life and regular tribal and inter-tribal gatherings. Some of the food resources managed were from forest ecosystems, while others were from riverine or grasslands environments.

USE OF FORESTS

Examples of the types of 'forest products' exploited by Aboriginal people include:

foods - fruit and nut trees, berries, tubers (of rushes, yams and bracken fern) grass seeds, wallabies, possums, kangaroos etc.

bark - shields, canoes, coolamons, drinking vessels, cladding for huts, boomerangs and blankets.

wood/timber - fuelwood, hut structure, boomerangs, woomeras, spears and spear throwers.

resins - adhesives.

Early explorers and some authors have suggested that the Aborigines used and occupied the woodlands more intensively than forests (Grey, 1841: I, 321-2, cited in Hallam, 1975; Ferguson, 1985). This is readily understandable because the diversity and richness of plant and animal resources is not necessarily related to the density of vegetation. In fact temperate, mid-latitude, deciduous and evergreen forests are considered to be among the least productive environments in the world (Harris, 1969). For example, in the south-west of Western Australia extensive surveys have shown that populations of common game species, western grey kangaroo and brush wallaby are highest in open woodland and lowest in the karri forest

(Christensen and Kimber, 1975). In this region, the greatest species diversity is in the woodlands, at the forest edge and along the banks of rivers, lakes and swamps, while the dense forests were comparatively marginal to Aborigines' economy (Ferguson, 1975). To a greater or lesser extent, it is likely that Aborigines throughout Australia preferred an open woodland environment to closed forests and took steps to secure it. The writings of many early explorers reinforce this view. They and the early settlers commented on the open park-like nature of the landscape and on the extensive use of fire to maintain it (Vancouver, 1801; Stirling, 1827; Sturt, 1849; Mitchell, 1848, cited in King, 1963).

ABORIGINAL USE OF FIRE

Although many early European settlers and explorers thought of Australia as a pristine environment left intact by the Aborigines there is ample evidence that Australian Aborigines had significant effects on both vegetation and land surface through firing.

Fire was probably the most important tool used by Aborigines to manipulate their environment. In 1980, Jones argued that throughout Australia Aborigines subjected their habitats to a massive, systematic regime of burning. They changed the fire regime from one of rare, high intensity, natural fires to one of frequent, low intensity fires. Jones' controversial views sparked a plethora of articles on the subject and, although it is generally accepted that Aboriginal burning affected vegetation, there is no consensus of opinion on the degree to which the vegetation was altered (Horton, 1982). It does appear that, over thousands of years and on a continental or regional scale, Aboriginal burning had little effect on vegetation compared to the changes wrought by climate (Clark, 1981). On a local scale, however, the Aboriginal burning regime may have had far greater effects. In wetter areas, such as south-west Tasmania and north-east Queensland where natural fires are rare and small, Aboriginal fires are considered to have had a major impact on vegetation.

There were many reasons for Aboriginal burning. They include: signalling, and clearing undergrowth to improve access and visibility, and as an aid to hunting by flushing out game. However fire was also used for longer term purposes: to encourage green pick which would attract kangaroos and other herbivores, to encourage regeneration particularly of edible plant foods, to maintain areas of open woodland and grasslands, and to protect certain valued areas of fire-sensitive vegetation.

Recently it has been suggested that Aboriginal firing also had some less desirable impacts. For example, Hughes and Sullivan argue that Aboriginal fire regimes led to an increase in hillslope instability and erosion rates in dry sclerophyll, hilly landscapes (because the ground surface was often exposed to accelerated rainsplash, sheetwash and rillwash erosion) during the mid to late Holocene (Hughes and Sullivan, 1986). There is no evidence that Aboriginal burning had wider detrimental effects, although it is probable that flora and fauna species from rainforest and other dense enclosed forest environments would have been disadvantaged by Aboriginal firing.

FIRE REGIMES

The Australian bush has remarkable powers of recovery after a bushfire due to the evolution of many adaptations to ensure survival (Good, 1981). Such adaptations reflect the intensity, frequency, seasonality and other variables of the particular fire regime within which they evolved.

There was no one burning regime applied across the continent or even in any one vegetation type. Aboriginal burning included a variety of burning regimes which varied regionally, locally and seasonally (Clark, 1981). Normally local vegetation patterns are dependant on local climate, soils and topography, with fires, floods and other disturbances playing a part. The interaction of all these aspects often produces a mosaic pattern of vegetation. Clark considers that Aboriginal burning probably had its greatest effect in enhancing this mosaic effect (Clark, 1981). By using a patch burn strategy and a particular fire regime, Aborigines are considered to have been able to manipulate the resulting mosaic of vegetation to increase species diversity and particularly to encourage the growth of food plants, many of which are fire dependent e.g. bracken fern (Pteridium esculentum and Blechnum spp.), cycads (Macrozamia and Cycas spp.) and blackboys (Xanthorrhoea spp.). Recent research in the Sydney area (Clark and McLaughlin, 1986) indicates that in bushland on the Hawkesbury sandstone burning at intervals either more or less frequent than used by Aborigines reduces species diversity.

In addition, recent research indicates the reliance of native mammals on the vegetation patterns produced by Aboriginal fire regimes. For example, the cessation of Aboriginal burning in the Tanami desert (N.T.) is now believed to be at least one cause for declining populations of the rufus hare-wallaby which prefers to feed on certain grasses which sprout after fire (Latz and Johnson, 1986; Griffin and Allan, 1986).

RESOURCE MANAGEMENT

Fire, although probably the most important and widespread method that traditional Aborigines used to manipulate their environment, was not the only method. A great variety of methods were used to extract resources from the environment and to manipulate it to ensure continuous food supplies, including planting and harvesting techniques, water regulation and aquaculture, fish traps, and selection and/or protection of valued food plants. (Campbell, 1965; Lourandos, 1980a, 1980b, 1985; Jones, 1975; Hynes and Chase, 1982; Coleman, 1982). Lourandos (1985: 390) suggests:

> Hunter-gatherers could intensify in a number of ways ... For example, productivity could be controlled or increased by regulation and management of resources and their

> regeneration, and <u>production</u> by improvement of harvesting and capturing methods and by expansion of the econiche (e.g. through exploitation of new resources and marginal areas) (emphasis added).

In the next section of this paper Aboriginal lifestyle, economy and specific resource management practices will be examined in specific forest and woodland environments (Fig. 1).

FORESTS OF SOUTH-WEST AUSTRALIA

There are a number of vegetation types in the south-west of Western Australia. The three major tree species are: jarrah (*Eucalyptus marginata*), marri (*E. calophylla*) and karri (*E. diversicolor*). In addition to forests there are also a number of mixed heaths, woodland-mallee and coastal heaths. Parallel to the west coast, the alluvial plain at the foot of the Darling scarp consists of grasslands interspersed with strips of forest. The vegetation of the plain is considered to be an Aboriginal artefact. 'Parts at least had been so modified before contact as to offer good grazing for native herbivores' (Hallam, 1975:153). At the end of the plain, thick karri forest dominates the south-west corner, changing to jarrah forest and woodland and then to the wandoo (*E. wandoo*) mallee-

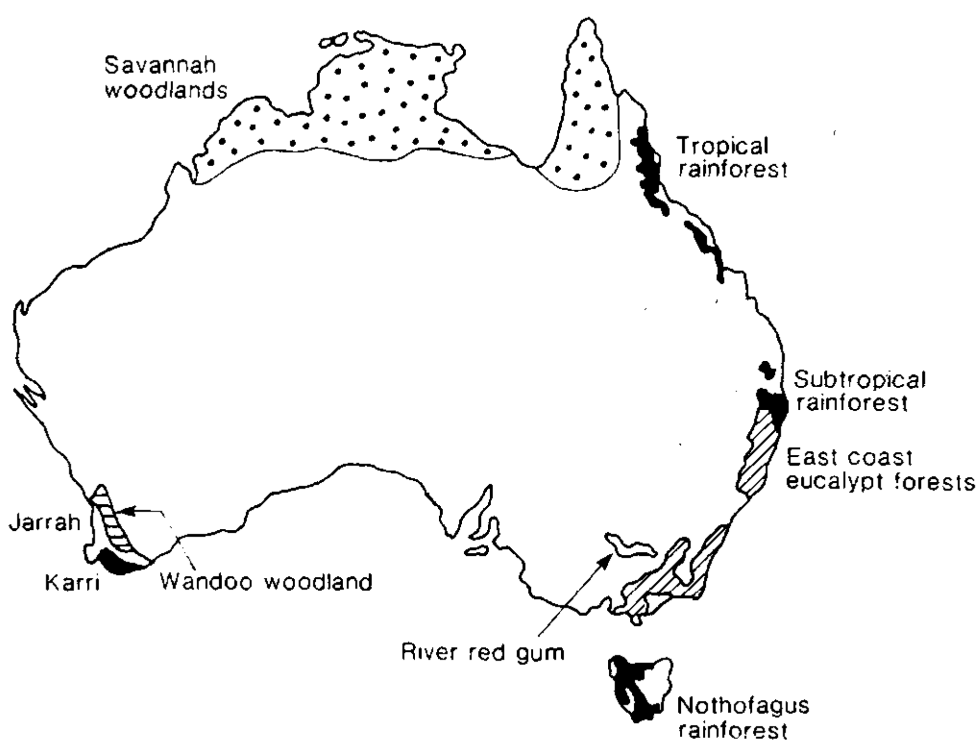

Fig. 1 Location of forest and woodland environments referred to in text

woodland rainfall, other climatic factors, topography and geology, as you travel north-east (Ferguson, 1985).

The Nyungar people occupied the entire south-west region from approximately 30,000 years ago (Hallam, 1975). Their economy was 'based on generalized foraging and extreme mobility' (Ferguson, 1985). A wide range of food resources was exploited and there does not seem to have been any strong reliance on a limited number of staple foods. The area 'did not abound in food' (Nind, 1831, cited in Hallam), and thus did not support a large population. The population density in early pre-contact days is estimated at one person per 10 square kilometres (Radcliffe-Brown, 1930, cited in Ferguson, 1985).

The Nyungar people were 'seldom stationary' (Nind, 1831, in Hallam, 1975) as they moved from one area to another following seasonal abundances of food. Their general pattern of movement was to live in scattered groups during winter and spring. At the onset of winter, coastal groups moved inland, taking advantage of stormy weather to hunt game, e.g. kangaroos, bandicoots, wallabies, possums and emus. During spring, the Nyungar exploited mainly vegetable foods, including cycad nuts and various roots, bulbs and tubers, especially Typha spp., supplemented with birds eggs. In late spring the Nyungar returned to the coast. Family groups began to reassemble for the commencement of the firing season. The country was systematically fired in 'consecutive portions' in order to procure a great abundance of game. The greatest assemblages of people occurred in autumn when fish are in greatest abundance.

Use and management of the forests

The most important 'management' tool used by the Nyungar was fire. In pre-European times it appears that on average the jarrah forest was burned approximately once every three years, while karri was burned once every five years or so (Dames and Moore, 1987). The pre-European fire regime in jarrah appears to have been one of frequent early summer fires, which less frequently, and only by late summer extended into the wetter karri. Fires in karri seem to have coincided with extremely hot weather to produce hot or even extreme fires.

Pollen studies in the area by Churchill (1968, cited in Hallam, 1975) show increasingly frequent burning over the last few thousand years, with earlier fires being relatively infrequent and intense while in later periods, fires became increasingly frequent and of lower intensity. This trend is seen by Hallam to be indicative of developing patterns of Aboriginal exploitation.

Overall, Churchill's graphs indicate that karri has been losing ground to the more fire-adapted jarrah over the last 5000 years, particularly during the last 1500 years. Hallam interprets these events as:

> ...intensifying effects of human exploitation, including firing, not only on vegetation, but also on geomorphology, from the millenia from 4 000-3 000 B.C. onward, when a narrowing coastal plain (Churchill, 1959), the onset of drier conditions (Churchill, 1968), and the advent of more efficient extractive equipment and techniques successfully converged to disturb previous ecological balances (Hallam, 1975: 104).

Hallam provides convincing evidence of active, planned use of fire (Dames and Moore, 1987). She sees fire as enabling the Nyungar to modify and exploit their terrain by 'systematic near-cultivation and resource management' to continue to extract sufficient resources for increasing populations (1975: 12-14). Near-cultivation of grasses, yams and typha roots in the south-west was reported by early explorers such as Grey in 1841 and Mitchell in 1848, while both Ferguson and Hallam consider that the rich woodland habitat, the focus of the Nyungar's economy, was a resource carefully managed and expanded by their use of fire, at the expense of the thicker, wetter, less hospitable and diverse karri which was almost devoid of game (Ferguson, 1985; Hallam, 1975).

THE FORESTS OF TASMANIA

Tasmanian vegetation is a mixture of Australian and southern Oceanic components. The forests of the drier eastern side of Tasmania are dominated by eucalypt species in wet and dry sclerophyll formations, while the rainforests of the wetter western side of the state have floristic affinities with New Zealand and South America.

Dry sclerophyll forests are the dominant vegetation of the drier parts of eastern and central Tasmania. They have an open canopy with trees 8 to 55 metres tall. The most common eucalypt species are: *Eucalyptus amygdalina*, *E. globulus*, *E. delegatensis*, *E. obliqua*, *E. ovata*, *E. pauciflora*, *E. pulchella*, *E. rubida*, *E. sieberi*, *E. tenuiramis* and *E. viminalis* (Felton, 1977).

In the wetter western side of Tasmania, where annual rainfall exceeds 1200 mm, *Nothofagus* rainforest is the climax vegetation. These forests have a dense canopy of trees of short to moderate height, 10 to 35 metres tall, with ferns and mosses as ground cover. The characteristic tree species is southern beech *Nothofagus cunninghamii*.

In addition to these forest types, there are substantial areas of moorland, sedgeland and coastal heath in Tasmania. Moorlands are low, dense, woody communities which occur at high altitudes, and grade into tussock grasslands where frosts are very severe. At lower altitudes on the western side, sedgeland communities characterized by button grass (*Gymnoschoenus sphaerocephalus*) occur. It is believed that the boundaries of these sedgelands have been extended considerably beyond their edaphic limits by the effects of repeated Aboriginal firing. Hiatt (1968) estimated that 47 per cent of the area occupied by sedgeland is suitable for rainforest. Coastal heaths form a dense layer of low shrubs, predominantly from the families Epacridacea and Leguminosae, on sites of low fertility, along the coasts of north-east and north-west Tasmania. These heaths also were burnt frequently by Aborigines, and firing has likewise extended the range of heaths into areas where poor quality forest would normally be the climax (Hiatt, 1968).

The vegetation distribution in Tasmania played a large part in the pattern of occupation by Aborigines. Aborigines were common along most of the coastline and along the major river systems in the eastern part of Tasmania, scattered throughout the central highlands, but absent from areas covered by rainforest. Hiatt suggests that this pattern of occupation was determined by the availability of food resources in each vegetation type.

Like the dense karri forests, the beech rainforests are unattractive to many animals as the heavy moss covering the forest floor provides poor food for mammals. The sedgelands of south-west Tasmania are also considered to be a poor habitat for fauna, although they contain more edible food than the rainforest. The richest fauna in species diversity and numbers occurs in the sclerophyll forests and coastal heaths where birds, macropods, possums and carnivorous marsupials abound. These environments were obviously more favoured by Aborigines.

There appears to have been little difference between the economies and lifestyles of various groups of Tasmanian Aborigines, although those of western Tasmania probably lived in larger groups in more substantial huts and were more sedentary. However the tool kit (technology) of the Tasmanian Aborigines is considered to have been simpler than that from the mainland (Hiatt, 1968; Lourandos, 1980) and it has been suggested that this limited the ability of the Aborigines to extract resources from their environment, and thus limited population growth (Lourandos, 1980). Lourandos has calculated the average population density of Tasmanian Aborigines at one person per six to seven square kilometres.

Resource management and use of forests

The most important and effective tool used by Tasmanian Aborigines was fire. It was customary for Aborigines to carry fire sticks and set fire to the bush as they walked (Jones, 1969). Bowman and Brown (1986) discuss the ecological effects of Aboriginal firing and argue that fire has been important in determining the pre-European distribution of vegetation in Tasmania and that fire in Tasmania is dependent on human ignitions. Present-day distribution of vegetation in Tasmania is believed to reflect past 'fire management' by Aborigines, which in most cases changed the vegetation into one which provided different food sources (Hiatt, 1968; Jackson, 1968). For example, Hiatt believed that 'another reason [for Aboriginal burning] may have been to alter the existing countryside so that it provided a more plentiful and/or different food supply' (p.212).

Jones (1969) considers the most important effect of Aboriginal firing was to 'extend man's habitat', particularly along the west coast of Tasmania where the Nothofagus rainforest was not readily useable by Aborigines and seldom penetrated. Aboriginal firing is thought to have assisted in pushing back Nothofagus rainforest and replacing it with sedgeland which was richer in both animal and plant foods. Hiatt (1968) expands the argument:

> The unnaturally large areas of sedgeland in the south-west ... may well be the result of the Aborigines' determination not to live completely on food from the sea. Although the sedgeland is not the best area for non-marine foods it does support wallabies, pademelons, wombats, marsupial carnivores and birds as well as freshwater crustacea; in any case, it certainly boasts more edible food than the rainforest which probably would have occupied a lot of this area if the resident Aborigines had not persisted in their firings (p.121).

Jones (1969) suggests that in eastern Tasmania Aboriginal firing extended the mosaic pattern of open sclerophyll forest and grassland plains. This mosaic provided an optimum habitat for common game such as kangaroos, wallabies, emus and native hens.

Ellis (1984) suggests that in the central highlands Mt Maurice plateau provides a good example of the effect that Tasmanian Aborigines had upon the vegetation. He claims: 'the present climate of the Mt Maurice plateau would allow rainforest to dominate the whole area, and that it does not is almost certainly attributable to Aboriginal burning practices' (p. 8). The present dry sclerophyll forest of the area, dominated by E. delegatensis, is considered to be appropriate to a drier climate and is 'likely to have been perpetuated by frequent and systematic burning off of the eucalypt stands during some thousands of years'.

E. delegatensis occupies large areas of the lower central plateau and has been shown to be both fire resistant and a fire requirer (Bowman and Kirkpatrick, 1986). Ellis (1984) suggests that Aboriginal firing could have affected the distribution of these forests by restricting the expansion of rainforest throughout the post-glacial eucalypt/grass vegetation, and by destroying existing rainforest to allow its replacement by grass, with or without eucalypts.

Although native grasslands and grassy woodlands in Tasmania are often assumed to have been maintained by Aboriginal firing (Jackson, 1965; Jones, 1969), other views have been advanced. For example, Thomas (1984) has concluded on the basis of charcoal particle and pollen analysis that native grasslands on the high plateau surface of the central plateau were not maintained by fire, while other areas of native grasslands have been shown to have developed following excessive ringbarking of former forests by early settlers (Kirkpatrick and Dickinson, 1984).

THE TROPICAL RAINFOREST ENVIRONMENT

The tropical rainforests of far north Queensland occur along the east coast mountains, plateaus and lowlands between Cardwell and Cairns. Before extensive clearance by European settlers, the dominant vegetation of the alluvial lowlands and of the fertile basaltic soils of the Atherton Tableland was a complex mesophyll vine forest while on the less fertile granitic and metamorphic soils of the highlands, less luxuriant mixed mesophyll and evergreen vine forests predominated (Harris, 1978). This rainforest region was formerly occupied by 12 Aboriginal tribal groups, whose territory was largely restricted to coastal and inland rainforest habitats (Tindale, 1974, cited in Harris).

The complex mesophyll vine forest is considered to be the most structurally complex and floristically diverse type of rainforest in Australia. A high proportion of deciduous rain-green species dominate the closed canopy. Shrubs and herbs are sparse and vines abundant. Many of the largest trees are from the family Lauraceae, which includes many of the edible nuts that were staple Aboriginal foods in this area. Although the mixed mesophyll and evergreen vine forests also contain nut trees they were most abundant in the complex mesophyll vineforests (Harris, 1978) and this accounts for the relatively higher population densities of Aboriginal groups in these forests (Harris, 1978). Harris estimates the pre-European population density in the lowland rainforests to be not less than one person per two square kilometres.

Despite the complexity and diversity of rainforest flora, the faunal populations, particularly of mammals and other vertebrates, which normally represent the major source of animal foods for Aborigines, were low. Rainforest-dwelling Aborigines thus relied very heavily on native nuts, with the bulk of animal foods coming from the eggs of cassowary, scrub fowl and scrub turkey, lizards and snakes.

Subsistence cycle of rainforest-dwelling Aborigines

Harris (1978) reconstructed the general pattern in which rainforest bands subsisted. In the relatively cool dry winter season people were mobile. The men made hunting trips to the more open woodland areas within and around the rainforest, fished in rivers and lakes, and climbed trees using looped lengths of lawyer cane in pursuit of arboreal mammals, birds and pythons. The women searched for goannas, cassowary eggs and yams. The end of the dry season (from October to December) was the time of most prolific fruiting of rainforest trees, particularly nuts such as black bean (*Castanospermum australe*), yellow walnut (*Bellschmiedia bancroftii*), Queensland almond (*Elaeocarpus bancroftii*) and black walnut (*Endiandra palmerstonii*). People began to aggregate and lead a more settled life, returning (or more fully occupying) semi-permanent camps which had characteristic dome-shaped, rainproof thatched huts. These camps were usually located close by a running stream where many of the toxic nuts were leached in fresh running water. This time of plenty was also the time when social and ceremonial life flourished. As the wet season advanced and there were fewer nuts, there was a corresponding decline in social activity. In these lean times, the rainforest Aborigines tended to stay in their wet season camps, living on stored supplies of nuts.

Management and use of forest

Tropical rainforest appeared to be used as a 'larder' because of an abundance of nut tree species (George Davis, pers. comm.). These nut trees were not managed, although Aborigines had developed specialized leaching techniques to detoxify the nuts. Although it is evident that trends towards specialization in the use of resources and towards sedentism existed among the rainforest tribes, it is clear that these trends did not lead to domestication or management of plants (Harris, 1978). The rainforest Aborigines did however use the resources of the forest to produce wooden swords and shields (from fig tree buttresses), bark cloth and blankets (hammered from the inner bark of fig trees), baskets and nets from lawyer cane and rushes, and of course their thatched huts.

SAVANNA WOODLANDS OF NORTHERN AUSTRALIA

Australian savanna lands form a wide continental arc which extends from the Kimberleys in north-western Australia across most of northern Australia to Cairns. Savanna woodlands have a graminoid (or 'bunch grass') understorey, favoured by summer rainfall (Beard, 1981), and a predominantly eucalypt upper stratum. There are six major types of savanna in Australia, the most widespread being monsoon tallgrass savanna (Mott et al., 1985). Over much of its range the upper stratum consists of low eucalypts such as E. tetrodonta and E. dichromopholia, with Melaleuca spp. on more poorly drained sites (Mott et al., 1985). The dominant graminoid understorey on heavier soils consists of perennial bunch grasses Thermeda australis, Sehima nervosum and Chrysopogon fallax, with tall annual Sorghum spp. being more important on lighter soils (Mott et al., 1985).

Kangaroos and wallabies are common in the monsoon tallgrass savannas, but by comparison with African savannas the number of animals is relatively low (Newsome, 1983 and Calaby, 1980, both cited in Mott et al., 1985). For these herbivores the major limiting factor is the low nutritional quality of the grasses.

Throughout the savanna woodlands, fires are an almost annual occurrence. Fire has apparently long been a part of the savanna woodland environment, and probably more important following the arrival of Aboriginal man. All the subhumid savannas are fire resistant and regenerate after the normal fire regime (Mott et al., 1985).

The savanna woodlands of northern Australia were probably the most heavily utilized and densely occupied ecosystems in Australia prior to European settlement. Because of the large numbers of Aboriginal groups, I will not attempt to summarize any one single subsistence strategy, but rather focus directly on the management and use of these savanna woodlands.

Management and use of savanna woodlands

Fire: Aboriginal fire-management regimes were employed widely in the savanna woodlands, in order to stimulate new growth and encourage game animals for hunting (Henderson and Chase, 1985). Henderson and Chase consider that these grassy woodlands of northern Australia were 'an Aboriginally created and managed landscape ... where both floral and faunal species diversity and composition ... were directly related to patterns of long Aboriginal use' (p.162).

Jones (1975) reports that the Gidjingali of the north coast of Arnhem Land began firing the woodlands in mid-March and continued until the following January, just before the big monsoon. He claims that the 'people used their fires accurately', for instance by aiming them into a natural break such as an old fire scar or swamp, and were careful not to burn fire sensitive 'jungle' which contained many edible species. The main reason for this program of burning given by the Gidjingali was in order to 'clean up the country'. When 'cleaned up' the land was easier to walk over, it was easier to see tracks and holes of various prey, and after rainfall a crop of 'green pick' would regenerate and attract native herbivores.

Further to the east, in the savanna woodlands of Cape York Peninsula, Harris (1978) reports that the seasonal and spatial availability of cycads (Cycas media), a major plant food resource to Aboriginal populations in the open canopy woodlands, was 'enhanced by the judicious deployment of fire' (p.429). He further suggests that 'the large stands of cycads extant today may be, in large measure, the result of Aboriginal manipulation of the woodland ecosystem'. Later work by Beaton (1982) has confirmed the role of fire in synchronizing, speeding up and increasing the yields of cycad fruits.

Other forms of management: While fire was the major landscape-altering process in the savanna woodlands, a number of other 'management' techniques were utilized by the Aboriginal population. For example, the presence of 'orchards' or 'groves' of native fruit and nut trees around old campsites in the savannah woodlands has frequently been observed (Stevenson, 1983; Jones, 1975; Hynes and Chase, 1982; Clark, pers. comm.). While it is not suggested that these 'orchards' were deliberately planted, they are undoubtedly Aboriginal artefacts. The fruit and nut seeds are passively dispersed, often discarded into midden heaps and later begin to grow. Jones (1975) claims the Gidgingali were quite aware that these seeds could grow and bear similar fruit, while Hynes and Chase (1982) report that such seedlings were protected by ground clearance and the erection of barricades. Jones sees the formation of 'orchards' as an example of a symbiotic relationship between man and his fruit trees 'where there was a selective advantage in terms of dispersal and the most favoured growing location for the seeds of the most favoured fruit trees' (p.25). This selective advantage he regards as the beginnings of early plant breeding by Aborigines.

Other examples of plant manipulation in the savanna woodlands include a yam (Dioscorea spp.) harvesting technique which ensured the growth of new yams in the following season (Jones, 1975; Hynes and Chase, 1982; Stevenson, 1985; Harris, 1977; Meggit, 1964); the transplantation of yams onto offshore islands to ensure a food supply for stranded visitors (Hynes and Chase, 1982) and the planting of coconut trees (considered to be a native species by coastal Aborigines of Cape York) and 'shade trees' of Ficus spp. around regular campsites (Hynes and Chase, 1982).

Hynes and Chase regard the present vegetation of old campsites to be the result of a plant management regime that has significantly controlled the distribution, density and to a degree the genetic selection of a suite of edible plant species.

SUBTROPICAL RAINFORESTS

Subtropical rainforests occur in areas where annual rainfall exceeds 1300 mm in northern New South Wales and southern Queensland, often associated with sheltered areas on the coastal side of the dividing range. These forests have a very diverse flora, with up to 60 species forming the two or three strata of trees in the canopy. The commoner tree species include booyongs (Argyrodendron spp.), yellow carabeen (Sloanea woolsii), rosewood (Dysoxylum fraseranum), figs (Ficus spp.) and lilly pilly (Acmena syzygium). Subtropical rainforests also have a characteristic ground cover of large-leaved herbs and ground ferns (Williams et al., 1984: 6).

Although the humid coastal zone in these areas was fairly heavily populated, areas of subtropical rainforest had a low population density and appeared to have been inhabited irregularly (Belshaw, 1978: 73). The local tribes exploited both coastal and inland resources, generally moving to the mountains in the summer months, and to the coast during cooler months.

The movement to the mountains during the summer months coincided with seasonal abundances of many vegetable foods, the most important being bunya nuts. The subtropical rainforests were highly valued as a source of vegetable foods (Sullivan, 1977) which included conjevoi (Typha spp.), roots of bracken fern, yams, roots of the pencil orchid, tips of young cabbage tree palms, quandong fruit (Elaeocarpus grandis), waterlilies, river chestnuts, macadamia nuts, wild oranges and limes, and bunya nuts (Araucaria bidwillii) (Winterbotham, 1957).

Bunya nuts formed an important part of the diet and lives of many Aborigines in this area, and the next section will concentrate specifically on bunya trees.

Bunya nut festivals

The bunya pine has a limited distribution. Apart from a small pocket north-west of Cairns (which has been speculated to be an Aboriginal artefact) the main distribution occurs in the sub-tropical rainforests of south-east Queensland, from the Bunya mountains in the south to Gympie in the north.

Bunya nuts formed a significant part of the diet of people living close to the Blackall ranges and the Bunya Mountains, where they were particularly prolific (Sullivan, 1977). The nuts ripen in January and February. Each year the trees bore a few cones which drew local tribes up from the coast. However every third year the trees bore a heavy crop, and in these years the bunya nut festivals were held, drawing people from up to 250 km away (Petrie, 1975; Sullivan, 1977). The festival attracted 600-700 people and lasted two to three months from January to March. The nuts were a rich source of carbohydrate and were a much relished food - although they contain no significant levels of protein.

Like many other gatherings, the bunya nut festival was not only motivated by the availability of food but also provided many social benefits such as regulating disputes and educating the young. It enabled the movement of people between seasonally abundant resources by imposing obligations to reciprocate the hospitality. For example, the hosts of the festival were able to exploit the annual mullet runs in winter as the guests of coastal tribes. Sullivan interprets the bunya nut festival as a kind of 'living storage', which enabled the maximum number of people to benefit from the super-abundance of nuts which could not be consumed or adequately stored by local tribes. In return, the hosts could exploit seasonal abundances in other areas to which they would not otherwise have had access.

Management of bunya trees?

Bunya trees were one of the few 'possessions' of Aborigines.

> Each blackfellow belonging to the district had two or three trees which he considered his own property, and no-one else was allowed to climb these trees and gather the cones ... the trees were handed down from father to son ... and everyone ... knew who were the owners. (Petrie, 1975).

Sullivan adds that while the locals owned some trees and had exclusive rights of exploitation, there were other trees set aside for visitors.

Besides owning the trees (and in a sense controlling the exploitation of nuts) the local Aborigines did take some steps to ensure a continued supply. As mentioned above, it has been speculated that the seeds of bunya pine were sometimes deliberately planted to secure a continuity of supply (Hyam, 1939, cited in Campbell, 1965), and this is a possible explanation for the discontinuous distribution of bunya pine. However it is also possible that the normal method of nut storage (burying them in boggy soil from where the trees sometimes germinate and grow), may have been misinterpreted as deliberate planting.

The local Aborigines also allowed the area to recuperate after the festivals. This was one of the reasons for their movement back to the coast for a month or so afterwards (Sullivan, 1977). Allowing areas where large gatherings were held to recuperate was a common phenomenon according to Sullivan. She says that owing to the depletion of local resources large gatherings were rotated, allowing three years out of four as a 'fallow'.

Use and management of sub tropical rainforests

Like other types of thick, dense and moist forest, subtropical rainforests were not favoured as sites of occupation. They were, however, highly valued as a source of vegetable foods, particularly bunya nuts. Bunya nuts provided local and other groups with a predictable food source, around which the bunya nut festivals developed. Although the Aborigines did not appear to manage the rainforest in any way, it appears that they did take some steps to ensure the continued supply of bunya nuts by restricting access and exploitation, allowing festival areas to recuperate, and possibly by planting bunya pine seeds.

RIVER RED GUM FORESTS OF THE CENTRAL MURRAY RIVER

River red gum (Eucalyptus camaldulensis) grows along the banks and floodplains of streams and watercourses throughout mainland Australia. It is the most widely distributed eucalypt in Australia, but is most highly developed along the central Murray River and its tributaries within the floodplain bounded by Echuca, Deniliquin and Tocumwal in the Barmah and Millewa forests (Allen, 1979; Dexter, 1979). River red gum is not only the dominant tree species in these forests, but on lower ground which is regularly flooded, it is the only tree species forming a natural monoculture. In these areas red gum usually forms a woodland or open forest association, with no shrubby understorey and a ground cover of various grasses, sedges and rushes (Chesterfield, 1986). On higher ground, not subject to regular flooding, red gum grows in association with black box (E. largiflorens), grey box (E. microcarpa) and yellow box (E. melliodora) (Chesterfield, 1986).

The Aboriginal inhabitants

Tindale identified three tribal groups in the Barmah-Millewa forest area - the Jota Jota, the Kwat Kwat and the Pangerang, although from the time of European settlement the three groups were regarded collectively by E.M. Curr, the area's earliest pastoralist, as the Bangerang and by others as the Yorta Yorta (W. Atkinson, pers. comm.).

The Barmah-Millewa forest area was densely populated. Based on Curr's estimates, the population density at the time of early European settlement was approximately one person per five to six square kilometres. However he concluded that the Aboriginal population had been greatly reduced by the impact of smallpox. More recent work indicates that this area may have been one of the most densely populated areas in Australia during the mid to late Holocene (Webb, 1984).

The Yorta Yorta had a broad spectrum economy, living principally on fish, wild roots and animals (Fahey, 1987). They were fairly sedentary, particularly during the warmer months, when they congregated around rivers eating fish, mussels, waterbirds, cumbungi roots (Typha spp.) and possums. In winter months they dispersed in family groups away from the many waterbodies to higher ground where they could avoid floodwaters but still retain access to staple foods such as fish and cumbungi.

Food resources were most abundant during spring and summer. At these times there was enough food, particularly fish, to support large gatherings of people for extended periods of time. The major meeting places for tribal and inter-tribal gatherings for the Yorta Yorta were the Moira and Barmah Lakes. They were held for a variety of social and other reasons, including initiation ceremonies, arranging marriages, settling disputes, celebrating the arrival of a particular food species, and trading goods.

Use of forest resources

Although much of their food resources was obtained from rivers, swamps and creeks, the Yorta Yorta used materials from the forest to make baskets, nets, spears, nuts, canoes and coolamons.

Masticated cumbungi stems were woven into a fibre to make bags and a variety of nets. Different types of nets were used to catch freshwater crayfish, yabbies and fish, while cross-line nets were strung low over water to catch startled ducks. Similar nets were used in kangaroo and emu drives (Fahey, 1987). Fish weirs were constructed from closely spaced stakes driven vertically into the mouths of receding flood-water channels. The trapped fish would provide a food supply for five to six weeks. The stems of a reed were used to make spear shafts - highly prized and a valuable item of trade.

Red gum (and occasionally box trees) provided the raw materials for the construction of huts made from saplings and bark slabs, and also for canoes and coolamons which were cut out from the bark of living trees.

Management of the forest

As a large part of their diet centred around water resources, 'management' activities often had the same focus. Fish weirs, described by Curr (1965) to be 'extensive affairs' were the property of various men of the tribe. These weirs provided easy access to fish, but ownership also controlled exploitation. Curr also observed local Aborigines regularly setting fire to cumbungi reed; this is likely to have prompted the growth of the tuber, which was a staple vegetable (Mulvaney, 1987).

The forest itself was also fired regularly. Curr observed the Aboriginals constantly setting fire to grass and trees both accidentally and systematically for hunting purposes and claims the Bangerang 'tilled his land and cultivated his pasture with fire' (Curr, 1965: 88). The use of fire cleared the undergrowth and killed fire sensitive red gum seedlings. As a result, the red gum forest, like many other forest environments manipulated by Aboriginal firing, had an open park-like appearance.

EAST COAST EUCALYPT FORESTS

These forests extend from the coast to the Great Dividing Range from Victoria to northern N.S.W., where annual rainfall exceeds 600 mm. The most widespread formation is open, dry sclerophyll forest, dominated by species such as tallow-wood (Eucalyptus microcorys), Sydney blue gum (E. saligna), turpentine (Syncarpia glomulifera) and brush box (Tristania conferta) in higher rainfall areas of the north coast, and by species such as blackbutt (E. pilularis), spotted gum (E. maculata) and bloodwood (E. gummifera) on poorer soils in lower rainfall areas of the south coast (Anderson, 1968: 129-130). Common understorey species include blackboys and grass trees (Xanthorrhoea spp. and Kingia spp.), members of the lily family and cycads (Macrozamia spp.), which all regenerate well after fire, which is not infrequent in these forests (Hall et al., 1970).

Although many coastal middens and other Aboriginal sites along the east coast have been studied, information concerning Aboriginal use and occupation of the forests of the coastal hinterland is sparse, making it difficult for prehistorians to determine Aboriginal subsistence patterns (Hiscock, 1982). From the information available it appears that the east coast eucalypt forests were occupied sparsely from about 20 000 years ago, but more intensively during the late Holocene. For example, Hughes and Lampert (1982) found a twofold to threefold increase in the number of sites on the south coast over the last 5 000 years and a sixfold to tenfold increase in the intensity of occupation of pre-existing sites over the same period. Attenbrow (1982) similarly found that in the Mangrove Creek area on the Hornsby Plateau very few shelters were occupied before 5 000 years ago, but, after that time the number of shelters being occupied for the first time, and the intensity of occupation, began to increase.

The east coast, particularly the wetter northern section is an area rich in natural resources which supported a large population of Aborigines. The population density of groups along the coastline has been estimated to have been between 1.5 and 3 people per square kilometre (Coleman, 1982). These communities are believed to have been fairly sedentary, living in large groups in substantial dwellings (Hall, 1982) and gaining much of their subsistence from the sea, the coastal plain and estuaries (Coleman, 1982). Stone built fish traps dot the coast and it is believed that large numbers of Aborigines co-operated in their construction and maintenance. These traps had the capacity to provide large groups of people with ample fish and enabled semi-permanent settlements (Coleman, 1982). For these reasons it is believed that the Aboriginal communities of the north coast of N.S.W. did not use the hinterland forests with any great intensity.

Conversely, Aboriginal communities south of Sydney are believed to have been less sedentary. Evidence from Poiner (1976) suggests a dispersal of people from the south coast to hinterland forests during winter when there was a relative scarcity of fish. Although few inland sites on the south coast have been found, Flood (1982) believes those that have may represent shelters and tool manufacturing centres to which coastal fishermen retreated in winter.

Use and management of the forests

The Aboriginal communities of the east coast had a great variety of foods available to them. Much of their food came from the sea, but further inland, rivers offered freshwater yabbies, crayfish and shellfish. In the dry forests beside the rivers (most occupation sites in east coast forests are found in valley bottom locations [Attenbrow, 1982]), there were a great variety of mammals, lizards, snakes, echidnas and birds to be hunted (Isaacs, 1987: 38) and a variety of vegetable foods which included cycad nuts (Macrozamia spp.) the roots of bracken fern, yam daisies (Microseris scapigera a staple food for many Victorian communities), the young shoots and leaves of cabbage tree palms (Livistona australis and L. eastonii), native cherries (Exocarpus cupressiformis) and grass trees (Xanthorrhoea spp.).

Fire was used extensively throughout the east coast forests as an aid to hunting, to promote green pick for native herbivores and to encourage regeneration of edible plant foods. In the forests of the south coast, thousands of years of Aboriginal burning, assisted by drier conditions, is believed to have driven rainforest back into the gullies, allowing drier eucalypt forest to dominate (Hilder, 1982). It is also believed that existing grassy clearings such as those at Yadboro Flat and Tingha clearing (near Ulladulla, N.S.W.) were created by Aborigines to provide feed for native herbivores. It is also possible that large stands of cycads (Macrozamia communis) in the area of the Clyde and Moruya rivers may be Aboriginal artefacts. In other areas of Australia cycads have been identified as an important resource, managed by fire (Harris, 1978). On the south coast firing of Cycad stands has been shown to synchronise, speed up and increase production of cycad nuts, and to encourage cycad plants at the expense of other plants. Beaton (1982: 54) 'there is ample suggestion that Jones' 'firestick farming' would be especially productive in cycads'.

Further north, in the Sydney area, Clark and McLoughlin (1986: 54) claim: 'the biological evidence is overwhelming in indicating that fire shaped the structure of vegetation systems encountered by the first white settlement'. Their investigations of the Lane Cove valley catchment show that the Aboriginal fire regime varied according to the environment type being burnt and the resources they wished to extract from the environment, among other factors. They suggest that burning was more frequent on shale ridges (1-5 year intervals) than on sandstone slopes (7-15 year intervals) and maintain that burning at intervals more or less frequent than this leads to reduction in species diversity.

CONCLUSION

A number of views concerning Aboriginal society have prevailed amongst white Australians since the first European settlement. Aborigines have been variously regarded as 'sub-human', aimless wandering nomads who lived from hand to mouth, and more recently as a people who lived in total harmony with the land, exploiting naturally occurring resources. European settlement in Australia has based itself largely on these views which conveniently preclude any ideas of Aboriginal ownership of the land - because they appeared to neither till the soil, invest any labour in it nor erect any permanent dwellings upon it.

This background of entrenched dogma makes it difficult for white Australians to break the cycle of ignorance and realise that Aboriginal people were actively involved in manipulating and managing their environments. They did, in some cases, till the soil, they did invest a lot of labour in their land, and they did erect dwellings upon it. However their management activities did not have the same focus as those of present day land managers. For example forests were not seen in terms of wood production, but for the food resources they sustained. This focus meant that thick, dense forest environments such as rainforests, which we regard as being rich and diverse, actually support few mammals and were not regarded by Aborigines as favourable sites for occupation and were often only marginal to their economy. Aborigines preferred woodland environments, which support many more mammals, and appear to have used fire to maintain and extend them, at the expense of closed forest types.

The importance of fire as a tool used by Aborigines to modify their environment cannot be overstated. Fire played an important role in maintaining an open 'park-like' environment, in flushing out game, in promoting green pick for native herbivores and in encouraging the regeneration of edible food plants, many of which appear in the early regenerative phase following burning. I will conclude this paper with a passage from 'Kakadu Man' by Bill Neidjie concerning the role of fire.

> This earth ... I never damage, I look after.
> Fire is nothing, just clean up.
> When you burn, new grass coming up.

That mean good animal soon ... might be goose, long-neck turtle, goanna, possum.
Burn him off ... new grass coming up, new life all over.

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REFERENCES

Allen, B., 1979 Red gum country - the forest of the floodplains, Forest and Timber 15(3): 2-4.

Anderson, R.H., 1968 The trees of New South Wales (N.S.W. Dept. Agriculture).

Attenbrow, V., 1982 The archaeology of Upper Mangrove Creek catchment: research in progress, in Bowdler, S., (ed.) Coastal archaeology in eastern Australia (Dept. Prehistory, R.S.Pac.S. ANU, Canberra): 67-78.

Beaton, J.M., 1982 Fire and water: aspects of Australian Aboriginal management of Cycads, Archaeology in Oceania 17: 51-58.

Beard, J.S., 1981 The vegetation of Western Australia at the 1: 3 000 000 Scale - Explanatory notes (Forests Dept W.A.).

Belshaw, J., 1978 Population distribution and the pattern of seasonal movement in northern New South Wales, in McBryde, I. (ed.) Records of times past: Ethnohistorical essays on the culture and ecology of the New England tribes (Aust. Inst. Aboriginal Studies, Canberra): 65-8.

Bowman, D.M.J.S. and Brown, M.J., 1986 Bushfires in Tasmania: a botanical approach to anthropological questions, Archaeology in Oceania 21(3): 166-71.

Bowman, D.M.J.S. and Kirkpatrick, J.B., 1986 The establishment, suppression and growth of Eucalyptus delegatensis R.T. Baker on multi aged forests 1. The effects of fire on mortality and seeding establishment, Aust. J. Bot. 34: 63-72.

Campbell, A.H., 1965 Elementary food production by the Australian Aborigines, Mankind 6(5): 206-211.

Chesterfield, E.A., 1986 Changes in the vegetation of the river red gum forest at Barmah, Victoria, Aust. Forestry 49(1): 4-15.

Christensen, P.E. and Kimber, P.C., 1975 Effects of prescribed burning on the flora and fauna of South-west Australian Forest, Managing Terrestrial Ecosystems, Proc. Ecological Society of Australia (9).

Clark, R., 1981 The prehistory of bushfires, in Stanbury, P. (ed.), Bushfires, their effect on Australian life and landscape (Macleay Museum, Univ. of Sydney, Sydney): Ch. 7.

Clark, S. and McLoughlin, L., 1986 Historical and biological evidence for fire regimes in the Sydney region prior to the arrival of Europeans: implications for future bushland management, Australian Geographer 17(2): 101-112.

Coleman, J., 1982 A new look at the north coast: fish traps and 'villages', in Bowdler, S. (ed.) Coastal archaeology in eastern Australia (Dept. Prehistory, R.S.Pac.S. ANU, Canberra): 1-10.

Curr, E.M., 1965 Recollections of squatting in Victoria, then called the Port Phillip District, from 1841 to 1851, 2nd ed, abridged, first publ. 1883 (Robertson, Melbourne).

Dames and Moore, 1987 Wacap, towards 2000. Environmental review and management programme, draft environmental impact statement for the extension of the licence for W.A. Marri woodchip export industry (Perth, W.Aust.).

Dexter, B., 1979 To flood or not to flood: that is the red gum question, Forest and Timber 15(3): 5-8.

Elkin, A.P., 1954 The Australian Aborigines (Angus and Robertson, Sydney).

Ellis, R.C., 1984 Aboriginal influence on vegetation in the Northeast highlands, Tasmanian Naturalist: 7-8.

Fahey, C., 1987 Barmah Forest: A history of the Barmah Forest, Historic Places Section, (Department Cconservation Forests and Lands, Melbourne).

Felton, K., 1977 Native Tasmanian Vegetation Types (mimeo, 5 pp).

Ferguson, W., 1985 A mid-Holocene depopulation of the Australian southwest (Unpublished PhD thesis, ANU).

Flood, J., 1982 Katungal, Paiendra and Bemeringal, in Bowdler, S. (ed.) Coastal archaeology in eastern Australia (Dept. Prehistory, R.S.Pac.S., ANU, Canberra): 79-95.

Flood, J., 1983 Archaeology of the Dreamtime (Collins, Sydney).

Ford-Robertson, F.C. (ed.), 1971 Terminology of forest science: Technology, practise and products (Society of American Foresters, Washington, D.C.).

Griffin, G. and Allan, G., 1986 Fire and the management of Aboriginal owned lands in Central Australia, in Foran, B. and Walker, B. (eds) The Application of Science and Technology to Aboriginal Development in Central Australia (CSIRO, Melbourne): Sect. 2.6.

Good, R., 1981 Adaptations of Australian plants to fires, in Standbury, P. (ed.) Bushfires, their effect on Australian life and landscape (Macleay Museum, Univ. of Sydney) Sydney: Ch.6.

Hall, J., 1982 Sitting on the crop of the bay: an historical and archaeological sketch of Aboriginal settlement and subsistence in Moreton Bay, in Bowdler, S. (ed.) Coastal archaeology in Eastern Australia (Dept. Prehistory, R.S.Pac.S. ANU, Canberra): 79-95.

Hall, N., Johnston, R.D. and Chippendale, G.M., 1970 Forest trees of Australia (A.G.P.S. Canberra).

Hallam, S.J., 1975 Fire and hearth 58 (Aust. Inst. of Aboriginal Studies, Canberra.)

Harris, D.R., 1969 Agricultural systems, ecosystems and the origins of agriculture, in Ucko, P.J. and Dimbleby, G.W. (eds) The domestication and exploitation of plants and animals (Duckworth, London): 3-15.

Harris, D.R., 1977 Subsistence strategies across Torres Strait in Allen, J., Golson, J. and Jones, R. (eds) From Sunda and Sahul. Prehistoric Studies in Southeast Asia, Melanesia and Australia (Academic Press, London): 421-63.

Harris, D.R., 1978 Adaptation to a tropical rainforest environment: Aboriginal subsistence in North eastern Queensland, in Blurton-Jones, N.G., and Reynold, V. (eds) Human behaviour and adaptation Symposium 18, Soc. Study Human Biology, (Taylor and Francis, London): 113-134.

Henderson, A.E. and Chase, A.K., 1985 Aborigines and savanna land: Historical and contemporary land use perspectives, In Tothill, J.C. and Mott, J.J. (eds) Ecology and management of the world's savannas (Aust. Academy of Science, Canberra): 161-65.

Hiatt, B., 1968 The food quest and the economy of the Tasmanian Aborigines, Part 2, Oceania 38: 190-219.

Hilder, W., 1982 The influence of man, Chapter 1 in Pigeon House and Beyond (Budawang Committee Publication, Eastwood, NSW): 19-42.

Hiscock, P., 1982 A technological analysis of quartz assemblages from the south coast, in Bowdler, S. (ed.) Coastal archaeology in eastern Australia (Dept. Prehistory, R.S.Pac.S. ANU, Canberra): 32-45.

Horton, D., 1982 The burning question: Aborigines, Fire and Australian ecosystems, Mankind 13(3): 237-51.

Hughes, P.J. and Sullivan, M.E., 1986 Aboriginal landscape, in Russell, J.S. and Isbell, R.F. (eds) Australian soils: the human impact (Univ Qld. Press, St Lucia): Ch.5.

Hughes, P.J. and Lampert, R.J., 1982 Prehistoric population change in southern coastal New South Wales, in Bowdler, S. (ed.) Coastal archaeology in eastern Australia, Proceedings of the 1980 Valla Conference on Australian Prehistory (Dept. Prehistory R.S.Pac.S., ANU): 16-28.

Hunter, Captain J., 1793 An Historical Journal of Events at Sydney and at sea 1787-1792 (with further accounts by Governor Arthur Phillip, Lieutenant P.G. King and Lieutenant H.L. Ball), edited by Bach, J. (Angus and Robertson, Sydney, 1968).

Hynes, R.A. and Chase, A.K., 1982 Plants, sites and domiculture: Aboriginal influence upon plant communities in Cape York Peninsula, Archaeology in Oceania 17(1): 38-50.

Isaacs, J., 1987 Bush food (Weldons, Sydney).

Jackson, W.D., 1965 Vegetation, in Davies, J.L. (ed.) Atlas of Tasmania (Hobart): 30-35.

Jackson, W.D., 1968 Fire and the Australian flora, Tasmanian Year Book (Hobart): 50-55.

Jones, R., 1969 Fire stick farming, Australian Natural History 16: 224-228.

Jones, R., 1975 The Neolithic, Palaeolothic and the Hunting Gardeners: Man and land in the Antipodes, in Suggate, R.P. and Cresswell, M.M. (eds) Quaternary Studies, (The Royal Society of New Zealand): 21-34.

Jones, R.M., 1980 Cleaning the country: the Gidjingali and their Arnhem Land environment, B.H.P. Journal 1: 11-15.

King, A.R., 1963 Report of the influence of colonization on the forests and the prevalence of bushfires in Australia. CSIRO Div. Phys. Chem. (incl. quotes by Mitchell 1848 and Sturt

1849 - Narrative of an expedition into Central Australia during 1844-5-6 Vol. 2).

Kirkpatrick, J.B. and K.J.M. Dickinson, 1984 Vegetation of Tasmania 1:500 000 map, (Forestry Commission, Tasmania).

Latz, P. and Johnson, K., 1986 Nature conservation on Aboriginal land, in Foran, B. and Walker, B. (eds) The application of science and technology to Aboriginal development in central Australia (CSIRO, Melbourne): Sect. 2.4.

Lourandos, H., 1980a Forces of Change: Aboriginal technology and population in south-western Victoria. (Unpublished PhD thesis, Dept. Anthropology, Univ. of Sydney).

Lourandos, H., 1980b Changes or stability?: Hydraulics, hunter-gatherers and population in temperate Australia, World Archaeology II(3): 245-64.

Lourandos, H., 1985 Intensification and Australian prehistory, in Price, T.D. and Brown, J.A. (eds) Prehistoric hunter-gatherers: the emergence of cultural complexity (Academic Press, Lodon): 385-413.

Meggitt, M.J., 1964 Aboriginal food-gatherers of tropical Australia, in The ecology of man in the tropical environment, IUCN 9th Technical Meeting, Publication Series 4:30-7 Morges.

Mott, J.J., Williams, J., Andres, M.H. and Gillison, A.N., 1985 Australian savanna ecosystems, in Tothill, J.C. and Mott, J.J. (eds) Ecology and management of the world's savannas (Aust. Academy of Science, Canberra): 56-82.

Mulvaney, D.J., 1987 The end of the beginning: 6000 years ago to 1788, in Mulvaney, D.J. and White, J.P. (eds) Australians to 1788 (Fairfax, Syme and Weldon Associates): Ch. 4.

Neidjie, B., Davis, S., Fox, A., 1985 Kakadu Man (Mybrood, NSW, Australia).

Petrie, C., 1975 Tom Petrie's reminiscences of early Queensland (Lloyd O'Neil, Hawthorn, Victoria), orig. publ. 1904.

Poiner, G., 1976 The Process of the Year among Aborigines of the central and south coast of New South Wales, Archaeology and Physical Anthropology in Oceania 11: 186-206.

Rindos, D., 1980 Symbiosis, instability and the origins and spread of agriculture: A new model, Current Anthropology 21(6): 751-72.

Ross, A., 1981 Holocene environments and prehistoric site patterning in the Victorian Mallee, Archaeology in Oceania 16: 145-54.

Stevenson, P.M., 1983 Traditional Aboriginal resource management in the wet-dry tropics: Tiwi case study, in Ridpatyh, M.G. and Corbett, L.K. (eds) Ecology of the wet-dry tropics (Blackwells/Ecological Society of Australia, Melbourne): 309-15.

Stirling, J., 1827 Letter to Governor Darling. Form H.M.S. Success, 1827: with enclosures - No. 1. Narrative of operations No. 2. Observations on the soil, etc. (by C. Fraser). Historical Records of Australia, Ser. 3(6) 1923: 551-584.

Sullivan, H., 1977 Aboriginal gatherings in south-east Queensland, (B.A. (Hons) thesis, Dept. Prehistory and Anthropology, ANU).

Thomas, I., 1984 Liawenee Moor: the post-glacial history of a Tasmanian alpine grassland. (Unpublished BA (Hons) thesis, ANU).

Vancouver, G., 1801 A voyage of discovery to the north Pacific Ocean and around the world, performed in the years 1790, 1791, 1792, 1793, 1794 and 1795 in the Discovery, sloop of war and armed tender, Chatham, under the command of Captain George Vancouver (John Stockdale, London): 3V.

Webb, S., 1984 Intensification, population and social change in southeastern Australia: the skeletal evidence, Aboriginal History 8: 1-2.

Williams, J.B., Harden, G.J. and McDonald, W.J.F., 1984 Trees and shrubs in rainforests of New South Wales and southern Queensland (Botany Dept. Univ. New England, Armidale).

Winterbotham, L.P., 1957 Gaiarbau's story of the Jinibora tribe of south-east Queensland. (Unpublished manuscript available IAS - Canberra) later published in edited form in Queensland Ethnohistory Transcripts, Some original views around Kilcoy. Book 1. The Aboriginal Perspective Vol. 1. Archaeology Branch, Queensland (undated).

PREHISTORIC ABORIGINAL RELATIONSHIPS WITH THE FORESTS OF THE RIVERINE PLAIN IN SOUTH-EASTERN AUSTRALIA

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INTRODUCTION

The study area is an extensive riverine environment within the central Murray region, situated in the broad floodplain of the Murray River between Echuca, Tocumwal and Deniliquin on the New South Wales - Victorian border (see Figure 1.) It consists of the Millewa group of forests in New South Wales and Barmah forest in Victoria, which together cover an area of almost 70 000 ha.

This paper outlines the prehistory of this area of the riverine plain, and describes the environment as it existed in pre-European times. Abundant archaeological material in the area (which has been left relatively undisturbed over the last century of management by two state forest services), shows how the former Aboriginal occupants utilized the resources available to them, while historical material, written by early European settlers in the area illustrates how Aborigines influenced vegetation patterns in these forests. Finally I will describe present-day utilization of the area and comment on how much change the vegetation has undergone under European management practices.

PREHISTORY OF THE RIVERINE PLAIN

Prior to 30 000 years B.P., the Murray River flowed west across the plain and was joined by the Goulburn River flowing from the south-east (Figure 2). At this time a glacial environment existed in the Snowy Mountains. In late spring when the snow thawed, high discharges reached the plains, carrying heavy bedloads from unstable catchment slopes. Stream channels on the plains were very wide, well incised and had wide meander belts. Gravels and sands were deposited in point bars intermittently along these rivers. In winter, when the water level fell, these point bars were exposed to strong westerly winds. There were no trees, so these winds obtained high surface velocities and blew sand from the point bars onto the east and north-east sides of the channels, forming source bordering dunes.

About 25 000 years B.P. the land just east of the junction of the Goulburn and Murray rivers was uplifted for some 25 km along the line of a north-south fault which extended for about 60 km (Bowler, 1978: 74). The Murray and Goulburn rivers were blocked by the uplift of land to the west of this fault (the 'Cadell Fault') and were diverted from their previous courses, leaving their old channels abandoned (Figure 3). The Goulburn developed a new course south of

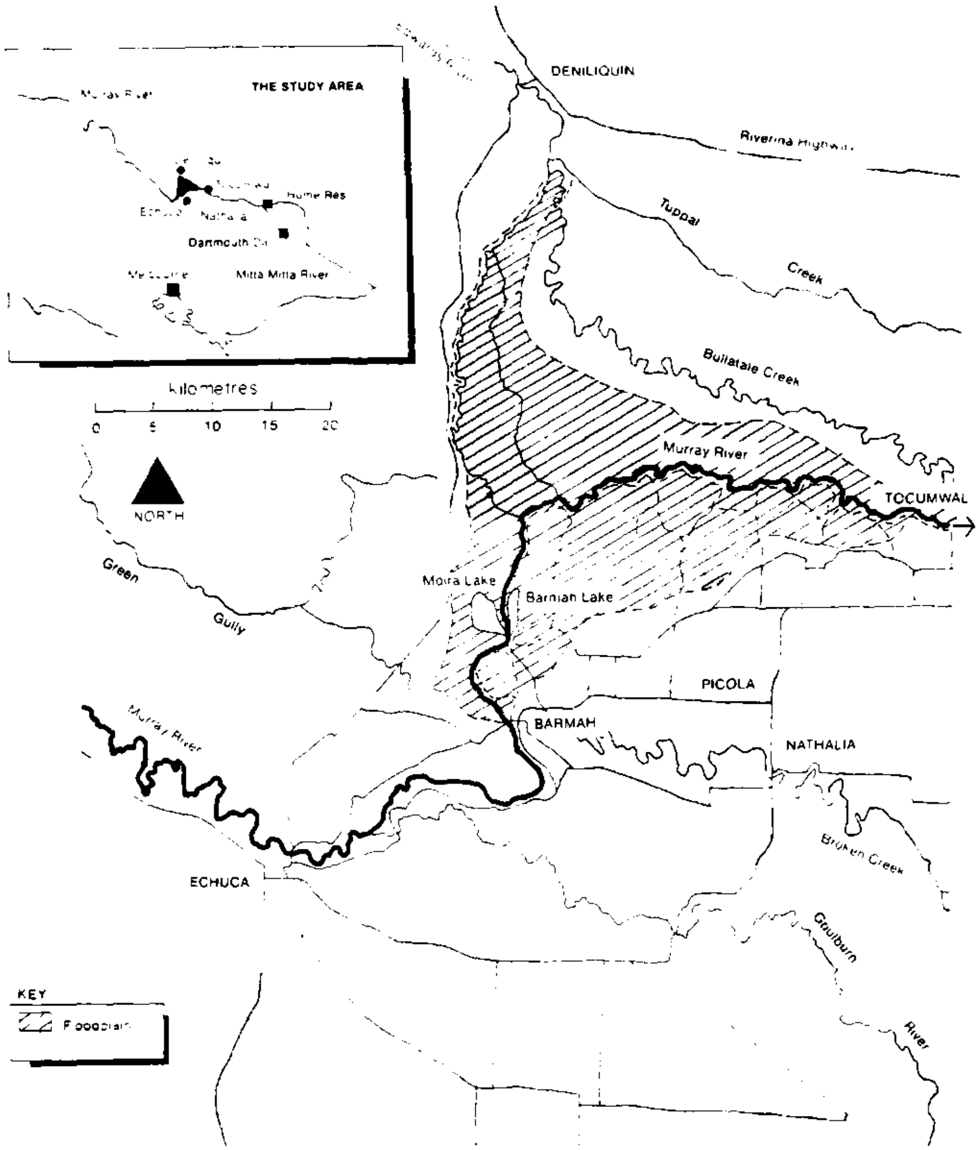

Fig. 1 Location map showing present day river systems, riverine plain, S-E Australia

the tilt block, while a series of channels developed near Deniliquin to divert the Murray waters to the north of the tilt block (Bowler, 1978: 74).

The new channels which developed were also wide. This was predominantly a bedload phase where channels migrated downstream, quickly excavating large volumes of sediment. Source bordering dunes developed along these new channels.

The fault movement also caused the formation of a lake, 'Lake Kanyapella' which was supplied by the Goulburn River (Bowler, 1978:

76). Coarse sediments were deposited on an active beach, south-westerly winds then blew these sands to the north-east side of the lake to form a sand lunette, now called the Barmah sandhills (Bowler and Harford, 1966). Lake Kanyapella dried up gradually around 20,000 years B.P., forming a small lake and sand lunette within the margins of the old lake (Bowler, 1978: 96).

About 15 000 years B.P. a major hydrologic change occurred in the river regimes due to changing climatic conditions. There is evidence of a regional trend towards aridity. Glaciers retreated and catchment slopes began to stabilize. The rivers were now characterized by a high proportion of suspended load and low discharge rates (Bowler, 1978: 105). Channel width diminished, meander wavelength shortened and meander belts were only one-quarter of the size of old channels (Bowler, 1978: 85). Woodland vegetation developed between 13 000 and 10 000 B.P. (Bowler, 1978: 105). By 10 000 B.P. channels very similar to those of today were in existence (Figure 4).

The final event in river development in the study area was the diversion of the Murray River south past Barmah through the Barmah sandhills to join the Goulburn river near the centre of the old Lake Kanyapella just before 8 000 B.P. There is an aboriginal legend relating to this time.

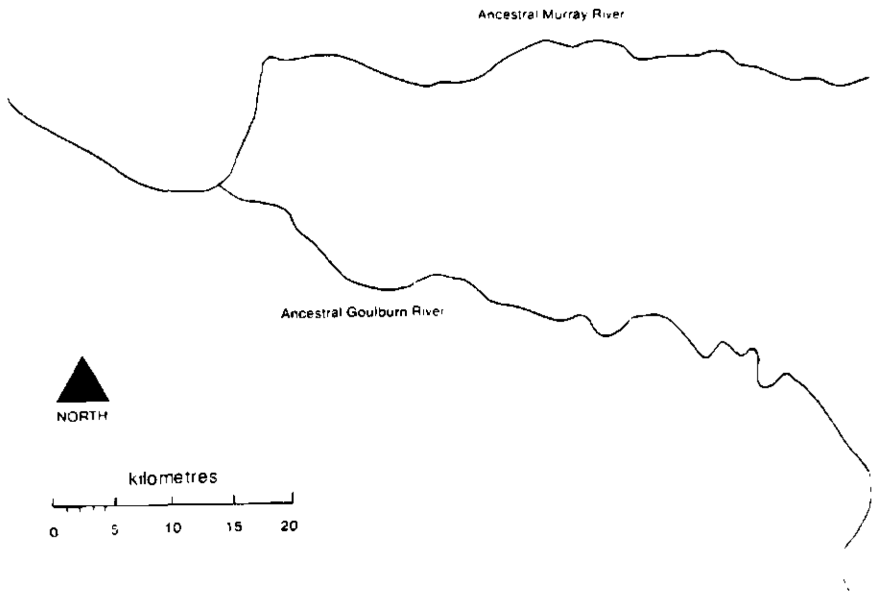

Fig. 2 Murray-Goulburn river system before 25 000 B.P.

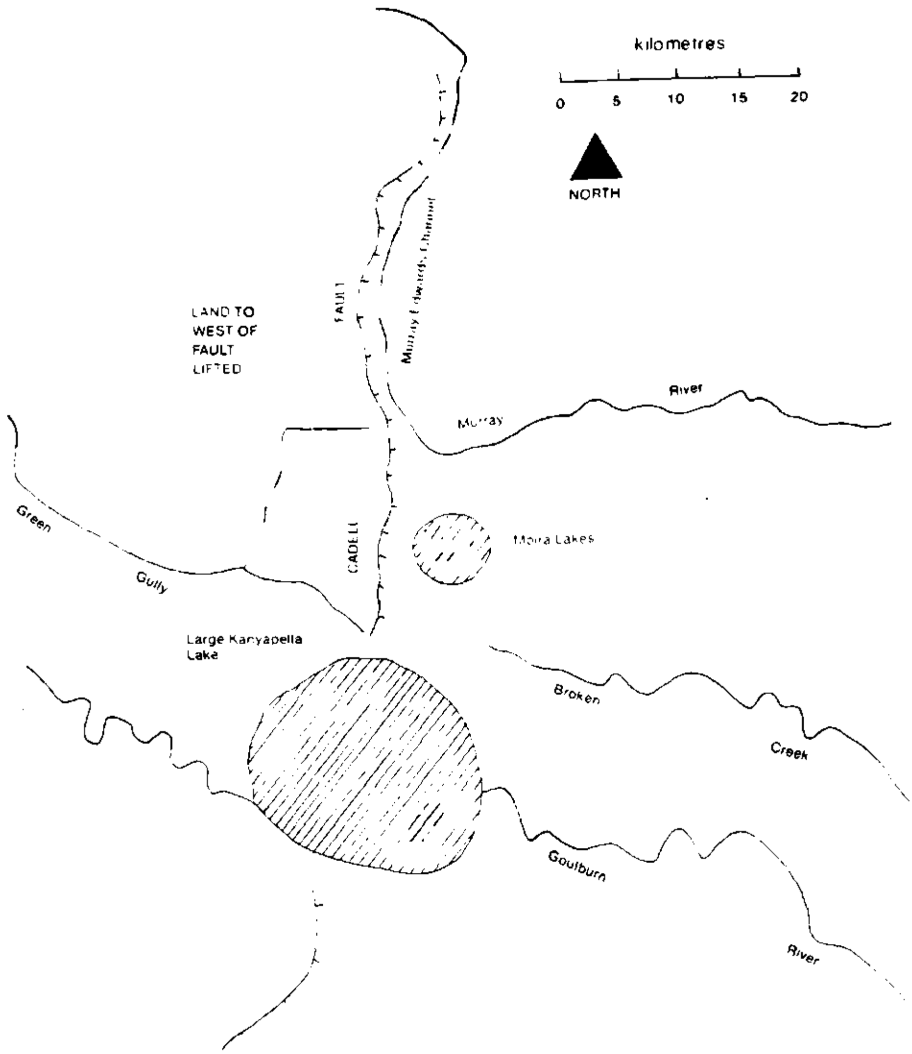

Fig. 3 Murray-Goulburn river system at 25 000 B.P.

Apparently the aborigines then living in the area could see that the waters of the Murray were mounting up higher and higher behind the Barmah sandhills. The water rose right up into the crowns of the trees. Concerned, the aborigines dug a small channel through the sandline with their digging sticks, where they could see the water was pushing. The force of the water behind the dune pushed the channel through and the Murray escaped, to flow down and meet the Goulburn (W. Atkinson, pers. comm.).

Both the Murray and Goulburn possess a larger number of now inactive prior stream channels, implying an evolutionary sequence extending back through a long period of time. Evidence of these can be seen in the sand dunes widespread throughout the study area, particularly on the New South Wales side of the Murray.

THE PRESENT - A LEGACY OF THE PAST

The distinctive array of forms in this landscape today are the result of a long and complex sequence of environmental changes. The riverine plain is very flat and is dissected by three major rivers - the Murray, the Goulburn and the Edwards. Their anabranches, lakes, swamps, old levee banks, creeks, billabongs, rivers, sand banks from ancient lakes, plains, depressions and sand dunes marking the course of ancient streams are all features of this landscape.

The Cadell fault has caused the floodplain to be triangular, with its apex near Tocumwal and its base the line of the fault. River red gum forests (Eucalyptus camaldulensis) cover most of the

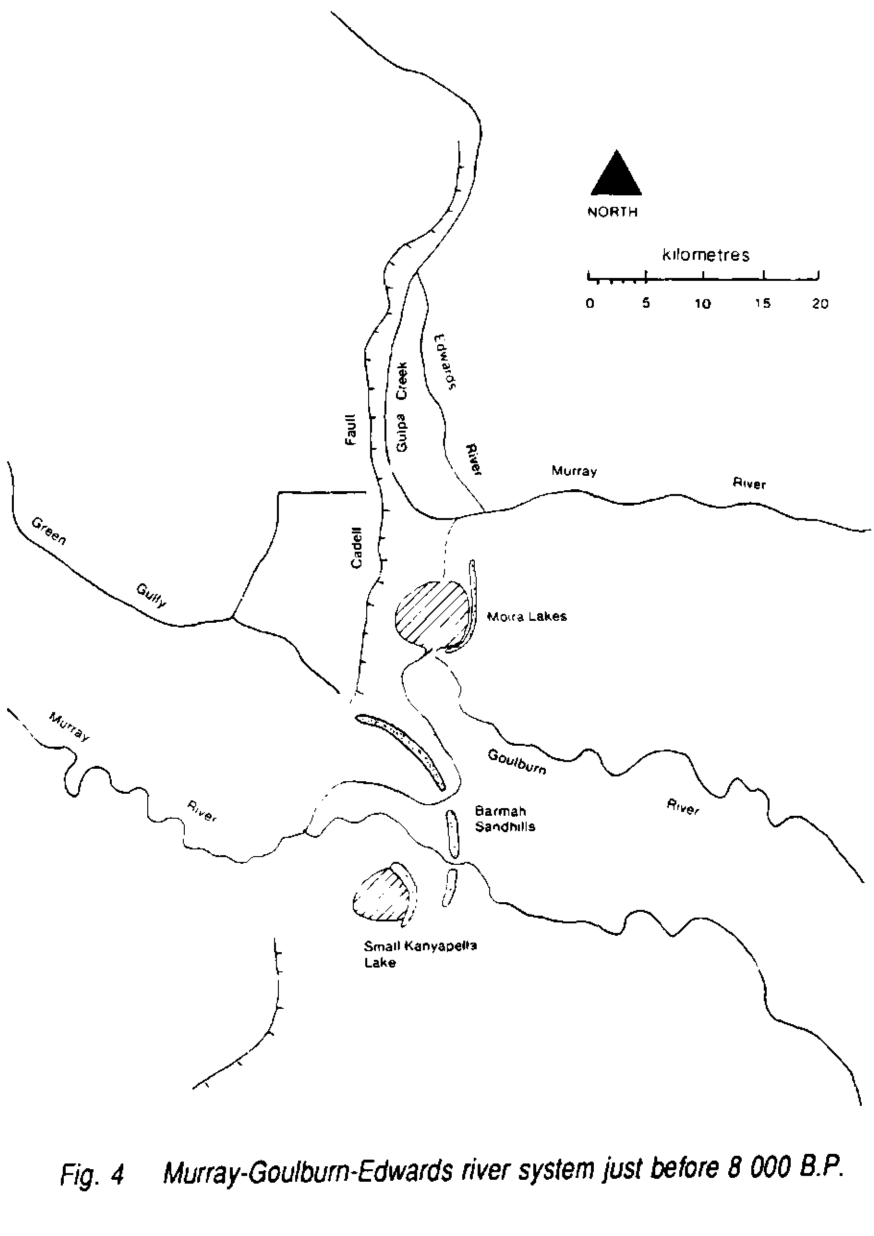

Fig. 4 Murray-Goulburn-Edwards river system just before 8 000 B.P.

floodplain. Grey box grows on slightly elevated and unflooded ridges within the floodplain, and yellow box is found on sandhills. Black box grows on surrounding plains and is uncommon within the red gum forest.

The climate of this region is very dry. The mean annual rainfall is only 425 mm while annual evaporation is 1400 mm. Periodic flooding is a very important source of water for these forests (Chesterfield, 1986).

Indeed the Aborigines had a most interesting environment to live in. Most of the forest would flood in the late winter, early summer period and at least once every two years. Even in dry summers water was never far away. Even now, although most of the water is regulated, it is possible to stand on a stream bank at one time of the year and see it flowing in direction, and then come back several months later and see it flowing the other way. It certainly is different to see rivers and streams flowing <u>out</u> of another major river when in most parts of Australia this is not the case at all. The Cadell fault has caused streams to run out of the Murray rather than into it. These effluents rejoin the Murray east of the fault in the Barmah Lakes area on the Victorian side, while effluents to the west of the fault rejoin the Murray of the N.S.W. side between Barham and Swan Hill.

Prehistoric occupation

The Red Gum forests of this area were and still are special environments. There is evidence that aboriginal people lived here at least throughout holocene (i.e. the last 10 000 years).

It is believed that the central Murray area may have been one of the most highly populated places in Australia before European arrival (Webb, 1984). In such a diverse and resource-rich environment this is easy to understand. Edward Curr was the first European squatter in the region. He called the tribal groups of the Barmah-Milliwa forest the 'Bangerang' although descendents of these groups refer to themselves as the Yorta Yorta (W. Atkinson, pers. comm.). Curr estimated the population of the Bangerang to number about 1200 in 1841 though he believed the country could have supported at least twice this number. This population had already been dramatically reduced however by major smallpox epidemics in 1788 and 1830. In 1838 Sturt noted the 'numerous fresh graves between the Edwards and Goulburn rivers which he said bore testimony to the ravages of a terrible mortality'.

The abundance of archaeological material in the study area indicates the high population density of Aborigines here before 1788.

A study of these sites, of their number, type and location gives us some insight into the way that the Yorta Yorta lived and utilized the resources of the riverine plain. Unfortunately, very limited archaeological work has been done in the area, and few informed or systematic observations were made of any of the south-east

Australian Aborigines (Atkinson and Berryman, 1983). The area does still, however, provide us with a rich source of archaeological material. The major types of sites are described below.

Scarred trees

The Barmah and Millewa forests contain a large number of Aboriginal scarred trees. Scars are found frequently throughout the red gum forests, and to a lesser degree may be seen in box types. These trees represent a legacy of canoe, shield and water vessel manufacture. Canoe trees are probably the most striking examples. The Yorta Yorta made canoes from the bark of river red gums with hafted stone axes. Once the bark had been carefully removed it was shaped over a fire, seasoned in the sun and end-blocked with clay. These canoes were capable of carrying people, and were used for travel, foraging and fishing (Atkinson and Berryman, 1983).

Smaller cutouts were made to produce shields and coolamons. Coolamons were used as dishes to carry food while it was being gathered. In this region women collected vegetable foods, mussels, yabbies, freshwater lobsters and other aquatic life from lagoons, rivers, swamps and flooded areas.

Unfortunately many of these scarred trees have been ringbarked in past forest improvement practices designed to encourage regeneration.

Oven mounds

Earthen ovens were used by traditional Murray valley Aborigines to bake large catches of game and large volumes of vegetable foods such as Typha roots. In the absence of natural stone, calcined or burned clay served as a heat retainer in the underground cooking pit. Accumulations of this clay, charcoal and organic debris have built up over thousands of years to form these mounds (Atkinson and Berryman, 1983). Mounds are generally located in great numbers on high ground adjacent to streams and rivers.

Fish weirs

Three known fish weirs are located in the study area. These are marked by middens and mounds on either side of a depression formed by the mouth of an anabranch, which fills when the Murray River is in flood. Closely spaced stakes were driven vertically into the mouth of receding floodwater channels to catch fish. These weirs could yield a bountiful harvest of fish which would support large numbers of people for five to six weeks (Fahey, 1987: 4-5).

Middens

These are the rubbish dump areas associated with camp sites. Shell middens are found mainly along the major rivers, probably where large mussel beds were known and regularly exploited.

Burial sites

Burial sites are commonly found in sandhills throughout the Barmah and Millewa forests. Some mounds also contain burials. It is believed that Aborigines found it much easier to dig burial pits in the soft soils associated with the mounds and sandhills, than in the hard clay soils which predominate this region.

ABORIGINAL INFLUENCE ON THE RIVER RED GUM ENVIRONMENT

The Aborigines here did profoundly shape the environment in which they lived mainly by their use of fire. Curr observed that the Bangerang set fire to the grass and trees as frequently as every five years, both accidentally and systematically for hunting purposes (Curr, 1965: 88). Chesterfield states that burning would have undoubtedly impeded regeneration and assisted woodland formation (as red gum is a fire-sensitive species) and may have even contributed to the maintenance of the forest-grassland boundary in some locations (Chesterfield, 1986). In prehistoric times the red gum stands were really woodlands, not forests. Even now, old bushmen describe how in the early days they used to be able to see the bullock teams coming for several miles through the bush before they could actually hear them. Apparently there used to be only one or two big old red gums growing per hectare.

EUROPEAN INFLUENCE ON THE RIVER RED GUM ENVIRONMENT

The vegetation has changed dramatically since European arrival on the scene. A long history of ringbarking and harvesting has caused the structure of the red gum stands to change. There are now many more trees in these forests, and no longer any areas resembling 'parkland'. Changes in flooding regimes due to river regulation have also caused many changes in forest types throughout the study area. Areas of forest have been killed where they receive too much water when high summer river levels are maintained for irrigation. Likewise some grasslands have been changed to perpetual swamps. Other areas no longer receive regular flooding and here swamps are being drained and trees have regenerated where there were no trees before. Large areas of forest rarely, if ever, flood any more and these are dying (Chesterfield, 1986; Paunovic, 1982).

The introduction of stock and altered river levels have changed the composition and extent of reedbeds. Extensive areas of common reed and cumbungi have contracted and now giant rush is the predominant reed, though it is found only in restricted areas in positions of low drainage (Chesterfield, 1986).

Curr described an area in Barmah forest near the mouth of Broken Creek in 1847 as 'of a very pleasant aspect, of a mixed Australian and semitropical character' (Curr, 1965: 77). After riding further north and climbing a tree he sighted a 'sea of reeds, of several miles in extent, as far as the eye could reach' (Curr, 1965: 78).

His description emphasises the changes which have occurred in these forests. There is certainly no 'semitropical character' about the red gum forests now and no longer are there any reed beds of the size he mentions. The introduction of sheep, cattle and rabbits, river regulation and altered burning regimes have dramatically changed the nature of these river red gum forests in just under 150 years.

REFERENCES

Atkinson, W. and Berryman, A., 1983 Aboriginal Association with the Murray Valley Study Area, Report to Victorian Land Conservation Council, 23rd February 1983.

Bowler, J.M., 1978 Quaternary climate and tectonics in the evolution of the riverine plain, south-eastern Australia, pp. 70-112, in Davies, J.L. and Williams, M.A.J. (eds) Landform Evolution in Australia (ANU Press, Canberra).

Bowler, J.M. and Harford, L.B., 1966 Quaternary tectonics and the evolution of the riverine plain near Echuca, Victoria, J. Geol. Soc. Aust. 13: 339-54.

Chesterfield, E.A., 1986 Changes in the vegetation of the river red gum forest at Barmah, Victoria, Australian Forestry 49(1): 4-15.

Curr, E.M., 1965 Recollections of Squatting in Victoria from 1841 to 1851 (Melbourne University Press, 2nd Ed. first published 1883 by George Robertson, Melbourne).

Fahey, C., 1987 Barmah forest: A history of Barmah forest, (Historic Places section, Department Conservation Forests and Lands, Melbourne).

Paunovic, P., 1982 River red gum forests of the central Murray River region: Problems caused by river regulation (Forestry Commission of N.S.W.).

Webb, S., 1984 Intensification, population and social change in south-eastern Australia: the skeletal evidence, Aboriginal History 8(1-2): 154-72.

ABORIGINAL USE OF FORESTS IN SOUTH-EASTERN AUSTRALIA: PAST AND PRESENT

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INTRODUCTION

At European contact much of Australia was covered in forest and woodland. By necessity, wholesale clearing to provide pasture was a primary objective for the first white settlers and must have seemed a daunting task, for 'he who has never looked on any other than the well cultured fields of England, can have little idea of a country that nature has covered with interminable forest' (Sturt, in Mulvaney, 1975).

Timber was the most important forest product for the growing colony but, for some thousands of years before 1788, Aboriginal people had utilized a much wider range of forest resources, demonstrated in the archaeological and ethnohistorical records. Palynological research has also indicated that Aboriginal burning practices had an impact on some forest ecosystems. The nature and extent of the impact is difficult to isolate from climatic influences, and interpretation of pollen and carbonized particle records has given rise to lively debate in the literature (Horton, 1982; Clark, 1983; Singh et al., 1981; Wright, 1986; Head, 1983, 1986).

Despite the loss of a traditional lifestyle in south-eastern Australia and a massive reduction in the areal extent of forests, Aborigines still retain a strong affinity with the forest environment, for both historical and cultural reasons. From the time that the first cedar getters moved into the Shoalhaven area in 1819, Aborigines have been involved in the timber industry (Sullivan, 1983). Today, the timber industry remains a major employer for Aborigines living on the far south coast and in Gippsland. In some ways this has led to a dilemma for Aboriginal people who also wish to maintain their links with the past, through preservation of culturally significant and archaeological sites on forested lands (Thompson, 1985).

In this paper I discuss some ideas about prehistoric and contemporary Aboriginal perceptions of forests, arising from fieldwork that I have carried out in montane forests in Namadgi National Park in the Australian Capital Territory and in the escarpment forests around Bega in south-eastern N.S.W. (Fig. 1). Different lines of evidence are presented in the context of a changing use of forests by Aborigines, from prehistoric through to the present time. Before white settlement, these changes were a culturally adaptive response by an autonomous society to environmental factors. Today, European political and economic controls strongly influence Aboriginal concepts about forested environments.

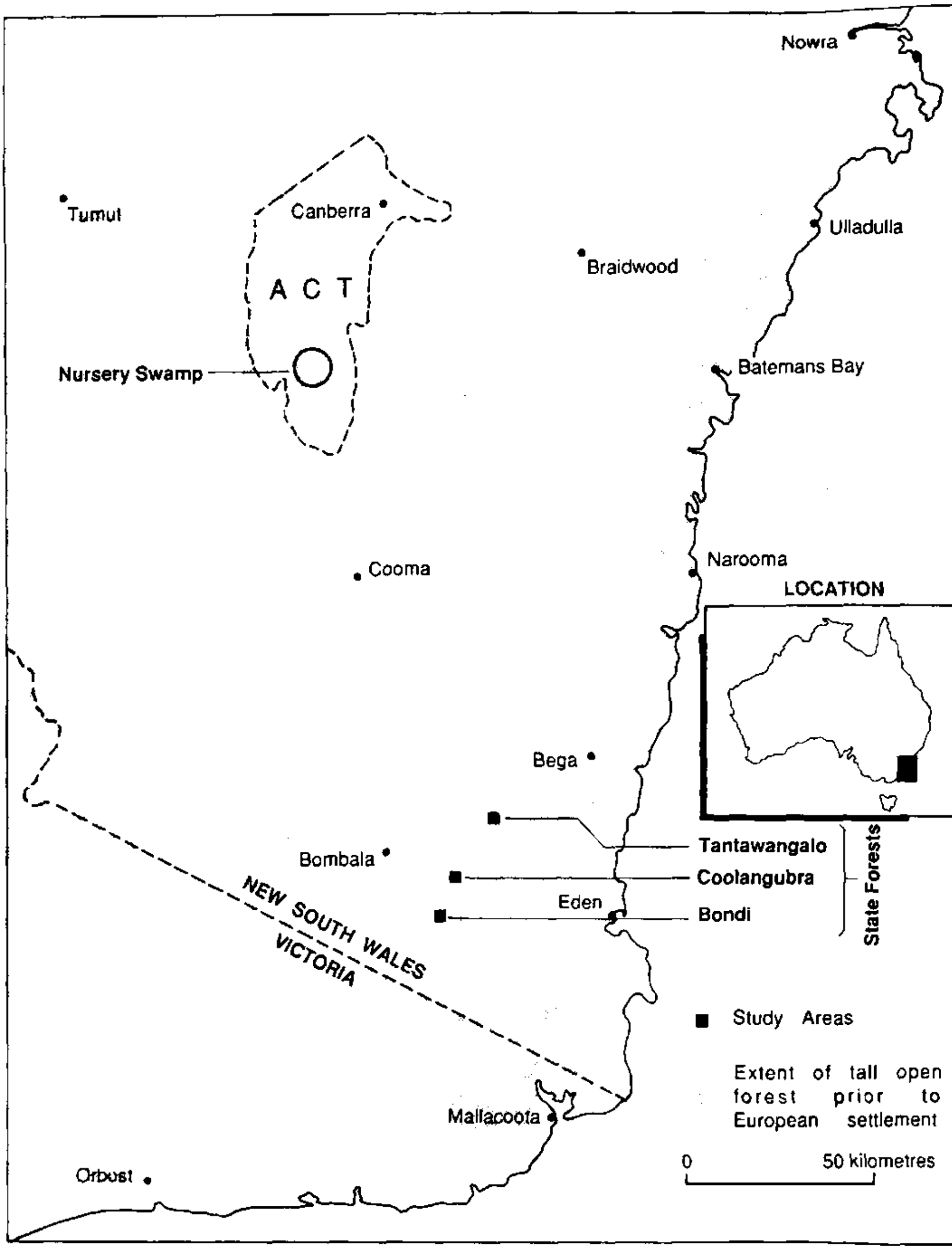

Fig. 1 *Locality map showing study area referred to in text with approximate distribution of tall open forests prior to European settlement*

PREHISTORY

In south-eastern Australia prehistoric exploitation of coastal resources is much better known than that of the forested hinterland, because research has concentrated in these areas (Bowdler, 1982). It is important to appreciate the reasons for this coastal orientation. Firstly there are very few early ethnohistorical observations of Aborigines away from the immediate coastline and these tend to be cursory (Attenbrow, 1976; Sullivan, 1983). Later accounts are more detailed (e.g. Mackaness, 1941; Howitt, 1904) but must be used with care as by this time European settlement had largely disrupted traditional patterns of subsistence and ceremonial life. I would also argue that the ethnohistorical records have a strong gender bias. All early observers of Aborigines were males, who reported on the highly visible, prestigious male-dominated activities such as hunting and male initiation ceremonies. The less flamboyant but none the less vital activities of Aboriginal women, such as collecting bush foods, went largely unnoticed.

Secondly, coastal middens are easy to see. Frequently these contain abundant, well-preserved organic material in a stratified context, which can be analysed and dated, providing a reasonable, if biased, interpretation of Aboriginal diet. Because of the highly visible nature of molluscan remains it was once thought that shellfish were a dietary staple. These theories have largely been dispelled and it is useful to reflect that the calorific value of one kangaroo is roughly equivalent to eating 12,000 bivalves (Feary, 1981). By contrast all of the archaeological sites recorded in forests have been surface scatters of stone artefacts. The paucity of organic material and lack of stratification makes reconstruction of past Aboriginal lifestyles much more conjectural.

Thirdly, the prospect of surveying extensive areas of rugged, thickly vegetated terrain is daunting to even the most ardent archaeologist. There are the logistic problems of access and of site discovery when ground visibility is severely restricted by forest litter or a thick understorey. Random sampling techniques are statistically valid but tend to militate against finding sites because of the visibility problem (Byrne, 1983a). Non-probabilistic techniques, involving survey along fire trails and other areas where human and animal disturbance has exposed bare ground, give a high probability of site discovery. However, one can never be entirely certain that the resulting patterns of site distribution are accurate reflections of human movement or a function of the sampling strategies.

Aboriginal use of forests has therefore had a high profile in Australian archaeological research only in the last decade, being prompted in part by environmental concerns over modern forest management practices. It also reflects a change in emphasis of archaeological methods, from site specific to regionally based studies which concentrate on investigating the interrelationships between humans and their environments.

Thus, fieldwork has been undertaken in the rainforests of Queensland (Horsefall, 1984) and northern New South Wales (Byrne, 1984; Sullivan, 1978); the karri/jarrah forests of south-western Australia (Hallam, 1979; Ferguson, 1985; Anderson, 1984); and the tall open forests of south-eastern New South Wales (Byrne, 1983a; Egloff, 1979; Feary, 1986); Southern Alps (Flood, 1980; Feary, 1983) and northern tablelands (McBryde, 1974; Godwin, 1983). Recently, interest has also focussed on the Tasmanian highlands (Cosgrove, 1984). Some of the forest-based research has been summarized in Bowdler (1982) as a basis for providing recommendations about protection of Aboriginal sites to the N.S.W. Forestry Commission.

A study of the Five Forests in the N.S.W. South Coast (Fig. 2) by Byrne (1983a) used a stratified random sampling technique and resulted in the recording of 39 sites, giving an average density of 1 site per 2.9 km², demonstrating unequivocally that Aborigines had made more than a fleeting use of forest resources in prehistoric times. Away from the immediate coastline, all sites were surface scatters of stone artefacts and most were located along ridge lines. This pattern of site distribution suggests that the sites may represent 'transit camps' of people moving through the forest making use of ridge lines as natural corridors, rather than foci of occupation for groups living close to forest resources. Resolution of this requires detailed artefact analysis to determine precisely what behaviour produces this type of site (Godwin, 1983).

Two interesting outcomes emerge from the Five Forests study; the apparent absence of sites in a zone between 3 km and 12 km from the coastline, even when variable visibility is taken into account and a considerably lower site density than that calculated for the Wandella-Dampier State Forests to the north-west (Byrne, 1981) (Fig. 2).

A possible explanation of the former is derived from ethnohistorical sources which point strongly to the existence of two populations, a coastal group concentrating on marine and to a lesser extent land-based foods and an inland group which relied upon land-based foods with some access to coastal resources (Howitt, 1904). These were probably not separate tribal groups, but different land-owning units of a tribal group whose western boundary coincided with the top of the coastal range (Fig. 3). Byrne (1983a) has postulated that coastal populations had base camps located within 3 km of the coast and from these hunting groups could forage over a 10 km radius, returning to their camp on the same day. Archaeological manifestations of this activity are likely to be below the threshold of archaeological visibility. Trips over greater distances may require an overnight camp, explaining the cluster of sites approximately 12 km from the coast. There is some ethnohistorical evidence to suggest that movement away from the coast occurred in the winter months but, since the sites contain no seasonal markers, this cannot be tested archaeologically. The inland group may have been based in major river valleys and around swamps, relying primarily on plant and animal foods from the forests and rivers but with limited, perhaps seasonal, access through kinship ties to marine resources.

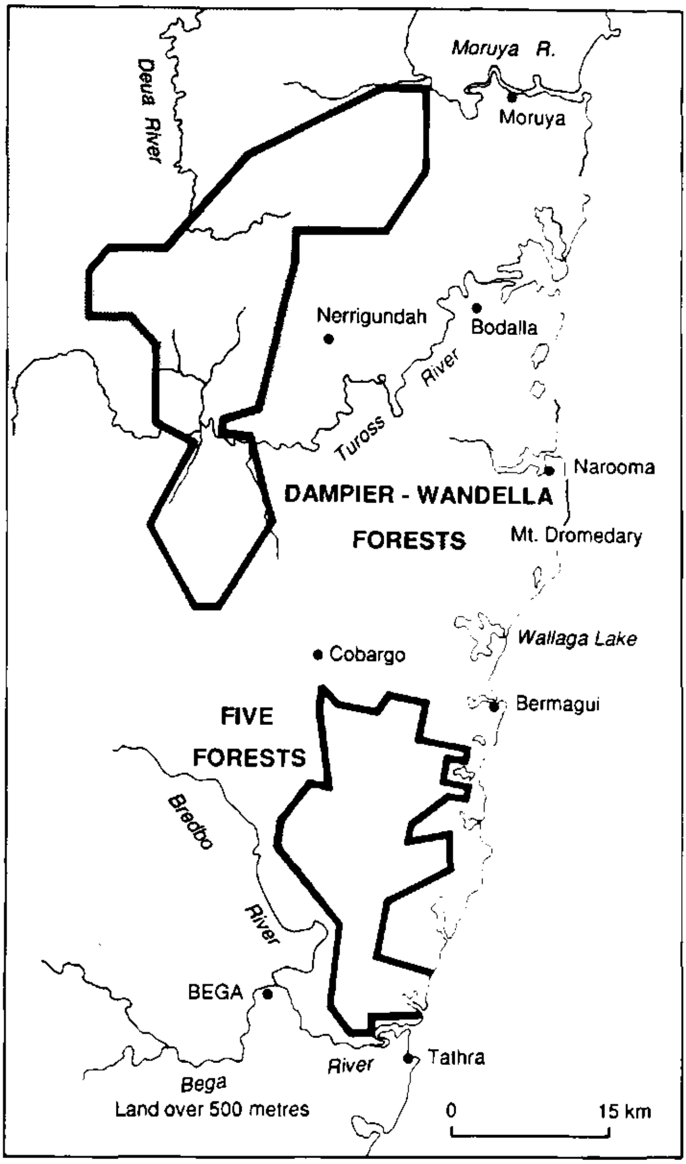

Fig. 2 Map showing the geographic relationship between Dampier-Wandella State Forests and Five Forests. Source: Byrne (1983a)

More recently, intensive field surveys in coastal forests north of the Clyde River have demonstrated that numerous sites do occur within this zone (Farrington, pers. comm.). Whether this reflects different and larger sampling designs, particularly a greater number of people carrying out the surveys, or a more substantial use of forests by Aboriginal groups to the north, has yet to be determined.

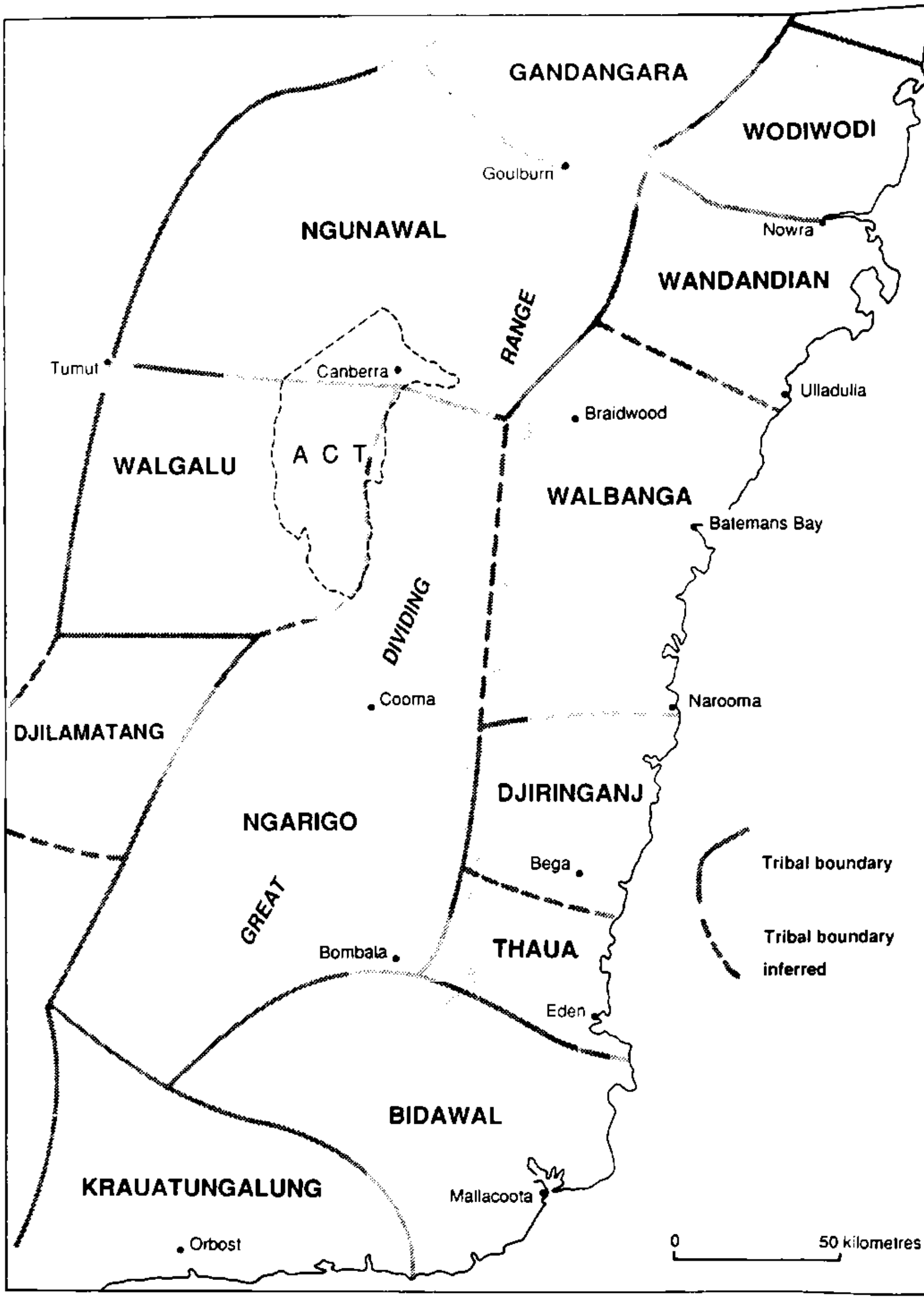

Fig. 3 *Map of Aboriginal tribal areas in south-eastern Australia showing correlation of boundaries with zones of high relief. Source: after Tindale, 1974*

The second phenomenon of a relatively low site density in the Five Forests, as compared to Wandella-Dampier forests is explained by Byrne (1983a) as being due to the absence of intensive logging in the latter. I would also postulate that higher site densities in forests remote from the coast reflect subsistence strategies of Aboriginal groups whose tribal boundaries did not include a coastal frontage. As shown in Fig. 3 the Ngarigo, Ngunawal and possibly the Bidawell linguistic groups had no, or only very limited, access to the rich and varied resources of the coastline. Their entire seasonal round relied on efficient exploitation of the various types of resources zones found within the forest of the coastal ranges, southern alps and tablelands (Feary, 1986). Many plants and animals could have been utilized for food and for manufacturing items of material culture, but their distribution would have been patchy and their availability seasonally controlled. Bowdler (1981), suggests that the yam daisy(Microseris scapigera) was a staple food for highland dwellers, but it is more likely that survival depended on opportunistic exploitation of a wide range of locally abundant resources. These would have been most effectively harvested by small family groups moving frequently, to take advantage of seasonally available berries, fruits and underground parts of plants. An intimate knowledge of habitat requirements of small forest fauna and some environmental manipulation by burning to attract larger game can also be assumed.

Site distribution patterns arising from a subsistence based on forest resources can be expected to differ from those of coastal tribes. Small sites and isolated finds along natural routes such as ridge lines will still be present, but in addition larger base camps will be positioned for easy access to a variety of resource areas. Such base camps are predicted to occur at the ecotone between forest and swamps or grassland and adjacent to major watercourses. Since forests vary in their floristics and structure according to physical and climatic parameters, localized high concentrations of certain plant and animal species would have facilitated longer residences and/or greater numbers of peoples in certain locations. Extensive modifications of forests since European contact make it almost impossible to reconstruct flora and fauna and thus patterns of human behaviour.

Very little research has been carried out in forested areas remote from the coast and in most cases only small areas were surveyed. The distribution of sites recorded during recent fieldwork in escarpment forests south and west of Bega are shown in Fig. 4 (Feary, 1986). Ridge lines contained little evidence of Aboriginal use; most of the sites, all artefact scatters, occurred along creeks and rivers and around swamps. The largest site, estimated to contain several thousand stone artefacts was found on flat, well-drained ground adjacent to Sheep Station Creek. A large complex of smaller sites was also recorded at the junction of Myamba and Stockard Creeks. Byrne (1983b) found a comparable site distribution pattern in the rugged country of Deua and Wadbilliga National Parks, where sites were concentrated along terraces adjacent to the major rivers (Fig. 5). Further afield, but in the same tribal territories, numerous sites occur along the lower Snowy River (Geering, 1981), the Murrumbidgee

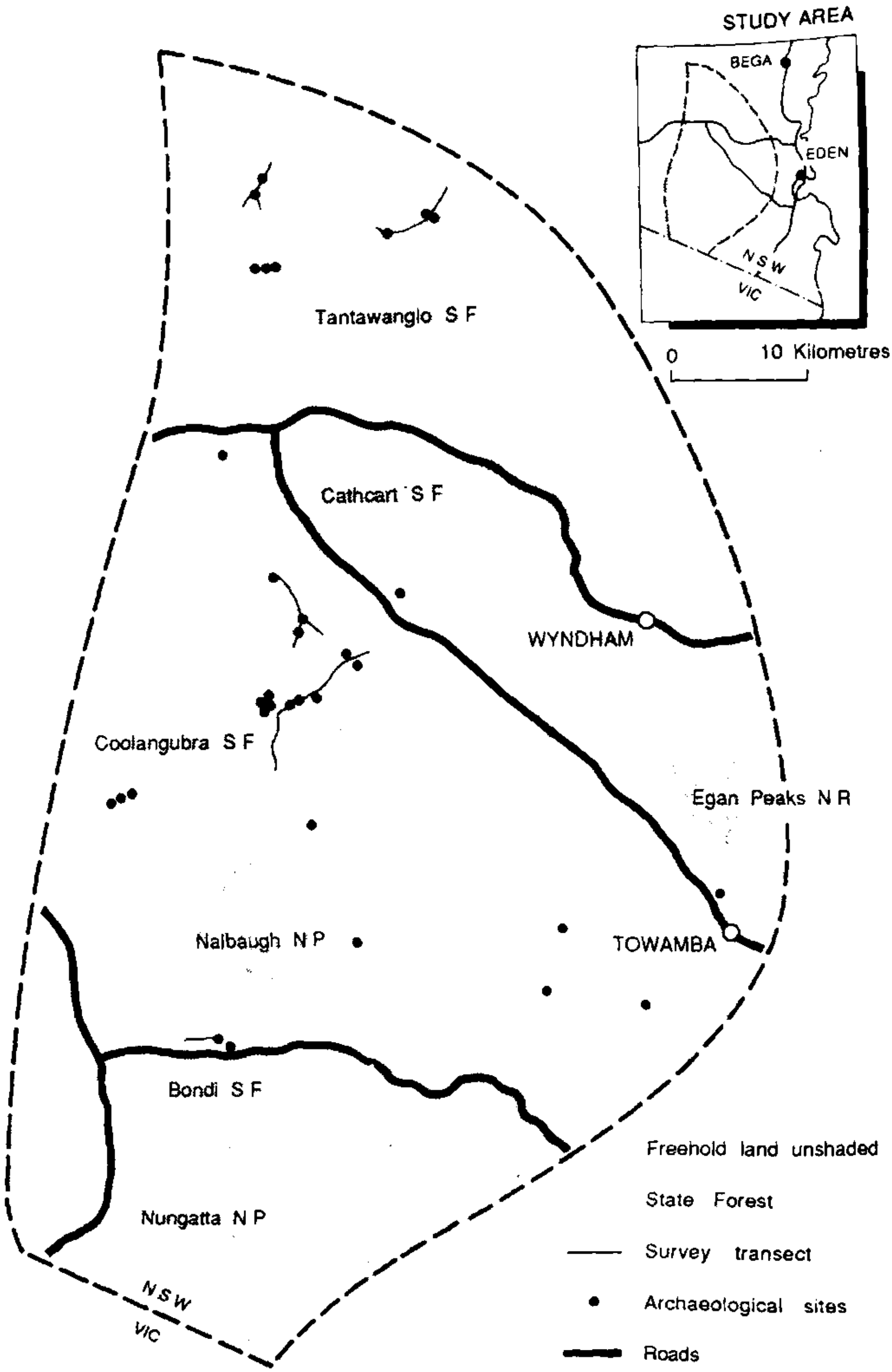

Fig. 4 Distribution of archaeological sites researched since 1986 in escarpment forests south-west of Bega

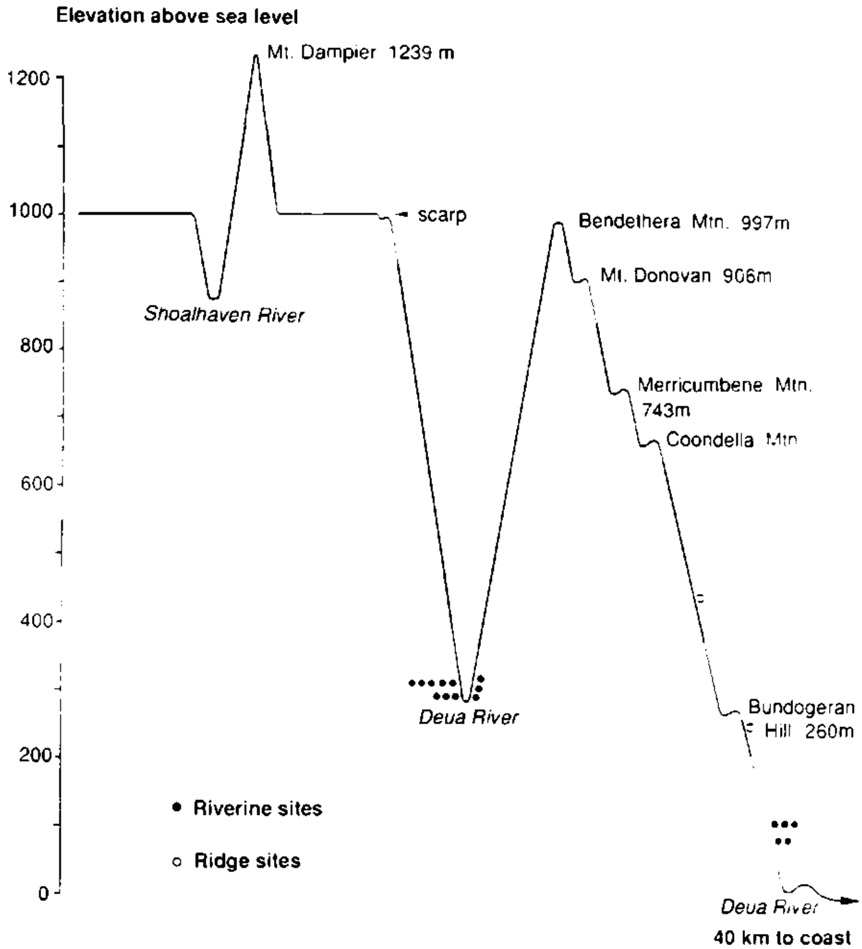

Fig. 5 Cross-section through Deua National Park showing relationship of archaeological sites to topography. Source: Byrne (1983a)

River (Barz and Winston-Gregson, 1981) and the Shoalhaven River (Attenbrow, 1983). In the latter case occupation of river tributaries was preferred, presumably to avoid cold air drainage effects in the main valley.

Topography exercised similar constraints in the montane forests of the southern A.C.T. (Fig. 6) Along ridge lines, large open sites, as found on the saddle at the northern end of Nursery Swamp, perhaps reflect stop-over places en route to the Snowy Mountains. Sites do occur along the ridge lines flanking the Nursery Creek valley but point to occupation in rock shelters provided by huge granite tors, some of which are near to bogong moth aestivation sites. By far the largest number of sites occur around the swamp and grassland associated with a major frost hollow (Feary, 1983).

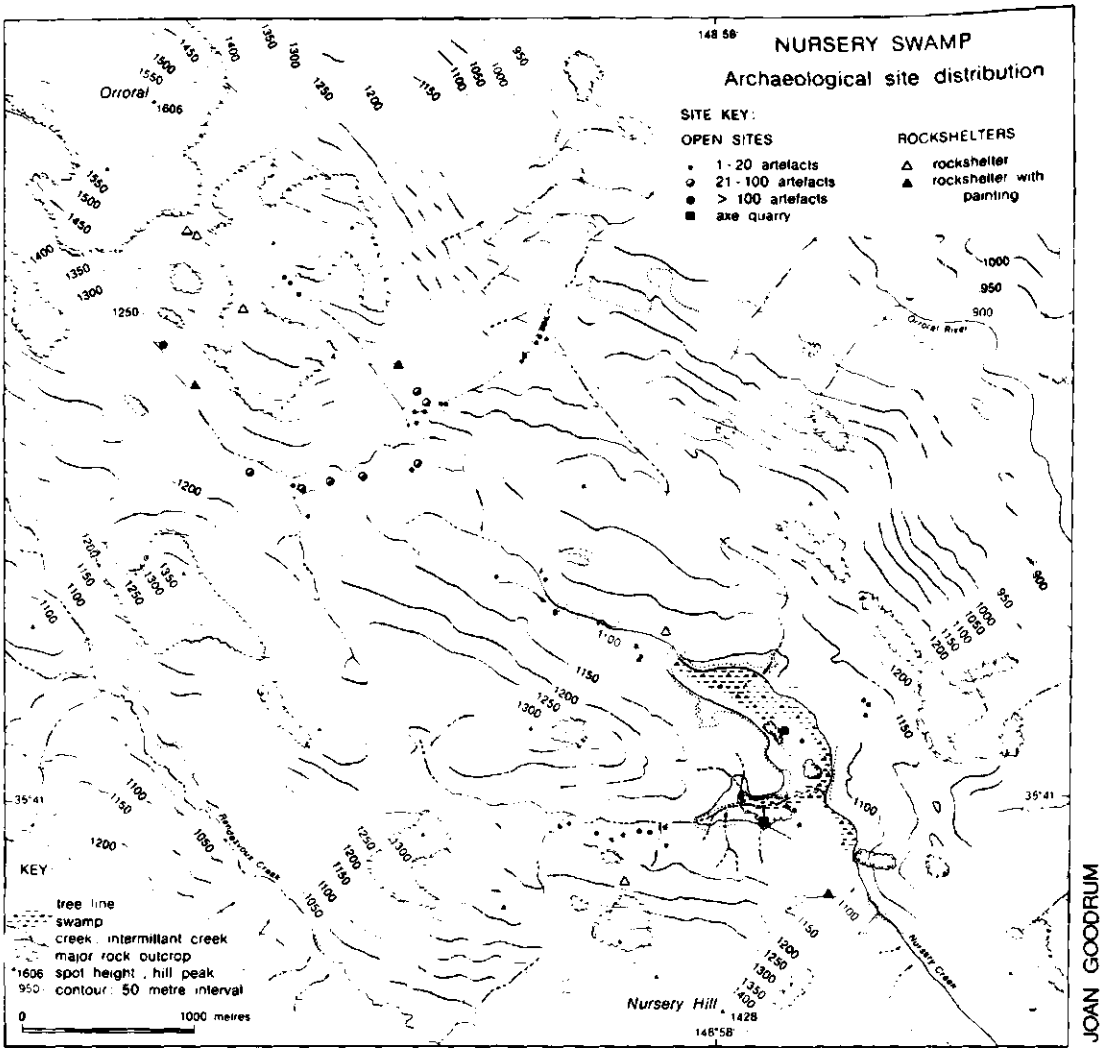

Fig. 6 Archaeological site distribution, Nursery Swamp, Namadgi National Park, Australian Capital Territory

Between the forests of the coastal ranges and the Great Dividing Range, the Ngarigo people of the Monaro used the treeless plain found there, once thought to be unoccupied (Flood, 1980). Recent research by Walkington (1986) revealed the presence of sites associated with a chain of ephemeral lakes on basalt bedrock. These comprise a unique suite of artefacts, possibly used for the processing of waterplants and hunting of migratory bird species.

In the seasonal round of highland and tableland Aborigines, the river systems, lakes and swamps may be envisaged as analogous to the coastline. People congregated here at those times of the year when a particular set of resources was abundant and at other times dispersed into the forested hinterland.

The archaeological evidence is not as arresting as that of coastal middens, but if one removed the organic remains from the latter, they would become comparable in size to the inland sites.

The time of the first occupation of forests in south-eastern Australia can only be inferred, because no sites have been excavated or radiocarbon dated. Stone tool typologies indicate that the sites are no older than 5 000 years with the majority of late Holocene age. Lourandos (1983) and Ross (1985) have postulated that population changes or increases in the late Holocene led to the colonization of what has been termed 'marginal environments' including forests, as a result of increasing population pressure. Discussion of this topic is beyond the scope of this paper, but, whatever the initial date of occupation, Aborigines were continuing a traditional lifestyle for at least a short period after European settlement. Two of the sites so far recorded, in Mumbulla State Forest and on a pastoral property at the base of Tantawangalo Mountain, contain pieces of flaked bottle glass as part of the stone tool assemblages (Hiscock, 1983).

HISTORY

The contact period

With the arrival of Europeans in south-eastern Australia came the devastation of a traditional hunter-gatherer lifestyle, although Byrne (1983a) states that Aborigines in the Bega valley enjoyed a more or less undisturbed use of these lands until about 1830. At this time, prime hunting lands on the fertile alluvial soils of the valley floor were taken for cattle pasture. Kangaroo and emu numbers were severely reduced and possum populations were depleted through the lucrative skin trade.

The rugged hills of the coastal ranges and Snowy Mountains would have offered some refuge to tribal groups displaced from their core territories, perhaps leading to a greater reliance on forest resources. The Kurnai of Gippsland are one of the few tribal groups which escaped the ravages of the smallpox epidemics in 1798 and 1820 and this has been attributed to their ability to escape to the more inaccessible tracts of their tribal lands (Butlin, 1983).

After the 1861 Robinson Lands Acts, selection of small holdings gave rise to fencing which further restricted access to game and places where cultural activities normally took place (Byrne, 1983). Forced inland movement of coastal tribes led to increased contact with tribes further to the west and a blurring of tribal boundaries as people competed for diminishing resources. Such pressures may explain the ethnohistorical accounts of fighting between coastal and hinterland tribes. Jauncey (1918) recalls a war between Monaro blacks and coastal tribes at Cobargo, and Flood (1980) refers to various altercations between highland and coastal Aborigines.

By the 1880s the roving lifestyle of Aborigines became a problem to the white inhabitants. Using various incentives, families were induced to settle on the reserves being established on the coast and tablelands, under the misguided but well-intentioned policies of the Aborigines Protection Board. In some cases, Aboriginal families were fortunate to be resettled within their own country, but for others it meant moving to an unfamiliar area to live with people unconnected in a complex of social interrelationships. The devastating effect of the movement on Aboriginal culture is well documented in Read (1982).

In south-eastern Australia reserves were located at Batemans Bay, Bega, Bermagui, Bodalla, Delegate, Eurobodalla, Jervis Bay, Kangaroo Valley, Mongarlowe, Moruya, Nelligen, Nowra, Roseby Park, Seven Mile, Wallaga Lake, Queanbeyan, Brungle and Yass in N.S.W. (McGuigan, n.d.) and at Lake Tyers and Rahamayack (Lake Wellington) in Gippsland. Most of these were revoked earlier this century.

Those still extant are now either owned or substantially controlled by Aboriginal communities, e.g. Lake Tyers, Wallaga Lake, Roseby Park and Jervis Bay. Interestingly, the small reserve established at Kiah in 1970 was an attempt to integrate Aboriginal people into the woodchip industry operation at Eden (Egloff, 1987).

Large gatherings of Aborigines are commonly referred to in the historical records (Attenbrow, 1976). While some of these may reflect traditional ceremonial gatherings, many were the direct result of European interventions. These included: centres of annual blanket issues; benevolent landowners who allowed Aborigines to camp on their properties; and industries which employed Aborigines in the workforce. The latter is particularly pertinent to the theme of this conference as there is good oral evidence for a substantial input of Aboriginal labour in the timber industry.

In 1987, the National Parks and Wildlife Service (N.S.W.) (NPWS) commissioned a study to record sites of cultural significance to Aboriginal people in the southern part of the Eden Woodchip Agreement Area. During the process of interviewing Aboriginal people it became apparent that most of the elderly Aboriginal men had, at some time in their lives, been employed to work in the forests as sleeper cutters or at the now defunct sawmills on the far south coast (Egloff, 1987). They also recalled their grandfathers and other relatives being employed in a similar manner, indicating that Aborigines were involved in forestry almost from its inception. Most of this work was casual, but Aboriginal knowledge of the forest, whereabouts of easy access routes and stands of timber suitable for milling would have been used to advantage by employers.

Much more oral history recording needs to be undertaken in this field, but must be done quickly as the old people are rapidly dying out. These studies should be supplemented by archival research into the statistical records of sawmills and forestry associated industries and would be a most valuable contribution to the scanty knowledge on the nature and extent of Aboriginal employment during the last century and the early part of this century.

The present

Despite 200 years of disruption Aborigines in south-eastern Australia still retain very strong emotional ties with the land. These links are manifest in two main ways; a desire for specific sites or places to be protected, and a general affiliation with natural landscapes.

In 1973, the NPWS began a programme of interviewing tribal elders about sites of cultural significance (Creamer, 1984). The large number of sites recorded demonstrated that the oral transformation of knowledge from generation to generation is still in operation. Many of these places are natural features of the landscape and have been destroyed because they are invisible to the European eye. Others still survive, but in a landscape so altered that their signficance in relation to traditional values is diminished or altered. Sites associated with Aboriginal religion or mythology are often located in remote areas to ensure that secret ceremonies such as initiation sites were not seen by uninitiated members of the community.

In south-eastern Australia large tracts of naturally forested lands set aside as national park, nature reserves and, to a lesser extent, state forests are important refuge areas where places of cultural significance may be preserved in an undisturbed context.

Today, these sites are coming under increasing threat from an Australian population searching for a 'wilderness' experience. With the rise in popularity of four-wheel-drive vehicles, there are fewer places which remain inaccessible, and these are decreasing at an alarming rate. Impact arises not only through physical destruction of the environmental context. In the case of secret or sacred sites, just the presence of Europeans or certain members of the Aboriginal community may be unacceptable.

Several places of cultural signficance have been recorded in the coastal forests in south-eastern New South Wales, the best known being Mumbulla Mountain in Mumbulla State Forest, south-west of Bermagui. The mountain is a landscape feature sacred to the Aboriginal community at Wallaga Lake and was a focus of male initiation ceremonies which utilized a complex of sacred sites on the mountain. Tribal elder Jack Mumbler, now deceased, initiated young men during the last ceremony held in about 1918. Of those initiated, at least one man is still alive as are descendants of other initiates. Mumbulla Mountain still has, therefore, a strong spiritual significance for contemporary Aborigines and in 1978 concerns arose over proposals to carry out logging on the mountain. Following representations to the State Government by tribal elders from Wallaga Lake, a conservation order was placed over the mountain. A study was commissioned to establish the significance of the area to the satisfaction of European bureaucracies and make recommendations for its future management (Egloff, 1979). The study recognized that alteration of the landscape in the vicinity of sacred sites would reduce the overall significance. Consequently, it necessitated preservation of the surrounding forested landscape. The top of Mumbulla Mountain was excluded from logging and a wider area was gazetted as Biamanga Aboriginal Place under the National Parks and Wildlife Act (1974). The management plan specifies consultation between the Yuin tribe, Forestry Commission and National Parks and Wildlife Service before any forestry activities are undertaken.

The Mumbulla Mountain experience demonstrates the need for Government authorities controlling naturally forested lands to identify such places so that management practices are modified to ensure their long-term protection.

With the exception of the Australian Capital Territory, all Australian states and territories have legislation to protect Aboriginal sites. In most cases the legislation only extends to tangible evidence of past Aboriginal activity, i.e. archaeological sites with for example, stone tools, middens or skeletal remains. The National Parks and Wildlife Act can also give 'site' status to topographic features, in recognition of their value to Aboriginal people.

In recent years Aborigines, as a group, have become a political force which is now in a position to articulate past and present wrongs and fight for redress. Land rights and Aboriginal sites are not legally connected in New South Wales, as the two are administered under different pieces of legislation. However, site identification and preservation has become intermingled at a conceptual level with the wider aspirations of Aboriginal people for recognition of prior ownership. Understandably, some Europeans are sceptical about assertions of the significance of apparently newly discovered sites, particularly if they stand in the way of development. In general, such sites had always been known but the information had gone underground. Aborigines were either reluctant to disclose what was traditionally classified information or did not have a political mechanism for voicing their concerns. Another complicating factor is that archaeologists and Aborigines tend to view sites in different ways. The former distinguish between prehistoric archaeological sites which can be studied using scientific methods, and sites of mythological/ceremonial significance which generally cannot. Such a distinction may not be meaningful to Aborigines, who attach cultural/spiritual values to archaeological sites (Byrne, 1984). This is prevalent in situations where a local Aboriginal community has lost most of its traditional knowledge about places of cultural significance. Egloff's (1987) oral history research on the far south coast revealed little new information on places of significance in forests, but it was apparent that all sites, regardless of their classification, are regarded as having political, educational and cultural significance.

At a more general level, forests are still highly regarded for their wild foods or 'bush tucker' and Aboriginal elders are keen to teach their children about traditional ways of hunting and gathering in forests (Thompson, 1985). Rural Aborigines survived the 'reserve' period of late 1800s by supplementing government rations with bush foods (Byrne, 1984). Bowdler (1983) states that on the north coast, rainforests are sometimes referred to as 'our supermarket' and this could reflect an association which spans millenia.

It is clear that contemporary Aborigines have a special affiliation with forested lands because they are the few areas of tribal lands with which they can still identify. They are some of the last tangible reminders of their original estate and contain sites in an undisturbed context. Even in white-dominated societies acknowledgement of association with a past is vital to the future of Aboriginal people. This presents a dilemma which is best described by Thompson (1985: 105):

> The other important aspect of current Aboriginal use of the land is the vital economic importance to Aboriginals of the timber industry. The timber industry is a major source of employment for Aborigines in East Gippsland, and the only major source of long-term or permanent employment. As unemployment is one of the greatest problems facing the Aborigines, they cannot be expected to be sympathetic to the view that the timber industry destroys the natural environment or endangers Aboriginal or archaeological sites. Furthermore the adoption of a position critical of any current land-use practices by these people would clearly endanger their jobs, and almost certainly result in discriminating retailiation from both employers and white employees.

CONCLUSION

The objective of this paper has been to demonstrate that forests have played a vital role in Aboriginal history in south-eastern Australia. In prehistoric times forests were utilized for food and raw materials and as a focus of spiritual activity. Recent archaeological research has demonstrated that forests were used more extensively than was originally thought and the presence of large open sites indicates long-term rather than fleeting occupation. Within the forest environment, the distribution of archaeological sites shows a preference for ecotones between forests and grasslands/swamps, particularly where flat, soft, well-drained ground was available for camping. Movement through forests in mountainous country was either along river valleys or ridge lines depending on the topography.

Although Aborigines no longer practice a traditional hunter-gatherer life style, their association with the forested environments remains very strong. In a much-modified landscape, forests are one of the few places that can be identified with original tribal lands. As part of the cultural revival movement, Aboriginal people are beginning programmes of recording sites in forests and teaching their children about bushfoods.

From the time that Europeans began exploiting native vegetation for timber and clearing for pasture, Aborigines have had an economic involvement with forests. The timber industry has been, and still is, an important employer of Aboriginal people, making them reluctant to side with conservation groups whose actions in preserving forests may cost them their jobs. It is the role of all Australians, through the democratic system to ensure that native forests are properly managed. The right of Aborigines to retain their cultural heritage must be respected and balanced against the need for nature conservation and forest products.

REFERENCES

Anderson, J., 1984 Between plateau and plain. Flexible responses to varied environments in southwestern Australia, Occ. Papers in Prehistory 4, Research School Pacific Studies, ANU, Canberra.

Attenbrow, V., 1976 Aboriginal subsistence economy on the far south coast of N.S.W., Australia. B.A. (Hons) thesis (unpublished), Univ. of Sydney.

Attenbrow, V., 1983 Welcome Reef Dam Project: preliminary investigations into Aboriginal archaeological sites. Report to Metropolitan Water Sewerage and Drainage Board New South Wales.

Barz, R.K. and Winston-Gregson, J.H., 1981 Murrumbidgee River Corridor: an archaeological survey for NCDC. Unpublished report to National Capital Development Commission, Canberra.

Bowdler, S., 1981 Hunters in the highlands: Aboriginal adaptations in the eastern Australian uplands, Archaeology in Oceania 16: 99-111.

Bowdler, S. (ed.), 1982 Coastal Archaeology in Eastern Australia, Proceedings of 1980 Valla conference on Australian prehistory, R.S.Pac.S., ANU, Canberra.

Butlin, N.G., 1983 Our Original Aggression (George Allen and Unwin, Sydney).

Byrne, D., 1981 Wandella-Dampier archaeological survey. Unpublished report to the Forestry Commission of N.S.W.

Byrne, D., 1983a The Five Forests: An Archaeological and Anthropological Investigation 2 vols. (National Parks and Wildlife Service, N.S.W.).

Byrne, D., 1983b Aboriginal sites in Deua National Park. Unpublished report to NPWS (NSW).

Byrne, D., 1984 Archaeological and Aboriginal Significance of the New South Wales Rainforests (Background material for N.S.W. rainforests World Heritage List nomination). Report to Dept. of Environment and Planning, NSW.

Clark, R., 1983 Pollen and charcoal evidence for the effects of Aboriginal burning on the vegetation of Australia, Archaeology in Oceania 18: 32-37.

Cosgrove, R., 1984 Aboriginal Economy and Settlement in the Tasmanian Central Highlands, (Tasmanian National Parks and Wildlife Service).

Creamer, H., 1984 A Gift and a Dreaming: The New South Wales survey of Aboriginal sacred and significant sites, 1973-1983. A report to NPWS, Sydney.

Egloff, B., 1979 Mumbulla Mountain - An Anthropological and Archaeological Investigation Occ. Paper No. 4, (National Parks and Wildlife Service, NSW).

Egloff, B., 1987 A report on an investigation of places of cultural significance to Aboriginal people in the southern portion of the Eden Woodchip Agreement area. Report to NPWS.

Farrington, I. Dept Prehistory and Anthropology, Arts Faculty, Australian National University, Canberra, (pers. comm.).

Feary, S., 1981 Mussels : the use of freshwater mussels as seasonal indicators in archaeology. BA (Hons) thesis, (unpublished) Australian National University, Canberra.

Feary, S., 1986 Aboriginal sites in the southern part of the Eden Woodchip area. Internal report, NPWS.

Feary, S., 1983 Current research at Nursery Swamp, Gudgenby Nature Reserve. Unpublished reports I and II to Dept. of the Capital Territory, Canberra.

Ferguson, W.C., 1985 A mid-Holocene depopulation of the Australian southwest. PhD thesis (unpublished) ANU, Canberra.

Flood, J.M., 1980 The Moth-hunters : Aboriginal Prehistory of the Australian Alps, (Australian Institute of Aboriginal Studies, Canberra).

Geering, K., 1981 Lower Snowy River archaeological survey, Unpublished report to NPWS (NSW).

Godwin, L., 1983 Archaeological site surveys on the eastern margin of the New England tablelands, Australian Archaeology 17: 38-47.

Hallam, S., 1979 Fire and Hearth : a study of Aboriginal usage and European usurpation in south-western Australia, (Australian Institute of Aboriginal Studies, Canberra).

Head, L., 1983 Environment as artefact : a geographic perspective on the Holocene occupation of southwestern Victoria, Archaeology in Oceania 18: 73-80.

Head, L., 1986 Palaeoecological contributions to Australian prehistory, Archaeology in Oceania 21(2): 121-129.

Hiscock, P., 1983 Appendix 3, in Byrne, 1983a.

Horsefall, N., 1984 Theorising about northeast Queensland prehistory, Queensland Archaeological Research 1: 164-172.

Horton, D., 1982 The burning question: Aborigines, Fire and Australian ecosystems, Mankind 13(3): 237-251.

Howitt, A.W., 1904 The Native Tribes of South-East Australia (Macmillan, London).

Jauncy, A.B., 1918 A history of Bega. The Royal Australian Historical Society. Journal and Proceedings, IV(vi): 297-309.

Lourandos, H., 1983, Intensification : a late Pleistocene-Holocene archaeological sequence from southwestern Victoria, Archaeology in Oceania 18: 81-94.

Mackaness, G. (ed.) 1941 George Augustus Robinson's journey into southeastern Australia, 1844, Royal Australian Historical Society and Proceedings 27: 318-49.

McGuigan, A., n.d. Aboriginal Reserves in N.S.W., N.S.W. Ministry of Aboriginal Affairs, Occasional Paper No. 4, Sydney (1984?)

McBryde, I., 1974 Aboriginal prehistory in New England (University of Sydney Press, Sydney).

Mulvaney, D.J., 1975 The Prehistory of Australia (Penguin Books, Melbourne).

Read, P., 1982 A double headed coin : protection and assimilation in Yass 1900-1960, in Gammage, B. and Markus, A. (eds), All that Dirt - Aborigines 1938 (History Project Incorporated, Res. School Social Sciences, ANU, Canberra): 9-28.

Ross, A., 1985 Archaeological evidence for population change in the middle to late Holocene in southeastern Australia, Archaeology in Oceania 20(3): 18-89.

Singh, G., Kershaw, A.P. and Clark, R., 1981 Quaternary vegetation and fire history in Australia, in Gill, A.M., Groves, R.H., Noble, I.R. (eds) Fire and the Australian Biota (Aust. Acad. Science, Canberra): 23-54.

Sullivan, H., 1983 Aboriginal usage of the forest environment (2), Appendix 1, in Byrne, D. The Five Forests : an Archaeological and Anthropological Investigation (NPWS) (NSW), Sydney.

Sullivan, S., 1978 Aboriginal diet and food gathering methods in the Richmond and Tweed River valleys, as seen in early settler records, in McBryde, I. (ed.) Records of Times Past (Australian Institute of Aboriginal Studies, Canberra): 101-114.

Thompson, K., 1985 A history of the Aboriginal people of East Gippsland, Report to the Land Conservation Council, Victoria.

Walkington, M., 1986 An Archaeological survey of selected small lakes on the Monaro tablelands, NSW, BA (Hons) thesis, (unpublished), ANU, Canberra.

Wright, R., 1986 How old is zone F at Lake George? Archaeology in Oceania 21: 138-139.

PRE-SETTLEMENT AND POST-SETTLEMENT VEGETATIONAL CHANGE AND PROBABLE ABORIGINAL INFLUENCES IN A HIGHLAND FORESTED AREA IN TASMANIA

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INTRODUCTION

Tasmania contains many highland areas which have relatively cool temperatures and a seasonally well-distributed mean annual rainfall greater than 1100 mm, and would be expected to support temperate rainforest dominated by Nothofagus and Phyllocladus. At the time of European settlement, and possibly for several millennia before that, such areas actually supported a complex vegetation that consisted of a mozaic of temperate rainforest, multi-aged stands of eucalypts (mainly Eucalyptus delegatensis), and open plains of tussock grasses dominated by Poa billardieri with sub-alpine herbs and shrubs. Since European settlement, considerable changes have occurred involving local expansion or contraction of all three vegetation types. In some areas eucalypt forest has been undergrown by and effectively replaced by, rainforest; in other areas rainforest has been burned and replaced by grassland; in much of the eucalypt forest cohorts of dense regeneration have developed in what were originally park-like stands, and the representation of grassland has diminished.

In this paper, we link archaeological and palynological studies with contemporary ecological investigations of vegetational succession in order to determine the likely relative importance of climatic and anthropogenic factors to changes in vegetation that have occurred from the late Holocene to the present; with special reference to an area of north-eastern Tasmania (Fig. 1).

PREVIOUS PALYNOLOGICAL STUDIES

In a number of recent papers, Macphail (1975, 1979, 1980, 1984) has reconstructed from pollen sequences the probable late Pleistocene and Holocene climates and vegetation of Tasmania. The general picture he presents is as follows. Late Pleistocene climates (12 000 y.B.P.) were colder and considerably drier than at present, with a decrease in rainfall along a strong west-east gradient. Most of the island was treeless, since the tree line was close to present sea level in the west and between 200 m and 400 m below present elevation in the east. Forests were probably restricted to the exposed continental shelf below present sea level, and to corridor

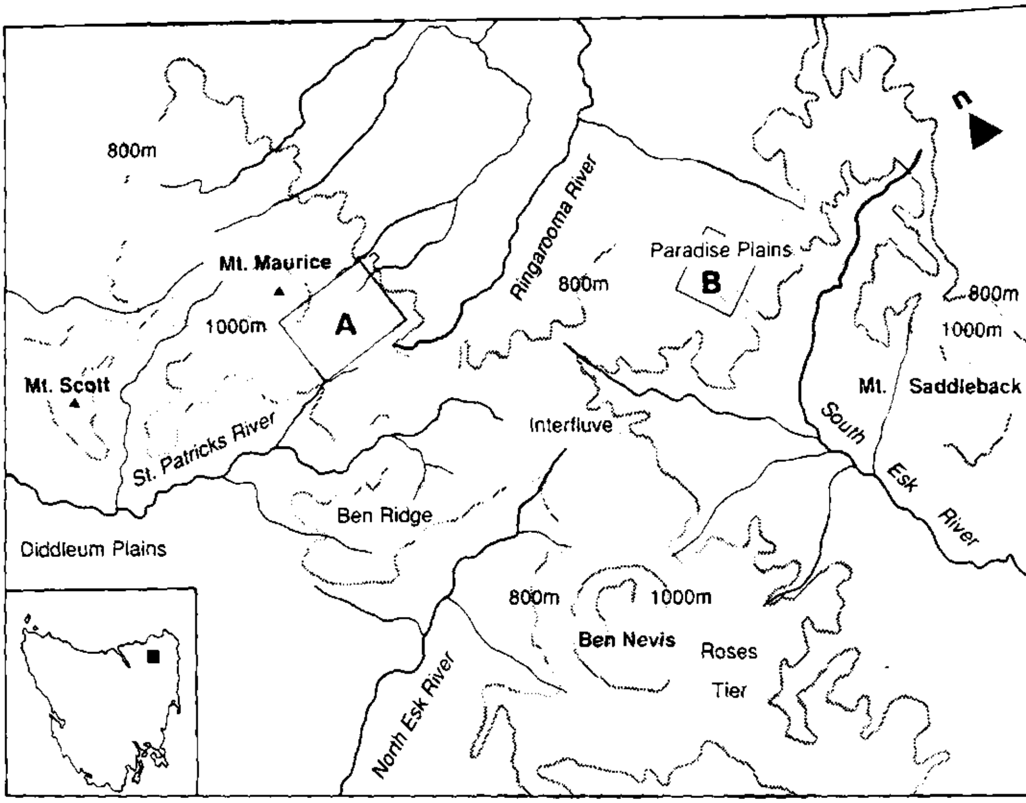

Fig. 1 Location map of the study area showing Mt Maurice reference area [A], and Paradise Plains reference area [B], north-east Tasmania

forests in the lower valleys. However all components of the present flora appear to have been represented in the late Pleistocene. The western mountains carried an alpine flora of cyperaceous sedgeland and sclerophyllous and coniferous heaths, whilst the drier eastern lowlands and highlands carried a steppe vegetation dominated by Poaceae, Asteraceae, Cyperaceae, Restionaceae and Chenopodiaceae.

At the start of the Holocene, the climate became first warmer (8 900 y.B.P.) then wetter (7 200 y.B.P.) and this allowed an expansion of forest; present tree lines were reached probably by about 10 000 y. B.P. The sequence of expansion was Eucalyptus → Pomaderris → Phyllocladus → Nothofagus.

Since 5000 y.B.P., Macphail (1980) considers that the climate has become more variable, with a greater incidence of drought and frost than in the previous millenium, although there has been little change in average temperature and rainfall. He concluded that the pollen record shows climatic change as a major factor determining trends within local and regional vegetation, with the changes occurring over periods of 2 000-3 000 years. However he suggests that over the last few forest generations, climatic influences could be assumed to be effectively constant.

Whilst pollen analyses reveal broad and relatively long-term changes in vegetation and, by inference, in climate, the patterns of tree-ring growth can reveal short-term changes in climate, and especially in temperature during the growing season. The persistence of individual trees for hundreds and sometimes for thousands of years is itself evidence for only limited fluctuations in climatic variables.

An examination of growth rings of Huon pine (Lagarostrobos franklinii) from western Tasmania showed no long-term trends in annual rate of growth and, by inference, in growing season temperature, during the last 2 000 years (T. Bird, pers. comm.). Similarly, studies of tree ring data for three locations in Tasmania have shown no detectable consistent trends in climate in the 200 years since European settlement (La Marche and Pittock, 1982), although fluctuations of 1-2°C in mean growing season temperature occurred over periods of three to five decades.

PRESENT CLIMATE OF NORTH-EASTERN TASMANIA

The north-eastern highlands are influenced by both westerly (mainly winter) and easterly (mainly summer) rain-bearing winds. The present climate is classified as cool-perhumid with a precipitation effectiveness of 128 (Gentilli, 1972). Periodic measurements of rainfall on the Mt Maurice Plateau between 1964 and 1982 were related to long-term (1886-1982) permanent records at nearby Scottsdale by geometric mean regression to produce the calculated long-term averages shown in Table 1.

The average annual rainfall is 1900 mm, with between 90 mm and 250 mm in each month; droughts of more than one month duration are rare. Although average annual temperature is 6-7°C, incursions of continental air in summer have produced screen maximum temperatures of +25 to +30°C in each of the five years in which measurements were made between 1964 and 1983, whilst incursions of Antarctic air in winter have produced near-ground (5 cm) temperatures of -10 to -14°C. Ground frost is recorded in every month of the year. Such variation is typical of other northern highland areas and clearly is within the tolerance of their present vegetation.

Table 1 Mean monthly rainfall (mm) 1886 to 1983 at Scottsdale (elevation 200 m) and on east and west sides of the Mt Maurice Plateau

	J	F	M	A	M	J	J	A	S	O	N	D	Total (yr)
Scottdale (200m)	59	50	60	85	104	121	133	121	102	97	71	69	1072
East Plateau (800m)	113	96	115	163	194	225	248	225	190	180	136	132	2017
West Plateau (920 m)	100	85	101	143	199	232	255	121	195	186	120	116	1853

VEGETATIONAL STUDIES

For the purposes of this study, 12 vegetational types were defined (Table 2) of which 11 were sampled. Studies were conducted in two reference areas in north-eastern Tasmania; at Mt Maurice and at Paradise Plains which occupy a plateau 900-950 m AMSL. Their vegetation is typical of many such highland areas extending from the north-east to north-west of the State. The transects were positioned to sample representative gradients of vegetational types. The position and size (stem diameter at 1.3 m above the ground) of each tree was recorded on the transect, and the maximum height of each species present in each stand was measured. Ages of different components of the stands were determined from counts of annual growth rings and such counts, together with counts on fire scars were also used to deduce the dates and frequency of past fires. The occurrence and species of dead trees and fallen decaying logs were also recorded.

The temporal and spatial relationships that emerged among individual species and forest types were as follows.

Mt Maurice Reference area

The sequence of species and forest types across a gentle, broad ridge just south of Mt Maurice is shown in Fig. 2. At the eastern end is old growth rainforest (Type 1). This was reduced in extent by 15-20 m during a fire early last century, before the first recorded visit of Europeans to the area in 1855 (Loone, 1928). The rainforest/eucalypt ecotone at that time, together with the burned old rainforest regenerated about 1850 to produce the present dense stand of young Nothofagus (Type 2). Eucalypts that also became established at that time died after 80 years or so. Dead mature eucalypts occur standing or fallen in this type. A later rainforest/eucalypt ecotone further up the slope (the present Type 4) is now composed of scattered, mature, open-grown and mixed-age younger Nothofagus in an

Table 2 Proportions (%) of the vegetational types on the reference areas at present, and probable proportions at time of European settlement

		Mt Maurice Reference area A		Paradise Plains Reference area B	
		1834	1984	1834	1984
1	Old growth rainforest on well drained sites and				
1*	Old growth rainforest on poorly drained sites	5.0	4.5	41.5	15.5
2	Even-aged secondary rainforest on well drained sites	<1.0	31.0	<1.0	4.0
3	Even-aged secondary rainforest on poorly drained sites	<1.0	8.0	<1.0	2.5
4	Dead and dying eucalypts over uneven-aged secondary rainforest	<5%	23.0	0.0	<0.1
5	Eucalypts over mature (rainforest) gap-phase shrubs	<5%	27.0	0.0	3.0
6	Eucalypts over young gap-phase and sclerophyll shrubs	80.0	6.5	0.0	12.5
7	Eucalypts over grass		0.0	10.0	6.5
8	Wattle over grass and shrubs	0.0	0.0	<10.0	12.0
9	Uneven-aged tea-tree over grass	<1.0	0.0	0.0	5.5
10	Grassland less than 100 years old	0.0	0.0	42.0	9.0
11	Grassland more than 100 years old	0.0	0.0		28.5
12	Open wetland	8.0	0.0	<1.0	<1.0

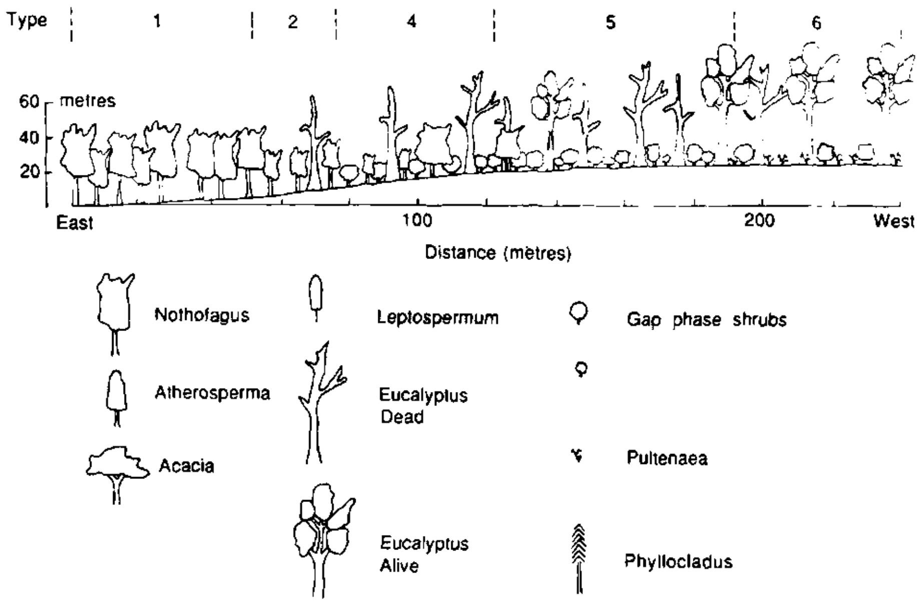

Fig. 2 Vegetational transect near Mt Maurice

overmature stand of gap-phase shrubs beneath mainly dead mature eucalypts; ground cover consists of ferns, moss and litter. It is probable that this stand has remained unburned for at least 130 years. Further up-slope again is the present rainforest/eucalypt ecotone (Type 5), in which Nothofagus seedlings are becoming established beneath a canopy of mature shrubs about 100 years old, with a ground cover of ferns and mosses; about half of the mature eucalypts have died during the last 50 years. Finally, Type 6 carries a shrub understorey of a younger age than that of Type 5 and with a ground cover dominated by grass; most of the eucalypts in this type are healthy. This sequence of secondary forest succession recurred throughout the reference area and was related to both its history of burning and to topographic position. The relationships among the different vegetational types are summarised in Fig. 3. In the absence of fire and with cool, moist topographic conditions, the transitions from grass eucalypt over grass to rainforest have taken about 100 years; under warm, dry topographic conditions, the transitions take much longer and in places are incomplete after probably 150 years without fire.

The present distribution of living stands plus the remains of mature dead stands shows that at the time of European settlement, tall forest-grown eucalypts occupied 80% of the reference area (Table 2) and occurred on all physiographic sites except swamp (8%). Old-growth rainforest (5%) was restricted to valley sites that were protected from fire. At several locations, overlapping fire scars on dead eucalypts showed that, in the 18th century, three or even four fires had occurred at intervals of 20-40 years. From counts of growth

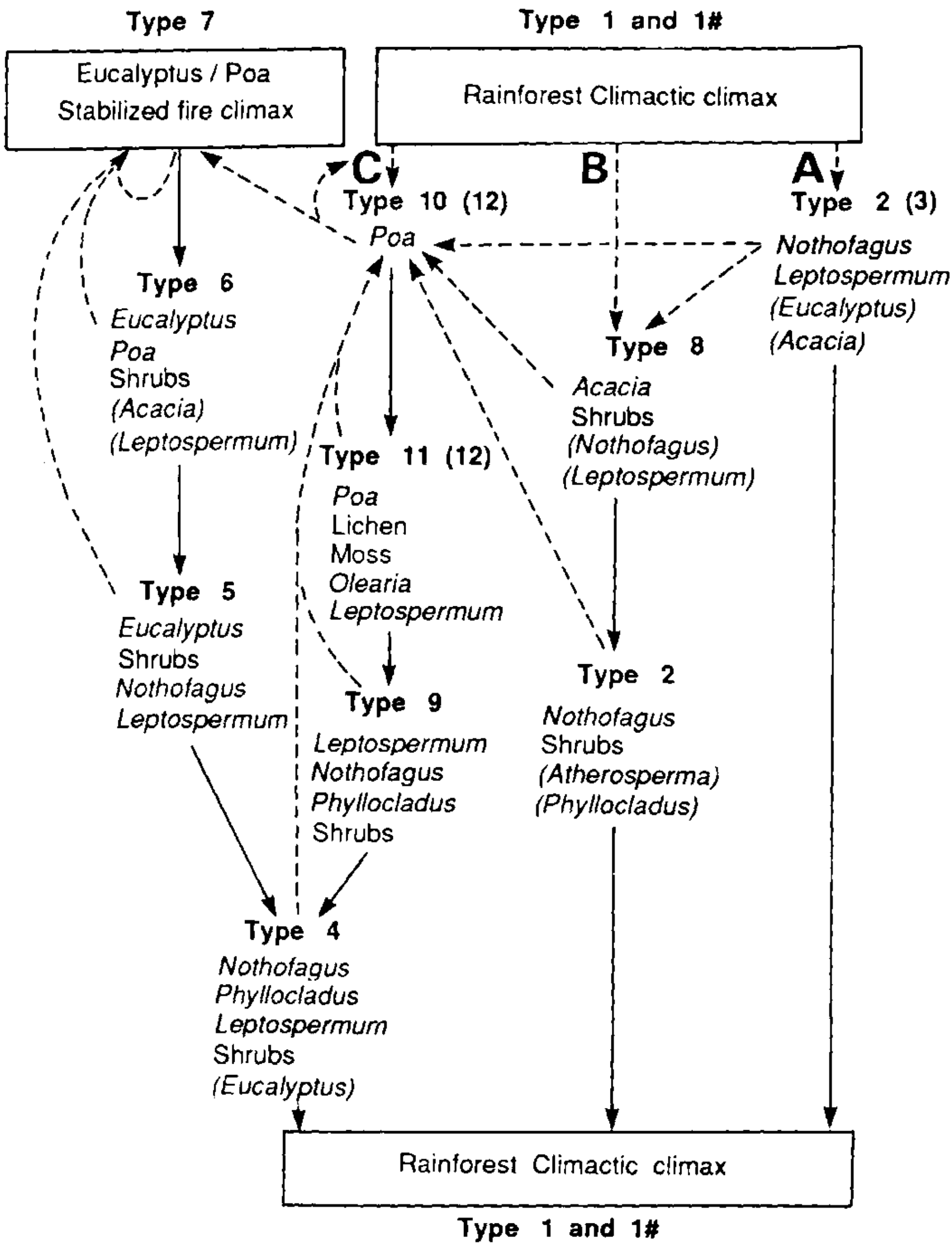

Fig. 3 Schematic diagram of secondary succession in rainforest in north-eastern Tasmania. (Dashed lines imply fire)

rings, expansion of rainforest was determined to have commenced between 1830 and 1860 and would have required fire-free conditions; but this clearly was preceded by an indeterminate period of regular fires.

Paradise Plains Reference Area

It is tempting to link vegetational change, such as that observed at Mt Maurice to long-term changes in climate. That climatic factors are unlikely to have been a prime determinant in this case is shown by the contrasting changes on a nearby area of sub-alpine grassland known as Paradise Plains. This grassland is littered with fragments of charred wood or whole logs from Nothofagus, which indicates that originally the entire area carried rainforest. Phyllocladus occurring in remnant rainforest was found to be 500-600 years old. Counts of annual growth rings on groups of eucalyptus that now occur on the oldest grassland have given maximum ages of about 200 years, which indicates that the rainforest was burned probably about the middle of the eighteenth century. Early this century, one or more fires associated with tin mining operations burned 65 ha of rainforest adjacent to the older grassland; that area now carries grass and scattered Acacia about 80 years old, and is littered with logs of Nothofagus. The Plains have been subject to grazing leases and sections have been burned at intervals throughout the last 100 years, most recently 20 years ago. These and earlier fires of Aboriginal origin have produced several concentric cohorts of regeneration around some of the original pioneer eucalypt trees. Where these pioneers were close enough, as in the eastern part of the Reference Area, the expanding groups have coalesced to produce closed forest over grass and shrubs, where 200 years or more ago there was old growth rainforest. This process is contemporary with, but the reverse of, that occurring at Mt Maurice.

At the time of European settlement, old growth rainforest occupied 42% of the Paradise Plains reference area, but subsequent fires have reduced this to 16% (Table 2). Despite the formation of new grassland early this century, the total area of grassland now is similar to that 150 years ago. This is due to the colonisation of some of the area of old grassland by stands of Eucalyptus, Acacia or Leptospermum; a process that was under way at the time of settlement.

From these two examples, it is clear that in this and probably in similar highland areas, the present balance between rainforest, eucalypt forest and grassland has been mediated by anthropogenic fires rather than by climate.

ARCHAEOLOGICAL STUDIES

The maintenance of fire-stabilised vegetation in the highlands up until European settlement, and the shift towards rainforest that has occurred in some areas since then, indicate that the Aborigines had a major impact on the forests. In this context some assessment of the likely intensity and kind of Aboriginal activity is necessary.

The question of Aboriginal use of high-altitude areas in Tasmania has received some recent attention, with the emerging patterns resembling those described for the south-eastern highlands of the mainland (Flood, 1980; Flood et al., 1987). In the central highlands, for example, small scatters of stone artefacts are widely distributed at high altitude and sandstone rock-shelters containing evidence of occupation are found on the southern central plateau and on the northern and western scarps of the plateau. Similarly, in a few exposures of sandstone in our study area, near Mt Victoria and the southern flank of Ben Lomond, were found rock shelters containing stratified Aboriginal deposits. Dates in preparation from these sites should allow construction of a cultural time scale similar to that being constructed for vegetation. Other sites in the Mt Maurice/Ben Lomond area consist of small scatters of stone tools, with quartz the most common rock type but with interesting components of cherty-hornfels and silcrete. This suggests that Aborigines from several locations used the highlands, since hornfels is readily available in the Eastern Tiers to the south of our area, and silcrete is very common on the northern coast although it is almost never seen further south: neither occurs on the plateau.

Walker (1898) and Jones (1974) consider that the so-called Ben Lomond tribe's territory encompassed the high country to the north of Ben Lomond up to and including the Mt Maurice plateau. Robinson (Plomley, 1966) refers to another group, a band of the north-eastern tribe, that lived exclusively in the dense forests just to the north of this area.

The density of Aboriginal sites found on Ben Lomond and adjacent parts of the north-eastern mountains falls in the range of 0.5 to 0.8 sites per km^2 for both open grassland and forest conditions, and up to 4 sites per km^2 in sandstone escarpment country. These figures are consistent with a transient pattern of occupation characterised by short, infrequent visits to the high country from larger bases in more sheltered locations (Lourandos 1983, Thomas 1983, Cosgrove 1984). Given the harsh climate, such visits probably were for the purpose of seasonal (summer) hunting or for transit.

From two sites in the upper Mersey valley, one at approximately 600 m and the other at nearly 900 m, where the vegetation at present is very similar to that on the Mt Maurice plateau, Lourandos (1983) has recovered a sequence spanning the entire Holocene period, including a lower phase of low intensity site activity and an upper phase of increased site activity beginning about 3 400 y. B.P. This sequence is similar to others that have been excavated in south-eastern Australia (Flood et al., 1987).

POLLEN STUDIES

The open plains of the north-eastern highlands offer good opportunities to conduct pollen analysis in places where the presumed effects of Aboriginal burning can be seen against a background of wet-forest communities, and where Aboriginal visitations were infrequent and of short duration.

A bog site was selected at an elevation of 900 m near Ben Nevis. The bedrock geology of the site is granite with local forest soils developed on both granite and colluvial slope deposits formed from Permian sandstone. Surrounding the site is a logged area which, before the early 1960s, was tall, multi-aged eucalypt forest: it was typical of forests in the study area with a well-developed shrub understory (Types 5 or 6). Today, the forest consists of regrowth and isolated large stems of E. delegatensis and E. dalrympleana, with a ground cover of ferns and grass (Poa spp.) and a sparse understorey of Coprosma nitida, Persoonia gunnii, Tasmannia lanceolata and Cyathodes glauca. Dense grass has become established in areas of greatest disturbance, such as snig tracks and landings. This structure is similar to that of the early successional type 7 (Fig. 3). The bog surface consists of a mat of the twig rush Empodisma minus and low mounds of Astelia alpina.

Pollen, spores and carbon particles were counted from three cores, all of which showed essentially the same sequence. This is illustrated in Fig. 4. There are two possible interpretations of the pollen profile. Firstly, that the profile represents typical late last glacial and Holocene changes in vegetation driven by changes in climate that commenced about 10 000 y. B.P., such as have been commonly observed in cores from central and western Tasmania (Colhoun and Van de Geer, 1986); or secondly, that the profile represents the imposition of humanly induced changes that have obscured any general climatic trends. Resolution of the problem may be achieved by consideration of the dating of the core and the pollen depositional characteristics of the site.

Lithology and dating

The upper 47 cm of the core consists of dark brown to black well-humified peat with many roots and rootlets in the top 10 cm. Occasionally roots penetrate to 25 cm. Between 47 and 50 cm is a gravelly horizon composed of angular, quartz grains and fragments encased in a clay matrix. Below 50 cm the core is composed of orange/grey mottled gleyed clays.

A basal peat sample from 47 cm in depth returned a radiocarbon date of 5 050±210 B.P. (A.N.U. - 5112). A second sample from 25 cm depth in the same core denoted a period of major change in the pollen stratigraphy; returning a date of 1 900±80 B.P. (Beta - 25272).

In such a short core, there is a remote chance that contamination of the lower levels by younger carbon could have occurred; possibly by mobile humic acids accumulating above the gleyed clay (Colhoun, 1986). If the basal date is spuriously young by up to 5 000 years, then the core could actually include the commencement of organic accumulation following deglaciation. However, the date of 1 900±80 B.P. obtained for the sample taken from the 20-25 cm level tends to substantiate the basal date, although it is possible that the upper sample also was contaminated.

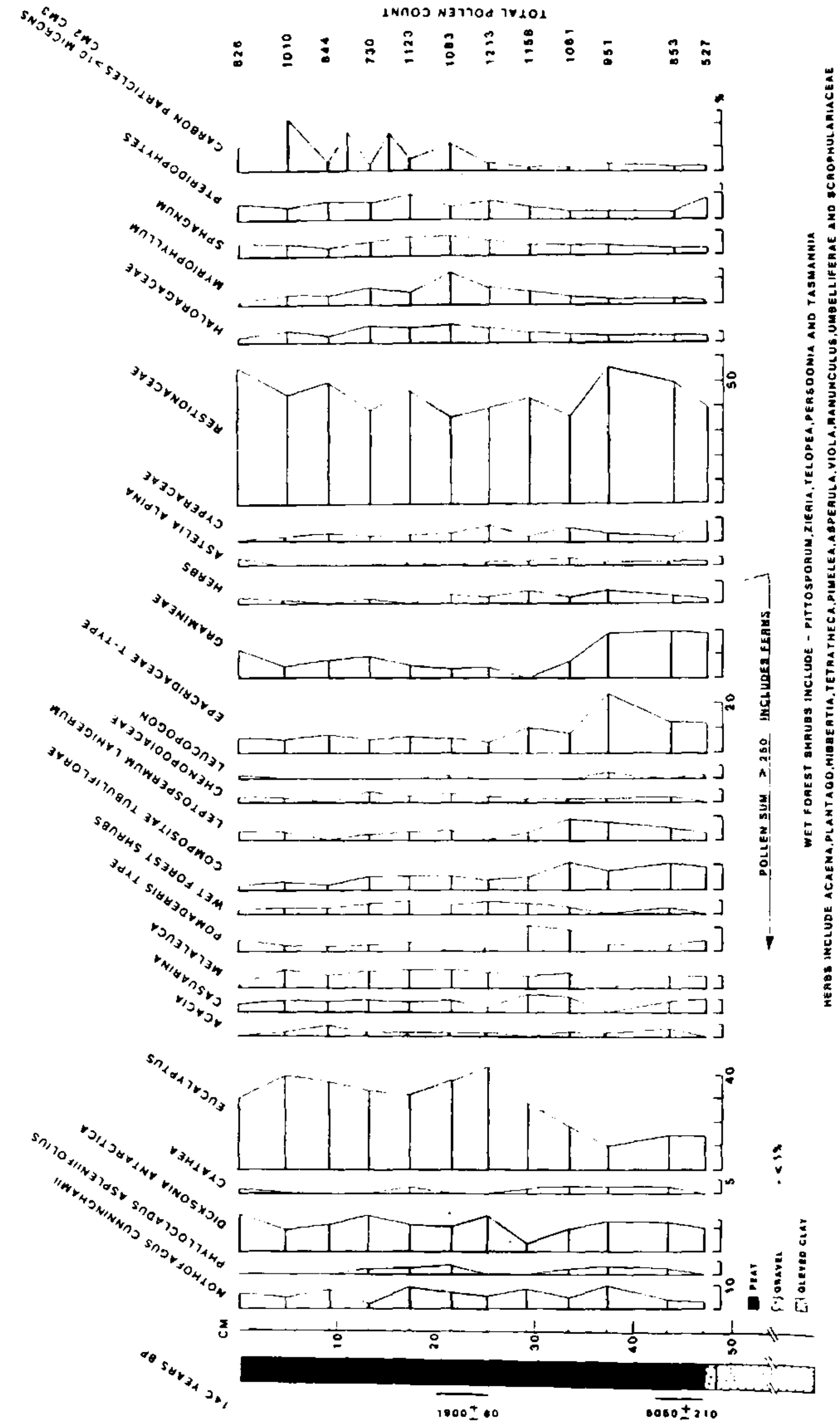

Fig. 4 Pollen diagram, Big Heathy Swamp near Ben Nevis, Tasmania

There are no stratigraphic or lithological features in the core which would suggest any breaks in organic accumulation, but likewise this possibility cannot be entirely discounted.

In western and central Tasmania at similar altitudes to ours, changes in pollen between the late last glacial and the Holocene (c. 10 000 y. B.P. tend to be correlated with changes in lithology. For example, a change from herb-dominated assemblages to forest-dominated assemblages would be accompanied by a change from inorganic sediments to organic sediments or peat. Our core shows a change from herbaceous to forest vegetation that is located well above the lithological break from clays to peats; i.e. very much later than the start of the Holocene. This would put the change out of synchrony with the general climatically induced changes of the early Holocene, and this is supported by the pollen stratigraphy.

Pollen stratigraphy

The main feature of the diagram is a change at about 30 cm from low to high values for Eucalyptus pollen. There are general inverse relationships between Eucalyptus and the Gramineae, Leptospermum, cool-tolerant open-habitat herbs such as Aspercula, Ranunculus and Euphrasia, the Epacridaceae; and members of Asteraceae. Positive relationships exist between Eucalyptus and wet-forest shrubs such as Coprosma, Zieria and Pittosporum, the Pteridophyte ferns and Sphagnum. Other taxa such as Pomaderris apetala, Dicksonia antarctica and Casuarina behave in more complex fashions. In general terms, an earlier herb-dominated open phase lasting for perhaps 2 000 years is succeeded by a rise in the local dominance of eucalypts and shrubs, culminating in full forest conditions. The change from an essentially open-structured vegetation to full forest took place over approximately 1 000 years, from 3 000 to 2 000 y. B.P.

Initially, both grasses and members of the daisy family were dominant, with an increase with time in the percentages of heathy epacrids and myrtaceous shrubs. Acacia attain its highest values in the lower third of the diagram, as did spores of the manferns Dicksonia antarctica and Cyathea. The dominance by grasses was short-lived as herbs and small shrubs invaded the open environment. The increasing complexity of the grasslands mirrors to some extent the subsequent increase in complexity of local and possibly regional forests. The sequence beginning with grasses and proceeding through herbs, myrtaceous shrubs, wet understorey shrubs and then full forest, is a successional path that has been observed on the plateau following the removal of Aborigines from the area in the 19th century (Ellis, 1985).

By 2 000 B.P., Eucalyptus attained its greatest values following a period free of major fires, and from 2 000 B.P. to the present the forest was associated with the constant presence of fires which have produced abundant carbon particles in the pollen record, including many of a large size (>100 microns). The previous open-grassland phase was also marked by the presence of fire, but in that case produced a few medium-sized particles (>10 microns) and many tiny background particles, but no large particles.

The development of the forest phase by 2 000 B.P. was accompanied by the first appearances of wet-forest shrubs such as Zieria, Pittosporum, Phebalium and Coprosma, and also by increases in Pomaderris apetala and Astelia alpina. Near the point of highest Eucalyptus and Pomaderris values, grasses dropped out completely and then staged a gradual comeback in tandem with pteridophytes. In this area, under conditions of no fire, a forest would likely maintain a grass-free understorey as it changes towards rainforest. The presence of grasses as an understorey component is indicative of frequent disturbance by fire.

DISCUSSION

First-hand accounts of Aboriginal burning practices in Tasmania made by early explorers and settlers are few and superficial, since, in the Tasmanian ethnohistorical records, there are no accounts of Aborigines living a traditional lifestyle actually being seen to light a fire; and, other than for the socially displaced people that accompanied Robinson (Plomley, 1966), there are no records which detail the timing and reasons for Aboriginal burning practices. Walker (1898) recorded that 'the blacks were accustomed to take considerable pains, by means of periodical burning, to keep down the scrub and promote the growth of grass on their favourite hunting grounds'. He also noted that 'many open plains, especially in the North, which were formerly known as favourite resorts of the blacks, subsequently became overgrown with forest through the discontinuance of the annual burning'.

From accounts of the early explorers and from other later records, Jones (1969) put forward the notion that fires lit by Aborigines constituted a major factor in the recent history and distribution of Tasmanian vegetation. This opinion gave support to the same notion expressed earlier by Gilbert (1959) and Jackson (1965) who recognised the part fire played in plant successions, and who realised that fire, as much as geology, climate, edaphic factors and passage of time, contributed to community structure, composition and distribution. However the methodology of Aboriginal use of fire is, and probably will remain, speculative.

Robson (1985) concluded from available evidence that 'the typical Aborigine moved through the countryside equipped with spears and a fire stick, with apparent indiscrimination setting alight virtually everything that would burn as he went along ... but this presumably was calculated to revive the bush and thus attract animals by the appearance of fresh and tender shoots'. This simplistic view conflicts with common sense. In many situations, indiscriminate fire lighting would be dangerous to the people themselves, whilst the objective of burning surely would have been to attract game to relatively small areas of fresh browse where they would be easily hunted, rather than distributing them over the whole landscape. In support of this concept Robinson, when visiting the Aborigines of Bruny Island, reported that he 'traversed a vast extent of open country interspersed with clumps or copses intended as cover for kangaroos. The whole range for miles forming a beautiful picturesque scenery. This has been done by the natives: when burning underwood they have beat out the fire in order to form these clumps' (Robinson in Plomley 1966). Nevertheless, during years of exceptional drought, it is inevitable that wild fires would have arisen from the Aborigines' habitual burning, and undoubtedly these would have penetrated to areas of forest remote from their usual travel routes and hunting areas. Aboriginal landscapes would have reflected the impact of both controlled and uncontrolled fires.

The archaeological evidence for Aboriginal occupancy of the highlands is plentiful. That they had a major influence on the vegetation may be inferred from the disequilibrium between vegetation and climate in the early 19th century, discontinuities in the fire regime at the change from Aboriginal to European land use, the rapid successional changes that have occurred during the last 150 years, and from the pollen record.

The vegetational evidence shows that contemporaneous forest successional sequences can proceed from eucalypt forest towards rainforest in the absence of fire, and from rainforest towards grassland and eucalypt forest under the influence of fire. Fire history and topographically determined microclimate combine to determine direction and rate of succession, and hence the composition of the vegetation at any one point within the spectrum of forest types permitted by the regional climate.

The presence of extensive eucalypt forest and grassland in an environment suited to rainforest has been maintained probably for the last 2 000 years by Aboriginal burning practices. However, it is clear that the spatial distribution of forest types was changing continually during that time. Was climatic change a factor in this?

The present area of grassland on Paradise Plains was formed during the last 200 years or so by the burning of rainforest. To the east of the Plains is primaeval rainforest; but to the west of the Plains is closed eucalypt forest of recent origin, as is shown by the presence of old open-grown trees and occasional remains of rainforest trees, amongst the tall forest-grown younger eucalypts. As one progresses further west across the plateau, the eucalypt forest appears to have been established for longer, since it contains forest-grown veterans and fallen trees and older secondary rainforest. At the western extremity of the plateau, the remains of eucalypt logs were found on a ridge top beneath secondary rainforest more than 200 years old. It may be that, as existing grassland became impoverished or overgrown with fire-resistant vegetation, the Aborigines abandoned it and generated new grassland by burning adjacent rainforest - a shifting agricultural practice common to many societies, including our own.

Once eucalypt forest was established it would be maintained, provided that fire occurred at least once every 80 to 100 years or so.

Given the prevalence of Aboriginal burning in and around the highlands, and despite the infrequency of occurrence of severe drought years, such a fire regime is likely to have been maintained throughout most of the eucalypt forest. It is not necessary to invoke changes in climate to account for these changes in vegetation.

It is unclear what the vegetation of the area was like before 5 000 B.P., at the beginning of organic accumulation in the bog; but it is likely that rainforest preceded open grassland. It is probable that peat commenced to accumulate when the water table rose following destruction of rainforest; a process evident today on Paradise Plains. The gleyed clays beneath the peat have not preserved enough pollen to justify counting. A scan of some dozens of slides reveals only a few grains of Restionaceae, Haloragaceae and Nothofagus pollen. and almost no carbon particles occur which are larger than 10 microns, although in the gravel layer at 50 cm there are numerous very fragile corroded dark particles which may or may not be the remains of past fires. It is not known if thousands of years of the oxidation-reduction cycles characteristic of gleyed clays would lead to the breakdown of carbon particles, as it invariably does with pollen.

There is a distinct increase in carbon particle size between the lower, more open phase and the upper forest phase. Additional to this is the fact that, because of a lower rate of accumulation of organic matter, the lower part of the core has substantially higher absolute pollen concentration values than the upper part. Carbon particle values, however, are much greater in the upper part, which indicates a real increase in the production of carbon particles independent of local organic accumulation rates.

Clarke (1983) has pointed out that high levels of carbon particles can be interpreted as meaning either low or high fire frequencies, depending on the crucial factor of fire intensity. In many instances, considering the derivation of some grasslands from forests by burning, it might seem acceptable to associate high values for carbon particles with grassland phases; however, in this case, low carbon particle values correlate with an open vegetation phase. This is probably explained by the stability of sub-alpine/alpine grasslands systems, which for a number of reasons (Ellis, 1985), tend to provide hostile conditions for the establishment of eucalypt seedlings. In the case of Paradise Plains, occasional light fires have maintained and even extended the grasslands over a period of at least 200 years.

The vegetation of Paradise Plains over the past two centuries is strikingly reminiscent of the lower part of the pollen profile. The successional paths established for Paradise Plains are mirrored in that core. As with present day succession, the historical sequences are unlikely to reflect climatic changes (Macphail, 1980). Although that core does not provide evidence for what vegetation existed prior to 5 000 B.P., one can speculate that either forest was burnt to create an open complex or, less likely, an open complex existed relict from Pleistocene times. Considering that the area surrounding the swamp is tall, wet eucalypt forest under today's conditions, and that in the absence of fire the forest would trend towards rainforests, it seems more likely that under the warmer and wetter conditions that occured before 5 000 B.P. the area carried rainforest. The vegetational evidence for Aboriginal burning in the study area in the recent past, and the presence of scatters of stone tools across the recently established plains, prove the presence of Aborigines in the north-eastern highlands. If the dating of the short core described in this paper is reliable then Aborigines have had major effects on highland vegetation for at least 5 000 years B.P.

REFERENCES

Clark, R.L., 1983 Pollen and charcoal evidence for the effects of Aboriginal burning on the vegetation of Australia, Archaeology in Oceania 18: 32-37.

Colhoun, E.A., 1986 Field problems of radiocarbon dating in Tasmania, Proc. Roy. Soc. Tas. 120: 1-6.

Colhoun, E.A. and Van de Geer, G., 1986 Holocene to middle last glaciation vegetation history at Tullabardine Dam, western Tasmania, Proc. Roy. Soc. Lond. B229: 177-207.

Cosgrove, R., 1984 Aboriginal economy and settlement in the Tasmanian central highlands, National Parks and Wildlife Occasional Paper No. 8, Hobart.

Ellis, R.C., 1985 The relationships among eucalypt forest, grassland and rainforest in a highland area of north-eastern Tasmania, Aust. J. Ecol. 10: 297-314.

Flood, J.B., 1980 The Moth Hunters, Australian Institute of Aboriginal Studies, Canberra.

Flood, J.B., Magee, D.J., English, B., 1987 Birrigai, a Pleistocene site in the south-east highlands, Archaeology in Oceania 22(1): 9-26.

Gentilli, J., 1972 Australian Climate Patterns, Nelson, Melbourne.

Gilbert, J.M., 1959 Forest succession in the Florentine valley Tasmania, Pap. and Proc. Roy. Soc. Tas. 93: 129-51.

Jackson, W.D., 1965 Vegetation pp. 30-35 in Atlas of Tasmania, J.L. Davies (ed.) Department of Lands, Hobart.

Jones, R., 1969 Firestick farming, Aust. Natur. Hist. 16: 224-228.

Jones, R., 1974 Tasmanian Tribes pp. 319-354 in Aboriginal Tribes of Australia by Norman B. Tindale, University of California Press, San Francisco.

La Marche, V.C. and Pittock, A.B., 1982 Preliminary temperature reconstructions for Tasmania, pp. 177-185 in Climate from Tree Rings, M.K. Hughes et al., (eds), (Cambridge University Press, Cambridge).

Loone, A.W., 1928 Tasmania's Northeast, Topographical Arts, Launceston.

Lourandos, 1983 10 000 years in the Tasmanian Highlands, Australian Archaeology 16: 39-47.

Macphail, M.K. 1975 Late Pleistocene environments in Tasmania, Search 6: 295-300.

MacPhail, M.K., 1979 Vegetation and climate in southern Tasmania since the last glaciation, Quat. Res. 11: 306-341.

Macphail, M.K., 1980 Regeneration processes in Tasmanian forests, Search 11: 184-190.

Macphail, M.K., 1984 Small-scale dynamics in an early Holocene wet sclerophyll forest in Tasmania, New Phytol. 96: 131-147.

Plomley, N.J.B., 1966 Friendly Mission: The Tasmanian Journals and Papers of George Augustus Robinson 1829-1834, T.H.R.A., Hobart.

Robson, L., 1985 A Short History of Tasmania Oxford University Press, Melbourne.

Thomas, I., 1983 An Archaeological Survey of Great Lake N. Press, Tasmania, Hobart.

Walker, J.B., 1898 Notes on the Aborigines of Tasmania, extracted from the manuscript journals of George Washington Walker, Pap. and Proc. Roy. Soc. Tas. 1897: 145-75.

PUBLIC FORESTRY

Hoop pine *(Araucaria cunninghamii)*, Qld

THE STATE OF KNOWLEDGE OF THE HISTORY OF PUBLIC FORESTS AND FORESTRY IN AUSTRALIA

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Having recently written what an obviously over-generous reviewer has described as 'the definitive text on the history of public forestry in Australia', I am naturally tempted in this review to report that the state of our knowledge of this subject is excellent! At least one can say, with due modesty, that our state of knowledge at the tertiary source level is reasonably comprehensive and probably fairly reliable but that getting at primary source material is difficult, that secondary source material is often biased (for understandable reasons), and that there is still plenty of scope for the sort of interpretive and analytical history which is both more colourful and more instructive - but for that the author is going to have to dig deeply and patiently.

Let me illustrate with a small experience. In the 1930s, the tenure of the then chief officer of a certain public forestry organisation (whom I shall call DP for 'dramatis persona', or 'displaced person' which is equally appropriate) was not renewed at the end of his first term. This is the manner in which the formal reports of government and conventional histories (such as the one referred to above) record the event. It was 'a fact'; no dubiety; had he thought to question its reality, he would have found his chair being warmed by someone else; and certainly his salary stopped there and then. On the surface of it, the historian might not see anything in this to get excited about, even if he/she read elsewhere that the government of the time was thinking of redefining the status of the organisation; the one might be a natural consequence of the other; legal contract, end of contract, nothing sinister there. Now it happened that I joined forestry a few years later (though in another State) and often heard my elders still tut-tutting about this event and over the years came to see 'it' as a _cause célèbre_ but without the faintest idea (or interest, really) why this should be so and without any idea of what 'it' was all about. Just one of the myths and legends of Australian forestry which abounds with them. But when, a few years ago, I got to the stage of wanting to get as wide a perspective on the history of Australian forestry as possible (even if I was selective in what I recorded), I naturally put this (along with several other events that I had collected as having 'stories' behind them) high on the list for inquiry. I therefore sought out those few of my elders who were still alive and asked them to tell me what it was all about. A couple claimed to have forgotten, 'it was all so long ago' (lesson to all historians - either get your subjects early or wait until they are all dead and there's no-one to contradict what you say!): a couple said 'Oh, that's history; not worth digging all that up again.' From the others I got garbled and quite contradictory stories and interpretations of the event, which I soon realised were highly correlated with the respective feelings of my informants towards DP, who appears to have promoted a wide range of reactions in people, from idolatrous adulation to unprintable antipathy. Only one version (from a present middle-level manager of the organisation whom I shall call MLM) sounded plausible, but the law relating to libel in Australia is so capricious and the language of the story so redolent of the unexpurgated D.H. Lawrence, that I reluctantly forbore to include it in 'the definitive history'.

However, just when the text was ready for the press and I was chafing with frustration at the number of such events which I had recorded whose factuality I was in no doubt of but whose 'story' I knew so little of, a utility truck somehow or other got into my first-floor office one night and from its back fell a file seven and a half centimetres thick bearing on the top a cryptic note 'It's all in here'. You can imagine my excitement. I spent the next many hours painfully wading through the file - painfully, because it was composed of dozens of letters, all in long-hand for confidentiality (many written in the bush by hurricane lamp), to a very prominent Commonwealth forestry official (whom I shall call IG) mainly from three people. One was DP himself; one was a very senior officer (VSO) of the organisation; and one was a very junior officer (VJO), a recent graduate fairly close to IG and very involved at the time in the formation of an association of foresters and the professional standards necessary for it. Between these three correspondents there was an amazingly detailed record of how the events had affected various people and the reactions of the writers, other members of the organisation, the Government and the Opposition; there were detailed speculations as to what might be done, crisp suggestions as to what should be done; and so on. But of what had actually happened, and why, there was not one damn clue! They all knew, of course; and they weren't writing for posterity. And, of course, there was nothing on the file from IG; it was his carefully kept file of replies to his letters. What his role in it was one could only guess at; certainly occasional handwritten letters from the Governor (a personal friend) through his secretary showed the level at which IG was trying (unsuccessfully, as it turned out) to operate. As to what 'it' was all about, I was (and remain), just as clueless as before - though I like to think MLM's version was the basis of it all!

But there was a bonus - the great deal I learned about IG, DP, VSO and VJO, all of whom I had thought I knew (or knew of) fairly well. The extra dimensions I gained of them were very helpful in making judgements on events they were involved in and they all occupied at one time or another important and influential positions in Australian forestry. And how much I found I hadn't known about them hitherto (especially VSO and VJO, whom I came to 'know' pretty well) confirmed an earlier decision I had made that in what I wrote it would be 'unfair and unwise to refer to people in other than a formal and impersonal way'. Nevertheless, I found this decision an unhappy one because, as I have said elsewhere, 'forestry is as much about the practitioners as it is about the practice' and many of the foresters, especially the leaders, up to about the early 1970s were very colourful and forceful characters. Some of this came out in The Foresters which the Institute of Foresters published a few years ago but, from the forestry point of view, the main interest is to see their personalities and philosophies reflected in what they did or tried to do or failed to do. As public servants, of course, much of their forcefulness was necessarily muted; it was tempered too in reaction to the policies of their political masters. To write convincing biographical material about these people is no easy task, as I have found in contributions to the Australian Dictionary of Biography. Getting a balance is difficult, most difficult in the case of someone like E.H.F. Swain, about whom there is a quite enormous amount of material - all written by himself!

Compared to historians in many other areas, of course, the forestry historian in Australia is fortunate in the requirement that public forestry organisations report annually to their respective Parliaments. From day one of their establishment, every such organisation in Australia has met this requirement meticulously (even in war times) and complete copies of these reports are available for each organisation in its own library and for all the organisations in central libraries in Canberra. Now the cynic will recall Sir Humphrey Appleby's dictum in the TV series 'Yes, Minister' to the effect that '... civil servants believe in telling the truth and nothing but the truth. But it would be profoundly inappropriate and grossly irresponsible for them to tell the whole truth'. I guess this applies as much to forestry department and forestry commission annual reports as to anything else. But - saving the fact that the compilers of such reports will naturally tend to emphasise the good and play down the bad, to high-light the successes and low-light the failures (except to illustrate the need for more funds) - the stories they tell are subject to as much public audit as their financial statements are to government audit and they 'economise on the truth' at their peril.

For various reasons, forestry in Australia has attracted a considerable number of inquiries, including a number of royal commissions at which people giving evidence are on oath and, in recent years, State and Commonwealth parliamentary inquiries of equivalent formality. The nature of these inquiries makes for very objective submissions and the reports of these inquiries are a rich lode of information - there were thirty significant State and Commonwealth inquiries between 1970 and 1980, for example.

All of this material - annual reports, reports of inquiries, and the innumerable 'PR glossies' - has of course suffered a digestive and transformation process, and the keen historian will want to get back to its origins in the raw material of the organisations themselves. This is a pretty fearsome job for various reasons - the geography of Australia; the sheer size and scope of the record; practical problems in storing and retrieving archival material; and, most importantly, the almost universal human trait of never putting down at the start of a file what the project (or whatever) is all about, what the intentions or motivations were, and so on. As an extreme example, I have never forgotten being thrown in as Exotics Experimental Officer immediately on graduation (in a State which had the reputation of being at that time the most technically progressive and successful in Australia) to replace the previous officer who was retiring. There were 87 experiments with a file for each, all tidy, with successive and very detailed measurements. But (1) not one bore a location diagram (indeed my new bride and I spent much of our 'honeymoon' mapping them!); (2) not one bore an experimental layout diagram; and (3) not one gave any indication as to what information the experiment aimed to provide. I found out later that as regards (1), the previous officer 'knew where they were'; (2) 'they weren't statistical experiments' and, because it was the custom to always start with Tree no. 1 in Plot no. 1 in the north-east corner, 'once you got that tree the rest sort-of fell into place'; and (3) 'the silviculturalist knows what they're all about'. I can lead you to a lot of administrative files being created today in forest services of Australia which aren't much of an improvement on that. The increasing use of the telephone and the corridor-chat for the giving and getting of information and the making of decisions also militates against the complete record which the historian favours; frequently, what isn't 'on the file' or 'lies between the lines' is as important from the historical point of view as what is present.

The forestry of some States has had valuable direct treatment from 'local' historians e.g. N. B. Lewis for South Australia and J. R. Robertson for Western Australia; and indirect treatment from the forest industry angle through M. Row and J. B. Dargavel (Tasmania), and J. R. Robertson and J. Mills (Western Australia).

During the past several years, public forestry in Australia has become the focus of a power struggle between Commonwealth and State politicians, variously supported by bureaucratic and legal interests and strongly influenced by self-interest groups. Many decisions are being made on short-term political grounds under 'hidden' influences. This increased politicisation of public forestry has added a complex dimension to its functions and performance and increased the difficulty of the historian seeking information at the primary source level.

It is more difficult to generalise about 'the state of knowledge of the history of public forests' in Australia. I have had experience of some of the 'forest histories' of Germany, France and Switzerland, for example, and only in one State, to my knowledge, where the management has been organised and the record made on a State Forest basis, would there be individual forest histories anything like comparable to those. In one State, the original administration established the practice of 'general' working plans, one for each of the several major species covering a lot of individual forests. Elsewhere the practice has been to develop working (management) plans for small groups of forests. But in all cases, I think, a European historian would find the historical record, by comparison, short on ecology, sociology and perhaps economics, and long on growth and yield.

INFORMATION SOURCES

TEXTS

1. Forests of Australia by A. Rule (Angus & Robertson, Sydney, 1967) has a couple of chapters of an historical nature e.g. Ch. 5 'Growth of government services'; some of the chapters on other topics include some description of their historical development. There are no formal references.

2. A Hundred Years of State Forestry, South Australia 1875-1975 by N.B. Lewis (Bull. 22, Sth. Aust. Woods & Forests Dept., 1975) deals specifically with that subject. There are no formal references.

3. The Fight for the Forests by R. & V. Routley (Aust. Nat. Univ., 1975) is mainly a polemic of the public forestry and forest industries situation of the 1960-1970's but contains historical elements within the text and an extensive list of references.

4. A History of Forestry in Australia by L.T. Carron (Pergamon - A.N.U. Press, Sydney, 1985) deals specifically with that subject and has an extensive list of references.

5. The Timber People by J. Mills (Bunnings Ltd., 1986) has some of the history of the forests and forestry of Western Australia within a history of the industrial firm of Bunnings Ltd.

6. Sawing, Selling and Sons, J. Dargavel ed., (C.R.E.S., A.N.U., Canberra, 1988) is a collection of histories of forty firms in Australia's timber industry but provides some references to the history of the public forest estate from which these firms drew much of their raw material.

7. The Foresters, A. Meyer ed., (Institute of Foresters of Australia (Inc.)). Biographical essays on five of Australia's first professional foresters: C. E. Lane Poole, N. W. Jolly, E. H. F. Swain, S. L. Kessell, M. R. Jacobs.

OTHER

There are a number of useful references not included in the above in "Research in the history of forestry and the forest products industry" Ad Hoc Communication Nos 1-5, J. Dargavel and L. Carron Eds.,

RE-WRITING THE HISTORY OF FORESTRY? CHANGING PERCEPTIONS OF FOREST MANAGEMENT IN THE NEW WORLD

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Interpretations of the history of forestry in the New World have long been dominated by a remarkably singular and enormously influential view of the past. The emergence of this view took more than three-quarters of a century and it was heavily influenced by developments in America and throughout the British Empire. Certainly there have been divergent perspectives amongst foresters concerning the most appropriate mix of market and state to achieve the optimum allocation of resources, but these differences seldom threatened the apparent consensus in a world of expansion, prosperity and common foes. These differences were even less divisive in the Australian context of predominantly state ownership and control of forests. The tremendous influence of the 'orthodox' view of forest history was a product of the early and wide acceptance of the seminal role of foresters in the history of natural resource conservation and the economic pre-eminence of timber until the second half of this century. The singularity of this orthodoxy was due to a number of factors, not the least of which was the role of foresters in interpreting and publicising their own history. This reflected an understandable pride in the tremendous achievements of a profession made insular by so much bureaucratic infighting, political antagonism and public apathy. The result, at least initially, was a view of the past written largely by foresters for foresters.

Today, interpretations of forestry history are made by a wider range of observers for a much more diverse audience, and society in general is far more tolerant of new and often radical ideas. Nevertheless, the major tenets of the orthodox view remain. These include the bureaucratization and professionalization of foresters, the persistent lobbying of politicians and the wooing of the public concerning the desperate need for progress in natural resource conservation. Foresters are portrayed as both active and passive environmental managers - often promoting the wider and more efficient use of forest products and then applying their expertise to achieve that end.[1] Much of the history of forestry in the New World is portrayed as the application of the principles of sustained yield and multiple-use management to an alien and sometimes hostile natural and socio-economic environment. In Australia, these special conditions included the management of predominantly hardwood, fire-dependent species, in semi-arid and often drought-prone environments.

The difficulties of achieving economically efficient forest utilization in pioneering communities with small markets and widespread public perceptions of endless supplies of raw materials, an unlimited faith in progress, and antipathy towards science and the role of the 'expert', are common themes in the literature on forestry in most New World regions. Similarly, most writers deal with the dangers of agricultural expansion, the impact of mining, and the widespread threat of uncontrolled fire. The threat of a devastating timber famine is a recurrent theme, with foresters portrayed as guarding the forests for present and future use from the depredations of corporate greed, public apathy, and political pork-barrelling. Finally, the complex evolution of federal administration from the initial colonial or state origins, and the development of closer co-operation with industry both receive much attention.[2]

In the past two decades, however, the interpretation of forest history has been subject to a major transition. The three major changes experienced may be interpreted as 'proliferation, pluralization, and polarization'. The nature, impact, and implications of these changes form the major focus of this paper. In particular I wish to examine the various challenges to the old historical orthodoxy and provide a framework for analysing the emerging conflicts and contraditions in approaches that can so bedevil the researcher.

The <u>proliferation</u> of historical interpretations of forestry has been due to a general resurgence in interest in our past. In Australia, the bicentennial celebrations have provided a major stimulus to the reinterpretation, or 'rewriting' of the past, to the extent that more critical, non-mainstream perspectives and themes (such as the role of women, the impact of European invasion on Aboriginal populations, and labour history) have become popularized. These approaches are not new, but the context in which they are judged has changed considerably. Pre-dating this popular interest in general history is the development from the early 1970s of 'environmental histories' concerned with the theme of the human impact on the natural environment. The demand for this type of history has long been met in the American case by a steady stream of books dealing with the history of the early conservation movement, and the management and disposal of the public domain.[3] In Australia, environmental histories have been more directly associated with the stimulus given by the radicalization of the environmental movement since the late 1960s, and more specifically have been designed to satisfy the needs of undergraduate university courses in geography and history.[4]

The <u>pluralization</u> of forestry history stems from a range of factors. The proliferation noted above has contributed to a major diversification. The publication of Carron's comprehensive work in 1985 represents both a fine example of the continued dominance of orthodox forestry history and yet, surprisingly, the first major general history of forestry in Australia.[5] Before this, Australian forestry history was either superficial or limited to relatively narrow themes or periodizations. Nevertheless, in recent years there has been a tremendous growth in the following areas of historical scholarship concerned with the development of forestry: corporate, thematic (including industrial archaeology, light railways, and industries developed on particular tree species), labour, regional, environmental, and professional histories.

Furthermore, forestry history has been the focus of an increasing number of academic studies. These have incorporated a range of different perspectives borrowed from a wide variety of apparently unrelated intellectual disciplines. The general trend in these works is the use of case studies in the history of forestry to investigate the utility of particular theoretical constructs central to specific problem areas. These analyses include the sociology of administration, radical political economy (ranging from examinations of the origins of the deep ecology movement to the application of dependency and world systems theory), the use of public interest theory to explain the geographical differentiation of the public lands, structuralist and pluralist theories of the state, the diffusion and innovation of ideas, and the role of myth and perception in environmental management. In some cases, studies of forestry have been framed in an orthodox historical context, but the conclusions reached have been heavily influenced by notions borrowed from unrelated fields. For example, in one thesis the crude but influential theme of 'conservative resistance' to the 'initiatives' of the Australian Labor Party was applied to the analysis of the history of afforestation in South Australia.[6] Unfortunately the specialist nature of much of this academic material makes it relatively inaccessible to the traditional practitioners of forestry history, let alone the general public.

As a result of this proliferation, pluralization and polarization, the fledgling history of forestry in Australia urgently requires a synthesis and critical review of these new approaches and challenges to the old orthodoxy. Alston's analysis of the evolution of ideological differences within American forestry is one of the finest examples so far of the type of historical analysis needed.[7] Nevertheless, many of the apparent conflicts and contraditions emerging are beyond the realm of ideology and lie in the often obscure philosophical depths of what has been called the 'mode of social theorizing' especially, as it impinges on our conceptions of history.[8]

In the latter context, however, we must follow Plumb in distinguishing 'the past' from 'history', and realise that the past has a variety of functions beyond that of being merely the subject of historical interpretation.[9] It may be used, for example, by different interest groups, classes, and institutions for the justification, sanctification, and validation of present and future ideas and actions. The degree of intent to consciously use the past for other than purely historical reasons varies considerably, but few interpreters of the past are unaware of the implications of their work. In any event, they are often powerless to prevent their interpretations from being taken out of context.

The rewriting of forest history, no less than the revision of any other form of history, is indicative of a changing social context within which the shortcomings of the old orthodoxy become manifest. The pathway we should follow between the extremes of historicism and presentism is rarely well defined. Tosh aptly describes the challenge, 'our priorities in the present should determine the questions we ask of the past, but not the answers ... at the same time, it is a fallacy to suppose that the aspiration to reconstruct the past in its own terms carries the promise of objectivity: no essay in historical recreation is proof against the values of the enquirer'.[10] Particularly in our bicentennial year it should not be too difficult to appreciate that 'the past' can become as coveted a resource as any forest ever was.

Attempts at 'objectivity' are always constrained by word limits and deadlines. Nevertheless, the major reason for selectivity in interpretations of the past is the continued dominance of teleological conceptions of history. The past is perceived narrowly as a particular pathway to the present, and the task of historians is to research and record 'how we got to where we are' or, in its more extreme forms, 'how we got to where we are going'. This streamlines the research effort and provides a simple and logical structure for historical writings but it too easily devalues evidence of alternative conceptions of the past. It becomes almost impossible to divorce historical observation from prevailing views of present conditions and trends. To pursue the metaphor further, too much material of historical significance may be ignored as the wrong path or at least an unnecessary detour. A variety of approaches has been suggested to objectify history but these have met with limited success.[11]

The polarization of interpretations suggested above can be demonstrated by outlining five of the major current trends in the re-writing of forestry history. It is difficult to construct a typology of different perspectives because of the variations and diversity of emphases within the works of different individuals. Therefore the following classifications are based on representative works at specific times.

The **'environmental challenge'** is a loose collection of themes that have forced a reappraisal of the traditional role of the expert in environmental management. One early attempt was to provide a narrow ecological perspective on forestry. Often associated with the call for increased public accountability and public participation in forest management, the historical origins of the narrow ideological bases of foresters and their close liaison and co-operation with the forest-based industries have become a major issue. The early triumph of utilitarian rather than preservationist views of forest conservation have clear implications for the dominance of wood production in forest-management plans. To some writers in this field the narrow equation of the public interest with the needs of the forest products industry has very long antecedents, while others see this as a more recent phenomena associated with the intensification of forestry in the early 1960s. Structural changes in industry, the concentration of ownership, and the increasing influence of multi-national corporations are major concerns here. More recently, questions of the regional impact of de-industrialization due to amalgamation and mill closure, the extent and influence of public subsidization of private industry and above all, the environmental impact of the intensive forestry practices, have received attention.[12]

The 'orthodox response' to the challenge of the environmental movement forms a major issue in modern forestry in all countries. In Australia, foresters saw the work of the Routleys as the first major threat to their image and professional status.[13] In response much historical work is re-emphasizing the environmental conservation aspect of forestry - for example, the early involvement of foresters in the wise use of natural resources, the claim that they were the 'first', 'true', or 'real' conservationists, and that only through their dogged efforts to preserve forests did the 'greenies' have something to squabble over.[14] The threat is often portrayed in terms of the challenge to the hallowed ideals of environmental stewardship by advocates of a misguided 'pop-ecology' who emphasize inevitable forest destruction from human interference because of the fragility of the natural environment.[15] The development and significance of the principles of sustained yield and multiple-purpose management are being highlighted, and much effort is being made to counter the image of the faceless bureaucrat through the publication of 'memoirs' and biographic works on foresters for the general public. These highlight a wider concern than the wood values of forests, a long history of community involvement, and the legendary camaraderie within the profession.[16]

Australian foresters have experienced much less division within their ranks than have their American counterparts. Thus, despite the works of individuals concerned with environmentalism and radical theory and others promoting the universality of the market in resource allocation decisions, the major distinction between 'silva-centric' and 'eco-centric' ideologies, noted in the American scene by Alston, has less immediacy here.[17] In Australia, the distinction is widely perceived as between that of the forestry profession and the environmentalists, but in America forestry history is largely being rewritten from within. This involves a remarkably radical, consistent and comprehensive challenge to the old orthodoxy. Alston calls this the 'eco-centric' school.

For more than twenty years a voluminous and detailed literature has been developed by those concerned with the need to promote the workings of the free market to achieve the optimum efficiency and, ironically, equity in the allocation of natural resources. In this view the history of forestry has largely involved the unnecessary interference with private enterprise by restrictive government policies. This interference has restricted the mobility of productive factors, confused price signals, and created artifical economic environments which have actually fostered short-term exploitative industrial activity. Historical studies have demonstrated the extent to which active policies of conservation - particularly resource substitution - were practised by the giant corporate users of forest products in the late nineteenth and early twentieth centuries.[18]

More recently, writers in this field have portrayed many of the hallowed ideals and principles of forestry as being based on a misguided and dangerous mythology. In its more sophisticated forms this approach builds on Schiff's work on foresters' perceptions of water and fire management in forested environments. It questions the applicability of the sustained yield principle borrowed from the inappropriate environmental, political and socio-economic conditions of pre-industrial Europe. Similarly, multiple use is seen as something that the forest service preached but did not practise.[19] According to Clary, the development of forestry was associated with three articles of faith widely held, but largely unquestioned, by foresters: the nation needed timber and would need more in the future, the threat of timber famine was ever present, and forest management required a technocratic outlook possessed only by foresters trained in traditional methods.[20] Nevertheless, forestry represents only one of a number of approaches to the management of forests.

Not surprisingly, this latest revision of the American past has gained favour from within the ranks of conservative politicians and throughout the forest products industry. This is particularly so given the latter's opposition to the current Forest Service's adherence to the principle of non-declining even-flow policies that are limiting the exploitation of the last great stands of virgin forest on the public lands of the American Pacific coast. Support for greater market freedom has also been forthcoming from within the mining industry - so long portrayed by orthodox forest historians as a threat to the forests, but now perceived as an ally against the threat of environmentalism.[21]

The profound impact of myth and misperception on the political process influencing environmental management is a major contribution of the more recent writings by the eco-centrics. Nevertheless, the fourth group of researchers has been demonstrating the utility of this approach for at least forty years.[22] This 'landscape author' group is composed almost exclusively of geographers, and their interest stems mainly from a concern with powerful individuals, institutions, and ideas as agents of landscape change. Their work encompasses a wide range of different perceptions of forests as resources in America, New Zealand and Australia. Initially developed to counter the more misleading forms of environmental and economic determinism, their research was refined during the 1970s as a response to the dominant positivism of their discipline during the 1960s. Based largely on humanist philosophies, their work focuses on the history of late nineteenth and early twentieth century resource evaluation and appraisal. Of necessity, particularly in the case of both Australia and New Zealand, this involved detailed examinations of the management of public lands under conditions of almost exclusive government ownership and control. The contribution of influential bureaucrats and politicians to the historical development of forest management is a major sub-theme, as is the role of pressure-group activity in the political process.[23] Wright's work on the influence of different bureaucrats' conceptions of the public interest has some interesting parallels with Alston's study of the influence of different ideologies on foresters.[24]

The final contribution to the rewriting of forest history I wish to examine here comes from the area of 'radical political economy'. Little has been written in the American context, although one notable contribution examines the alleged suppression of references to class conflict within the timber industry in one prominent orthodox forest history.[25] In Australia the political economy approach is exemplified by Dargavel's analysis of the history of the timber industry in Tasmania.[26] Stimulated by an interest in radical theories and later pursued in works on forestry in the third world, his doctoral thesis suggests that the development of forest management is most fruitfully explained in terms of the changing needs of the capital.[27] This work provides an interesting and potentially fruitful historical link between the excesses of forest exploitation during the colonial period and the recent trends in intensive industrial forestry that so concern the environmentalist lobby. More recently, Dargavel's work has become more orthodox in its perspective. His role as a key facilitator and co-ordinator of Australian forestry history has become more prominent and his own research has diversified considerably.[28] This leaves something of a gap in the political economy interpretation of forestry history, particularly in terms of theoretical work. It seems likely that this 'heritage' will devolve back to researchers within the 'environmentalist challege' school, particularly given the politicization of forestry issues following the Helsham inquiry.

The application of the Marxian 'capital logic' model of development in Dargavel's earlier work represents a major challenge to each of the preceding forms of historical revisionism, although some foresters have long suspected that many environmentalists may embrace related ideologies.[29] Nevertheless, there are a number of factors that may detract from the applicability of this model to other places and times and much work is needed in this area. Thus, we need to consider recent challenges to dependency and world systems theories, the emerging impasse in theories of the state as both left and right move toward the pragmatic but theoretically untenable 'relative autonomy' conceptions, the actual mechanisms by which capital informed the state, and the extent to which the experience of such obviously dependent island economies as Tasmania's is representative of the Australian mainland states.

One of the more obvious contradictions between the political economy and more orthodox approaches discussed concerns the autonomy of individuals relative to the supposed underlying structural forces shaping the nature of society and the progress of history.[30] This is particularly so with regard to colonial resource management. The administration of forests during colonial periods in the New World and more recently in present Third World nations has been examined fruitfully in terms of notions of dependency. And yet it is exactly during these periods of greatest dependency that the powerful politicians and influential 'gate-keepers' have so influenced the emerging colonial landscape. Perhaps it is only a matter of 'big fish in little ponds', but there is a great need for the implications for research perspectives on resource management to be clarified.

How then should we approach such questions as the role of the state, the individual, ideas, and institutions? How can we resolve questions of the applicability of the free market? How relevant is the emphasis on perceptions and mythology in a world of deeper forces? Is a pluralistic or Weberian notion of the political process and the role of the state irrelevant because governments have so rarely conflicted with the general needs of capital; because bureaucrats have so readily identified with powerful economic interests; or because of our manifestly long and continuing history of dependence on foreign powers? Furthermore, what is the relevance of examining the influence of different perceptions of the public purpose in a world where the individual has no, or relatively little, autonomy? Alternatively, should we criticize structuralist perspectives because the state has so often conflicted with the needs of individual capitalists; appointed radical conservation-minded foresters, even in colonies or states long dominated by reactionary development-oriented ideologies; or because bureaucratic infighting and empire building contradicts notions of the state's unity of purpose? Finally, if (as I believe) the role of the state in colonial resource management should receive greater attention, what level and type of theory should we use to inform our work, and which, or whose, theory of the state should we pursue, given the bewildering array of ill-defined conceptions now and in the past?[31]

One small example of the potential contradictions in forestry history may serve to illustrate these concerns. Persistent lobbying of politicians by large gold-mining companies was a major stimulus to the reservation and management of forests on public lands in the colony of Victoria during the late nineteenth century. Their voracious use of timber for pit-props and as fuel for vital steam engines, together with their tremendous political influence ensured this. Even a cursory examination of the likely interpretations of this historical 'fact' reveals a plethora of possibilities. Depending on your perspective, this may be clear evidence of:

i) the undue power of large corporations with specialist forest product needs, possibly interfering with the long-term viability of the forests or conflicting with broader conceptions of the public interest (orthodox view);

ii) the shortcomings of a political system in which there was too much political restriction and bureaucratic red tape to allow an efficient working of the market mechanism (eco-centric view);

iii) a short respite in the history of the devastating environmental impact of the mining industries, possibly indicative of the process of 'bureaucratic capture' (environmentalist view);

iv) a complex process whereby bureaucrats or politicians perceived the needs of, or at least acted upon, the urgings of a powerful user group (landscape author view);

v) yet another example of the subservient role of the state in a dependent colony during the age of monopoly capitalism and imperalism (political economy view).

Clarification would require far more exacting historical scholarship, but for the budding researcher faced with an almost bewildering array of often contradictory approaches, the task may be daunting. Perhaps forestry history is suffering from too many reductionist perspectives - the complexities of reality are being glossed over in the numerous attempts to simplify and revise the past. Whether or not this indicates the need for more integration or perhaps more holistic approaches is partly a philosophical as well as a practical question. A concern with the extent to which history should be narrowly theoretical or broadly eclectic is another critical issue presently determined by the various uses to which we put 'the past'.[32] Whatever the answers, there is an urgent need for comprehensive syntheses and critical reviews of the nature of historical writings to form a foundation for this wider debate.

Five distinctive trends in the writing of forestry history have been examined and compared with the 'old orthodoxy'. These represent a wide variety of ideological stances, perspectives on history, and potential uses of the past. Furthermore, at least four major philosophies or modes of social theorizing are involved - empiricism (formist types of 'orthodox'); positivism (organicist types of 'orthodox', 'orthodox response', and 'eco-centrism'); humanism (formist and contextualist types of 'landscape authors'); and structuralism or mechanism ('radical political economy'). The 'environmentalist' school is so diverse that it includes some aspects of each of the four philosophies.

Irrespective of the desirability of a common approach, this differentiation ensures that opportunities for consensus are limited, at least because of underlying differences in what have been referred to elsewhere as philosophical presuppositions.[33] These are the fundamental building blocks of philosophy which form the foundation for different beliefs about the origin and nature of reality. Furthermore, they constrain and delimit understanding and provide a context for 'appropriate' methodology (see Fig. 1).

Given the enormous variation in philosophy and ideology and the diversity of conceptions of history and uses of the past, there appears little reason to doubt that as forestry history receives more attention the past will continue to be rewritten. Furthermore and regardless of these deeper forces, forest historians will continue to find the fruits of their labours judged within a political context. Nevertheless it is hoped that with professionalism, commitment and enthusiasm we may at least find strength in diversity. In so doing it might also be possible to heal some old wounds and considerably reduce antagonism. Hopefully we can go far toward debunking myths and providing realistic appraisals of the past on which to base future decisions in resource management.

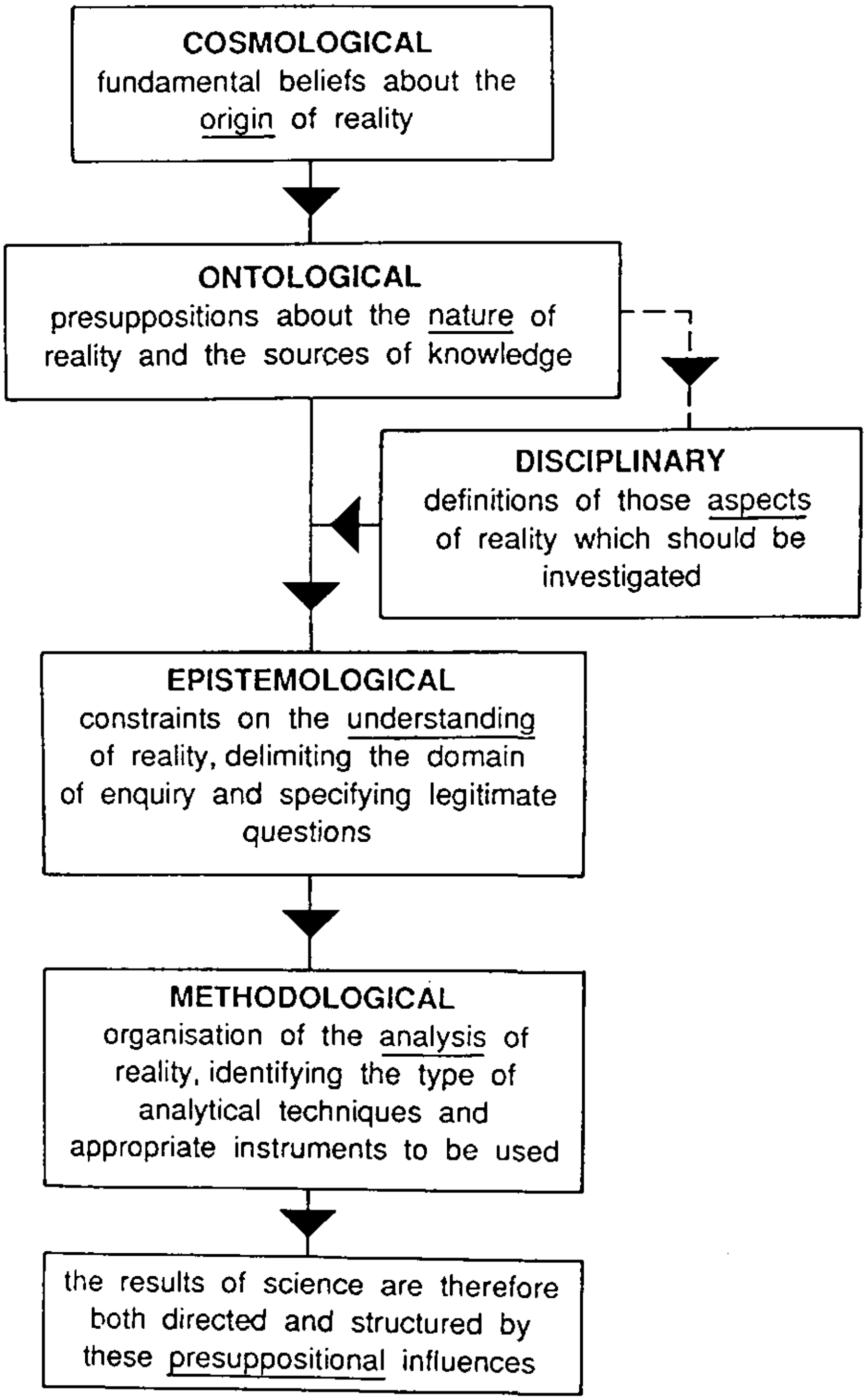

Fig. 1 Disciplinary building blocks

NOTES

1. Foresters were instrumental in the 'promotion of [a] popular consideration of forestry'. For example note the foundation of the Australian Forestry League - 'Report of the Interstate Conference on Forestry, Sydney. Nov. 1911'. Govt Printer, Sydney. 1912 pp.20-22.

2. In the Australasian context these include: Rule, A. Forests of Australia. Angus & Robertson, 1967; Lewis, N.B. A Hundred Years of State Forestry: 1875-1975. Woods & Forests, Adelaide, 1975; Vear, K.W.E. 'South Australia's Forests - Their History', in Boardmann, R. and Corbett, D. (eds) Our Forests in Focus. Publn. No. 43, Univ. of Adelaide, Dept of Education, 1975; Carron, L.T. A History of Forestry in Australia. A.N.U. Press, 1985; Poole, A.L. Forestry in New Zealand. Hodder & Stoughton, 1969; Simpson, T.W. Kauri to Radiata. Hodder & Stoughton, 1973; Allsop F. The First Fifty Years of New Zealand's Forest Service. Govt Printer, Wellington, 1973.

3. Huth, H. Nature and the American. Univ. of Nebraska, 1957; Hays, S.P. Conservation and the Gospel of Efficiency, Cambridge, 1958; Nash, R. Wilderness and the American Mind. Yale Univ. Press, 1967; Robbins, R.M. Our Landed Heritage - The Public Domain, 1776-1936. Princeton Univ. Press, 1942.

4. Powell, J.M. Environmental Management in Australia, 1788-1914. Oxford Univ. Press, 1976; Bolton, G. Spoils and Spoilers. George Allen & Unwin, 1981; Whitelock, D. Conquest to Conservation. Wakefield Press, 1985.

5. Carron, L.T. op. cit.

6. Manhood, G. 'Afforestation in South Australia, 1870-1950' B.A. Hons. Thesis, Univ. of Adelaide, Dept. of History, 1961.

7. Alston, R.M. The Individual vs the Public Interest - Political Ideology and National Forest Policy. Westview Press, 1983.

8. Based on the work of the American philosopher, Stephen C. Pepper, and developed specifically for the analysis of historical interpretations - see Pascoe, R. The Manufacture of Australian History. Oxford Univ. Press, 1979 esp. pp. 3-7.

9. Plumb, J.H. The Death of the Past. Macmillan, 1969.

10. Tosh, J. The Pursuit of History. Longman, 1984 p.21.

11. These include 'formist' approaches in which much effort centres on distinguishing the unique and the particular; the use of 'counterfactual historical analysis' to investigate what might have been; and the common pragmatic approach of limiting the scope of historical analysis to include only a few selected

aspects of the past or current issues requiring historical clarification.

12. For example, see: Webb, L. 'The Rape of the Forests' in Marshall, A.J. (ed.) The Great Extermination. Heinemann, 1966 pp. 178-231. Routley, R. & V. The Fight for the Forests. R.S.S.S., A.N.U. 1973; Johnson, D. The Alps at the Crossroads. V.N.P.A., 1974; Plumwood, V. & Penna, I. 'Services to industry - the role of forest bureaucracies', Chain Reaction 42/43, 1985 pp. 47-52; Rawlinson, P. & Penna, I. 'Timber the Overextended Resource' in Birrell, R. et al. (eds) Quarry Australia. Oxford Univ. Press, 1982, pp. 197-221.

13. See the exchange between N.B. Lewis and the Routleys: Aust. For. Vol. 15 No. 3 Sept., and No. 4 Dec. 1974.

14. See Prof. Bachelard's review of the history of forestry in Victoria, which possessed forests that attracted attention from the new breed conservationists of the 1960s and 1970s: 'Those very forests were a tribute to the multiple-use policies of the Forest Commission and its officers, given the appalling state of the forests at the time they came under the Commission's charge in 1918' I.F.A. Newsletter Vol. 26 No. 4 Dec. 1985 p.12.

15. See Rotheram, I. 'Forests, A Magic Puddin', I.F.A. Newsletter Vol. 27 No. 1 Mar. 1986 pp. 8-9 and Campbell, S.R. 'What Price Professional Forestry?' I.F.A. Newsletter Vol. 28 No. 1 Mar. 1987 esp. p. 2.

16. Meyer, A. The Foresters. I.F.A., 1985; Underwood, R. (ed.) Leaves from the Forest - Stories of the Lives of West Australian Foresters. Perth, 1987.

17. Australian environmentalists would confuse 'eco-centricism' with being ecologically centred rather than economically centred. They would also see themselves as silva-centric in Alston's terms. Ironically, despite their contradictory ideologies, there are many parallels between the environmentalist and eco-centric challenge to the alleged mythology of the orthodox foresters.

18. Olsson, S.H. The Depletion Myth. Harvard Univ. Press, 1971.

19. Schiff, A.L. Fire and Water. Harvard Univ. Press, 1962; Clawson, M. 'Forests in the Long Sweep of American History'. Science 204, 15 June 1979 pp. 1168-1174; Clawson, M. & Sedjo, R. 'History of sustained yield concept and its application to developing countries' in Steen, H.K. (ed.) History of Sustained-Yield Forestry: A Symposium I.U.F.R.O. 18-19 Oct. 1983 pp. 3-15 (and see the reply by Lee, R.G. 'Sustained-Yield and Social Order' in Steen, H.K. op. cit. pp. 90-100); Nelson, R.H. 'Mythology instead of Analysis: The Story of Public Forest Management' in Deacon, R.T. & Johnson, M.B. (eds) Forestlands - Public and Private. Ac. Studs. in Pub. Pol. Ser., 1985 pp. 23-76.

20. Clary, D.A. Timber and the Forest Service. Univ. of Kansas Press, 1986.

21. Evans, R. I.F.A. Newsletter. Vol. 26 No. 4 Dec. 1985.

22. Wright, J.K. 'Terrae incognitae: the place of imagination in geography'. Ann. Ass. Am. Geog. 1947, 35 pp. 1-36.

23. Powell, J.M. op. cit.; Powell, J.M. 'Wood, trees and vision: forest management policies in Australia, 1901-1939'. Proc. 21st I.A.C. Conference, Perth 10 May 1986 pp. 300-305; Powell, J.M. An Historical Geography of Modern Australia - The Restive Fringe. Cambridge, 1988 pp. 160-168. Powell's approach has been influential and is reflected in the following works: Frawley, K.J. 'Forest and Land Management in North East Queensland, 1859-1960', Ph.D. Thesis, A.N.U. 1983; Frawley, K.J. 'Past Rainforest Management in North East Queensland: Background to the Daintree Road Issue' A.N.U., C.R.E.S. Working Paper 25, 1985; Frawley, K.J. 'Queensland Rainforest Management and Public Policy', Proc. 21st I.A.G. Conference, Perth 10 May 1986 pp. 305-31; Roche, M.M. 'An Historical Geography of Forest Policy and Management in New Zealand, 1840-1930'. Ph.D. Thesis, Univ. of Canterbury 1983; Roche, M.M. Forest Policy in New Zealand - An Historical Geography 1840-1919. Dunmore Press, 1987. Other relevant works in historical geography include: Wynn, G. 'Pioneers, politicians and the conservation of forests in early New Zealand'. Journ. of Hist. Geog. Vol. 5 No. 2, 1979 pp. 171-188; Williams, M. 'Clearing the United States Forests: Pivotal Years, 1810-1860'. Journ. of Hist. Geog. Vol. 8 No. 1, 1982 pp. 12-28; and the comprehensive studies by Bardwell, S. 'National Parks in Victoria, 1866-1956' "For All the People for All Time", Ph.D. Thesis, Monash Univ. Dept. of Geography, 1974; and Turner, A. 'National Parks in N.S.W. 1879-1979. Participation, Pressure Groups and Policy', Ph.D. Thesis, A.N.U., 1979.

24. Wright, R. 'Space and the Public Purpose - Crown Land Reservation in Victoria, 1836-84', Ph.D. Thesis, Monash Univ., Dept. of Geography, 1985.

25. Harring, S.L. & Strutt, B.R. 'Lumber, Law and Social Change: The Legal History of Willard Hurst', Am. Bar Foundn. Rev. Journ. 1985, Vol. 113 No. 1 pp. 123-137; and reply, pp. 138-144.

26. Dargavel, J.B. 'The Development of the Tasmanian Wood Industry - A Radical Analysis', Ph.D. Thesis, A.N.U., 1982.

27. See also Dargavel, J. 'The political detection of an Australian forestry perspective' Aust. For. Vol. 43 No. 1, 1980 pp. 5-15; Dargavel, J., Hobley, M., Kenyon, S. 'Forestry of Development and Underdevelopment of Forestry' C.R.E.S. and Dept of Forestry, A.N.U. D-3/V3.

28. See Dargavel, J.B. op. cit. 1988; and Dargavel, J.B. and Sheldon, G. (eds) Prospects for Australian Hardwood Forests. C.R.E.S. Monograph 19, 1987.

29. Letter to the Editor of Habitat from Dr G.J. Bacon, President I.F.A. reported in I.F.A. Newsletter. Vol. 27 No. 1 March 1986 p.4:
'Dear Sir,
Your editorial (Habitat 14(1)), in criticising the forestry profession, adopts the language and style of Marxist analysis employing the cultural framework popularised by the disciples of Antonio Gramsci. The sensibilities of your readers may have stopped the author from going the whole hog. It would have been in keeping with the rest of the article to use a title such as "Class Struggle for the Forests" and to refer to the forestry profession as the "ruling class" instead of the "institutionalised elite" ...'

30. The structuralist approach to history is eschewed in the Ph.D. analyses of both Bardwell and Turner dealing with the development of national parks because it discounts the role of the individual. Unfortunately, structuralist insights are largely ignored in other historical works dealing with forestry, except for the works of environmentalists.

31. Theories of the role of the capitalist state is one of the most rapidly expanding areas of research in social theory. On the latter point see Docker, J. 'Can the centre hold? Conceptions of the state 1890-1925' pp. 57-88 in Sydney Labour History Group, What Rough Beast? George Allen & Unwin, 1982. A fruitful perspective emphasising geographical and historical variation in the role of the state is offered in Skocpol, T. 'Bringing the State Back In: Strategies of Analysis in Current Research' in Evans, P. et al. (eds) Bringing the State Back In. Cambridge, 1982. Traditional economic history works have emphasised the state's role in agriculture, e.g. Glynn, S. Government Policy and Agricultural Development. Univ. of W.A. Press, 1975, but too often these are based on limited theoretical frameworks, e.g. Frost, L.E. 'Victorian Agriculture and the Role of Government, 1880-1914', Ph.D. Thesis, Monash Univ. 1982.

32. On this point see the doctrinaire approach by Fincher, R. 'The inconsistency of eclectism', Environment and Planning A. 1983, 15, pp. 607-622.

33. Harrison, R.T. & Livingstone, D.N. 'Philosophy and problems in human geography: a presuppositional approach'. Area, Vol. 12 No. 1, 1980 pp. 25-31.

THE ROLE OF FOREST RESEARCH IN THE EXOTIC PLANTATION FORESTS IN SOUTH-EAST QUEENSLAND

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INTRODUCTION

Approximately 114 000 ha of plantations of exotic conifers have been established in Queensland and 90 000 of these are in the south-eastern parts of the state, near Brisbane, Gympie and Maryborough (Figure 1). In the same region there are also about 45 000 ha of plantations of native conifers - hoop pine (*Araucaria cunninghamii*) and bunya pine (*Araucaria bidwillii*). Yet 70 years ago no plantations existed. There was merely a desperate concern amongst the forestry profession that the native hoop and bunya softwood forest resource was rapidly being lost to clearing and settlement (Figure 2).

The current plantations are the product of a sustained effort designed to alleviate the loss of the natural resource. The very first plantations were of the native species, but these require highly fertile sites much in demand for settlement and agriculture. Consequently the areas needed were generally unavailable and thoughts turned in 1923 (Anon., 1923) to the possibility of using the large swathe of infertile wallum country, described by Coaldrake (1962), which stretches from Brisbane to Bundaberg - an area of land not agriculturally productive nor in demand at that time but close to the major markets of the southern part of the state (Anon., 1926) including Brisbane, Gympie and Maryborough. The exotic plantations have subsequently converted this unproductive country to a highly productive forest resource.

The Queensland exotic plantations which were developed on the wallum were based on an applied research program which repeatedly indicated need for modifications and has guided development and changes of silvicultural procedures. This paper reviews the development of the research program for these exotic forests of south-east Queensland and highlights the research needs of modern development projects.

The species concerned are primarily the slash pine (*Pinus elliottii* var. *elliottii*), the Caribbean pine (*Pinus caribaea* var. *hondurensis*) and the loblolly pine (*Pinus taeda*). However the slash and Caribbean pines were not separated taxonomically until 1948 and before that date both were known as *Pinus caribaea*. Thus there is a danger of mistaking the species referred to in older reports. To avoid such confusion, whenever the term '*Pinus caribaea*' is used but

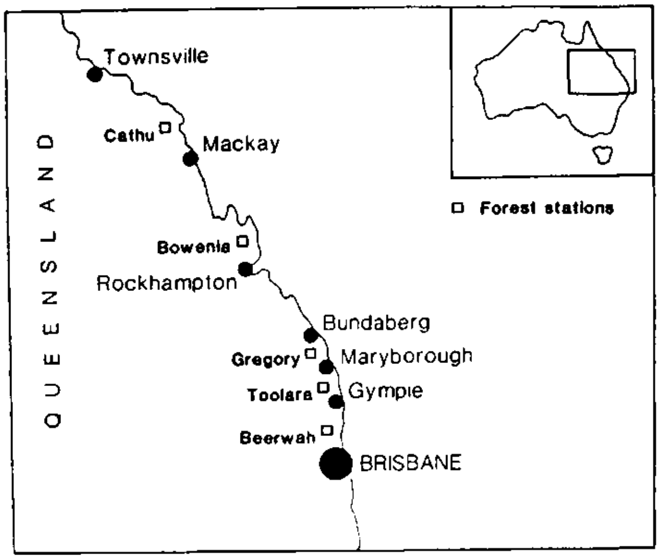

Fig. 1 The location of the major cities and forest stations in southern and central Queensland

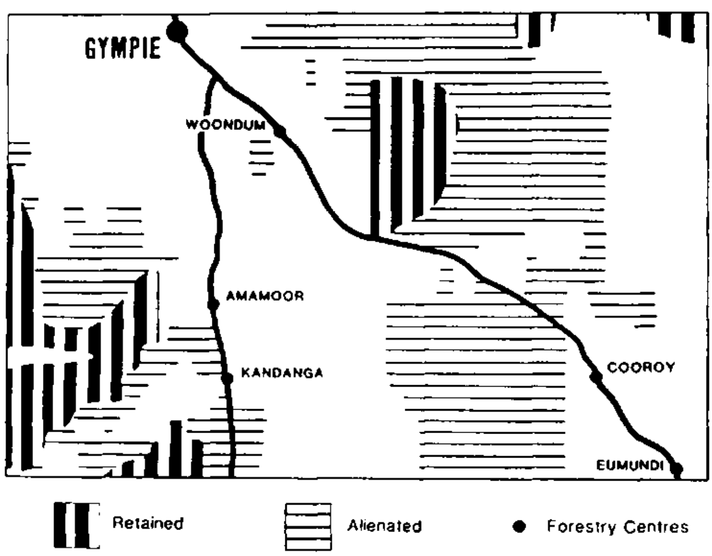

Fig. 2 A map redrawn from the 1929 Provisional Forestry Board annual report showing areas of forest reserve alienated and the areas retained under forestry control

the reference is to slash pine this is indicated in the text by the use of the common name in parentheses.

PLANTATION PROGRAM DEVELOPMENT

There is a sequence to the development of the operations of a plantation program and each phase of the sequence demands its own research and development program. The phases are:

(i) selection of the species to be used;

(ii) development of techniques for establishment, including procedures for use in the nursery, for clearing the existing vegetation, for planting and for tending;

(iii) manipulation of the development of the forest, including its nutrition and its silviculture;

(iv) development of local seed supply and possibly the establishment of seed orchards and breeding programs;

(v) development of procedures for harvesting and marketing the timber as thinnings and final crop.

In Queensland each phase has been marked by intensive applied experimentation and development of procedures based on the experimental results. Progress in each, except the harvesting, is summarized below. But mention must be made of the guidance from the senior administrators. The Directors of Forests, Jolly, 1911-1918, and Swain, 1918-1932, who had charge of the development during the early stages of plantation development, placed great emphasis on research. Jolly initiated the studies of natural and artificial regeneration of the native species and established the first growth plots (Carron, 1980). But it was Swain who emphasized how the earliest plantation work with the Hoop pine had begun:

> with experiment and hesitancy because for our rich range of native species there was no technique available and the lessons of the winter rainfall countries were not appropriate to our summer rainfall land (Anon., 1926);

and noted that after the first 10 years :

> we have laboured the experimental beginning of the incline of the afforestation graph and have surmounted the difficult initial grades ... from a ten-year experience in experiment the Queensland Forest Service has culled invaluable lessons and has built up a planting technique which is especial to its species ... (Anon., 1926).

Indeed Swain continually emphasized the importance of experimentation in the development of procedures - thus,

> All issues relating to the selection of the ultimate components of the standardized timber crops of tomorrow may be decided only by time and experiment (Anon., 1926).

This tradition of using research findings to develop techniques continued with the active support of later Directors or Conservators - V. Grenning, 1932-1964, A. R. Trist, 1964-1970, and C. Haley, who was not only Conservator, 1970-1974, but also Senior Research Officer from 1948 to 1964. During this time Haley was directly responsible for the management of the research program and the interpretation of its results for silvicultural benefit.

That the Department still attaches great importance to its research programs can be deduced from the latest Research Report (Anon., 1987) which lists 38 scientists employed directly on such work.

SPECIES SELECTION

Swain was a climatologist who placed great faith in homoclimal matching (E.H.F.S. 1971) and who directed the initial choice of species for the wallum to those from the summer rainfall zones of the world :

> There are people who would urge us to plant larch and fir and oregon and British oak in Queensland, not knowing the law of the forest which gives to some species the summer rain land and to others the winter rain regions ... There are however, in Florida, in India, in the Philippines, in similar climates to our own, trees which on similar soils might be usefully introduced to supplement our own native stores. Such trees have been observed by Queensland Forest Officers in their natural haunts and are now being grown here experimentally. Already the chir pine of the Himalayas may be seen flourishing in the Brisbane botanical gardens ... The important Caribbean (slash) and loblolly pines of the sand loam wet plains of the south-eastern USA should grow equally well upon the better quality sites of the Beerwah-Beerburrum land ... These trees and others the forester may call to his aid in Queensland to supply the needs of the expectant sawmills of sixty years hence (Anon., 1925).

The progress of the species trials of exotics is illustrated by the following excerpts from the Annual Reports of the Forest Board from 1924 to 1932:

> 1924 - An experimental station was established at Beerwah for the purpose of trying out the softwood species of southern USA - i.e. _Pinus caribaea_ (slash pine), _Pinus taeda_, _Pinus palustris_ and _Taxodium distichum_. If these species produce the expected results large areas of waste coastal land may be afforested successfully with these valuable species (Anon., 1924).

> 1926 - The board has obtained a forest reservation of 15 300 acres ... 48 miles from the softwood-hungry Brisbane market and ... is taking the first steps towards materializing pineries of the Caribbean (slash) and loblolly pines of Florida. Pinus echinata has also be requisitioned and from other summer rain lands ... have been brought Pinus patula, Pinus leiophylla and Cupressus arizonica, Pinus montezumae, Araucaria brasiliana, Pinus insularis, Pinus merkusii and Juniperus procera and the chir pine (Pinus longifolia).
>
> At Maryborough a 10-acre aboretum was established on poor wallum waste and twenty different species were set out. It is intended to add a large range of trees in order to prove by survival which ones may be applied eventually to the reclamation of the large areas of waste wallum along the coast of Queensland (Anon., 1926).
>
> 1930 - Present indications are very hopeful for the reforestation of large areas of this waste coastal country with Florida pines. Large stocks of young plants in the nursery are showing excellent growth, whilst robust plants in the plantation have reached a height of 8 feet in two years from planting (Anon., 1930).
>
> 1931 - At Beerwah, Pinus taeda planted out three years ago has reached heights of 18 to 20 ft (Anon., 1931).
>
> 1932 - Extensive planting of slash pine (Pinus caribaea) was carried out at Beerwah and the results have been highly satisfactory (Anon., 1932).

So by the early 1930s the two species, slash pine and loblolly, had indicated their potential for the wallum country and up to 1953 these species constituted the bulk of the exotic plantings in the ratio of 2:1 slash:loblolly.

The attention to homoclimal matching to determine the potentially most suitable seed sources in Florida proved extremely far-sighted. The area chosen - Ocala National Forest, Central Florida (Rogers, 1957) - proved amongst the best in later wide-ranging provenance tests of the two species (Nikles, 1962; Slee and Reilly, 1966).

It was some time later that the Honduras Caribbean pine came under notice. To quote the 1947-48 Annual Report:

> Plots of the Honduras strain of Pinus caribaea were established at Beerwah and at Tuan Creek (Maryborough). In the nursery this strain exhibited characters markedly different from normal Pinus caribaea and appears to be more prone to losses when planted open root (Anon., 1948).

This material was to prove superior to slash pine in most locations (Rogers, 1957; van Altena, 1971) but its continuous growth habit meant it did not develop a hardened dormant phase naturally and could not be planted open root until techniques were developed in 1976 (see below).

NURSERY AND ESTABLISHMENT PROCEDURES

The first five acres of exotic forest plantation were established at Beerwah in 1926. This was ten years after planting of hoop pine had commenced and some 1 500 acres of softwood plantations, mainly hoop pine, had been established throughout the state and the annual planting rate had reached 800 acres. Thus the procedures for raising and planting hoop pine were well defined (Anon., 1926). Not surprisingly, the initial procedures used for the exotics were those for the hoop pine. The most important were the use of shaded nursery beds and the planting of tubed stock - essential with hoop pine to facilitate its early development and because the species does not develop a hardened winter-dormant condition. Planting difficulties which this causes are exacerbated by the unreliability of winter rains. Thus:

> Drought itself is a normal condition of Queensland silviculture and upon consideration of drought must be founded our forest technique ...
>
> There is no assured planting season in Queensland. In summer the sun beats down fiercely and insolation is an ever present risk ...
>
> The planting period has ordinarily been staged subsequent to the time of greatest heat and prior to the advent of the usual winter drought ...
>
> Open root planting is out of the question for Queensland (Anon., 1926).

Despite the last statement the situation with the exotics was rather easier. Both slash and loblolly pines do have winter-dormant periods and can tolerate the harsh conditions rather better than hoop pine. This was evident very quickly and allowed both open root planting and the use of open unshaded nursery beds. Thus:

> Pinus taeda is showing very encouraging development. It would appear that open root planting after the summer rains is possible (Anon., 1928).
>
> The future of Pinus taeda on the poor coastal lands ... would seem assured, experiments indicate the adoption of open root planting and treatment in the open nursery. Dispensing with the shades will greatly reduce nursery costs (Anon., 1929).

Nevertheless the variability of the winter rains was (and still is) a concern and the exotic plantings were treated very carefully. Thus:

> 1933 - At Beerwah planting was considerably delayed awaiting the winter rains. After a fall of 70 points planting was commenced only to be followed by a further dry spell. Results, however, have been particularly good and the care taken in planting has been fully justified (Anon., 1933).
>
> 1935 - The winter open-root plantings of slash and loblolly pines ... again established well in spite of very dry conditions (Anon., 1935).

In 1937 the procedures became fully accepted -

> Rainfalls well below average in all districts with record maximum temperatures, low humidities, high evaporation and high winds in spring and summer, particularly following the severe 1935-36 conditions, combined to make 1936-37 the most difficult year from all climatic aspects ever experienced in the history of silviculture and forest management in Queensland. The efficiency of the developed technique was severely tested this year as the bulk of the plantings were on sites which had not received soaking rains for two years. The results of the open root winter plantings of slash and loblolly pines were ... gratifying (Anon., 1937).

There were numerous nursery studies. The importance of mycorrhizae for development of these Pinus species was well understood (Anon., 1928; Anon., 1938) and a series of other experiments defined and detailed procedures such as maintenance of bed fertility, seed pre-treatment, rates of sowing, depth of sowing, optimum density of plants in the beds, frequency of root wrenching to control development and the procedures for lifting, culling and transporting the seedlings to planting. The procedures used have been summarized in Hawkins and Muir (1968 and 1987).

However one of the Queensland Department's greatest achievements came in 1976 when large-scale open root-planting of Caribbean pine commenced. This species does not have a winter-dormant phase of growth and thus has to be forced into a hard condition to allow it to tolerate the rigours of open-root planting. The procedure used to do this includes frequent root wrenching and topping. The seedlings are also protected by clay dipping the roots following lifting and careful culling of unsuitable seedlings. The techniques used were developed from a series of nursery studies (Bacon and Hawkins, 1977, Shea and Armstrong, 1978), and a PhD program at the Australian National University by Bacon (1978).

Caribbean pine has 20-40% greater volume production than slash pine on well-drained sites as well as superior wood qualities. Thus the productivity of large areas of the exotic resource were immediately increased by its use. Some idea of the complexity of the open-root operations and the skill involved can be deduced by the fact that no other forest service plants the species in this way despite its being an important plantation tree in over 30 countries.

TENDING OF YOUNG PLANTATIONS

Weed growth in young plantations was a major problem. The development of eucalypt coppice could be especially damaging (Henry, 1958). A wide range of methods have been used to overcome weed competition. These are so extensive as to be beyond the scope of this paper, but they include manual slashing, the use of hormonal sprays both pre- and post-planting and, more recently, machine clearing and intensive ploughing. These have also been associated with the development of procedures for drainage and mounding of the wetter sites (Francis, 1984; Hawkins and Muir, 1987; and others).

PATHOLOGY AND FERTILIZER APPLICATIONS

By 1932 there was enough confidence in the exotic program to expand. Earlier plantings had been of the order of 10 acres or less per annum and these increased in 1932 to over 400 acres, to nearly 300 in 1933 and to over 600 in 1934. There must therefore have been considerable consternation when symptoms of ill-health known as 'fused needle' appeared and became serious in 1934. In trees affected the needles of each fascicle twist and adhere to each other, shoot growth is depressed and a very shrubby and stunted tree is produced. Only 6% of the plantations were to be affected but this would not have been known at the time and some stands were virtually destroyed with over 80% of the trees debilitated (Young, 1940).

A full description of the studies into fused needle has been given by Young (1940), a pathologist seconded from the Department of Agriculture and Stock in 1934 to study the problem. The following extracts from the Annual Reports indicate the seriousness with which the problem was regarded and summarize the progress in development of an understanding of its relationship with phosphorus levels and satisfactory mycorrhizal development.

> 1934 - It was hoped that the 'Fused Needle' disease now attacking some of the trees at this center will not become epidemic in proportion (Anon., 1935).
>
> 1935 - Results to date (in the fused needle investigation) fail to support theories correlating the disease with soil and inheritance and have almost definitely disproved it to be virus. The question of any relationship between mycorrhizae and the disease being especially investigated (Anon., 1935).
>
> 1937 - The pathological investigations concerned with Fused Needle in the exotic species have given a lead on the possibility of the use of fertilizers with these species (Anon., 1937).
>
> 1938 - The investigations concerned with the 'fused needle' in exotic conifers have advanced considerably and it appears that the diseased condition is intimately bound up with microbiological relationships in the soil. The application of phosphatic dressings in affected areas has resulted in a

change in the direction of these activities with consequent beneficial effects towards the pine trees. Trials with fertilizers other than those containing phosphorus have given no beneficial results. Zinc sprays and root grafts have also given negative evidence (Anon., 1938).

1939 - Investigations concerned with the fused needle disease at Beerwah have proceeded and the phosphate treatments established some years ago have again proved superior to all others and in the oldest plots all evidence of the disease has been completely obliterated. It has been shown that the addition of ammonium sulphate to any of the treatments depresses their effect. Ammonium sulphate alone depresses growth and increases the severity of the fused needle disease; investigations into the reasons for this are in progress. The mycorrhizal relationships of the disease seem to be firmly established and observations during the year have strengthened this view (Anon., 1939).

1940 - a phosphate survey was commenced at Beerwah with the object of determining the fertilizer applications necessary to ensure healthy growth of previously unsatisfactory stands. The results showed a close correlation with previous research work determining the minimum quantity of P_2O_5 required by both species.

Fertilizing (phosphate addition) has been adopted as a routine operation on areas deficient in phosphates planted with exotic species ... the degree of application being determined beforehand by careful survey (Anon., 1940).

Young (1940) specified the total phosphate level necessary in the surface soil for satisfactory growth as 110 parts per million (ppm) for slash pine and 135 for loblolly and, as noted above, the use of phosphate fertilizers in the exotic plantations to ensure satisfactory levels became a routine operation in 1940 (Anon., 1940). This routine application of fertilizer in forest plantations was a most radical operation for that time. In Europe, fertilizer applications to forest trees were still generally not regarded as desirable twenty years later, in the late 1950s.

It is also worth noting the rapidity with which the operations were introduced. The Annual Report of 1939 is the first to clearly define the need for phosphate fertilizing and yet within a year the soil surveys and fertilizer applications were in place. Such rapidity of application of research findings has been a hallmark of the Queensland operations and is indicative of the close links which exist between routine operations and the research programs.

Further studies on fertilizer requirements have subsequently refined the procedures for different sites and species and defined the use of other nutrients (see Richards, 1958, 1961a, b Hawkins and Muir, 1968, 1987). The high phosphate requirements of loblolly pine led to its being dropped from the program in 1953 (Hawkins and Muir, 1968).

TREE-TO-TREE SPACING, THINNING AND PRUNING

The year 1936 marked a change in emphasis of the research work. After ten years, studies of thinning and pruning became more important than those on establishment and early tending (Anon., 1936). Some of the Queensland Forestry Department's most important research work has been into the development of thinning, spacing and pruning schedules and throughout the period 1934-1945 the Annual Reports contain details of the development of the regimes.

The Queensland approach to thinning was very strongly influenced by the work of O'Connor and Craib in South Africa. There the concepts Craib developed whilst working in the Wattle Research Institute had been applied successfully to the South African plantations of exotic Pinus species (Craib, 1947).

The first thinning studies relied heavily on the use of free-growth plots (Robinson, 1968). These plots were first used in South Africa (O'Connor, 1935) and their use in Queensland has been described in detail by Trist (1956). In their simplest form these consist of a series of plots at a wide range of different spacings established whilst the trees are still small and not competing with each other. By careful measurement of the individual trees it is possible to determine when tree-to-tree competition commences in each plot. The Pinus elliottii free-growth plots showed that trees of this species planted at 800 per acre started competing with each other at age 5 whilst at a spacing of 80 per acre competition commenced at age 9 (Haley, 1955).

However the free growth experiments were of more value later in the rotation. The availability of a set of plots with trees at different spacings (in the case of Pinus elliottii from 800 to 80 trees per acre) allowed the growth rates which occurred at these spacings to be measured and the size and the value of the trees produced at each spacing to be determined.

Thinning data indicated that basal area increment was approximately constant over a wide range of different spacings (Trist, 1956). Also at all spacings increments were found to decrease with age - in the case of slash pine quite markedly after age 10.

Trist notes the utility of this data. Trees planted at the standard spacing of 2.1 m x 2.1 m would not be of sufficient size to allow merchantable thinning before age 10. Yet after age 10 the stand growth would be so low that the remaining trees would be unable to respond vigorously and the thinning would be ineffective. This posed the question: When would be the most effective time for an early, unmerchantable thinning to be carried out. Trist outlined the solution based on the work of Richards (1954) which demonstrates the value of the information available from the free-growth plots:

> A stocking of 400 stems per acre had been found to give maximum merchantable volume production.

> Tree-to-tree competition started at age 4 for trees at 2.1 m x 2.1 m spacing. There was therefore no advantage in thinning before that time.
>
> Field examination showed that at age 4 the trees were sufficiently developed to allow those of best form (straightness and branching) to be selected.

An unmerchantable thinning could therefore be applied at age 4 and leave the best trees in the stand. Subsequent analysis indicated this was justifiable economically (Trist, 1956).

There have been many subsequent experiments but the early free-growth plots established in 1936 in both Pinus elliottii and Pinus taeda, which produced trees growing at a very wide range of stockings allowed such silvicultural decisions to be made with considerable confidence. Indeed the objects of management could be defined very precisely: viz. on the better sites a final crop of 80 trees per acre with mean gbh of 60 inches (152 cm) at age 60 (Grenning, 1957). Bevege (1972) took the information a stage further in 1963-64. He defined the optimum basal areas for different site types and proposed thinning schedules to maximize production on different sites.

It is again worthy of note that these heavy-thinning regimes were most radical. Many concepts of forest management at the time were based on the German practice of carrying forests heavily stocked and with only very light thinning (Hiley, 1967). Swain reports (E.H.F.S., 1971) that, in 1934, Australia's foremost foresters - Messrs Jolly and Lane Poole - gave evidence before a South Australian Royal Commission that thinning was unnecessary. He also comments that Craib's radical thinning proposals were howled down at the 1947 British Commonwealth Forestry Conference. Nevertheless, with the research results to support their programs, Queensland's foresters were prepared to develop these innovative thinning regimes. One wonders what the position would have been if there had been no detailed research data, free-growth plots or thinning experiments in existence in the state's exotic forests.

PRUNING

To facilitate rapid production of high-quality timber, pruning and thinning have to be closely associated. It is essential to balance removal of the branches with the need to avoid slowing growth and having the trees at a spacing which ensures the maximum value will accrue on the remaining trees. Robinson (1968) summarized the extent of the knowledge available and how the thinning and pruning research program had defined the responses of the trees to different conditions:

> Pruning experiments were carried out in stands with initial stocking varying from 550 to 900 stems per acre, about 160 of which were pruned to 21 feet [6.4 m] in three or more stages. It was found that knotty cores of up to 18.8 [48 cm] inches

> in girth ... had to be accepted if loss of height increment of the pruned stem were to be avoided ...
>
> Pruning schedules were devised for each species which prescribed the timing of each pruning lift.
>
> An adapted straight blade bow saw is the favoured pruning tool.
>
> The cost of pruning is unlikely to be recouped on more than 120 stems per acre.

SEED PRODUCTION AND TREE IMPROVEMENT

Plantation programs usually aim to become self-sufficient in seed supply as soon as possible. In Queensland seed was available from the plantations by the mid-1930s, as the following quotations from the Annual Reports indicate:

> 1934 - Seed collected from plantation trees of slash and loblolly pines at Beerwah has germinated freely yielding sturdy and healthy seedlings (Anon., 1934).
>
> 1935 - At Beerwah all the seed of *Pinus taeda* and *Pinus caribaea* available was collected, about 4 lb of the former, but only 2 oz of the latter, being secured. However, the seed was particularly good and it is hoped that all seed requirements of these species will be met by local collection in the near future (Anon., 1935).

The possibility of controlling the genetic constitution of the plantations must have been realized very early in the program. Consideration was given in 1934 to the possibility of the fused needle problem being inherited (Anon., 1934). This was really quite a remarkable suggestion for the time. To compare - in Britain there had been some consideration of benefits from tree breeding in 1930, but in the U.S.A. in 1936 there were only nine professionals engaged on forest genetics research and in Australia there were no genetic studies on radiata pine until 1937 (Toda, 1974).

Serious attention to the importance of parentage in controlling progeny performance was effected in 1941 when seed was collected from a range of different types of parents, including trees with S-shaped bends in the boles and those with heavy high-angled branching as well as high-quality trees (Haley, 1957). Controlled pollinations between high-quality trees were also made at this time. By 1948 the results were conclusive. S-bend trees produced S-bend trees and there was a marked increase in the frequency of high-quality trees in the progenies of high-quality trees (Anon., 1948; McWilliam and Florence, 1955; Haley, 1957).

Consequently, selection of seed trees in the plantations commenced in 1946 and by 1953 there were 440 such trees and by 1963 there were 750 in slash pine. The 1963 seed collection from these trees totalled 459 lb (Slee and Reilly, 1967).

Establishment of seed orchards commenced in 1953. By 1964 two separate orchards with a total of 11.3 ha were in production and in 1966 these fully met the requirements of the state. (Slee and Reilly, 1967). However before seed orchard establishment commenced two supporting studies guided the siting and design of the orchard. One determined the probable extent of pollen contamination (Florence, 1955). The other investigated seed production at different tree spacings and was able to define the spacing which gave maximum seed production per acre (McWilliam and Florence, 1956).

The gain from the seed orchard stock over unselected material was estimated at over 30% (Nikles, 1962). Subsequently the program has been developed, producing later generations of improved slash pine. However a more important achievement has been the improvement of Caribbean pine. Since the early 1960s this species has been the major plantation species of north and central Queensland and the breeding program has progressed through several generations, under the guidance of D.G. Nikles, in parallel with that for slash pine. The development of the open-root planting technique in conjunction with the improvement of stem straightness by tree breeding allowed this species to become the major component of the planting program in the southern areas of the state in 1976 (Hawkins and Muir, 1987). The current expectation is that the hybrid between slash pine and Caribbean pine will also be produced for routine use in the near future, as it combines the best features of each of its parents (Nikles <u>et al</u>., 1987).

In summary, therefore, the breeding program with the exotic pines has progressed from improved seed collections in slash pine through several generations of slash and Caribbean pine breeding, with Caribbean pine replacing slash, to possible development of a hybrid program.

<u>SITE</u>

Another most important program was the site analysis of Pegg (1967). The wallum is a mosaic of ecological communities and land forms. Some are suitable for tree growth. Others are not suitable without such operations as drainage and mounding. The early plantings avoided the difficult areas. Pegg's study classified the sites in terms of potential tree growth and indicated where intensive site preparation would be necessary. It thus provided the foundation for the site preparation techniques developed in the 1970s (Hawkins and Muir, 1987).

<u>CONCLUSIONS</u>

This review has necessarily been brief and has had to omit much of the experimental work in the exotic forests of south-east Queensland since 1926. Nevertheless it is clear that the Queensland plantation program has been based on techniques developed by close liaison between research and routine. The plantation program could not have been successful without the guidance of the research program.

It is pertinent to compare the Queensland program and its cautious and careful progress with the programs for many development projects. The Queensland Department did not proceed beyond a 4 ha planting for five years until it was confident of its ability to grow the trees successfully. Even then there were major problems with the phosphate requirements. Perhaps we should contrast this with some typical international development projects in which, for example, 20 000 ha are to be planted in 10 years without prior experiment and without an associated research program. Suffice it to say that had this been done in Queensland there would have been massive losses or failures of loblolly pine from phosphate problems after about 10-15 years and the need for an unmerchantable thinning program in slash pine would have led to problems in that species also.

REFERENCES

Anon., 1923 Report of the Provisional Forestry Board for the year ended 30th June, 1923, Brisbane.

Anon., 1924 Report of the Provisional Forestry Board for the year ended 30th June, 1924, Brisbane.

Anon., 1926 Report of the Provisional Forestry Board for the year ended 30th June, 1926, Brisbane.

Anon., 1930 Report of the Provisional Forestry Board for the year ended 30th June, 1930, Brisbane.

Anon., 1928 Report of the Provisional Forestry Board for the year ended 30th June, 1928, Brisbane.

Anon., 1929 Report of the Provisional Forestry Board for the year ended 30th June, 1929, Brisbane.

Anon., 1931 Report of the Provisional Forestry Board for the year ended 30th June, 1931, Brisbane.

Anon., 1932 Report of Forestry Board, Queensland 1932, Brisbane.

Anon., 1933 Annual Report, Sub-Department of Forestry, Queensland 1933, Brisbane.

Anon., 1935 Annual Report, Sub-Department of Forestry, Queensland 1935, Brisbane.

Anon., 1937 Annual Report, Sub-Department of Forestry, Queensland 1937, Brisbane.

Anon., 1938 Annual Report, Sub-Department of Forestry, Queensland 1938, Brisbane.

Anon., 1948 Annual Report, Sub-Department of Forestry, Queensland 1947-48, Brisbane.

Anon., 1987 Research Report 1985, Department of Forestry, Queensland, Brisbane.

Bacon, G.J. and Hawkins, P.J., 1977 Studies of the establishment of open root Caribbean pine planting stock in southern Queensland. Aust. For. 40: 173-191.

Bacon, G.J., 1978 Physiological aspects of conditioning Pinus caribaea Mor. var. hondurensis B. & G. seedlings to withstand water stress. Ph.D. thesis, Australian National University.

Bevege, D.I., 1972 Girth and basal area growth of slash pine and their significance to plantation management in Queensland. Queensland Dept. For. Res. Paper No. 2: pp.69.

Carron, L.T., 1980 A history of forestry and forest product research in Australia. Historical Records of Australian Science, 5: 7-57.

Coaldrake, J.E., 1962 The ecosystem of the coastal lowlands ('wallum') of the southern Queensland, CSIRO Bull. No. 283.

Craib, L.J., 1947 The silviculture of exotic conifers in South Africa, Paper presented to 5th British Empire Forestry Conference, Great Britain, 1947.

E.H.F.S., 1971 A selection of the papers left by E.H.F. Swain, edited by N. Foote, R.M. Black and B.U. Byles, NSW Forestry Commission, Sydney.

Florence, R.G., 1955 Observations of the dispersion of pollen from a slash pine plantation. Its possible effect in contaminating a slash pine seed orchard, Qld. For. Ser. Res. Note No. 5.

Francis, P.J., 1984 The role of cultivation in plantation establishment in subtropical eastern Australia, Symposium on Site and Productivity of Fast Growing Plantations. Pretoria and Pietermaritzburg, South Africa, 1984: 579-587.

Grenning, V., 1957 Production of quality wood in coniferous plantations in Queensland, Paper presented to 7th British Commonwealth Forestry Conference, Australia and New Zealand, 1957.

Haley, C., 1955 Some observations on the thinning of hoop and slash pine, Paper presented to meeting of Institute of Foresters of Australia, Brisbane, 1955: 18 pp.

Haley, C., 1957 The present status of tree breeding work in Queensland, Paper presented to 7th British Commonwealth Forestry Conference, Australia and New Zealand, 1957.

Hawkins, P.J. and Muir, J.D., 1968 Aspects of plantation management in tropical and sub-tropical Queensland, Paper presented to 9th Commonwealth Forestry Conference, India, 1968.

Hawkins, P.J. and Muir, J.D., 1987 Aspects of plantation management in tropical and sub-tropical Queensland, Rev. edn, ed. G.M. Shea, Qld. Dept. For., Brisbane.

Henry, N.B., 1958 Use of 2, 4-D and 2, 4, 5-T for killing small eucalypts, Qld. For. Ser. Res. Note No. 5.

Hiley, W.E., 1967 Woodland Management, Faber and Faber, London.

McWilliam, J.R. and Florence, R.G., 1955 The improvement in quality of slash pine plantations by selection and cross breeding, Aust. For. 19: 8-12.

McWilliam, J.F. and Florence, R.G., 1956 The influence of spacing on seed production, Zeitschrift fur Forstgenetik und Forstpflanzenzuchtung, Bund 5.

Nikles, D.G., 1962 Tree breeding in Queensland 1957-62, Paper presented to 8th British Commonwealth Forestry Conference, East Africa, 1962.

Nikles, D.G., Bowyer, P.C. and Eismann, R.L., 1987 Performance and potential of hybrids of slash and Honduras Caribbean pine in the subtropics, Proc. Simposio sobre silvicultura y mejoramiento genetica de especies florestal, Argentina, 1987: 67-78.

O'Connor, A.J., 1935 Forest research with special reference to planting distances and thinning, Paper presented to 4th British Empire Forestry Conference, South Africa, 1935.

Pegg, R.E., 1967 Relationship of slash pine site index to soil, vegetation and climate in south-east Queensland, Qld. Dept. For. Res. Note No. 19.

Richards, B.N., 1954 The development of thinning schedules for plantations of slash and loblolly pines in Queensland, Queensland For. Ser. Res. Note No. 3: 43 pp.

Richards, B.N., 1958 The effect of phosphate on slash and loblolly pines in Queensland, Qld. For. Ser. Res. Note No. 5.

Richards, B.N., 1961a Fertilizer requirements of Pinus taeda in the coastal lowlands of subtropical Queensland, Qld. Dept. For. Bull. No. 16.

Richards, B.N., 1961b Fertilizing slash pine on shallow soils, Qld. Dept. For. Res. Note 16.

Robinson, W.M., 1968 Pruning and thinning practice in Queensland plantations, Paper presented to 9th British Commonwealth Forestry Conference, India, 1968.

Rogers, L.J., 1957 Exotic forest trees in Queensland, Paper presented to 7th British Commonwealth Forestry Conference, Australia and New Zealand, 1957.

Shea, G.M. and Armstrong, P.A., 1978 Factors affecting survival in open root plantings of Caribbean pine - coastal Queensland. Qld. Dept. For. Tech. Paper No. 8, 18 pp.

Slee, M.U. and Reilly, J.J., 1966 Recent highlights of tree breeding in Queensland, Proc. 6th World Forestry Conference Madrid: 1 773-1 778.

Slee, M.U. and Reilly, J.J., 1967 The production of improved seed in Queensland, Proc. International Symp. on Man-made Forests, Canberra, Australia 1967: 1 183-1 203.

Toda, R., 1974 Forest tree breeding in the world, Maguro, Tokyo.

Trist, A.R., 1956 The planning of forestry research, Aust. J. Sci. 15: 130-139.

van Altena, A.C., 1971 The performance of two tropical pines in the coastal plateau region of north-eastern Queensland, Qld. Dep. For. Res. Paper No. 1: 19 pp.

Young, H.E., 1940 Fused needle disease and its relation to the nutrition of Pinus. Qld. Forest Ser. Bull. No. 13 108 pp.

Hauling red cedar, Atherton Tableland, north Qld, 1904

INDUSTRIES AND LABOUR

A REVIEW OF AUSTRALIAN FOREST INDUSTRY AND LABOUR HISTORY

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Although a number of articles, books and theses on the history of Australia's forest industries and the people who work in them have been written and are reviewed here, they cover only a fraction of the topic. Importantly no overall history of the industries exists that covers the whole country. We can speculate on reasons for this - the remote nature of the operations that kept them from historians' eyes, the small scale of most timber firms, their dispersion across a continent with many forest types that may have made generalisation seem difficult - but the fact remains that the literature is limited. It consists largely of accounts of particular firms or localities. However these are very valuable, not only regionally but also as materials for more comprehensive future studies which would in turn provide useful frameworks for further detailed local studies.

Nor have the forest industries received much attention in general works on Australian economic and industrial history; the export staples of wool, gold, wheat, meat and minerals, and later the manufacturing of textiles, steel, cars and whitegoods have provided their main interests. A notable exception is Linge's (1979) history of the rise of Australian manufacturing in the nineteenth century. Linge bases much of his work on the statistical returns of 'manufactories' reported annually to colonial parliaments in the statistical registers and hence reports sawmills, bark mills, paper mills and so forth like all other industries. His work is a rich source of information that facilitates comparisons with other industries.

Before proceeding, it is worth considering what the full scope of the topic might be. Geographically, the essential matter is how the industries were shaped by, and in turn shaped, the forest resources. Confronted by huge trees in a trackless land, why did the industries develop mostly as small-scale dispersed operations? What was the effect of 'cut out and move on' practices on the forest and its ability to supply resources later? And how did the resource and the spatial location of the industry change with time? Politically, the essential matter is how the industries related to the state, which retained control of three-quarters of the resources but provided them on generous terms. And linking these two aspects, how did industries interact with governments in the development of resource policies? Economically, there are three areas of interest: markets, production and organisation. How did the Australian industries fare in international and domestic markets? Some of our forest industries have at times been export oriented - blue gum piles from Tasmania, jarrah from WA, and now woodchips, for example - but mostly they have faced keen competition from imports in the domestic markets. This situation obviously raises questions about log, labour and capital costs in Australian production and its efficiency in using these factors. The histories of various individual firms have been written, but questions remain on the changing pattern of organisation in the industries as a whole. Technologically, the essential matter concerns the nature and introduction of new processes and their impacts on the industries. Socially, the essential matter is the traditional concern of labour historians: the struggle between capital and labour for profits, productivity, wages and conditions.

The scope of history of the forest industries is complicated by their variety and inter-connections, as only a few special cases can be considered virtually independently. The sandalwood industry is one such; it has been an economically important activity but its harvesting from arid areas in Western Australia and, to a lesser extent Queensland, conflicts with little else (Statham, 1988). Another is the wattlebark industry, which was important in domestic and export markets but probably impinged on little else (although its history has not as far as I know been written). The inter-connections of the major wood-using industries have not been charted fully but are of two types: those in the line from forest to consumer, and those where industries with different markets are integrated. Three examples will illustrate.

Logging The logging industry obviously cuts the trees in the forest and supplies them to the mills. Sometimes logging has been done by the mills themselves, sometimes by contractors, and in either case it has been common for snigging and haulage to be done by sub-contractors. Since the 1960s it has been common for 'integrated' logging operations to supply different mills; typically sawlogs to the sawmills, pulplogs to domestic pulp or woodchip export mills.

Sawmills and merchants The small sawmills that were scattered through the hardwood forests had to sell their rough-sawn green timber either locally or, more commonly, through metropolitan timber merchants. With the advent of successful kiln drying of eucalypts from the 1920s some larger sawmillers and merchants who were able to afford kilns and dressing equipment bought their green timber from small mills and processed it, or timber they cut themselves, for further sale. The timber merchants often had quite complex businesses; buying imported timber through agents and re-sawing it, cutting their own hardwood timber and buying it in from small forest sawmills, kiln drying, dressing and various joinery or other manufacturing operations.

Pulp and woodchip mills The advent of the domestic pulp and woodchip industries added further connections. Breaking-down sawmills were installed at some pulpmills, enabling cants of the best timber to be saved for ply or sawmilling, and chippers were installed in most sawmills, enabling their waste to be used by the pulp mills.

Such interconnections make it difficult, and now largely impossible, to study the history of any single one of the major wood industries in isolation from the others to which it is connected.

Having now considered the scope and difficulties of the topic, this paper will next provide an overview of what history has been written. It will then be possible to see how much of the topic has been covered and detect where the major gaps are.

The material has been loosely grouped under headings: national overviews of industries; state overviews of industries; individual district firms; sawn timber and plywood technology; labour and social history; and industries and the state.

NATIONAL OVERVIEWS OF INDUSTRIES

Pulp and paper industry Rawson's (1953) thesis provides a general history of Australian paper making from its start in 1818 to the 1950s. Two papers written by pioneers of the development of processes to pulp eucalyptus wood and establish domestic paper manufacturing based on local pulp in the 1920s to 1940s period not only cover the technical processes but describe company manoeuvring in the period (Jeffrey, 1947 and Benjamin, 1959; see also Holden, 1936). Watson and Cohen (1969) have reviewed research into pulping eucalypts and provided an extensive bibliography.

The monopolistic structure that was firmly established in the 1930s and 1940s was described by Davidson and Stewardson (1974), as noted earlier, with a prime interest in the price and market strategies of the industry (see also Johns, 1962). Apart from useful general descriptions put out by various major companies, no other works have been located.

Sawmilling industry Annie Boutland and I have collated some of the long-term statistics reported by the colonial and Australian governments and have offered tentative explanations (Dargavel and Boutland, 1988 a and b; see Figures 1-8.

Sandalwood As noted earlier, an overview of the sandalwood industry is provided by Statham (1988).

STATE OVERVIEWS OF INDUSTRIES

Tasmania Row (1977) has made a detailed tabulation of Tasmania's timber-trade statistics over the period 1830-1930. Her work brings out very clearly the diversity of products traded and the importance of New Zealand as a market during the gold rush and development of the South Island in the 1860s. I have described the development of the wood industries in Tasmania from a political economy perspective that pays particular attention to the relationship between the industries and the state (Dargavel, 1982; 1984b). I have also described the operation of the pulp and paper industries and have given a history of timber inspection there (Dargavel, 1984a; 1987).

Western Australia Western Australia is the state best served by historians of its forest industries. A series of early articles described some of its history (Thomas, 1939). Subsequently theses by Robertson (1956) and Dolin (1967) provided substantial treatments; the former a general perspective, the latter a detailed study of the economics of the timber industry's organisation as an oligopoly. Mary Calder's (1980) popular history provides a far more accessible, if at times romantic, account. A shorter history paying particular attention to the depletion of the resource and its environmental impacts was prepared by the Campaign to Save Native Forests and the Workers Information and Research Centre (1985). Southcombe (1986) documents the role of the steam engine in the development of the timber industry in the state and gives considerable detail on Bunnings' and Millars' operations. Southcombe also describes the life of the timber workers 40 years ago, and covers some other aspects of sawmilling history.

INDIVIDUAL AND DISTRICT FIRMS

The largest number of publications concern individual firms or all those in a particular district. There are two types of publications that will be mentioned first, as they are not cited in detail in this review. The first type consists of various pamphlets, booklets and other material prepared by various firms, often to mark an anniversary or other occasion. The second type consists of journal articles. The Australian Timber Journal, which started in 1935 and later became the Australian Forest Industries Journal, is not only an important source, but has carried a number of historical articles, particularly in its early years. Appita is an important source for the pulp and paper industry, particularly for its scientific and technical aspects. Light Railways contains many articles on the tramways that were used by timber firms.

The histories included in this review cover a wide range; from the smallest to the largest firms, across all states, and from 1825, when Degraves and MacIntosh built Australia's first sawmill, to the present. Most of the histories are short chronological descriptions.

Only four full-length histories have been written on individual large firms. Carter's thesis on the Kauri Timber Company (1972) and her monograph on Gunnersens (1986) provide business and economic histories. The Kauri Timber Company was formed to make a spectacular and successful takeover of three-quarters of New Zealand's kauri timber industry in 1888. It realised that the New Zealand resource would be exhausted eventually and relocated part of its timber production first in Western Australia and later in Tasmania. Carter's study only covered the period to 1914, but the Company's subsequent history of withdrawal from New Zealand, over-extended diversification in Australia, virtual financial collapse, and the takeovers of its Tasmanian sawmills by multi-national corporations warrant further treatment. Gunnersens is a well-known firm of timber merchants that diversified into sawmilling. They formed an interesting network of companies with two other merchant groups:

Alstergrens and Le Messuriers. A substantial part of the network has now been taken over by larger firms. However Risby Bros in Tasmania, described in Brownlow's (1968) thesis, and Bunnings Ltd in Western Australia; described in Mill's (1986) monograph, are still largely controlled by their founding families. Risbys established Tasmania's first steam-driven sawmill in 1844 and is Australia's oldest surviving timber firm. Bunnings now has a virtual monopoly on the hardwood industry in Western Australia but for much of its history had to 'play second fiddle' to the mighty Millars Karri and Jarrah Company.

Another substantial individual history of a timber firm, Whittakers in Western Australia, is included by Moore (1987) in his account of the three firms that went to make up the Bristile group. Like Risbys, Bunnings and Gunnersens, Whittakers was both a merchant and sawmiller. Taken together these business histories provide a unique view of businesses in an industry which is changing from family firms to large corporations.

Carter in her two histories, and to a lesser extent Brownlow, was able to locate ledgers from which past profits and losses could be reported. I was similarly fortunate in locating and obtaining access to ledgers of two firms of Melbourne timber merchants : J. Wright & Sons, and Bowen & Pomeroy (histories of each are in Dargavel, 1988). Wright's ledgers were exceptional in enabling sales, stock and profit/loss figures to be tabulated from 1861 to the present. Otherwise no other economically oriented business histories have been written.

There has been substantial forest and archival research into the tramways and light railways that were used so extensively by the timber industry from the 1840s for about a century. This interest has been extended to cover the sawmills and has resulted in several monographs concerning Victoria, mainly published by the Light Railway Research Society of Australia (as well as the articles in the Society's magazine, Light Railways, mentioned earlier; see also the Society's general introduction 1974). Between them Houghton (1975, 1980, 1986) and McCarthy (1983, 1987) have provided details of some 100 sawmilling firms that operated in five districts in Victoria. Stamford et al. (1984) wrote a railway history of the Victorian Hardwood Company's operations at Powelltown and Winzenried (1986) prepared an interesting account of Cumming Smith's wood distillation works that operated in the nearby Warburton district from 1907 to 1924 and then continued in sawmilling. For the Atherton Tablelands in north Queensland, Pearson (1985) has provided a few details of tramways and operations of the Cairns Timber Company.

Shipping was not as necessarily committed to timber as the tramways were and has not led researchers of that form of transport to investigate the timber industry as deeply. However Richards (1980) has included a chapter on Allen Taylor & Co.'s shipping, and its continuation by the North Coast Steam Navigation Co., in his book on coastal shipping from the north coast of New South Wales.

SAWN TIMBER AND PLYWOOD TECHNOLOGY

Although the railway historians have documented much of the transport history of the industries, and there is a considerable amount of descriptive and photographic material about logging, there is very little material on the development of sawing, woodworking and plymilling technology. Much of this could be reconstructed since the 1930s from the Australian Timber Journal, but this still leaves a century for which we know little of technological change. We can, however, gain some indication that change was not rapid from official statistics of average mill size and engine power (Figures 3 and 4). We can also see that there were changes in the sources of power. Some of the early mills were driven by horses, many by water and even two by the tides. A few brief descriptions of the layout and operation of sawmills before the 1930s can be found in some of the compendia published in the later nineteenth century (McLeod 1868, Franklyn, 1880).

The development of drying techniques was most important for Australian timbers. Early white settlers complained that the native timbers were liable to split, twist and warp (see for example Daniel Paine's comments in 1796 in Knight and Frost 1983). But somehow air-drying methods must have been developed and it was not until the 1890s that the Reiser method of kiln drying was introduced and not until the 1920s that fully successful methods of drying eucalypts were developed by CSIRO. Substantial archival and official reports exist on this, from which a valuable history could be written.

LABOUR AND SOCIAL HISTORY

The literature on the history of labour and forest-based communities is not large and most of it is scattered through many more general sources. Little has been written specifically on the labour process or the struggles of organised labour.

The production of timber in the early colonial settlements was a particularly bloody part of those nasty societies. Getting timber by hand and carrying it out of the forests on human backs was such hard, 'back-breaking' work that it was used as yet a further punishment for those already transported. The notorious punishment stations of Norfolk Island, Newcastle, Maria Island, Macquarie Harbour, Port Arthur and Moreton Bay (Brisbane) all included timber production as part of their regime; there 'man lost the aspect, and the heart of man' (West, 1852). Convicts also cut timber in the less severe sawing stations. Accounts of production in Tasmanian sawing and punishment stations are given in Dargavel (1982, 1988) and Edwards (1975).

Convicts who were assigned to free settlers, or who had obtained 'tickets-of-leave', also cut timber, and as the numbers of emancipists (those whose sentences had been served) increased, they formed the bulk of an expanding proletariat. The sawyers, splitters and cedar getters were doubtless a rough lot and lived a rough life;

some descriptions can be found in Fenton (1891), the sometimes exaggerated account by 'An emigrant mechanic' (1847), and Jervis' (1939) history of the cedar getters. The degree of their exploitation by the merchants who supplied their food and took their timber under the 'truck' system has not been quantified (and unless records are unearthed, may never be).

Although something is known of the labour history of the convict and manual period, we know little of the labour history of sawmilling from its establishment in the 1850s to the early part of this century. The scattered and small-scale nature of production combined with the prevalence of piecework, probably inhibited the assembly and combination of workers. A timber workers' union existed at least as early 1890 in Western Australia, which had the largest mills. A society that probably included some timber workers started in Tasmania about the same time. The Australian Workers Union helped the Tasmanian workers start a timber union in 1908; by 1911 this had become a branch of the Federated Timber Workers Union and by 1918 the No. 6 Tasmanian branch of the Australian Timber Workers Union. Three accounts of long and bitter strikes have been prepared: Keane's (1971) thesis covers the 1907 strike in Western Australia; I have included a brief account of the 1922 strike in Tasmania in a larger thesis (Dargavel, 1982); and Dixson (1963) has made a substantial study of the debilitating 1929 strike fought long but unsuccessfully on a falling market. There is, however, no general history of the union in either the timber or paper industries.

On a more cheerful note, the axemen's sport of woodchopping has been described in a book by Beckett (1983), and in a specialist newspaper, The Sporting News and Axemen's Journal, which made a brief appearance in Launceston from 1901 to 1904.

The social history of the forest industries is distinctive for the long period that lasted until the 1950s and 1960s during which many sawmills were located in very isolated situations in the forests. Workers and their families were housed by the firms in huts and cottages built around the mills. The conditions and quality of life in such settlements varied widely and have been variously described. Hannah (1986) has undertaken an extensive oral history of the lives of people working in the forests and sawmills of New South Wales. Accounts for Western Australia include Calder's popular history (1980) Katharine Susannah Prichard's novel, Working bullocks, (1926) and an illustrated account of one settlement by Trautman and Trautman (1980). While these portray what may seem an attractive view, other realities, such as exploitation through the company store system and even typhoid epidemics through lack of sanitation, existed.

INDUSTRIES AND THE STATE

Interest in the relationships between the forest industries and the state centre on three topics: the allocation of the resources, the prices paid for them, and the provision of future resources in natural forests and plantations - the last topic being central to the history of public forestry. I am currently studying legislative, regulatory and administrative methods that have been used in each state to allocate wood resources on public forests to industries (Dargavel, 1985; Dargavel et al., 1986/1987) and the history of the allocation systems in Tasmania has been described in detail (Cunningham, 1982; Dargavel, 1982; Hoysted, 1981; Kemp, 1982; Meadows, 1982).

A RESEARCH AGENDA

If the materials that have been reviewed here are compared to the scope of the topic, as discussed at the start, a research agenda to fill missing portions can be suggested. Such an agenda would have two parts: detailed studies on the many aspects that have been mentioned, and overall thematic or analytical studies that would draw much of the detailed material together. The interdependence of the two parts needs, I believe, to be emphasised. Clearly any overview of the industries must rely for much of its information on many detailed studies of particular aspects. But detailed studies need an overall framework in order to determine what is unique or significant about each.

Clearly there are glaring gaps in our detailed knowledge of the history of the forest industries; several have been mentioned in the course of this review. The scope for further research seems to be without limits through doubtless the paucity of source materials will impose severe ones on many aspects. But there is no overall history of the industries, and this I suggest should head the research agenda. Until many more detailed studies have been completed it could not be definitive; nevertheless the number of detailed studies reviewed here do provide a basis from which to start.

Table 1: <u>Histories of individual and district firms</u>

State	Firm or district	Period	Source
All	20 sawmilling and merchant firms	1825-1985	Dargavel 1988
NSW	Broadhead sawmills	1865-1965	Broadhead 1965
"	Allen Taylor - sawmiller, merchant skipper	1893-1957	Richards 1980
Qld	Atherton Tablelands - tramways and Cairns Timber Co.	1911-1920s	Pearson 1985
"	Hyne and Sons - sawmiller, merchant	1882-1979	Hyne 1980
SA,NT,VIC,WA	Shepherdsons - sawmillers	1849-1984	Mack 1986
TAS,WA,NZ	Kauri Timber Co - sawmiller, merchant - NZ and Australia	1888-1914	Carter 1972
TAS	Risby Bros - Sawmiller, merchant	1844-1965	Brownlow 1968
VIC	Cumming Smith - wood distiller, sawmiller	1907-1936	Winzenried 1986
VIC	Erica district - tramways, many sawmills	1910-1950	McCarthy 1983
VIC	Gembrook district - tramways, many sawmills	1885-1985	McCarthy 1987
VIC	Gunnersen Pty Ltd - merchant, sawmiller	1879-1986	Carter 1986
VIC	Murrindindi forest	1885-1950	Houghton 1986
VIC	Otway ranges	1850-1970	Houghton 1975
VIC	Powelltown - Vic. Hardwood Co.	1911-1983	Stamford <u>et al.</u> 1984
VIC	Wombat forest	1855-1940	Houghton 1980

WA	Bunnings Ltd sawmiller, merchant, woodchip exporter	1886-1986	Mills 1986
WA	Jarrahdale	1872-1972	Fall 1972
WA	Whittakers Ltd. sawmiller	1896-1986	Moore 1987

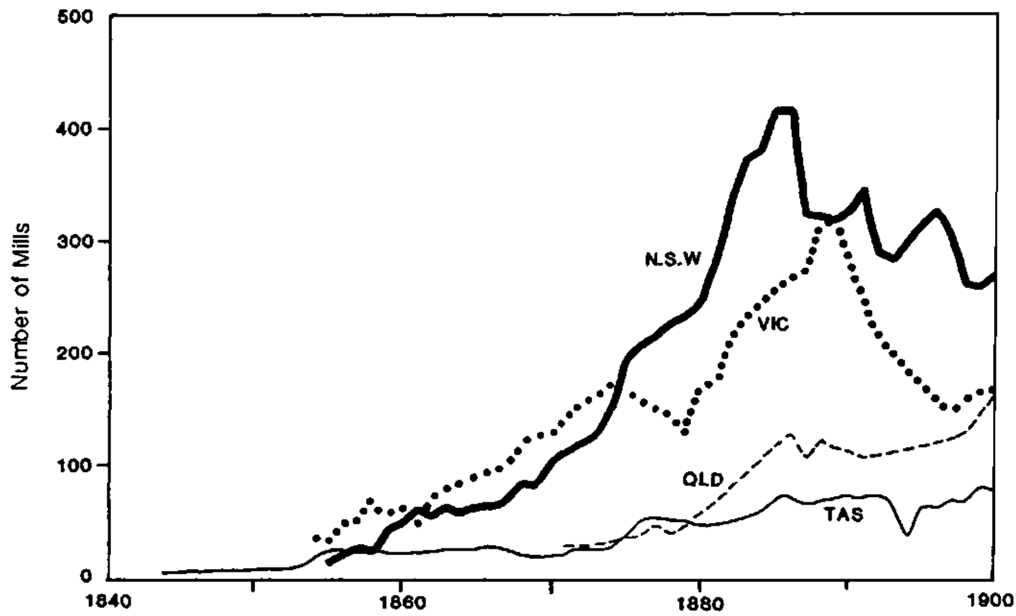

Fig. 1 Sawmill numbers in the 19th century: four colonies

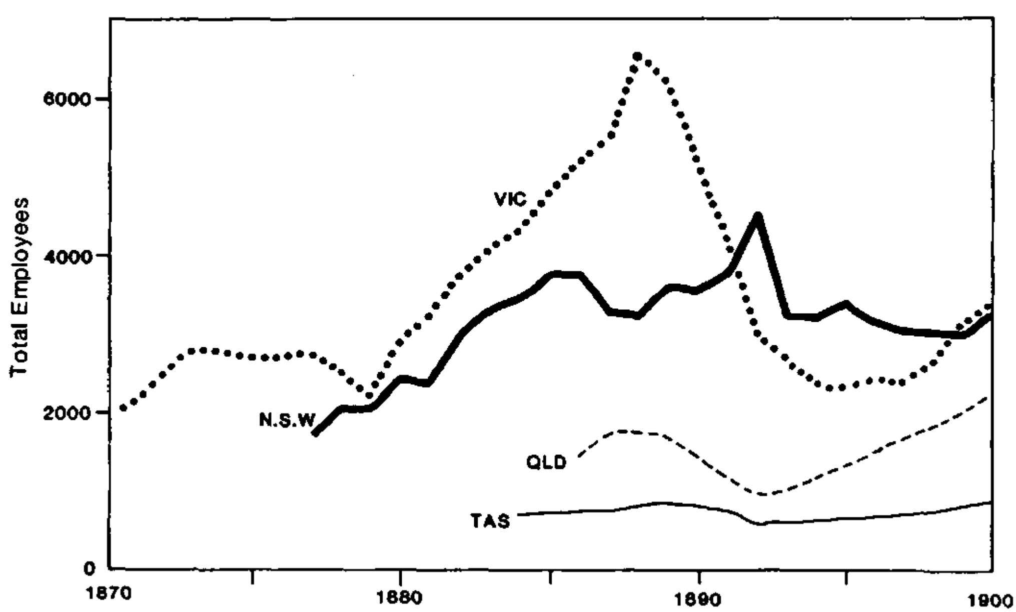

Fig. 2 Sawmill employment in the19th century: four colonies

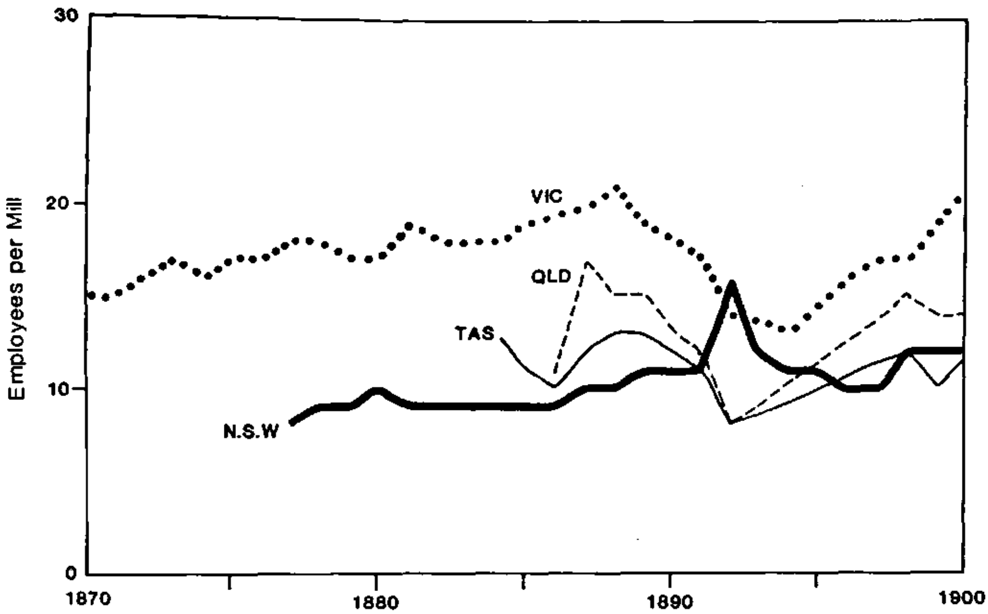

Fig. 3 Average employment per sawmill in the 19th century: four colonies

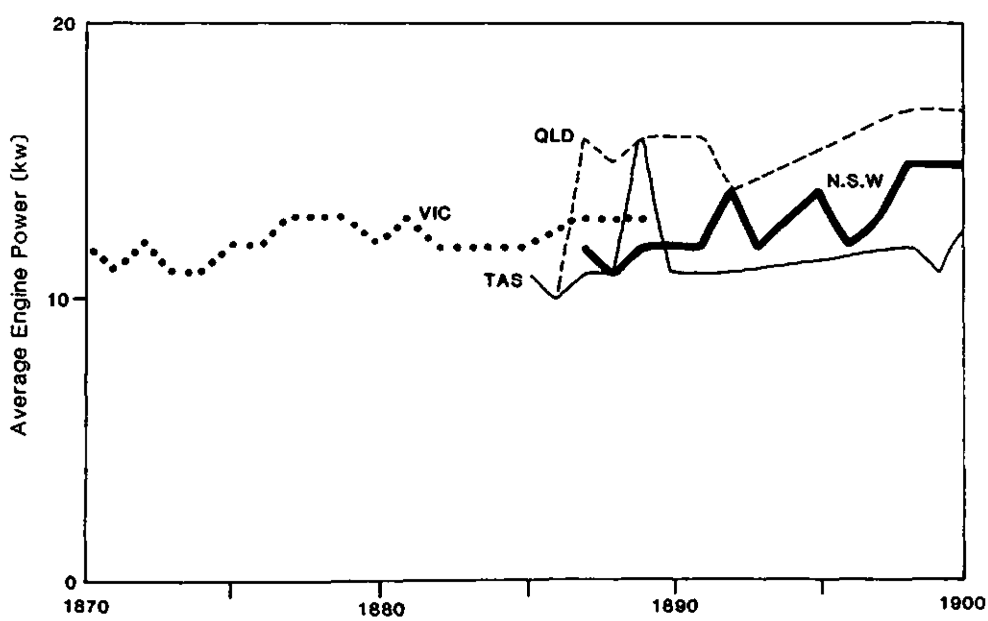

Fig. 4 Average sawmill size in the 19th century: four colonies

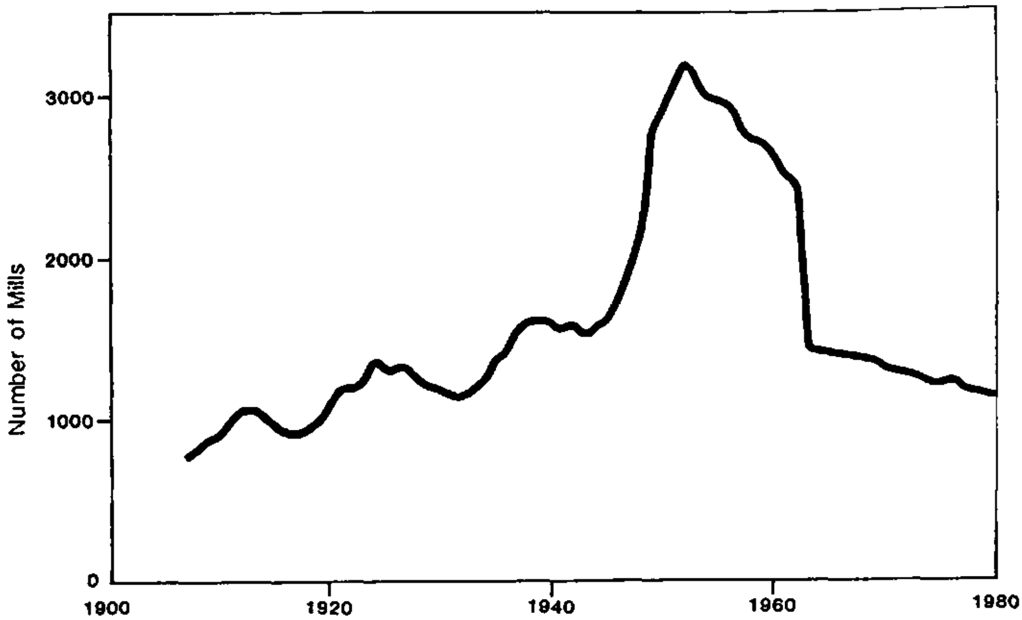

Fig. 5 *Number of sawmills in the 20th century: Australia*

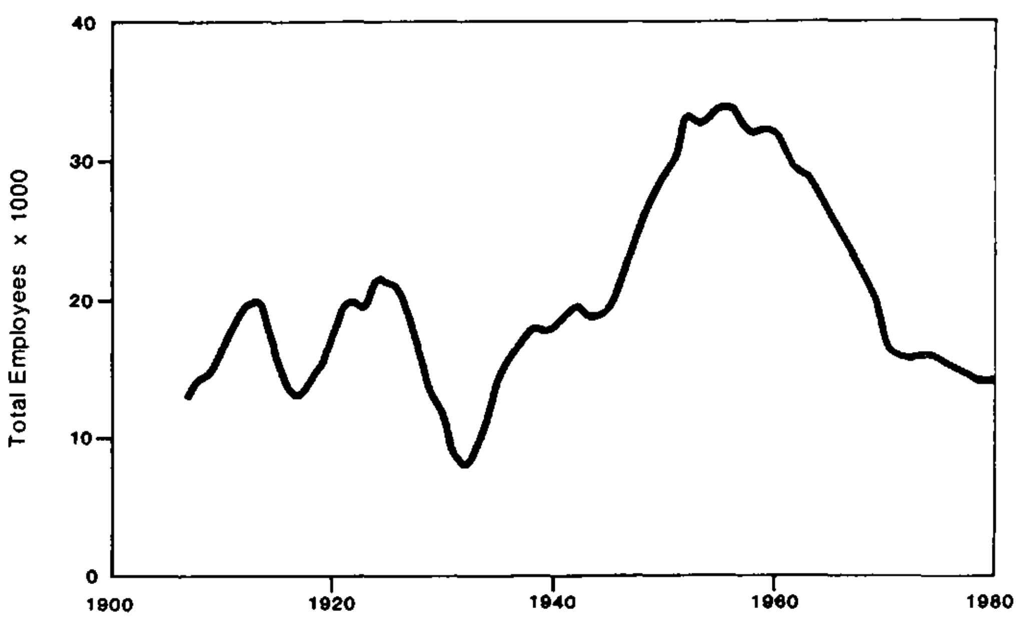

Fig. 6 *Employment in sawmills in the 20th century: Australia*

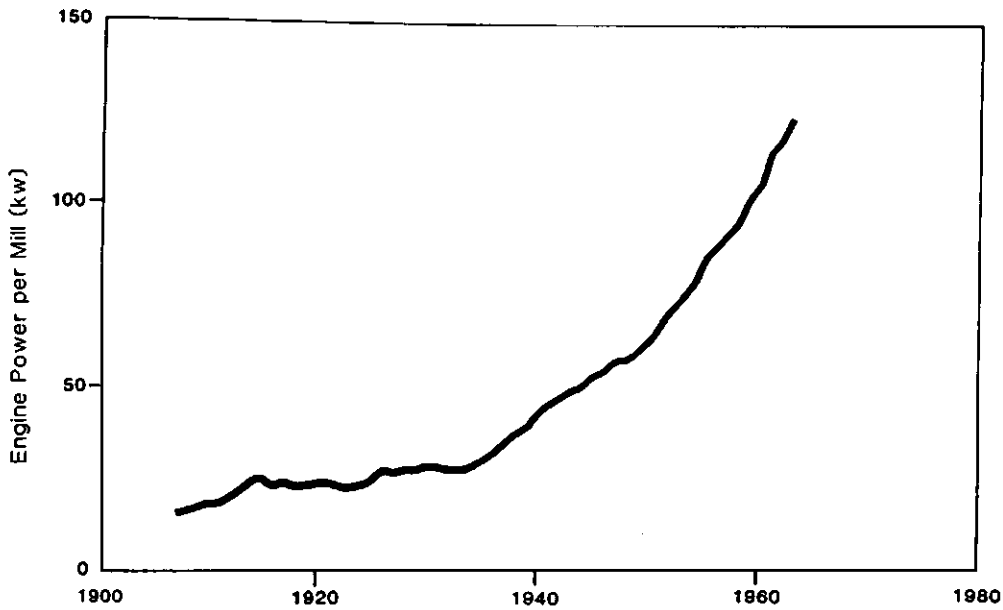

Fig. 7 Average sawmill size in the 20th century: Australia

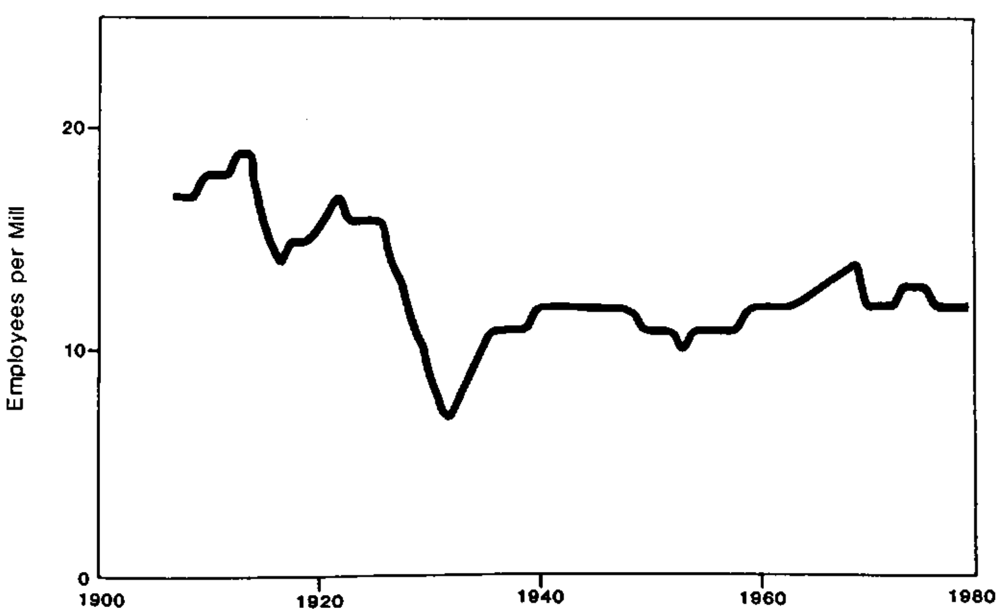

Fig. 8 Average employment per sawmill in the 20th century: Australia

References

An emigrant mechanic ('Alexander Harris'), 1847 Settlers and convicts or Recollections of sixteen years' hard labour in the Australian backwoods, (London), 2nd Australian edn, with foreword by C.M. Clark, (Melbourne University Press, Carlton, Vic.).

Beckett, R., 1983 Axemen Stand by your logs! (Lansdowne Press, Sydney): 167 pp.

Benjamin, L.R., 1959 The challenge of the eucalypts, Appita 13(3): 90-103.

Broadhead, B., 1965 100 years in timber, (Abbey Publishing Co., Sydney): 40 pp.

Brownlow, D., 1968 Risby Bros Pty Ltd, the rise to prominence in the Tasmanian timber industry, (University of Tasmania, Hobart) Thesis, B.A.(Hons).

Calder, M., 1980 Big timber country, (Rigby Publishers Ltd, Adelaide).

Campaign to Save Native Forests and the Workers Information and Research Centre, 1985 The timber industry in the south-west of Western Australia. A preliminary investigation from early days to 1984, Report: 48 pp.

Carter, B., 1972 The Kauri Timber Company, 1888-1914, (University of Melbourne, Melbourne): Thesis, M.A.

Carter, B., 1986 Gunnersen in Australia : A century in timber, (Gunnersens Pty Ltd., Melbourne): 120 pp.

Cunningham, T.M., 1982 Dedication of state forests in Tasmania - a short history, Australian Forestry 45(4): 217-20.

Dargavel, J., 1982 The development of the Tasmanian wood industries : a radical analysis, (Australian National University, Canberra) Thesis, Ph.D.

Dargavel, J., (ed.) 1984a Pulp and paper monopolies in Tasmania, in Taylor, M., The geography of Australian corporate power (Croom Helm, Sydney): 69-89.

Dargavel, J., 1984b The radical analysis of forest history, in Steen, H.K. (ed.) History of sustained yield forestry : a symposium (Forest History Society USA): 297-305.

Dargavel, J., 1985 Theory and practice in resource allocation, Proceedings of forest and forest products industries economists conference (Brisbane).

Dargavel, J., 1987 Timber inspection and the state : the Tasmanian experience, Journal of Forest history 31(4): 164-172.

Dargavel, J., (ed.) 1988 Sawing, selling and sons : histories of Australian timber firms (Centre for Resource and Environmental Studies) Australian National University, Canberra).

Dargavel, J. and Boutland, A., 1988a Establishing Australian sawmilling, in Dargavel, J., (ed.) 1988 Sawing, Selling and Sons : histories of Australian timber firms (Centre for Resource and Environmental Studies, Australian National University, Canberra): 37-42.

Dargavel, J. and Boutland, A., 1988b Timber firms in the 20th century, in Dargavel J., (ed.) 1988 Sawing, Selling and Sons : histories of Australian timber firms (Centre for Resource and Environmental Studies, Australian National University, Canberra): 69-74.

Dargavel, J., Goddard, J. and Caton, S., 1986/1987 Allocating forest resources in New South Wales : a guide to legislation, regulation and administrative practice, (Centre for Resource and Environmental Studies, Australian National University, Canberra), CRES Working Paper 1986/32
and similar CRES Working Papers
1986/38 for South Australia;
1987/1 for Queensland;
1987/2 for Tasmania;
1987/3 for Victoria and
1987/17 for Western Australia.

Dargavel, J. and Sheldon, G., (eds) 1987 Prospects for Australian hardwood forests, (Centre for Resource and Environmental Studies, Australian National University, Canberra), CRES Monograph 19.

Davidson, F.G. and Stewardson, B.R., 1974 Economics and Australian industry (Longman Cheshire, Hawthorn, Vic.)

Dixson, M., 1963 The timber strike of 1929, Historical Studies. Australia and New Zealand 10(40): 479-92.

Dolin, J.E., 1967 The timber industry of Western Australia : a study of organisation and competition (University of Western Australia, Perth) Thesis, M.Ec.

Edwards, W.M., 1975 McQuarie (sic) Harbour : penitentiary or profit? (Tasmanian College of Advanced Education, Hobart), Dissertation, B.Ed.

Fall, V.G., 1972 The mills of Jarrahdale : a centenary of achievement (Royal Western Australian Historical Society, Nedlands, W.A.)

Fenton, J., 1891 Bush life in Tasmania, fifty years ago Reprinted Devonport: Richmond, 1964.

Franklyn, H., 1880 A glance at Australia in 1880 (Mortimer, Melbourne).

Hannah, H., 1986 Forest giants : timbergetting in the New South Wales forests 1800-1950 (Forestry Commission of NSW, Sydney): 120 pp.

Hoysted, P.A., 1981 The content and historical development of forestry legislation in Tasmania (Centre for Environmental Studies, University of Tasmania, Hobart) Project report 1981/3.

Holden, E.A., 1936 Paper making in Australia, Australasian Engineer 7: 17-21.

Houghton, N., 1975 Sawdust and steam. A history of the railways and tramways of the eastern Otway ranges (Light Railway Research Society of Australia, Melbourne): 102 pp.

Houghton, N., 1980 Timber and gold : a history of the sawmills and tramways of the Wombat forest, 1855-1940 (Light Railway Research Society of Australia, Melbourne): 84 pp.

Houghton, N., 1986 Timber mountain. A sawmilling history of the Murrindindi forest, 1885-1950 (Light Railway Research Society of Australia, Melbourne): 106 pp.

Hudson, I. and Henningham, P., 1986 Gift of God friend of Man. A story of the timber industry in New South Wales 1788-1986 (Australian Forest Industries Journal Pty Limited, Sydney): 349 pp.

Hyne, J.R.L. (ed. W.R. Johnston) 1980 Hyne-sight. a history of a timber family in Queensland (Maryborough): 86 pp.

Jeffrey, R.G., 1947 A brief historical review of pulp and paper making in Australia, Appita 1: 64-73.

Jervis, J., 1939 Cedar and cedar getters, Journal of the Royal Australian Historical Society 25(2): 131-156.

Johns, B.L. 1962 The effect of entry and merger on competition in two related industries : paper and paper-converting. Paper to ANZAAS Conference, Section G, Sydney.

Keane, R.F., 1971 The Western Australian timber workers' strike of 1907 (University of Western Australia, Perth) Thesis, B.A. (Hons).

Kemp, A.G., 1982 History and development of the exclusive forest permit and licensing system, Australian Forestry 45(4): 223-29.

Knight, R.J.B. and Frost, A., (eds) 1983 The journal of Daniel Payne, 1794-1797 (Library of Australian History, Sydney): 107 pp.

Light Railway Research Society of Australia, 1974 Tall timber and tramlines : an introduction to Victoria's timber tramway era (Light Railway Research Society of Australia, Melbourne).

Linge, G., 1979 Industrial awakening : a geography of Australian manufacturing, 1788-1890 (Australian National University Press, Canberra).

McCarthy, M.J., 1983 Trestle bridges and tramways : the timber industry of Erica district 1910-1950 (Light Railway Research Society of Australia, Melbourne).

McCarthy, M.J., 1987 Bellbrakes, bullocks and bushmen. A sawmilling and tramway history of Gembrook, 1885-1985 (Light Railway Research Society of Australia, Melbourne): 104 pp.

Mack, D., 1986 The Shepherdsons : timber mining in Australia 1849-1984 (The author, Camden Park, Sth Aust.).

Meadows, W.G.H., 1982 History, development and benefits of the Tasmanian pulpwood concession system, Australian Forestry 45(4): 230-235.

Mills, J., 1986 The timber people (Bunnings Ltd, Perth): 296 pp.

McLeod, D., 1868 Melbourne factories (Walker, Melbourne).

Moore, B., 1987 From the ground up : Bristle, Whittakers and Metro Brick in Western Australian history (University of Western Australia Press, Nedlands): 257 pp.

Pearson, L.M., 1985 Timber tramways on the Atherton Tablelands (The author, Cairns): 16 pp.

Prichard, K.S., 1926 Working bullocks (Sirius Quality paperback edn. Angus and Robertson, London) 1980.

Rawson, J., 1953 A history of the Australian paper making industry 1818-1951 (University of Melbourne, Melbourne) Thesis, M.A.

Richards, M., 1980 North coast run : men and ships of the N.S.W. north coast (Turton and Armstrong, Wahroonga): 174 pp.

Robertson, J.R., 1956 A history of the timber industry of Western Australia (University of Western Australia, Perth) Thesis, B.A. (Hons).

Row, M., 1977 The Tasmanian timber trade, 1830-1930 : case study in spatial interaction (University of Tasmania, Hobart) Thesis, B.Sc. (Hons).

Southcombe, M.R.H., 1986 Steam in the Forests (Hesperion Press, Carlisle, W.Aust).

Stamford, F.E., Stuckey, E.G. and Maynard, G.L., 1984 Powelltown. A history of its timber mills and tramways (Light Railway Research Society of Australia, Melbourne): 151 pp.

Statham, P., 1988 The Australian sandalwood trade : small but significant (Department of Economic History, RSSS, Australian National University, Canberra) Working Paper in Economic History No. 100.

Thomas, W.C. 1939 Of mills and men in Western Australia, Western Mail, 30 March to 27 July 1939 (series of 18 weekly articles).

Timber Merchants Association (Victoria), (n.d.) A century of service, 1883-1983, Centenary year (The Association, Melbourne).

Trautman, E. and Trautman, J., 1980 Jinkers and jarrah jerkers (Cannet Press, Fremantle): 51 pp.

Watson, A.J. and Cohen, W.E. 1969 Pulping of eucalypts: an historical survey. Appita 22(4) : xvii-xxxi.

West, J., 1852 The history of Tasmania (Darling, Launceston) facsimile edition 1971. (Angus and Robertson, Sydney).

Winzenried, A.P., 1986 Britannia Creek. Wood distilling in the Warburton district (APW Productions, Melbourne): 130 pp.

THE 'TEDDY BEARS': A HISTORY OF THE SOUTH WEST TIMBER HEWERS CO-OPERATIVE SOCIETY, WESTERN AUSTRALIA

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'The Teddy Bears' - how did the sturdy axemen of the South West Timber Hewers Co-operative Society Limited come to have such an appealing nickname? - one of which they became immensely proud. The 'Teddy Bears' were members of a unique co-operative which operated between 1902 and 1920 and was successful in an industry dominated by a powerful amalgamation of London-based companies, Millars Karri and Jarrah Company (1902) Limited, known locally in Western Australia as 'The Combine'.

Research so far has discovered two explanations for the nickname which are not entirely satisfactory and these will be revealed in due course. First, it is necessary to give a brief background to the sleeper-hewing trade as it stood in November 1902 when the co-operative was first formed in the south-western coal-mining and timber town of Collie. It is also necessary to give an outline of the growth of the very lucrative sawmilling industry which supplied road paving blocks to Europe and heavy-section timbers to countries in Europe, the Middle East and Asia so that it eventually played a dominant part in the world timber trade.

The south-western portion of Australia grew some of the world's finest hardwoods, which became renowned for their durability and strength. They included the jarrah (Eucalyptus marginata) and karri (Eucalyptus diversicolor). Early settlers to the Swan River Colony, using axes and pit saws, produced the first trial export of Swan River mahogany (jarrah) for the British Admiralty only a year after settlement in 1829. Convict transportation to Western Australia in 1850 brought additional labour and capital to the colony so that road and port facilities were improved and small businesses began to exploit the rich jarrah forests of the Darling Range. Settlers and ticket-of-leave men developed skills in falling the difficult hardwoods to produce railway sleepers, beams, wharfing timbers and poles for export to South Australia, the eastern states, India, Britain, New Zealand, Mauritius, South Africa and even China.

In 1870 the Western Australian Governor-in-Council granted three huge concessions of timbered land to three different companies, two of them backed by eastern states' capital. These companies introduced steam power to the forest to drive sawmill engines and locomotives. By the 1880s the colonial government looked to building railways throughout the colony and the obvious timber to use for these schemes was the local hardwoods. Successful railway contractors from the eastern states joined the already established firms to set up sawmills to supply the needed timber. One of these companies was C. and E. Millar of Melbourne.

It brought 200 men to the colony, including timber hewers to help cut the many sleepers needed for the Albany-Beverley railway. Other contractors followed, especially after the building of the Perth-Bunbury railway in 1893. This brought easier access to the port of Bunbury.

Despite intermittent mutterings of concern in Parliament and the local press on the need for conservation of the unique hardwood forests, governments of the day showed very little concern. Sadly the State's first Conservator, John Ednie Brown, overestimated the forest resources by millions of acres in a report made in 1895[1] so that after his death in 1899 politicians were content to leave control of the Woods and Forests Department in the hands of its chief clerk, who set up his own small empire and happily granted timber concessions, leases and permits along the length and breadth of the Darling Range, covering the Murray, Wellington and Nelson Districts. Demand grew and jarrah paving blocks and heavy section timbers left the country on sailing ships from the ports of Fremantle, Rockingham, Bunbury, Busselton, Hamelin and Flinder's Bays. Larger sawmills were needed and by 1897 several Western Australian timber companies were floated in London. With prominent and influential London businessmen on their boards to influence trade throughout the British Empire, exports increased from £74 804 in 1894 to £500 533 in 1902.[2]

By the beginning of 1900, the highly wasteful paving block trade dropped off as other materials were used for road construction and a slump resulted in the industry, with local and overseas competition for markets forcing an amalgamation of eight big London-based companies as Millars Karri and Jarrah Company (1902) Limited, under the determined leadership of railway contractor Henry Teesdale Smith. However railway sleepers were still in demand and most contracts stipulated hand hewn-sleepers as these were considered to be more durable.

The axemen were the glamour men of the industry and the highest paid. By law they were obliged to take out their own licences to cut timber and they were issued with their own distinctive brand to mark each tree that they felled. Most either worked for the timber companies direct or for a contractor who supplied to these timber companies. Sometimes these contractors had their own outlets. They organised cutting on private farmlands, sawmill concessions or special government reserves, including one at Collie which was laid aside for firewood to fire the boilers for the coal-mine steam engines. Until the Forests Act 1918 the timber hewer could choose his own trees.

Sleeper cutting was regarded as an art and the training was painstaking. Hewers mostly worked independently, but with a mate close by in case of accidents. Usually a father would take his teenage son into the forest with him as an offsider, only allowing him to do the mundane work such as removing the bark. A sleeper not passed by the government inspector could mean the loss of valuable hours of work.[3]

To the sleeper cutter his kit of tools - two axes, one broadaxe, spare axe-handles, one timber bar, one cant hook, one set of wedges and a maul, two rings, one 6ft crosscut saw, a chalkline and a small spirit level - were all important. Once initiated, a young sleeper cutter would take his new tools to various older men to be given the treatment, so that they would all be balanced and primed correctly for skilled use. A bottle of whisky was the accepted fee.[4]

The hewers and their families lived in large bush camps of up to 500 people. Houses were timber-framed and made of galvanised iron and hessian painted with lime. Sometimes the walls were lined inside with paper. Bags were sewn together for carpet and also hung at the windows to keep out the glare and heat in summer and the steady forest rain in winter. Furniture was generally a solid jarrah plank for a table and kerosene tins for chairs. The fireplace was made of wood. The children slept several to a bed. All these possessions were demountable when the time came for them to be loaded onto a cart or a railway wagon and transported to the next camp. Bullocks and horses were used for taking the sawn timber out of the forest and to the rail sidings. They too lived in makeshift homes. Horseshoes were hammered into obliging trees and poles were used as sliprails.

The decline in the paving-block trade made sleeper cutting more attractive. This proved a lucky break for the young men who had come west seeking work at the beginning of the century from the drought and depression ridden eastern states.

Many were the sons of small farmers and the only skills they had were those of clearing land and cutting fence posts. Dugald Cameron and Geoffrey Dowling were typical of the type of men who were to become 'Teddy Bears'. Cameron, a shy proud upright man, arrived in the State with a pretty wife and one child. He came from a Scottish crofter background near Fort William on the west coast of Scotland and his parents had settled in the Mallee district of Victoria. Geoffrey Dowling's family were small farmers at Invermay, near Ballarat, and his grandfather had come to Victoria from Tipperary, Ireland, where the family were of some substance. His father arrived on the sailing ship <u>Commodore Perry</u> on the day that Burke and Wills left Melbourne on the ill-fated expedition.

Cameron took his small family to a sleeper-cutting camp not far south of Perth, at Jarrahdale, and then south to Allanson, near Collie, and on to Mullalyup, near Balingup, while Dowling, younger and unattached at that time, went straight to Collie to join a large band of sleeper cutters who worked supplying timber for the coal mines and local contractors. Both of these men had some education and descendants remember reading aloud around the fire at night from Tennyson and Sir Walter Scott as an important part of the family gathering.[5]

While neither Cameron or Dowling were aggressively political they, like many of the 't'othersiders' who came to Western Australia at that time, were supporters of the Labor movement.

Most likely they were also readers of the Westralian Worker which was established as a Labor paper in the goldfields town of Kalgoorlie in September 1900 and very quickly gained circulation throughout the State, with a strong following among timber workers. The paper set out to educate the workers in Labor philosophy by publishing the writings of Karl Marx, Emile Zola and many others. From the State it encouraged the growth of co-operatives with a special column on the world-wide movement, numbers of members and encouraging profits. There were articles by the well-known British exponent of co-operatives, George Jacob Holyoake (1817-1906), advocating co-operation among workers for the common good. He wrote:

> Co-operation is a new form of industry which attains competency without mendicancy and effaces inequality by equalising the fortunes of the industrious. Co-operation proceeds by self-help not by State help - by reason, not by restraint ... It always shares losses as well as profits.[6]

At the same time, the newspaper advocated the necessity for a strong trade union movement within industry, encouraging the workers to belong to a union and, where possible, as on the goldfields, the coalfields and in the timber industry, to amalgamate and demand 8/- for a 48-hour week. Western Australia lagged sadly behind the eastern states.

A.J. Wilson, secretary of the Australian Workers' Union and later Member of the Legislative Assembly for the south-west timber constituency of Forrest, canvassed throughout this area to stimulate the Labor vote by encouraging mill hands, engine drivers and local farmers to add their names to the electoral rolls. Workers were urged to stand up for their rights, to ask for more attention to safety at the mills and to seek better pay and conditions.

The amalgamation and formation of the Millars' 'Combine' in August 1902 produced a powerful monopoly which, under Teesdale Smith's leadership, intimidated governments as well as workers. The timber hewers formed branches of the Australian Workers' Union (A.W.U.) to protect themselves against employers cutting and quibbling over wages, and on the King's Birthday weekend November 10-14, 1902, they held a conference at Collie. Apart from magnificent log-chopping displays by the champions, Jumbo Frazer and Johnny Elliott, to raise money for a Mechanics Institute, serious business was discussed. This was the formation of a limited liability company under the title of the Timber Hewers' Association for the purpose of trading on co-operative lines in the sleeper-hewing business. The government, which was probably concerned about buying railway sleepers at a price dictated by the Combine, had let it be known that it would do business with the hewers collectively if the price was right and if they formed themselves into a company under the Companies Act.

At the meeting it was agreed that there should be 2 000 shares valued at £1 each, 2/6 to be paid on allottment and the balance in calls of 1/- a month if needed.

No shareholders were allowed more than five shares and no shares were to be allocated to other than bona fide members of the Timber Hewers' Branch of the A.W.U. Any profits were to be devoted to building up a reserve fund for the extension of the company's operation to the extent of at least 50%, and in the advent of a division being made it should not be on the share capital basis but on the amount earned by shareholders for the company. Members evidently applied for shares in a most enthusiastic manner.

Orders came quickly from the Perth Tramway Company, the local Collie Cardiff-railway, and one from South Africa to supply 20 000 sleepers a month for six months. A board of seven was appointed to run the co-operative, which included Labor organiser A.J. Wilson. By January 23, 1903 the Westralian Worker reported:

> The co-operative system in the timber-hewing industry has emerged from the realm of expectation and entered into the industrial life of this State in practical form to thrive or languish on the stormy seas of competition with the capitalist and concessionaire.[7]

The co-operative became an attractive proposition for the government as the Combine, fraught with labour problems, sought to juggle overseas and eastern states competition, conservation pressures, workers' pay demands, increased government rail and wharfage costs, overseas shareholders' demands, a stop-go industry, and charges of monopolistic practices from the small sawmillers.

Economic depression in the Western Australian timber industry saw a continual reduction in wages and an increase in hours of work between 1903 and 1907, culminating in a fourteen-week strike from March to the end of June 1907. The Combine was also accused of ignoring the Truck Act 1899 by grossly overcharging at company stores.[8]

Conservation pressure at this time caught up with both the co-operative and the Combine when a Royal Commission was held into the Western Australian timber industry in 1903-1904, and both Millars and the Timber Hewers' Association came under fire. Millars were accused of monopolising the trade and the timber resource and the hewers were charged with causing prodigious waste in the forest. The results of the two-part Royal Commission were restrictions on some cutting but also, ironically, the opening up of further permit areas in the Wellington and Nelson districts to placate the smaller operators.

The co-operative managing director, Tom Adams, reporting on hewing prices to the Royal Commission, said that 8 inch x 4 inch x 7ft sleepers were 1/-; 9 inch x 4 inch x 7ft, 1/3; 10 inch x 5 inch x 7ft, 1/6 and 10 inch x 5 inch x 9ft, 2/3; with a rebate of 1d per sleeper if it was cut in new forest which was harder country. Hewn beams with heart, up to 50ft were 6d per cubic ft, 50ft and over 8d per cubic ft. The lowest price for free-of-heart beams was 9d. The greatest length that could be successfully cut without heart was about 40ft. He said that 60 men working at Greenbushes in May of that year cut 9 304 sleepers or 155 each in the month. The men worked a 48-hour week with football on Saturday 'after dinner' (lunch).

Work was on an average of 20 to 22 days a month because of rain. There were now 390 shareholders holding 1 150 shares. The co-operative as a whole cut 27 630 sleepers in May and management costs were about £70 a month. The average hewer's pay was about £2.14.0 a week.[9]

No wonder hewers working outside the co-operative for the Combine stopped work in March 1906 when the company decided to reduce the price of sleepers from 2/4 to 2/- and to pay at the rail siding and not at the stump. Hewers downed their axes and many left for the eastern states and better pay. One said: 'W.A. was a Combine-cursed country in which the hewers were fighting wealth and influence in the government'.[10]

The co-operative fared better. In August 1904 Western Australia's first Labor government, led by Premier Henry Daglish, came to power and in the following November representatives for the Timber Hewers' Association (now registered as the South West Timber Hewers Co-operative Society Limited) waited on the Minister for Lands, John Drew, seeking exclusive rights to take timber from at least a portion of a 40 000 acre government reserve at Lucknow, near Collie, which had been set aside for coal-mining needs.

The deputation asked for an area big enough to keep 300 men at work for 12 to 15 years and said that it was prepared to pay royalties if necessary. It also admitted that in the past at least 200 hewers had been illegally removing sleepers and beams from the area. The Minister was sympathetic to their claim.

This was a government which during its short reign of one year was criticised as having come to power on a non-alienation-of-land platform and of selling off land 'as fast as the energetic Minister of Lands can dispose of it'.[11] It also managed to allow timber getters into a unique flora and fauna reserve established in 1894 at North Dandalup. However no permission was given for the Lucknow Concession.

The Co-operative Society, undismayed, continued to cut sleepers in the area, and in 1909 was officially granted 19 000 acres as permit 26/11 in the district of Wellington with a stipulation that a sawmill was to be built. H.T. Jackman was named as company secretary.[12]

The South West Timber Hewers' Co-operative Society Limited had grown in public standing during the days of the drawn-out timber strike in which the parliamentary Labor Party supported and encouraged the timber workers in their fight for 8/- a day and a 48-hour week.

Prominent among these Labor representatives was John Holman, M.L.A. for the Murchison, who organised a highly successful defence committee which received donations from all over Australia. Holman was very impressed with the co-operative system and in negotiations with Teesdale Smith and the Combine suggested that one way the large company could get around difficulties in paying a fair wage would be to let the workers run some of the company mills on a co-operative basis. There was even mention in the press of an amalgamation with the South West Timber Hewers' Co-operative Society. Eventually an agreement was reached at the end of June 1907 whereby a minimum wage of 7/9 for an 8-hour day was paid, prices would be lower at the company stores, and one or more sawmills would be run by the men on a co-operative basis.[13]

Negotiations for a co-operative sawmill went on between the company and the union for about a year and were finally dropped when the union was paid about £2 000 in compensation and costs which helped it to get on its feet. Legend has it that the Timber Workers' Union invited Teesdale Smith to be manager.[14] He left Millars at this time to return to the eastern states, and it was rumoured that he too was disgruntled with his pay. Millars' London directors could well have delayed the promised co-operative at the thought of the 'Little Napoleon' leading a rival show of timber workers.

Such a scheme of workers running their own sawmill under capable business management may not have seemed feasible to Millars' far-away London directors. The South West Timber Hewers' Co-operative Society under H.T. Jackman's leadership prospered at Collie, despite failure at this time to get the Combine to agree to uniform prices and conditions in the hewing industry. It ignored a gloomy comment in a Friendly Society's report in December 1908 that the credit system was antagonistic to co-operatives and that co-operatives only thrive in thickly populated areas. The success of the Hewers' Society was probably due to the fact that although they operated in isolated forest areas their production was one which generated a quick profit. Heavy-section timbers (known as 'green' timbers) did not require seasoning, and were paid for immediately they were delivered on board a ship.

Although life was tough and rough for the sleeper cutter and his family there were moments of joy. One must surely have been the visit of 15 American warships to the port of Albany in September 1908. Most of the co-operative shareholders were brilliant axemen both in their work with the broadaxe and the cross cut, and at the many log-chopping contests held around the south-west, where big prize money was sometimes donated there was always a chance of having a bet on a mate. On this occasion the government invited the co-operative to send representatives to put on a show for the visitors and arranged a special train to take the men to Albany. While the taciturn teetotal Dugald Cameron and Geoffrey Dowling were not on the list of axemen, they were surely there to cheer on their friends. Legendary heroes of log-chopping history demonstrated their skills with axes that were prize possessions, some like the Black Plumb coming from as far away as America.[15]

Jackman by now had established the men and their families at Lucknow and was recognised as a shrewd operator, well liked by the men. One story told about him is how he was invited by Millars to share in an order and help fix a price for tender. Jackman agreed and then went home and put in a lower tender, thereby winning the contract.[16] It may have been at about this time that the 'Teddy Bears' earned their nickname. One story relates that Jackman returned triumphant from a sales trip to South Africa stating that the shareholders would all be millionaires, and that they would even have enough money to build their own ships.

The President of the United States, Teddy Roosevelt, had been game shooting in Africa at that time, and when Jackman addressed the men in rather ostentatious long shooting boots they laughed with pleasure and teased him, saying that he was living the grand life and that they were his 'teddy bears'.[16]

With news of a railway being built from Pinjarra to Dwellingup in prime jarrah country, Jackman looked to this area for a fresh concession. In January 1909 the South West Timber Hewers' Co-operative Society Limited acquired a ten-year permit, No. 27/11, close to Dwellingup. They were to erect a big sawmill cutting 60 loads of timber a day.[17] Geoffrey Dowling rode with the surveyor's party across the Darling Range from Collie, probably along the Harris River and then on through what in those days was fresh parkland jarrah forest, and now in 1988 is still very beautiful and silent but full of great burned stumps showing how Millars, local companies and indeed the 'Teddy Bears' ravaged the forest for export.

But no one thought much about such things in 1909 as the timber industry took off on a second export boom which was to peak in 1913 with £1 089 486 worth of timber being sent out of the State. A timber concession file of those days shows that Jackman and his Board of shareholders were granted a permit over 19 711 acres of forest in the Dwellingup area. By now they had become a force to be reckoned with in an industry still tender after the 1907 strike.

They became cheeky and were not frightened to petition the Minister for Lands, James Mitchell, for a transfer of some of Millars adjacent forest block which serviced its big mill at Marrinup near Dwellingup. They needed this land for a mill site, and in return they offered to sell sleepers to the government but demanded exemption from royalty. Their price delivered alongside the railway was higher than the government could obtain elsewhere.[18] Naturally the government refused their offer. The days of preferential treatment for the co-operative were nearly over.

Work began on building the mill in 1910 after the Pinjarra-Dwellingup railway had been extended in July to the hewers' siding. The Lucknow mill was sold to finance the project but no dividend was paid to shareholders.[20] The new mill was to be called Holyoake after George Jacob Holyoake. Originally the shareholders wanted to call it Havelock after the British general who relieved Lucknow, but that name was already taken up. Once the permit was granted in 1908 the 'Teddy

Bears' arrived to begin work at the bush camp cutting timbers to build the mill. Dugald Cameron was cutting timber at South Bunbury and his wife and family had been delighted to live there in a house that actually had glass windows, but soon it was back to the bush as they climbed onto a train which also pulled all their wordly belongings, namely the framing, hessian and bits of chimney wood that would make yet another rough bush home.

Cameron's little daughter very carefully carried a hat box full of fresh eggs packed in sawdust. When they arrived all the family waited while the ever-considerate Cameron stood back till last to unload their possessions.

Eventually one of his friends chided him to get a move on or the more pushy shareholders would have left him with nothing. He was the sort of man who, when he found a hewer's rasp in the bush, would spend all day looking for the owner and wasting his own valuable working time.[21]

At this time a meeting of shareholders was held at Holyoake to authorise Jackman to use reserves to build the new mill. The shareholders also voted to increase his salary to about £300 but Jackman said to leave it and just pay him a bonus of 1% of the profits to keep him on his toes.[22] One wonders if, at this profitable time in the industry, Jackman knew more than the men and it was he who turned them into 'Teddy Bears' after his very successful trip to South Africa.

Another reason given for the nickname is that one of the shareholders was given money to go to Perth to buy machinery for the new mill, but instead he absconded to America where Teddy Roosevelt was a former President, and toy teddy bears were the new popular playthings. When a meeting was called to let shareholders know that the co-operative had lost valuable capital reserves and that the company was in a difficult position, instead of deep doom and gloom one shareholder dug another in the back and said 'That's what we are, just Teddy Bears' and they all went home and told their wives, and for some reason became very proud of their nickname.[23] Most shareholders were simple people who had never had much anyway.

In June 1912 Jackman acquired another large permit area (60/11) of 38 000 acres which ran from east of Holyoake along the Darling Range almost to Collie. In March 1913 the co-operative acquired lease 69/11 of 4 997 acres in the Murray district near the original 27/11.[24] With these resources came stability and a chance for the company to grow bigger. However most of the original shareholders continued to work in the bush at their trade while the mill work was left to paid hands. It appears that hewers had to be shareholders to cut on the co-operative's concessions and were guaranteed permanent work and, although no dividends were paid, members got 1d or 2d above the going rate for sleepers and beams.[25]

This was a time for Dugald Cameron and Geoffrey Dowling to build houses for their families. Cameron bought a small holding two miles out of town and called it Lochiel, while Dowling built a house which still stands at Holyoake today. Steep-sided, jarrah covered hills ran down to the mill valley, which was divided by a clear running creek. The store and post office, a hall, a school and churches were nearby and families built houses up the valleys which ran into the central area. It was a very pretty place. Mrs Stirton was the local midwife, and it was a proud boast that she had never lost a mother or child. She was trained as a nurse in Adelaide and would always arrive at a delivery in her uniform, which had immaculately starched collars and cuffs. She brought with her a wicker basket and told anxious siblings that that was where the baby came from. On dark windy wet nights she would ride out to a call on a big white horse with a lantern strapped to the saddle.[26]

The South West Timber Hewers' Co-operative Society Limited was a product of the labour movement of the early 1900s in Western Australia. It was created out of workers' demands for fair wages and hours of work. It did well to survive in a cut-throat industry dominated by the Millars' Combine. However Labor philosophy of changed through the years and the writings of such men as Holyoake were forgotten as the movement looked to the feasibility of State ownership. This change of policy introduced a conflict between the State and the Co-operative which, despite its simple origins, was now in the hands of professional managers. Both organisations would compete for the forest resource.

The co-operative now had an important head office in Perth and a suburban timber yard and sawmill at Carlisle, a few kilometers east of the city on the south-west railway. Jackman had left and his job was taken over by one-time sleeper contractor, Walter Benjamin Secton.

Certainly it seems that the co-operative's demise was accelerated by the second state Labor Government. After an unexpected landslide victory in 1911, Labor Premier Jack Scaddon set about implementing State ownership in various industries. With an eye to the expected building of the Transcontinental Railway his government entered the sawmilling industry, winning a contract from the Federal Government to supply over a million sleepers for the project. The government quickly built three large sawmills in the lower south-west at Pemberton and Manjimup. The previous government had built the Banksiadale sawmill near Holyoake to supply the needs of the Western Australian Government Railways.

Now the government, with another mill to be built at Wuraming nearby, would covet the valuable forest permits held by the 'Teddy Bears' in the area so that renewal dates became a worry.

Former ally and admirer of the co-operative system, John Holman, was now secretary of the very powerful Timber Workers' Union which represented about 5 000 workers. Between 1912 and 1919 the industry and the union were continually at loggerheads over rates of pay, with the union dissatisfied and demanding increased wages. An agreement was finally reached in 1919 in the Federal Arbitration Court when the humanitarian Mr Justice Higgins made an award which was to be retrospective, so that some individual Australian sawmillers were expected to have to back pay as much as £30 000. Mill hands at Holyoake would have benefited from various awards over this period, while shareholder hewers may have felt it was their earnings paying the piper without calling the tune.

The co-operative, like other companies in the industry, was hard hit by the 1914-1918 war. The war brought recession in an industry which relied on exporting 70 per cent of its output. Some business was done with the eastern states but shipping was almost impossible to charter. Young men joined up, leaving the old to run the mills. Older hewers must have been proud of the young axemens' record at war. Two of them, Harry Murray of Dwellingup and Martin O'Meara of Collie, won the Victorian Cross. Problems at home, however, were added to by the bad drought of 1914, which caused the price of chaff to rise so high that it was impossible to keep on the bullock and horse teams needed for log hauling. By 1916, 23 out of 35 mills had closed in Western Australia.

While other timber firms complained bitterly to the State government about competition from the big new State sawmills, the co-operative, apparently with little money, must also have felt the pinch, and old timers remember that by 1915 there was a group known as the 'Second Teddy Bears' and the shares were up to £10. It is likely that this nickname was given to the Nelson Co-operative Timber Society trading as timber merchants and general storekeepers. They took up permit 73/11 of 7 000 acres at Palgarup, near Manjimup, on January 1, 1915 and eventually handed it over to the Minister of Works in 1917.[27] The members of this co-operative were probably hewers who left the Holyoake area to take advantage of the opportunities to cut sleepers under contract to the State Sawmills in the lower south-west.

The wartime shortage of imported timbers caused a renewed interest in the Western Australian forest as an asset which should be kept in perpetuity. In 1916 on the advice of respected forester, Sir David Hutchins, the government appointed C.E. Lane Poole as Inspector General of Forests. Lane Poole was educated at Trinity College, Dublin, and at <u>L'École Nationale des Eaux et Fôrets</u> at Nancy in France. He came to Western Australia from Sierra Leone. He immediately set about evaluating the forest estate, while sawmillers became anxious about increased royalties, the end of long-term concessions and restrictions on indiscriminate cutting.

The Forests Act 1918 was assented to by Parliament on January 3, 1919 and this Act gave Western Australia the best forest regulations in Australia. Tree marking was introduced to the forest so that hewers on government land could no longer cut as they chose. Only those with licences (pink tickets) issued before the war could operate on crown land. Many of the 'Teddy Bears', proud of their bush skills and reluctant to work as mill hands in a diminished industry, were employed by the Forests Department as field staff, timber inspectors or sleeper passers.[28] Dugald Cameron became a forest ranger in the Dwellingup area while Dowling went sleeper cutting on private land.

In 1917 the French conservator of forests and former principal at the forestry school at Nancy, Colonel Mathel, visited Western Australia as a representative of a large French company, the Societé Franco-Australian Syndicate of Paris which was interested in buying into the Western Australian timber industry. At some time this company must have approached the Teddy Bears to sell but in a rather complicated set of manouevres in 1919 the government then sought to sell the State Sawmills to the French while also negotiating to buy out the South West Timber Hewers' Co-operative Society Limited.

The French company offered £385 000. The State Minister of Works, W.J. George, asked for £425 000. This was agreed subject to a deposit being paid into a London bank. Unfortunately the French paid the sum in War Bonds rather than the required sterling and George, already under fire in Parliament for selling off a part of Australia's heritage, withdrew the deal.

One interesting detail of the French agreement which would have no doubt influenced Lane Poole in negotiating the sale was that the French forestry school offered to found two 2-year scholarships for Western Australian students. It was not to be. The Conservator lamented:[29]

> without wishing unduly to disparage the management of the State Sawmills there is no doubt that under existing conditions the particular portion of the State's heritage covered by State Sawmilling permit areas is being exploiuted with a maximum of waste, and without any view to the future. The same may be said of the large jarrah private firms operating in the jarrah country.[30]

Would the French have managed the forest any better?

Time was up for the South West Timber Hewers' Co-operative Society Limited. The original strong young axemen had grown old, and after years of no dividends they wished to see something for their investment. Some shares had been sold, 'for sale' notices were posted up in the mill shop, and some shareholders had moved off, but many of the originals were still in the Holyoake area. Despite sentimental speeches by W.J. George, the Minister of Works and Peter O'Loughlen, the Labor member for Forrest, the 'Teddy Bears' sold out to their ideological rival, the State Sawmills. On January 15, 1920 the West Australian newspaper announced the government purchase for about £84 000. £47 000 represented assets which were largely timber stacked and ready for sale. The balance of £37 000 included the cost of the mill permit areas and freehold land. Later the Perth Carlisle timber mill and yard were also included for a sum of £61 500 less unsecured creditors.[31]

It is thought that shareholders eventually received about £200 a share. Not much really for 18 years spent in a hard and volatile industry. One which saw changes in Labor philosophy so that the spirit of co-operation would be overtaken by a policy of government involvement and preference in the lucrative timber trade.

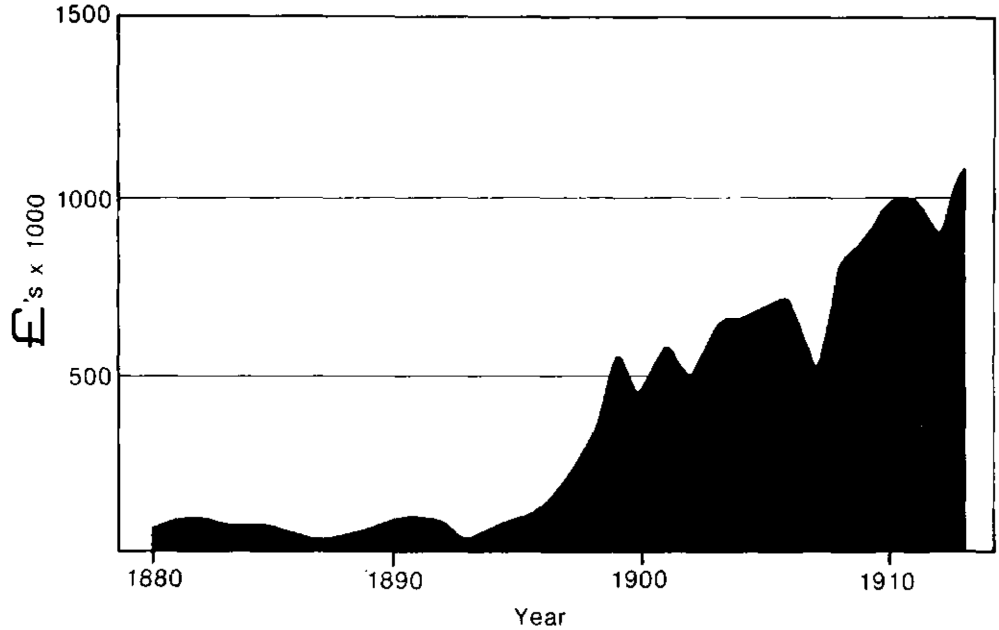

Fig. 1 Value of timber exports from Western Australia, 1880-1913

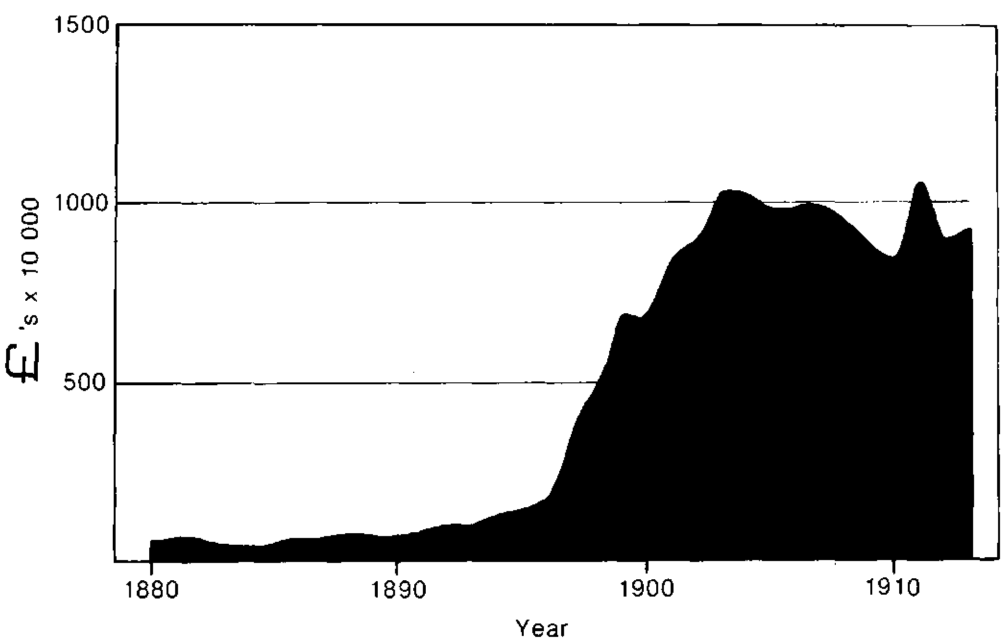

Fig. 2 Value of total exports from Western Australia, 1880-1913

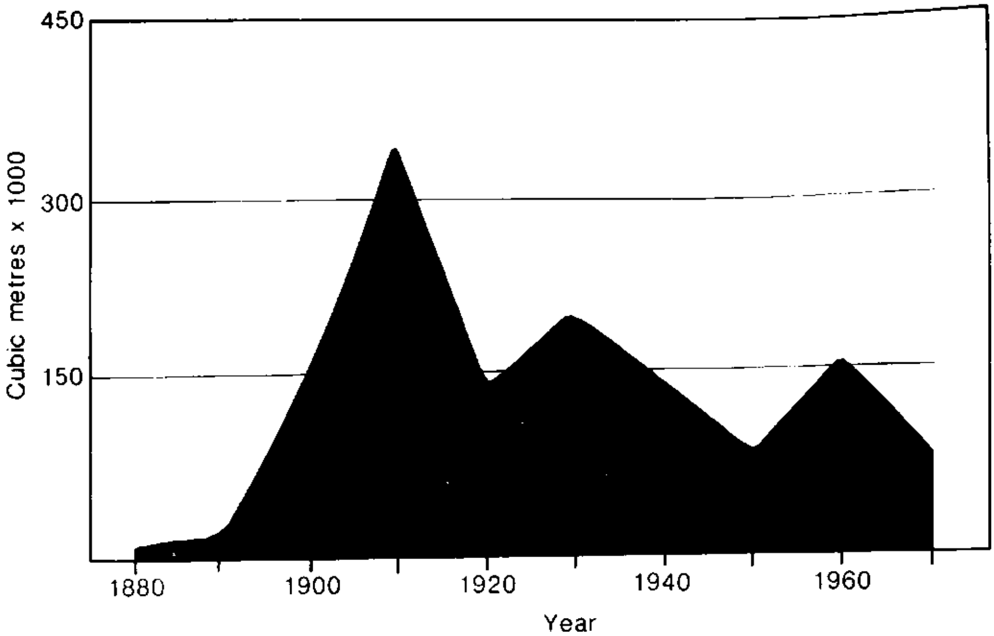

Fig. 3 Volume of timber exported from Western Australia, 1880-1970

NOTES

1. J. Ednie Brown, 1896 Report on the Forests of Western Australia, their Description, Utilization and Proposed Future Management with Plan and Illustrations (Government Printer, Perth): p.51 and A. Meyers, 1985 The Foresters (Institute of Foresters [Inc.], Hobart): pp.9-10.

2. R.T. Appleyard, 1981 'Economic and Demographic Growth' in C.T. Stannage (ed.), A New History of Western Australia (Univ. Western Aust. Press, Nedlands): p.236.

3. J.P. Gabbedy, 1981 The Forgotten Pioneers - Axemen - their work, times and sport (Fremantle Arts Press, Fremantle): p. 71.

4. J.P. Henderson, n.d. The Lost Art of the Sleeper Cutter. A lecture given to the Bunbury Historical Society.

5. Interview with Mrs Betty Martin of Nollemara (grand-daughter of Dugald Cameron) and with Mrs Lucy Phillipson of Holyoake (daughter of Geoffrey Dowling) in March 1988.

6. Westralian Worker, 24 January 1902.

7. ibid., 23 January 1903.

8. Bro. R.F. Keane, 1971 'The Western Australian Timber Workers' Strike of 1907', (B.A. Hons thesis, Univ. Western Aust.)

9. T. Adams in evidence at the Royal Commission to look into the Western Australian Timber Industry, Votes and Proceedings 1903-1904, No. 24: pp. 53-55.

10. J.R. Robertson, 1956 'A History of the Timber Industry of Western Australia', (B.A. Hons thesis, Univ. Western Aust.): p. 83.

11. Westralian Worker, 10 March 1905.

12. ibid., 10 August 1904 and J.P. Gabbedy, The Forgotten Pioneers: p. 100.

13. Westralian Worker, 7 June and 28 June 1907.

14. Bro. R.F. Keane, 'The Western Australian Timber Workers' Strike of 1907' p. 63.

15. J.P. Gabbedy, op. cit., p. 40.

16. Interview with Mrs Lucy Phillipson of Holyoake, March 1988.

17. Files held at Dept. of Conservation and Land Management (C.A.L.M.) office, Como, Western Australia. Permit No. 27/11.

18. Timber Leases. Precis of Correspondence held at Dept. of Conservation and Land Management office, Como, Western Australia.

19. J. P. Gabbedy, op. cit., p. 101.

20. Interview with Mrs Betty Martin of Nollemara, March 1988.

21. J.P. Gabbedy op. cit., p. 101.

22. ibid: p. 101.

23. Interview with Mrs Betty Martin, March 1988.

24. Permit Files held at Dept. of C.A.L.M. office, Como, Western Australia. Permit Nos 60/11, 69/11, 27/11.

25. J. P. Gabbedy, op. cit., p. 101.

26. Interviews with Mrs Betty Martin, Mrs Lucy Phillipson and Mr Wilf Stirton of Waroona, Western Australia, March 1988.

27. Permit files held at Dept of C.A.L.M. office, Como, Western Australia. Permit No. 73/11.

28. J.P. Gabbedy, op. cit., p. 105.

29. West Australian, 11 September 1919.

30. C.E. Lane Poole, 'Report of the Forests Department of Western Australia for the year ended 30th June, 1920', Votes and Proc. 4th Session 10th Parliament, 1920: p. 6.

31. J.P. Gabbedy, op. cit., p. 107.

RAIL OR ROAD? THE STATE'S POLICY DILEMMA ON TIMBER TRANSPORT IN THE OTWAY RANGES 1890 - 1955

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THE FOREST INVADED

The attraction for land was a powerful social and political force throughout the nineteenth century and, as in all other parts of Victoria, the impact on this was felt in Geelong, Colac and the Otways. The plains country to the north of the Otway Ranges was originally settled by Europeans in 1836-1838. After 1840, several enterprising cattlemen took out grazing licences in the timbered country but few had success in their endeavours, owing to cattle losses in the dense bush, and high working expenses.

Following the gold rushes of 1851 and the vastly increased population of Victoria, the gold-rush immigrants agitated for the break-up of pastoral holdings and the opening of unoccupied forest areas for closer settlement. The pastoralists resisted the pressure on their preserves for a time, but popular feeling won the day and amendments to the Land Act in 1865 and 1869 made it possible for people of small means to obtain land. The pastoralists did not hold all of the state, as many rugged, timber-covered areas were unsuitable for grazing, but the new wave of would-be settlers turned their aspirations to these undeveloped regions in order to satisfy their land-hunger. The prevailing ideology of the state favoured and encouraged the development of a rural, family-farm economy, and so the colonial government was sympathetic to the demands made of it. The gold-mining and construction industries, as well as water-supply interests, were opposed to the settlement of forest areas as the settlement schemes reduced the future prospects for local timber and water supply. The two competing interests continually lobbied the government, and the see-sawing policies of successive administrations reflect the changing power balance.

FOREST ALIENATION

It was after 1865 that several parishes south of Colac were first settled, but the government soon became concerned that settler interests might push for more land further to the south and destroy the forest, so in April 1873 the Kerferd government barred further settlement in the Otway Ranges. Many of the new settlers fell into difficulties and sold out, but this prospect did not dampen local enthusiasm. Colac, and to a lesser extent Geelong, interests were the main promoters of Otways settlement, and they pressed on regardless of the settler failures. The electors of Colac, through their local member, J. Connor, extracted a promise from a compliant Lands Minister in the Berry government that more land would be made available. The promise was given in September 1875, but before Minister Longmore could do anything about realising it the government fell, and the succeeding Minister in the McCulloch administration vetoed it. The 1877 elections returned Berry to office along with a new member from Colac, W. O'Hea, who was just as strong a believer in Otways settlement as both his predecessor Connor and the permanent head of the Lands Department who, strange to relate, was none other than Longmore. O'Hea and Longmore then set about opening the Otways and, in May 1879, proclaimed the lands around Apollo Bay as available for selection. The central portion of the western Otway Ranges - known as the Beech Forest - was still untouched, but amendments to the Land Act in 1884 and subsequent years led to the area south of the Gellibrand River being made available for selection. Such were the grandiose schemes for the Beech Forest that a reserve was made for an agricultural college at Olangolah and a proposed railway from Colac to Gellibrand was shown on maps (Figure 1).

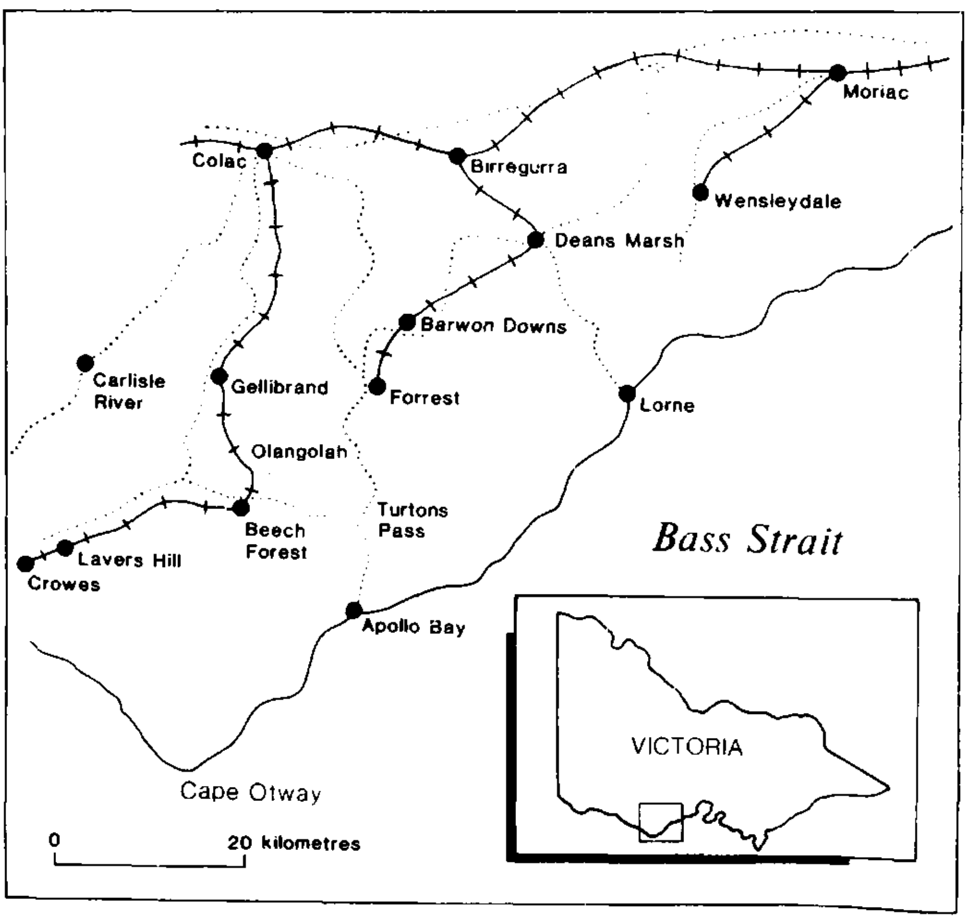

Fig. 1 *Transport routes in the Beech Forest showing the proposed Colac to Gellibrand railway*

IRRATIONAL FORESTRY POLICY

It seems incredible today that the Otway Ranges could have then been regarded as agricultural and grazing land when in many parts it was a thickly timbered, crumpled landscape of near-40° slopes. Forestry considerations received a low priority, and no rational and consistent policy existed to select and preserve Otways timber-lands for the Colony's timber supplies. The extraction of timber from the Otways after 1865 was, in many respects, an accidental result flowing from settler-clearing operations, and in consequence the state's transport policy was geared to the requirements of settlement, and not timber interests as such.

RAIL SUPREME

Rail transport was then the preferred policy option, and such was the state's commitment to rail that in the period 1874 to 1913 all roadworks were made the responsibility of local government and received no direct state funding.

The two railways proposed in the 1880s for the eastern Otways - Moriac to Wensleydale and Birregurra to Forrest - soon became realities, and were opened in 1890 and 1891 respectively to serve settler and timber interests. These lines pushed rail access to the very edge of the rugged terrain.

The Wensleydale railway was unusual in that one of its prime purposes was to supply Geelong with timber (mostly boiler wood for the city's factories) so it was a rather basic construction. In the western Otways no such transport system then existed.

One result of this deficiency in the western Otways was that the timber on settlers' blocks - worth millions of dollars if it could be taken to market - was seen as a nuisance and a hindrance to cultivation, and with official sanction much of it was destroyed by ring-barking and fire. By 1899 approximately half of the 50 000 hectares occupied in the western Otways had been ruined as a timber-producing source. When a settler had cleared a few hectares the land was used for grazing, vegetable and fruit growing and egg production, but not much else, because it was pointless growing any surplus if no means existed to transport it from the farm. Thus many settlers eked out a near-subsistence living. It was soon realised that under conditions such as these all the timber would be ruined and the farms would stagnate unless the transport problem was solved. The Colac Shire Council was the local government authority in charge of the area, and although the question of building roads and tramways south into the bush was discussed during the 1870s and 1880s, nothing was done apart from making marginal improvements to existing tracks. It fell to the colonial government to remedy the deficiency.

In 1884 Surveyor Collis had run a trial survey for a broad-gauge rail route south from Colac to the top of the main north-south dividing ridge of the Otways, about 50 km from Colac. This survey became a sore point with selectors, for many claimed they had taken up their blocks under the impression that a railway would soon be built but had seen no progress in the years since they had arrived. Another survey by Surveyor Stoddart in 1889 proved just as inconclusive because of the enormous costs involved in laying a broad-gauge railway in such difficult terrain. The financial depression of the 1890s ended any hopes of expending vast sums on such a railway, and there the matter rested until 1895.

PRIVATE ENTERPRISE OFFER

In that year a prominent Victorian sawmiller, Robert Robertson, offered to build a light railway, 50 km in length and of 1 066 mm gauge, from Colac to the foot of the spurs across the Gellibrand River and to lay branches up to the spurs to tap the timber. Robertson planned to use government finance, but the government ignored his offer and began its own investigations on whether a cheaply built narrow-gauge railway could be laid in the direction of the earlier surveys. By 1898 the recommendation for such a railway, of 762 mm gauge, was handed down by the Parliamentary Standing Committee on Railways. The rails reached Beech Forest in 1902, and in 1911 a 17 km extension to Crowes was opened.

RAILWAY PERFORMANCE

The three Otways railways became mainly timber-extraction railways, as agricultural produce was not a great provider of traffic.

In the period 1850-1900 numerous small and frequently-moved mills had been established in the less difficult country of the Otways and firewood-cutters and lath-splitters also roamed through the area, but there was no large-scale, systematic method to timber-harvesting.

This changed as soon as the three railways opened because the readily marketable timber that had not been destroyed through ring-barking or fire was, sooner or later, turned into firewood, palings, mining props and laths, charcoal, sleepers, posts, piles, barrel staves and sawn timber for building purposes.

Sawmills were operated with varying levels of capital investment by selectors, Colac businessmen and established companies from Geelong and Melbourne. Family companies of local origin dominated the industry at Wensleydale and between Colac and Beech Forest, and mostly derived timber supplies from alienated selections. The ridge from Olangolah to Crowes was favoured by outside companies because of access to state forest sites, but quite a few family businesses successfully operated on Crown and alienated sites in the area. The major mills at Forrest and Barwon Downs were owned by professional millers moving down from the cut-out forests of central Victoria.

Three phases characterised Otways timber traffic on rail between 1900 and 1930. The initial boost to timber production was provided by the Central Highlands' market for mining timbers after supplies from the forests surrounding the mining centres were exhausted. This trade persisted until 1914, when mining went into decline. After 1918 the War Service Homes Commission contracted a large portion of its Victorian timber requirements to a Beech Forest-based supplier, R. Driver & Co., so a colossal increase in production was evident from 1920 to 1923, when six mills were exclusively devoted to this contract. The boom period was terminated by falling markets in 1928, and a lengthy period of industrial unrest in 1929 that saw several mills permanently close, with a consequent reduction in timber freight for the railways.

TRAMWAY FEEDERS

The timber was transported to the railway by four separate means prior to 1929, these being:

(a) horse-drawn sleds;

(b) horse or bullock-drawn jinkers, wagons or wagonettes;

(c) horse or bullock-worked timber tramways;

(d) winch-powered tramway inclines.

The timber tramway represented the most suitable means of carrying timber through the roadless bush, and so successful was this mode of transport that more than 300 km of tramway was laid to the Otways railways.

There was, therefore, no road competition with rail, but this was to change in 1919.

OPERATING LOSSES

Meanwhile, the Beech Forest railway was posting huge operating losses each year due to a low level of inwards loading, freight rate anomalies and costly train-working methods in the difficult terrain. In 1917 the Railways administration was desperate for new track-laying materials due to the war, and targeted several non-paying lines for closure and recycling of their materials. The Wensleydale and Beech Forest railways were two such targets. In this move the Railway administration was proposing to abandon to road transport all of the timber traffic in the western Otways and the eastern extremity of the eastern Otways. Local political pressure averted the closures and Cabinet declined to back the Railways administration, and as a consequence two non-paying railways remained in existence in defiance of economic rationality.

ROAD COMPETITION

With the conclusion of the war in 1918 a huge stock of Army surplus motor vehicles flooded onto the market, and for the first time road transport interests could compete with rail in terms of speed and ease of door-to-door delivery. The competition was first felt in

1919, but it took until 1924 for the Railways administration to admit publicly that road vehicles were a threat to the entire system, and had been so for five years.

During this period, Otways timber production moved to markets over two substantially different transport sub-networks. The eastern Otways were served by very long tramways, up to 35 km, running out of the ranges to the state rail system on the flats, whereas the western Otways were served by very short trams, the longest being 13 km, running to the narrow-gauge rail system that entered the ranges. This was to have profound repercussions on the viability of the West Otways railway after the 1920s.

TIMBER OUTPUT

Timber-production levels along the West Otways railway peaked from 1915 to 1927, when annual output was in excess of 25 000 cubic metres, but this level could not have been maintained indefinitely. The timber resource close to the railway was not infinite and had been substantially depleted by 1927, and the timber-harvesting technology then used could not have sustained the higher outputs that occurred later in the 1940s and 1950s.

Poor markets, as well as the 1929 timber strike, caused the permanent closure of several mills in the late 1920s, and their log allocations remained unused until a new generation of sawmillers re-opened the sites in the 1940s.

ROAD MAKERS

The formation of the Country Roads Board (C.R.B.) in 1913 and the Otway Shire Council in 1919 signalled a new transport era. The Otway Shire was anxious to remedy the neglectful years of Colac Shire Council administration of forest roads; the C.R.B. had a brief under the Development Roads Act to provide a road from every farm gate to the nearest rail-head.

Lest sawmillers and wood-cutters were tempted to use the new roads in an injudicious fashion, the Shire made regular use of the Width of Tyres Act to prevent timber wagons cutting the road surfaces to pieces during wet months.

The railways were used to convey road-making materials into the Otways, and thereby helped to diminish their own traffic. It was an absurd contradiction and an example of how broadly based Otway affairs were determined by rivalry between Ministries in Melbourne - such as the Victorian Railways, the C.R.B., the Forests Commission, the Lands Department and the State Rivers & Water Supply Commission.

MAIN ROADS OPENED

All-weather roads began snaking across the Otways, with the routes Forrest to Apollo Bay (1927) and Colac to Gellibrand (1931) being the first major projects. The Otway Shire Council had its road-building programme in full swing, and in 1929 asked the Victorian Railways for access to a former railway ballast pit near Gellibrand for road metal. The Railways flatly refused, thus indicating a change in policy. But events moved swiftly for the railways, and within two years the administration tried to secure Parliamentary approval to abandon the Beech Forest line. Most of the loading on the railway was outwards timber, and with the collapse in the timber market in 1930-31 very little traffic was being carried.

PARLIAMENTARY ENQUIRY

The Parliamentary enquiry canvassed the entire range of options for Otways settlement, timber extraction and transport, and revealed deep divisions and contradictory policies between the main Ministries. The economically sensible solution to close the railway and permit saw millers to truck timber over the newly-formed roads to the rail-head at Colac was not adopted, mainly because it was regarded as being undesirable to lose the value of the state's infrastructure investment in settlement, roads and railways and the attitude of local residents that a railway was an essential part of the state's development strategy.

ROADS EVERYWHERE

Critics of the Railways administration charged that closure of the Beech Forest railway in 1931 would be premature as the road network was incomplete. However it should be noted that from 1929, with the opening of Turton's Pass, it was possible to drive a motor vehicle out of Beech Forest via Forrest, but not direct to Colac. This link was opened in 1935. Moreover, a tarred road between Beech Forest and Laver's Hill had been in use since 1928. The presence of this link had been the major determinant of a decision in 1930 by the Railways to reduce the Beech Forest to Crowes service almost to nothing, in the expectation that farmers and sawmillers would truck their output to the Beech Forest rail-head. But the rail users were so annoyed by the short notice given that they mostly turned to road transport for direct cartage out of the Otways to Colac via Turton's Pass or Carlisle River.

In 1935, when the direct Colac to Beech Forest all-weather road route was opened, the West Otways railway ought to have been closed, but this did not happen for a variety of reasons. In the first instance, local political pressure came into play. Secondly, transport regulation in favour of rail had been introduced on a State-wide basis in 1935. Thirdly, the reduced train service, employing a powerful Garratt locomotive, enabled all trains running to be loaded to the maximum, and fourthly the presence of the Country Party Government which held office from 1935 to 1943 prevented policy actions deemed to be inimical to country people.

AN UNWANTED RAILWAY

So, in other words, an unneeded railway was kept open, mostly for timber traffic and to serve sawmillers who would rather have used road transport but were prevented from doing so by Transport Regulation Rules.

The outbreak of war in 1939 and the introduction of petrol and rubber rationing in 1941 gave rail a dominant role in transport, and although sawmillers had the occasional grumble about the poor rail service, they accepted the situation.

POST-WAR CHANGE

After the war, vast changes came about due to technological advances and the experiences of returned servicemen who had been trained to drive and service all the motorised equipment of modern armed forces. In their minds rail was obsolete, and road the only way to go.

Areas remote from the Otways railways and previously without roads were opened for log extraction by the Forests Commission from 1945. These areas were mostly to the south-east and south-west of Beech Forest and south from Barramunga, and were worked by a combination of mobile motor-winches and crawler-tractors, with heavy-duty trucks taking logs to centrally established mills in Forrest, Deans Marsh, Gellibrand and Colac. The road trucks operated under a quota-and-permit system maintained by the Transport Regulation Board. All mills were permitted to cart all their logs from the forest to the mill. Small mills were allowed to cart all their production by road anywhere, and large mills were permitted a quota (around one-third) with the balance being trucked direct to the nearest major railway station at Colac, Forrest, Barwon Downs or Deans Marsh. The West Otways railway was by-passed regardless of the means adopted within the permit system then operating, as it was too inconvenient to use. An example of this can be seen in a sawmiller's consignment of, say, a house-lot of sawn timber for Geelong. This timber would have to be loaded onto a road truck at the mill, carted to the station, placed in the rail truck, be transferred to the broad-gauge at Colac, taken to Geelong and unloaded onto a road truck for final delivery. This took at least two days, sometimes longer, and involved multiple handling, whereas direct road transport took one handling at the mill and had the timber delivered in half a day.

The Calco mill at Beech Forest was the only mill to rail out reasonable quantities of timber during the 1950s.

The permit system was illegally evaded when sawmillers found it expedient to speed up deliveries or felt they had been disadvantaged by a rival being given a permit. Night-time delivery runs, using indirect routes, were a favoured tactic. The railway system was slow to respond to new developments, and sometimes imposed added costs to saw milloperators. For example, traditional timber-loading points at Beech Forest, Forrest, Barwon Downs and Deans Marsh had 6-tonne transfer-cranes yet Colac, a major loading point after 1945, had nothing comparable until 1956. Thus, a full jinker-load of timber had to be off-loaded into the rail truck by hand - an operation taking 3 to 4 hours and immobilising a carrying vehicle for half a day.

These transport contradictions were eventually resolved by default to road transport. The operating inefficiencies and losses on the railways resulted in the closure of the lines, with Wensleydale being the first to go in 1943, Forrest in 1957 and Beech Forest in 1962.

Thus, in retrospect, the state would have gained greater economic benefits by not constructing the railways and instead permitting private tramway operators to run lines from the Geelong to Colac railway directly into the forest. There was sufficient expertise and capital locally available to do this. That it was not the adopted policy was a reflection of the prevailing ideology and lack of long-term planning in the management of the state's resources. What has changed in 100 years?

Mountain ash *(Eucalyptus regnans)*,
Strzelecki Ranges, Vic

REGIONAL APPROACHES

REVIEW PAPER: THE FOREST RECORD IN AUSTRALIAN LOCAL AND REGIONAL HISTORY

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The last two decades in Australia have seen the production of a massive number of works of local and regional history. In many districts and communities, these publications have been prepared in conjunction with centennial or sesquicentennial celebrations of European settlement or founding of local government. At the local level, there is also a link with family history research and publication. On a national level, the wave of interest in Australian history has been further boosted by the bicentennial, and 1988 has seen a flood of historical works led by the impressive ten volume set, Australians - A Historical Library, published by Fairfax, Syme and Weldon Associates.

The aim of this paper is to review the extent of forest history material in published Australian local and regional histories and historical geographies. The review covers monographs only. The research has ranged from the more widely circulated works, such as regional histories written by professionals, to local publications, such as those commissioned by local governments, whose authors vary widely in expertise. Virtually any matter pertaining to the forests and woodlands has been considered - European descriptions of the original vegetation and subsequent changes, Aboriginal use of the forests, early timber-getting, industrial aspects (sawmilling, employment, forest products), government regulation, plantations, environmental impacts, and forest conservation.

As Spearitt (1987: 135) has pointed out, there is no definition of the difference between 'local' and 'regional' history in Australia, as the labels are loosely used. In general terms, however, the 'local' designation is commonly used to refer to the history of a particular town, city, or shire while 'regional' refers to the coverage of larger areas which have either developed an identity based on similarity of topographic features or industries ('formal' regions) or are defined by interactions ('functional' regions). The Darling Downs (Queensland) exemplifies the former, while any city and its hinterland would exemplify the latter. For the purposes of this review, 'local' and 'regional' history was considered to be all those works which dealt with an area less than a whole state - the only exception being the Australian Capital Territory. Where the term 'local' is used below, it implies both 'local' and 'regional'.

There is currently no thorough national bibliography of Australian local and regional history. However, there are excellent compilations for Victoria (Beaumont, 1980: 1,196 items, with update by

Neville, 1986) and New South Wales (Jack et al, 1987 : almost 2600 items). Both of these are annotated and also contain a potentially very useful listing of business and commercial directories (Victoria - 1836-1974; New South Wales - 1828-1950). Beaumont suggests that the wealth of information contained in these directories has not yet been fully appreciated by researchers. For South Australia, there are the compilations of Letcher (1981) (listing 277 items published between 1976 and February 1981), and Warcup (1983) (items arranged regionally). For Queensland, the non-annotated bibliographies of state history by Johnston (1981) and Johnston and Zerner (1985) each contain a section on local history subdivided by regions (the latter with 800 entries). For the Northern Territory, there is a useful general guide to Territory history by Hamilton (1986). None of the foregoing bibliographies is restricted to monographs.

This review is based primarily on the holdings in the Australian National Library, identified mainly through the Subject listing in the library's microfiche catalogue. This contains monographs catalogued or re-catalogued since 1980. Holdings of the University College (Australian Defence Force Academy) library were also used. The bibliographies referred to above were also checked for additional items. Material was searched using the names of towns, cities, and local government areas. In 1986 there were 836 local government areas in Australia. These are listed and mapped in Australian Council of Local Government Associations (1986). All the publications revealed by the search of the National Library's microfiche catalogue were surveyed. In total, the review is based on more than 1,100 items, with New South Wales (430) and Victoria (280) taking the largest share. Other totals are South Australia (160), Queensland (130), Western Australia (100) and Tasmania (40) (rounded figures). The Australian Capital Territory is included with New South Wales. No separate mention is made of the Northern Territory because there are so few items.

In a review of this nature, some general observations on the source material seem appropriate. The discussion of Victorian local history writing by Beaumont (1980: 10-14) also makes some observations which are pertinent Australia-wide.

There is enormous variation in the style and quality of local history publications. They range from collections of jumbled pieces about the area in question, often recording the 'firsts' of everything, and including the photos of local worthies in their Sunday best, through to well-crafted scholarly works which follow some themes, seek to interpret and provide context for events and conditions, show intelligent selection of factual material, acknowledge sources, and finally present the results in an organised and lucid narrative. Any evaluation of what is 'good' local history is necessarily subjective, but is perhaps assisted by observing the trends in the writing itself, where, increasingly, the latter style of work is replacing or supplementing the former. The parochial, inward looking nature of local history, and its general lack of methodological sophistication have endowed it with a stigma that has resulted in an avoidance of the field by professional historians. Nevertheless, a school of regional history which developed in the

1960s (for a review see Bolton, 1979), and particular local histories such as those of Echuca, Vic. (Priestley, 1965), Ballarat, Vic. (Bate, 1978), and Rockhampton, Qld. (McDonald, 1981) have given an indication of the potential of the field.

A feature of much local history, especially that written before the 1970s and by 'amateur' writers to this day, is its focus on material progress and development. Many such histories are chronicles of pioneering, of overcoming adversity, and of subduing the environment and the original inhabitants of this land. The results of this 'booster' viewpoint, with its chronicles of the glorious past and prognoses of an unbounded future, are perceptively described by Porter (1977), quoted in Beaumont, 1980: 14);

> In stapled booklets published on celebratory occasions, Back-to-Bairnsdales and the like, the town's history comes on to the shiny pages shrunken but dry-cleaned and invisibly mended. Here no pioneer is rapacious, no Leading Citizen vainglorous and insufferable, no cup-winning sportsman a boor and a braggart, no do-gooder up to no-good.

Though the settling of the land is central to most of these accounts, environmental change in itself is rarely directly considered in any detail. As in Australian historiography as a whole, the environment has usually been seen as simply the backdrop to the central focus on social, political and economic events. It is only in the more recent works by professional historians and geographers, or those with professional training in history or a related discipline, that environmental considerations have been brought much more to the fore as part of a more restrained, questioning approach generally.

If our knowledge of environmental change following European settlement is to advance, it would seem that much of this would have to build from the local and regional level. An example of the coherent picture of landscape evolution which can be constructed from detailed local investigation may be found in the classic, The Making of the English Landscape, by W.G. Hoskins (1955). Settlement of the Australian continent involved the appraisal of differing landscapes; on the basis of the often inappropriate knowledge and experience of the British landscape. The 'coming to terms' with these new and regionally varied environments is worthy of a larger place in Australian history. There are some works, especially in the regional genre, which have made the history of environmental interaction a central focus: Hancock (1972) for the Monaro region of New South Wales; Heathcote (1965) for the semi-arid plains of north-western New South Wales and south-western Queensland; and Meinig (1962) for the 'wheat frontier' of South Australia in the latter half of the nineteenth century. For those which tackle this theme of environmental interaction, land settlement has been the key interest. By contrast, a specific focus on the forest industries (as in Calder's Big Timber Country (1980) for the south-west of Western Australia) has been rare.

Australia-wide, some reference was made to the forests and woodlands in 55% of the items searched. The highest proportion was in Queensland (72%) reflecting, perhaps, the variety and extent of that State's original forest cover and its importance to many local economies (Table 1). Material revealed in the search was classified into ten categories. These are shown in Table 2 with the number of entries for each.

Table 1 Forest and woodland material in monographs searched

State	No. of monographs	No. with forest entries	Percentage with forest entries
New South Wales	430	231	54%
Victoria	278	129	46%
South Australia	156	84	54%
Queensland	126	93	72%
Tasmania	42	28	66%
Western Australia	80	49	61%
TOTAL	1 114	614	55%

Forest and woodland descriptions

As shown in Table 2, 20% of monographs that contain some forest material make reference to the vegetation cover at the time of European settlement or later. Most of the descriptions of 'original vegetation are simplistic, generalised and give little idea of sources - though this is not to imply that they have no value. The following randomly chosen descriptions are typical:

> The soil in the southern half of 'Burrawang' substantially was black soil; that in the other half generally was red loam, carrying stands of pine, belah, box, kurrajong, wilga and other timber commonly affiliated with that type of soil in central western New South Wales.
> (Connor, 1983: 56) (Forbes, N.S.W.)

Not all the district was heavily timbered. The river flats were covered with good stands of red gum, but elsewhere - especially north of the Goulburn - there was much open grass land interrupted here and there by clumps of trees. Early survey maps note the nature of the timber and they show 'open flats with gum and peppermint' on considerable areas of the Mount Pleasant, Niagaroon and Whanregawen runs.
(Noble, 1969: 4) (Alexandra Shire, Vic.)

Table 2 Forest and woodland material - entries in monographs classified by subject

Subject	Number of entries	Percentage of total entries N = 952	Percentage of the subset of monographs containing forest entries* N = 614
1. Forest and woodland descriptions	124	13.0%	20.0%
2. Aboriginal use of forests	16	2.0%	2.5%
3. Settlement and forest clearing	161	17.0%	26.0%
4. Early timbergetting (e.g. pitsawing)	250	26.0%	40.5%
5. Forest industries, sawmilling forest products	292	30.5%	47.5%
6. Employment in forestry/ forest industries	29	3.0%	4.5%
7. Government regulation, forest services, native forest silviculture	26	2.5%	4.0%
8. Plantations (softwood)	13	1.5%	2.0%
9. Environmental effects related to forest use	29	3.0%	4.5%
10. Forest conservation	12	1.5%	2.0%
TOTAL	952	100.0%	

* See Table 1. Column will not total 100% as monographs may have entries under more than one subject.

Note: all percentages rounded to nearest half per cent.

A number of works quote from the records of early European explorers, such as the botanist, Alan Cunningham, who recorded the vegetation during his journeys in south-eastern Queensland in 1827 and 1828. Some describe the original vegetation, as well as changes following European settlement:

> The island was once partly clothed with a dense forest of blue and white gum and blackwood, but fires, intentional and otherwise, have removed this, and the characteristic cover now is melaleuca and tea tree scrub and boxthorn hedging, with a few recent plantings of eucalyt and pine.
> (Hooper, 1973: 1) (King Island, Bass Strait)

> ...the timber on Carrabah years ago was not nearly so thick. There was a good deal of plain country with small clumps of brigalow in places. But as time went on the timber increased, especially after the 1902 drought; and as the [prickly] pear was so thick it was impossible to check it. When the pear was destroyed several years later, a lot of money was spent on clearing the timber (by) ringbarking and other methods...
> (Fox, 1959: 90) (Taroom, Qld)

Two of the best examples of the potential of local history for vegetation reconstruction are in the histories of the Bute district (S.A.) by Paterson and Price (1984) and Narrandera Shire (N.S.W.) by Gammage (1986). For the Bute district, original vegetation patterns are shown in a map which is based on the plans drawn by the first surveyors, supported by an examination of areas of remnant native vegetation. The vegetation has been classified into formations and communities. Gammage draws on the scientific record to begin his vegetation reconstruction at 60 million years ago and concludes with a Landsat photograph which shows its status in 1983. Original vegetation patterns are also well presented (mapped and discussed) in the history of Temora (N.S.W.) (Temora Centenary Historical book Committee, 1981). Another notable attempt at ascertaining the original vegetation cover is in McWilliam's (1978) history of Hawthorn (Melbourne, Vic.) where the problems with using surveyors' field books are discussed. Surveyors' descriptions may be the only contemporary records, and their usefulness can only be judged at the local level. Their accounts are often generalised, as in the following for Gnowangerup (W.A.):

> Going out from Tambellup for the first eight or nine miles, I passed through a lot of white gum country rather poor, sandy and whitish looking ... After that I came to a good deal of jam, york gum and morrel and salmon gum country mixed for about 14 miles. I passed the Pallinup river and came to the Jakatup [sic]. Wherever I went in that neighbourhood I saw wonderful grass country.
> (quoted in Bignell, 1977: 139)

The characteristics of surveyors' descriptions reflect the fact that survey work was primarily directed towards land settlement.

The original standing timber volumes and quantities cut since European settlement in the heavily forested parts of Australia have long been an intriguing question - one often asked about the rainforests of north Queensland, for example. Some estimates may be found, based on surveys of unlogged forest, but, as Borland (1940) in his history of Cairns and district states, the best response that may be possible in many areas to the question of 'How much timber?' is 'All the timber you don't see growing in the scrubs or on the farmland now!'

Aboriginal use of forests

Aboriginal use of the forests is poorly represented in local and regional history. There appear to be two main reasons for this. First, there is a lack of knowledge of the topic generally, and, where there is knowledge, it may not be readily accessible to the local historian. Second, earlier works and those by 'amateurs' tend to focus more on the struggles between settlers and Aborigines - with details of battles fought and Aboriginal 'treachery'. The demise of the Aboriginal people is often seen in Social Darwinist terms, and there is little recognition that their culture may have survived despite European dominance post-contact. Some authors of recent higher standard works (e.g. Hardy, 1984 [Cloncurry, Qld]) now recognise that their locality had a history before European settlement, and that the land was not a terra nullius. Hardy describes the culture of the proud and independent Kalkadoon people and their use of the local woods; in particular, corkwood and gidyea.

Some items contain brief and general comments on Aboriginal forest use and forest products:

> Weapons used by the aborigines were clubs, boomerangs and spears made of reeds, seed stalks of the grass tree, box tree and iron bark ... Water was carried in bark vessels shaped like canoes. The aborigines put pieces of bark with the ends thinned out in the hot ashes of their fires to make the bark pliable. The pieces were then folded and tied at the ends. Fibres for making nets were taken from a shrub of the Pimelia species which grew plentifully along the river.
> (Temple, 1971: 3) (Kiewa Valley, Vic.)

> Heytesbury Forest covered most of the inland from near Colac to near Warnambool and the coastal tribes had little contact with the Aborigines who lived north of the Forest. There was some trading, however, and some travel along the creeks, for stone tools have recently been found at several places along Curdie's River and Campbell's Creek ... Wood, which made good spears or shields could be traded for lumps of specially adhesive eucalyptus gum.
> (Duruz, 1971: 2) (Port Campbell, Vic.)

The question of Aboriginal burning of woodland environments is one that receives some attention. The idea of widespread burning which kept the country open is enthusiastically embraced by Rolls (1981) in his environmental history of the Pilliga scrub of northern inland New South Wales. Further south, one author gives it credit for the 'park-like' country which the first graziers found:

> An almost unbroken forest extended from the banks of the Murrumbidgee, across the Murray to near the summits of the Great Dividing Range, which borders the district on the south. Not too heavily timbered and with little undergrowth, the general aspect was parklike ... The natives were accustomed to burn it off almost every year and thereby prevented the heavy growth of young trees. That these frequent fires had the effect of keeping the country open was demonstrated in many parts. After settlement put an end to the practice, and the aborigines had died out, dense masses of scrub then took possession of large areas of valuable country, especially on the lower slopes of the mountains in the south.
> (Andrews, 1920: 27) (Upper Murray area, N.S.W.)

Hancock's (1972) discussion of this topic in his study of the Monaro (N.S.W.) is exceptional, for he rejects the sweeping statements sometimes made on the Aboriginal use of fire, and examines carefully the scientific literature, the observations of landholders and the records of early observers. From these it is evident that burning practices in the Monaro region were not uniform but varied according to elevation, and that the distribution of vegetation types has also to be related to environmental factors.

Settlement and forest clearing

An important part of Australian forest history must concern those forests and woodlands which no longer remain, but were cleared as part of a grand agricultural and closer settlement vision for Australia. In local history writing, this 'yeoman farmer' ideal is translated into what Hirst (1978) has termed the 'pioneer legend'. As Hirst notes, the legend provides a 'simple, unofficial, popular history of the nation' in which pioneer farmers are the nation builders. Typically, local histories contain a detailed treatment of the process of clearing and maintaining new land, but include little discussion of the broader social, economic and legal frameworks surrounding land settlement, such as state land policy. The latter is more likely to be well canvassed in regional works (e.g. Bolton, 1963, 1972; Hancock, 1972; Powell, 1970; Waterson, 1968). Nevertheless, a major benefit of local history writing is that it provides detailed records of work practices, tools and methods used, and local solutions to problems. As the pioneering of new land recedes further into history, and advances in technology completely replace former means of clearing and working the land, these records will assume greater importance.

Slightly more than one-quarter of the monographs containing forest material make reference to land settlement and forest or woodland clearing (Table 2). There is a wide range of content. At one extreme are the simple, paraochial chronicles of pioneering achievement, and the beneficial transformation of the previously forested landscape:

> Upon Mr Walker finally deciding to occupy Wallerawang it was granted to him by the Governor with a full assignment of Crown prisoners and as characteristic of the Scotch race he threw his best energies into the work of forest reclaiming and in a few years time the place was a veritable metamorphosis from its original habitat to a landscape of rare scenic beauty. Hills were denuded of dense foliage and impenetrable swamps became richly verdured meadows over which herds of cattle were soon peacefully grazing.
> (O'Sullivan, 1913: 11) (Hartley, N.S.W.)

> In the smooth facilities of modern day transport ... the average Australian seldom gives any thought to the immense difficulties overcome by the earlier generations who settled the country. These conquered their fears of the lurking black and ventured forward from the confines of the early settlements. They hacked tracks out of the impenetrable scrub-covered ridges to find a likely home site. They felled trees, cross-cut them to lengths they could manhandle and then pitsawed them into timber to build their first rough shelters.
> (Swancott, 1966: vii) (Gosford, N.S.W.)

At the other end of the spectrum are the regional works previously referred to, and the occasional local histories written by professional historians such as that for Monto (Qld) (Johnston, 1982). Here, land development in the 1920s based on large scale planning and a scheme established under special legislation (Upper Burnett and Callide Land Settlement Scheme) is placed within a national and empire context.

Particular forest and woodland landscapes feature prominently in the literature reviewed - the rainforests, the mallee, and the wet sclerophyll forests. Some of the items contain detailed descriptions of the work of clearing. Crawford's (1983) history of Alstonville (N.S.W.), for example, clearly outlines the stages in clearing rainforest using a 'drive.' Eunson's (1978) history of the Mirboo area provides a well-written account of the assault on the massive eucalypts of south Gippsland (p.7).

> The pioneers freely admitted their lack of skills in axemanship, for at this stage, they had had little time to measure their courage and endurance in forests where trees 300 feet tall were extraordinary, but not exceptional. New arrivals stood dwarfed in a theatre of massive natural barriers which had to be removed by the axe, ingenuity and commonsense. The axe was the primary essential tool. Selectors confronted by solid walls of scrub, devised new methods, learning fast, sometimes unfortunately with tragic consequences. From experience the axeman acquired a considerable working knowledge of the individual

> characteristics of big trees and the various forest layers beneath the canopy. On a favoured home site he marked a 'free splitter' which would supply boards, palings, beams and shingles for a bush hut and, later, a more substantial house with out-buildings and fenced yards. This timber-yard, on site, eliminated cartage or shouldering the materials from a distance. The reduction of a big tree to house timbers was a challenge demanding ingenuity and skill. Axemen devised three structures to raise their operations at least ten feet above ground level where hard spurs on the base of the tree ran into the smoothly rounded trunk. From the plentiful supply of scaffold timbers they erected a platform around the tree, or a ladder with a top platform, or used springboards. This last device was sophisticated to a point where it is today a spectacular showpiece. It was then the most recent aid to tree-felling and eliminated scaffolding in its traditional form.

A brief, illustrated account of the disastrous attempt to settle the similarly forested Strzlecki Ranges nearby is contained in Noble (n.d.).

Land settlement in the east coast rainforests has received much attention. Examples of works are: Henderson and Henderson (1983) for Illawarra (N.S.W.), Bayley (1960) for Kiama (N.S.W.) and Daley's (1966) classic regional history of the Richmond River district (the former 'Big Scrub' of northern New South Wales). Hannah's (1979) 'Folk History of the Bulga Plateau' settled this century, is an oral history of this former rainforest/wet-sclerophyll-forest area. Queensland's extensive 'scrublands' were highly sought after for settlement, and histories of many of these areas, containing details of settlement and forest clearance, have been written. The Murphy and Easton (1974) history of six south-east shires focuses on land settlement and the associated timber industry. There is also an extensive compilation of material for the Caboolture Shire (Caboolture Shire Council, 1979). North-eastern Queensland, and particularly the Atherton Tableland, is also well covered. Bolton's (1963) regional history deals with the period to 1920. The shires of Cardwell and Johnstone and the city of Cairns and its district are given excellent treatment in the lengthy books of Jones (1961, 1973, 1976). As with the 'Big Scrub' in New South Wales, the pioneering of the Atherton Tableland has become prominent in Australian folklore. Its settling is included in works by Pike (1976), May (1959), McGeehan (1951) and Atherton Centenary Committee (1985). The publication by Cairns and Johnston (c. 1985) contains reproductions from an outstanding set of photographs (W.H. Bunker collection) dating from 1910 which record the settling of the Tableland following the large land opening of 1907. The monograph by Frawley (1987) contains a detailed study, partly based on oral sources, of the settling of the last blocks to be opened on the Atherton Tableland (in 1954).

Mallee and other woodland clearing features prominently in the histories of inland areas of southern Australia. The problems of preparing mallee country for agriculture, due to the difficulty in removing the large, woody roots, and the suckering which occurred if they were not completely removed, have received much attention:

> Some sparsely timbered areas were simply burned off at ground level. This was known as 'yankee grubbing', and caused endless trouble through straining and breaking of cultivation implements.
> The clearing of the Mallee scrub was a problem of greater magnitude, and the first method adopted was the rolling of the whipstick timber with heavy log-rollers drawn by bullock teams. This was a crude and tedious process and meant that sufficient of the growth had to be killed to enable a fire to carry through after a long period of hot summer weather. Even when a good burn was obtained, it took years to kill out the recurring growth of suckers. The modern method of destroying this dwarf eucalypt is by pulling down with heavy chains strung between powerful crawler tractors.
> (Griffin, 1970: 5) (Ardlethan and Beckom districts, N.S.W.)

A good account of settling mallee country in South Australia may be found in Jones (1986: ch. 3). The following are brief extracts only:

> The new settler's first task was to clear the mallee from his land. With the power available limited to that of a team of horses - and few of the settlers could afford large teams - the only method possible was to break off the mallee branches at ground level. Many of the rollers used were the products of farmer improvisation: some were made by town blacksmiths. The roller itself was either an old factory or ship's boiler which was no longer fit for its original purpose or a big log.
> ...
> Clearing mallee was hard on both men and horses. Rolling 10 acres was a very good day's work.
> ...
> The mallee stumps were not yet dead and there were soon new mallee shoots growing up in competition with the crop. Each regrowth shoot had to be cut. The farmer walked up and down his paddock with a slasher and slashed the regrowth. The slasher had a two edged blade about 15 inches long on the end of a handle about 4 feet long. The two edged blade enabled him to cut a shoot each way on the swing.

Other accounts of mallee clearing may be found in Jones (1987) (Tatiara, S. A.), District Council of Tumby Bay (1981) (Tumby Bay, S.A.), Chandler (1979) (Red Cliffs, Vic.). The latter contains an illustrated account of the use in the 1920s of the remarkable 'Big Lizzie' in mallee clearing for soldier settlement after World War One. This was a huge 45 ton tractor, powered by a 60 horsepower crude oil engine and running on traction wheels, which was originally designed to haul wool wagons weighing a total of 70 tons from Broken Hill stations. Other descriptions or references to particular equipment used in clearing, and particularly the grubbing out of tree stumps - the hardest task, may be found in Chessborough (1982) (the use of 'forest devils' for tree pulling in the Griffith district of New South Wales) and Johnson (1982) (the use of hand operated tree pullers in the Albany district of Western Australia). For some districts there is a record of the extensive use of Chinese labour for contract clearing and ringbarking, such as at Yerong Creek (N.S.W.) (Yerong Creek Centenary History Committee, 1981) and the Bygoo district (N.S.W.) where a contract is recorded for ringbarking 24 500 hectares (Webster, 1956).

Early timbergetting

This category refers to manual production of timber for local uses or supply to merchants and is referred to by 40% of those monographs which contain forest material. The accounts show the pivotal role of timber in the nineteenth-century economy, though there is little discussion or analysis of the commercial context in which timbergetters operated, or the development of government control. For those local histories which dwell on the 'colourful past', early timbergetting provides ideal material. The results are evocative accounts of exploration of the wilds in search of timber, of pitsawing and of bullock wagon transport, along with descriptions of the hardy 'characters' involved. The items reviewed contain considerable detail on early timbergetting in the major forest areas of Australia and the particular timbers cut.

There is some, though limited, reference to timbergetting by convicts. Pink's (1984) history of Strahan and Macquarie Harbour (Tas.) makes note of the convict sawpits on Sarah Island which began the Macquarie Harbour Huon pine industry. Beattie (1905) mentions convict timbergetting at Port Arthur, Tasman Peninsula (Tas.). In a history of Hornsby Shire (Research Committee Hornsby Shire Historical Society, 1983), there is a description of a convict sawyer's working day in the New South Wales colony of the late 1810s . Steele (1975) refers to the convict sawpits near the Brisbane River in the 1820s.

Pitsawing is well covered, in diverse locations, and with a number of photographs. While there is the suggestion that the first sawpits, worked by convicts, were dug into the ground and walled to prevent collapse (Maitland Centenary Historical Committee, 1963), there were later modifications and shortcuts. A suitable gully could save the work of digging a pit (Cameron, 1987 [Glen Innes, N.S.W.]), (Bayley, 1960 [photograph of gully sawpit, Kiama, N.S.W.]). Photographs from the Queensland Darling Downs (Macqueen, 1981), the nearby Dividing Range (Dansie, 1985), and the Wandoan district (Fox, 1959) show that raised sawpits were quite common in Queensland. They probably better suited the Queensland climate, and though they required that the logs be raised by way of ramps onto a platform, this was less of a problem when dealing with the lighter hoop and cypress pine. Macqueen has described the different methods (pp. 49-50).

> One could be excused for believing this [pit-sawing] was something invented by the devil. The principle of the method involved the vertical sawing of a horizontal log, one man on top, another underneath. The saw itself only cut one way, so

> the job of the man below was simply to push back the saw so the operator on top could saw down another stroke. The older pit-saw sites were pits dug into the ground and slabbed so they would not cave in. Mr Nick Thornton recalls one at Pine Park (on the Stonehenge to Leyburn road) in 1913, when the family first went there. It was a pit 12 feet long, 4 feet deep, and 3 feet wide. Two logs were placed lengthways along the edge of the pit, and then on top, two short logs were laid over the ends, which were adzed or planed flat. The log to be cut was then rolled up on these and locked firm with a spiking device known as a 'dog'.
> More 'modern' pits used a wooden frame, so that the whole operation took place above ground: this of course meant that the logs had to be rolled up higher to be put in position, but for a short single job such as the building of a selector's cottage, this method seemed to be favoured, rather than the digging and slabbing of a pit. Whatever the pit, the man below was in a torture chamber.

Furnell (1981) shows a similar raised sawpit at Bangalow in northern New South Wales.

The transport of logs is well covered in photographs of bullock teams, log rafts on the water, and rafting grounds. These transport methods span both the early timbergetting and later sawmill establishment periods. Examples include: Cato (1979) (Noosa, Qld - bullock teams and rafting grounds), Holthouse (1982) (Gold Coast, Qld - bullock teams and rafting grounds), Williams (1982) (Fraser Island, Qld - log rafts), Hannah (1981) (Comboyne Plateau, N.S.W. - bullock teams), Dundon (1979, 1985) (Gosford, N.S.W. - bullock teams).

Some timbers feature prominently in the accounts of early timbergetting. In Western Australia, sandalwood for trade with the Orient receives much mention, especially in the wheatbelt; e.g. Lange (1981) (Pingelly), Pederick (1979) (Wagin). In Tasmania, Huon pine is prominent; e.g. Huon Newspaper Company (1936) (Huonville), Pink (1984) (Macquarie Harbour). In the east coast rainforests, red cedar was the prime target for early timbergetters and, in a historical sense, has probably become the country's best known tree (see Vader, 1987). References to red cedar are numerous. Daley's (1966) account of the Richmond River district (N.S.W.) cedar trade is unsurpassed. Other references include Walter (1976) (Coffs Harbour, N.S.W.), Griffith (1978) (Kangaroo Valley, N.S.W.), and Jones (1976) (Cairns, Qld).

The importance of timbergetting in the early social and economic history of many Australian rural communities is shown throughout the local histories. Timbergetting is also closely intertwined with land settlement well into the twentieth century. Many timbergetters later selected land in areas where they had cut timber. First selectors were often only able to survive by timbercutting as well as farming.

A number of the histories refer to particular events, communities, traditions and activities. Jones (1976) discusses the attempts by Burns Philp to transport cut cedar from the Atherton Tableland to the coast in north Queensland, and what she considers to have been exaggerated accounts of a trial at 'freshing' - purportedly resulting in massive timber destruction over the Barron Falls. The lives and exploits of cedar getters are included in many accounts of the east coast. In Tasmania the Huon piners rate special mention; likewise, in South Australia the sawyers, splitters and shingle cutters of the 'Tiers' in the Mount Lofty Ranges. Porter (1977: 131) described the annual woodcutters' procession in Bairnsdale (Vic.):

> Most [processions] were attempts at the spectacular and playful. The annual woodcutters' procession was otherwise: subdued and somehow touching. On 24 August 1925, for example, I remember watching twenty lorries and wagons which, though (or perhaps because) they and their horses were hung with garlands and flowers, made me think of a funeral. Fifty tons of firewood was moving decorously along Main Street towards the hospital and its fireplaces, stoves, and laundry coppers. This donation, essentially sweat and muscle and time, was all the Sarsfield woodcutters could afford.

Forest industries, sawmilling, forest products

This category contained the largest proportion of entries (30.5%), and these were to be found in almost half the items which contained forest material (Table 2). The category is a broad one and includes forest products such as firewood, the collection and sale of which spans the whole period since European settlement. The development of sawmilling is given much attention in local and regional history. The construction of sawmills and often, associated roads and railways, was a great symbol of progress. Sawmillers were often prominent citizens and, therefore, prime candidates for inclusion in local histories.

Some particular forest and woodland products which feature in local histories include: firewood, mine timber, railway sleepers, eucalyptus oil, wattlebark, yacca gum and charcoal. As the following examples show, local history provides some insight into forest uses no longer in existence or much reduced in importance.

It is difficult not to underestimate the importance of firewood in Australia's economic development and changes to the landscape. Its uses as an energy source were as diverse as Murray River paddlesteamers and irrigation pumps, Queensland sugar mills, and bakers' ovens across the continent. Especially in woodland areas, the impact on the vegetation was soon apparent. Roderick (1984) in his history of Charters Towers (Qld) records an observation made in 1885 that 'every tree has been cut down and the ground is without vegetation of any kind'. Firewood for 250 mine and mill boilers and 30 000 people was brought in by the railway to a special firewood siding. Kerr (1983: 29) shows the huge firewood stack at the Pemberton sugar mill, Woongarra, in 1910 (Bundaberg, Qld). For Barongarook (Vic.), Houghton (1979) noted that the area previously carried on an 'enormous' firewood trade 'in the form of 2ft, 4ft and

5ft lengths for industrial and domestic use. The butter factories at Colac and Cororooke, wood yards in Colac and district farmers were the major consumers ...' Roysland (1977) recalls childhood years on the Murray, supplying firewood to the river boats and to Number One pumping station at Renmark. It has been stated that each of the major Murray pumps used 30-35 tons of wood every 24 hours (Hannah, 1986: 72). In the remote and arid north-western corner of New South Wales at Tibooburra, Gerritsen (1981: 89) shows firewood collection from the sparsely wooded landscape by children with goat carts.

The demand for mining timber and firewood is clearly shown in the woodland devastation that occurred around inland mining centres such as Kalgoorlie (W.A.), Broken Hill (N.S.W.) and Charters Towers (Qld). These centres had to resort to importing mine timbers from overseas (e.g. oregon from North America), or from other districts within Australia. In Western Australia, salmon gum from the Geraldton area was sent to the Murchison goldfields (Halley and Wilson, 1948). Red gum from the Echuca district supported the Ballarat and Bendigo gold mines (Morris, 1952; Priestly, 1965). There are other references to mining timber throughout Australia. Jenkins and Jenkins (1980) detail the supply of props and laths in working the alluvial gold of Sebastopol (Vic.). Pryor (1963) shows the large quantity of timber needed in underground mining in the Moonta copper mines of South Australia, which resulted in the destruction of the surrounding 'dense' mallee and cypress pine.

In those parts of Australia naturally vegetated by robust eucalypt forest, sleeper-cutting (in the mill or manually in the forest) has long been a major forest industry. In the case of the Western Australian jarrah and the Murray River red gum forests, street paving blocks were an associated sawmill product. Many local histories dealing with the eucalypt forests make reference to the sleeper-cutting trade, including overseas export. Examples include: Snell (1986) (Drakesbrook, W.A.), Wellings (1965) (Eden, N.S.W.), Hibbins (1978) (Nathalia Shire, Vic.), Bayley (1953) (Nundle Shire, N.S.W.). In some instances, there is some data on the industry; e.g. McConnell (1951) gives volumes and values for red gum sleepers cut at Barham (N.S.W.). Specifications for sleepers were generally rigidly defined in terms of species and measurement tolerances. Webb's (1980) history of Kurrajong (N.S.W.) refers to the official inspection of the sleeper cutters' month's tally (p. 140).

> 'Sleeper-pass day' in the 1930's, was an important event for the timber cutters of the Kurrajong.
> On an appointed day each month, a Railway Official from Sydney, would be at Kurrajong goods yard, to inspect and 'pass' the sleepers the men had carted in from the bush - the result of a month's hard toil.
> After laying the sleepers out in rows, ready for inspection, the men would stand nearby while the inspector carefully checked each sleeper.
> One requirement was that they be cut from an Iron bark tree. A 'ring in' of a few grey gum sleepers, if successful, was considered 'smart work'. As the timber from the Iron bark

and grey gum is very similar, only an expert could differentiate between them.
A 'victory' for one of the local men was good for the morale.

The distilling of eucalyptus oil has been carried out in various parts of Australia where suitable species could be found, especially peppermints. The collection of leaves was often a sideline for farmers. In Western Australia, the use of the leaves of young salmon gums is recorded in Eaton's (1979) history of Quairading. Mitchell (1984) gives a detailed account of distilling from black peppermint on the far south coast of New South Wales. Victoria appears to have been the main eucalyptus oil producer and there are a number of references for that state; including Carmody (1981) (Upper Murray); Berwick, Pakenham Historical Society (1982) (Shire of Berwick); and Houghton (1979)(Barongarook).

Minor forest products which appear in local histories include wattlebark, yacca gum, and charcoal. References to wattlebark include: Moruya Historical Society (1983) (Moruya, N.S.W.); Harvey and Learmonth (1966) (Portland, Vic.), Hibbins (1978) (Nathalia Shire, Vic.), and Williams (1985) (Yankalilla, S.A.). This last also contains a section on the collection of yacca gum from grass trees (Xanthorrhoea tateana) which grow on the higher country of the southern Fleurieu Peninsula. Charcoal burning has been carried on throughout the forests according to demand. The ancient technique of constructing an earth covered mound in which the fire could be contained was generally followed, but there were exceptions - for example, between 1916 and 1918 at Barongarook (Vic.), Houghton (1979) records the use of a circular iron retort. At Bundaberg, in Queensland, charcoal burners supplied their product to the Millaquin sugar refinery (Rackemann, 1985). In the Wangaratta area (Vic.), there was a demand for charcoal for the mine forges (Lloyd, 1978). Keast (1987) notes that many Italian families in the Kalamunda district (W.A.) earned money in the 1920s by charcoal burning while they were establishing orchards. At Robertstown (S.A.), larger scale mechanised charcoal production using green mallee was established in the late 1970s (District Council of Robertstown, 1986).

In the items reviewed, there is a wide coverage of sawmilling and the forest products industry, ranging from the use of portable sawmills on farms, e.g. Oulton (1986) (Lexton, Vic.), to the establishment of large industrial enterprises, such as Australian Paper Manufacturers at Broadford (Vic.) (McDonald, 1983). There is a similar wide coverage of types of timber drawn on, from the inland cypress pine to the coastal rainforests and the exotic softwood plantations. Most of the accounts of sawmilling are simple narratives of establishment and operation at the local level, without much analysis of the wider context in which these took part. Some of the discussions of sawmilling establishment merge with family history.

Boatbuilding was an important adjunct to sawmilling in some areas; e.g. Fremantle (W.A.) where jarrah was used (Ewers, 1948); Echuca (Vic.) where boats and barges were made from red gum

(Priestley, 1965); Devonport (Tas.) where coastal traders were built from blue gum and huon pine (Binks, 1981).

Waterpower provided the energy for some mills well into this century, requiring the skilful construction of long water-races. Examples are given in Popham (1980) (Armadale-Kelmscott, W.A.), Herring (1975) (Batlow, N.S.W.), and Byard (1984) (Wynyard, Tas.).

Many of the items reviewed contain excellent photographs of sawmills and associated forest operations. Williams (1982), in his history of Fraser Island (Qld), includes a chapter on timber which contains many photographs, in particular, log transport. In Western Australia, Snell's (1986) history of Drakesbrook is notable for its comprehensive, well-illustrated chapter on the timber industry with photographs, maps, and details of community life. Anon. (1905) contains internal photographs of the box factory of Petersen and Larsen, South Melbourne (Vic.). Another example of good quality internal photography may be found in Harrison (1910) (Ipswich, Qld).

References to sawmilling and the forest industries vary from short entries to comprehensive chapters of the type mentioned above for Drakesbrook (W.A.). Another detailed Western Australian work is that of Coy (1984) for Serpentine-Jarrahdale in the heart of the jarrah forest. In Victoria, Butler's (1979) work on Buln Buln Shire contains a section on sawmills in the area, including a useful detailed description of Fraser's Mill at Powelltown in 1886. Some items give a short and generalised history of the local timber industry incorporating the major milestones in its development, such as the introduction of motor lorries for log transport: e.g. Anon. (1979) (Calliope, Qld); Ward's River-Johnston's Creek School Centenary Committee (1972) (Ward's River, N.S.W.). It is common for works - especially the more traditional style of local history - to give some attention to the families involved in sawmilling and to chart their fortunes over time. An example is Hall's (1983) reference to Bagot Brothers' timber mills, Ballina, New South Wales for the period 1884-1960.

Employment in forestry/forest industries

Forest-related employment is automatically subsumed under other headings; this category, which refers to specific discussion of employment and presentation of employment data, is therefore one that contains a relatively small number of entries (Table 2). In the items reviewed, the main entries concern numbers employed in various activities (e.g. as sawmill workers or bullock drivers) at different times, contract rates of pay and wage levels, employment conditions, and unionism.

The potential of oral history in the reconstruction of working conditions has not yet been fully realised. Hannah's publications on the Comboyne Plateau (N.S.W.) (1981) and the Bulga Plateau (N.S.W.) (1979) illustrate this potential. References to unionism around the turn of the century are contained in Keast (1987) (Kalamunda, W.A.) and Gibbney (1980) (Eurobodalla, N.S.W.). One of the more interesting discoveries in the review was the (rather colourful) account of Miss Julia Hale, who operated a logging and sawmill business in the Corryong district of north-eastern Victoria between 1947 and 1964 (Mitchell, 1981). The following is a brief except (pp. 133-4):

> One spring evening in 1946, a newly-elected shire president drove up to the Court House Hotel in Corryong and beheld a most unusual sight. A huge timber-jinker was drawn up in front of the slightly crumbling red-brick of the old hotel. In front of the jinker were half a dozen giants of loggers, all looking most uncomfortable and trying to get behind one another. In front of them was a bundle of fury in the shape of a medium-sized woman, her brown hair plaited in 'cow pats' over her ears. She was giving the loggers (who towered above her) a piece of her mind, and they were anything but relishing the stream of caustic criticism she was directing at them.
>
> ...
>
> ... Julie Hale got her logging permit, and the Forests Commission its biggest shock. The super-efficient team of Hale, Brew, and Moore (starting in October, 1946) built a good 13-mile mountain road right into the Pinnabar Forest and started logging, and the Upper Murray had a new industry, with a brand new sawmill in the Nariel Valley employing some 50 men. The mill started cutting logs in November, 1947, only 13 months after Julia Hale got her permit - an outstanding achievement.

In general, this review shows that local and regional history does not have a lot to offer in this category though some of the specific information could be useful.

Government regulation, forest services, native forest silviculture

This category, largely concerned with the intervention of the state in forest use and management, is not well represented in local and regional history. This is a reflection of the lack of context which characterises local history writing. Those which refer to government involvement, in general, adopt an optimistic tone. Having traced through an earlier period of forest destruction and wasteful cutting, these works see management which has sustained yield as its goal as offering the possibility of a stable forest industry into the future. In a few instances, wider forest values are considered: e.g. Calder (1980) (south-west Western Australia); Temora Centenary Historical Book Committee (1981) (Temora, N.S.W.).

A number of items contain small sections referring to forest service supervision of forestry activities, regeneration plans and silvicultural activities: e.g. McConnell (1951) (Barham, N.S.W. - Murray River red gum forest sustained yield plan); Banfield (1964) (Shire of Ararat, Vic. - messmate (Eucalyptus obliqua) forest silvicultural program). Williams' (1982) comprehensive chapter on Fraser Island timber is followed by an appendix detailing the

Queensland Forestry Department's management of the area. Mullett (1979) refers to the employment of gangs of men in weed clearing, ringbarking and firebreak cutting, as part of the locally termed 'silver culture' of the Goodnight Scrub hoop pine forest of the Kolan district (Qld.). In the history of Narrogin (W.A.) by Pustkuchen (1981), there is mention of unemployment relief work in forestry, replanting mallet (Eucalyptus astringens) during the great depression.

Softwood Plantations

In 1986 there were 832,000 hectares of coniferous plantation in Australia. Most of this was exotic Pinus spp. except for 45,700 hectares of native Araucaria plantation, mainly in Queensland (Australian Bureau of Agricultural and Resource Economics, 1987). This aspect of Australian forestry has only a few entries in the material reviewed, partly because the plantations, though located throughout the country, are highly concentrated in particular areas. The entries tend to be mainly simple descriptions of the planting programs and the benefits to the local community. Some examples are Mitchell (1981) (Corryong, Vic.); Harvey (1972) (Beechworth, Vic.); Hill (1972) (Mt Gambier, S. A.); Williams (1985) (Yankalilla, S.A.); Donald (1967) (Gympie, Qld); Murphy and Easton (1974) (Nanango, Qld). The latter refers to Araucaria (mainly hoop pine) planting.

Environmental effects related to forest use

This question is only likely to be raised in those works which adopt a more restrained or questioning approach to the emphasis on development and progress which characterises much local history writing. The category accounts for three per cent of total entries. These cover a range of matters, including: soil erosion due to tree removal - e.g. Moore (1981) (Burra County, Queanbeyan district, N.S.W.); shrub growth due to increased fire frequency - e.g. Field (1977) (Grampians, Vic.); and prickly pear infestation in Queensland - e.g. Armstrong (1970) (Bendemere Shire (Surat)). Soil salinity is discussed by Edey (1981) in the Red Cliffs area of the Victorian mallee. For the Biggenden district in Queensland, Stewart and Stewart (1981), in their comprehensive history of the establishment of rural industries in the area, refer to 'non-descript' scrub replacing the original tall forest. The history of Numurkah (Vic.) by Bossence (1979) refers to the problems created for the red gum forests by the demands placed on the Murray River for irrigation water and the consequent altering of the summer dry/winter inundation cycle to which the trees were adapted. Though it is more than a local history, the book by Seddon and Ravine (1986) on Perth (W.A.) contains an excellent example of the possibilities of local history in reconstructing past vegetation patterns and subsequent changes.

The trend in local history writing appears to be that this category will receive greater attention. The Paterson and Price (1984) history of Bute district (S.A.), which attempts to reconstruct original vegetation patterns and then examines patterns of change and the agents of change, gives some indication of what could be achieved.

Forest conservation

Utilitarian-based forest conservation (maintaining timber production but bringing it under some regulatory agency) has been considered under a previous heading. This category is concerned with reservation of land from timber production as in national parks or similar reserves. The category has only a small number of entries. Examples include Mitchell (1981) (Corryong, Vic.) and McDonald (1968) (Wellington, N.S.W.).

Conclusion

From the point of view of the forest record, the review has shown that the value of local and regional history so far published is variable. By far the greatest amount of information is on original vegetation, early timbergetting, clearing, sawmilling, and the development of the forest industries. Aboriginal use, government regulation, environmental impacts, plantation forestry and forest conservation fare less well. There is an identifiable trend towards a higher standard of local and regional history in which the broad field of environmental management will probably receive greater attention.

From the material reviewed, something can be said about the role of the forests and their associated industries in most parts of Australia. The works often drawn on (and therefore make known) perishable local sources, such as oral ones and locally held photographs. The items show that there is a photographic record that will become increasingly valuable as the nature of the timber industry and its technologies change. The potential for oral history has yet to be fully recognised and depends, to a considerable extent, upon the ability of researchers and local history writers to ask the appropriate questions of their informants.

The record shows the unashamedly parochial nature of local history writing, with details of local forest use, local solutions to problems and adaptations, and aspects of social history such as life in mill towns. The regional works tend to a more expansive view and contextual approach. Despite its limitations, local and regional history provides clues to a better understanding of Australia's environmental history - though its full potential has yet to be realised.

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REFERENCES

Andrews, A., 1920 The First Settlement of the Upper Murray 1835 to 1845, with a Short Account of over Two Hundred Runs 1835 to 1880 (D.S. Ford, Sydney).

Anon, 1905 Jubilee History of the City of South Melbourne and Illustrated Handbook (Periodicals Publication Co., Melbourne).

Anon, 1979 Calliope Shire Council Centenary 1879-1979 (Calliope Shire Council, Calliope).

Armstrong, G.O. 1970 The Changing Years: a History of the Shire of Warroo Incorporating Bendemere Shire History (W.R. Smith and Paterson for the Warroo Shire Council, Fortitude Valley, Brisbane).

Australian Bureau of Agricultural and Resource Economics, 1987 Australian Forest Resources 1986 (Aust. Govt Publ. Serv., Canberra).

Australian Council of Local Government Associations, 1986 List of Local Governments in Australia (The Council, Canberra).

Atherton Centenary Committee, 1985 Tall Timber and Golden Grain, Atherton 1885-1985 (The Committee, Atherton).

Banfield, L.L., 1964 Like the Ark: The Story of Ararat (Cheshire, Melbourne).

Bate, W., 1978 Lucky City: The Generation at Ballarat 1851-1901 (Melbourne Univ. Press, Melbourne).

Bayley, W.A., 1953 Hills of Gold: Centenary History of Nundle Shire New South Wales (Nundle Shire Council, Nundle).

Bayley, W.A., 1960 Blue Haven: History of Kiama Municipality (Kiama Municipal Council, Kiama).

Beattie, J.W., 1905 Port Arthur and Tasman Peninsula, illustrating the Convict Days of Tasmania (The author, Hobart).

Beaumont, C., 1980 Local History in Victoria: An Annotated Bibliography and Victorian Directories 1836-1974 (La Trobe University, Bundoora).

Berwick, Pakenham Historical Society, 1982 In the Wake of the Pack Tracks: a History of the Shire of Berwick now the City of Berwick and the Shire of Bannockburn (The Society, Berwick).

Bignell, M., 1977 The Fruit of the Country: A History of the Shire of Gnowangerup Western Australia (Univ. of Western Australia Press, Perth).

Binks, C.J., 1981 The Story of Devonport (The author, Devonport).

Bolton, G.C., 1963 A Thousand Miles Away: A History of North Queensland to 1920 (Aust. National Univ. Press, Canberra).

Bolton, G.C., 1972 A Fine Country to Starve In (Univ. of Western Australia Press, Perth).

Bolton, G.C., 1979 'Regional History in Australia', in Historical Disciplines and Culture in Australasia; an Assessment, Ed. J.A. Moses (Univ. of Qld Press, St Lucia): 215-27.

Borlant, H.A. 1940 From Wilderness to Wealth: Featuring the Storied History of the District of Cairns (Cairns Post Print, Cairns).

Bossence, W.H., 1979 Numurkah (Hawthorn Press, Melbourne).

Butler, G., 1979 Buln Buln: A History of the Buln Buln Shire (Shire of Buln Buln, Drouin).

Byard, T., 1984 More Merriment - Writ in Remembrance (Neptune Press, Newtown, Vic.).

Caboolture Shire Council, 1979 From Spear and Musket 1879-1979, Caboolture Centenary: Stories of the Area once controlled by the Caboolture Divisional Board, Shires of Pine Rivers, Caboolture, Kilcoy, Landsborough, Maroochy, Landsborough and the City of Redcliffe (The Council, Caboolture).

Cairns, J., and Johnston, W.T., c. 1985 Early Tableland Days: W.H. Bunker Photographic Collection (The authors, Cairns).

Calder, M., 1980 Big Timber Country (Rigby, Adelaide).

Cameron, A.W., 1987 A Short History of Glen Innes (Glen Innes and District Historical Society, Glen Innes).

Carmody, J., 1981 Early Days of the Upper Murray (Shoestring Press, Wangaratta).

Cato, N., 1979 The Noosa Story: A Study in Unplanned Development (Jacaranda, Milton).

Chandler, M.J., 1979 Against the Odds: The Story of the Red Cliffs Settlement (The author, Mildura).

Chessbrough, S., 1982 A Spread of Green Grifith, Its People and Past Events (Kalora Publications, Sydney).

Connor, A.M., 1983 Where Whirlwinds Rise Tall: Featuring the 'Burrawang' Run and the Ootha Settlement (The author, Bilambil Heights, N.S.W.)

Crawford, F., 1983 Duck Creek Mountain now Alstonville: a Story of Early Settlement and Progress (The author, Alstonville).

Coy, N.J., 1984 The Serpentine: A History of the Shire of Serpentine-Jarrahdale (Shire of Serpentine-Jarrahdale, Mundijong).

Daley, L.T., 1966 Men and a River: A History of the Richmond River District 1828-1895 (Melbourne Univ. Press, Carlton).

Dansie, R., 1985 Morass to Municipality: Celebrating Toowoomba's 125th year as a Municipality (Darling Downs Institute Press, Toowoomba).

District Council of Robertstown, 1986 Emmaus to World's End: a History of the Robertstown Council Area (The Council, Robertstown).

District Council of Tumby Bay, 1981 The History of Tumby Bay and District (The Council, Tumby Bay).

Donald, R.H., 1967 Souvenir of Gympie's Centenary (Gympie Centenary Celebrations Committee, Gympie).

Dundon, G., 1979 Old Gosford and District in Pictures Rev. Edn (The author, Gosford South).

Dundon, G., 1985 Old Gosford and District Album: Photographic Memories of Gosford (The author, Gosford South).

Duruz, R.M., 1971 The Story of the Port Campbell District (The author, Port Campbell).

Eaton, F., 1979 The Golden Grain and the Silver Fleece: A History of Quairading from 1859-1930 (Wescolour Press, East Fremantle).

Edey, J.F., 1981 From Lone Pine to Murray Pine: The Story of a Mallee Soldier Settler (Sunnyland Press, Red Cliffs).

Eunson, W., 1978 The Unfolding Hills: Mirboo Pioneers of the Gippsland Forests 1878-1914 (Mirboo Shire Council, Mirboo).

Ewers, J.K., 1948 The Western Gateway: 100 Years of Local Government in Fremantle, Western Australia (Fremantle City Council, Fremantle).

Field, J., 1977 Waggon Wheels thro' the Wildflowers (Hawthorn Press, Melbourne).

Fox, G., 1959 Pioneers of the Taroom and Wandoan District: Historical Notes on the Shire of Taroom (Taroom Shire Council, Taroom).

Frawley, K.J., 1987 The Maalan Group Settlement, North Queensland, 1954: An Historical Geography, Monograph Series No. 2, Department of Geography and Oceanography, University College, Australian Defence Force Academy, Canberra.

Furnell, L.C., 1981 Out of the Big Scrub, Bangalow (The author, Homebush).

Gammage, B., 1986 Narrandera Shire (The author for the Narrandera Shire Council, Narrandera).

Gerritsen, J., 1981 Tibooburra - corner country (Tibooburra Press, Tibooburra).

Gibbney, H.J., 1980 Eurobodalla: History of the Moruya District (Library of Australian History, Sydney).

Griffin, J.J., 1970 The Years of Change: a Story of the Development of the Ardlethan and Beckom Districts (The author, Beckom, N.S.W.).

Griffith, J., 1978 A History of Kangaroo Valley, Australia (Kangaroo Valley Historical Society, Kangaroo Valley, N.S.W.).

Hall, G., 1983 Port of Richmond River (1840s-1980s) being a Personalised Regional History of Ballina and the Lower River (The author, Lismore).

Halley, E.M. and Wilson, H.H., 1948 More about the Victoria District, Part 2 (The authors, Geraldton).

Hamilton, C., 1986 Guide to Northern Territory History (Darwin Institute of Technology Library, Darwin).

Hancock, W.K. 1972 Discovering Monaro: A Study of Man's Impact on his Environment (Cambridge Uni. Press, London).

Hannah, H., 1979 The Mountain Speaks: A Folk History of the Bulga Plateau (The author, Elands).

Hannah, H., 1981 Together in this Jungle Scrub: A Folk History of the Comboyne Plateau (The author, Elands).

Hannah, H., 1986 Forest Giants: Timbergetting in the New South Wales Forests 1800-1950 (Forestry Commission of New South Wales, Sydney).

Hardy, P., 1984 A Short History of the Cloncurry District (Cloncurry Shire Council, Cloncurry).

Harrison, G. (ed.), 1910 Jubilee History of Ipswich: A Record of Municipal Industrial and Social Progress (Diddams, Brisbane).

Harvey, R.C., 1972 Background to Beechworth from 1852 (Beechworth Progress Association, Beechworth).

Harvey, E.W. and Learmonth, J.W., 1966 Portland 1800 to 1920 (A Synopsis) (Portland Town Council, Portland).

Heathcote, R.L., 1965 Back of Bourke: A Study of Land Appraisal and Settlement in Semi-Arid Australia (Melbourne Univ. Press. Carlton).

Henderson, K. and Henderson, T., 1983 Early Illawarra, People, Houses, Life: An Australia 1838 Monograph (History Project Inc., Canberra).

Herring, E., 1975 Batlow: The Growing Years From gold to Apples (Batlow Historical Society/Horwitz, Cammeray, N.S.W.).

Hibbins, G., 1978 A History of the Nathalia Shire (Hawthorn Press, Melbourne).

Hill, L.R., 1972 Mount Gambier: The City around a Cave. A Regional History (Investigator Press, Leabrook).

Hirst, J.B., 1978 'The Pioneer Legend', Historical Studies 18: 316-37.

Holthouse, H., 1982 Illustrated History of the Gold Coast (Reed, Sydney).

Hooper, R.H., 1973 The King Island Story (Peko-Wallsend, Sydney).

Hoskins, W.G., 1955 The Making of the English Landscape (Penguin, Harmondsworth).

Houghton, N., 1979 Barongarook: a Rural Portrait (Barongarook School Centenary Committee, Barongarook).

Huon Newspaper Company, 1936 Centenary of the Settlement of the Huon (The Company, Franklin).

Jack, I., Hughes, J. and Eslick, C., 1987 Bibliography of New South Wales Local History: An Annotated Bibliography of Secondary Works (New South Wales Univ. Press, Kensington).

Jenkins, E.D. and Jenkins, A.J., 1980 The Golden Chain: A History of Sebastopol with special reference to Gold and Mining (Cressaid Media for the Borough of Sebastopol, Sebastopol).

Johnson, L., 1982 Love Thy Land: A Study of the Shire of Albany, Western Australia (Albany Shire Council, Albany).

Johnston, W.R., 1981 A Bibliography of Queensland History (Library Board of Queensland, Brisbane).

Johnston, W.R., 1982 A New Province? - The Closer Settlement of Monto (Boolarong Publications for the Monto Shire Council, Brisbane).

Johnston, W.R. and Zerner, M., 1985 A Guide to the History of Queensland: a Bibliographic Survey of Selected Resources in Queensland history (Library Board of Queensland, Brisbane).

Jones, A., 1986 Karoonda, East Murray: A History to 1986 (District Council of Karoonda, East Murray, Karoonda).

Jones, A., 1987 Tatiara: The First 140 Years 1845-1985 (District Council of Tatiara, Bordertown).

Jones, D., 1961 Cardwell Shire Story (Jacaranda, Brisbane).

Jones, D., 1973 Hurricane Lamps and Blue Umbrellas: A History of the Shire of Johnstone to 1973 (Bolton, Cairns).

Jones, D., 1976 Trinity Phoenix: A History of Cairns and District (Cairns and District Centenary Committee, Cairns).

Keast, J., 1987 Valleys of Solitude: Italian Settlers of the Kalamunda District 1890-1945 (Kalamunda and District Historical Society, Kalamunda).

Kerr, J., 1983 Southern Sugar Saga: A History of the Sugar Industry in the Bundaberg District (Bundaberg Sugar Company, Bundaberg).

Lange, S., 1981 Pingelly: Our People and Progress (Pingelly Tourist and Town Beautification Committee, Pingelly).

Letcher, G., 1981 Local Histories of South Australia: a Selected Bibliography 1976-Feb. 1981 (Sth Aust. Inst. of Tech., School of Architecture and Building Library, Adelaide).

Lloyd, B., 1978 Gold at the Ten Mile. The Jamieson Goldfield (Shoestring Bookshop, Wangaratta).

Macqueen, N. (ed.), 1981 Back Creek and Beyond: Millmerran's Story of change, 1881-1981 (Darling Downs Institute Press, Toowoomba).

Maitland Centenary Historical Committee, 1963 Maitland 1863-1963 (Oswald Ziegler Publications for the Council of the City of Maitland, Maitland).

May, J., 1959 Eacham Shire Historical Data (Unpubl., Malanda).

McConnell, T.R., 1951 The History of Barham (D.W. Paterson, Melbourne).

McDonald, D.I., 1968 They Came to a Valley, Wellington 1817-1967 (Wellington Historical Society, Wellington).

McDonald, E.H., 1983 Country Life (The author, Broadford).

McDonald, L., 1981 Rockhampton: A History of City and District (Univ. of Qld Press, St Lucia).

McGeehan, T.D., 1951 Marching with the Years: A Brief Outline of the Early History of the Atherton Tableland (Atherton Tableland Agricultural Society, Atherton).

McWilliam, G., 1978 Hawthorn Peppercorns (Brian Atkins, Melbourne).

Meinig, D.W., 1962 On the Margins of the Good Earth: The South Australian Wheat Frontier 1869-1884 (Rigby, Adelaide).

Mitchell, T.W., 1981 Corryong and 'The Man from Snowy River' District (Wilkinson Printers, Albury).

Mitchell, W.R., 1984 'Distilling Eucalyptus Oil in the Wyndham, Towamba, and Lower Towamba Districts', in Tales of the Far South Coast, Vol. 2, Ed. Far South Coast History Committee (Southern Publishers, Bega): 94-5.

Moore, B., 1981 Burra County of Murray: a history of Burra in the County of Murray in the Queanbeyan District (The author, Pearce, A.C.T.).

Morris, A., 1952 Rich River (Riverina Herald, Echuca).

Moruya Historical Society, 1983 Moruya - the First 150 Years (The Society, Moruya).

Mullett, J.W., 1979 Centenary, Shire of Kolan 1879-1979 (Kolan Shire Council, Gin Gin).

Murphy, J.E. and Easton, Ew., 1974 Wilderness to Wealth. A History of the Shires of Nanango, Kingaroy, Wondai, Murgon, Kilkivan, and the Upper Yarraman portion of the Rosalie Shire (Smith and Paterson, Brisbane), 2nd Edn, orig. pub. 1950.

Neville, N., 1986 Local History in Victoria: An Update of Carole Beaumont's 1980 Bibliography (State Library of Victoria, Melbourne).

Noble, G.W., 1969 The Red Gate: A History of Alexandra (Council of the Shire of Alexandra, Alexandra).

Noble, W.S., n.d. The Strzleckis: A New Future for the Heartbreak Hills (Forest Commission Victoria).

O'Sullivan, W.D., 1913 Early History of Hartley: Its Rise and Decline (The Worker Trade Union Print, Sydney).

Oulton, M., 1986 A Valley of the Finest Description: A History of the Shire of Lexton (The author and the Shire of Lexton, Lexton).

Paterson, R.M. and Price, E.L., 1984 From Stumps to Stubble: A History of the District of Bute (District Council of Bute, Bute).

Pederick, M.J., 1979 The Emu's Watering Place: A Brief History of the Wagin District (Churchland's College for the Shire of Wagin, Churchlands).

Pike, G., 1976 Pioneer's Country (The author, Mareeba).

Pink, K., 1984 Through Hell's Gate. A History of Strahan and the Macquarie Harbour (Advocate Newspaper, Burnie).

Popham, D., 1980 First Stage South: A History of the Armadale-Kelmscott District, Western Australia (Town of Armadale, Armadale).

Porter, H., 1977 Bairnsdale: Portrait of an Australian Country Town (John Ferguson, Sydney).

Powell, J.M., 1970 The Public Lands of Australia Felix: Settlement and Land Appraisal in Victoria 1834-91 with special reference to the Western Plains (Oxford University Press, Melbourne).

Priestley, S., 1965 Echuca: A Centenary History (Jacaranda, Brisbane).

Pryor, O., 1963 Australia's Little Cornwall (Rigby, Adelaide).

Pustkuchen, O.E., 1981 The Way Through: the Story of Narrogin (Artlook Books Trust for the Town of Narrogin, Narrogin).

Rackemann, N., 1985 A Century of Progress: Woongarra Shire, 1885-1895 (Woongarra Shire Council, Bundaberg).

Research Committee Hornsby Shire Historical Society, 1983 Pioneers of Hornsby Shire 1788-1906 (Library of Australian History, Sydney).

Roderick, D., 1984 The Town They Called 'The World': Charters Towers (Boolarong, Brisbane).

Rolls, E., 1981 A Million Wild Acres (Penguin, Ringwood).

Roysland, D., 1977 A Pioneer Family on the Murray River (Rigby, Adelaide).

Seddon, G. and Ravine, D., 1986 A City and Its Setting: Images of Perth, Western Australia (Fremantle Arts Centre Press, Fremantle).

Snell, L., 1986 Drakesbrook Days and Waroona Years: An Illustrated History of Waroona Shire (Shire of Waroona, Waroona).

Spearitt, P., 1987 'City and Region' in Australians: A Guide to Sources (Australians: A Historical Library, Vol. VII), Eds D.H. Borchardt and V. Crittenden (Fairfax, Syme and Weldon Assoc., Broadway, N.S.W.): 131-9.

Steele, J.G., 1975 Brisbane Town in Convict Days 1824-1842 (Univ. Qld Press, St Lucia).

Stewart, G. and Stewart, F., 1981 Biggenden's Beginnings, the Pastoral Background (Biggenden Historical Society, Kingaroy).

Swancott, C., 1966 Gosford and the Henry Kendall Country (Brisbane Water Historical Society, Woy Woy).

Temora Centenary Historical Book Committee, 1981 Temora Yesterday and Today 1880-1980 (J.A. Bradley and Sons, Temora).

Temple, E., 1971 The Kiewa Valley and its Pioneers (Kiewa Valley Historical Society, Mt Beauty).

Vader, J., 1987 Red Cedar: The Tree of Australia's History (Reed, French's Forest, N.S.W.).

Walter, R.A., 1976 The Coffs Harbour Story (Central North Coast Newspaper Company, Coffs Harbour).

Warcup, J., 1983 Local Histories of South Australia: A Regional Bibliography (Dept. of Environment and Planning, Adelaide).

Ward's River-Johnston's Creek School Centenary Committee, 1972 Ward's River-Johnston's Creek School Centenary 1872-1972 (The Committee, Ward's River, N.S.W.).

Waterson, D.B., 1968 Squatter, Selector, and Storekeeper: A History of the Darling Downs 1859-93 (Sydney Univ. Press, Sydney).

Webb, V., 1980 Kurrajong: An Early History (The author, Seaforth).

Webster, R., 1956 Bygoo and Beyond (Halstead Press, Sydney).

Wellings, H.P., 1965 Eden and Twofold Bay: Discovery, Early History and Points of Interest 1797-1965 (Bega News Print, Bega).

Williams, F., 1982 Written in Sand: A History of Fraser Island (Jacaranda, Milton).

Williams, R.F., 1985 To Find the Way: History of the Western Fleurieu Peninsula (Yankalilla and District Historical Society, Yankalilla).

Yerong Creek Centenary History Committee, 1981 A History of Yerong Creek and District: Published to Commemorate the Centenary of Yerong Creek Public School, 1831-1981 (The Committee, Yerong Creek).

APPROACHES TO A FOREST HISTORY OF THE NORTHERN TERRITORY

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INTRODUCTION

The Northern Territory (NT) is an example of a land unit arbitrarily defined by boundaries of latitude and longitude established in an era of European colonisation when coastal delimitations of the 'new' land were reasonably well known but inland was terra incognita. The non-coastal boundaries of most of the Australian States and Territories (including the former jurisdiction of Papua and New Guinea) have been defined in this way, and, in the case of the Northern Territory, South Australia, New South Wales and Queensland, arbitrarily shifted in the nineteenth century (see e.g. Donovan, 1981). Nevertheless, the NT vegetationally demonstrates a clear environmental gradient from its southern boundary in the deserts of Central Australia to the monsoonal climate of its 'Top End', strongly reflected in the distribution of tree species, whether natural or anthropogenic. Whilst its longitudinal boundaries are less environmentally and vegetationally defined, there are differences between the forests of north Queensland and the open landscapes of the north of Western Australia. The Northern Territory does not have any of the non-seasonal rain forest found in north Queensland, and apart from the extreme north of the Kimberley region, there is no monsoon forest or woodland in the north of Western Australia. However, on its northern boundary, the vegetation of the NT's Top End has climatic and floristic similarities with the island of Timor.

Our research on the history of forests and forestry in the Northern Territory has demonstrated some reasonably clear temporal divisions in the Top End, defined by Lacey (1978) as the higher rainfall zone north of Larrimah. The shrublands and arid vegetation of the 'Red Centre' have a different and relatively recent history with respect to tree planting, and in this paper we shall review the areas separately. Table 1 shows the temporal framework we have identified and which we shall use to summarise our preparation for a detailed forest history of the Top End.

PRE-ABORIGINAL PLEISTOCENE FORESTS

Evidence for the development of Holocene vegetation in the north of Australia is scant. There have been a few broad reviews on the history of climate and vegetation in Australia (Kemp, 1981; Kershaw, 1981; Smith, 1982; Walker & Singh, 1981) from which the composition of NT vegetation can only be inferred. Martin (1978) traces palynologically the change from essentially rainforest vegetation to that dominated by Myrtaceae (although not of the eucalypt type) in the Pliocene. Smith (1982) suggests that there was no widespread distribution of savannahs and savannah woodlands until

Table 1

Temporal divisions of forest history in the Top End

(Note In this table the word 'forest' covers the spectrum from relatively open savannah woodlands [see e.g. Cole 1963] to monsoon forests [see e.g. Webb & Tracey, 1981]).

1. Pre-aboriginal Pleistocene forests (pre-40 000 [?] B.P.).

2. Aboriginal influences on Pleistocene and Holocene (Recent) forests (40 000 B.P. to about 1700).

3. Pre-European (mainly Macassan) contact on the northern Australian coast (1650-1906).

4. European contact and settlement - the exploitative phase.

   (a) The early settlements (1824-1849)
   (b) Post-1863 settlements
   (c) Establishment of sawmills
   (d) Mining
   (e) The overland telegraph (1870-1979)
   (f) The North Australia Railway (1886-1976)
   (g) The Pacific War (1942-1945).

5. European settlement - the rise and fall of plantation forestry and forestry research in the NT (1957-1978).

6. European settlement - NT self-government, a 'conservation phase' (1978-present).

   (a) Territory Parks and Wildlife Commission/Conservation Commission of the Northern Territory
   (b) Mine site rehabilitation
   (c) Voluntary activities - e.g. Greening Australia, The Outstation Movement.

the Pleistocene. However the progression from wet to dry vegetation was intermittent, and Kemp (1981) states that wetter intervals in the Holocene saw the re-establishment of rainforest. Janzen (1985) argues that prior to Aboriginal invasion(s), tropical northern Australian vegetation was woody vegetation ranging from dry season mixed deciduous and evergreen (e.g. Darwin-Kakadu-Kapalga area) to evergreen (e.g. Atherton - Cairns area). It would have had lowest physiognomic stature in the driest areas, tapering out into semi-arid grass and shrubs as rainfall declined and the wet season got shorter (e.g. Katherine and south). In areas where lightning occurs concomitant with the beginning of the wet season, as in north-western Australia and parts of the Top End, there could be occasional catastrophic fires at long intervals which could lead to the establishment of Eucalyptus-grassland habitats which would gradually return to closed canopy forest, perhaps to be eventually burned again. Such a scenario has been described by Johns (1986) from the Gogol River valley near Madang in Papua New Guinea, and the widespread fire destruction of rainforest in East Kalimantan in 1985 is probably another example of such events, associated with 'El Nino' conditions.

Janzen (1985) further argues that at this time throughout tropical Australia, the woody-fruited Myrtaceae (Eucalyptus, Melaleuca and similar genera) were site specialists with highly patchy distributions in disturbed habitats such as swamps, beach dune successions, erosion-prone slopes, fire-prone sites, creekbeds and rocky ridges. The forest proper would have been species rich, containing many plant families, many life forms and many seed-dispersal modes. He further postulates that the mammal fauna would have exhibited a wide range of body sizes and forms, with giant ratites along with the smaller ones seen today.

ABORIGINAL INFLUENCES ON PLEISTOCENE AND HOLOCENE FORESTS

The generally accepted time-span for the earliest Aboriginal presence on the continent of Australia is 50 000-40 000 years B.P. This is firmly in the last glaciation. At Lake George in south-eastern New South Wales a long pollen diagram shows four major vegetation fluctuations over the last 350 000 years, corresponding roughly to the four major glacial/interglacial cycles recorded in the northern hemisphere. In these pollen spectra the interglacials appear to have been dominated by forests or woodlands, whilst the glacials had open vegetation, mainly of grassland species (Singh et al., 1981).

In north-eastern Queensland, Kershaw (1978) presents evidence of the last interglacial/glacial cycle from Lynch's Crater, Bromfield Swamp and Quincan Crater on the Atherton Tableland, presently within the natural limits of the extant rainforest. This work reveals that forests dominated by rainforest angiosperms occupied the area during most of the last interglacial (120 000-80 000 B.P.) and most of the Holocene (from 7 000 B.P.). Kershaw (1978) infers that both periods must have enjoyed a high effective rainfall. At the beginning of the last interglacial about 80 000 B.P., the angiosperm-dominated rainforest was replaced by a gymnosperm-dominated rainforest in which Araucaria reached its maximum extent, possibly because of a cooler climate. Casuarina and Eucalyptus expanded concomitantly with Araucaria, but they only became dominant in the last half of the glacial from about 38 000 B.P. From about 30 000-10 000 B.P. the rainforest was virtually eliminated from the region and replaced by sclerophyll woodlands of Eucalyptus and Casuarina (Singh et al., 1981). Charcoal particle counts indicate that fire was associated with this expansion of sclerophyll vegetation; prior to 38 000 B.P. charcoal amounts were modest, but fire activity expanded markedly after this date contemporaneously with the expansion of sclerophyll vegetation. Singh et al., (1981) attribute this to human activity. Kershaw (1981) argues that the replacement of closed forest by shade-intolerant eucalypts demands that the former be removed first, and fire is the most likely agent. However Walker & Singh (1981) point out that rainforest returned to the region during the climatic change that occurred at the beginning of the Holocene, and the incidence of fires was reduced.

Janzen (1985) argues that in tropical Australia from the time of entry of Aboriginal hunters until about 100 years ago, the original Pleistocene forest (see above) was hunted sufficiently to eliminate the larger (and probably slower) non-burrowing mammals and the ratites. It was also irregularly burned early in the dry season as part of the hunting activity. These relatively regular fires resulted in the removal of virtually all of the original forest in the drier portions of the tropics, but with patches surviving in the more moist parts of the Australian tropics; the higher the moisture the larger the surviving patches. It is possible that some of these areas were deliberately protected from fire by Aborigines for the purposes of hunting-gathering. This scenario would certainly account for the patchy distribution of monsoon forest in the Top End and north Queensland, ranging from the odd hectare in Kakadu National Park to large areas in North Queensland. Nevertheless, these patches would contain only a fraction of the original flora, since plant species would be lost by a combination of range restriction, elimination of mutualists, and climate modification. The same reduction in species composition would have applied to the smaller mammals.

Janzen (1985) further states that the original forests would have been replaced with grasslands variously overlain with reproducing populations of Eucalyptus trees with an extremely fire-resistant physiology and life-form. They would occur at sufficiently low density to allow light penetration for grass cover to develop.

Pollen spectra are sparse in the dry continent of Australia, restricting a detailed reconstruction of vegetation changes during the Pleistocene and Holocene. Such paucity of evidence is exemplified in the Top End, but there are two instances of Holocene pollen spectra research (Stocker, 1971; Russell-Smith, 1985), using the technique of dating disused scrub-fowl mounds. Scrub-fowl scratch up large mounds of earth and litter to form a nest. Nests are used repeatedly and are built up further each season, sometimes reaching 25 m diameter and 3 m in height. The prime habitats of the birds are rainforest and monsoon forest. Thus the occurrence of abandoned mounds in eucalypt-dominated vegetation in the Top End indicates that the area was once under monsoon forest (Stocker, 1971). Stocker excavated five mounds on the Karslake Peninsula of Melville Island, where there is no European disturbance. He found the oldest mound to be about 8 200 years B.P. and the youngest about 1 600 years B.P. He inferred a gradual reduction of monsoon forest to the two extant small patches in the area. Such diminution could be due to a reduction in rainfall, lengthening of the dry season and/or Aboriginal use of fire. However the relative absence of such mounds in much of the eucalypt forest of the Top End indicates that the monsoon-eucalypt forest boundary has been relatively stable for at least 8 000 years. Specht (1958) postulates an original early Holocene continuous monsoon forest formation across the Top End; if this is true, then the great reduction of monsoon forest area must have occurred at least 8 000 years B.P. (Stocker, 1971).

Russell-Smith (1985) excavated a site in the South Alligator River region on a small headland called Kiina and a nearby site called Kumunkuwi. There is no extant monsoon forest in Kiina, but the excavated scrub-fowl mound was only about 100 years old. At Kumunkuwi there are small patches of monsoon vine forest but no resident scrub-fowl; there is, however, an abandoned mound within the forest aged at about 100 years. Thus, scrub-fowl were active there until recently. Russell-Smith states that this indicates a marked vegetation and habitat change in the Kiina and Kumunkuwi areas within the last 100 years, which he attributes to the activity associated with European arrival. Russell-Smith (1985) attributes this to an increase in fire activity and severity and the introduction of feral animals such as water buffalo. This is supported by Janzen (1985) who argues that approximately 100 years ago the grassland-_Eucalyptus_ associations became subject to much more frequent and regular fires set by Europeans, often in the second half of the dry season with higher and more flammable fuel loads. Where grazing is light or non-existent, these fires eliminate the bulk of the non-adult cohort of _Eucalyptus_, since the grass fuel load is sufficient to produce a fire that kills the _Eucalyptus_ regeneration - above ground parts first and a gradual destruction of root systems. Where grazing is heavy, fire intensity and frequency is nearly eliminated, resulting in increased survival of non-_Eucalyptus_ fire-sensitive species, including introduced species. The grazing would include intense browsing of _Eucalyptus_ seedlings and sucker shoots. Again, this death of the non-adult _Eucalyptus_ cohort will eventually return the habitat to a non-_Eucalyptus_ grassland forest, provided seed sources are available. Janzen (1985) states that intermediate conditions occur between these two extreme states, and postulates that they mimic the situation where _Eucalyptus_ occurred as a ruderal tree prior to the Aboriginal invasion of Australia.

MACASSAN CONTACT ON THE NORTH AUSTRALIAN COAST

Macknight (1986) states that, whilst there were undoubtedly a range of contacts with Aboriginals on the north Australian coast prior to the main European arrivals, the best documented is that of the 'Macassans'. He reserves the term 'Macassan' for the distinctive enterprise of annual voyages from the port of Macassar (now Ujung Pandang in Sulawesi) to gather and process trepang (bêche-de-mer or sea cucumber) as a commercial undertaking. Macknight (1976, 1986) dates the commencement of this between 1650-1750, and argues that it was not until about the 1720s that the industry was of any size (Macknight, 1986).

From the point of view of forest history, the main effects of Macassan contact have been species introductions, influence on Aboriginal use of timber for dug-out canoes, the use of wood and timber for boat repairs, and export of timber to Macassar.

The tamarind tree, (Tamarindus indica), is generally accepted to have been introduced by Macassan voyagers (see Macknight, 1976) and is used as a Macassan site indicator. It was almost certainly a casual introduction, as the fruits were brought with them as food on their voyages. They also set up beach camps erecting bamboo and palm structures using material they brought with them.

Macknight (1972) points out that both dug-out canoes and shovel-nose spears used by north Australian Aborigines are based upon Macassan models and depend upon a supply of metal. He sites this as an example of a particular element of Macassan cultural influence being localised in a new social and economic context, maintaining its form but changing its function (Macknight, 1986). The function of both dug-out canoe and shovel-nose spears is far more generalised in Aboriginal society than in Sulawesi (Macknight, 1972). This enlargement of function can be related to the less sophisticated nature of the Aboriginal economy (Macknight, 1986).

Hinz (1978) states that the Macassans used local mangrove for the smoking of trepang. Goodwin (1980), citing Macknight (1976), writes that they found the local timber well adapted for repairs to their prahu boats, including for masts. Ironwood timber (Erythrophleum chlorostachys) was carved into anchors and some of these were taken back for sale. The bark of the roots of the mangkude or cheese fruit tree (Morinda citrifolia), which yields a red dye, was also exported. (The fruits of this tree were much favoured by the Macassans, although they taste somewhat of cheese mixed with vinegar!). Cypress pine (Callitris intratropica) was undoubtedly shipped back when there was room; there are extant houses in Ujung Pandang incorporating cypress pine timber.

The Macassan voyages to north Australia were officially stopped in 1906 (Macknight, 1976, 1986).

THE EARLY EUROPEAN SETTLEMENTS (1824-1849)

Powell (1982), in his short history of the Northern Territory, devotes a chapter to the three abortive British attempts to settle the north coast of Australia - Fort Dundas, on Melville Island (1824-28), Fort Wellington at Raffles Bay (1827-29), and Port Essington (1838-49). The scant extant remains of these settlements indicates that substantive buildings were of stone, but they must have used timber for rafters, frames, doors etc. It may also be presumed that local material was used for fuelwood. Whilst these short-lived enterprises could not have had a particularly profound effect on the surrounding forest, they do mark the beginning of an exploitative phase of demand on the Top End forest to assist the establishment and development of European settlements.

POST-1863 SETTLEMENTS - SOUTH AUSTRALIA AND THE COMMONWEALTH

Exploitation of Northern Territory timbers by Europeans from the south of Australia began with the establishment of inland cattle stations, mining camps along creek banks, and government outpost settlements on the north coast. It was soon discovered that timber structures fell prey to white ants (Mastotermes darwiniensis and Coptotermes acinaciformis). Inevitably certain timbers were selected for termite-resistant properties, in particular cypress pine and ironwood. Nevertheless, other species were logged for convenience and Hinz (1978) attributes the demise of some monsoon forest species to indiscriminate clear-felling, for example the relatively rare Nauclea orientalis (Leichhardt's tree) and the native kapok, Bombax ceiba.

On 6th July 1893 Letters Patent were issued from Britain, revocable at will, annexing the Northern Territory to South Australia, and the South Australian Parliament passed an Act on the 12th November 1863 to regulate the settlement of the NT (Powell, 1982). The establishment of Darwin (then Palmerston) in the 1860s saw the commencement of 'timber getting' in the Top End as a full-time occupation. Timber was needed for construction and wood for fuel. The construction of the new Government Residency by Captain Bloomfield Douglas in the colony's second year required cypress timber brought by sea from a logging camp thirty miles away (Lockwood, 1970). Clearly, even in these early stages of Palmerston and the colony, good building timber was difficult to come by. The main evidence for such activity is from the issuing of timber licences to individuals, many of them Chinese (Hinz, 1978) (Table 2).

Despite the licensing of timber procurement, there is no evidence of any serious control over the utilisation of the forests or their replacement. Bauer (1964) states that in 1900 there was only one source of timber for Palmerston - a sawmill at Malay Bay was sending down 'dressed timber'. A South Australian Parliamentary Paper 45/1902 draws attention to the difficulty of finding firewood in the vicinity of Palmerston with it being cut on the western side of Port Darwin and brought across in sampans.

Even the botanists of that time were not very interested in the native vegetation. Indigenous species were considered useless for crops of any kind. An extensive programme with introduced species was carried out by the curators of the Botanic Gardens, Dr Maurice Holtze (from 1876) and his son Nicholas Holtze. Maurice Holtze wrote in 1889:

> Our collections of fodder grasses and valuable exotic timber trees are ... added to constantly. Amongst the latter, I ... draw ... attention to the splendid growth made by the Indian teak trees, about 100 of which have been planted in the

Table 2

Timber licences issued 1889-1905

(Source: Annual Governors' Reports 1889-1905)

Year	No. issued	Notes
1889	?	A number of licences issued to Chinese to cut timber on the Alligator Rivers. Licences specified that any cypress pine cut shall not be less than 8" diameter. It having been found that the country near settled distrincts was fast being denuded of pine saplings.
1897	13)	The high number issued was due to 'the facility on obtaining timber that was felled by the effects of the cyclone for firewood and also to procure timber for rebuilding purposes'.
1898	21)	
1899	5	
1900	5	
1901	4	
1902	2	
1903	8	
1905	7	

> outskirts of the gardens, and if their growth continues as it has now it would be well worth the consideration of the Government to establish forests of this tree in the Territory.

It was not until 1908 that any attempt was made to propagate native trees for timber, and this was only done at the request of the Government Resident (Hinz, 1978) as early as 1903. Nicholas Holtze wrote in 1903:

> As instructed by you, steps are being taken to plant up a small block in the garden with cypress pine and tecoma wood - two of the best of our native woods. Valuable data as to the rate of growth, etc., will thus be acquired, which may be useful in after years. I had planted a few cypress pine trees in the nursery several years ago and the rate of growth, so far, has been encouraging.

(Note: Tecoma or 'pink tecoma' is the common name for Pandorea ricasoliana, a native of South Africa; it is likely that Nicholas Holtze is referring to P. doratoxylon, which is included in 'A checklist of vascular plants of the Northern Territory' [Dunlop, 1987]).

INDIAN ISLAND FOREST RESERVE

The designation of Indian Island as (the first) forest reserve in 1889 is an important example of the growing realisation of the Northern Territory administration that local timber supplies were becoming critical. Indian Island lies in Bynoe Harbour, 120 km west of Darwin, and is 2 648 ha.

It is mentioned in a report (SAA 790/1878/178) from the Government Resident to the South Australian Minister dated 8th March 1878:

> The Flying Cloud is still profitably employed in bringing Cypress Pine from Indian Island, and the quantity she can bring during a [?voyage?] will be fully equal to the expense of her maintenance. It is now on up [sic] cheaply at Manders & Barlows Steam Saw Mill.

It is further mentioned in a report (SAA 790/1878/458) of 1st August of that year:

> Another gang are camped on Indian Island cutting cypress pine. As they have cut a large quantity of timber I have sent to bring them back.

Despite the confidence expressed, the Resident stated in an earlier report (SAA 790/1876/453) of 22nd December 1876 to the 'Minister of Agriculture and Education Northern Territory' (sic):

> Timber for building. Good timber impervious to white ants can be had, but it is not plentiful, and at present taking into account the expense of a steam saw mill I think it cheaper to import, but I will make further enquiries on this subject.

Of the declaration of Indian Island as a forest reserve by the South Australian Government in 1889, Bauer (1964) is somewhat cynical, saying that it had been declared a reserve after the timber had been cut!

Nicholas Holtze was sent to Indian Island in 1911 and reported to the Acting Administrator, Mr Justice Mitchell, on 31 May 1911 on the extent of growth and regeneration of the remaining cypress pine. He concluded:

> ... the species is a very slow growing tree and that any steps in afforestation must be taken well ahead of the exhaustion of natural supplies.

Indian Island is mentioned again in a Commonwealth Home and Territories Department file of 1924, which includes a typed rendering of Holtze's report of 1911. This was in response to an application for an agricultural lease by one Charles James Williams for the northern part of the island, but by the time the report was written he had withdrawn his application in favour of land in the Hundred of Glyde. To have granted the lease would have required the cancellation of Reserve status. The Director of Lands and Mines was of the opinion (26 September 1924) that 'the Island is of little use for any purpose'.

A sketch map (Figure 1) was included in the report, which may be compared with the surveyed map of 1987 (Figure 2) produced by the Conservation Commission of the Northern Territory as part of a draft area statement, which lists, inter alia, 'relatively undisturbed cypress communities' as of conservation value. Indian Island is now listed on the Register of the National Estate.

SAWMILLS

> Mr Mander's new establishment will be of much service to the town. He has erected steam saw mills and workshops for turning out drays and wagons and all kinds of carpenters work. He principally employ Chinese labor.'
>
> (Government Resident's Report, 14 May 1878).

In addition to the obvious needs for wood and timber processing in and around the administrative capital of the NT, missions created a small demand for timber and they were usually in coastal regions away from the main European settlements. Small sawmills cutting mainly cypress pine supplied the needs of the stations, and later in the 1930s shipped small amounts to Darwin, but the operations were really a means of survival and local supply and not primarily economic ventures. Although some financial returns were gained from the timber itself, all mission stations were subsidised in some way (Hinz, 1978).

From 1915-1922, Father W. Henschk was on Bathurst Island. During that time he ran a small sawmill that supplied timber, not only for the buildings on Bathurst Island but also for Darwin and its environs. The first police station at Daly River was built with this timber, and also the mission buildings on Goulburn Island. He also sold some timber to Jolly & Co. of Darwin (Pye, 1978). Peter de Hayr joined the mission staff in 1934 as a builder (at the age of 64!) and ran the sawmill. He worked on the missions, mainly on Bathurst Island, for 24 years. He was a voluntary worker and during his time he built two boats, a large church and presbytery, the convent, a hospital and dining room, a kitchen, a school and army disposal huts. He also did building at Garden Point and Port Keats (Pye, 1978).

In addition to the mission sawmills, some were established by somewhat colourful 'timber getters'.

In 1905, Joe Cooper built a camp on Melville Island at a place now called Paru. He brought with him a number of Aborigines from Cape Don and a few Tiwis he had met in Darwin. He used the latter to explain to the indigenous Tiwis that he wanted to establish a buffalo camp and to employ some of them. He is reputed to have shipped out some 2 000 buffalo hides in a ten-year period. When the

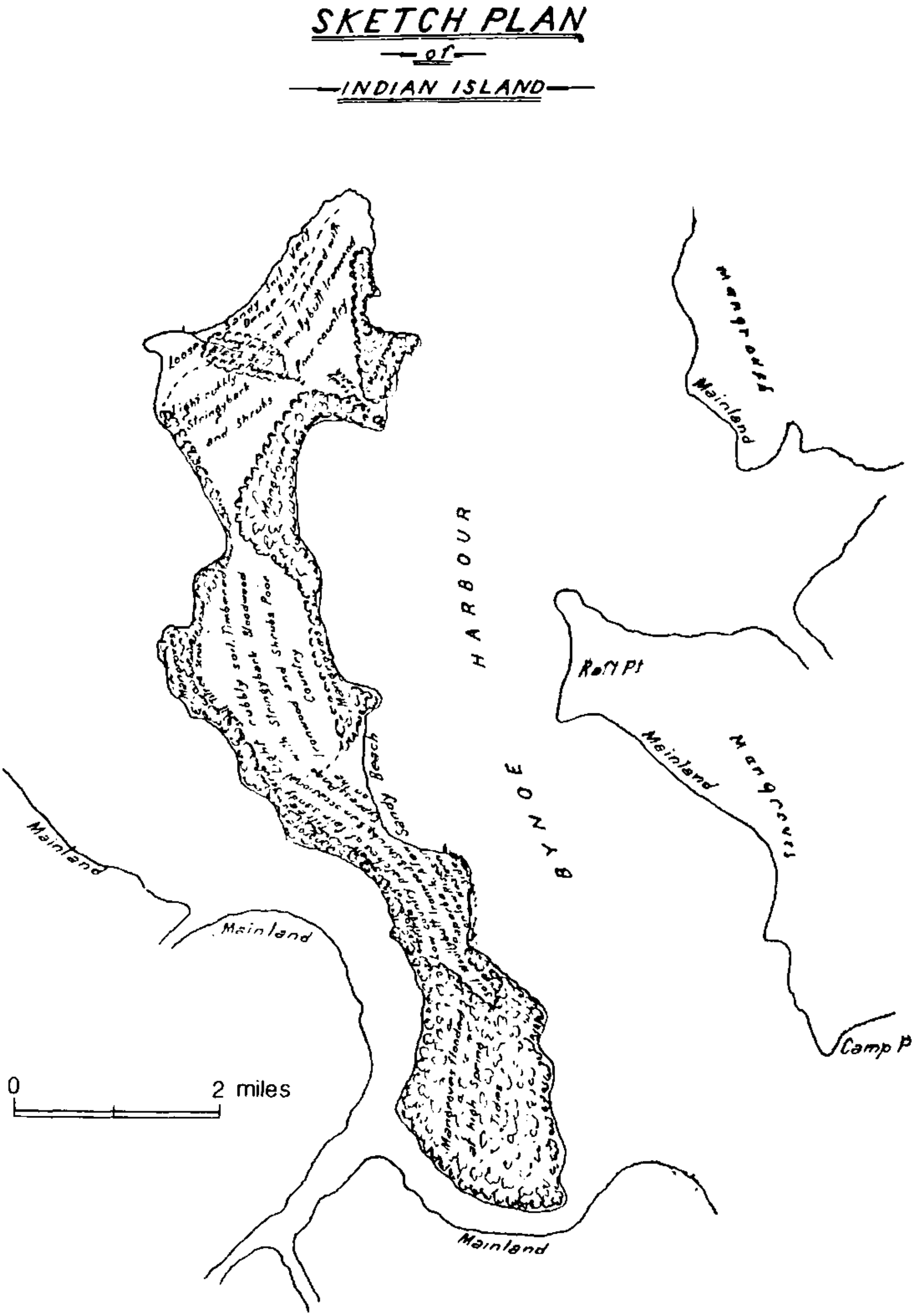

Fig. 1 Sketch map of Indian Island, west of Darwin, from report of Nicholas Holtze, 1911

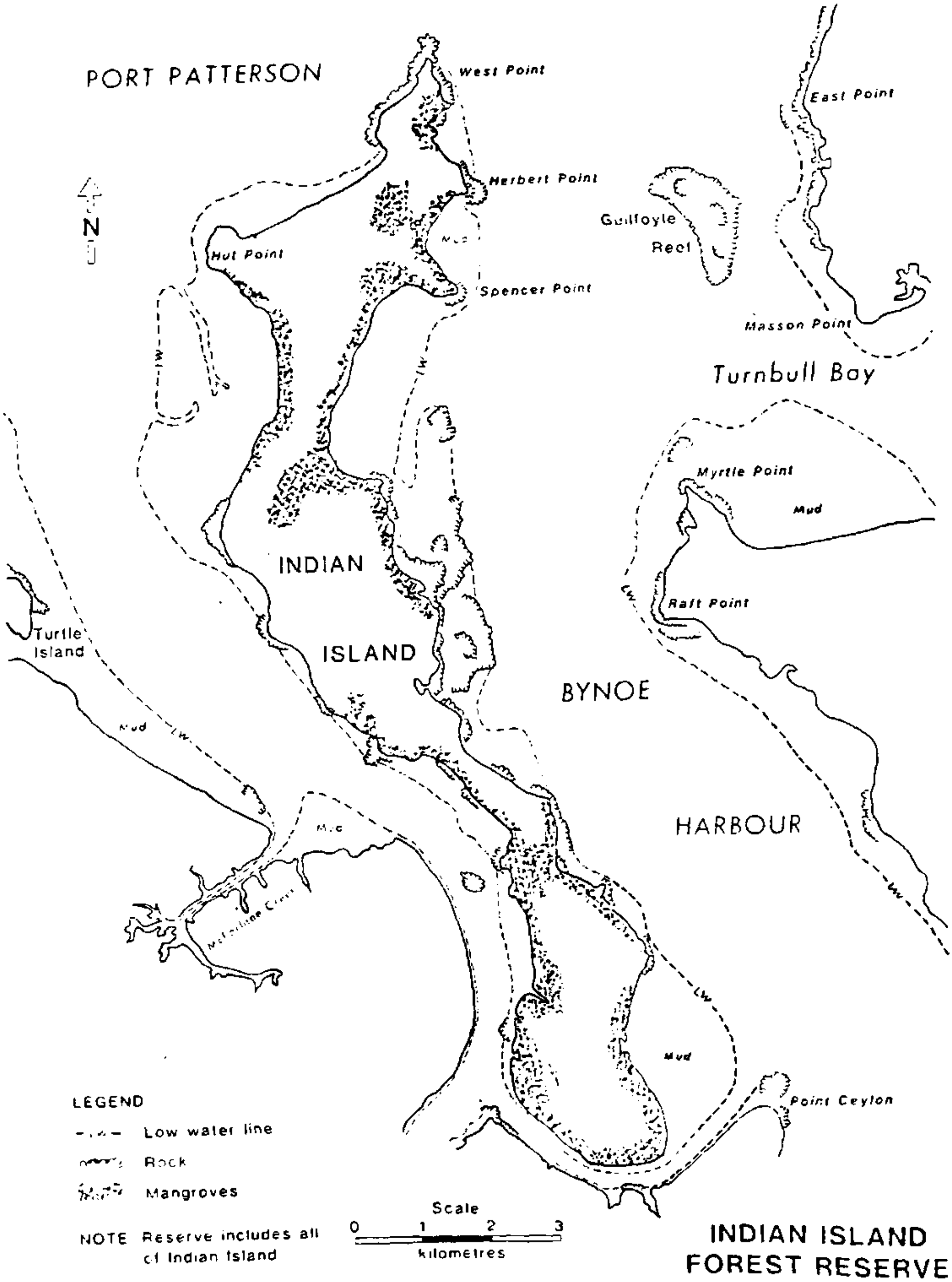

Fig. 2 Indian Island Forest Reserve, 1987
Source: Conservation Commission, N.T.

herds were severely depleted, he turned his attention to the cypress pine stands on the islands. For a few years he shipped pine logs to a sawmiller in Darwin, but eventually established his own mills at Danyuru, Tuyu and Ililiu, shipping out sawn timber to Darwin. He must have run these enterprises from Darwin as he left Melville Island in 1914, dying in 1936 at the age of 76. His son, Reuben Cooper, later supplied timber to the army from the Cobourg Peninsula during 1939-41. He had a mill in the Flora and Fauna Reserve, producing 10 000 super feet per week in 1941. This was, of course, quite illegal, and the Native Affairs Branch of the NT complained of his activities because the area was declared an Aboriginal Reserve in 1940. The letter suggests that if the resources of Aboriginal reserves are to be exploited, then this should be done by the government and not private enterprise. The Administrator attached a note to the letter stating that Cooper '... is far more likely to make it pay than the Branch would be.'

Sam Green was a contemporary of Joe Cooper and lived inland and alone. He worked on both Tiwi islands, Melville in particular, from about 1909 to 1918. He had a mobile sawmill and owned a boat, Maggie, with which he carried his sawn timber to the mainland. He sold out to Peter Stewart and Dan Thompson, who took over the operations of the sawmill (Pye, 1978).

MINING

Mining in the NT must have had a significant impact on timber, both for structures and props, but we have as yet been unable to quantify this from the archives, or by investigation of sites. The latest reference work on mining in the NT (1870-1946) by Jones (1987) does not address this problem. Pearce (1984) in a study of historic sites in the Tennant Creek area for the National Trust of Australia makes two references to timber use in mines:

- Northern Star mine: timber tailing races;
- Peko mine (old workings): a timbered shaft of the early Peko mine.

There are, however, more references to use of timber in buildings and equipment associated with mining activities. For example, a wooden jetty was constructed at Southport in order to land the first consignment of crushing machinery for the Kapunda Yam Creek Gold Mining Company and the Telegraph Prospecting & Gold Mining Company (Pine Creek); the two companies combined to construct the jetty to receive the shipment which arrived on the barque Coorong on 6th June 1873 (Pearce, 1984). There are also occasional newspaper reports of construction of mine buildings; for example, the Northern Territory Times of 28 July 1883 reported on the take over of the Standard Battery in Pine Creek Field by a Mr Jensen:

> Olaf Jensen had erected a sawmill & office, and replaced the old mine buildings which had been ravaged by white ants. He told the visiting Parliamentary delegation in February 1882

> that he intended to erect a residence and plant oats or maize to save on horse feed which cost £1 per bushel.

and of 16 May 1885:

> By May 1885 work had begun on Olaf Jensen's new house & men's cottages near the Standard Battery. The owner's residence was described as 'better than anything outside Palmerston'.

Use of native timber is described in a South Australia Parliamentary paper of 1906, describing 'badly constructed' windlasses employed by the Chinese workers to raise ore:

> The bucket rope winds upon a eucalyptus trunk grooved round at a short distance from either end, to receive & rest upon the well-greased prongs, produced by the intersection of two cross-stays, with which the wooden cylinder is turned by means of a roughly-hewn inlet handle at one end. Rigidity is imparted to the frame by cross-staying. Where changes in inclination occur in underlie shafts, small horizontal wooden rods, turning on pivots, act as rollers for the rope; the buckets sliding up the incline on long bamboos spaced a foot apart, and joined transversely by stays on the underside.

THE OVERLAND TELEGRAPH

The overland telegraph was started 1870 (see e.g. Taylor, 1980). Bauer (1964) described it as:

> 1500 miles of telegraph line through country which had been seen by few white men, where natives were unknown and unfriendly, and where timber and water were at best uncertain.

In the race with time to complete the overland telegraph by 1872, almost any timber was used, but most poles had to be replaced with cypress pine in a second race against termites. Eventually the cypress pine poles also had to be replaced. Clune (1955) states that each pole was specified to be of hardwood or iron; 20 feet in length and 9-10 inches diameter at the butt. Eventually most poles were replaced by metal, although a few remains of timber poles have been identified by the National Trust. In fact some iron poles produced by Oppenheimer & Co. were used in the original construction along parts of the route where timber simply could not be obtained. Taylor (1980) points out that, even during the construction phase, some timber poles had succumbed to white ants and that Sir Charles Todd, South Australian Government Astronomer and Superintendent of Telegraphs, supervised the unloading of the first shipment of Oppenheimer poles from Manchester, England, at Southport, NT, in May 1872. Todd himself commented (Pearce, 1984):

> Timber of any size is wholly confined to the creeks and there the description suitable for telegraph poles is by no means

plentiful. Mr Harvey (Overseer) had considerable difficulty in procuring the quantity required, having to cart poles long distances. Many of the trees on the northern end of Section E, and from there to the end of Mr Harvey's work, are small and very crooked; they were, however, the best he could procure. The bulk of the poles are full-sized and good: the others, although unsightly & small, are sufficiently substantial, and will probably last as long as the rest. When this section is repoled, I would advise iron throughout; indeed, iron poles for the north end of the section have already been provided.

THE NORTH AUSTRALIA RAILWAY

Railway construction started in 1886-87, initiating a small boom in timber cutting (Bauer, 1964). Ironwood trees, although only found in relatively small scattered stands, fell by their tens of thousands up to 1889 to act as sleepers to support the steel narrow gauge track to Pine Creek. Although ironwood logs have been known to last for up to 100 years, the species is slow growing, of poor timber form, and has a low regeneration rate. The poor form leads to much waste of material; the scattered remains of branches around a cut stump used to make perhaps one to four sleepers can still be observed in the bush in a broad sweep along the old route of the railway (Lukitsch, 1987). In a report on Top End forests, Jacobs (1933), calculated that the useable ironwood trees made up one per cent of the eucalypt woodlands. He further calculated that on average four half-pound sleepers could be cut from one useful tree, requiring a three mile strip on either side of the line to be denuded of ironwood to supply one set of wooden sleepers for the whole line! Harvey (1968) states that in addition to ironbark (sic), bloodwood (Eucalyptus dichromophloia) or cypress pine were to be used on bridges and level crossings where metal sleepers could not be used.

The rest of the railway line from Pine Creek to Birdum was built between 1915 and 1927. The first 21 km from Pine Creek to Emungalan was laid on steel sleepers, but the rest of the line used 94 000 'powellised' karri (Eucalyptus diversicolor) and 10 000 untreated jarrah (E. marginata) sleepers brought from Western Australia. The powellising process was supposed to render the sleepers white-ant proof, but proved to be not very effective, as by 1921 renewals became necessary. A continuing renewal programme commenced and, for 1927 alone, 6 931 sleepers were renewed at a cost of £5 000, and arrangements made for the supply of 70 000 local ironwood sleepers to eventually replace every original sleeper (Stevenson, 1979).

The railway enjoyed brief booms during the 1942-45 Pacific War and with the post-war mining industry. The last scheduled freight train ran from Larrimah to Darwin, arriving on 30 June 1976. Eighty thousand wooden sleepers, originally purchased in 1973 to replace ones between Pine Creek and Katherine, were donated to Indonesia under the Colombo Plan (Stevenson, 1979).

THE PACIFIC WAR

Hinz (1978) states that, with the onset of the Pacific War following the Japanese bombing of Darwin in February 1942, attention was focused on the 'neglected north coast of Australia'. Army and Air Force units as well as the Allied Works Council operated sawmills in the Top End for approximately three years from 1942 to 1945, exploiting most of the better remaining stands including Southport, Katherine and Black Jungle. During these years it is estimated (Hauser, 1967) that at least 30 million super feet were milled. Various surveys were undertaken at this time, primarily with a short-term view to the war effort (Table 3).

Table 3

Source	Year	Notes
F.G. Garrity (Inspector of Forests)	1941	Southport, Katherine, Howard River and Table Top Ranges surveyed.
G.W. Nunn	1943	Report entitled 'Reforestation in the Northern Territory'. Noted lack of care over felling and protection of regeneration sites. Identified fire as main problem, urging the military to exercise fire control.
Major A.E. Shillinglaw	1944	Batchelor, Mt Johns, Finniss & S. Finniss River, Reynolds River thoroughly surveyed. Concluded 'NT is poorly endowed with timber supplies necessary for army requirements and its future development.

PLANTATION FORESTRY AND FORESTRY RESEARCH IN THE NT

In 1924 the Commonwealth Forestry Bureau was set up by the Federal government, and in 1927 the Australian Forestry School, but this did little to focus attention on NT forests. The only mention in Parliamentary debates was in the Forestry Bureau Bill of November 1927 - 'The NT remains to be investigated.'

Following warnings from various officers, particularly Mr G.F. Hill of CSIRO, that the available supplies of cypress pine and ironwood in the NT were inadequate, the Inspector General of Forests made representation that the timber supplies of the NT should be investigated, recommending the services of Mr Jacobs.

Jacobs (1933) carried out a thorough survey along the main transcontinental traffic route, reporting on the timber supply and making recommendations for the inauguration of a forest policy for the Territory (Carron, 1985). As a result of the Jacobs Report, Mr C.E. Lane-Poole, Inspector General of the Bureau, recommended policy initiatives to the government. He saw an ecological survey by a forester as the key to the proper allocation of land for agricultural pursuits and a cypress pine planting programme as the most constructive measure (Carron, 1985).

Nothing was done until after the war, when any utilisation was supervised by Lands Officers of the Territory administration (Carron, 1985). Hinz (1978) writes:

> Even after the war with increased Government expenditure and development in industry in Australia no effort was made to fully understand the complete ecosystem of the Territory. Man surveyed for his immediate needs, took what he wanted and left with little thought to the consequences of his actions or his needs in the future. Man's interest in the Top End forests had only been in timber. No effort was made at research of the total ecosystem. But the war years brought four wheel drive vehicles and, as more people became acquainted with the environment and aware of environmental issues some concern was beginning to be expressed about the destruction of the vegetation cover.

Little of the grand scale of development of the 1950s reached into the Territory. Some small-scale mining and pastoral expansion saw further depletion of the indigenous forests in clear felling and burning, with no thought to reafforestation programmes. Bushfires had become so much part of the NT scene that planting or seeding of trees appeared to be a sheer waste of time, effort (difficult in the tropics) and money.

This hundred years of forest exploitation changed with the appointment of W. Bateman in 1950 as Forest Officer for the Territory within the Forest and Timber Bureau of Canberra, which was responsible for advising the Administrator of the Territory on the management of its forests. He surveyed the Territory between 1950 and 1954, but with a view to establishing a viable plantation industry and not to any conservation areas (Hinz, 1978). In 1957-58 proposals for a forestry programme were made, and the saga of the rise and fall of classical forestry in the Territory begins.

The details are listed in the Appendix to this paper, and we shall simply highlight some illustrative aspects here. The preceding century of exploitative disregard for NT forest resources was displaced by a welcome enthusiasm but a disastrous optimism. Examples include a paper by Evans (1969) reviewing progress since the 1959 Forest Ordinance of the NT Legislative Assembly; the initial hardships of 'the handful of pioneer staff' are described in graphic detail, followed by brief descriptions of the major plantations of cypress pine, Pinus caribaea, African mahogany (Khaya senegalensis) and teak (Tectona spp.). Nursery production is eulogised and the establishment of sawmills at Maningrida and Murganella, both in Arnhem Land, is described. An undated map (estimated circa 1970) in our possession headed 'Forestry Branch N.T.A. - Forest Areas on Aboriginal Reserves' indicates many large areas of potential forest exploitation in Arnhem Land. It is difficult to reconcile what is now known about the vegetation of this area with the confident predictions of the map. We can only assume that the areas are homologous with the then presumed distribution of cypress pine. Evans (1969) concluded:

> The new decade we are embarking on holds great promise of effort and achievement, for those with enough courage and foresight to participate in the future development of the Territory.

The 'Forwood' (Forestry and Wood-based Industries Development) Conference of the Australian Forestry Council in 1974 predicted a major contribution from the Territory of forest produce for the industry (see Table 4).

In May 1978 the House of Representatives Standing Committee on Expenditure of the Parliament of the Commonwealth of Australia reported on the 'Northern Territory Forestry Program' (Parliamentary Paper 199/1978). It was devastating:

> To give one example of the inconsistencies in resource assessments, the Department (of the NT) in 1974 informed the Forwood Conference that the anticipated production of hardwood sawlogs in the Territory in 1980 would be 58 000 cu. metres. Despite criticism from foresters this figure, again for 1980 production, was raised in 1977 to 82 000 cu. metres. The Committee is now informed that the figure has been revised in 1978 to zero.

(Note the reference to 'criticism from foresters...'. It should be clearly stated that a number of members of the profession were concerned about extravagant claims for NT forestry, and their representations on the issue directly influenced the establishment of the investigation by the Expenditure Committee. This is clearly stated in the editorial of Australian Forestry, September 1978 [Bachelard, 1978]).

> Evidence reveals that at Maningrida, where a major sawmill facility was installed in 1971 at a cost variously estimated at $140 000 and $250 000, at 1971 costs and operated at a small fraction of its capacity until 1977 when it closed down, there is little prospect of the sawmill re-opening for any purpose other than to mill a small quantity of timber for local needs.
>
> ... the department of Aboriginal Affairs has spent $370 000 in grants for forestry operations at Maningrida since 1975 for a total revenue of $1500.
>
> The Committee can only conclude that the offer of such a statistical tabulation (even if one were prepared to accept the figures as accurate) as the dimensions of an exploitable resource is little more than sophistry.

Table 4

(From the Forwood Conference Proceedings, 1974)

Future availability of forest produce (cubic metres) by States and ownership categories

State or Territory	*Ownership*	*Removals 1970-71*	*1975*	*1980*	*1990*	*2000*	*2010*
Queensland	Public	912 100	1 936 100	2 147 700	2 669 100	3 251 800	3 587 000
	Private	739 900	465 900	573 500	790 700	827 700	811 400
New South Wales	Public	2 055 100	2 946 400	3 169 900	4 228 400	5 883 900	6 501 900
	Private	982 700	1 050 100	907 100	824 100	989 100	1 080 100
Australian Capital Territory	Public	54 200	178 100	182 700	231 100	235 800	235 800
	Private	–	–	–	–	–	–
Victoria	Public	1 985 700	3 355 000*(a)*	3 630 000*(a)*	4 114 000*(a)*	5 650 000*(a)*	6 265 000*(a)*
	Private	590 400					
Tasmania	Public	1 231 700	4 281 400*(a)*	4 390 000*(a)*	4 970 600*(a)*	5 706 600*(a)*	6 058 800*(a)*
	Private	627 100					
South Australia	Public	642 300	1 197 500*(a)*	1 229 000*(a)*	1 249 900*(a)*	1 607 700*(a)*	1 497 100*(a)*
	Private	164 800					
Western Australia	Public	1 174 300	1 880 200	2 001 300	2 044 300	2 098 700	2 253 800
	Private	159 500	126 100	131 400	124 900	161 200	181 800
Northern Territory	Public	3 300	1 999 000	1 989 000	2 097 000	2 221 000	2 426 000
	Private	–	–	–	–	–	–
Australian Total	Public	8 058 700	19 415 800*(a)*	20 351 600*(a)*	23 344 100*(a)*	28 633 500*(a)*	30 898 700*(a)*
	Private	3 264 400					
TOTAL		11 323 100	19 415 800	20 351 600	23 344 100	28 633 500	30 898 700

(a) To maintain confidentiality of private companies' data, only total future availability is supplied.

For the Northern Territory just entering its period of self-government on 1 June 1978, the report was both horrifying and 'a classic example of bungling caused by remote control'. The Northern Territory News reported on 8 June 1978 that the Deputy Majority Leader, Mr Perron, said 'the real victims of "this sorry saga" were Territorians who had missed the chance of participating in a now viable forest industry'.

Hawkins & Reilly (1978) were asked by the NT government to carry out an independent assessment. Although more measured than that of the Commonwealth it held out little hope for a rejuvenation of the programme, which had, perhaps, been marred by the original objectives, confusing economic return with social objectives for the improvement of the education, training and welfare of Aboriginal communities.

The Commonwealth Committee's recommendations (Table 5) essentially closed any economic forestry programme in the Territory.

NT SELF-GOVERNMENT - A CONSERVATION APPROACH TO FORESTS

Whilst the demise of the commercial and research forestry programme was not welcomed by the new government of the Territory, reality was faced and the activities of foresters were absorbed into the Territory Parks and Wildlife Division, later the Conservation Commission of the Northern Territory. Table 6 shows the changes in Forest Reserve status:

Aboriginal Areas:

Maningrida, Murganella and Melville Island were 'forestry settlements' in Aboriginal Reserves. Now all are Aboriginal Land. Melville Island, identified as the only possibly viable forestry area is now operated by the traditional owners, who are seeking capital.

At this stage we can only speculate on how the 'absorption' of a large number of professional foresters into the NT Conservation Commission has determined its activities and direction. This is an area for further study. Nevertheless, it is possible to observe that the demise of commercial forestry in the Territory coincided with the recognition of environmental concerns at Federal and State government levels, and perhaps a change of emphasis was inevitable, reflected in the change of approach to mining impact in the Territory.

MINE SITE REHABILITATION

In contrast to the ignorance of environmental impact of immediate post-war mining operations, such as those at Rum Jungle, in the NT, environmental considerations are important in recent mining operations, such as those at the Ranger and Narbalek Uranium mines. Experiments with native tree planting and regeneration are integral parts of their plans to rehabilitate the mine area environment as operations close down. An important aspect of this is the requirement to revegetate the site according to the perceptions of the traditional Aboriginal owners.

Table 5

(From the Report of the House of Representatives
Expenditure Committee Report of 1978)

RECOMMENDATIONS

The Committee recommends that:

1. given the dearth of useful research into all aspects of planting, protection, processing and marketing, the planting of softwood be discontinued.
2. should it be decided that partial or total Territorial self-sufficiency in timber products is desirable, at least ten years of research into all the factors in (1) above be undertaken to establish the feasibility of a revised planting program and the form that program should take.
3. when, and if, a forestry program is recommenced in the Northern Territory, its policy objectives be clearly set out and adhered to and program budgeting in relation to the objectives be precise.
4. the forestry section of the Department of the Northern Territory be substantially disbanded and the expertise and Northern Territory experience of its staff availed of elsewhere.
5. the exploitation of native timbers on Aboriginal reserves for local use only, be continued if the local Aboriginal council so desires with suitable training equipment and technical assistance provided by the Department of Aboriginal Affairs.
6. existing softwood plantations on Melville Island be maintained but, subject to (2) above, not expanded and the Howard Springs and Gunn Point plantations be written off as production areas.
7. management programs of native forests be discontinued and only major access roads be maintained for transport purposes, except to the extent that forestry work at established centres is integral to Aboriginal training and employment.
8. the Government, in negotiating the estimates of expenditure for the Northern Territory for the financial year 1978-79, having regard to the evidence placed before this Committee and to the Committee's findings, substantially reduce funding for the Northern Territory forestry program.
9. in subsequent years, the level of Commonwealth Government financial assistance for softwood plantation operations in the Northern Territory be decided on the same basis as now applies to the States of Australia i.e. under the terms and conditions of the *Softwood Forestry Agreements Act* 1978.

Table 6

Forest Reserve Changes 1979-1987

Status 1979	Status 1987
Murganella Sanctuary	Murganella Sactuary & Research Area
Radio Block Forest Reserve	(Now Crown Land controlled by Lands Department. Licences can be obtained to cut timber)
Holmes Jungle F.R.	Holmes Jungle Nature Park
Indian Island F.R.	Indian Island F.R. (conservation draft area statement prepared 1987)
Gunn Point F.R.	Gunn Point Prison Farm (Correctional Services Department)
Cape Hotham F.R.	Cape Hotham F.R.
Fish River F.R.	Fish River F.R.
Howard Springs F.R.	Howard Springs Hunting Reserve

VOLUNTARY ACTIVITIES AND THE ARID ZONE

Non-statutory body activities in tree planting have become active since the advent of NT self-government, such as those of 'Greening Australia', which has active members in Darwin, Katherine and Alice Springs. Whilst these activities relate to the whole of the Territory, it is useful to give an example with reference to the arid zone, where Greening Australia has supported the tree planting activities of the Aboriginal Outstation Movement.

The Pitjantjatjara Council established community programmes for reafforestation and horticulture, the first in the Musgrave Ranges in the north of South Australia in 1975, to grow trees around newly established homes (Last, 1985). A nursery was established at Ernabella to meet the demand. This eventually inspired other communities to grow trees and shrubs, such as the Ngaanyatjara community in the Blackstone Ranges in 1978, which was supplied initially from the Ernabella nursery and later from the Forestry Branch nursery in Alice Springs; the women were very active in establishing the programme (Last, 1985). Since then community tree planting 'has become infectious throughout the Ngaanyatjara, Pitjantjatjara and Yangkunyatjara lands'. In 1979 a Resource Centre was established at Alice Springs with the following aims:

(i) To build a plant nursery and supply material to the outstation and community.

(ii) To build a centre around the plant nursery illustrating the principles and ideas significant in arid zone horticulture and reafforestation for Aboriginal people.

(iii) To build an extension service to the community and outstation extending ideas and principles, helping with local problems and assessing the plant material needs of each group of people.

(iv) To establish a training programme in nursery management and horticultural principles.

For this pioneer work, Mike Last of the Pitjantjatjara Nursery at Alice Springs has been recommended for the Greening Australia National Award for 1988.

THE FUTURE?

The catastrophic demise of the commercial forestry programme in 1978 has virtually made 'forestry' an unacceptable word in the Northern Territory - an unfortunate state of affairs, as productive tree growth, as well as amenity planting, in the Territory has much to offer. Whilst large-scale timber growing is probably not viable, there is a need for local timber and wood, including fuelwood in the rural and outstation areas. There is promise for the latter in coppicing species such as Eucalyptus camaldulensis, already on trial at Ernabella (Last, 1985). There is also promise for silviculture of native species for both fruit production and timber or wood supply; an example is the 'Kakadu plum' (Terminalia ferdinandiana) a traditional Aboriginal food in the Top End, which has the highest Vitamin C content of any known plant tissue. An initial research programme at the University College of the Northern Territory has not only established the commercial viability of the fruit, but also potential for the wood properties.

CONCLUSION

Following the 1978 House of Representatives report, Lacey (1978) described forestry in the Top End as 'part of the Northern Myth'. However, we believe that this review of our research reveals:

(i) a period of over-exploitation, followed by

(ii) undue optimism for exotic species plantations, then by

(iii) a conservation and environmental reaction, and

(iv) current review of horticultural and agroforestry potential;

This is by no means unique to the Northern Territory. It is certainly paralleled in many other developing parts of the World's tropics, and is, perhaps, also a lesson to be learned 'down South'.

ACKNOWLEDGEMENTS

Many people have given their time to our current research into a forest history of the Northern Territory, not the least the Libraries of the University College of the Northern Territory, the Darwin Institute of Technology and the State Reference Library. Permission to examine documents in the care of the Conservation Commission of the Northern Territory is most gratefully acknowledged. There are also the many people who have given accounts of their personal experiences of events in the forest history of the NT; whilst it is usually invidious to single out any particular person, in this case we have no hesitation in giving especial recognition to considerable time, both with documents and in the field, willingly given to us by Merv. Haines of the Conservation Commission of the Northern Territory.

REFERENCES

Bachelard, E.P., 1978 Professionalism and organisational loyalty, Editorial, Australian Forestry 41: 136-7.

Bauer, F.H., 1964 Historical geography of white settlement in part of northern Australia, Part 2, the Katherine-Darwin region, CSIRO, Div. Rep. 64/1.

Carron, L.T., 1985 A history of forestry in Australia, Australian National University Press. Canberra.

Clune, F., 1955 The story of the overland telegraph, Angus and Robertson, Sydney.

Cole, M.M., 1963 Vegetation nomenclature and classification with particular reference to the savannas, South African Geogr., Jnl., 55: 13-14.

Donovan, P.F., 1981 A land full of possibilities, Univ. of Qld Press, Brisbane.

Dunlop, C.R., 1987 A checklist of the vascular plants of the Northern Territory, Conservation Commission N.T., Darwin.

Evans, R.W., 1969 Forestry in the Northern Territory, N.T. collection, Darwin Institute of Technology (source unidentified).

Goodwin, W., 1980 History of Melville Island and History of Murganella, unpublished manuscripts.

Harvey, J.Y., 1968 The Palmerston and Pine Creek Railway, Historical Society Bulletin, No. 364: 25-48.

Harvey, J.Y., 1970-71 The north Australia railway, Historical Society Bulletin, Nos. 365, 394, 397, 400, 401.

Hauser, J.P., 1967 Northern Territory forestry development since 1959, Australian Territories, 7(4-6) July-Dec.: 2-9.

Hawkins, P.J. & Reilly, J.J., 1978 Report on the forestry programme of the Top-End of the Northern Territory and adjacent Islands, unpublished manuscript.

Hinz, C.K., 1978 No escape from man: a short history of trees in the Top End of the Northern Territory, unpublished manuscript.

Jacobs, M.R., 1933 A reconnaisance of the timber resources of the Northern Territory, Commonwealth Forestry Bureau Report, Canberra.

Janzen, D.H., 1985 Biological traits of the Australian tropics: the great Australian barbeque, unpublished report to CSIRO.

Johns, R.J., 1986 The instability of the tropical ecosystem in New Guinea, Blumea, 31: 341-371.

Jones, T.G., 1987 Pegging the Northern Territory, Northern Territory Govt, Darwin.

Kemp, E.M., 1981 Tertiary paleogeography and the evolution of the Australian climate, in Keast, A. (ed.) Ecological Biogeography of Australia, Junk, The Hague: 33-49.

Kershaw, A.P., 1978 Record of the last interglacial-glacial cycle from north-east Queensland, Nature, 272: 159-161.

Kershaw, A.P., 1981 Quaternary vegetation and environments, in Keast, A. (ed.) Ecological Biogeography of Australia, Junk, The Hague: 83-101.

Lacey, C.J., 1978 Forestry in the Top End of the Northern Territory: part of the Northern Myth, Seminar series on 'Problems of utilising forest resources as a component of development', Development Studies Centre and Forestry Department, ANU, Canberra.

Last, M., 1985 Advance in Aboriginal reafforestation and horticulture in the last decade, Pitjantjatjara Council, unpublished manuscript.

Lockwood, K., 1970 Darwin sketchbook, Rigby Ltd, Adelaide.

Lukitsch, P., 1987 Pers. comm.

Macknight, C.C., 1972 Macassans and Aborigines, Oceania 42: 283-321.

Macknight, C.C. 1976 The voyage to Marege, Melbourne Univ. Press, Melbourne.

Macknight, C.C., 1986 Macassans and the Aboriginal past, Archaeol. Oceania 21: 69-75.

Martin, H.A., 1978 Evolution of the Australian flora and vegetation through the Tertiary: evidence from pollen, Alcheringa, 2: 181-202.

Pearce, H., 1984 Tennant Creek historic sites study, Nat. Trust Aust. report, Vols 1 & 2.

Powell, A., 1982 Far Country : a short history of the Northern Territory 2nd edn. Melbourne Univ. Press, Melbourne.

Pye, J., 1978 The Tiwi Islands, Coleman Pty Ltd, Darwin.

Russell-Smith, J., 1985 A record of change: studies of Holocene vegetation history in the South Alligator River region, Northern Territory, Proc. Ecol. Soc. Aust., 13: 191-202.

Singh, G., Kershaw, A.P. & Clark, R., 1981 Quaternary vegetation and fire history in Australia, in Gill, A.M., Groves R.H. & Noble, I.R. (eds) Fire and the Australian biota, Australian Academy of Science, Canberra: 23-54.

Smith, J.M.B. (ed.), 1982 A history of Australasian vegetation, McGraw-Hill Sydney.

Specht, R.L., 1958 The geographical relationships of the flora of Arnhem Land, in Specht, R.L. and Mountford, C.P. (eds) Records of the American-Australian Scientific Expedition to Arnhem Land: Botany and Plant Ecology, Vol. 3, Melbourne Univ. Press, Melbourne: 415-78.

Stevenson, I.R., 1979 The line that lead to nowhere: the story of the north Australia railway, Rigby, Ltd, Adelaide.

Stocker, G.C., 1971 The age of charcoal from old jungle fowl nests and vegetation change on Melville Island, Search, 29: 28-30.

Taylor, P.T., 1980 An end to silence: the building of the overland telegraph line from Adelaide to Darwin, Sydney.

Walker, D. & Singh, G., 1981 Vegetation history, in Groves, R.H. (ed.) Australian Vegetation, Cambridge Univ. Press, Cambridge: 26-43.

Webb, L.J. and Tracy, J.G., 1981 Australian Rainforests: patterns and change, in Keast, A. (ed.) Ecological Biogeography of Australia, Junk, The Hague: 606-94.

APPENDIX

THE RISE AND FALL OF COMMERCIAL FORESTRY AND FOREST RESEARCH IN THE NORTHERN TERRITORY

1957-58

Proposals were prepared for a forestry programme. The Minister for Territories, following consultation with the Department of the Interior and the Forestry and Timber Bureau, formulated a forestry policy for the NT.

This policy prescribed a programme of investigation and experimental work aimed at increasing the timber resources of the Territory with plantations of exotic and indigenous species. In addition, control of logging activities was to be effected together with the development of the natural forests on Aboriginal reserves. In these activities employment was to be provided for Aborigines.

1958

An experimental station was established in Darwin by the Forestry and Timber Bureau.

1959

A five-year forestry programme to implement the first part of the policy was approved. Also a Forest Ordinance was passed through the Northern Territory Legislative Council which provided for the control of harvesting of forest produce from leasehold, reserved and vacant Crown lands, the establishment of working plans and the collection of timber royalties.

The first programme provided $338 000 for the establishment of a Forestry Research Station at Berrimah in Darwin. The main functions of the research station were to develop techniques for the establishment of plantations and to investigate the growth of native forests.

Carron (1985) states: 'The program was the result of joint recommendations of the Bureau and the Department of Territories to be administered on behalf of the Territory administration by a forestry section temporarily within the organisation of the Bureau. The understanding was that the forestry program would be initiated by the Bureau and handed over to the NT administration as a going concern after 5 years.'

The first programme was three-pronged; it included:

1. an investigation of the extent, growth and appropriate management of stands of indigenous species;

2. small trial plantings of local species, and the introduction of subsequent trial exotic species

3. the employment and training of 'aboriginal wards' through the advice and assistance of the Welfare Branch of the NT administration.

Three foresters, four technical staff and field assistants were appointed to the Forestry and Timber Bureau, NT Section. Early trials were conducted in Darwin and then in 1960 an initial 10 acres were established at the government settlement at Snake Bay (Milikapiti), Melville Island, to determine the feasibility of the employment of Aborigines for forestry work. Hauser (1967) states: 'This trial proved to be successful and showed that once Aborigines had settled down into a stable environment they proved suitable for forestry work.' A small planting of cypress pine at Bargieva in December 1960 marked the commencement of a plantation establishment plan.

In subsequent years, over 70 exotic species were tried, and few of them proved suitable for NT conditions. Teak and African mahogany showed considerable promise, but it was determined that the most suitable plantation species was the indigenous cypress pine for which nursery and plantation techniques were established. The advantages of this species are that its wood is termite-resistant and is readily accepted by the local building trade.

1960

A forester was appointed to supervise operations under the ordinance, and also to provide extension activities from the results of the research programme. At this time there was a commercial interest in cypress pine stands to the east of Borroloola, south of the Gulf of Carpentaria; however surveys eventually proved these stands to be unsuitable for exploitation.

1961

After only two years of the research programme the administration expanded its initial involvement into a four-year Welfare Forestry programme on Reserves for Wards, approved by Cabinet in 1961. The main objectives of this programme were to expand forestry activities on certain areas of Aboriginal Reserves, to train and employ Aborigines in forestry work, and to provide social and economic benefits to Aboriginal communities. Approved expenditure was $725 000. (At that time Aborigines were paid far less than the standard wage so there was little difficulty in justifying the scheme on economic grounds). The programme also provided for the establishment of plantations at Snake Bay, the implementation of the Forestry Ordinance, and the commencement of fire control in forest areas. Plantation establishment of up to 80 acres per year started at Melville Island and by the end of the four year programme over 200 acres of cypress ne were growing at Snake Bay. In addition, an extensive road programme was commenced and a major road built from Snake Bay to the natural cypress pine stands on the southern part of Melville Island.

APPENDIX

THE RISE AND FALL OF COMMERCIAL FORESTRY AND FOREST RESEARCH IN THE NORTHERN TERRITORY

1957-58

Proposals were prepared for a forestry programme. The Minister for Territories, following consultation with the Department of the Interior and the Forestry and Timber Bureau, formulated a forestry policy for the NT.

This policy prescribed a programme of investigation and experimental work aimed at increasing the timber resources of the Territory with plantations of exotic and indigenous species. In addition, control of logging activities was to be effected together with the development of the natural forests on Aboriginal reserves. In these activities employment was to be provided for Aborigines.

1958

An experimental station was established in Darwin by the Forestry and Timber Bureau.

1959

A five-year forestry programme to implement the first part of the policy was approved. Also a Forest Ordinance was passed through the Northern Territory Legislative Council which provided for the control of harvesting of forest produce from leasehold, reserved and vacant Crown lands, the establishment of working plans and the collection of timber royalties.

The first programme provided $338 000 for the establishment of a Forestry Research Station at Berrimah in Darwin. The main functions of the research station were to develop techniques for the establishment of plantations and to investigate the growth of native forests.

Carron (1985) states: 'The program was the result of joint recommendations of the Bureau and the Department of Territories to be administered on behalf of the Territory administration by a forestry section temporarily within the organisation of the Bureau. The understanding was that the forestry program would be initiated by the Bureau and handed over to the NT administration as a going concern after 5 years.'

The first programme was three-pronged; it included:

1. an investigation of the extent, growth and appropriate management of stands of indigenous species;

2. small trial plantings of local species, and the introduction of subsequent trial exotic species

3. the employment and training of 'aboriginal wards' through the advice and assistance of the Welfare Branch of the NT administration.

Three foresters, four technical staff and field assistants were appointed to the Forestry and Timber Bureau, NT Section. Early trials were conducted in Darwin and then in 1960 an initial 10 acres were established at the government settlement at Snake Bay (Milikapiti), Melville Island, to determine the feasibility of the employment of Aborigines for forestry work. Hauser (1967) states: 'This trial proved to be successful and showed that once Aborigines had settled down into a stable environment they proved suitable for forestry work.' A small planting of cypress pine at Bargieva in December 1960 marked the commencement of a plantation establishment plan.

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In 1961 forestry work commenced at Maningrida, a government settlement established in 1957 on the northern coast of Arnhem Land, over 200 miles east of Darwin. The first forestry supervisor arrived towards the end of that year. The scheme involved several operations. A sawmill for construction timber was run under the control of the Department of Territories and the developmental projects and logging were administered by the Forestry and Timber Bureau. At first the greatest emphasis was placed on the erection of buildings, and development of a general infrastructure. By 1963 over 100 Aboriginal people, including women, were on the payroll. They were involved in track construction, logging, fire-fighting and other protection work, enrichment planting and associated propagation of cypress pine seedlings, and removal of eucalypt overwood.

The Bureau pointed out to the government that this mix of basic forestry research and a social programme for the development of Aboriginal people should not be judged on conventional economic criteria.

1963

Over 1600 square miles of forest country in Aboriginal Reserves were photographed at a scale of 20 chains to one inch. These photographs covered many of the natural cypress pine stands in Arnhem Land, and provided the base for management maps and estimates of timber volumes.

1964

A forestry settlement was established at Pikertaramour on the southern side of Melville Island, in the centre of natural cypress pine stands. Activities included protection, logging, enrichment and thinning of the natural timber stands. Later, plantation work was commenced.

On the Howard Springs Reserve, 16 miles from Darwin, routine plantings of cypress pine commenced, and by 1967 some 200 acres had been planted. There were 1100 acres within the reserve and it was envisaged as becoming a major timber resource for Darwin.

A camp was established at Murganella.

1965

Licensing of forest products commenced in 1965 and timber licences and permits were issued for extended periods to encourage local timber production and stability within the industry.

The 1961 programme was extended for a year, to enable an interdepartmental committee to review progress and to examine proposals to continue and expand the programme.

A submission was made to split the research and operational activities of the unit.

1966

The Australian government introduced a major softwood plantations programme of 75 000 acres per year to provide for a growing national consumption of forest products. The NT was allocated an interim planning programme of 1 000 acres per year as part of this programme.

Another four-year extension of the original programme was approved with a total expenditure of $3.5 million, emphasising research, Aboriginal employment, resources inventory and an expanded plantations programme. There was provision for progressive staff increases up to 78, including 15 foresters. This second four-year plan also provided for a state-type forestry organisation to be set up within the Territory administration.

1966/67

A permanent settlement at Murganella commenced.

1967

The Forestry Branch of NT administration was established to carry out operational and applied research functions, and included those who had been part of the Forestry Section of the Forest Research Institute of the Forestry and Timber Bureau of the Department of National Development, who had been engaged in management-type activities.

Those who had been engaged in research-type activities were retained as the nucleus of a Northern Regional Station of the Forest Research Institute (based at Canberra), to continue basic research. The function of the Northern Regional Station was research into afforestation by tropical conifers, the growth and yield of indigenous forest and silvicultural treatment of the cypress pine plantations.

The Forestry Branch commenced research into the protection and regeneration of tree cover in the arid zone of central Australia, and the training of Aborigines in forestry work.

1968

Aborigines working in all aspects of forestry and sawmilling were no longer paid under the 'training allowance' scheme but received standard wages. Correspondingly, numbers employed fell by about one half.

Doubts began to be expressed by some members of the Branch and Research Station staff concerning the validity of assumptions on cypress pine growth rates on which an expanded plantation programme was largely based, but these doubts were neither shared nor accepted by the Branch.

During the next few years further doubts were expressed by these staff members about the extent and rate of expansion of the Branch, about statements of forest potential, the likely demand for timber within the Territory and local supply, and about a switch from cypress to Carribean pine.

1970

A second interdepartmental committee review of NT forestry activities recommended a third four-year programme, with projected expenditure of $845 000, to be reviewed annually in the budget.

1971

In 1968 the bench mill at Maningrida had been damaged by fire, and the new Forestry Branch decided it should be replaced with a modern mill with a capacity of 1100 cubic metres per annum. The mill was opened in 1971; it is doubtful that more than one-tenth of its capacity was produced in any one year.

1974

The Prime Minister, Mr Whitlam, and several of his Ministers (including the Minister for Aboriginal Affairs) visited Maningrida and met with the Council and advisors, who let it be forcefully known that they rejected the notion of the town of Maningrida as it had become. In particular they rejected the large population of Europeans, which had risen rapidly since 1969 to some 320. After a series of administrative reversal and delays, the Aboriginal people themselves decided to reduce the number of Europeans employed and to take control of the town. By August the patience of the Maningrida Council was exhausted and the forestry operation was dismissed. The project retained a presence on a caretaker basis until the end of the year, but in the wake of Cyclone Tracy all personnel and equipment (except the large and expensive mill) were withdrawn.

1975

In the wake of Cyclone Tracy, which struck on 25 December 1974, a co-operative survey was carried out by several Commonwealth organisations to assess the damage to native forest and plantations.

In July the Forest Research Institute was reidentified as the CSIRO Division of Forest Research and the staff and resources of the Darwin Regional Research Station were gradually redeployed.

1978

In June the Standing Committee on Expenditure of the House of Representatives presented a report on forestry activity within the Northern Territory. It stated that the real problem lay in unrealistic goals, as well as the changing attitude of Aboriginal people to the programme.

As a result of the Standing Committee report, the then Minister for the NT commissioned P.J. Hawkins and J.J. Reilly of the Queensland

Forestry Department to carry out a technical evaluation of the softwood-planting programme and to advise on any future role for an NT forestry organisation. Hawkins and Reilly disagreed with the Standing committee report which stated that there had been a dearth of useful research over the years. They said much useful work had been done, although inadequately documented or effectively implemented. They recommended continuation of the programme on Melville Island and the continued management of natural forest at Murganella.

The Minister for Home Affairs who was responsible for the Territory at the time of the enquiry handed the two reports to the NT Government, which had assumed office on 1 July 1978, to enable it to decide on future forestry policy.

At the same time the Forestry Section activities were incorporated into the Territory Parks and Wildlife Commission.

1979

The CSIRO Division of Forest Research announced its decision to withdraw from research activities in the NT.

1980

Legislation enacted to introduce the NT of Australia Forestry Act and repeal legislative control previously extended to the NT through the 1882 Woods and Forests Act of the State of South Australia.

Forestry functions assumed by the Conservation Commission of the Northern Territory, which replaced the Territory Parks and Wildlife Commission on 23 March.

1982

The NT government approved the handing over of assets in both the Murganella native forest project and the Melville Island plantations to the traditional Aboriginal owners. The government announced its intention to cease operational involvement from 30 June 1987, but to continue to provide research and advisory services through the Conservation Commission.

CLEARING THE SCRUBS OF SOUTH-EAST QUEENSLAND

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Introduction

This paper is concerned with the dependency of the Queensland timber building tradition on the original forests of south-east Queensland. It suggests that this tradition depended on the ready availability of softwood drawn from the 'Araucarian scrubs' in that part of the colony. The existence of these scrubs is confirmed by journals of exploration, government departmental reports and inquiries, and pictorial evidence. However none of those sources indicates their actual distribution. A method by which this might be done more precisely, by using early surveying records, is proposed and applied in a number of south-east Queensland parishes. The former widespread distribution of the scrubs is confirmed, as is their close juxtaposition with open eucalypt forest on ranges and river flats - the latter a pattern likely to have been artificially maintained by the use of fire.

The coexistence of hardwood forests and softwood scrubs in close proximity provided a basis for the local building tradition of hardwood framing with softwood cladding. Timber, the predominant building material used in Queensland, was popularised by a form of construction which was both economical and attractive and was not restricted by building regulations which often limited its use elsewhere. Its popularity persisted until the supply declined after World War I - the outcome of appalling wastage and ineffective forest policies which resulted in the destruction of the Araucarian scrubs of south-east Queensland, Australia's major softwood resource and, by early reports, a landscape of unsurpassed beauty.

A timber building tradition

In its overwhelming use of timber rather than masonry for building construction up to World War I, Queensland differed from at least the other mainland states. In the early study, Rude Timber Buildings of Australia,[1] the Queensland illustrations match neither the title nor the text. Examination of those buildings demonstrates that they are far from unsophisticated. All were probably the work of architects - for example, St George's Church of England at Beenleigh[2] was the work of the then Colonial Architect, F.D.G. Stanley (Fig. 1). Nor is the timber of which these buildings were predominantly built the hardwood on which that text concentrates. They were largely built of pine. It was used not only for flooring and joinery,[3] but also for the cladding and linings until after 1900, and in some earlier examples for the roof framing as well.

> tongue grew high up in the trees. You can fancy how I enjoyed scrambling about this lovely place and nearly lost myself, tho' it is not more than 100 yds wide and about a quarter mile long, but often you cannot see thro' the entanglement a yard before you. We brought away a boat load of ferns etc. having the boatman to dig them up for us. They now adorn the Verandah in pots. The contrast which these Scrubs present to the ordinary vegetation - that is dried up grass and scrubby grey looking gum trees which one sees all around, is most extraordinary and unaccountable.[9]

To better establish the extent and distribution of the original vegetation of the south-east, the reports of exploration compiled by John Steele[10] are invaluable. These reports from 1823-30 record the journeys of the surveyor John Oxley, of the botanists Alan Cunningham and Charles Fraser, and of the officers of the 57th Regiment, Edmund Lockyer and Patrick Logan (Fig. 2). The major journeys were the exploration of the Brisbane River (Oxley 1823, and Oxley and Cunningham 1824); the Logan River (Logan, 1826-7); the southern parts of the region (Cunningham, Fraser and Logan, 1828); the south-west (Cunningham, 1828) and the west and north-west (Cunningham, 1829).

Following Oxley's return to Sydney from his first visit to Moreton Bay in 1823, newspapers repeated his enthusiastic reports of the journey up the major river which emptied into the bay:

> One side is generally mountainous, while the other is low land, alternatively changing in this manner, but both sides are never low, nor yet high, at the same parts of the river. The high land is studded with majestic trees, for the most part, pines forming fine but by no means thick forests ...[11]

In the following year Alan Cunningham, who accompanied Oxley on his second journey up the river, observed an equivalent pattern to the topography in the vegetation - alternating thick brush wood and open forest land - along the river's banks:

> In this reach [the Bulimba Reach] the right or east bank was more particularly clothed with twining plants and a density of brushwood than the opposite or western shore where the open woodland, in forest ridges was remarked. In the thick and shaded brushes, and towering above the highest trees, were observed the Corymbose branched Heads of a pine ... We continued our voyage westerly about 13 miles ... the banks being alternately brushy or densely overhung with a matted and tressed mass of vegetation, and the open forest land.[12]

Samples of the newly discovered pines were soon utilised. In 1824, when Sir Thomas Brisbane made a visit to Moreton Bay and the river (which by then bore his name), the top masts of the Brig Amity in which he travelled were of Moreton Bay pine. Of this timber, he observed:

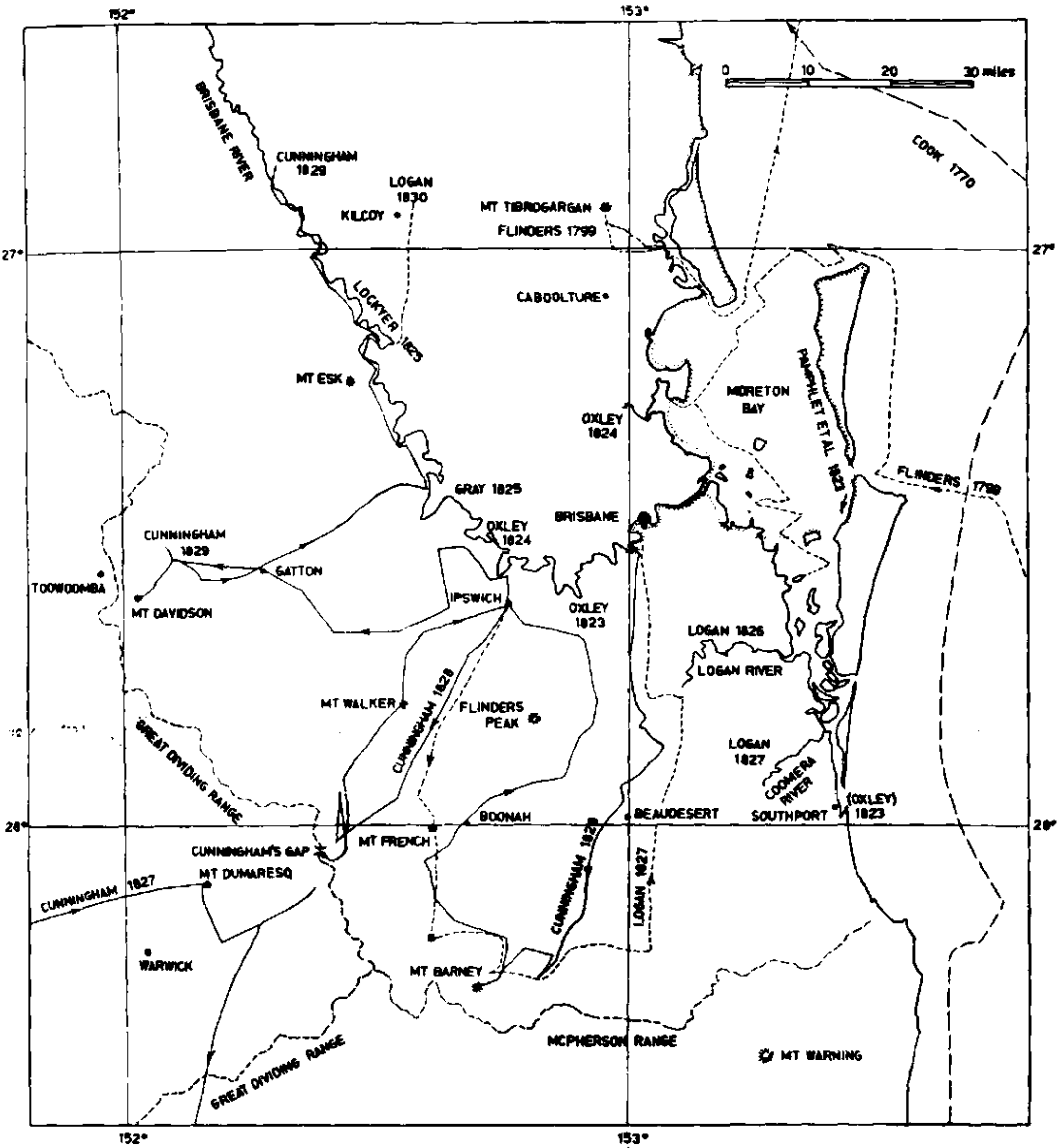

Fig. 2 Explorers' routes, Moreton Bay District
Source: Steele, 1972: 1

> There are endless quantities of these most beautiful trees, many of which I measured from nine to ten feet in circumference, and from eighty to one hundred feet in height, perfectly straight without knot or branch; and some individuals stated to me their having seen them nearly double the above dimensions.[13]

In using this information to determine the extent of the Araucarian scrubs, there are a number of difficulties. Although such reports, and the surveys (Fig. 3) which accompanied them, indicate that the scrubs were widespread, the size and location of scrubs and forests is imprecise, especially on flat land. This partly resulted

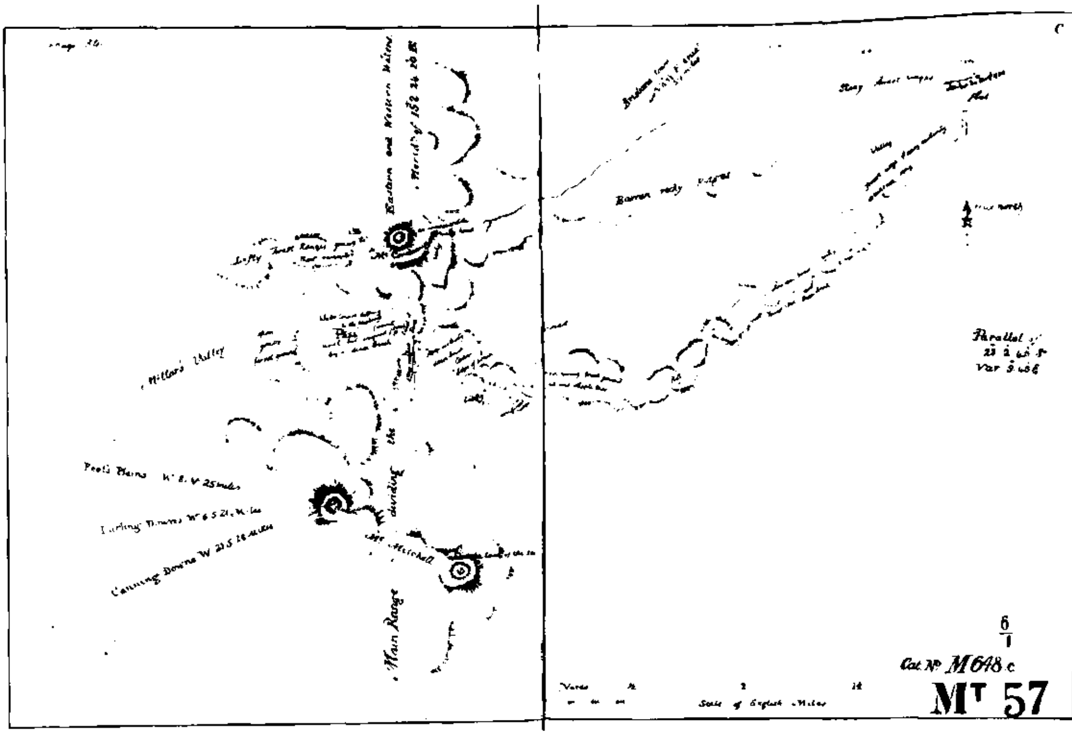

Fig. 3 Sketch of Cunningham's Gap
Source: Steele, 1972: 292-3

from the difficulties in seeing any distance. The most useful reports commented on mountains, ridges and ranges which were the most easily seen features of the landscape. Cunningham observed that, even after climbing a ridge, the brush prevented any view:

> Upon discovering on reaching the highest point of this Pine ridge [Pine Mountain] that in consequence of the stupendous growth of the Trees and general density of the brushes, no view could be obtained ...[14]

The expeditions up the river established that scrubs occurred on one or other bank of the river through most of what is now Brisbane,[15] and in a large area west from above the junction of the Bremer River.[16] Similar scrubs had been found on the North Pine River,[17] and probably along Pumicestone Passage also.[18] Expeditions by Lockyer and Logan found extensive scrubs further upstream on the Brisbane, on the Logan and its catchment, and on the Border Ranges. When the Colonial Botanist, Charles Fraser, visited the penal settlement in 1828, he visited the scrubs along Breakfast Creek.[19] Attempts in 1828 to travel westwards from the headwaters of the Logan to the main range were frustrated by impenetrable scrubs on the western bank of Teviot Brook, a tributary of the Bremer.[20] These extended from the main range north to Mt French and east to Flinders Peak.

Later in the same year, Cunningham, seeking to discover the pass through the Main Range which he had discovered from the Darling

Downs in 1928, travelled west-south-west from Limestone, chiefly on eucalypt forest ridges,[21] keeping south of the extensive scrubs seen from Mt Crosby and Mt Araucaria in 1824. He kept north of the even more widespread scrubs which had earlier prevented his approach to Flinders Peak from Limestone and, just previously, had frustrated all efforts to travel westward from the headwaters of the Logan in search of the same pass. In this way he avoided the large scrubs at Rosewood and Tenthill. When in the following year he sought the headwaters of the Brisbane and was forced by a flood in the river to travel through the scrubs west of Pine Mountain, he found them 'perfectly impervious'[22] and had to go south and west to avoid them.

Despite the wonder at the newly found vegetation, the difficulties of passage through the scrubs may have diminished affection for it. The following comment is one of a number which couple barrenness with the scrubs:

> Having previously passed over some tolerable grazing patches in the forest ground, the land began to assume a barren cast, and jungles again occupied the surface, among which we managed to advance another half mile, when these brushes uniting formed one dense mass, and obliged to stop.[23]

Early pictorial evidence

Such comments contrast strongly with earlier reports which frequently comment on the scenic qualities of the landscape: 'the river very beautiful';[24] 'Having crossed the river, we penetrated through a very thick brush abounding with stately and magnificant pines, which tower far above the other timber of the hill';[25] 'A more magnificent view it has not often fallen to my lot to behold';[26] 'The scenery on each side was truly picturesque; on one side high open forest would present itself, whilst on the other, a comparatively low country, covered with close vegetation, was to be seen: these views were alternate, and from the striking contrast, were of the most engaging description';[27] 'entered some thick brushes at the base of the Pine Range ... as we penetrated upward it was with admiration, on passing through a stupendous Forest';[28] 'The finest tract of land I have seen in this or any other country';[29] 'The country now exceeded, in beauty and fertility, anything I had before seen';[30] 'There is not in any explored part of New South Wales a more beautiful subject for the pencil of the artist than the landscape presented to the traveller for the centre of Bainbrigge's Plain to which no description of mine can possibly do justice'.[31]

It is disappointing, therefore, that there is so little pictorial evidence of the original landscape. Cunningham's sketches of his exploration are mostly useful as an indication of the topography.[32] One of the few who made sketches of the landscape was the artist Conrad Martens, during his travels in south-east Queensland in 1851-52.[33] His work includes a sketch of the Brisbane River near Cressbrook (Fig. 4), which accords closely with Cunningham's reports in the same vicinity,[34] and a study of pine scrub (Fig. 5). Others, such as Henry Grant Lloyd's sketch of the Logan River[35] in 1871, give

Fig. 4 'On the Brisbane near Cressbrook, 7.2.1852'
Source: ML ZPXC972

Fig. 5 'Study - Pine Scrub, Feby 9th 1852'
Source: ML ZPX295

no indication of the scrubs which existed there ('magnificent forests of cedar and pine were everywhere observable'),[36] which may have been cleared by then.

A few early photographs exist: by Richard Daintree (held by the Queensland Museum, unfortunately without an identified location); by the surveyor Walter Hume of the scrub downstream of Brisbane which was described by his wife[37] (held in the Fryer Library); and some like that of scrub at Southport, c. 1880 (Fig. 6). Sometimes, the scrubs appear as backgrounds, such as in a photograph of the Brisbane house 'Kelvin Grove' with the so-called Three Mile Scrub in the background[38], held in the John Oxley Library . Somewhat later are various scenic photographs, for example, Enoggera Creek, Brisbane c. 1900; and of Queensland Scrub (Fig. 7). From 1913, Annual Reports of the Department of Public Lands include some forestry photographs - often of the Atherton Tableland which was by then being opened up.

Generally surviving pictorial records are of timber-getting and sawmilling, or of cleared land and the settlement which followed (Fig. 8). These photographs, frequently undated, are probably later than earlier, and overlook some interesting aspects of timber-getting. No photographs have been discovered of 'freshing' (a practice in the Mary River of using annual floods to convey fallen timber to Maryborough), although there are a number which include rafts and rafting grounds (Fig. 9). Rafts often occur in other photos also, for example those of Brisbane from Bowen Terrace showing rafts of timber from the Logan River at Birley Brothers, Kangaroo Point sawmill. Over-all, these records indicate less of the nature and extent of the original forests and scrubs than of their demise (Fig. 10).

Parliamentary reports

Evidence of governmental interest in forestry, which is contained in the Votes and Proceedings and in the Parliamentary Papers of the Legislative Assembly, is summarised in Frawley's paper on Past Rainforest Management in Queensland.[39] Although parliamentary records are also of limited use in reconstructing the extent of the original forests, they demonstrate clearly that the repercussions of government policies and regulations were clearly foreseen and regularly expressed by expert witnesses. They include: the proceedings of the Select Committee on Forest Conservancy of 1875[40] and the representations of the Acclimatisation Society which prompted it;[41] Annual Reports by the Director of the Brisbane Botanic Gardens, in which he urged new regulations to protect the supply of timber[42] and also included his frank reply to a despatch from the British government respecting colonial timber[43] and his report on timber on Fraser Island;[44] from 1881 the reports on Forest Conservancy; the Annual Reports of the Department of Public Lands and the reports of the Director of Forests. The reports of the various Crown Land Commissioners also contain details of activity in the timber industry as well as reports on the extent and rate of the clearing of the scrub and the weed infestation which often followed.

Fig. 6 Scrub at Southport c.1880. Source: JOL

Fig. 7 'Queensland Scrub' Source: ML

Fig. 8 'Opening up a Queensland Pine Forest, Imbil, 1920'
Source: QPP 1029 (1): 1 004

Fig. 9 Rafting ground, Noosa district, c. 1889
Source: JOL

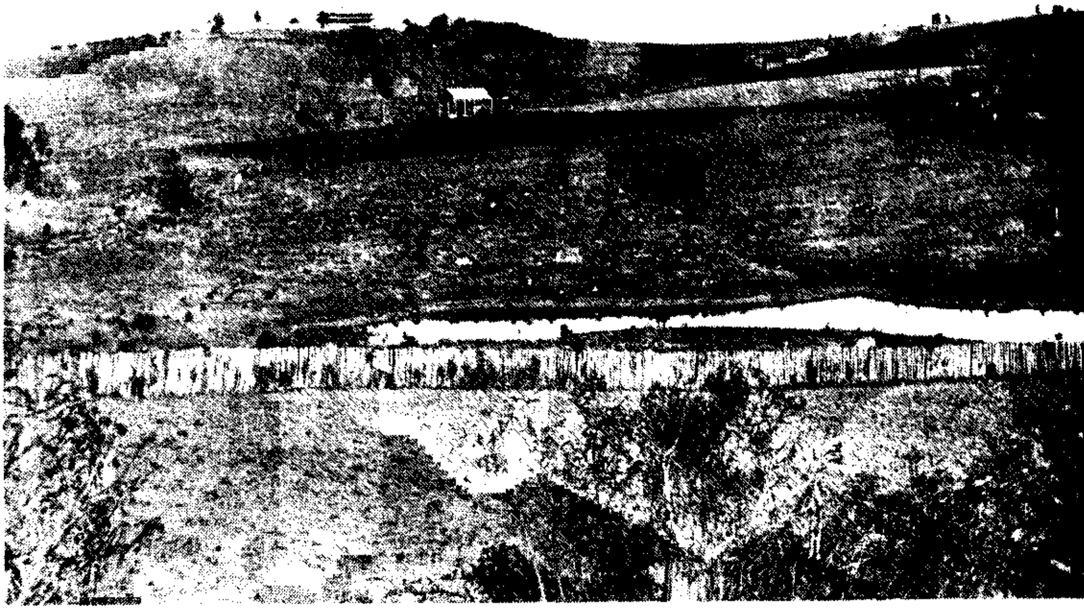

Fig. 10 'Smith's Residence at Marburg'. Originally 90 per cent of this property (Woodlands) was scrub. T.L. Smith was a Marburg timber merchant. Source: JOL

The solution to the problem of forest conservation appears to have been to ignore it and remove any opposition to almost uncontrolled exploitation. The Acclimatization Society lost its government grant;[45] Henry Massie, possibly the first forest ranger and responsible for the creation of nearly 50 000 acres of timber reserves, was removed within 18 months;[46] and the Director of the Botanic Gardens, Walter Hill, was dismissed. This practice continued into the twentieth century, with the sacking of E.H.F. Swain, the energetic but frustrated first chairman of the Queensland Forestry Board. By then the scrubs had been almost entirely cleared.

<u>Survey plans</u>

In seeking to determine the original extent of the scrubs, survey records are much more useful. Not only were land holdings precisely located but also, in many early instances, the potential of the land for pastoral or agricultural use (as well as for assessment of government charges) was indicated by data on topography and vegetation. In annotating these surveys, the convention adopted was the same as for exploration - (pine) scrub and open (eucalypt) forest.

Following The Crowns Lands Alienation Act of 1868, surveys were prepared for many of the pastoral runs in the Moreton and Wide Bay districts. These often included additional information on forest vegetation[47] and, less frequently, qualification regarding the nature of the scrub.[48] The detail provided varied with the surveyor,[49] the version of the survey[50] and the nature of the run. Most surveys were

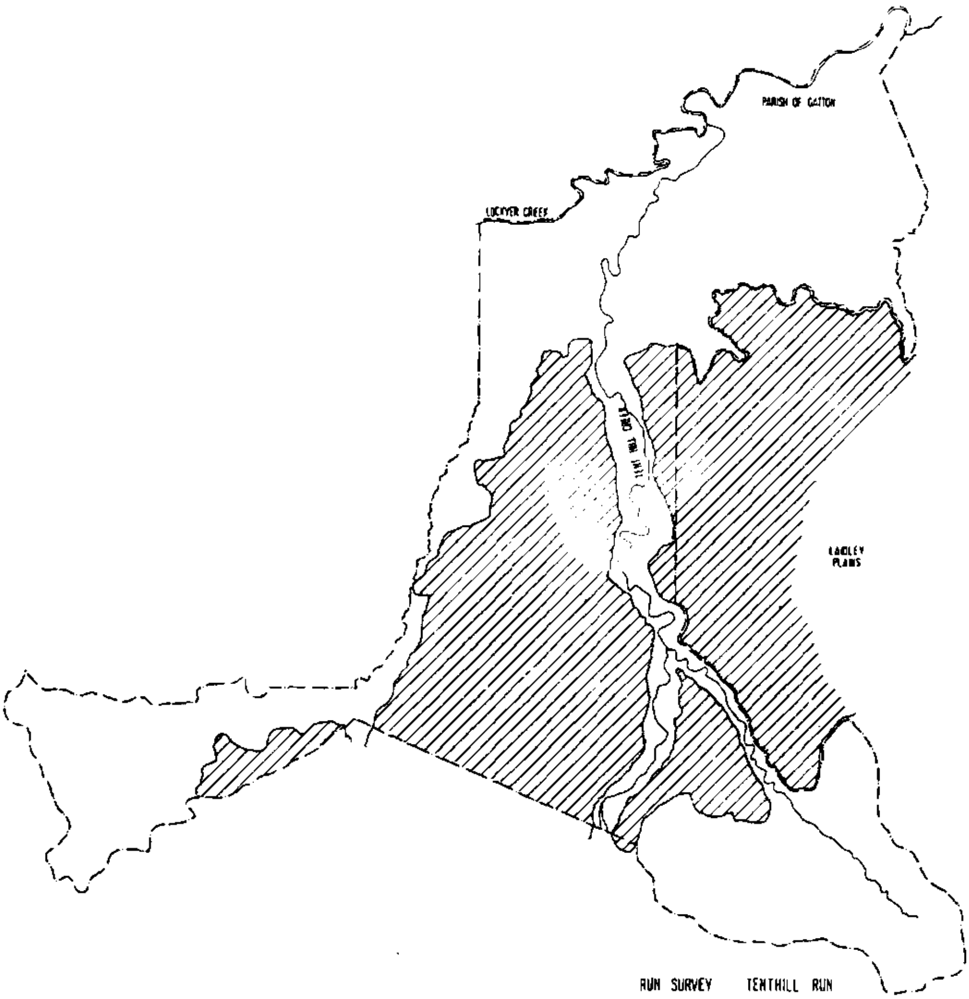

Fig. 11 Tenthill Run Survey, n.d. (scrub shaded)
Source: redrawn from QDGI: M33-33

more complete along existing or proposed boundaries than within the run. Not all runs may have been surveyed,[51] nor have all the surveys undertaken survived,[52] and many exist with later subdivisions added to the original.

Although all available run surveys in the Moreton pastoral district have been examined,[53] for this paper I have redrawn only a sample.[54] Some in the Mary River valley in the Wide Bay district have also been checked[55] but only the consolidated Widgee Run (Fig. 23) has been redrawn. These microfilmed surveys are difficult to decipher.

The area of scrubs within the region, as indicated already, was widespread, and may have exceeded the better known 'Big Scrub' of the Richmond River district in northern New South Wales. Their location confirms the experiences of explorers 40 years earlier. Dense and very extensive scrubs are indicated where difficulties had

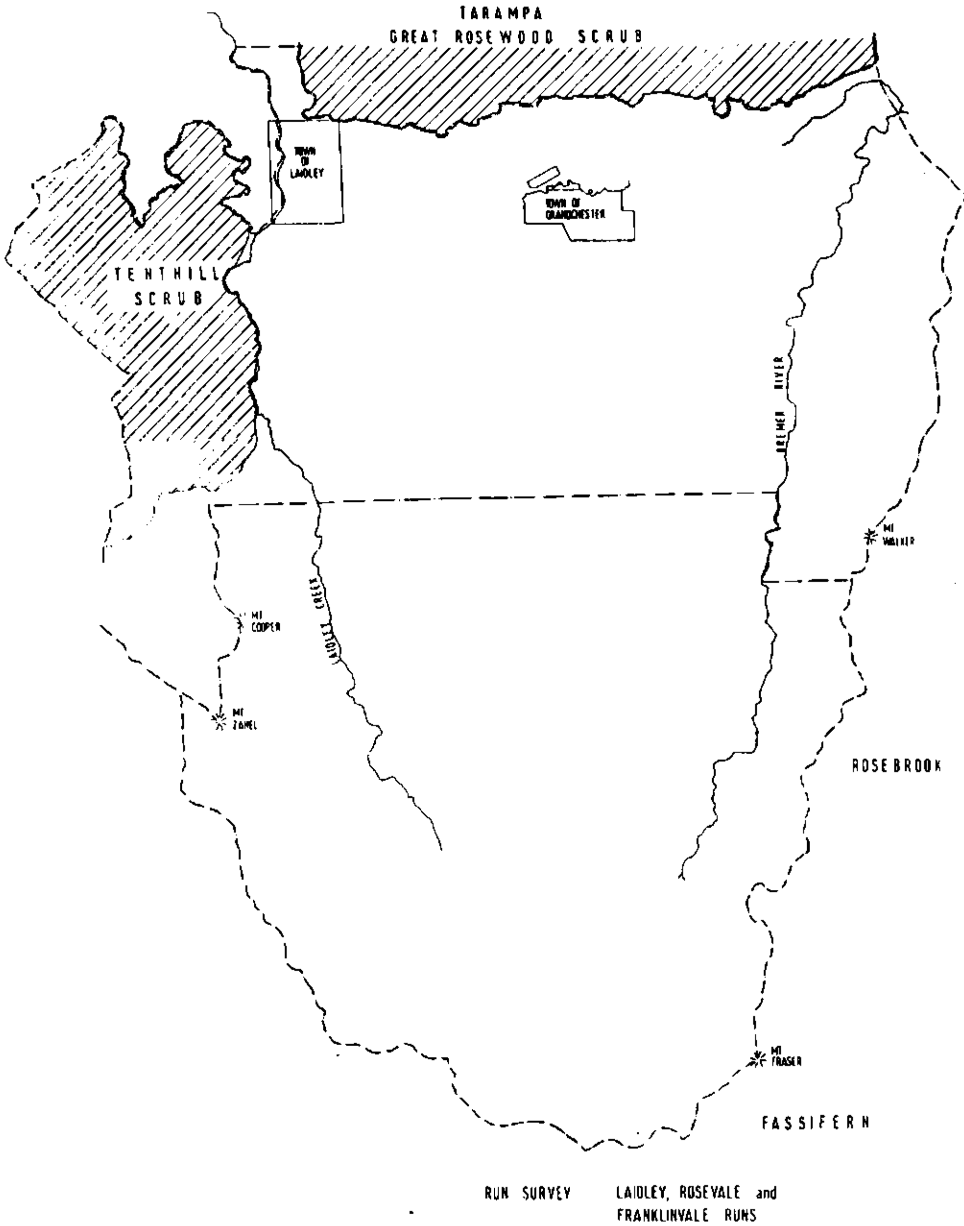

Fig. 12 Laidley, Rosevale and Franklinvale Runs survey, 1868
Source: redrawn from QDGI: M33-60

been experienced or passage found impossible, for example the scrubs on the western bank of Teviot Brook in the Dugandan and Coochin runs.[56] So dense were the scrubs that their edges[57] were sometimes adopted as the legal boundaries of runs which they abutted, apparently taken to be an equally permanent feature of the landscape as watercourses or mountain ranges.[58] Some of these boundaries are still used despite the clearing of the scrubs. The extent to which clearing occurred prior to the run surveys is as yet unknown. Many pastoralists are known to have also engaged in timber-getting.[59]

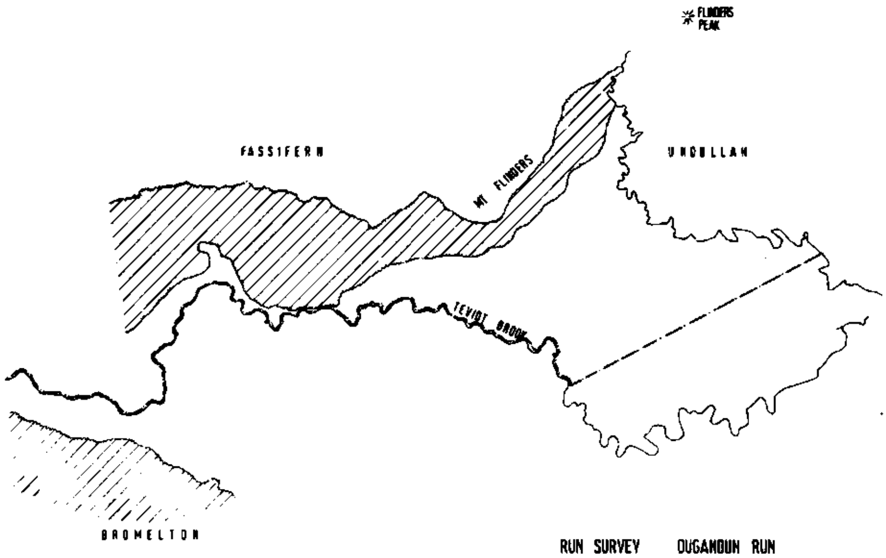

Fig. 13 Dugandan Run survey, 1869 (scrub shaded)
Source: redrawn from QDGI: M33-30

Fig. 14 Tarampa Run survey, n.d. (scrub shaded)
Source: redrawn from QDGI: M33-48

Other survey plans are also helpful in reconstructing former patterns of vegetation. Feature surveys of rivers and creeks and for proposed roads contain specific information on the vegetation intersected and adjacent. In particular, a series of feature surveys of the Mary River and its tributaries which are very detailed[60] show that those waterways were lined with scrub on one or both banks for almost their entire lengths.

Together with the surveys of runs in the Mary Valley, these surveys most clearly reflect the alternating pattern of vegetation noted in exploration. Although no account has yet been taken of the local ecology, the pattern of vegetation appears 'unaccountable' in Katie Hume's words, except if artifically maintained by the use of fire. There are, of course, numerous reports of Aborigines using fire in the Moreton Region, including an attempt to incinerate Cunningham in 1829.[61]

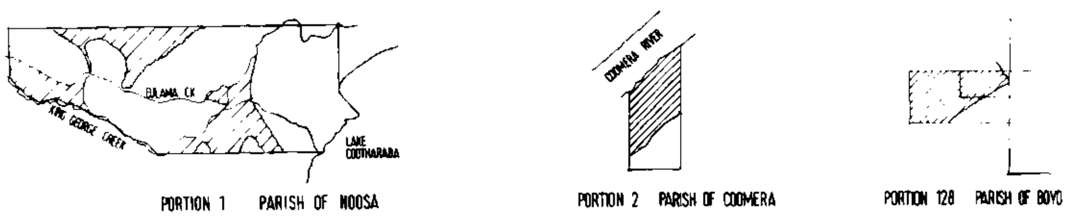

Fig. 15 Typical portion surveys (scrub shaded). Portion 1, Parish of Noosa W37.112, 1867); Portion 2, Parish of Coomera (W31.32); Portion 128, Parish of Boyd W31.39). Source: Portion surveys, QDGI

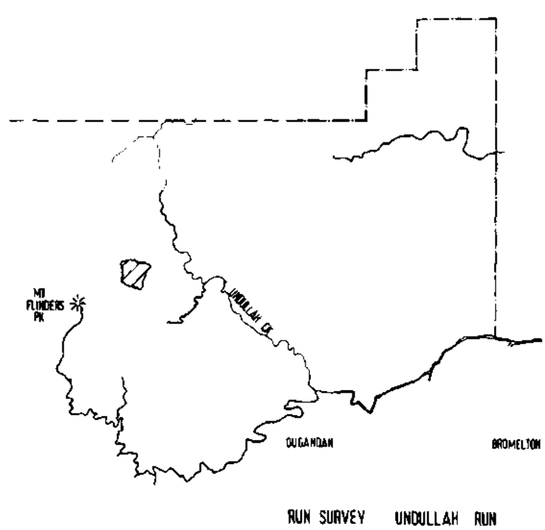

*Fig. 16 Undullah Run survey, 1868 (scrub shaded)
Source: redrawn from QDGI: M33-32*

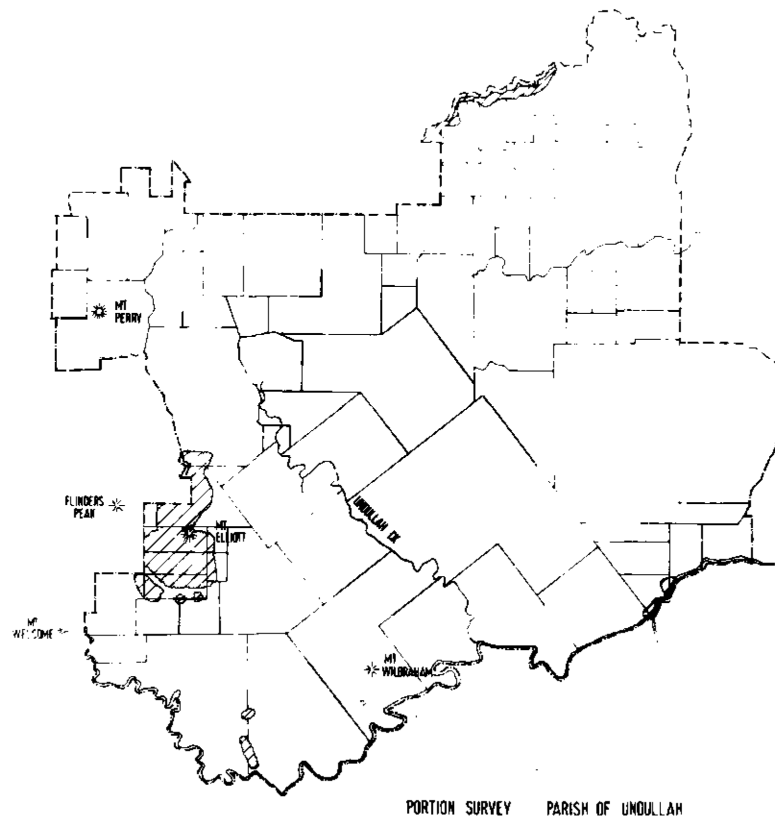

Fig. 17 Compilation of Portion surveys, Parish of Undullah (scrub shaded)
Source: Portion surveys, QDGI

The boundaries of pastoral runs of the 1860s often provided the basis for the later creation of parishes, both in name and extent. The later portion surveys of subdivisions within each parish (Fig. 15) also gave information on vegetation, and less frequently, weed infestation (such as lantana and later prickly pear), recent clearing, or felling in preparation for a 'burn', etc. A more detailed map of the vegetation (as existing at the later date of individual portion surveys) can be obtained by compiling this information, together with similar surveys (if available) of Crown land such as reserves and state forests within each parish. The parishes selected for initial investigation were small to reduce the number of microfiche print-outs needed. Nor were they necessarily those in which the occurrence of scrub was known to have been extensive, such as the Fassifern valley where the number of portions exceeds 400.

The parishes for which portion surveys have been undertaken are Undullah (Fig. 17), Northbrook (Fig. 19), Samford (Fig. 21) and Parker (Fig. 22) (both in the Moreton region) and Glastonbury (Fig. 24) (in Wide Bay). For each of these, an earlier run survey existed. It must be remembered that the dates for portion surveys varied considerably - up to half a century - so that the extent of scrub

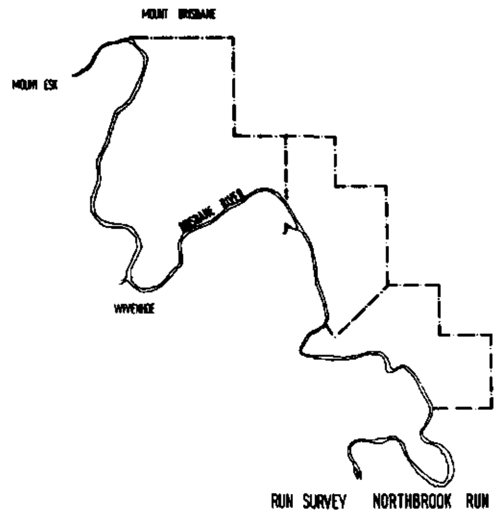

Fig. 18 Northbrook Run survey, 1869 (scrub shaded)
Source: redrawn from QDGI: M33-54

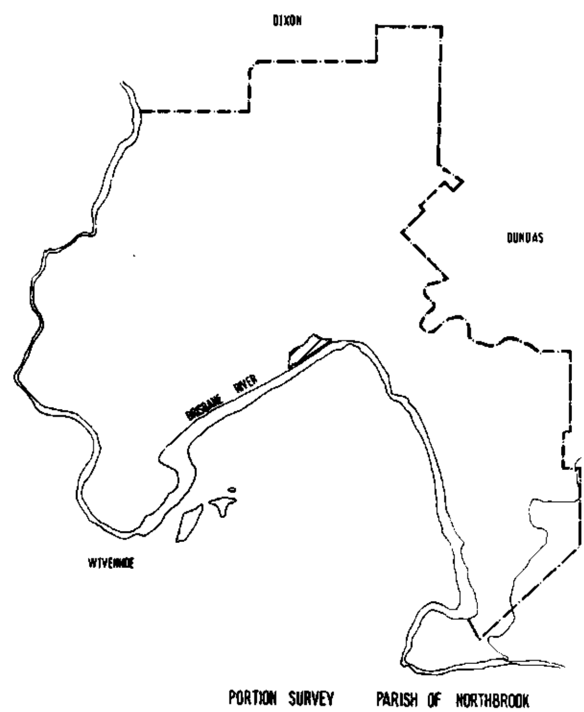

Fig. 19 Compilation of portion surveys, Parish of Northbrook (scrub shaded)
Source: Portion surveys, QDGI

indicated is inevitably less than that which existed initially. Two surveys or more of different dates may exist for adjacent or overlapping portions. Despite this, the parishes which were checked showed more scrub than had been indicated on the earlier run surveys, although the general patterns coincided.

Timber construction in Queensland[62]

The overwhelming predominance of detached houses which distinguished Brisbane from other eastern state capitals resulted from the lack of any building regulations or Act to control the subdivision of land, and the development of an aesthetically acceptable form of timber construction.

Despite claims to the contrary, no legislation controlling building existed when the separate colony of Queensland was created in 1859.[63] Expectations that a Building Act would soon be enacted were not fulfilled, even after a disastrous fire destroyed parts of the city. Instead, sections of the city were designated first-class. In these, buildings were to be constructed of brick, stone or other incombustible material. Similar provisions were later enacted in other towns. Effective administration of the provisions proved difficult after the courts held that corrugated sheeting of timber framing complied. As a result, the proclamation proved ineffectual even in the comparatively small areas of towns which were designated.

Recurrent forecasts of conflagrations were all too often fulfilled when fires occurred with depressing frequency. Householders' efforts to save any more than their lives were generally unsuccessful, as their timber-framed, shingle-roofed houses (not infrequently lined with calico) quickly succumbed to the flames. In built-up areas, demolition was often the only means of preventing fire spreading unchecked. Detached kitchens did little to reduce the risk. More often they too were destroyed where fire spread from the main house after candles ignited mosquito curtains or lamps exploded.

The need for volunteer fire brigades was more often discussed than acted on - unlike insurance where rates rose and threats to refuse cover were made against timber construction. The fire-resisting qualities of different species of timber was a matter of concern - just as in different circumstances was their relative calorific values or their resistance to white ant attack.

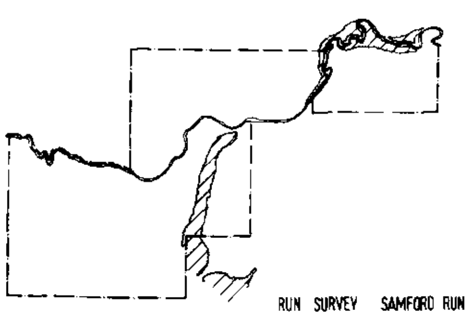

Fig. 20

Samford Run survey, 1869 (scrub shaded)
Source: redrawn from QDGI: M33-61

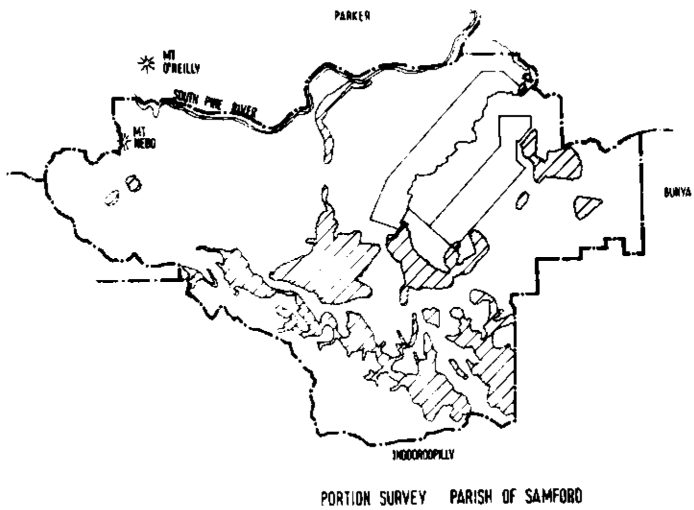

Fig. 21 Compilation of portion surveys, Parish of Samford (scrub shaded)
Source: portion surveys, QDGI

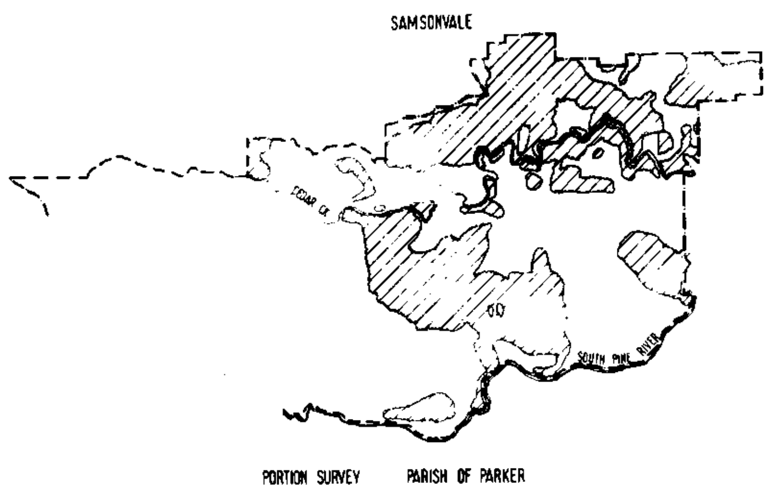

Fig. 22 Compilation of portion surveys, Parish of Parker (scrub shaded)
Source: Portion surveys, QDGI

In 1885, with Brisbane overrun with land speculators, excessive subdivision posed a threat of overcrowding. Faced more by the fear of an epidemic than by the dangers of fire spreading between closely spaced timber houses, proposals were revived for controls over building. Side-stepping the issue, Parliament passed an Act to prevent the undue subdivision of land little different to one first proposed more than 20 years earlier.[64] Minimum dimensions were prescribed for streets and lanes, for set-backs from the centres of lanes, and for allotments. While the Act did not prevent the construction of (masonry) terrace houses it destroyed them as a form of speculative housing, in that individual houses within the terrace could not be sold separately.[65] As an alternative, building speculators turned to groups of detached but identical timber houses (or sometimes duplexes), each of which was on an allotment of at least the prescribed 16 perch minimum. The Act ensured that almost all housing in the colony would continue to be built in timber without endangering whole blocks from the threat of fire.

No further controls over building were instituted in Queensland until The Local Authorities Act of 1902 gave local government the long-sought power to regulate building. A comprehensive code of regulations for Brisbane came into force in 1904, more than 50 years after comparable enactments in southern states, and by which time the practice of timber construction was firmly established.

Equally important in the acceptance of timber as the preferred building material in Queensland was the development of a form of construction that not only took advantage of the timber which was available locally, but also had sufficient aesthetic pretentions to satisfy Victorian architectural taste.[66]

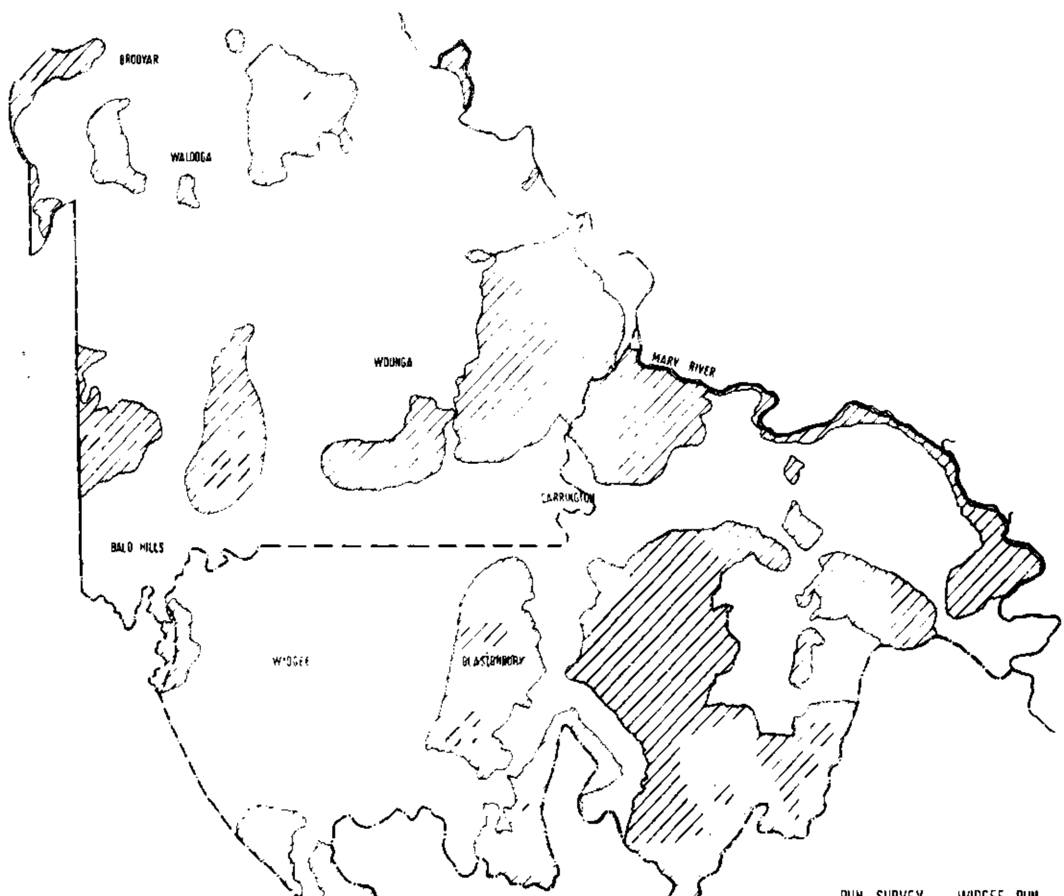

Fig. 23 Widgee Run survey (includes the later Parish of Glastonbury) (scrub shaded)
Source: redrawn from QDGI: WB39.82

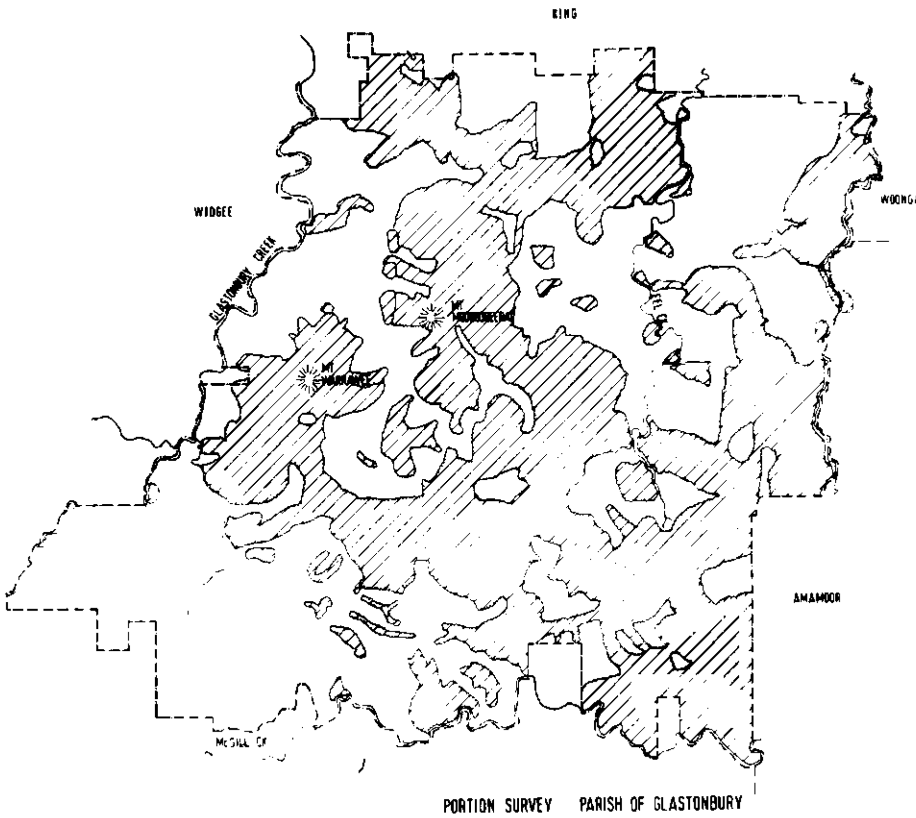

Fig. 24 Compilation of portion surveys, Parish of Glastonbury (scrub shaded)
Source: portion surveys, QDGI; Glastonbury State Forest map, D6/12.1922, QSA

Until the middle of the 1860s, timber construction in Queensland did not differ from the conventional stud-framed, timber sheeted buildings built in southern states and elsewhere. From 1865, the architect R. George Suter (influenced by the so-called Selwyn Style in New Zealand), designed buildings for both the Queensland Board of General Education and the Church of England which inverted the normal practice of external cladding by sheeting only the inside of the frame (Fig. 25). The studs, plates and bracing were arranged in a manner which recalled European half-timbering. The pattern was reinforced by the appropriate use of (dark) hardwood framing with (light-coloured) softwood cladding. The specification for painting of those buildings required that the original colours be reproduced. Not only was this form of construction economical in its use of materials, but it also provided a better finish internally in pioneering buildings where the lining was often deleted to reduce cost. It was also climatically appropriate. The responsibility of Suter's clients to educate and provide pastoral care for the whole colony ensured that his plans were widely distributed. They were immediately popular and generally imitated. Despite some technical deficiencies, the 'claims to architectural taste' of exposed studding were sufficiently potent to establish timber framing as the general form of building construction in southern Queensland, where it endured for more than half a century, often, in later examples, without the visual pretentions of the original.

Fig. 25 Allora National School and Teacher's Residence, 1867. Archt R.G. Suter Source: JOL

In its simplified form (not inappropriate given changes in taste), timber construction adjusted to the rising costs of softwoods as supplies diminished (Fig. 26). Dressed, rebated and weathered softwood cladding was often replaced soon after 1900 by rough-sawn, feather-edge hardwood boards. After World War I, the former T & G (tongue and groove) pine linings gave way to various sheet materials - plywood, fibreboard, asbestos cement and plaster. As imports rose and costs increased still further after World War II, the hardwood external cladding was also replaced by sheet materials or a veneer of brickwork. The Queensland timber building tradition survived little longer than the scrubs which produced it.

The assistance of Bill Kitson of the Queensland Department of Geographic Information, and Stephen Gee, Chris Ipsom and Merv Gordon of the Department of Architecture is gratefully acknowledged. The research was partly funded by the University of Queensland.

NOTES

Abbreviations:

JOL	John Oxley Library
ML	Mitchell Library
QDGI	Queensland Department of Geographic Information
QPP	Queensland Parliamentary Papers
QSA	Queensland State Archives

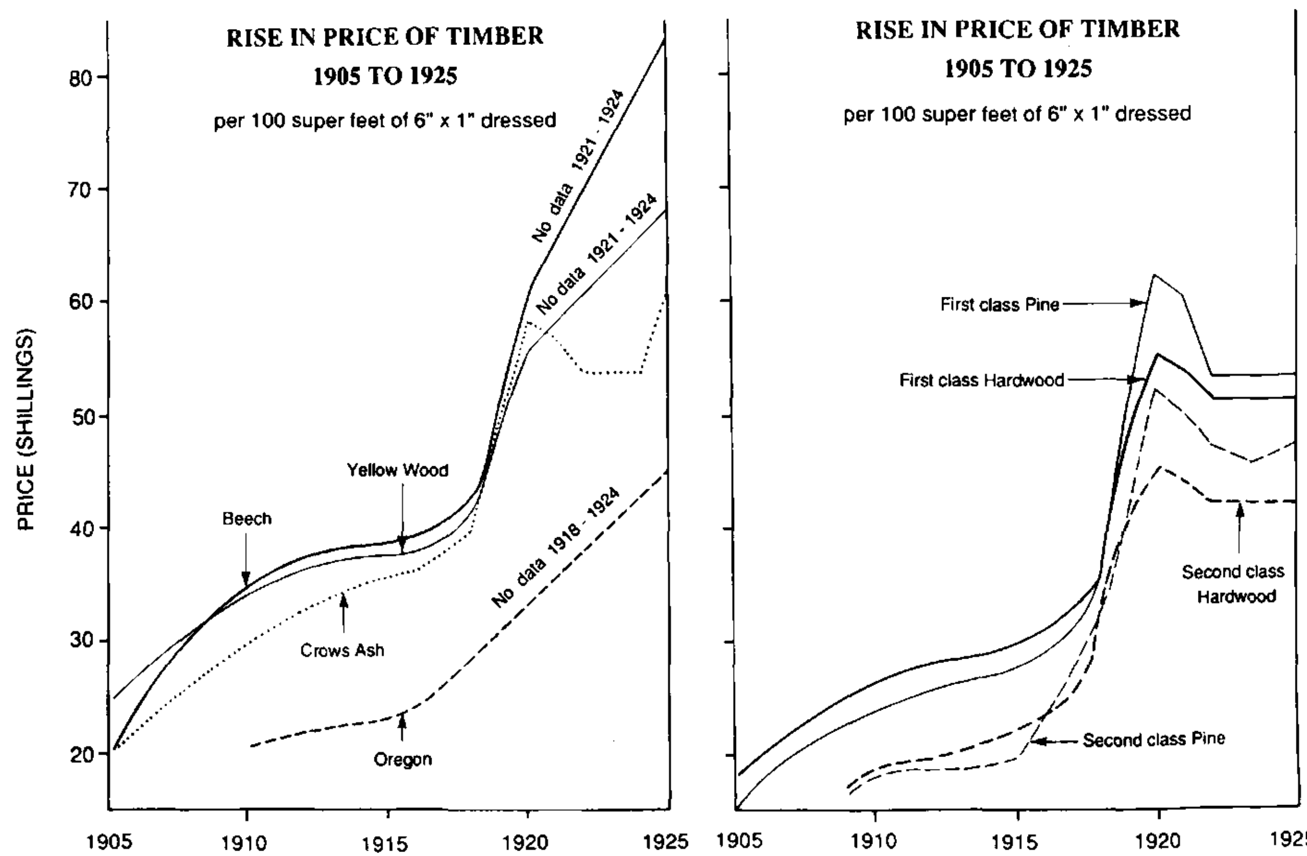

Fig. 26 Rise in the price of timber 1905-25
Source: QPP 1926 (2): 309

VPLAQ Votes and Proceedings of the Queensland Legislative Assembly

Steele Steele, J.G., 1972 The Explorers of the Moreton Bay District 1770-1830, Univ. Queensland Press, St Lucia.

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1. Philip Cox and John Freeland (1980), Rude Timber Buildings of Australia, Angus and Robertson, London.
2. ibid., Plate 104.
3. ibid., p. 70.
4. For example:

Table 1

State	Timber Imports by state for 1905 (Super feet)
Victoria	531 078
New South Wales	336 689
South Australia	122 953
Western Australia	83 326
Tasmania	10 137
Queensland	2 892

(Source: QPP 1906(2) p.56)

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5. The preferred term varies. Cunningham used 'brush'; Fraser, 'brush' or 'pine forest'; Lockyer, 'brush' or 'pine'; Logan, 'scrub'.
6. Cunningham 27.6.1829 [at Mt Walker] in Steele, p. 332: 'the flora of these shades is identical to that of the Brisbane River'; Cunningham 22.8.1828 [at Cunningham Gap] in Steele, p.285: 'clothed with a thick brush of plants common to the Brisbane River'; Cunningham 15.6.1829 [near Pine Mt] in Steele, p.312: 'The plants of these jungles were chiefly the same species as those that occupy the brushes on the Brisbane in the vicinity of the settlement.' etc. It should be emphasised that Araucaria cunninghamii was only one of a number of important timbers found in the scrubs - red cedar (Toona australis), crows ash (Flindersia australis , black bean (Castanospermum australe), and beech (Gmelina leichhardtii) were others.
7. E.H.F. Swain (1928), The Forest Conditions of Queensland, Govt Printer, Brisbane, p.59.
8. Logan Journal, 14.6.1827 in Steele, p. 212.
9. N. Bonnin, ed. (1985), Katie Hume on the Darling Downs: a colonial marriage, Darling Downs Inst. Press, Toowoomba, pp. 79-80.
10. Steele, J.G. (1972), op. cit.
11. The Australian, 9.12.1824 in J.G. Steele (1975), Brisbane Town in Convict Days, Univ. Queensland Press, St. Lucia, p.21.

12. Cunningham Journal, 17.9.1824 in Steele, pp.153-4.
13. Sir Thomas Brisbane to Earl Bathurst, 1.1.1825, Historical Records of Australia, vol. 11, p.457.
14. Cunningham Journal, 21.9.1824 [Pine Mountain] in Steele, p. 166.
15. Bulimba, New Farm, East Brisbane, Petrie Bight, the Botanic Gardens, South Brisbane to Hill End, St Lucia, Yeronga, Long Pocket, Tennyson, Chelmer, Sherwood, Fig Tree Pocket, Corinda, Seventeen Mile Rocks, Kindalee, Wolston Park, Moggill, Wacol, Goodna, upstream of Kholo Ck (both sides), west of College's Crossing, Pine Mountain, Mt Crosby, etc.
16. Oxley Field Books, 20-24.9.1824, in Steele, pp. 137-46.
17. Oxley Report, 10.1.1824 in Steele, p. 119.
18. ibid., p. 122. Given Oxley's confusion between Cupressus australis and the newly discovered pine, it seems likely that hoop pine was abundant there also.
19. Fraser Journal, 4.7.1828, in Steele, p. 230.
20. ibid., 7.8.1828, in Steele, p. 252; Cunningham Report 7.8.1828, in Steele, p.271.
21. Cunningham Report, 18-20.9.1828, in Steele, pp. 282-4.
22. Cunningham Report, 14-17.6.1829, in Steele, p. 312.
23. Cunningham Report, 26.6.1829 [at Mt Davidson] in Steele, p. 320.
24. Oxley Field Books, 2.12.1823, in Steele, p. 110.
25. ibid., 21.9.1824, in Steele, p. 139.
26. ibid., 22.9.1824, in Steele, p. 141.
27. Sydney Gazette, 9.12.1824, in Steele, p. 175.
28. Cunningham Journal, 21.9.1826, in Steele, p. 165.
29. Logan to Macleay, 28.8.1826, in Steele, p. 206.
30. Logan Journal, 9.6.1827, in Steele, p. 210.
31. Cunningham Report, 26.8.1828, in Steele, pp. 294-5.
32. Frequently illustrated in Steele, e.g. Country west of Mt Araucaria, Fig. 20, p. 144; Mt Barney, Fig. 34, p. 246.
33. Sketches of Conrad Martens held by the Mitchell Library: Pine trees, Old Road Cunninghams Gap, Dec 12 1851 PX25, ML; Pine cutters' Hut Mount Joy under Mt Sturt, Dec 30th 1851 ZPXC972, ML; On the Brisbane near Cressbrook, 7.2.1852 CPXC972, ML; Study - Pine Scrub. Feb 9th 1852, ZPXC295, ML; The Bunya Pine, Cooyar. Feb 13th 1852, (ZPX*D307-4, ML).
34. 'steep boundary hills, crowned with the picturesque pine', Cunningham Report, 8.7.1829 in Steele, p. 332.
35. Waterford Ferry on the Logan ZPX*D28, ML.
36. Sydney Gazette, 28.10.1826, in Steele, p. 207.
37. Bonnin, op.cit., pp. 79-80.
38. Charles Fraser Journal, 4.7.1828, in Steele, p. 230: 'Accompanied Capt. Logan to examine a forest on the banks of a stream called Breakfast Ck, three miles north west of Brisbane Town, noted for its gigantic timber, and the vast variety of its plants. In this interesting forest, I observed several species of Ficus upwards of 150 feet high, enclosing immense iron bark trees'.
39. K. Frawley, Past Rainforest Management in Queensland, in Australian National Rainforest Study Report, Vol. 3, eds G.L.

Werren and A.P. Kershaw (World Wildlife Fund/ACF, Melbourne), pp. 529-45.
40. VPLAQ, 1875(2), pp. 1228-83.
41. VPLAQ, 1875(2), pp. 1206-19.
42. For example, the Nineteenth Annual Report on the Brisbane Botanic Gardens, in VPLAQ, 1879(2), pp. 969-71.
43. VPLAQ, 1875(2), pp. 1286-91.
44. VPLAQ, 1879(2), pp. 977-9.
45. VPLAQ, 1879(2), pp. 965-6.
46. VPLAQ, 1875(2), p. 1240.
47. Typical are: 'forest ridges, sandy and grassy, lightly timbered gum and apple, broken ridge country, iron bark ridges, gum and iron bark ridges, gum and apple ridges, gum and apple forest, apple tree flat, lightly timbered flat, gum and apple plain, flat open country, open forest plain, open forest grassy hills stony in places, ordinary forest, open ironbark'.
48. For example: 'scrub, dense scrub, scrubby spurs, ridges partly forest and partly scrub, very high pine range, high range covered with pine, cedar scrub, dense cedar scrub, dense vine scrub, dense pine scrub, rich scrub, broken mountainous country with patches of pine scrub, Tenthill scrub, Great Rosewood scrub, in the scrub are some good pine trees'.
49. Some, such as Clarendon Stuart, Alfred A. Hull, Robert Austin, show more detail than others.
50. Copies often on linen contain less information than those on paper held by the Qld Univ. Dept of Geographic Information, e.g. the survey of Laidley, Rosevale and Franklinvale at the Department includes the Tenthill and Great Rosewood scrubs which are not shown on a copy at A1878, QSA.
51. No run survey has been located for Coochin Coochin (Dulhunty's Plain) but a sketch map of the run exists at A1870, QSA which indicates scrub along the entire western boundary of the run from Mt Alford through to Boonah, as well as on the eastern boundary in the Dugandan Range: '<u>land tinted green nearly all dense scrub</u>'.
52. Helidon (M33-40A, QDGI) has been lost but a copy is held by Bill Kitson, QDGI: Kenilworth W.39.9 has been missing since 1946, etc.
53. The complete list is: Dugandan, Bromelton, Undullah, Tenthill, Grantham, Kerry-Sarabah-Nindooimba, Helidon, Cressbrook, Emu Ck, Telemon, Wallaby Ck (Colinton West), Tambourine, Avoca-Squirrel-Monsildale, Tarampa, Tamrookum, Melcome and Heads of Logan, Mt Stanley-Taromeo-Cooyar, Kangaroo-Spring and Neara Cks, Emu and Maronghi Cks, Northbrook, Kilcoy, Eskdale and Heads of Cressbrook, Buaraba, Durundur, Laidley-Rosevale-Franklinvale, Samford, Moondoolun, Tabragalba, and Rosebrook.
54. Dugandan (Fig. 13), Undullah (Fig. 16), Tenthill (Fig. 11), Tarampa (Fig. 14), Northbrook (Fig. 18), Laidley-Rosevale-Franklinvale (Fig.12) and Samford (Fig.21).
55. Curra, Imbil, Gutchy, Kilkivan, Widgee, Tahiti-Ulirrah-Borea Vale.

56. Cunningham Report, 8.8.1828, in Steele, p.271.
57. Cunningham reported that the edge of a scrub may be more dense than the interior: '..on penetrating their dense skirts, we found within sufficiently open and free from vines to allow us to travel forward by means of our compass...', ibid., 27.6.1829, in Steele, p.321.
58. For example, the boundary of the northern portion of Franklynvale as described by the surveyor George Pratten, included the following: '...thence on the north by a line easterly about 40 chains to a large waterhole thence by that waterhole easterly to the Great Rosewood Scrub thence by that scrub southerly and easterly to a point where it is intersected by the 10 mile boundary around Ipswich ...', LAN/AF805, 1868/3333, QSA.
59. Archer correspondence, Fryer Library.
60. Gutchy Ck (WB39.51a-b); Mary R. (WB39.4a-d), Tinana Ck (WB39.26), Six Mile Ck (WB39.44.1,2), Mary R. from Traverston Crossing to Red Banks (WB39.52), Twelve Mile Ck (WB39.56a-b), Mary River from Obi-Bunya Ck (WB39.70).
61. Cunningham Report, 19.6.1829, in Steele, pp. 315-6.
62. This section summarises Sections 3,5,6 in Don Watson, (1984), 'The Queensland House' an unpublished Report to the National Trust of Queensland.
63. J.M. Freeland, (1972), Architecture in Australia, Cheshire, Melbourne, pp. 88, 110.
64. 49. Vic. No. 15. The Undue Subdivision of Land Prevention Act.
65. During the debate it was anticipated by one speaker that it would prevent their construction. This was not so, e.g. the Mansions Terrace in Brisbane (1890) and others. They were however of limited value to speculative builders whose capital was tied up rather than released for further development.
66. See Watson, Don (1987), Outside Studding: Some Claims to Architectural Taste, Historic Environment 6(2 & 3), pp. 22-31.

Rainforest dweller *(Litoria* spp.*)*, Atherton Tableland, north Qld

CONSERVATION AND NATIONAL PARKS

THE HISTORY OF CONSERVATION AND THE NATIONAL PARK CONCEPT IN AUSTRALIA: A STATE OF KNOWLEDGE REVIEW

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INTRODUCTION

A survey of the literature rapidly brings one to the assessment that the history of conservation and the national park concept is an under-researched field in Australia. This is not surprising, as environmentalism only became a significant political force from the early 1970s. Since this period, environmental protection and planning have been progressively incorporated into government policy-making in the form of both legislation and administrative measures (see Australian Environment Council, 1986). The environmental movement, which grew from a pre-existing but small base in the 1960s, looked not only to the resolution of particular conflicts but also to bringing questions of environmental management permanently onto the agenda in government policy-making. By the 1980s considerable success had been achieved in this regard, transforming the movement in the process to one requiring a high standard of professionalism. The spectacular environmental conflicts of recent times and the successes of the conservation movement in achieving certain goals have greatly overshadowed the earlier development of conservation ideas. In some instances, especially in forest management, it was the earlier, predominantly utilitarian-based, conservation goals that were coming under challenge in the 1970s.

CONSERVATION AND ENVIRONMENT IN AUSTRALIAN HISTORIOGRAPHY

Australian historiography has been characterised by a central focus on social, political and economic events for which the environment generally, or regional environments specifically, have usually simply provided the backdrop. Yet, at a conceptual level, historians have not completely ignored the environment. As Bolton (1976: 114) notes, the idea that societies were shaped by their environment ('environmental determinism') and the alternative, that the environment was a _tabula rasa_ on which economic man could impose his will, were stances seen in much Australian historical writing. For example, in _A Land Half Won_, Blainey (1980) argued that the climate, especially the occurrence of drought, was a major influence on 'the mood and motivations in Australian history'. Alternatively, Fitzgerald (1982, 1984), in his two-volume history of Queensland, set out to show how a commitment to 'progress' and economic development affected the environment, institutions and people of Queensland.

For Australian colonial and later governments, the major initial environmental question was how to manage the disposal and settlement of the public lands so as to achieve certain social objectives, maintain law and order over the expanding domain, and meet the imperatives determined by the forces of the capitalist world system. The history of land settlement has received a great deal of attention, in which the investigation of environmental aspects has varied widely. Roberts' (1924) History of Australian Land Settlement, for example, deals almost exclusively with the legislative aspects even though, to take one example of environmental impact, the disastrous results of overstocking, drought and the rabbit plague in the rangelands had contributed to the collapse of the pastoral economy at the end of the nineteenth century. There are a number of regional works, however, which explore the development and role of environmental ideas and geographical knowledge, showing the importance of human perception and appraisal in fashioning a land-use system. For example, Heathcote (1965) has shown how a pastoral system based on 'opportune use' was the practical solution to the problem of the ephemerality of natural resources on the inland plains. Meinig (1962) has shown the importance of the folk idea that 'rain follows the plough' and the scientific idea 'that trees bring the rain' in understanding the advance of the wheat-growing frontier in South Australia in the second half of the nineteenth century.

Other types of traditional resource development (e.g. minerals, water) have also been given attention in Australian historiography. Concepts of conservation have been but a minor theme in this story of resource development and national economic progress, except perhaps in the case of water, where development of storages and diversions (in effect, a form of harvesting) may also be seen as conservation.

At the broadest level, the relationship between humans and the environment in Western cultural traditions provides the framework within which the history of resource exploitation and conservation in Australia since 1788 may be considered. The timing of the European settlement of Australia had important implications for resource exploitation. From the outset, the planning for the new colony was based on an over-optimistic misperception of the resource base, which contrasted with the dismal images of the continent portrayed by the Dutch navigators from the early 1600s. The British culture transplanted to these unfamiliar surroundings - which were interpreted in terms of the British landscape - brought with it a rational view of nature and confidence in the ability to be master over it. On rational principles it was believed that people 'had a right and duty to transform the environment into greater productivity' (Bolton, 1981: 11). Conversion of the wilderness and improvement on nature formed part of the foundations of Western civilisation. The empiricism of the Scientific Revolution was also baring the mysteries of nature (Gilbert, 1981) which, in metaphorical terms, was beginning to be perceived in terms of a machine able to be dismantled, reconstructed and manipulated (Mills, 1982). Perhaps most importantly, the Industrial Revolution was about to give humans the technological means to fully assert this mastery over nature. This revolution profoundly transformed resource exploitation. Distance-shrinking railways, new farm machinery, steam-powered sawmills and cheap barbed-wire fences allowed greater and more efficient production and the domestication of the wild landscape.

As colonial Australia became incorporated into the capitalist world economy in the nineteenth century, it is important to consider the role taken by the state in the exploitation and management of resources - especially as a mediator between the resources themselves, the local population and the industrialising bourgeoisie of Britain looking to Australia for markets, cheap resources and avenues for profitable investment of surplus capital. Colonial (later State) and Federal governments facilitated overseas investment by undertaking development works too large or too risky for private investment, such as railways (Jeans, 1987). With regard to basic natural resources, there has been a tendency within the country to keep these under Crown control - except in the case of land alienated for agriculture. Even here, there are differences between States. In the case of Queensland there is a long history of leasehold for both small agricultural and large pastoral holdings. Given the dryness of the Australian continent, the British-derived common-law rights to water were replaced at the turn of the century by state control, on the model of Victorian legislation drawn up by Alfred Deakin (Pigram, 1986). Now all significant abstractions of water are controlled under licence from the Crown (Bates, 1983: 126). Similarly, those recognised forest lands remaining after alienation for agriculture have generally been reserved to the Crown throughout the Australian States. Crown ownership rather than alienation has had long-term significance for conservation and other values such as recreation. As conservation values have been recognised, and have supplanted earlier exploitative or utilitarian ones, there has been greater certainty of achieving changes in land-use practice in those areas remaining under Crown control. In the case of the disused travelling stock routes and reserves in New South Wales, for example, it was recognised in the 1970s that these areas, originally reserved for another purpose, now had significant conservation value associated with remnant woodland. In 1977 the NSW Minister for Lands issued strict guidelines to prevent their disposal, on the realisation that once they were alienated there could be no guarantee that the woodland would be left, and once cleared such loss might be irreversible (Breckwoldt, 1986). Also, significant areas of National Park in all states have come from Crown holdings such as State Forest, Timber Reserve, or Vacant Crown Land.

The evolution of conservation ideas and policy

From disparate sources, some of the main milestones and important periods in the evolution of conservation ideas and policies in Australia may be identified. It is evident that the development ethos and exploitative pioneering were challenged in some systematic way from the second half of the nineteenth century. The three decades from 1860 were a period of substantial economic growth, in the latter part of which the argument for the 'wise use' of resources was raised and began to gain some currency. Bardwell (1974) has described the period from the 1880s through to the First World War as one where many new ideas and movements for change in environmental management practices took hold. During this period the first major flora and fauna protection Acts were passed and the colonies (later States) began considering the formation of the forestry departments which they progressively established between 1882 and 1920. Significant steps were also taken in water management.

World War I brought a major disruption to the Australian economy and after the war new emphasis was given to economic development. The development strategy aimed to increase agricultural exports, expand domestic manufacturing and encourage British manufacturers to set up branch plants in Australia. Population growth was also promoted and there was keen interest in the development of northern Australia. But there were questioning voices and some stalwart opponents to the direction of development (though not development per se). The newly established group of professional foresters put forward proposals for forest reservation nationally and argued against incautious alienation of the remaining forest estate. Soil conservation also became a focus of concern in the inter-war period, with legislation in 1923 in South Australia and a Soil Erosion Committee (1933) and legislation (1938) in New South Wales (Mosley, 1972).

From the end of World War II until 1974, Australia experienced a period of substantial economic growth and development. By 1974 the conservation movement was becoming well established and was more than simply a reaction to development excesses. Rather, it was linked to a wider tide of social change, feelings of Australian pride and nationalism, and international environmental concern. The earlier predominant 'wise use' or utilitarian-based approach to the environment was increasingly seen as deficient by itself or leading to the destruction of other values. Growing also was the argument for a changed environmental ethic - one less human-centred and more biocentric.

International influences have always been identifiable in Australian conservation ideas, evident, for example, in the early reading and quoting of the highly influential work of George Perkins Marsh (Marsh, 1965), the adoption of the philosophies of the North American Progressive Conservation Movement (1890-1920), and the application of the Arcadian tradition of 'park-making' and improving on nature for public enjoyment and recreation. This international context became more important after World War II, given the global nature of environmental concern (headed by the threat of nuclear destruction), the formation of international conservation organisations, and the transference of conservation ideas, such as the wilderness preservation concept, between countries. The importance of environmentalism in Australian society is shown in the membership of the hundreds of nature conservation and cultural environmental bodies. One estimate of membership numbers for these two broad categories of groups is 250 000 and 120 000 respectively (Yencken, 1982: 8). The list of sympathisers and supporters would substantially raise these numbers. Noteworthy is the persistence with which campaigns are waged, often with minimal resources and utilising volunteer labour.

As noted previously, the importance of environmentalism is also demonstrated in government policy-making.

The environmental movement

There is now an extensive literature dealing with the modern environmental movement, most of it of European or North American origin and coming from sociology, political science, history, geography and the broad field of resource management (see, for example, Nicholson, 1987; O'Riordan, 1976; Cotgrove, 1982; Pepper, 1984; Schnaiberg, 1980; Sandbach, 1980). Despite this, the movement is still not well understood and public perceptions are often based on misleading stereotyped images as represented through the mass media. In Australia there has been no comprehensive analysis of environmental groups comparable to that by Lowe and Goyder (1983) for Britain. Their classification of groups and some of their general observations are probably also relevant to Australia. This is not to suggest that there is no Australian literature. Mosley (1973) gave an account of groups and tactics and has recently reviewed the history of the movement and its current status (Mosley, 1988). Holloway (1986) has looked at changes in the organisational core of the Tasmanian Wilderness Society (now The Wilderness Society) following the achievement of its major goal. Davis (1981) has examined the characteristics and influence of the conservation movement using some case studies. Birrell (1987) has explored the social processes shaping appreciation of the Australian natural and built heritage, giving special attention to changes in the aesthetic response to the landscape.

One of the crucial aspects underlying the more radical environmentalist critiques is opposition to the dominant values and institutions of industrial society and a desire to change them (Cotgrove and Duff, 1980). Cotgrove (1982) has outlined the contrasts between aspects of the 'dominant paradigm' in such societies and the 'alternative environmental paradigm'. These ideas have currency in Australia (see Hutton, 1987). Clearly, then, environmental issues will not be resolved simply 'by getting the facts right' - on the supposition that these are value-free - when underlying assumptions or first principles are also under challenge. The 'facts' compiled by development interests (often proclaimed to be scientific and objective) and those compiled by conservation interests on the same subject (often criticised as emotional and subjective) are often widely different and, even when they do accord, radically different solutions to problems are likely to be proposed (Mercer, 1986). The philosophical underpinnings to environmental action are not always clearly articulated publicly, but they have been the subject of many essays in conservation journals such as Habitat Australia (e.g. for the views of one of the most influential and inspirational opinion leaders in the Australian conservation movement see Brown (1987)). Other useful sources are biographies (e.g. Thompson, 1984), evocative illustrated publications (e.g. Angus, 1975), accounts of campaigns (e.g. Green, 1981; Wright, 1977), and collections of the writings of prominent individuals (e.g. Thompson, 1986).

CONSERVATION IDEAS AND POLICY IN AUSTRALIA

From North American literature on conservation and environmental history, two main strands of conservation thought are identifiable in the late nineteenth century. The dominant movement (termed the 'Progressive') was scientifically based and managerial in focus, concerned with rational planning to promote efficient development and 'wise use' of natural resources (Hays, 1959). Its leaders came from the newly developed fields of applied science such as forestry, hydrology, agronomy and geology and its philosophical underpinnings lay in Benthamite Utilitarianism - 'the greatest happiness for the greatest number'. A core concept was that of 'sustained yield' or, put simply, the supply of a certain volume or quantity of a particular natural resource in perpetuity. The other movement (described as 'Preservationist' for want of a better term) was concerned with setting aside areas from use (especially from resource exploitation) as wilderness and maintaining public ownership (Nash, 1974). The wilderness preservation movement had its roots in the Romanticism of the late eighteenth and early nineteenth centuries with its enthusiasm for wild forested and mountainous country, and later the philosophy of Transcendentalism, as espoused by Emerson and Thoreau, which, in the relationship between humans, nature and God argued for the spiritual value of wild and natural country. Neither the 'wise use' nor the 'wilderness preservation' strand of conservation philosophy has been the subject of detailed analysis for Australia, though it is evident that the former did influence resource management by providing a persuasive rationale for state intervention. The place of wilderness is less clear. Positive promotion and argument that wild country needed protection from development may effectively only date from this century when the bushwalking conservation movement began to campaign for extensive areas to be preserved from large-scale human intrusion, though the term 'primitive area' was often used in preference to 'wilderness'. Other perceptions predate this.

In a survey of the literature on conservation ideas in Australian history, it seems useful also to make some reference to works which refer to attitudes to the environment. Indirectly, these tell us much about both the present appearance of the landscape and the acceptance or otherwise of conservation concepts. Heathcote's (1972) classification of the images or visions of Australia still provides a useful overview (see also Heathcote, 1976; Frawley, 1987 and Powell, 1972). Heathcote identified five visions: the Scientific, Romantic, Colonial, National and Ecological, of which the Colonial, based around improvement, progress, development and indifference to the natural landscape, was dominant and remains so, though decisively challenged by the Ecological. The first European reactions to the Pacific, including Australia, are discussed in detail by Smith (1960) who shows how an empiricism based on naturalistic philosophical perspectives challenged both neo-classical art and traditional science, and how landscape tastes preconditioned descriptions of the colony. A most useful collection of papers dealing with the perception of, and attitudes to, the Australian environment is contained in Seddon and Davis (1976). In an interesting survey, Watkins (1984) has examined attitudes to nature as evidenced in contributions to the Victorian Naturalist between 1884 and 1982. Within a general stance of domination of nature, exploitation and stewardship have been the dominant attitudes of the field naturalists, with stewardship only becoming the most prominent in recent times. Another characteristic was a European bias in observing nature (see also Seddon (1982) for a wider discussion of 'Eurocentrism' and Australian science).

A generalised environmental history of Australia including the development of conservation ideas may be found in Bolton (1981). Beginning with the impact of British settlers and their cultural baggage, Bolton traces the development of the rural and urban landscapes, the strength of the development ethos, the first recognition of adverse environmental affects and the movement for conservation beginning in the later part of the nineteenth century. Using a historical-cultural approach, Powell (1976) has examined Australian environmental management to 1914 with a focus on the south-eastern corner. Attention is given to the role of colonial science and associated learned societies in fostering questions about environmental management, as well as the impact of Marsh's Man and Nature (1864) and the ideas of the North American Progressive Conservation Movement. It is in water management that the 'wise use' concepts of resource management are first given significant application in Australia.

Powell's conclusion on the importance of the professional expert or technocrat in Australian environmental management is a useful reminder to those researching forest history. This work has recently been significantly extended in Powell (1988). The short history of conservation in Australia by Mosley (1972) showed how conservation has been largely utilitarian-based (p. 153).

> The history of conservation in Australia shows that it has been a minor activity concerned for the most part with piecemeal action to limit the loss of productivity in the case of forests, soils and pastures, maximise the output of minerals, harvest water, maintain residual natural areas and, more recently, to control the grosser forms of pollution. The biggest advance has been the recognition that depletion can be avoided by land use planning ... conservation as a whole has been insignificant compared with resource depletion as a factor affecting the Australian environment.

Nineteenth-century colonial science was concerned not only with natural history and medicine but its ranks also included individuals who raised questions of conservation and environmental change following European settlement. There was, therefore, an early scientific stream to Australian conservation thought which has grown into an increasingly powerful rationale for conservation action. Colonial science was organised through bodies such as the Royal Societies, Philosophical and Acclimatization Societies and from 1886 the Australasian Association for the Advancement of Science, with membership being drawn from the ranks of the professionals and colonial elites. It was in the forums of these organisations that forest conservation and the effects of forest removal were first raised. In 1876, for example, in his vice-presidential address to the Royal Society of New South Wales the prominent geologist, Rev. W.B. Clarke, spoke of both the utilitarian and aesthetic values of the forest cover, the threat posed by ruthless ringbarking, and the need to bring the 'woods and forests' under government protection (Clarke, 1876; Powell, 1976). A decade later, the Queensland pastoralist and member of parliament, Albert Norton, reported on the 'dieback' afflicting the tree cover of the New England district of New South Wales and looked to an ecological explanation for the phenomenon (Norton, 1886). In the twentieth century, organised science became involved in specific proposals for strict natural area protection, with perhaps the most significant result being the 1963 establishment of a 25 000 hectare 'Primitive Area' in Kosciusko State (later National) Park in spite of objections by the powerful Snowy Mountains Authority (Turner, 1979; Frawley, 1987). In recent times, scientific values have become the primary basis for some conservation campaigns and particularly those involving World Heritage nomination (see for example, Rainforest Conservation Society of Queensland, 1986; Australian Heritage Commission, 1981). One important feature of colonial science was the activities of the acclimatisation societies, and in what would be seen today as a somewhat muddled view, prominent colonial scientists such as Baron Ferdinand von Mueller (Victorian Government Botanist from 1852) supported and assisted acclimatisation while at the same time arguing for conservation. Acclimatisation was looked upon as a means of correcting the deficiencies of Australian nature and establishing useful plants and animals, but also as bringing reminders of 'home' to homesick Britons (Birrell, 1987). Early botanical investigation, natural history and colonial science have been the subject of some research (e.g. Gilbert, 1962, 1970, 1971; Hoare, 1974; Finney, 1984; Mozley Moyal, 1976; Moyal, 1986), while Frith's <u>Wildlife Conservation</u> (1973) and Marshall's indictment of our treatment of the indigenous flora and fauna in <u>The Great Extermination</u> (1966) both contain historical material.

One of the most fascinating areas in the study of the relationship between humans and their environment is the changing concepts of 'wilderness'. Today the term is much used by the tourist industry in Australia and is given widely diverse and confused meanings which bear little relationship to the historical meanings, which all have in common a sharp edge of contact with nature, either terrifying at one extreme or benign and spiritually uplifting at the other. Nash (1974) has traced the ancient meanings of wilderness and the importance of the concept in North American environmental history. While it is evident that the concept has been very important in Australian conservation ideas and action over the last two decades, its historical roots in Australia are less clear. Conservation literature shows that North America has been a major source of ideas and inspiration, ranging from quotations from Henry David Thoreau and Aldo Leopold to arguments for similar wilderness legislation (see, for example, Johnson, 1974). One limited study by McLoughlin (1977) concluded that wilderness was 'not a concept indigenous to Australia, apart from the ideas of pioneer bushwalkers such as Myles Dunphy, and is not part of the cultural background of many Australians at present'. Prineas (Prineas and Gold, 1983) disagrees, taking the view that the wilderness idea 'goes back in different forms to the beginning of European settlement and probably much further'. His focus is less on the cultural concept of 'wilderness' and more on the presence of, and response to, 'wild places' - prompted by what he sees as recent attempts to treat 'wilderness' as only 'a state of mind' independent of the kinds of landscape and ecological qualities which make the experience of wilderness possible. Prineas (pp. 15-43) goes on to trace ideas about the wild and unsettled parts of Australia, categorising those lands as (i) a terra nullius, (ii) a refuge for the Aborigines and those attempting to evade the law, (iii) a cathedral evoking a spiritual and aesthetic response of a Transcendentalist nature, (iv) a battleground between the wilderness preservation movement and development interests. Ironically, these lands once beyond European law and control now need legislation and human protection to survive. What is evident from the foregoing is that any exploration of the wilderness concept in Australia must be sensitive to not only the influence of overseas ideas but the peculiarly Australian aspects as well. In a more secular society than the United States, biblical images appear to be less prominent and different terminology has been used, e.g. 'primitive area'. The National Parks and Primitive Areas Council formed in New South Wales in 1932 was, in North American terms, a wilderness preservation movement.

Brief discussions of the wilderness concept in Australia, sometimes with historical aspects, may be found in the reports and inventories completed over the last decade (Helman, 1981; Helman et al., 1976; Feller et al., 1979; Lesslie and Taylor, 1983; Hawes and Heatley, 1985; Wilderness Working Group, 1986; Lesslie et al., (1988). There are also some compilations of conference proceedings (Robertson et al., 1980; Mosley, 1978; Martin, 1982; Mosley and Messer, 1984) and at least one thesis which examines the wilderness preservation aim as a political demand (Figgis, 1979). In perhaps the most wide-ranging study to date, Hall (1988) has investigated the evolution and development of wilderness preservation in Australia and considered the potential for Federal government action under international heritage agreements to protect wilderness, concluding that a national wilderness system is both possible and a natural development in the history of wilderness preservation in Australia.

The influence of the ideas of the North American Progressive Conservation Movement and 'wise use' concepts of resource management generally on Australian practice, and the assumptions of the groups of professionals involved, remains an area worthy of investigation. At various times, but especially from the last two decades of the nineteenth century, Australian colonial/State governments assumed more direct responsibility for management of resources and progressively employed trained 'experts' to carry out that task. These individuals brought with them unquestioned first principles internalised through their professional training and they were mainly concerned with the technical aspects of management: how to achieve the shortest wood rotations; how to best harness the rivers for productive use of the water; how to most efficiently extract the minerals. Basic assumptions were generally that resources were there to be used, that they should be wisely managed to maximise community benefits (usually not well defined), and that management was a task which should be the preserve of technical and professional experts. Not only did these resource management professionals respond to political demands but, through the strength of their technical expertise, they were also able to set their own agendas, advising and winning approval from governments on how resources should be managed. Carron (1980), for example, has shown how the forestry profession established the goal of softwood self-sufficiency for Australia - probably at the first Interstate Forestry Conference in 1911 - and how this carried through to the (Commonwealth) Softwood Forestry Agreement Act 1967 and endorsement by the influential FORWOOD conference in 1974. Probably the best known case is that of the Tasmanian Hydro-Electric Commission which has operated virtually without reference to parliament for fifty years (Thompson, 1981). Many of these basic assumptions were questioned and challenged by the conservation movement from the 1960s, in what seemed to many professionals as inexplicable attacks on their own integrity - the furore over the critique of Australian forestry by Routley and Routley (1974) being an outstanding case. Environmental groups, in line with other movements for social change, were no longer satisfied to 'leave it to the experts', and demanded public involvement in resource decision-making, especially the formulation of goals. They also began to examine critically, untested statements on community benefits (economic and otherwise) of resource projects and in particular, proposed that for the gain of other benefits (especially of an aesthetic, recreational, scientific or spiritual type) resource development in some instances should not proceed. To the utilitarians of the 'wise use' school such a view sometimes appeared to border on the incomprehensible, and indeed some resource management professionals had developed the view that ecological systems could not survive without their active intervention and management. In general, understanding of the environmental conflicts in Australia over the recent decades would be enhanced by a better understanding of the fundamental belief systems of the protagonists involved and with regard to the resource management professionals this is particularly so. Environmental philosophies have been given a greater airing through the publications of the groups involved.

The pattern of use, ownership and control of Australian forested and other landscapes increasingly bears the imprint of conservation ideas and the campaigns of the last two decades. A research agenda for Australian conservation history should, therefore, include not only the early roots but also the period of vigorous activity since the 1960s. From the point of information sources, there is a high turnover of volunteer workers in conservation activity whose insights may prove invaluable in the future but are likely to be lost. There is also the need to encourage the preservation of records which are probably more at risk when there is not a continuity of staff or the use of formal record-keeping procedures. There have been some studies of this period. The 'Green Ban' action of the early 1970s, which coalesced a range of factors (class struggle, environmental [especially urban quality of life] concern, urban politics) into a unique movement which gave a major boost to

Australian environmentalism, is dealt with by Roddewig (1978), Hardman and Manning (n.d.) and Jakubowicz (1984). The Colong Committee from New South Wales has produced a blow by blow account of the campaign to save the north-coast rainforests (Colong Committee, 1983). Similarly, Wright (1977) has detailed one of the early sustained conservation campaigns of the post-war period in her account of the defence of the Great Barrier Reef from the threat of mining and oil drilling. The volume of conference papers edited by Mosley and Messer (1984) contains accounts of recent 'battles lost and won' for wilderness throughout Australia. The regular publications of conservation organisations are not only a valuable source for this period but also occasionally feature historical material such as the Special Border Ranges Issue of Habitat Australia (Vol. 4(3) 1976).

The structure of Australia's federal system of government has left most aspects of the administration and management of lands and resources to the respective State governments. While broad ideas about conservation and resource management may be identified nationally, a proper understanding can only be gained from an examination of the State level. The only State for which a history of conservation (and exploitation) appears to have been completed is South Australia (Whitelock, 1985). Notable regional histories of exploitation and moves for conservation are contained in Gee and Fenton (1978) for south-west Tasmania and Johnson (1974) for the Victorian Alps. At the national level, the Report of the National Estate (Hope, 1974) stands as an important stocktake of both the state of the natural and built environment and measures taken to that date to conserve it. Yencken provided a follow-up review in 1982, in a report which also contained historical material.

THE NATIONAL PARK CONCEPT

Australia has one of the oldest national park systems in the world, with the first reservation being the (Royal) National Park near Sydney in 1879. At 31/12/1986, there were 34 500 000 hectares of land reserved (primarily for nature conservation but including small areas of historic and Aboriginal sites) under various classifications across the States and Territories. Reservations are made under State, Territory and Commonwealth legislation and comprise 4.5% of the land area of Australia (Mobbs, 1987). In 1970, the Fourth Ministerial Council of Nature Conservation Ministers of the Australian States agreed to the following definition (Goldstein, 1979):

> A National Park is a relatively large area set aside for its features of predominantly unspoiled natural landscape, flora and fauna, permanently dedicated for public enjoyment, education and inspiration, and protected from all interference other than essential management practices, so that its natural attributes are preserved.

With the exception of areas in the External Territories and the Northern Territory reserved under the Commonwealth National Parks and Wildlife Conservation Act 1975, Australia's national park system is a creation of the respective State governments. There has been some commonality across the States with regard to the timing and nature of national park legislation, declaration and management, but each State has its own legislation, administrative arrangements and forms of reservation. These are summarised in Mobbs (1987).

In the post-war period and especially since the 1960s, the number and area of national parks and other reserves saw a spectacular increase throughout Australia (Table 1). This era of rapid land acquisition derived from the realization by the newly formed or higher profile park services that land not quickly placed in reservations would be lost to conservation as development pressures grew. The trend now is for the rate of acquisition to slow, with more focus on the management of already acquired lands.

Table 1 Expansion of National Parks and other Nature Conservation Reserves 1968-86 (hectares)

State or Territory	1968[1]	1978[1]	1986[2]	% of land area (1986)
ACT	4 858	9 843	111 841	46.6
NSW	862 204	2 073 232	3 438 939	4.3
VIC	201 307	294 871	1 401 194	6.2
QLD	940 715	2 212 397	3 492 031	2.0
SA	1 169 584	3 920 940	6 710 970	6.8
TAS	288 259	681 147	947 786	13.9
WA	1 150 920	12 649 401	14 648 708	5.8
NT	4 842 523	5 222 590	3 779 243	2.8
External Territories	n.d.	n.d	3 157	
Australia	9 460 370	27 064 421	34 530 702	4.5

1. 'National Parks' and 'Nature Reserves' (from Ovington, 1980)
2. 'Nature Conservation Reserves' - includes all designations (from Mobbs, 1987)

The most comprehensive histories of the national park concept in Australia are in the doctoral theses of Turner (1979) and Bardwell (1974), the former focusing on New South Wales, the latter on Victoria. In addition, Whitelock (1985) devotes two chapters of his book to national parks in South Australia. There are brief national summaries by Ovington (1980) and Boden and Baines (1981), a State by State review in Goldstein (1979), and a discussion of the evolution of systems of national park policy-making in Australia by Black and Breckwoldt (1977).

These works show that between 1879 and World War I, all the Australian States accepted the idea of reserving areas of land as national parks. Beginning with the (Royal) National Park (NSW, 1879), others followed: Belair (SA, 1891), Tower Hill (Vic., 1892), Swan

View (later John Forrest) (WA, 1895), Witches Falls (Qld, 1908), Mt Field and Freycinet (Tas., 1916). Other forms of reserves had predated most of these. Small as many of the initiatives were, they were nevertheless a significant first step, given prevailing attitudes towards the environment and resource exploitation. The most significant pieces of legislation were the Queensland <u>State Forests and National Parks Act</u> of 1906 and the Tasmanian <u>Scenery Preservation Act</u>, 1915 (Turner, 1979: 81). The Queensland Act was the first specialist National Parks Act in Australia and perhaps the world and, with this and the Tasmanian initiative, Australia stood as an international pioneer in this sphere (Bardwell, 1974: 169). However Turner describes the following period until after World War II as one of legislative inactivity when the early initiative was lost. The only exceptions were the general <u>Land Act</u>, 1933 in Western Australia and the 'highly important but idiosyncratic' Kosciusko State Park Act, in New South Wales. Two waves of legislation since the mid-1950s have remedied the deficiencies which resulted from the 40-year period of inactivity. The first, between 1955 and 1966, saw general legislation (rather than that to create a particular park) passed in the Northern Territory, South Australia and Victoria, with provision for centralised control. The second and most important began with New South Wales' National Parks and Wildlife Act, 1967. In subsequent years all States and Territories remodelled their legislation and administrations, and in 1975 the Commonwealth also became involved by creating an Australian National Parks and Wildlife Service - with limited jurisdiction due to the provisions of the Australian Constitution.

While the passage of comprehensive national park legislation, the great expansion of reserved areas, the establishment of central administrations and the employment of professional staff by national park services in recent decades may be related to the more general growth of environmental concern, the scientific arguments for reservation of representative samples of Australian ecosystems and interest in outdoor recreation in natural settings, the origins of the early ideas to create National Parks and the motivations for the first declarations remain more obscure. In examining early motivations there is clearly the risk of transplanting the conservation ideas of the 1970s into Australian society of the 1870s, and similarly with assuming that the idea was simply an import of the 1872 Yellowstone initiative in the United States. The first parks in New South Wales, South Australia and Western Australia were all close to the main centres of population and were 'urban parks', more likely to have been modelled on the large parks being created on the outskirts of metropolitan London than the remote wilderness of Yellowstone. Turner (1979: 187) argues that in 'genesis and administration The (Royal) National Park was an urban park in the Arcadian tradition of "parkmaking", of improving upon nature, owing more to the British urban parks and formal gardens movement than the Yellowstone innovation of 1872'. Whitelock's (1985: 124) description of Belair is similar:

> The Belair National Park, bisected by a railway, scarred by decades of tree felling, soon to be studded with tennis

courts, groves of exotic trees, kiosks, even a maze, was always more a recreation park, as the current name implies, than a nature sanctuary. Like Sydney's Royal National park, it was seen essentially as a 'people's playground', a bigger, boskier, more relaxed version of a municipal park.

Public health, recreation and enjoyment appear, therefore, as prime motivations for these declarations, with management oriented to these ends involving substantial 'improvement' upon nature - in which the enthusiastic acclimatisers were eager to assist.

If both the goals for, and the management of, these first reservations seem confused by today's standards, it is only through the attempt to interpret them in terms of modern national park philosophy. They were not manifestations of support for nature conservation but remained firmly within the exploitative pioneering ethic. However, in both the North American and Australian instances, the retention of these areas under public ownership was a significant step. Turner (1979: 141) has suggested that early national park legislation was primarily about the ownership of resources, about <u>who</u> would exploit the resources and <u>who</u> would gain the benefit, not whether such resource exploitation should be permitted.

Early in the twentieth century, national park images began to undergo a change related to the favourable aesthetic responses to the landscape associated with Romanticism (most strongly evident in the 'bushwalking conservation movement') and concern for wildlife conservation (which saw in 1909 the founding of the Wildlife Preservation Society of Australia) (Stead, 1949). In addition, organised science also became part of what might be broadly termed the 'National Parks movement', adding a nature conservation focus to the 'primitive area' recreational interest of the bushwalkers. Evidence of the changing images can be seen in two of the early National Park declarations in Queensland: Lamington in 1915 and Bunya Mountains in 1908. Promotion of the idea of a National Park (later named after Lord Lamington, Queensland governor, 1896-1901) in the rainforested McPherson Ranges of south-eastern Queensland by R.M. Collins was in the Romantic tradition, inspired by United States' national park ideas and a visit to Yellowstone. Collins' emphasis was on retaining the natural features of the ranges, rather than on 'improvements' and development associated with the Arcadian ideal (Collins, 1896-7). Reservation of the Bunya Mountains was based on scenic and recreational values partly derived from the presence of the large stand of hoop and bunya pine. The latter, with its distinctive dome-shaped crown and Aboriginal associations had become a colonial curiosity and object of scientific interest. Significantly, the park was declared despite the commercial value of this timber stand.

Nature conservation and outdoor recreation based on the natural environment, rather than improved and developed landscapes, were the national park images promoted by the various National Parks Associations and similar organisations formed in subsequent decades. Victoria had the first National Parks Association in Australia though it was absorbed into the Town Planning Association in 1914, not to re-emerge as a separate association until 1952. The first sustained organisation was formed in Queensland in 1930 by the dynamic Romeo Lahey (Turner, 1979: 88-92). The role of organized science in promoting the national park concept can be traced back to the early field naturalists' organisations such as the South Australian group which was involved in all the early park declarations in that State (Whitelock, 1985). For Kosciusko National Park, Turner (1979) has traced the important role played by the Royal Zoological Society and the Australian Academy of Science, especially in promoting the idea of reserving parts of the park from all human use as reference areas for scientific research. The value of national parks for scientific research especially through zoning which allowed for strict preservation as the primary management goal for particular areas, was most strongly articulated in the post-war period. National parks were seen as being able to make a substantial contribution to the attempts to achieve a national system of reserves covering the major ecosystems of Australia (Australian Academy of Science, 1968; Specht <u>et al</u>., 1974; Fenner, 1975).

There are a number of historical accounts of the establishment of particular national parks. Examples include: Stanley (n.d., 1984) and Stanley and Hutton-Neve (1976) for Kosciusko, Brisbane Water and Royal National Parks in New South Wales; Cordes (1983) for Belair National Park, South Australia; Groom (1949) for Lamington National Park, Queensland; and Jackman-Muir (1982) for Serpentine National Park, Western Australia. These accounts, generally of a narrative type, have value in illustrating some of the common characteristics of national park declarations: the often residual nature of the land involved, the role of citizen advocacy usually involving a small dedicated group, the need for sympathetic politicians and bureaucrats, and the importance of aesthetic and recreational arguments in early park declarations.

CONCLUSION

This review has shown that the environmental interactions of European settlers have not been given sufficient attention in Australian historiography which has focused more on social, political and economic events. It is evident that by the latter part of the nineteenth century some of the landscape impacts of pioneering excesses in resource exploitation were becoming apparent and had begun to bring some reactions on the part of both the better educated (mainly professional) colonial population and those whose interests were being threatened by this unbridled exploitation. Conservation ideas began to be given a hearing and were soon to find their first incorporation in public policy.

Exploitation of the forests and woodlands, and concern for their future, featured prominently in the arguments for wiser use of natural resources. Into this century, bitter public policy battles were fought over continuing land alienation as the establishing forestry profession argued for the demarcation, reservation and professional management of forests - mainly for timber production. In recent times, the management of the diminished native forests has been even more hotly contested as changing community perceptions of forest values have found public and political expression. Some of the recent conflict derives from the withdrawal of forest lands from actual or perceived potential timber production into the national park estate, which now contains 5 million hectares (12%) of the remaining 41 million hectares of native forest. Since the creation of the first national park in Australia in 1879, there have been significant shifts in national park concepts at both official and broader community levels.

From the foregoing, it is possible to make some suggestions for a research agenda for 'conservation ideas and the national park concept in Australia'. These would include:

(i) conservation philosophies - their origins, evolution, impact on public policy and mechanisms of incorporation therein. Specifically, the influence of 'wise use' concepts on Australian public policy needs more investigation, as do the philosophies which have guided environmental groups;

(ii) community perceptions of forest values and appropriate forms of management;

(iii) the origin and evolution of the national park concept in Australia; and

(iv) some specific attention to the conflicts over forest management and the reservation of forest lands in the period since 1960.

As well as the above, there is certainly scope for detailed case studies of particular conservation conflicts and national park declarations, for only in this way will the importance of the variables in environmental policy-making (e.g. images of key actors, institutional settings, issues contested) be unravelled.

REFERENCES

Angus, M., 1975 The World of Olegas Truchanas (Aust. Conservation Fdn, Melbourne).

Australian Academy of Science (Committee on National Parks and Reserves), 1968 National Parks and Reserves in Australia, Report No. 9 (Aust. Acad. Science, Canberra).

Australian Environment Council, 1986 Guide to Environmental Legislation and Administrative Arrangements in Australia, 2nd edn, AEC Report No. 18 (Aust. Govt Publ. Serv., Canberra).

Australian Heritage Commission, 1981 Nomination of Western Tasmania Wilderness National Parks for inclusion on the World Heritage List (Aust. Govt Publ. Serv., Canberra).

Bardwell, S., 1974 The national park movement in Victoria (Ph.D. Thesis, Monash Univ., Melbourne).

Bates, G.M., 1983 Environmental Law in Australia (Butterworths, Sydney).

Birrell, R., 1987 The social origin of Australia's conservation movement, Jnl of Intercultural Studies 8(2): 22-39.

Black, A. and Breckwoldt, R., 1977 Evolution of systems of national park policy-making in Australia, in Leisure and Recreation in Australia, ed. D. Mercer (Sorrett Publ., Melbourne): 190-9.

Blainey, G., 1980 A Land Half Won (Macmillan, Melbourne).

Boden, R. and Baines, G., 1981 National Parks in Australia - origins and future trends, in Outdoor Recreation - Australian Perspectives, ed. D. Mercer (Sorrett Publ., Melbourne): 148-55.

Bolton, G., 1976 The historian as artist and interpreter of the environment, in Man and Landscape in Australia: Towards an Ecological Vision, eds G. Seddon and M Davis (Aust. Govt Publ. Serv., Canberra): 113-24.

Bolton, G., 1981 Spoils and Spoilers: Australians make their environment 1788-1980 (George Allen and Unwin, Sydney).

Breckwoldt, R. (for the National Tree Program), 1986 The Last Stand: Managing Australia's Remnant Forests and Woodlands (Aust. Govt Publ. Serv., Canberra).

Brown, B., 1987 Greening the conservation movement, Habitat Australia 15(6): 8-12.

Carron, L.T., 1980 Self-sufficiency in forest policy in Australia, Australian Forestry 43(3): 203-9.

Clarke, W.B., 1876 Effects of forest vegetation on climate, Jnl and Proc., Royal Society of New South Wales 10: 179-235.

Collins, R.M., 1896-7 The south-eastern highlands of Queensland, Proc. and Trans., Queensland Branch, Royal Geographical Society of Australasia 12: 20-25.

Colong Committee, 1983 How the Rainforest was Saved: the Inside Story of the 10 year Battle (Colong Committee, Sydney).

Cordes, D.D., 1983 The Park at Belair (Island Press, Kingscote).

Cotgrove, S., 1982 Catastrophe or Cornucopia? The Environment, Politics and the Future (John Wiley, Chichester).

Cotgrove, D. and Duff, A., 1980 Environmentalism, middle-class radicalism and politics, Sociological Review 28 (2): 333-51.

Davis, B.W., 1981 Characteristics and influence of the Australian conservation movement: an examination of selected conservation controversies (Ph.D. Thesis, Univ. of Tasmania, Hobart).

Feller, M., Hooley, D., Dreher, T., East, I. and Jung, R., 1979 Wilderness in Victoria: An inventory, Monash Publications in Geography No. 21 (Geography Dept., Monash Univ., Melbourne).

Fenner, F. (Ed), 1975 A National System of Ecological Reserves for Australia, Report No. 19 (Aust. Acad. Science, Canberra).

Figgis, P., 1979 The politics of wilderness conservation in Australia: the movement and the issue (B.A. Hons Thesis, Univ. of Sydney).

Finney, C.M., 1984 To Sail Beyond the Sunset: Natural History in Australia, 1699-1829 (Rigby, Adelaide).

Fitzgerald, R., 1982 From the Dreaming to 1915: A History of Queensland (Univ. of Qld. Press, St Lucia).

Fitzgerald, R., 1984 From 1915 to the early 1980s: A History of Queensland (Univ. of Qld Press, St Lucia).

Frawley, K.J., 1987 Exploring Some Australian Images of Environment, Working Paper 1987/1 (Dept of Geography and Oceanography, Univ. Coll., Aust. Defence Force Acad., Canberra).

Frith, H.J., 1973 Wildlife Conservation (Angus and Robertson, Sydney).

Gee, H. and Fenton, J., 1976 The South West Book: A Tasmanian Wilderness (Aust. Conservation Fdn, Melbourne).

Gilbert, A., 1981 The state and nature in Australia, Australian Cultural History 1: 9-28.

Gilbert, L.A., 1962 Botanical investigation of eastern seaboard Australia 1788-1810 (B.A. Hons thesis, Univ. of New England).

Gilbert, L.A., 1970 Plants, politics and personalities in nineteenth century New South Wales, Jnl Royal Australian Historical Society 56: 15-35.

Gilbert, L.A., 1971 Botanical investigation of New South Wales 1811-1880 (Ph.D. Thesis, Univ. of New England, Armidale).

Goldstein, W. (ed.), 1979 Australia's 100 years of National Parks (National Parks and Wildlife Service [NSW], Sydney).

Green, R., 1981 Battle for the Franklin: Conservations with the Combatants in the Struggle for South West Tasmania (Fontana/Aust. Conservation Fdn, Melbourne).

Groom, A., 1949 One Mountain After Another (Rigby, Adelaide).

Hall, C.M., 1988 The geography of hope: the history, identification and preservation of wilderness in Australia (Ph.D. Thesis, Univ. of New England).

Hardman, M. and Manning, P., n.d. Green Bans: The Story of an Australian Phenomenon (Aust. Conservation Fdn., Melbourne).

Hawes, M. and Heatley, D., 1985 Wilderness Assessment and Management (The Wilderness Society, Hobart).

Hays, S.P., 1959 Conservation and the Gospel of Efficiency: The Progressive Conservation Movement 1890-1920 (Harvard Univ. Press, Massachusetts), Rep. Atheneum, New York, 1979.

Heathcote, R.L., 1965 Back of Bourke: A Study of Land Appraisal and Settlement in Semi-arid Australia (Melbourne Univ. Press, Carlton).

Heathcote, R.L., 1972 The visions of Australia 1770-1970, in Australia as Human Setting, ed. A Rapoport (Angus and Robertson, Sydney): 77-98.

Heathcote, R.L., 1976 Early European perceptions of the Australian landscape: the first hundred years, in Man and Landscape in Australia: Towards an Ecological Vision, eds G. Seddon and M. Davis (Aust. Govt Publ. Serv., Canberra): 29-46.

Helman, P., 1981 Wild and Scenic Rivers: A Preliminary study of New South Wales (National Parks and Wildlife Service [NSW], Sydney).

Helman, P., Jones, A.D., Pigram, J.J.J. and Smith, J.M.B., 1976 Wilderness in Australia: Eastern New South Wales and South Eastern Queensland (Dept of Geography, Univ. of New England, Armidale).

Hoare, M., 1974 Science and scientific associations in eastern Australia 1820-1890 (Ph.D. Thesis, Aust. National Univ., Canberra).

Holloway, G.M., 1986 The Wilderness Society: the Transformation of a Social Movement Organisation, Occ. Paper No. 4 (Dept of Sociology, Univ of Tasmania, Hobart).

Hutton, D. (ed.), 1987 Green Politics in Australia (Angus and Robertson, Sydney).

Hope, R.M., 1974 Report of the National Estate (Aust. Govt Publ. Serv., Canberra).

Jackman-Muir, J.H., 1982 Serpentine National Park: ABbrief History (National Parks Authority, Perth).

Jakubowicz, A., 1984 The green ban movement: urban struggle and class politics, in Australian Urban Politics: Critical Perspectives (Longman Cheshire, Melbourne): 149-66.

Jeans, D.N., 1987 The incorporation of Australia, in Australia - A Geography, 2nd edn, Vol. 2 (Space and Society), ed. D.N. Jeans (Sydney Univ. Press, Sydney).

Johnson, D., 1974 The Alps at the Crossroads: The Quest for an Alpine National Park in Victoria (Victorian National Parks Association, Melbourne).

Lesslie, R.G., Mackey, B.G. and Shulmeister, J., 1988 National Wilderness Inventory: Stage II - Wilderness Quality in Tasmania (Aust. Heritage Comm., Canberra).

Lesslie, R.G. and Taylor, S.G., 1983 Wilderness in South Australia, Occ. Paper No. 1 (Centre for Environmental Studies, Univ. of Adelaide, Adelaide).

Lowe, P. and Goyder, J., 1983 Environmental Groups in Politics (George Allen and Unwin, London).

Marsh, G.P., 1965 Man and Nature: or Physical Geography as Modified by Human Action, ed. D. Lowenthal (Belknap, Harvard), First Publ. New York, 1864.

Marshall, A.J. (ed.), 1966 The Great Extermination (Heinemann, Melbourne).

Martin, V. (ed.), 1982 Wilderness (The Findhorn Press, Moray, Scotland).

McLoughlin, L., 1977 Some Australian images of wilderness (B.A. Hons Thesis, Geography Dept, Sydney Univ.).

Meinig, D.W., 1962 On the Margins of the Good Earth: The South Australian Wheat Frontier 1869-1884 (Rigby, Adelaide).

Mercer, D., 1986 Institutional and Counter-Institutional Forces in Australian Environmental Decision-Making, Working Paper No. 21 (Geography Dept, Monash Univ., Melbourne).

Mills, W.J., 1982 Metaphorical Vision: Changes in Western Attitudes to the Environment, Annals Association American Geographers 72: 237-53.

Mobbs, C.J. (ed.), 1987 *Nature Conservation Reserves in Australia (1986)*, Occ. Paper No. 21 (Aust. National Parks and Wildlife Service, Canberra).

Mosley, J.G., 1972 Towards a history of conservation in Australia, in *Australia as Human Setting*, ed. A. Rapoport (Angus and Robertson, Sydney): 136-154.

Mosley, J.G., 1973 Evolving government policy in land use conflict resolution: the Australian experience (Unpubl. paper ANZAAS Congress, Perth).

Mosley, J.G. (ed.), 1978 *Australia's Wilderness: Conservation Progress and Plans* (Aust. Conservation Fdn, Melbourne).

Mosley, J.G., 1988 The Australian conservation movement, in *The Australian Experience: Essays in Australian Land Settlement and Resource Management*, ed. R.L. Heathcote (Longman Cheshire, Melbourne): 178-88.

Mosley, J.G. and Messer, J. (eds), 1984 *Fighting for Wilderness* (Fontana/Aust. Conservation Fdn, Melbourne).

Moyal, A., 1986 *'A Bright and Savage Land': Scientists in Colonial Australia* (Collins, Sydney).

Mozley Moyal, A. (ed.), 1976 *Scientists in Nineteenth Century Australia: A Documentary History* (Cassell, Melbourne).

Nash, R., 1974 *Wilderness and the American Mind*, Rev. Edn. (Yale Univ. Press, New Haven).

Nicholson, M., 1987 *The New Environmental Age* (Cambridge Univ. Press, Cambridge).

Norton, A., 1886 On the decadence of Australian forests, *Proc. of the Royal Society of Queensland* 3: 15-22.

O'Riordan, T., 1976 *Environmentalism* (Pion, London).

Ovington, J.D., 1980 The parks: a national perspective, in *The Value of National Parks to the Community: Values and ways of improving the contribution of Australian National Parks to the community*, eds J. Messer and J.G. Mosley (Aust. Conservation Fdn, Melbourne): 45-56.

Pepper, D., 1984 *The Roots of Modern Environmentalism* (Croom Helm, London).

Pigram, J., 1986 *Issues in the Management of Australia's Water Resources* (Longman Cheshire, Melbourne).

Powell, J.M., 1972 Images of Australia, 1788-1914, Monash Publications in Geography 3 (Geography Dept., Monash Univ., Melbourne.

Powell, J.M., 1976 Environmental Management in Australia, 1788-1914 (Oxford Univ. Press, Melbourne).

Powell, J.M., 1988 An Historical Geography of Modern Australia, The Restive Fringe (Cambridge Univ. Press, Cambridge).

Prineas, P. and Gold, H., 1983 Wild Places (Kalianna Press, Sydney).

Rainforest Conservation Society of Queensland, 1986 Tropical Rainforests of North Queensland: Their Conservation Significance (Aust. Govt Publ. Serv., Canberra).

Roberts, S., 1924 History of Australian Land Settlement (1788-1920) (Melbourne Univ. Press, Melbourne).

Robertson, R.W., Helman, P. and Davey, A., 1978 Wilderness Management in Australia (School of Applied Science, Canberra Coll. Advanced Educ., Canberra).

Roddewig, R.J., 1978 Green Bans: The Birth of Australian Environmental Politics (Hale and Iremonger, Sydney).

Routley, R. and Routley, V., 1974 The Fight for the Forest: the takeover of Australian forest for pines, woodchips, and intensive forestry, 2nd edn (Research School of Social Sciences, Aust. National Univ., Canberra).

Sandbach, F., 1980 Environment, Ideology and Policy (Blackwell, Oxford).

Schnaiberg, A., 1980 The Environment: from Surplus to Scarcity (Oxford Univ. Press, New York).

Seddon, G., 1982 Eurocentrism and Australian science: some examples, Search 12(12): 446-50.

Seddon, G. and Davis, M. (eds), 1976 Man and Landscape in Australia: Towards an Ecological Vision (Aust. Govt Publ. Serv., Canberra).

Smith, B., 1960 European Vision and the South Pacific 1769-1850 (Oxford Univ. Press, London).

Specht, R.L., Roe, E.M. and Broughton, V.H. (eds), 1974 Conservation of Major Plant Communities in Australia and Papua New Guinea, Aust. Jnl of Botany Supp. No. 7 (CSIRO, Melbourne).

Stanley, H., 1984 The History of the Establishment and Administration of Brisbane Water National Park (National Parks and Wildlife Service [NSW], Sydney).

Stanley, H., n.d. A History of the Establishment of Kosciusko National Park (National Parks and Wildlife Service [NSW], Sydney).

Stanley, H. and Hutton-Neve, M., 1976 History, in Royal National Park, ed. W. Goldstein (National Parks and Wildlife Service [NSW], Sydney): 162-70.

Stead, D.G., 1949 A brief history of the Wild Life Preservation Society of Australia 1909 to 1949, Australian Wildlife 2(2): 33-72.

Thompson, P., 1981 Power in Tasmania (Aust. Conservation Fdn, Melbourne).

Thompson, P., 1984 Bob Brown of the Franklin River (George Allen and Unwin, Sydney).

Thompson, P., 1986 Myles Dunphy: Selected Writings (Ballagrin, Sydney).

Turner, A., 1979 National parks in New South Wales, 1879-1979: Participation, pressure groups and policy (Ph.D. Thesis, Aust. National Univ., Canberra).

Watkins, E., 1984 Ways of seeing nature: attitudes to nature in the Victorian Naturalist 1884-1982, Victorian Naturalist 101(1): 30-47.

Whitelock, D., 1985 Conquest to Conservation: History of Human Impact on the South Australian Environment (Wakefield Press, Netley, Sth Aust.).

Wilderness Working Group, 1986 Report of the Wilderness Working Group (Dept of Planning and Environment [NSW], Sydney).

Wright, J., 1977 The Coral Battleground (Nelson, Melbourne).

Yencken, D.G.D., 1982 The National Estate in 1981: A Report to the Australian Heritage Commission (Aust. Govt Publ. Serv., Canberra).

TIMELESS WILDERNESS? THE USE OF HISTORICAL SOURCE MATERIAL IN UNDERSTANDING ENVIRONMENTAL CHANGE IN GIPPSLAND, VICTORIA

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This paper illustrates the importance of historical research in understanding ecological change in some Victorian landscapes.

By way of introduction, I would like to quote William Hoskins in The Making of the English Landscape:

> The landscape itself, to those who know how to read it aright, is the richest historical record we possess. There are discoveries to be made in it for which no written documents exist, or have ever existed. To write its history requires a combination of documentary research and of fieldwork, of laborious scrambling on foot wherever the trail may lead. The result is a new kind of history ...[1]

Similarly, Professor John Turner argued in May 1975 that the proper study of local history is not man but 'man's home - the landscape in which he lives and works'.[2] He cited Sir Keith Hancock's Discovering Monaro (1972) as a model text on Australian local history in which the historian joins the ecologist to answer the enquiry into how man in Monaro has used the land on which he lives so that, as the supplier of water to the world's driest continent, the region will be used well in the future.[3]

However, at the local level landscape histories are not being compiled. There has been a flood of published histories encouraged by the Victorian sesquicentenary and the Bicentenary celebrations. Ironically, a lot of this research has been made available through the accessibility of public history sources, such as land selection files with their census style forms revealing much social data. The relevance of such archival sources to local history was demonstrated very graphically in the case studies appended to J.M. Powell's 1970 study of settlement and land appraisal in Victoria from 1834 to 1891, The Public Lands of Australia Felix.[4] Also as part of the officially funded sesquicentenary program a 145 page guidebook to historical research in Victoria was published - Local History: A Handbook for Enthusiasts. The section on Land highlights two complementary approaches - the 'magic carpet' overview of patterning; and the specific closer look on the ground at one particular piece of land.[5]

Research tools, the archival finding guides, are now available as keys to unlock the interpretation of landscapes, but the work is not forthcoming. Why don't we want to understand our landscapes?

Landscapes are the products of a host of processes - geological, physiographic, biological, climatic and anthropomorphic, and have been studied from the viewpoint of those disciplines. Yet landscapes are now perceived as public resources; hence, says Jim Davidson, 'the almost philatelic concern of the National Parks Service to complete its set of parks drawn from the 62 major habitat types to be found in the State'.[6] Herein lies the clue - these landscape types are compiled on floristic alliances - botany alone! Selection of park types takes the most representative natural areas, even if exploited in the past. But the park management culture tends to eradicate the memory and relics of past European uses in favour of an image of naturalness and primitiveness.

Davidson believes that the greening (revegetation) of Australia has proceeded hand in hand with a rediscovery of it: through folk music, folk museums and heritage parks, and regional galleries, which all testify both to the acculturation of the countryside and to its increasing integration with urban culture. A spiritual identification with the country has been sought by many, and one indication is the upsurge in rural residential population in the last decade. Yet the vast majority who still live in the metropolis manifest what Geoffrey Dutton believes is the fourth stage in the history of white occupation: 'the love the city people have developed for the land of Australia'.[7] However this love is based on emotion - nostalgia for the supposed good old days and aesthetics - the pretty 'good looks' of a rural idyll, 'the countryside', but not the sunburnt country of harsh sweeping plains. It is also based on a new nationalism arising from the scientific understanding of the Australian bush and the value of its plants - we now accept that those former national heroes, Burke and Wills, died of starvation in a place recognised by Aborigines as a land of plenty. This love is also blind; it wants to see the beloved as natural, a paradise free from the intrusions of everyday life, a landscape unravaged. Its expression is obvious in the nature conservation movement in all its facets. But the historical facts dictate otherwise!

Turner has described Victoria's green mantle before 1800 and then the human impact on it: settlement began in 1835, increased dramatically from 1852 with the gold rushes, and by 1885 about 40 per cent of the State (most of the fertile land) had been alienated from the Crown and partly cleared for agriculture. Alienation, especially in the Mallee and Gippsland, continued rapidly, until by 1920, some 60 per cent of the State was in private ownership. Since that time the rate of alienation has greatly decreased and approximately 38 per cent of the State is still in public ownership.

Thus the present-day man-made landscape of Victoria was largely established between 1855 and 1930, a period of 75 years.[8] In contrast, the landscape of Great Britain as we know it today is the product of the last two thousand years. It is difficult for today's city dwellers, divorced from the natural cycles of the countryside, to realise the rapid and brutal devastation caused by goldmining, uncontrolled timber-getting and the careless attitude towards fire. Early photographs of Walhalla and the Strzeleckis showing denuded hillsides provide sharp contrasts with today's verdant conditions.

If white man's first effect on the green mantle was through the grazing of introduced domesticated cattle and sheep, his major impact was the destruction of forest cover - by the axe, ring-barking and fire. Then came the plough, the introduction of rabbits, foxes and cats, of new crops, alien grasses and weeds and later of fertilisers, and the secondary use of fire in 'burning off' to encourage a 'green pick' and to protect his property from wild fires. The impact of mining was also important in the gold-bearing districts, partly because much of the gold was near the surface and partly because of the extravagant use of timber for fuel used in the recovery of gold from the quartz of the deep mines.

Since the catastrophic state-wide bush fires of 1939 and with greatly improved agricultural techniques on farms and silvicultural practices in the forests, much of the Victorian landscape has greatly mellowed under its regenerated clothing of native vegetation, especially the Eucalyptus species. This has led viewers to perceive a 'virgin bush', untouched and unsullied, and demand legislation and keepers to protect its virtue. But this virtue of 'pristine condition' may be an illusion born of ignorance of the detailed history of the place. A case study of Wilson's Promontory National Park illustrates this.

A Survey of Wilderness Quality in Victoria published in June 1987 was based on the concept 'that wilderness quality is a continuum of remote and natural environmental conditions'. The authors found that most of the smaller areas included in the survey have only low to moderate wilderness quality values, characteristically because of their proximity to settlement, relative accessibility and, in most cases, history of land use. The exception was Wilson's Promontory 'where the major degrading influences are concentrated on the western side, and consequently high wilderness quality values were recorded in the eastern half of the survey area'.[9]

If the eastern coast is today perceived as remote and natural, was it always so?

Wilsons Promontory (Fig. 1), an isolated coastal area was subjected to successive commercial developments in an attempt to utilise its supposed and actual resource base from 1798 to 1936.[10] These developments all had an impact on the local landscape: sealing, whaling, navigational refuge and consequent refuelling stop, timber milling, quarrying, pastoral uses, mining, fishing, recreation and military training. These will now be examined in detail.

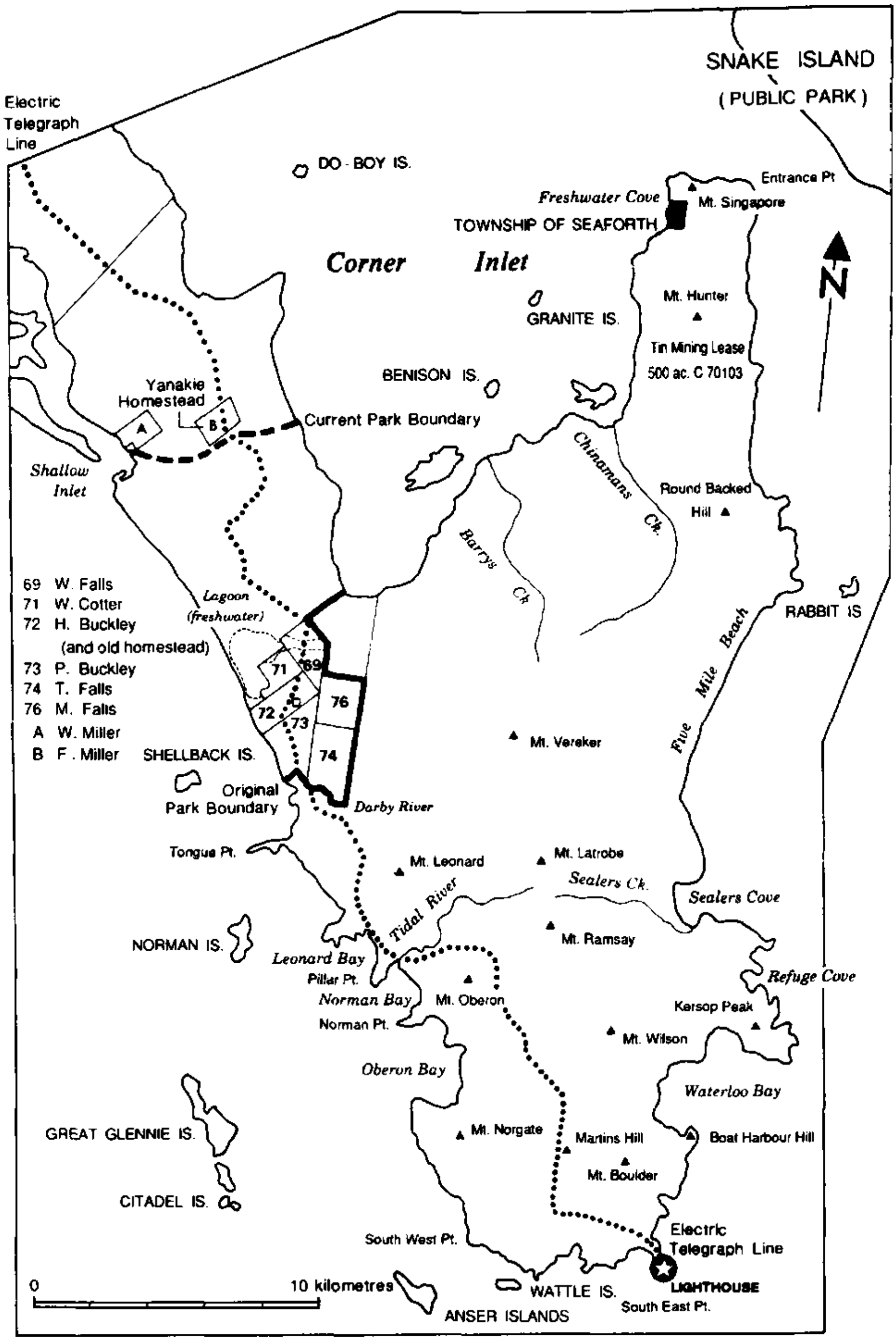

Fig. 1 Wilson's Promontory National Park, showing grazing blocks (1909)

Sealing:

George Bass, on his famous whaleboat journey in January 1798, named Sealers Cove on the east coast of the Promontory 'from the use it may be of to anyone coming here to seal ... there is plenty of fresh water, and wood enough to hand to boil down any quantity of blubber ...'[11] It is well documented that sealing was established soon after in Bass Strait. There are no actual documents written by sealers occupying the Promontory coves, but in 1842 Captain J.L. Stokes found traces of their former occupation - dogs had been left on the nearby islands by sealers, and he had it on some unquoted authority that the rabbits on Rabbit Island 'had multiplied from a single pair turned loose by a praiseworthy sealer six years before'.[12]

In 1846 George Haydon recorded that the remains of a sealer's hut and vegetable garden could be seen on Rabbit Island.[13] There was at least one sealer still operating in the area and shipping the skins out through Port Albert in 1850.

In the 1890s a sealer was reputedly living at Boat Harbour on south Waterloo Bay and sealing on Anser Island but no documentary evidence for this has been found.[14]

Stokes also described the local resources: abundant water and fuel 'on the point abreast of Rabbit Island', fresh rivulets at either end of Five Mile Beach, and trees on the south-western side of this beach which 'were large and measured eight feet in diameter'.[15] These details, published in 1846, help to explain why sealers and whalers had been attracted to the area and why timber millers and steamships' captains were attracted there once settlement was occurring locally.

Navigational refuge:

From the time of Bass's visit, the coves on the east coast of Wilsons Promontory were well known as navigational refuges and Stokes renamed Lady's Bay (Fig. 2) as Refuge Cove (Fig. 3) 'from its being the only place a vessel can find shelter in from the eastward on this side of the Promontory'.[16]

With increased settlement at Port Albert and the need for settlers to have transport to the major towns, the east coast coves became places of trans-shipment. At the end of 1846 the Commissioner of Crown Lands for Gipps' Land, C.J. Tyers, requested that a post office be established on Rabbit Island and suggested that a hotel might be built on the small sandy bay on the north-western side to accommodate people waiting to trans-ship.[17] However this scheme was not favoured officially.

With the advent of steamboats, delays caused by storms led boats to the east coast coves to take on wood for fuel for the steam-engines.[18] This wood gathering must have had an impact on the forested landscape.

Fig. 2 *1843 - Robert Russell sketch of Lady's Bay (now Refuge Cove)*
Source: Mitchell Library, N.S.W.

Fig. 3 *1980 - Commercial fishermen in Refuge Cove (J. Lennon)*

The next official navigational aid was the lighthouse on the south-eastern point, recommended in 1853 and finally completed in 1859 at a cost of £19 500.[19] In 1860 the lighthouse was connected by telegraph line to Fish Creek via Yanakie, Darby River and Mt Oberon, but there are no descriptions given of the state of the bush at that time.

Whaling:

At the same time as the pastoral industry was coming to Gippsland and bringing increased commercial sea traffic, another sea-oriented industry was operating on the shores of Wilsons Promontory - whaling. There are newspaper accounts from 1841 of the ships involved and their catches.[20]

Captain J. Lort Stokes described:

> ...a whaling establishment in the South West corner (of Refuge Cove) and the houses for the boats and their crews formed quite a little village. The person in charge, with one or two others, remains during the summer.[21]

H.B. Morris, a passenger on the yacht 'Midge' described the Lady's Bay whaling establishment in June 1843: 'huts still stand and piles of enormous whalebones strew the shore, showing the success of former occupants'.[22] Another passenger was Robert Russell, a Melbourne surveyor, who made the first sketch recorded of a building on Wilsons Promontory. It is entitled 'Whaler's Huts - Lady's Bay' and dated May 2nd.[23] He also notes that the huts were 'built by Dr Imlay's men' from Twofold Bay, New South Wales.

George Haydon, who was a member of the expedition that drove the first cattle overland to Port Albert in 1844, noted that each of the safe harbours on the east coast had been occupied by whaling stations: 'They are still favourite cruising places for the colonial whalers, many tons of oil being procured here annually.'[24]

The last recorded on-shore whaling party was in August 1847, but whether the shore station continued to process whales brought in from off-shore is not known.

Timber milling:

By 1849 Port Albert merchants were running a timber milling business at Sealers Cove.[25] Bullocks and supplies for the splitters were landed, while staves, samples of wood and 'sassafras tree' leaves were taken off. A pit-saw was installed in September 1850. By the end of October, there was a build-up of 45 000 staves cut in the bush, 5 000 laths and 1 000 posts and rails waiting transport to the Melbourne market. There was also an overseer and ten splitters.

During 1851, a recorded total of 59 170 staves, 1 650 spokes and felloes, 3 300 posts and rails and 21 pieces of lightwood were shipped out of Sealers Cove; this excludes any timber shipped to Port Albert for use by up-country squatters.

There are no known records of any shipments of timber during 1852, but in 1853 there are many. However a significant change in type had occurred: the majority of shipments were of sawn timber, presumably from a primitive saw-mill, rather than staves. The timber was also carried in larger vessels, schooners of about 160 tons, not cutters. The total recorded amount shipped in 1853 was 464 928 ft of sawn timber and 20 000 ft of battens.

During 1854, the total recorded amount of timber shipped out almost doubled to 867 319 ft. Passenger movement was also recorded in the Shipping Intelligence columns of the newspapers and one notable passenger from Sealers Cove was Dr Ferdinand von Mueller, Victoria's first Government Botanist, who arrived back in Melbourne on 21 August 1854. He had also visited the Prom. in 1853, collecting plant specimens subsequently recorded in Bentham's <u>Flora Australiensis</u>.

The increased shipments necessitated an increased labour force and the 1854 Census recorded 53 men and 8 women at Sealers Cove a large community for a sawmilling establishment even by today's standards.

With the increased demand for timber in Melbourne and on the goldfields, it was now profitable to establish other mills in the vicinity and from July 1854 a recorded total of 64 000 ft of timber (including 6 000 ft of blackwood) was shipped from Franklin River. The Steep Bank sawmills on the Steep Bank (later Franklin) River were established in 1855 by Septimus Martin, who selected that site 'because the timber was close to my hand'.[26] During 1855, the amount of timber shipped out of the Franklin trebled and this competition, plus foreign imports, probably account for the declining amount shipped from Sealer's Cove - 261 664 ft and 8 000 laths. This amount was halved again in 1856.

In 1857 Turnbull, the Port Albert merchant, wrote to his Hobart agent asking for 5 or six pairs of splitters to work at Sealers Cove and during 1857, 115 piles and 4 900 posts and rails were recorded as being shipped to Melbourne consigned by William Buchanan to Turnbull Bros. At the same time local schooners were shipping timber to Port Albert.

However in 1858 the whole sawmilling industry in Corner Inlet underwent a change as a result of new management - the Franklin River mills were bought by Messrs Turnbull, Buchanan and Co., Patrick & George Turnbull of Melbourne and William Buchanan of Sealers Cove. No further shipments of timber from Sealers Cove were recorded; presumably the tall, marketable timber had been cut out over the previous ten years when the gold rushes created such a voracious demand.

The local newspaper noted in September 1858 that Mr Buchanan, 'who had been long resident in Sealers Cove, had for his own purpose constructed 17 miles of tramway at a cost of 300 pounds per mile'.[27] This suggests that timber-cutting was carried out some distance inland - a line would have been topographically feasible to the foothills of Mt Ramsay and Mt Latrobe. A reticulate network crossing and recrossing gullies would account for the mileage, as Mt Latrobe is only three miles inland from Sealers Cove as the crow flies. Such an extensive network must have allowed timber-cutting throughout the flat swampy areas and lower slopes of the mountains and have caused a significant alteration of the landscape.

Part of the tramway and plant at the Cove were dismantled by William Buchanan and removed to the Little (Agnes) River, where they linked with a new mill at Muddy Creek (present-day Toora). In the first half of 1860, 33 vessels loaded railway sleepers, piles and scantlings from this mill. Approximately 17 000 railway sleepers valued at £7 000 were shipped direct to Karachi.

The increased shipping activity within Corner Inlet and direct to other ports necessitated the appointment of a customs officer and pilot, Charles Petersen, who was stationed at Biddy's Camp, at the foot of Mt Singapore from 1 January 1859. Petersen and family probably account for some of the six males and three females listed in the 1861 Census as being resident on Wilson's Promontory.

With the relocation of sawmilling from Sealers Cove, other resources of Wilsons Promontory were developed but none resulted in economic or settlement activity equal in impact to the 1849-1858 timber milling period. Figures 4 and 5 show Sealers Cove in 1906 and 1980.

Quarrying:

A quarry operated at Refuge Cove from 1859 until 1863, procuring granite for shipment to Port Albert and Tarraville for road-making purposes. Presumably after the road contracts were finished the quarry fell into disuse for there are no further records of its use.[28]

Pastoralism:

During the period of timber milling and quarrying, Wilsons Promontory was also used for pastoral purposes. The runs were held by the Turnbull Bros. and carried very low numbers of stock, presumably as the fresh meat supply for the timber splitters at Sealers Cove and for the three man police station at Tanakie from 1851 to 1857.

The three runs, totalling 38 400 acres, were forfeited by the Turnbulls in 1863, when the provisions of the Duffy Land Act of 1862 led to increased rentals. Significantly, the Sealers Cove timber mill had already closed by this date.[29]

In 1865 the Sealers Cove run was taken up by John Baragwanath, who had been master of various schooners in the Port Albert to Hobart Town cattle trade. His obituary notice in the

Fig. 4 c.1906 - Sealers Cove showing jetty and sawmiller's house (Mr P. Parker King)

Fig. 5 1980 - Sealers Cove showing remnants of jetty stumps at low tide

Gippsland Standard of 14 May 1912 recorded that he had a cattle run on the Promontory for five years, when there was only one other family there, and that they enjoyed swimming at Sealers Cove, where the homestead was situated on a northern bluff. The site of this homestead has not been identified.[30]

Under the Duffy Land Act of 1865, the runs were reconstituted and the South Corner Inlet, or Yanakie, run was held by William Miller and Mr Noyes, while Robert Turnbull renewed his interest in Wilson's Promontory. The names and areas of the runs on the Prom. changed frequently during this period. However there was no incentive to buy the freehold as the land was extremely poor and not well suited for grazing, and cattle were liable to the 'coast disease'. The area was also too isolated from major markets.

After 1870 poor quality runs fell into disuse and only properties which showed some promise, like Yanakie, survived. By 1890 Yanakie was a very profitable sheep station run by W. Miller.

The impact of grazing and associated burning off has radically changed the vegetation pattern. The first 'raging bushfire' recorded on the Promontory was in January 1863, when the captain of a passing steamer reported that the heat was so great that he could scarcely stand on deck although two and a half miles offshore.[31] Pastoralists later burnt off to encourage green pick for stock. However close nibbling by sheep and deer introduced by the Acclimatization Society in April 1864[32], also had a dramatic impact on the dune grass associations and coastal scrub of the Yanakie Isthmus where sand blowouts were initiated and spread inland. J.B. Gregory recorded in 1885 that 'thousands of acres of Yanakie Station were swallowed up by the dunes and they threaten to cover the whole of it'.[33]

Mining:

The gold fever rampant in Gippsland during the 1860s did not bypass the Promontory. In May 1866, William Buchanan and syndicate applied for a gold-mining lease of 25 acres on Mt Singapore, about two miles from the water's edge. A three-roomed corrugated-iron house, surrounded by a 'hideous fence of dead honeysuckle', was located midway between Mts Singapore and Hunter. However, despite sinking two shafts, the area proved non-productive and by 1870 all gold-mining activity was concentrated across Corner Inlet at the Stockyard Creek (Foster) rush.[34]

Good indications of tin were found but it was not mined until the 'national interest' demanded its exploitation towards the end of World War I. The matter became a public issue with the Age newspaper supporting the would-be mining company and the Argus supporting the new national park supporters. The Argus of 3 September 1918 expressed hope that Cabinet would not grant leases and quoted American parallels as a precedent, mining being forbidden in national parks there. Cabinet compromised and granted permission to prospect 'under supervision'. It would grant a mining lease only if it could be shown to be a national asset.

A geologist accompanying the prospecting team left an unfavourable account, emphasising the unevenness of deposits, variable ore yields, the necessity to sink shafts and import timber for these, and the necessity to pump water up from the sea for the mining operation itself. It seems, therefore, that the issue was largely political and reports in the Age much exaggerated. However in January 1920 three twelve-month leases were granted and the mine operated until 1936.[35] Photographs of the mine show a very open landscape compared with the impenetrable Hakea thickets of today (Figs 6, 7).

Fishing:

Fishing was another industry which flourished at various times around the Promontory shores. Chinese were involved in fishing and the names Chinamen's Creek, Long Chinamen's Beach and Johnny Souey Cove bear witness to this. From 1865 until 1868 coastal steamers called at Sealers Cove for wicker baskets of live fish (whiting, mullet and pike) and bags of smoked cured fish. There were eight different consignees listed but irregular steamship communication was blamed for driving away the trade. It is not known for how long the Chinese occupied the shores but their impact on the landscape was minimal.[36]

Commercial fishermen from Port Welshpool were granted permission to erect fish-pens in Refuge Cove in 1913 to keep fish alive in the non-migratory winter season on condition that they did not breach any of the national park regulations.[37]

The final battle : Commercial development versus conservation:

Following an overland journey to Wilsons Promontory lighthouse in 1884, J.B. Gregory suggested reserving the Promontory as a national park to safeguard its natural scenic grandeur, calling it 'the Cornwall of Victoria'.[38]

The concept of a national park was not new in Victoria. In 1866 an area of 597 hectares near Warrnambool was set aside as a public park to preserve its outstanding geological features. This area encompassing Tower Hill was given the status of a national park in 1892 by a special Act of Parliament and thereby became Victoria's first 'national park'.[39] In New South Wales, The National Park (now Royal National Park) of 18 000 acres of rugged scenery just south of Sydney was dedicated in April 1879. This was the second national park established in the world, but set aside as 'a sanctuary for the pale-faced Sydneyites fleeing the pollution - physical, mental and social - of that densely packed city' rather than with the romantic rhetoric surrounding the establishment of Yellowstone National Park in the U.S.A. in 1872.[40] The Field Naturalists' Club of Victoria was concerned to have large areas set aside similar to those in New South Wales.[41]

Fig. 6 1924-5 - Mt Hunter tin mine, Wilson's Promontory

Fig. 7 1974 - Mt Hunter tin mine site showing dense regrowth

In 1887 Gregory's suggestion was put before the Field Naturalists' Club, which enthusiastically commenced agitation to make the Promontory a reserve. This needed immediate action as a counter proposal had already been submitted to the Government to settle 1 000 Skye crofters on the Promontory. However fishermen from Queenscliff to the Gippsland Lakes united in opposition to this proposal. The Minister for Lands refused the settlement request and said he looked forward to the locality becoming a maritime resort for the people of Victoria.[42]

Meanwhile, Victoria was enjoying an economic boom and land speculation and tourism were in vogue. An auction advertisement for Liverpool township on the Franklin River described it in 1888 as 'the principal port in the Inlet, where all must embark for Wilson's Promontory, the future Peoples' Park, the sanitorium of Victoria, the most picturesque spot in the Colony ...'[43] Local steamboat companies also advertised 'the people's picnic and marine excursion' to the east coast coves and a brass band from Melbourne 'will play any music required by dancers on shore on arrival at Sealer's Cove'.[44]

In 1890 the Field Naturalists sent a second deputation to the Minister for Lands asking for the reservation of the Promontory. Eventually, in November 1898, the temporary reservation of 91 000 acres as a sanctuary for native flora and fauna and a site for a national park was gazetted.[45]

This did not deter the incursions of timber millers at Sealers Cove. In 1903, Messrs P. King of Metung and Robert W. McCulloch of Lakes Entrance formed a partnership to install a sawmill at Sealers Cove. A milling plant was purchased from Widdis Bros of Lake Tyers and transferred to the Cove by a sailing ketch the <u>Ethel B.T.</u>, owned and commanded by Captain Limscow. A canvas village was made to accommodate the millhands and then work began to build the mill and a pier 800 ft out into the Cove. Approximately 40 people lived at Sealers from 1903 to 1906: the McCulloch, Gilbert, Walmsley, Marshall and Mozen families plus single millhands. The Collingwood family ran a boarding-house. Each family had its own house and there were six huts for millhands, a community hall, an office and workshops - a total of 16 buildings.

The logs, mainly of blue gum, myrtle and blackwood, were hauled to the tramline at first by horses and then by bullocks. Then they were hauled along the tramline by steam winch. Logs were cut in the sawmill and railed along the pier to be loaded onto the Huddart Parker steamships trading between the Gippsland coast and Melbourne, namely, the <u>Wyrallah, Despatch</u> and <u>Queenscliffe</u>. At the end of 1906 a bushfire swept into the Cove and burnt out the mill and settlement except for the hall and pier. Timber-milling was discontinued.[46] The pier was repaired in 1908 and used by small coastal steamers which called in for water for their engine boilers and wood as their coal ran out battling against heavy seas and gales trying to round the Prom.[47]

The government's own Lands Department surveyed 5 000 acres on the Singapore Peninsula in 1892 and gazetted the township of Seaforth. All the building lots were sold at auction in Melbourne on 7 June 1892, at prices ranging from £15 to £55, but nothing was built and in 1906 A.D. Hardy assessed that 'the township, except for the Gazette notices and the overgrown survey marks, is a myth'.[48]

During September 1904, rumours circulated that Wilsons Promontory would be sub-divided into grazing blocks. Sir Baldwin Spencer, Professor of Biology at the University of Melbourne and President of the Royal Society, headed a deputation of protest to the Minister for Lands and they were successful in scotching the lease. Spencer campaigned tirelessly to obtain a permanent reservation for a larger area, with control of the park vested in trustees and a resident ranger as custodian. The united pressure of all the scientific societies and several public figures (including Sir John Madden, Speaker of the Legislative Assembly) finally triumphed.[49]

In March 1905 the permanent reservation of 75 000 acres as a national park was gazetted, but the entire coastal strip up to half a mile inland and the Seaforth Reserve were excluded from the park and classed by the Minister as 'temporarily reserved'.

Conservationists found this situation intolerable as they claimed that it was impracticable for a trust authority to exert control over the reserve when it did not have control of the beaches surrounding it. Early in 1908, James W. Barrett wrote an article in the Argus which was subsequently reprinted in the March 1908 edition of The Foster Mirror. After giving directions to the park and describing the scenery, he discussed its current condition:

> The park is let on a grazing lease by the Government. The Park has just been thoroughly burnt from end to end. The fine timber at Sealer's Cove has gone, and doubtless most of the native bears and other animals have gone with it. The scrub has gone. The Promontory now presents a piebald appearance - numerous green patches alternate with patches of blackened sand or bare charred timber.
>
> Either the national park is a park or a cattle run, it cannot be both. Put an end to the vandalism going on at Wilson's Promontory.

In May 1908, His Excellency the Governor Sir Reginald Talbot sailed across to Wilsons Promontory and rode across to the lighthouse. There was extensive newspaper coverage of this visit and park management proposals. The visit was a success because in June 1908 grazing licences for six selections held by three tenants were cancelled three years before they were due to expire. Arrangements were made for the appointment of trustees to take over the national park as soon as the stock were removed.[50]

In October 1908, over 20 years after the idea of reserving the Prom. was first mooted, regulations were gazetted for the care, protection and management of Wilsons Promontory National Park. The regulations stipulated a rabbit-proof fence across the reserve's land boundary. The carrying of firearms, the landing of dogs, and any interference with native flora and fauna were prohibited. Tourists wanting to camp had to apply to the Honorary Secretary, Mr J. Kershaw of the National Museum in Melbourne, for a permit. In 1909 the first ranger was appointed - Charles McLennan, an enthusiastic naturalist and frequent contributor to 'Nature Notes' in the Argus.[51]

Early National Park Landscape:

Barrett's description of fire effects also mentions the loss of timber and scrub. Kenyon commented on the ease of travel of the 1906 Field Naturalists' Club excursion from bay to bay through 'comparatively open-timbered country'. Today, the dense coastal scrub makes this impossible except via constructed tracks.

Prior to 1913, the country between the landing jetty at south-west Corner Inlet and the ranger's house at Darby River used to be covered with forest: 'a thickly timbered flat, extending across to the tree-covered sand dunes which margin the ocean beach. Most of the timber which consists principally of fair size eucalyptus, with a few scattered blackwoods, has been ringed, their whitened skeletons remaining to show what had once been'.[51]

A series of biological surveys were carried out and written up by A.J. Ewart in the Victorian Naturalist between 1909 and 1911. It was found that Wilsons Promontory supported 600 flowering plants and ferns, 550 of which were native species. These surveys provide data to describe spot changes. For example, prior to 1927 Pillar Point, which is a granite outcrop with a thin covering of granitic sands and leaf-mould, was heavily timbered with tall eucalypts, including some magnificent blue gums; but a fire swept down from Yanakie to Tidal River, where a change of wind caused it to burn the vegetation on the whole of Pillar Point, reducing the forest to ash.[53] Today the area is covered in impenetrable tall to low scrub.

In 1913, W. Cripps succeeded McLennan as ranger and a building program was initiated. Rest huts were erected - one at Vereker Landing (to-day named Millers Landing in honour of Alf Miller, who succeeded Cripps and remained a ranger for nearly 30 years until 1940) and the other at Darby River. The Committee of Management built a three-roomed cottage at Darby River for official use. The Postmaster General's Department also had a hut there for the telegraph linesman. In 1922 the Committee hut was extended into a chalet to accommodate 30 persons on the north bank (where the CRB camp demolished in 1970 stood). Approximately 14 horses were kept for visitors to ride along the various tracks and to the lighthouse. Huts were also built at Sealers Cove and Tidal River and in 1927-28 130 camping permits were issued.[54]

In the 1920s a £1 444 contract was finally let to build the rabbit-proof park boundary fence. The logs, approximately six feet in length, used in construction were split on the Vereker Range and dragged by horse down to the fence, which was finished with nine strands of barbed wire and four foot six inch netting.[55] A section of this original fence remains adjacent to the Millers Landing Nature Walk.

Mid-century landscape:

An aerodrome area of 400 acres was levelled between 1935 and 1939 and a road was constructed to the Darby River chalet, opening in February 1939. World War II broke out soon after and the park was closed to visitors until 1 February 1946.

In February 1941 the No. 7 Infantry Training Centre for army commandos was established, with headquarters at the Darby River chalet and two independent camps at Tidal River. After much debate, the Committee of Management decided to shift the park headquarters in 1946 (after the War) from Darby River to the commando camp site at Tidal River. In their first post-war development plans, top priority was given to reafforestation, as much tea-tree at Tidal River had been destroyed by military manoeuvres. A store and post office opened in December 1947 and a campers' lounge and cabins soon after.[56]

During a Royal Commission into forest grazing in 1947, Judge Stretton observed that the park on Wilson's Promontory was 'a ghost of its former self'.[57] This was the result of fire and grazing.

But in 1951 wild fire raged for about a week over 75 per cent of the national park causing major landscape changes. Lilly Pilly Gully, one of the show places of the Prom., a fern-filled cathedral, was burnt open to the sky. In many areas where fires have continually recurred it has been found that species of Hakea have spread widely, choking the heathland community almost out of existence. In other areas the repeated burnings have prevented reseeding by the new growth and the habitat has been drastically altered.[58]

Many places on the Promontory exhibit these alterations today. Forests have been replaced by woodlands, and woodlands by thickets, heathlands and grasslands. The vegetation cover on the Promontory today is more dense than it has ever been since the first European descriptions. The regeneration is so thick on almost 90 per cent of the montane areas, the slopes and even the heathlands and thickets, that it is very difficult to even push one's way through the foliage.

Conclusion:

A wilderness? The eastern part of Wilsons Promontory is perceived currently by conservationists as a wilderness due largely to management over the last 30 years which has allowed natural regrowth of the forest. The 1987 management objectives for the national park state that the natural environment and landscape values of the Park will be protected and that natural processes will be allowed to continue with a minimum of disturbance, except where habitat manipulation is proved to be desirable.[59] Historical evidence of previous activities, such as on-shore whaling and timber-mill sites will require such site-specific manipulation as the field evidence is being obliterated over time by natural regrowth and recreation activities at these sites.

A large section of the public (uninformed and urban-based) do not want to know the facts of the more recent past - the 200 years of European impact on the landscape - and appear to see national parks as primitive/primeval places with 40 000 years of sensitive Aboriginal occupation in harmony with the ancient landscape. This attitude links the new 'naturalists', the urban conservationists, with the Aboriginals and their land rights causes in a new environmental nationalism. But it is a romantic view not borne out by the scientific and historical facts. David Lowenthal has argued, in The Past is a Foreign Country, that the enormous popularity of reconstructed 'landscapes that we never knew, but wish we had' suggests refusal to face up to the dilemmas of the present.[60] It is to this present that we direct the results of our forest history research.

Currently, the time is right in Australia for the 'new history' described by Hoskins in 1955. In his Archaeology of Untouched Wildernesses, Iain Stuart has developed the notion of 'cultural landscape' for a landscape in the Upper Delegate River catchment of eastern Victoria, where after an early grazing phrase the area was mined extensively and remains of both uses are still evident, in flora and in archaeological sites. Nevertheless the area is widely perceived as being a wilderness and this is a pivotal argument currently for its conservation as a natural forest. Similarly, botanists have provided information to the conservation lobby which results in newspaper headlines like 'Logging Hits Forest Harder than Ice Age, Study Shows.'[61] Yet this report, derived from pollen analysis of bogs, was based on faulty interpretation of the data - the research ignored the early European pastoral and mining history which resulted in marked vegetation and soil disturbance of the area for a short time.

Historical research allows us to determine the sequence of occupation and the effects of that occupation on the landscape. This information then enables us to read or interpret the existing landscape (Hoskin's 'new history'). This interpretation can then be used to predict likely impacts because of the knowledge of past cycles and resultant patterns. For example, park managers could use historical data in working out more detailed land unit management objectives such as habitat manipulation or in monitoring the effects of fire on the landscape. Historical research is an essential component of the natural resource management planning process.

Historical evidence helps us to understand the current condition of the land and realise that humans have been and continue to be an ecological agent in the landscape. It is deception to promote static concepts such as 'pristine wilderness' in a constantly changing native forest landscape. Appearances are deceptive!

NOTES

1. W.G. Hoskins, The Making of the English Landscape, Hodder & Stroughton, London, 1955, p. 14.

2. John Turner, The Proper Study of Mankind, The Victorian Historical Journal, vol. 46, no. 3, Aug. 1975, p. 463.

3. W.K. Hancock, Discovering Monaro, A Study of Man's Impact on his Environment, Cambridge Uni. Press, Cambridge, 1972, p. 14.

4. J.M. Powell, The Public Lands of Australia Felix, Oxford Uni. Press, Melbourne, 1970, pp. 267-280.

5. G.M. Hibbins, C. Fahey and M.R. Askew, Local History: A Handbook for Enthusiasts, George Allen & Unwin, Sydney, 1985, pp. 30-83.

6. Jim Davidson, Victoria, in The Heritage of Australia, Macmillan/Aust. Heritage Commission, Melbourne, 1981, pp. 3-7.

7. ibid.

8. John Turner, op.cit., pp. 468-9.

9. Kathy Preece and Rob Leslie, A Survey of Wilderness Quality in Victoria, A report to the Ministry for Planning and Environment Victoria and the Australian Heritage Commission, June 1987, p. viii.

10 . Jane Lennon, Wilson's Promontory in Victoria, Its Commercial Utilisation in the 19th Century, The Victorian Historical Magazine, vol. 45, no. 4, Nov. 1974, pp. 179-200.

11. G. Bass, Voyage in a Whale Boat, Historical Records of N.S.W., vol. 3, 1895, p. 326.

12. J. Lort Stokes, Discoveries in Australia, T. & W. Boone, London, vol. 2, 1846, p. 426.

13. G. Haydon, Five Years Experience in Australia Felix, London, 1846, p. 51.

14. Mr Harry Miles was the sealer, Pers. comm. Pt. Franklin fishermen, Dec. 1980.

15. J. Lort Stokes, op. cit., p. 429.

16. ibid.

17. Colonial Secretary's Inwards Correspondence, letter no. 47/95, from C.J. Tyers, 21 Dec. 1846.

18. Port Phillip Gazette, 30 June 1841, report on the steamer Aphrasia; Gippsland Guardian 27 May 1859 re Shandon.

19. Parliamentary Papers, Legislative Council of Victoria, vol. 1, 1853. Report of the Select Committee of the Legislative Council on Lighthouses, p. 12, Appendix C; vol. 4, 1856-7, Australian Lighthouses: further correspondence relating to the lighthouses on the Australian coast, pp. 8-9.

20. Jane Lennon, op. cit., p. 183.

21. J. Lort Stokes, op. cit., p. 430.

22. H.B. Morris, A Trip to Gippsland in April, 1843, Hobart Town Courier, 23 June 1843.

23. The original pencil sketches by Robert Russell are in Mitchell Library, Sydney.

24. G. Haydon, op. cit., p. 51.

25. The detailed sources on timber milling are found in Jane Lennon, op. cit., pp. 185-192.

26. Votes and Proceedings of the Victorian Legislative Assembly, 1856-7, return no. 27, p. 9.

27. Gipps Land Guardian, 24 September 1858.

28. Lane Lennon, op. cit., pp. 192-3.

29. ibid., pp. 193-4.

30. Victoria Archaeological Survey, Newsletter, July 1987, p. 12. A school play based on Anne Baragwanath's life at Sealers Cove and entitled 'The Box of Matches' was printed in the Victorian Education Department School Paper for Grades 7 and 8, no. 624, 1 Sept. 1954, p. 121.

31. Gipps Land Guardian, 16 Jan. 1863, report from Captain Walker of SS. City of Melbourne.

32. ibid., 8 April 1864.

33. J.B. Gregory, To Wilson's Promontory Overland, Victorian Naturalist, no. 4, Aug. 1886, p. 447.

34. Jane Lennon, op. cit., p. 195.

35. P.J.F. Coutts, The Archaeology of Wilson's Promontory, Master of Arts thesis, A.N.U., May 1967, pp. 323-7.

36. Jane Lennon, op. cit., pp. 195-7.

37. VPRS No. 242, letter from Mr C. Anderson, Port Welshpool dated 28 Sept. 1912; letters C5711 and C57514.

38. J.B. Gregory, op. cit., vol. 2, no. 12, April 1886 pp. 154.

39. Anon., Victorian Year Book 1975, p. 2.

40. Carolyn Pettigrew and Mark Lyons, Royal National Park - A History, Australia's 100 Years of National Parks, Parks and Wildlife, vol. 2, Apr. 1979, p. 18.

41. Sandra Bardwell, National Parks in Victoria: 1866-1956, Ph.D. thesis, Monash University, 1974, p. 383.

42. The proposal to settle Skye crofters is described in more detail in Jane Lennon, op. cit., pp. 198-199.

43. Yarram Chronicle, 20 April 1888.

44. Gippsland Standard, 31 March 1888.

45. The campaign for declaration as a national park is summarised by T.S. Hall, Wilson's Promontory as a National Park, Victorian Naturalist. vol. 21, no. 9, 1905, pp. 128-131.

46. Letter from W. McCulloch to W. Thomson, Fish Creek dated 10 May 1967 and accompanieed by sketch of settlement layout.

47. Memoirs of Mr Arnie Smith, Port Welshpool, 1970.

48. A.D. Hardy, Excursion to Wilson's Promontory, Victorian Naturalist, vol. 22, No. 12, 1906, p. 106.

49. D.J. Mulvaney and J.H. Calaby, So Much That Is New, Baldwin Spencer, 1860-1929, A Biography, Melbourne Univ. Press, Melbourne, 1985, pp. 259-60.

50. John Noonan and Anne Fraser, Of Wamman and Yanakie, 1969, Foster, pp. 16-18.

51. ibid., p. 19.

52. Victorian Naturalist, 1913, vol. 29, no. 9, p. 171.

53. Roy P. Cooper, Wilson's Promontory National Park and Its Avifauna, Melbourne, 1975, p. 11.

54. John Noonan and Anne Fraser, op. cit., pp. 20-21.

55. ibid., p. 22.

56. L.M. Smith, Wilson's Promontory, The Etruscan, No. 1965, vol. 13, no. 3, pp. 1-6.

57. Quoted in Tony Dingle, _Settling_, Vol. 2 of _The Victorians_, Fairfax, Syme and Weldon, Melbourne, 1984, p. 247.

58. Roy P. Cooper, _op. cit_., pp. 10, 12.

59. _Wilson's Promontory National Park Management Plan_, National Parks Service, Dept. Conservation Forests and Lands, Melbourne, 1987, p. 37.

60. David Lowenthal, _The Past is a Foreign Country_, Cambridge Uni. Press, New York, 1985, p. 13.

61. _Age_, 18 July 1987, p. 1

THE 'WORTHLESS LANDS HYPOTHESIS' AND AUSTRALIA'S NATIONAL PARKS AND RESERVES

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'Nothing dollarable is safe, however guarded' - John Muir

INTRODUCTION

One of the most fascinating controversies in the study of American conservation history in recent years has been centred around the proposition that national parks were, and to a certain extent still are, created because they were regarded as 'worthless lands' (Cox, 1983; Runte, 1972, 1973, 1977, 1979, 1983; Sellars, 1983; Utley, 1983; Winks, 1983; Journal of Forest History, 1984). The purpose of the present paper is to examine the applicability of the 'worthless lands' hypothesis to the creation of national parks in Australia. The paper is divided into three sections. First, a review of the 'worthless lands hypothesis'. Second, an examination of the factors that led to the creation of national parks in Australia. Third, a discussion of present day park creation and management policies and the applicability of the 'worthless lands' hypothesis to the Australian situation.

THE 'WORTHLESS LANDS' HYPOTHESIS

Undoubtedly, the most pervasive form of opposition to the creation of national parks in both the nineteenth and twentieth centuries has been that based upon materialistic values. As Hampton, (1981; 45) has observed regarding the establishment of national parks in the United States:

> In the nineteenth century a sceptical Congress had to be assured that proposed parks contained nothing of exploitable value. In the twentieth century materialistic opponents have operated most efficiently in blocking extensions of older parks and modifying boundaries and provisions of ingress in the new ones.

The strength of the materialistic opposition to national parks stands in clear opposition to the idealism and altruism of the national park idea. Indeed, it has come to be argued that the dominance of material over aesthetic and ecological values was such that national parks were only designated on land which was regarded as waste or as worthless. The clearest expression of the notion that natural, as opposed to cultural, national parks were created because they were regarded as 'worthless' lands comes from the work of Alfred Runte. According to Runte (1973: 5):

> An abundance of public land that seemed worthless - not environmental concern or aesthetic appreciation - made possible the establishment of most national parks in the United States. Nothing else can explain how aesthetic conservationists, who in the past have represented only a small minority of Americans, were able to achieve some success in a nation dominated by a firm commitment to industrial achievement and the exploitation of resources. A surplus of marginal public land enabled the United States to 'afford' aesthetic conservation; national parks protected only such areas as were considered valueless for profitable lumbering, mining, grazing, or agriculture. Indeed, throughout the history of the national parks, the concept of 'useless' scenery has virtually determined which areas the nation would protect and how it would protect them.

Runte's 'worthless lands' argument arose from the very first speech in Congress which contained elements of the national park idea. Senator John Conness of California on introducing a bill to cede Yosemite to the State of California as a park noted, somewhat paradoxically, that the location in the Sierra Nevada mountains was 'for all public purposes worthless (my emphasis), but which constitute, perhaps, some of the greatest wonders in the world' (Congressional Globe, 38th Congress, 1st session, May 17, 1864: 300 in Runte, 1979: 48-49). The speech reflected the dominant utilitarian attitude of the time: 'The wording reassured Conness's colleagues that no universally recognized alternative to preservation had been detected in the Yosemites' and, hence, they 'certainly could afford to recognize the valley for its substantial "intrinsic" worth' (Runte, 1983: 135).

The first national parks were national monuments, regarded as natural expressions of American independence from the Old World (Sax, 1976). An abundance of monumental scenery was the most important criteria for the establishment of a park. However an abundance of scenery had to be matched by an absence of exploitable wealth. For instance, the world's first national park, Yellowstone, was only preserved after Dr Ferdinand V. Hayden, head of the United States Geological and Geographical Survey of the Territories, reported to the House Committee on Public Lands that the proposed park took 'nothing from the value of the public domain'. In particular, Hayden stressed that settlement was ' problematical' unless there were 'valuable mines to attract people', but it was highly improbable 'that any mine or minerals of value' would be found in the area (Runte: 1973, 5). Yellowstone was therefore preserved not so much for what it was, but for what it was not.

Similarly, the parks that were established by Congress between 1899 and 1919, including Mount Rainier (1899), Crater Lake (1902), Glacier (1910), Rocky Mountain (1910) and the Grand Canyon (1919) were all in areas considered worthless for industrial or commercial uses. The new parks contained little of economic value to the nation, and were regarded as containing no significant timber, mineral, grazing, or agricultural resources (Runte, 1973, 1977, 1979).

Indeed, as Runte (1973: 8) pointed out in relation to individual park legislation: 'no vested economic interests were affected, nor was any federal agency prevented from developing parkland to meet the economic demands of businessmen, agriculturalists, or mining concerns'.

Virtually all national parks created in America up to the 1930s were examples of rugged scenery. 'Mountain top parks' comprising but 'a fringe around a mountain peak', a 'patch on one slope of a mountain extending to its crest', or 'but portions of a slope' (Wright et al., 1933: 37, 39). Yet such mountain top parks were of some economic value. The romantic appreciation of wild landscape had led to the development of a tourist industry associated with national parks. Railroad companies were major advocates of national parks in the United States. Similarly, in Canada national parks were created because of the desire of government and the railroad companies to develop the western provinces through tourism. However, according to Runte (1983: 1940-1941), 'tourism does not contradict the worthless lands hypothesis it supports it. In the chess game of scenic preservation, ecology was the pawn - only economics could checkmate economics'.

Tourism provided the national parks with a defence mechanism. The economic value of tourism proved a valuable weapon for preservationists in the development of more parks and in the protection of others. Tourism gave parks a material value. Aesthetics were important, but only so far as they enabled the procurement of the tourist dollar. Materialistic considerations were still the dominant factor in the establishment of national parks.

The rise of ecology gave another aspect to the reasons for park creation. However, according to Runte (1983: 138), 'ecological needs have come a poor second because the nation has been extremely reluctant to forego any reasonable opportunity, either present or future, to develop the national parks for their natural resources'. National parks are still not defined or established on the basis of ecological criteria. The American government 'protects primarily what the business ethic of the nation allows it to protect' (Runte, 1973: 11). In the search for compromise and 'balanced' land use, ecology is no match for material gain.

Several commentators have criticised Runte as being too narrow or overzealous in the presentation of his 'worthless lands' thesis (Cox, 1983; Sellars, 1983; Winks, 1983). Nevertheless, it may be wondered to what extent such criticism has arisen because Runte is, in essence, debunking one of the great myths of American society, namely the supposed idealism and altruism inherent in the American creation of national parks. In opposition to Runte, one commentator suggested that the purpose of those who shaped the American national park system 'was, and is, to find the compromise between altruism and materialism that best captures the public interest' (Utley, 1983: 142). However, the question needs to be asked as to what interest for which public? As Runte (1983: 141) concluded:

> The 'worthless lands' hypothesis does not deny the achievements of preservation; it merely asks why the United States still seems to weigh economic issues more seriously than ecological ones. Perhaps one day Congress will establish a national park without even asking about its other potential uses. Perhaps - but that day is not history yet.

THE CREATION OF NATIONAL PARKS IN AUSTRALIA

The question must of course be asked as to how the perception of national parks as worthless lands applies to Australia. The first national parks in Australia were created for reasons of tourism, scenic beauty and a lack of intrinsically valuable resources (Hall, 1988). The preservation of flora and fauna for scientific reasons received only limited attention. Parks were regarded as waste lands that could be made productive through the creation of tourism opportunities.

As in the United States, nineteenth-century Australia was dominated by utilitarian ideals. As Jevons (9 March 1856, in Collison Black and Kinekamp, 1972: 214) noted, 'while money is to be made, trees will never in Australia be spared for mere ornament'. By 1892 some ninety-five million hectares of New South Wales forests had disappeared through clearing or ringbarking, 'a little more than a quarter of the total area which was under forest when the white man came a century earlier' (Bolton, 1981: 45). However, despite the warnings of forest experts, including George Goyder and the South Australian Forest Board, grazing and agricultural interests maintained the need to clear the land of trees for economic reasons. As W.E. Abbott expressed the situation in 1880 at a meeting of the Royal Society of New South Wales, 'The very rapid spread of the ringbarking in spite of the opposition of all the lovers of fine scenery, and of so many scientific men ... proves that there must be a clear gain to the graziers in getting rid of the timber' (in Bolton, 1981: 44).

The forests debate that raged in Australia in the latter half of the nineteenth century is strikingly similar to that which occurred in the United States. The reservation of forests came to be seen as an important conservation issue because of their economic importance. Economic or utilitarian conservation was the dominant theme in the creation of state forst reserves and the institutional arrangements for their management.

One of the main advocates for a rational economic approach to forest conservation was Baron Ferdinand von Mueller. Mueller (1871 in Powell, 1976: 70) wrote of the need to conserve forests for the continued economic well-being of future generations:

> But this formation of dense and at the same time also thriving settlements, how is it to be carried out, unless indeed we place not merely our soil at the disposal of our coming brethren, but off with this soil also the indispensable requisites of vigorous industrial life, among

which requisites the easy and inexpensive access to a sufficiency of wood stands wellnigh foremost.

However, Mueller also articulated an ethical dimension in forest conservation: 'that individual life, whatever it may be, which we so often thoughtlessly and so ruthlessly destroy, but which we never can restore, should be respected. Is it not as if the sinking tree was speaking imploringly to us, and when falling wished to convey to us its sadness and its grief?' (in Powell, 1976: 70-71).

Mueller's consideration of the utilitarian, aesthetic and ethical arguments for conservation helped to provide the basis for the reservation of forests in Australia. However, of the three streams of conservationist philosophy, it was the utilitarian which came to dominate the first moves towards the creation of forest and wildlife preserves. This was undoubtedly due to the influence of British and Imperial attitudes towards forestry, which saw forest lands as being concerned with single rather than multiple-purpose forestry (Roach, 1984; Roche, 1984; Carron, 1985). As Powell (1976: 81) observed, 'the aesthetic evocation of the bush was concerned with rural Australia in its entirety, not solely or even largely with the true wilderness areas'. The much celebrated bush ethos offered very little real protection for the quickly diminishing wilderness. The first reserves were not created to protect entire landscapes but, as in Canada, New Zealand and the United States, they were established to provide a degree of protection for scenic sites of significance for commercial tourism.

The first reserve in Australia which may claim some association with the national park concept was the reservation of an area of 5 000 acres (2024 ha) in the Fish River (Jenolan) Caves district in the Blue Mountains in October 1866. The caves, which had previously been a refuge for aboriginals and bushrangers (Harvard, 1934), were covered by legislation which was intended to protect 'a source of delight and instruction to succeeding generations and excite the admiration of tourists from all parts of the world' (Powell, 1976: 114). The protection of natural monuments with tourism potential has obvious North American parallels. In 1870 the head of Jamieson Creek in the Blue Mountains was reserved, while the Bungonia Lookdown was reserved in 1872. Both areas were 'beauty spots' which provided views of spectacular gorges (Prineas and Gold, 1983: 28).

In 1879, seven years after the creation of Yellowstone, 7 284 ha of land were set aside as a national park at Port Hacking, south of Sydney. This area was increased to 14 000 hectares the following year (Black and Breckwoldt, 1977: 191). An exhibit organised by the Royal Society of New South Wales in 1878 contained a description of Yellowstone but it 'is unlikely that Yellowstone National Park provided more than an idea for a name' for the new Sydney park (Pettigrew and Lyons, 1979; 18: Slade, 1985-86). The creation of The National Park (later Royal National Park) was inspired more by a desire to ensure the health of Sydney's working population than the provision of a wilderness experience. According to a member of the New South Wales Legislative Assembly, John Lucas, the park was created 'to ensure a healthy and consequently vigorous and intelligent community ... all cities, towns and villages should possess places of public recreation'. The most likely model for the park was the large 'common' parks of urban Britain, and represented an antipodean version of the then popular views of the negative effects of the city on health and morality. The National Park was to be 'a sanctuary for the pale-faced Sydneyites - fleeing the pollution - physical, mental and social, of the densely packed city', not an escape to wild, untamed nature (in Pettigrew and Lyons, 1979: 15, 18).

One of the most notable aspects of the creation of the park was the role of a planned rail link to the park. The railway line enabled the park to be brought into quick and easy reach of the inhabitants of Sydney, some twenty-two kilometres away. The importance of railways in the creation of national parks is a situation analogous to that which occurred in Canada and the United States and which relates to the establishment of national parks for purposes of commercial recreation and tourism.

A native flora and fauna reserve of 64 777 hectares, with apparently little potential for agriculture, was established in the Murray River area between Pinjarra, North Dandalup and the Bannister River in Western Australia in 1894. In a restatement of the 'worthless lands' attitude, the reserve was altered to that of 'Timber - Government Requirements' on 7 April, 1911, despite the advocacy of the Western Australian Natural History Society (Australian Academy of Science Committee on National Parks (Western Australian Sub-Committee), 1963: 17-18). The change in designation of the Murray River Reserve is broadly comparable to attempts to revoke national park designation for some areas of the early American parks for purposes of mining; the central issue for legislators being not the protection of scenery or flora and fauna but whether land could contribute to economic development.

The first reserve in Western Australia to which the term 'national park' was applied was an area of only 43 hectares at Greenmount near Perth. Enlarged a further 1 423 hectares in 1900 it was named John Forrest National Park - an extremely apt dedication given Forrest's interest in natural history. The focus of the park was the attractive waterfalls of Jane Brook, as two memoranda between Forrest and the Lands Department indicated:

> I should like a National Park reserved above the tunnel on the Eastern Railway, a beauty spot. I should be glad to advise the Surveyor-General.
> (Memo Hon. the Premier John Forrest to the Minister For Lands, 26 August 1900)
>
> Please note Premier, I think we have anticipated this request by making reserves to include the waterfalls in this locality.
> (Memo Minister For Lands to Under Secretary for Lands, 28 August 1900 (Lands and Surveys Department File No. 10617/99))

A railway line also ran through the park and a station was established at the main public picnic grounds. However, the role of the railways in ensuring the continued prosperity of the park as a major recreation and tourism destination has not been acknowledged in any of the literature dealing with the history of national parks in Western Australia.

As in other Australian states, natural history and scientific societies played a major role in advocating the creation of national parks and nature reserves. However the efforts of many of the early champions of national parks 'were thwarted by the development urge and particularly by the exceptions made for mining interests and pioneer settlement in most of the reservations' (Powell, 1976: 115). The Australian Association for the Advancement of Science; Sir John Forrest, Premier of Western Australia; Mr. Bernard Woodward, Director of the Western Australian Museum; and Governor Sir William Robinson, were all actively involved in attempting to preserve fauna and flora. Baron von Mueller was especially influential in creating a climate conducive to the first moves towards preservation in Western Australia and throughout the rest of Australia. According to Mueller (1890: 10).

> Choice areas, not necessarily very extensive, should be reserved in every great country for some maintenance of the original vegetation, and therewith for the preservation of animal life concomitant to particular plants. Where the endemic riches are greatest, unless timely measures are adopted for the reservation of some sequestered spot, to which rural occupations should never be allowed to have any access with their disturbing influence on primeval harmonies. Such spots should be proclaimed for all times the people's inalienable property, and every inhabitant or visitor of the locality should consider himself the co-preserver of such areas, so as to aid in preventing accidental invasion or casual ignition or intentional spoliation.

In 1891 the Government of South Australia passed the National Park Act, which set aside the Old Government Farm at Belair, an area of 796 ha, as a reserve. The Act was designed to 'establish a national recreation and pleasure ground as a place for the amusements, recreation and convenience of the Province of South Australia'. Despite attempts, by both politicians and the Field Naturalists Section of the Royal Society of South Australia, to allow the park to be retained in its natural state the Playford government insisted that the park be organised along the lines of Sydney's recently established National Park (Black and Breckwoldt, 1977: 192). 'The area was developed with tennis courts, ovals, pavilions and walking trails through the bushland. Stands of ornamental trees were planted along curving drives through the park and it became a favoured picnic area for the people of the Adelaide region' (Goldstein, 1979: 215).

Despite continued pressure from the field naturalists for the creation of a comprehensive system of fauna and flora reserves the South Australian government emphasised the protection of popular recreation interest (Powell, 1976: 114-115). For instance, the National Park Act of 1891 gave the Commissioners power to 'set apart such portions as they think fit for the conservation of water, for the purposes of sports and games, for landscape gardening, for temporary platforms along the railway line, for enclosures of birds and animals and any other purpose for public enjoyment they think fit ... ' (Black and Breckwoldt, 1977: 192). An emphasis continued in the South Australian National Pleasure Resorts Act of 1914. It is interesting to note that railways again played a prominent role in the establishment of an Australian state's national park system. The interrelationship between national parks and railways demonstrates that protection of indigenous fauna and flora was only a secondary effect of the intent of state governments to provide recreational and tourism opportunities for the general population.

In 1866, Tower Hill, an area of 597 hectares near Warrnambool in southern Victoria was set aside as a public park in order to preserve its outstanding geological features. In 1882, Fern Tree Gully, a small area of the Dandenong Ranges near Melbourne was reserved for recreation in its natural state (Johnson, 1974: 177). In 1892 the Victorian Parliament passed the Tower Hill National Park Act thereby creating Victoria's first national park. The Tower Hill park was designed mainly for recreational purposes and the Crown reserved the right 'to all gold, silver and coal within the park, its right to prospect or mine there, and its liberty to occupy any parts of the park which might be required for the roads, railways, water courses, reservoirs, drains, sewers etc.' (Black and Breckwoldt, 1977: 191).

In 1878 a pastoralist from the McPherson Ranges near the Queensland - New South Wales border, Robert Collins, was impressed by the national park idea while on a trip to the United States (Goldstein, 1979: 133). After his election to the Queensland Parliament, Collins continually stressed the direct and indirect advantages of tourism arising from the creation of national parks (Powell, 1976: 115) - a situation bearing remarkable similarities to the advocacy of national parks in the United States and Canada. The tourism dimension of national parks in Queensland is further indicated in the passing of legislation 'to provide for the reservation, management and protection of ... national parks' in 1906.

> ... areas which ... as localities are likely to become popular resorts as the population grows larger - places to which those who desire to take a holiday may like to go from time to time and know that they will get pure air, good scenery and country life.
>
> Hon. J.T. Bell, Secretary for Public Lands, 1906 (in Goldstein, 1979: 133-134).

The Queensland State Forests and National Parks Act of 1906 was probably the first legislation in the world concerning the procedures to be followed in establishing national parks. However, as Black and Breckwoldt (1977: 192) recorded, 'The Minister for Public Instruction commented that in attempting to establish a national park

Queensland was following the lead given by the southern states' and the United States. The first national park created under the Act was an area of 131 ha at Witches Falls on Tambourine Mountain. Land which was judged, according to Powell (1976: 114), as 'unfit for any other purpose' - a clear restatement of the 'worthless lands' hypothesis.

Tasmania was the last Australian state to establish a national park. In 1915 an area of 11 000 ha at Mount Field, seventy kilometres to the west of Hobart, was set aside as a national park. However scientific associations such as the Royal Society of Tasmania had been unsuccessfully urging the creation of flora and fauna reserves since the late 1840s.

Under the Waste Lands Act of 1863 and the subsequent Crown Lands Act a variety of Tasmanian reserves were established for their scenic value. As in other Australian states, institutions such as the Tasmanian Museum, scientific and natural history organisations, and certain committed individuals played a major role in creating national parks. The initial attention of those interested in the national park concept focused on creating a national park in the Mount Field - Russell Falls area. Led by William Crooke, the National Park Association was formed which successfully agitated for the establishment of a reserve of some 10 927 ha for the purpose of a national park. The campaign for the park was a blend of the various elements which also occurred in campaigns for national parks in the United States: aesthetics, science and tourism. The proposed Tasmanian reserves were described as 'living museums' for the preservation of Tasmania's flora and fauna, while the moral overtones of scenic preservation were witnessed in the description of hunters and timber interests as 'spoilers and utilitarians' (in Mosley, 1963: 215), a statement which could equally have been made by the American wilderness preservationists of the time.

The tourism aspects of national parks were favourably received by the Tasmanian government. The Mercury spoke of the Mount Field area as 'a public resort of quite first class value ... and more especially for the citizens of Hobart and the increasing number of tourists'. The recently established Government Tourist Bureau took an active role in scenic preservation, while the advantages of increased revenue on the Derwent Valley Railway, due to increased usage, were also noted (in Mosley, 1963: 213-214, 215).

The Scenery Preservation Act of 1915, under which the Mount Field National Park was created, was 'advanced legislation for its time' and the Scenery Preservation Board which the Act created 'was the first special authority in [Australia] for the creation and management of parks and reserves' (Goldstein, 1979: 142) and one of the first in the world. However the scenic 'nature's monuments' approach of the Scenery Preservation Board is evidenced by the Surveyor-General's announcement, at the first board meeting on 16 July 1916, that he had requested his surveyors to take special note of 'waterfalls, forest clad outcrops, attractive and commanding viewpoints, or other places of historical or scientific interest and natural beauty suitable for reservation' (in Mosley, 1963: 217).

The early days of national park and wilderness preservation in Australia closely parallels the North American situation. Emphasis was placed upon scenic values, the preservation of nature's monuments, the restoration of mental and physical well-being, the virtues of 'the bush' as opposed to 'the city' and, to a small extent, the preservation of fauna and flora for their scientific values. Nevertheless, national parks and wilderness areas were generally regarded as waste lands or worthless lands that could only be made productive through the creation of tourism opportunities, especially in relation to the railway system. The preservation of aesthetic or ecological values was only a minor force in the creation of the first Australian national parks.

PRESENT-DAY PARK CREATION AND MANAGEMENT OPPORTUNITIES

In the age of ecology, national parks and reserves are seen as having far greater value than just tourist destinations, although tourism is still regarded by many as an integral component of the park concept. National parks are recognised as sources of genetic material, as gene pools in which the processes of evolution can continue relatively unimpaired by humankind, as places for ecological research to measure and compare human impacts on natural environments, as means to preserve rare and endangered fauna and flora, and as places of recreation and education. However, these are characteristics of parks and reserves that do not fit easily into any cost-benefit analysis of the worth of a national park.

The first national parks in Australia were established partly because they were not seen as infringing material or utilitarian interests. Yet to what extent does this situation still apply? Although a complete survey of the development of national park and reserve systems is beyond the scope of the present paper, several issues - park revocation, mining in national parks and park management - reveal the prevalence of the attitude that national parks are regarded as 'worthless' lands.

As Mercer and Petersen (1986: 134-135) have observed:

> Internationally national parks are threatened both within and from without. ... Internal pressures are mounting everywhere as visitor numbers escalate and as management costs rise. External forces are less well-documented, but in a world of growing populations and resource scarcity they are associated with the expansions of such activities as mining, agriculture, forestry and hydro-electric power generation.

One of the major pieces of evidence for the influence of external forces on national parks is when they are revoked or when portions of land are excised for non-park purposes. Revocation serves as a significant indicator of land-use allocation priorities. Mercer and Petersen have recorded the extent of national park and reserve revocations in Tasmania (Table 1):

Table 1: Major Revocations from Tasmanian National Parks

Name of Reserve	Area (ha)	Date revoked	Reason
Cradle Mountain - Lake St Clair National Park	1295	3.5.39	Wolfram mine
Cradle Mountain - Lake St Clair National Park	225	4.9.40	Hydro-electricty
Freycinet National Park	4	4.5.41	Mining
Freycinet National Park	2	11.3.42	Granite Quarrying
Hartz Mountains National Park	1214	7.4.43	Forestry
Hartz Mountains National Park	405	12.3.52	Forestry
Hartz Mountains National Park	283	5.3.58	Forestry
Hartz Mountains National Park	2150	1.1.79	Forestry
Mt Field National Park	1489	14.12.50	Forestry
Lake Pedder National Park	89	18.2.70	Hydro-electricity
Franklin - Lower Gordon Wild Rivers National Park (part)	14125	2.9.82	Hydro-electricity

Source: Mercer and Petersen, 1986: 138.

It can be seen in Table 1 that the reason for major national park revocations in Tasmania is that of commercial gain. Undoubtedly, revocations have also occurred for administrative reasons. However, the dominant factor in revocation is without doubt that of material interests, particularly forestry, mining and hydro-electric power generation.

In addition to examining the reasons for revocation, it is also valuable to examine what lands are included within national park systems. In 1986 only 4% of Tasmania's forests were in reserves (Mercer and Petersen, 1986: 139). The Tasmanian reserve system is strongly biased towards the protection of alpine regions and buttongrass plains - areas with minimal value for agriculture, forestry and mineral extraction. Bell and Sanders (1980: 59) have provided a 'residual' explanation of the pattern of Tasmanian reserves. That is, they are lands left over from the needs of economic interests, or as Mercer and Petersen (1986: 139) have expressed it: ' areas are reserved only if they are seen to have no commercial value, (my emphasis).

Tasmania is not alone in having the composition of its reserves apparently dictated by material interests. A glance at a map of Australia's national parks and reserves system reveals that reserves are primarily located at past or present frontiers of economic development (McDonald, 1987). For instance, the vast majority of Western Australia's reserves are located in the arid inland. However, as the frontier of economic development and environmental exploitation advances, even the more remote parks and reserves are threatened by material interests (Mercer and Petersen, 1986: 137; McDonald, 1987).

In the rush to 'open up' economically peripheral areas, ecology and aesthetics are secondary considerations in the decision-making process. As the Committee of Inquiry into the National Estate (1974: 77-78) reported:

> National parks and other large reserves have generally been made only in areas unwanted for any other purpose. Sectional pressures have ensured that other areas, whether their potential is for agriculture, grazing, mining, forestry, water storage or settlement, have largely remained unreserved (my emphasis).
> Many reservations have been made, not from any settled government policy of land acquisition and representation of habitat, but because of public pressure for their protection. Since governments are generally tardy in responding to this kind of pressure, and public priorities have only recently begun to change in favour of national parks and nature reserves, it is now very late in the day for obtaining anything like a full and adequate representation of habitats and ecosystems, or for achieving a good percentage of recreational land in reserves, particularly in the more closely settled 'fertile crescent' and in major agricultural and pastoral areas. Time is pressing.

The question of mining in national parks goes directly to the heart of the notion of parks and reserves as 'worthless lands'. Conservation in Australia is currently marked by several major controversies regarding mining and mineral exploration in national parks and wilderness areas. Shelbourne Bay, Kakadu National Park and Fraser Island have all assumed centre stage at the Commonwealth level, while in Western Australia several major parks - Hammersley, Rudall River, D'Entrecasteaux and the Fitzgerald River - are either being explored for minerals or are earmarked for such exploration.

The release of a report to the West Australian state government on mining in national parks (Committee on Exploration and Mining in National Parks and Nature Reserves, 1986), commonly known as the Bailey Report, has focused considerable attention on the values of parks and reserves. However, the outcome of the Western Australian government's deliberations on mining in national parks reflects the problem of compromise discussed earlier in the paper.

According to the state government (1988), the new policy on mining and exploration in national parks and nature reserves has struck a 'sensible balance' (Western Australian State government, 1988):

> This policy will see the beginning of the end of the long period of crude attempts to both utilise and preserve the environment ... With an open mind and a willingness to co-operate, fair minded people will see that this Government has found the "sensible balance" between mining and the environment.

The new policy represents a classic statement of compromise. Mining and exploration have not been banned but applications to mine or explore can be rejected at various stages within the 'protection plan'. The idealism of the national park concept is not such as to be able to overcome the demands of material interests.

The question of whether or not mineral exploration and mining should be conducted in national parks may be seen as a contemporary restatement of the value of national parks and reserves. If mineral exploration, mining, grazing or forestry occurs in park lands then it may well be argued that decision-makers still see these lands as 'worthless' in material terms, because the reasons for the establishment of such reserves - scenic preservation, the protection of fauna and flora, and recreation - are deemed insufficient to preserve the land from land-use which is incompatible with national park designation.

CONCLUSIONS

As Runte (1983: 138) has observed, 'everyone would prefer to attribute the national park idea to idealism and altruism'. However, the truth of the matter is that the creation and continued protection of national parks in Australia and the United States has been as much dependent on the absence of material wealth as it has been on the weight of aesthetic and ecological arguments. The notion that national parks were, and to an extent still are, created because they can be regarded by legislators as 'worthless lands' serves as a timely reminder of the interests involved in the establishment and preservation of national parks.

The creation or continued protection of a national park is not a rational process. It is a political battle, a process which involves the values of interests in the struggle for power relative to government decisions. Despite the supposed victories of conservationists in the Franklin Dam, the Wet Tropics and Kakadu National Park cases, the preservationist ideal is slowly being eroded in the search for compromise. As Runte (1983: 141) observed:

> Over the long term, preservationists never 'win' environmental battles; they can only hope to minimize their losses ... the essence of any political struggle is compromise. Compromise in the ecological context, regrettably, is simply another definition for loss.

Hotels are being constructed in the western Tasmanian wilderness parks, the Commonwealth government has stated that it foresees the possibilities of tin-mining and certain logging activities within the prospective Wet Tropics World Heritage nomination, while approximately thirty per cent of Kakadu Stage 3 is being opened up to mineral exploration. These examples add up to a contemporary restatement of the dominance of material interests even in those areas set aside as national parks or proposed for World Heritage listing. Australia's national parks are not purely the result of aesthetic and ecological considerations. Instead, they serve as antipodean reminders of Runte's thesis regarding the creation of national parks in the United States. Namely, that the character of national parks in Australia has been, and still is, strongly determined by the materialist perception that national parks are, in essence, 'worthless lands'.

REFERENCES

Australian Academy of Science Committee on National Parks (Western Australian Sub-Committee), 1963 National Parks and Nature Reserves in Western Australia, ed. The Standing Committee on Conservation of the Royal Society of Western Australia, Australian Academy of Science and the National Parks Board of Western Australia, Perth.

Bell, C. and Sanders, N., 1980 A Time to Care: Tasmania's Endangered Wilderness, (C. Bell, Blackman's Bay).

Black, A. and Breckwoldt, R., 1977 'Evolution of Systems of National Park Policy-making in Australia', 190-199 in D. Mercer (ed.) Leisure and Recreation in Australia, (Sorrett Publishing, Melbourne).

Bolton, G., 1981 Spoils and Spoilers: Australians Make their Environment 1788-1980, (George Allen and Unwin, Sydney).

Carron, L.T., 1985 A History of Forestry in Australia, (Australian National University Press, Canberra).

Collison Black, R.D. and Kinekamp, R. (eds), 1972 Papers and Correspondence of William Stanley Jevons, Vol. 1 (Macmillan in association with the Royal Economic Society, London).

Committee of Inquiry into the National Estate, 1974 Report of the National Estate (Aust. Govt Publishing Service, Canberra).

Committee on Exploration and Mining in National Parks and Nature Reserves (The Bailey Report), 1986 Report to the Hon. Ministers for Conservation and Land Management, and the Environment and Minerals and Energy, December.

Cox, T.R., 1983 The 'Worthless Lands' Thesis: Another Perspective, Journal of Forest History 27(3), July, 144-145.

Goldstein, W. (ed.), 1979 Australia's 100 years of National Parks, Special edition of Parks and Wildlife, 2(3-4), April.

Hall, C.M., 1988 The Geography of Hope: The History, Identification and Preservation of Wilderness in Australia, unpublished Ph.D. Thesis, Department of Geography, University of Western Australia, Nedlands.

Hampton, H.D., 1981 'Opposition to National Parks', Journal of Forest History, 25(1), January, 36-45.

Havard, W.L., 1934 'The Romance of Jenolan Caves' Royal Australian Historical Society Journal and Proceedings, 20(1), 18-65.

Johnson, D., 1974 The Alps at the Crossroads: The Quest for an Alpine National Park in Victoria, Victorian National Parks Association, Carlton.

Journal of Forest History, 1984 'Readers Respond to 'Worthless Lands Forum', Journal of Forest History, 28(1), January, 44-46.

McDonald, G., 1987 'Land Use Planning at the Economic Periphery', paper presented at Geography and Public Policy, the Institute of Australian Geographers 22nd Conference, Australian Defence Force Academy, Canberra.

Mercer, D. and Petersen, J., 1986 'The Revocation of National Parks and Equivalent Reserves', Search, 17(5-6), May-June, 134-140.

Mosley, J.G., 1963 Aspects of the Geography of Recreation in Tasmania, unpublished Ph.D. Thesis, 2 Vols., Australian National University, Canberra.

Mueller, F. von, 1890 'Inaugural address', Australian Association for the Advancement of Science, Melbourne meeting 1890, 2: 1-26.

Pettigrew, C. and Lyons, M., 1979 'Royal National Park - A History', Parks and Wildlife, 2(3), April, 15-30.

Powell, J.M., 1976 Environmental Management in Australia 1788-1914 (Oxford University Press, Melbourne).

Prineas, P. and Gold, H., 1983 Wild Places: Wilderness in Eastern New South Wales (Kalianna Press, Chatswood).

Roach, T.R., 1984 'Steward's of the People's Wealth: The Founding of British Columbia's Forest Branch', Journal of Forest History, 28(1), January, 14-23.

Roche, M., 1984 'Reactions to Scarcity: The Management of Forest Resources in Nineteenth-Century Canterbury, New Zealand', Journal of Forest History, April, 82-91.

Runte, A., 1972 'Yellowstone It's Useless, so why not a Park?', National Parks and Conservation Magazine, March, 4-7.

Runte, A., 1973 '"Worthless" Lands - Our National Parks: The Enigmatic Past and Uncertain Future of America's Scenic Wonderlands', American West, 10, May, 4-11.

Runte, A., 1977 'The National Park Idea: Origins and Paradox of the American Experience', Journal of Forest History, 21(2), April, 64-75.

Runte, A., 1979 National Parks: The American Experience, University of Nebraska Press, Lincoln.

Runte, A., 1983 'Reply to Sellars', Journal of Forest History, 27(3), July, 135-141.

Sax, J.L., 1976 'America's National Parks: Their Principles, Purposes and Prospects', Natural History, 85(8), October, 58-88.

Sellars, R.W., 1983 'National Parks: Worthless Lands or Competing Land Values?', Journal of Forest History, 27(3), July, 130-134.

Slade, B., 1985-1986 'Royal National Park: The People in a People's Park', Geo: Australasia's Geographical Magazine, 7(4) December-February, 64-77.

Utley, R.M., 1983 'Commentary on the "Worthless Lands" Thesis', Journal of Forest History, 27(3), July, 142.

Western Australian State Government, 1988 Mining and Environment. Balancing the Scales, A Western Australian Government Policy Report, (The Government of Western Australia, Perth).

Winks, R.W., 1983 'Upon Reading Sellars and Runte', Journal of Forest History, 27(3), July, 142-143.

Wright, G.M., Dixon, J.S. and Thompson, B.H., 1933 Fauna of the National Parks of the United States: A Preliminary Survey of Faunal Relations in National Parks, Contribution of Wild Life Survey Fauna Series No. 1 - May, 1932, National Park Service, United States Department of the Interior, (United States Government Printing Office, Washington).

Andy Connolly, veteran 80 y.o. rainforest timber man, Windsor Tableland, north Qld, late 1970's

SOURCES

REVIEW PAPER : KEEPING TRACK OF THE WORLD OF FORESTERS

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Launceston, Tasmania

An essential element in the study of the history of Australia's forests is the preservation of government archival materials relating to the past administration of these forests. To date there has been no systematic assessment of archival resources, and the following list is a very preliminary and incomplete guide to what is available.

To determine what was available in government archives, a form letter was sent to each state archive in the first half of 1988. All state archivists replied, and each sent a listing of the forestry records that had been deposited in their archive. These have been printed below. Without a detailed knowledge of the history of forest policy and use in each state, I am not really qualified to judge how complete the attached list is. However, from my experience of Victorian records, a few observations can be offered.

First, it is clear that the records of the Victorian Forests Commission tell only a small part of the forest history of Victoria. A creation of the twentieth century, Forests Commission records have no way of recording the period of greatest exploitation of Victoria's forests - the second half of the nineteenth century. To explore this period the researcher must look elsewhere.

In the case of Victoria, the early history of European exploitation of forests is to be found in the records of the Department of Crown Lands. There is no simple way of using these records and the researcher must cast a wide net to explore forest history. Thus the early maps and diaries of surveyors are often a useful starting point. In these records will be found descriptions of vegetation prior to agricultural settlement. After 1870, the Victorian records of land settlement tell a great deal about the destruction of forests. In the files of individual selectors the researcher will find descriptions of the original vegetation and the way this was cleared to produce small farms.

The story of early timber-milling also requires a great deal of searching through the Lands Department records to produce, at best, an incomplete picture. For most of the nineteenth century no statistics were published on timber production from the Victorian state forests and timber reserves. The unpublished records are of little assistance. For the most part the correspondence of the Lands Department simply deals with the establishment of state forests and the licensing of millers. Files can be found on many millers but these provide little detail on the scale or operation of mills. Some information can be obtained from the records of local Lands Offices as noted later.

In 1908 control of Victoria's forests was placed in the hands of a Forests Department and a decade later a Forests Commission was established. However, as the list of records indicates, no records seem to have survived for the years 1908 to 1920. What has become of the records of this period is simply not known. During my employment (until late 1988) in the Department of Conservation, Forests and Lands, I was informed that these records had been destroyed. Undoubtedly much valuable information from these early years of forestry in Victoria has simply been destroyed. But, as with all Victorian forest records, researchers will be rewarded if they are prepared to persevere, since many files from these years have been simply incorporated in later Commission files. There is no simple way to find these files and the researcher has to simply wade through the later Forests Commission records.

In the attached list the records of the Victorian Forests Commission appear an exceptionally sparse record for over fifty years of forest management. In all there are only about a hundred archival boxes of correspondence. A closer inspection reveals that the picture, although depressing, is not as grim as this list reveals. The simple fact is that those records that have survived have simply not made their way into the public archives. The reasons for this are twofold. First there is the problem that foresters do not want their work examined by outsiders, so old records have remained in the custody of current administrators. In the case of Victoria, for example, the log allocation files have been removed from the Public Records Office, as a former Commissioner considered that they were too sensitive to be seen by the general public. This may represent an isolated case but bureaucratic secrecy is a major obstacle for the researcher. The Victorian situation is no doubt similar to that in other states - note, for example, the scanty archival holdings in Queensland and Western Australia. At a time when there is intense community interest in the management of public forests, this obsessive secrecy can only be counter-productive to the standing of forest services in the eyes of the public. It also leaves researchers with little choice but to make 'intuitive leaps' on the basis of the available evidence, when better access to records would possibly allow a more complete picture.

In Victoria, the second reason why the majority of Forests Commission records have not been placed in the Public Records Office is simply because the latter claims that it has not sufficient resources to house them. The professional archivists did however advise the Forests Commission on how to store its records and in the early 1970s a disposal schedule was introduced. Under this schedule a considerable volume of records has been destroyed. Many of these records were ephemeral - cheque books, receipts and the like - but I suspect that many valuable files have also been destroyed. In undertaking research on the red gum forest at Barmah on the Murray River, I discovered that many potentially important files had been destroyed. Records seemingly protected by the schedule have also gone astray. All but two of the annual log output books from 1920 to the early 1970s are missing. These records would have allowed the researcher to determine the output of timber from every mill operating on crown land.

Looking at the Victorian list of records it will be observed that very few regional records have made their way into state archives; in the attached list only the records of the Creswick office are listed. Despite the rumours of periodical clean-outs by zealous foresters it is clear that many regional offices hold valuable records. In my work on the Barmah forest I was able to locate records on production predating the Forests Commission in the local Department of Conservation, Forests and Lands office in Nathalia. In this office I was also able to locate copies of correspondence sent to Melbourne and no longer available in Melbourne.

The example of Victoria suggests that a great deal of the records relating to forestry has been lost and much that survives has not made its way into the public archives. It should be one of the primary goals of forest historians to ensure that what remains, in both Melbourne and the bush, is saved and properly stored, and that the unfortunate story of Victoria is not repeated in other states.

The forestry profession can make a major contribution to Australian environmental history by taking greater care of the records, preventing further loss, and acting to make them more accessible. Ultimately, this combination of professional care and accessibility is best achieved by archival deposition but clearly, as experience shows, records also need greater respect within the agencies to avoid a repetition of the appalling losses now evident.

APPENDIX

AUSTRALIAN FORESTS RECORDS IN STATE ARCHIVES

1. South Australia
2. Victoria
3. New South Wales
4. Queensland
5. Western Australia
6. Northern Territory
7. Tasmania

1. SOUTH AUSTRALIA

WOODS AND FORESTS DEPARTMENT

GRG 16
Series
List
Page 12

Rough minute book of the Forest Board 1875-81, 1 vol.	1
Agenda papers of the Forest Board 1878-80, 1 vol.	2
Letters sent by the Conservator of Forests 1878-80 1, vol.	3/2
Memorandum 17/1901 re Fire at Bundaleer Forest 1901	3/2
Correspondence files of the Office of Minister of Afforestation (formerly Commissioner of Forest Lands) 1915-17and 1933-43, 7 cm	4
Correspondence files of the Woods and Forests Department (formerly Forest Department) 1914-48. Also 1912, 1 file, and some files 1950-57	5
Correspondence files: 'Forest Officers' 1913-36, 50 cm	6
Unregistered correspondence 1877, 15pp.	7
Press cuttings 1877-91 and 1915-37, 4 vols	8
Miscellaneous printed items c 1957-75, 2 cm	9
Cancelled leases for grazing, cropping etc. c 1970-76, 1.5 m (List filed with master copy of transfer sheet)	10
B.T. Finniss Papers: re Forest Board (See Special List) 1875-82, 1 vol. (Formerly Acc.68)	11

B. T. FINNISS PAPERS - FOREST BOARD

GRG 16
Series 11
Special
List
Page 1

1.		Notes on the Acts constituting the Board.
2.		Form of Pastoral Leases of Forest Reserves.
3.	1875-82	List of meetings of Board
4.	1875-81	Copies of various minutes
5.	28 Oct. 1879	B.T. Finniss to Col. Barber re postponement of meeting of Forest Board, and action of Chairman
6.	1881-82	Various newspaper cuttings
7.	21 Nov. 1881	Draft of minutes of Board meeting held 'to reconsider the subject of the transfer of garden blocks'
8.	16 Dec. 1881	Col. Barker to the Chairman of the Forest Board, tendering his resignation owing to the opposition of the Commissioner of Crown Lands to the Board
9.	23 Dec. 1881	Minutes of Chairman of Forest Board re resignation of Col. Barber and advising the abolition of the Board
10.	30 Dec. 1881	Sec. of Forest Board to B.T. Finniss, requesting his attendance at an interview between the members of the Board and the Commissioner of Crown Lands
11.	3 Jan. 1882	Draft of minutes of Board meeting
12.	5 Jan. 1882	Copy of report of Surveyor General to Commissioner of Crown Lands on minute of Board passed at above meeting, with copy of minute of Commissioner of Crown Lands
13.	5 Jan. 1882	Copy of minutes endorsed on Board's resolution of 3 Jan. 1882
14.	11 Jan. 1882	Sec. to B.T. Finniss, giving notice of a special meeting to consider the reply of the Commissioner of Crown Lands to the Board's minute of 3 Jan.
15.	16 Jan. 1882	Report of special meeting held to consider the opposition of the government to the Board and attitude of the Surveyor General in supporting the government
16.	16 Jan. 1882	Rough draft of above

17.	4 Feb. 1882	Reply of Commissioner of Crown Lands to No. 15, with reply by Board (13/2/82)
18.	—	Resignation of B.T. Finniss from the Board
19.	6 Mar. 1882	Copy of resolution of the Board notifying the Commissioner of Crown Lands that Messrs Finniss and McEwin have not received any reply to their resignations
20.	16 Mar. 1882	Commissioner of Crown Lands to B.T. Finniss accepting his resignation
21.		Duplicates of some of above papers

State Archives of South Australia
North Terrace
Adelaide, S.A. 5000
Tel: (08) 223 8414

2. VICTORIA

VPRS	SERIES TITLE	DATE RANGE	QUANTITY
3222	Forests Commission Minutes of Meetings	1919-1978	6 films & 1 envelope
3223	Fire Report Files	1960-1978	1 box
3224	Mount Buller Alpine Reserve Committee of Management Minutes of Meetings	1948-1978	1 box
3225	Log Allocation Files	1935-1975	2 boxes
10567	Correspondence re Occupation	1953	81 boxes
10568	Correspondence - Annual Reports	1921-1960	13 boxes
10569	Salary Registers	1939-1969	62 vols
10570	Funds Ledgers	1950-1963	6 vols
10571	Plant Ledgers	1944-1950	2 vols

Forest Commission, Creswick

5794	Forest Thinning Record Book	1890-1909	3 vols
5795	Cattle Branding Record Book	1885-1891	1 vol.

Public Records Office
City Reference Room
1 Little Collins Street
Melbourne, Vic. 3000
Tel: (03) 651 2987

3. NEW SOUTH WALES

N.B. This list is a cumulation of all entries in the Concise Guide and Supplements Volumes 1-9.

1. Aerial mosaics of Pilliga Scrub, c 1958 (A.O. Maps Nos 6194-6199) 6 maps

This is a map of the Baradine Forestry District in six sheets showing forest areas and fire control data. It is annotated to show boundaries of areas filmed by Adastra Airways.

These sheets index the series: Aerial mosaics of Pilliga Scrub, 1938 (A.O. Maps Nos 18981-19040).

3. Aerial photographs of state forests in New South Wales, c 1930-56 (11/1-75, 11/110-122) 249 boxes

A full listing is available in the Archives Office.

4. Photographs of state forests and nurseries, activities and equipment, and forestry officers, c 1900, c 1920s-1930s 1960s (4/8680-8684) 5 boxes

The photographs were in no discernable archival order when accessioned, so an attempt has been made to group them into subject bundles. These overlap to a great extent, because an activity such as logging could also be grouped with those photographs of a particular state forest. Consequently the arbitrary grouping that has been used is only partially useful, and a full search is indicated for any researcher.

5. State forest map tracing, c 1910-66 (unprocessed). c 992 tubes

Map and tracings of linen, mounted helics and cartographic paper, recording mainly timber types, compartments, contours, roads, boundary compilations, improvements, soil types, tracks, fencing, elevations and survey surrounds. Photocopies of index cards maintained by the Forestry Commission and relating to the maps have also been transferred with the maps and are located in the Intermediate Records file in the Archives Office.

6. Index cards to state forest maps of New South Wales, c 1910-66 (Kingswood 3/3093) 1 box

Records name and number of state forest, address, sheet number, subject and date of map.

FORESTRY COMMISSION

7. Registered files, 1897-1972 (Kingswood 3/2377-2381, 3/5944). 6 boxes

These files deal with land and policy matters; they relate to: (1) special leases for ringbarking permits; occupation permits for grazing, fruit and vegetable cultivation, tramlines, etc. and (2) exclusive rights to take timber; site quality surveys; wage rates; and policies implemented during wartime.

A full listing is available in the Archives Office.

8. File on Afforestation in New South Wales, c 1889-1912 (4/7848) 1 bundle

This file contains typescript reports, newscuttings, manuscript articles and some correspondence on afforestation.

9. Papers concerning eucalypts (Ecological files, 6-7), 1911-24 (4/490) 1 box (part)

10. File concerning proposals for a light railway line south from Twofold Bay to the Victorian border at Timbillica, 1919-23 (1/2844.1) 1 box (part)

This file is part of the main series of correspondence and concerns a proposal which lapsed for a railway line to utilise the timber in the Eden District.

11. Improvement leases, 1899-1915 (X741 part) 1 box (part)

Under the Forestry Act 1916-1935, Section 25, current licences or leases held from the crown and affected by the dedication of land as a state forest, flora reserve or catchment reserve, came under the jurisdiction of the Forestry Commission and the Minister in dealing with these licenses had the powers of the Secretary for Lands.

12. Miscellaneous leases, 1903-16, 1937 and 1940-42 (X741 part) 1 box (part)

These include scrub leases, settlement leases and crown leases. Under the Forestry Act 1916-35, Section 25, current licences of leases held from the crown and affected by the dedication of land as a state forest, flora reserve or catchment reserve came under the jurisdiction of the Forestry Commission and the Minister in dealing with these licenses had the powers of the Secretary for Lands.

13. Public Services Board Inquiry into charges by the Forestry Department of maladministration on the part of the Lands Department in connection with the disposal of portion 108 within F.R. 13457 Country Vernon, Parish Enfield, 1882-1914 (6/1036) 1 box

14. Inquiry by Mr O.A. Edwards S.M. into the relations between the Chief Commissioner of the Forestry Commission, Mr R.

Dalrymple-Hay, and his colleague Mr N.W. Jully, 19-23 November, 1923 (Kingswood 3/2498) 1 bundle

15. Assessment survey field book, March 1924 (Kingswood 7/5885) 1 vol.

Field book of Assessor W. Poole covering Olney State Forest No. 124 and Watagan State Forest No. 123, Sections 1, 2 and 3, exemplifying timber assessment and topographical mapping prior to photogrammetric methods currently used.

16. Hume-Snowy Catchment Areas Bush Fires Prevention Scheme Management Council: minutes and related papers, 1956 (Kingswood 3/6733) 1 box

This bundle consists of Minutes of the 12th Meeting of the Hume-Snowy Catchment Areas Bush Fires Prevention Scheme Management Council held at Cabramurra on 11 April 1956 and Minutes of the 13th Meeting held at Sydney on 29 October 1956. A copy of the Minutes of the Local Committee Meeting No. 11 held at Yarrangobilly Village on 3 May 1956 is included. Copies of letters relating to the above Council are also included.

GOSFORD STATE NURSERY

17. <u>Forests of the Bellingen River</u> by E.H.F. Swain. Department of Forestry Bulletin No. 5, 12 November (Kingswood 3/2279) 1 vol.

18. <u>List of Exotic and Indigenous Trees and Shrubs for Cultivation</u>. Sydney, Government Printer (for the Forest Department) 1899 (printed) (Kingswood 3/2277) 1 vol.

19. Baron F. von Mueller. <u>Select Extra Tropical Plants</u>, Sydney, Government Printer, 1881 (Kingswood 3/2280) 1 vol.

20. <u>Price List of Exotic and Indigenous Trees and Shrubs for Cultivation</u>, Sydney, Government Printer (for the Forest Department), 1905 (printed) (Kingswood 3/2278) 1 vol.

21. Lists of plants available for distribution from the State Nursery, Gosford, 1936 season (Kingswood 3/2276) 1 vol.

22. Foresters' log books, 1933-36 (Kingswood 3/2282) 2 vols

23. Letter book, October 1901 - December 1902 (Kingswood 3/2283). 1 vol.

24. Registers of letters received, July 1915 - October 1927 (Kingswood 3/2284, 3/29901A part) 2 vols (part)

25. Despatch books of plants, shrubs etc. distributed by the Gosford Nursery, 1899, 1901-06 and 1908-35 (Kingswood 3/2286 part-2287 part, 3/2288-2295, 3/22889A) 10 vols (part)

26. Postage book, July 1917 - December 1920 (Kingswood 3/2285) 1 vol.

27. Employment books, 1918-20 (Kingswood 3/2286 part, pp 1-59; 3/2290A part) 2 vols (part)

28. Visitors book, January 1892 - February 1910 (Kingswood 3/2287 part, pp. 1-10) 1 vol. (part)

29. Requisition and seed testing book, 1918-35 (Kingswood 3/2296) 1 vol.

Archives Office of N.S.W.
2 Globe Street
The Rocks
Sydney, NSW, 2000
Tel: (02) 237 0100

4. QUEENSLAND

Q.S.A. LOCATION NO.	DESCRIPTION
	FORESTRY DEPARTMENT
FOR/1	Cyclostyled 'Reply' by the Forestry Board to the Report of the Royal Commission on the development of North Queensland and associated papers, 1931
FOR/L1	Ledger of the Provisional Forestry Board, 1 May 1926 - 1 Jan. 1953
FOR/M1-3	Cash books of the provisional Forestry Board, 1 Oct. 1919 - 1 Oct. 1934
FOR/M4-5	Collection account cash books, 1 Jul. 1921 - 31 Jul. 1933
	LANDS DEPARTMENT
LAN/124	Report of the State Consultation Committee on development proposals on the economic survey of the Cabinetwood Forest Region North Queensland, and associated papers; and Report of the Forest Boundaries Committee on the areas applied for the Forest Reservations in the Brisbane Valley and Nanango Working Plan areas, 1931
LAN/AL 83 BATCH 287	Correspondence re forestry exhibits at agricultural shows, Jan. 1908 - Jan. 1922
LAN/AK 15 BATCH 12	Reports of areas under forest, 1898
LAN/A1-6 and LAN/A8-561	Letters received, 9 Aug. 1866 - 1 Dec. 1867, 14 Apr. 1868 - 8 Jul. 1970, 4 Jan. 1871 - 31 Dec. 1897, 8 Nov. 1880 - 29 Dec. 1911
LAN/B1 1866	Register of letter received, Aug. - Sep.
LAN/B1a-12b	Registers of letters received, Jan. 1869 - Dec. 1947
LAN/B127-161	Registers of letters received, 1963 - 66
LAN/C1-2	Indexes to registers of letters received Jan. 1866 - Jun. 1870

LAN/C1-4	General letterbooks, 4 May 1867 - 18 Oct. 1870
LAN/H1-11	Indexes to registers of letters received Jan. 1866 - June 1870
LAN/AKI-143	Correspondence batches, 1883 - 1935 Indexed by A/21899
A/21899	Batch indexes, ? - 1979
A/26107	Correspondence index c 1925 - c 1951
	LAND AGENT, INGHAM
LAG 12D/2	Register of reports received by the Forestry Office, and of instructions received by the Crown Lands Ranger, 9 Aug. 1918 - 4 Jan. 1935
	LANDS AND WORKS OFFICE
LWO/8-11	Letterbooks of letters on lands matters 15 Sept. 1863 - 3 May 1867
LWOO/12	Letterbooks on lands matters 3 Apr. 1862 - 15 Sep. 1863
LWO/13-15	Indexes to letterbooks of letters on lands matters, Apr. 1962 - May 1866
LWOA1-32	Letters received, 1862-66
LWO/B1-3	Registers of letter received, Apr. 1862 - Aug. 1866
LWO/C1-3	Indexes to registers of letters received, April 1862 - Aug. 1866
	COLONIAL SECRETARY'S OFFICE
COL/C1-2	Indexes to registers of letters received, 1861-77
COL/R1	Miscellaneous letterbooks, 10 Dec. 1859
COL/A1-35	General correspondence records, 1859-1862
COL/B1-3	Registers of letters received, 15 Dec. 1859 - 1862

Queensland State Archives
162 Annerley Road
Dutton Park, Qld, 4102
Tel: (07) 443 215

5. WESTERN AUSTRALIA

1. Registered correspondence files, 1896 - 1939

2. Registers and indexes, 1896 - 1915

(Post 1939 files have been retained by the Department of Conservation and Land Management)

J.S. Battye Library of W.A. History
40 James Street
Perth, WA, 6000
Tel: (09) 328 7466

6. NORTHERN TERRITORY

Series Fl	1.	53/382	Forestry NT Policy
	2.	55/466	Forestry Seeds
	3.	56/1866	Forestry Ordinance 1956
	4.	56/186	Forestry Nat. Policy

These files cover the years 1950 - 1961.

Northern Territory Archives
P.O. Box 39771
Winnellie, N.T. 5789
Tel: (089) 89 6017

7. TASMANIA

FORESTRY COMMISSION [TA 66]

DESCRIPTION		REFERENCE
General correspondence ('old system') 1916 - 1930	50 cm	FC 1
General correspondence, files Acc 1 - Tim 6 1914 - 1956	89 cm	FC 4
General correspondence, 'Archives Nos.' series c 1920 - 1983	75 m	FC 5
Index to general correspondence ('old system' FC1) 1922 - 1930	8 cm	FC 6
Register of file titles and some file numbers allocated c 1940 - 1960 ?		FC 30
Record of titles and contents of files withdrawn from the current file sequence. c 1940 - 1960 ?		FC 31
Correspondence and associated papers relating to E. Alexander's claim regarding irregularities permitted by the Lands and Surveys Department in administering timber leases in the Cradle Mountain area; to the case Alexander v. Williams; and to other matters touching the work of the Conservator of Forests 1919 - 1922	5 cm	FC 7
Correspondence and associated papers relating to the foundation of the Australian Forestry School 1920 - 1930	2 cm	FC 8
Correspondence and associated papers relating to the production of paper pulp c 1921	1 cm	FC 9
Correspondence and associated papers relating to plantation homes schemes and group settlement 1921 - 1929	2 cm	FC 10

Correspondence and associated papers relating to the establishment of a nursery at Sisters Hills, and to the maintenance of nurseries and plantations generally in North-West Tasmania 1921 - 1930	2 cm	FC 11
Correspondence and assosiated papers relating to the British Empire Exhibition 1923 - 1925	2 cm	FC 12
Correspondence, evidence, exhibits and associated papers in connection with a Joint Select Committee appointed to investigate and report on Rural Fire Control Feb. 1941	7 cm	FC 13
Miscellaneous papers relating to fire prevention and use of radio in fire control 1939 - 1953	1 cm	FC 35
Miscellaneous correspondence.	3 cm	FC 14
Miscellaneous unregistered correspondence c 1919 - c 1939	4 cm	FC 15
Copies of circulars sent from Head Office 1930 - 1936 1938 - 1939	2 cm	FC 16
Minutes of meetings of Forestry Department executives 9 Sep. 1940 - 10 Dec. 1943	4 cm	FC 32
Ministerial submissions to the Executive Council on matters relating to Forestry, and associated papers 1923 - 1929	3 cm	FC 17
Report of a forest survey of Tasmania by G.J. Rodger 1928	1 cm	FC 38
Report on reorganisation of the administration of Forestry Department, Tasmania, by A.V. Galbraith Dec. 1940	3 cm	FC 39
Proclamations creating state forests and and revoking forest reserves 1925 - 1926	5 mm	FC 18
Applications for registration as sawmills 1948 - 1954	30 cm	FC 19

Journal showing monthly balances of various departmental accounts Jan. 1943 - Jun. 1948	2 cm	FC 28
Notes on Tasmanian timber and trees n.d.	2 cm	FC 37
Newspaper cutting books relating to forestry and associated matters c 1921 - c 1929	60 cm	FC 34
Aerial photo-mosaics of forest areas 1930 - 1945	1 m	FC 2
Forest division topographical maps 1938 - 1944	5 cm	FC 3
Sketch map of National Park area 24 Oct 1949		FC 43
Plan illustrating the mode of systematic Wattle Culture, by G.S. Perrin, Conservator of Forests c 1880		FC 30

Smithton Office

General correspondence c 1935 - 1972	2 m	FC 44

Launceston Office - North-East Division

General correspondence c 1975 - 1978	1 m	FC 45

South-East Office

Diaries kept by forest ranger (T.K. Evans) 1952 - 1980	34 cm	FC 46
Register of applications for land selections by the Lands and Surveys Department for approval Jun. 1926 - Feb. 1941	4 cm	FC 20
Working plan for Sassafras and Mount Horror (Pieman River) areas. c 1930	1 cm	FC 21
Roneoed notes on state forest policy prepared by the Conservator for use by government in the Loan Council, and notes on post-war Forestry Programme 1943, Forestry Bill 1945, and statement by Chief Commissioner of	4 cm	FC 22

Forests 1948
c 1935 - 1936

Registers of applications for forest permits c 1900 - c 1940	20 cm	FC 36
Registers of licences issued for cutting timber, and royalties paid 1912 - c 1941	14 cm	FC 33
Example of timber licence and receipt Jul. 1947 - Oct. 1948	2 cm	FC 40
Example of timber licence Jun. - Sep. 1950	1 cm	FC 41
Collector's case book Nov. 1946 - Oct. 1949	1 cm	FC 42
Register of fees charged for the inspection of timber for export 27 Aug. 1910 - 11 Jul. 1924	4 cm	FC 23
Register of the amount of royalty due for timber cut under lease or permit Apr. 1921 - Jun. 1931	5 cm	FC 24
Register showing amounts due to the department by way of royalties Feb. 1943 - Apr. 1945	1 cm	FC 25
Cash book of departmental receipts 1 Apr. 1921 - 30 Jun. 1944	80 cm	FC 26
Registers of departmental expenditure Jul. 1926 - Dec. 1936	10 cm	FC 27

Archives Office of Tasmania
91 Murray Street
Hobart, Tas. 7000
Tel: (002) 30 2490

ARCHIVAL RESOURCES FOR FOREST HISTORY

Michael Saclier
Archives of Business and Labour
Australian National University, Canberra

Introduction

This paper is intended as a general survey of the archival resources available in Australia for the study of forests and land-use history. It makes no pretence, however, to being exhaustive. For example it contains little information on the major mainland manuscript libraries. The South Australian and Western Australian state archives are not included but it is very likely that there will be major resources on forests in those institutions. Details about records in the eastern states should enable generalisations which can be applied to the archives of the other two-thirds of the country.

The following are the kinds of archival records of interest to forest historians:

Government records specifically tagged 'forest' or 'forestry'

Government records not so tagged but likely to relate to forests in the sense of timber-producing areas

Government records likely to document changes in the overall botanical environment (land, conservation, exploration, mapping etc.)

Private papers relating to forestry and the botanical study of tree species of value for timber

Private papers relating to the exploitation of forest resources

Private papers shedding light on changes to the botanical environment

The obvious places to begin a survey of archival resourses are the records of state governments and, in particular, those departments and agencies which have been specifically charged with the administration of state forests. The following is a brief state by state review. The volume of material is recorded in shelf metres (e.g. 40 cm, 5 m).

Tasmania

A useful start in Tasmania is Wettenhall's Tasmanian Government Administration which sets out the chronology and a succinct history of the administration of forests in Tasmania.[1] This history points up one of the major issues to be considered in looking for forest records in the state archives. That is, prior to 1920 in

Tasmania, there was little in the way of administration of forests as a recognised economic resource of the state. Timber-getting on crown land was governed by regulations under successive Crown Lands Acts. Records relating to forests are therefore somewhat hard to come by. However after 1885 there was, from time to time, a conservator of forests in the Department of Lands and Surveys.

World War I engendered an appreciation of the importance of forest resources and in 1920 a Forestry Act was passed creating a Forestry Department and (of special interest) a special fund for 'forestry administration, afforestation, reafforestation and other works of forest improvement'.

From 1935 to 1968 the administration of fire prevention and control in rural areas, at first directly and then indirectly through the Rural Fires Board, was the responsibility of the Forestry Department (later the Forestry Commission). In 1968 following the disastrous fires of February 1967, the function was moved to the Chief Secretary's Department.

In 1945, allegations of maladministration in relation to forests forced the appointment of a royal commission which sat from December 1945 to May 1946. Its report prompted the creation in 1946 of the Forestry Commission which directly administers state forests and is involved in many peripheral activities.

The identifiable records of forestry in the Archives Office of Tasmania fall into three parts, one major and two minor. Two small series in the Lands and Surveys Department archives are:

LSD 73. Letterbook of the Conservator of Forests, including reports to the Minister for Lands and Works, 1887-1889

LSD 74. Surveyor-General's letterbooks of letters relating to timber-cutting, wattle-bark stripping and forest resources, 1895-1903, 1907-8, 1913-16

There are also the records of the 1946 Royal Commission on Forestry Administration including the transcripts of evidence.

Finally there are the records of the Forestry Commission itself which, when one examines them, turn out to engross the records of earlier administrations. Thus, the major series of correspondence are:

FC 1. General Correspondence ('old system'), 1916-30 (50 cm)

FC 2. General Correspondence, files Acc 1 - Tim 6, 1914-1956 (89 m)

FC 3. General Correspondence 'Archives Nos', c. 1920-1983 (75 m)

Apart from these, there are numerous small correspondence series on many aspects of the administration of the Department or Commission which would probably be equally well described as 'special bundles' in another place. There are also some registers of applications for permits and the like, for fairly extended periods, and miscellaneous other records.

On the whole, however, the holdings are disappointing in the sense that they are patchy, covering isolated short periods, and that many obvious kinds of records are missing entirely or are represented by fragments.

The most obvious lacunae are the absence of most of the records relating to revenue from forests and the absence of minutes of meetings of the Commission. Thus, for example, there is a Cash Book of departmental receipts 1921-1944 (FC 26) and various registers of royalties due and similar records, but there is no coherent set of financial records to provide a picture of the income derived from forests by way of fees and royalties. Some of this story will appear in the correspondence series. More of it will probably be available through the records of the Treasury given that each each year the income of the Department (later the Commission) was paid into consolidated revenue and then the following year part or all was paid into the forestry fund.

Similarly the only minutes available are of meetings of Forestry Department executives 1940-43.

Note, however, one metre of aerial photo-mosaics of forest areas dated 1930-1945 (FC 2). This early material should, I imagine, prove valuable when compared with modern aerial material from the Lands and Surveys mapping programme and from Landsat.

Two interesting peripheral series are :

FC 44. Smithton Office - General Correspondence c. 1935-1972 (2 m)

FC 46. South-East Office - Diaries kept by forest ranger (T.K. Evans) 1952-1980 (34 cm)

Do not ignore the fact that there are more individual deposits of family and estate papers in Tasmania than anywhere else. Many of these relate to very long-standing farming estates - from the 1820s for example - and have much to say about the primaeval environment which the original settlers found and about the effects of humans on that environment.

The Archives Office itself has private papers of this kind (see particularly the records of the Van Diemen's Land Company) while others are in the Allport Museum and Library and in the Sir William Crowther Collection in the State Library.

Do not forget the collections of the Royal Society of Tasmania. These are now in the library and archives of the University of Tasmania. The Royal Society was founded in the late 1830s during the governorship of Sir John Franklin and was the centre of Hobart intellectual life. The Proceedings of the Society would probably contain much of interest and profit, but in addition it accumulated a major library and a considerable quantity of papers.

Victoria

In Victoria the control of forests was originally a function of the Board of Crown Lands and Survey, but it subsequently passed through a number of other departments. In 1882, forests were controlled by the Department of Agriculture but returned to Crown Lands in 1888 as 'State Forests and Nurseries'. Forests were transferred to Mines in 1892, back to Lands again the following year, and to Agriculture once more in 1903.

The Department of State Forests was created in 1908 and the Forests Commission within that department in 1918. These survived their subsumption into the super-department of Conservation, Forests and Lands in 1983. The State Forests and Lands Services is the agency now responsible for the management and protection of forested lands (as well as the administration of other crown lands).

The records in custody[2] are somewhat disappointing. The major series are :

VPRS 3222. Forests Commission, Minutes of Meetings 1918-78 (6 films, 1 envelope)

VPRS 10568. Correspondence - Annual Reports 1921-1960 (13 boxes)

VPRS 10567. Correspondence re Occupation (81 boxes). This series is said in the List of Holdings to date from 1953 but this seems unlikely.

All of these records are open and all are at the Laverton repository of the Public Records Office of Victoria.

There are, of course, numerous other series bearing on the history of the administration of forest administration (i.e. its place in the bureaucracy) rather than on the administration of forests.

By contrast, the records of the lands administration (under which forestry resided for most of the 19th century) are detailed and voluminous and I suspect that there is much of value amongst them.

The La Trobe Library collection should also be examined for the kinds of family and estate papers previously noted for Tasmania.

New South Wales

The administrative procedure seems to have followed much the same pattern in New South Wales as in Victoria and Tasmania. A Royal Commission in 1907 'into the effectiveness of the forest laws' prompted the enactment of the Forestry Act, 1909, and the creation under it of a Forestry Department headed by a Director of Forests.

For whatever reason, the 1909 Act lasted only until 1916, when a new Act was passed constituting a Forestry Commission in addition to the Department. Richard Dalrymple Hay (who had been Director of Forests) became permanent head of the Department and, from 1918, Chief Commissioner. This administrative arrangement appears to have remained until 1944.

If the records of Tasmania and Victoria are disappointing, one can only describe the New South Wales archival holdings as a disaster. There is virtually nothing to show for nearly 80 years of forest administration. There are, however, some sad indications. For example there is a series called Registered Files 1897-1972, which might lead one to think that here would be found the heart of forestry administration in NSW. Alas, the series measures less than two metres and may indeed be less than one - depending on the size of the '6 boxes'. Similarly there is a series called Papers concerning Eucalypts 1911-1924. This single box of material is described as being composed of 'Ecological Files 6-7'.

Both these series suggest that they have been the victim of 'Great Grey Weeder'. This virulent pest is usually 58-63 years of age and a middle-management type within the department. He has a short time to go to retirement and cannot be sacked or otherwise exterminated. Rather than permitting his further depredations in the workplace he is moved out of the chain of command and given the job of 'doing something about records'. 'Doing something' usually means destroying everything except Victor Trumper's application for employment as a junior temporary clerk and similar wonders.

Since the records listed above were deposited there has been an agreement to make some minor accessions of records. I have no quantities available and my informant was not certain that all or any had actually been received - only that they were to be deposited. The series involved and their date ranges are as follows:

Occupation Permit Files 1917 +
Sawmill Licence Files (Private Property) 1917 +
Forest Lease Files (Sample only, 6 per year) 1917-87
Unauthorised Operations (Prosecutions) Files 1965+

I am given to understand that the Forestry Commission in NSW is a law unto itself and it is possible that it retains good records. It would not be life-affirming behaviour, however, to hold one's breath until these are released first to the Archives and then to the research-oriented public.

Almost the only good news is in the photographic area. There are 288 boxes of aerial photographs of state forests in NSW dating from the mid-1930s to 1956 (11/1-75, 11/110-322). There is a full listing. Apparently there has been a subsequent deposit of similar material. There are 60 sheets of aerial mosaics of the Pilliga dating from 1938 (Kingswood AO Map Nos 18981-19040) and there are six key maps to this series (6194-6199). There are also five boxes of miscellaneous photographs of forests and nurseries, activities, people and equipment dating from around 1910 to 1960.

There is a small cache of records relating to the Gosford State Nursery. The earliest of these date from 1892, but the interesting material is basically from the first to the fourth decades - especially despatch books of plants distributed from 1899-1935, and a requisition and seed testing book 1918-35.

It is worth noting that there is another source of information about forest administration in New South Wales which, prima facie, looks a better source of information than the Forestry Commission itself. This is the Conservation Department which existed from 1944 to 1974. The Forestry Commission was 'brought under the control' of the Minister for Conservation in 1944 and under the Department of Conservation by the Conservation Authority Act, 1949. In 1975 the Department of Conservation was abolished and the Forestry Commission transferred to the Lands Department.

There are 121 boxes of correspondence files from 1945-74 at Kingswood (10/3408-3528) dealing with (amongst other things) a good many forestry issues. There are 27 boxes (10/3562-3588) of correspondence files from the Forestry Commission 1955-74. A series of three boxes dealing with the Eden woodchip industry 1967-74 (10/3588-3590) and another one of five boxes dealing with the NSW Timber Advisory Council 1965-74 (10/3591-3596).

The Mitchell Library is a repository which must be considered. The following are some examples of the holdings:

> Elizabeth Yabsley, Diary kept at Coraki 1968-69. (1 vol., 63 pp.) Record of work done in shipbuilding and timber business of William Yabsley at Coraki. (B1180)
>
> William Carron, Fieldbooks, 1870-1871. (2 vols) Data on forest reserves in the Boyd, Clarence, Richmond and Tweed districts. (C351-352)
>
> William Carron, Fieldbooks, 1875. (2 vols) Kept while collecting timber on the Clarence and Richmond Rivers for the Philadelphia Exhibition 1876. Diary and descriptions of 74 specimens
>
> E.H.F. Swain, Reports and other papers on forestry in Qld, SA & NSW, 1931-48. (18 vols) Printed and duplicated material. (A3119-3136)
>
> Nicholas & Reymond, Cash and Account Books, 1866-1893. (2 vols) Joseph Bernard Reymond and Auguste Nicholas founded a sawmill in Forbes in 1861 and in 1870 began operating a flourmill.

The above are simply some items selected from the index of the two volumes of the printed catalogue produced in 1967 and 1969 of material acquired from 1945-1967. No account has been taken of more allusive material which may be of more value - e.g. the Macarthur Papers. The researcher must necessarily attend to both the pre-1945 dictionary catalogue and other finding aids and to the finding aids subsequent to Volume B of the printed catalogue.

Queensland

The Queensland State Archives has provided a skeleton list which indicates that there is not much joy to be had in the records explicitly labelled 'forests'.

Forests were the responsibility of the Colonial Secretary's Office from 1859 to 1862, of the Lands and Works Office from 1863 to 1866 and of the Lands Department from 1866 on. Finding material on forestry is, therefore, very much a matter of searching the general records of those offices.

There was (and presumably still is) a Forestry Department but the only deposited records are of a Provisional Forestry Board which existed from 1924 to 1932.

Australian Capital Territory

In the ACT you should not ignore the holdings of the Archives of Business and Labour. The following are significant:

Z210. NSW Forest Products Association. Mainly files 1970+ (c. 10 m)

Z261. Victorian Sawmillers' Association (and Hardwood Sawmillers Association of Victoria) c. 1920-1980+ (19 m)

Z163. J. Wright & Sons (and predecessors and subsidiaries). Minutes, financial, stock, wages and other records, c 1960-1965 (but main range much narrower - no minutes before 1950). (c. 10 m)

44. Allen Taylor & Co. Ltd. Miscellaneous fragmentary records for various periods from 1896 to 1945. (1 m) A major collection from this company is in the Mitchell Library.

Bowen & Pomeroy Pty Ltd. Most types of records 1910-1955 but mostly 1930s-1940s. (1 m and 1 reel)

Australian Timber Workers Union, Federal Office and NSW, SA, Vic and Tas Branches. (c. 26 m) All kinds of records.

In addition to the overt material relating to forestry, the Archives holds large quantities of material relating to the pastoral industry from as early as 1826 and routinely from the 1880s. This contains a great deal of information about the landscape virtually from the time of first white settlement in many areas and continues that information forward over long periods. The records also shed light in some cases on the methods of working (e.g. felling, ringbarking, burning) which affect the landscape.

The National Library Manuscript collection should also be considered where, for example, a collection of C.E. Lane Poole's papers are held (MSS 3799).

The Department of Territories records in the Australian Archives will presumably supply information relating to the pine forests in the ACT, while other Commonwealth agencies will certainly be found to have something to say about timber, its growing, and trade in it - for example CSIRO (records of the Forest Research Division and its predecessors), Trade, the Tariff Board, and so on.

Conclusion

In conclusion, it should hardly need saying that there is likely to be need for a certain amount of lateral thinking in looking for records relating to forest history. In talking about Tasmania I mentioned the likelihood of Treasury records being useful (if they have survived). This is equally true in other states - and the pessimistic caveat is just as important.

As we have seen, Forestry as a discrete department of state tends to appear fairly late in state administration, and for much of our history the details of timber harvesting and its administration are to be found first in such areas as the Colonial Secretary's office and later in Lands and Public Works.

Often these records will be allusive rather than declamatory. They will need to be followed with patience and perseverence - often through seemingly endless registers following an annual single number registration system. There will be a need for sensitivity and imagination in searching out material.

Notes

1. Wettenhall, R.L., 1968 Tasmanian Government Administration (Hobart)

2. In custody in 1985. At the time of preparing the paper I was unable to verify what deposits of records have taken place since the Public Records Office of Victoria published its List of Holdings.

ORAL HISTORY SOURCES FOR AUSTRALIAN FOREST HISTORY

Jennifer Gall
National Library of Australia
Canberra, ACT

The Man with the Pipe

Back in the 1940s in the timber world down here
Talk of Japanese wood-chips would've sounded mighty queer
Before the buzz of the chain-saw you could here the broad-axe ring
For in the ridges and gullies along this coast the sleeper cutter was king.

From Bateman's Bay to Eden wherever the boats could call
The timber ships from New Zealand were a welcome sight to all
Cutters camped and slaved and swore and the prospect of a pass
Meant some days in civilisation and the chance to raise a glass

The trucks brought sleepers from near and far and stacked them twenty high
Returned to the bush for the final load and to bring it in or die
Down in an awful gully or across a boggy creek
Or around the side of a mountain where you might be stuck for a week

Changing wheels in the pitch-black dark, swearing at the rain
Unloading sleepers in a bog, then loading them on again
I dips my lid to the carters, they knew what they had to do
For the cutters, cheques and theirs as well depended on getting through

Quite an event was the Pass day, and when the time was ripe
The inspector arrived upon the scene, his name - 'the man with the pipe'
A tall straight man with an eagle-eye and an air that made it clear
Your sleepers had to be up to scratch or take them away from here

Some thought the man with the pipe was tough, others thought him not
But the man knew the timber he wanted and that was the timber he got
Thousands of sleepers were turned each week for the man with the pipe to see
The cutters came to respect him and it's evident to me
The bushman put to the test and quickly came to see that
The man with the pipe was a bushman too, with a great philosophy

'For the piece of timber, my boy' said he, after a long hard day
'Each has its fault if you look close enough and you look in a certain way
If its got one fault then pass that fault, we really shouldn't take any

But if that piece has two faults, then that's two faults too bloody many'

'I promised Ron I wouldn't swear any more through this because I know that some people become offended ...'

Joe Caddy - born 1924, interviewed in 1975 at the age of 51 by Ron Stafford for the Tathra Historical Society, describing the life of a Tathra sleeper cutter, comparing the conditions of his youth with the modern demand for woodchips.

Recorded 25/9/1975
TRC 520/2
NLA Oral History Collection

Oral history has been defined, rather unkindly, as 'geriatric debriefing'. This description evokes images of a generation of eager historians armed with portable tape-machines and their best bedside manners searching the countryside in an attempt to record the Voice of Our Heritage before anecdotes of the Real Australia vanish beneath the media-tainted ramblings of the post-television generation.

In fact, oral history is not an invention of the technological age - it has much more venerable origins. The oral tradition, in many cultures, extends back through time, persisting as a link with the distant past where the written word did not exist.

Ancient historians from many different cultures quoted information from witnesses of the major events they were chronicling. Herodotus' The Histories is a particularly entertaining and remarkably modern piece of writing because of the broad spectrum of source material he uses. The Histories depicts the colourful kaleidoscope of political, military and social events described and explained with reference to the legends, customs and religious practices of those who lived at the time.

In comparison with the short recorded history of our Australian forests, European forestry records date back hundreds of years. As well, forest history is strongly represented in the oral traditions of each country's folklore. It is fascinating to read early documents describing forest management and to see that frequently these are transcriptions of foresters' reports. In a statement to the Dean Forest Commissioner in 1788, Miles Hartland, an English forest official, describes the encroachment of cottagers on the forest:

> ... the greater number of the cottagers are from the neighbouring parishes; but there are also a great many from Wales, and from various parts of England, remote from the forest. They are detrimental to the forest by cutting wood for fuel, and for building huts, and making fences round the patches which they enclose from the forest; by keeping pigs, sheep and co., in the forest all the year, and by stealing timber.[1]

By talking to people about their perceptions of events, the distance is reduced between the historian and the subject of the history. As well, paths for discovering new information are opened. These are the strengths of oral history which have been recognised for generations.

In the 20th century, oral history is alive and well as a method of historical research. Many traditional 'print oriented' historians insist that, as a valid medium for research, oral history is good only in part and must be interpreted in relation to all available documents. However the reality is that modern technology enables us to revive the art of listening to and recording the impressions and opinions of others with great accuracy. For the first time the opportunity to record the actual sound of someone's voice is available to all of us, and as Professor Patrick O'Farrell has remarked:

> ... whether anybody likes it or not, oral history is likely to remain a significant aspect of historical activity: the technology, the outlets and the demand continue.[2]

The importance of oral history in Australia as a serious medium of research is reflected in the collections of the National Library which now contain over 30 000 tape recordings, many with accompanying transcripts, dating from the 1930s. Subjects range through Federal politics to art, music theatre, literature, ballet, church history, law, science, technology, academic law, folk music and folklore, Aboriginal history and environmental issues.

Several of these subject areas encompass many aspects of forest history, so I have restricted the examples I am quoting to interviews specifically with people living or working in forests. Our on-going series of interviews with the poet Judith Wright typify oral history which examines forest history from a political, environmental and literary standpoint. There are a host of other interviews of this nature in the collections.

Australia's oldest oral history belongs to our Aboriginal peoples. Their dreamtime stories are still transmitted orally within their own tribes. Since white settlement, Europeans have attempted to transcribe Aboriginal legends and to preserve in words the pattern of life of a people who had no written tradition. To people like F.A. Fitzpatrick, a collector of reminiscences from the Manning district in the early 1900s, we owe descriptions which clearly depict the interaction of the Aboriginal people with their environment.

The following is a description of the preparations for the Aboriginal ceremony of 'Man Making' in the Manning district. It comes from the recollections of Mr John Allen in his descriptions of Aboriginal life in the late 19th century.

> The blacks next began to prepare for the important event, by making two rings - one on top of a low ridge, and the other on a level place at the bottom. This latter was established

> in a roomy place, so that all the gins could camp there, close to the ring. The trees all around the top ring were carved in a fantastic manner. The bark was cut through and bore peculiar marks - waving lines (diamond shaped), and all sorts of fancy patterns. The women and children, it might here be pointed out, were forbidden to approach near the top ring. They were told that the marks on the trees were made by the 'Devil Devil', or Spirits. The rings were formed by clearing off the surface soil, and piling it round in ring shape. The two rings were connected by a pathway. The remains of these rings were to be seen for many years on Kimbriki, but the marks on the trees soon were overgrown, as they were only bark deep. We often came across them in the mountains, up at Cooplacurripa, where, judging by their number, the blacks must have been numerous in the long ago. The top ring was made very smooth, and was then carpeted with leaves. A fire was made in the centre of it, and was never allowed to go out.[3]

These early transcriptions and the continuing interviews with Aboriginals conducted by linguists, anthropologists, historians and archaeologists create a bridge from the recent past into the deeper past where written records are non-existent.

Oral history is thus extremely useful for reconstructing the pattern of Aboriginal interaction with the forests by using the archaeological and physical evidence in the environment as a basis for questioning informants.

Tom Roberts, an aboriginal of Coraki in the Northern Rivers district, is such an informant. In a recent interview with Chris Sullivan,[4] a National Library oral history collector, he describes how the local people would go into the scrub to collect timber for boomerangs and nulla nullas. He himself brought back timber to make spears. Mr Roberts also describes the making of the Bundjalung tribe's Bora Ring at Wyrallah in the days before white settlement, explaining how the rainforest was cleared with axes.

Folklore is another branch of oral history which reaches back into our pre-literary past, encompassing yarns, folk music, folk songs and customs of ordinary people.

A particularly enjoyable timber-getting yarn describes an adventure of 'Big Dan Withers', who apparently was a hero in his own time in the cedar-cutting camps around Lismore in the 1950s. Louise Tiffany Daley in Men and a River retells the tale of how Dan tackled a bad log jam in one of the creeks:

> The timber was tightly wedged in a heaving mass two or three hundred yards long, but Big Dan with his handspike sprang to the rescue. As he inserted it and gave a mighty shove, the logs leapt forward with a crack like a rifle, his foot slipped and he was sucked underneath!

'Dan is gone, he is under the block' wailed his mates, but Dan was a superman. He dived and swam under the block to come out, weak and exhausted, fifteen yards in front. Without doubt, 'he was a wonderful man in a creek'.[5]

One can imagine that stirring stories like the tale of courageous and daring Dan Withers were a very important means of boosting morale for the cedar cutters and their families, who faced serious injury and perhaps death, daily.

I would like to include two items of folk material collected by Warren Fahey:[6] the well-known song 'Bullocky-O' and 'Stuck Up at the Mill'. These items were collected from Cyril Dunean in June 1973.

BULLOCKY-O

I draw for Smeckle's Mill, bullocky-O, bullocky-O,
And there's many a log I drew, bullocky-O.
I draw cedar, beech and pine, and I never get on the wine;
I'm the king of bullock drivers, don't you know,
Bullocky-O, bullocky-O.

There's Guinea and Wapples too, bullocky-O, bullocky-O,
And it's many a log they drew, bullocky-O.
I can tell you it's no slander when I say I raise their dander,
When they hear the crack of me whip, bullocky-O, bullocky-O.

There's Anderson and Cameron too, bullocky-O, bullocky-O,
And it's many a log they drew, bullocky-O.
I can give them a hundred feet, act square and never cheat,
I'm the king of bullock drivers, don't you know,
Bullocky-O, bullocky-O.

STUCK UP AT THE MILL

For bullock bells at night keep me wake till daylight,
You can get no sleep at the mill,
It was there Harry Hassler the blue ribbon took,
And out of my bottle had his fill,
For his hair I think he tore, and I'm much afraid he swore,
When he got stuck up at the mill.

'Gee Ratler' he cried, 'I'll tan your old hide', (rattler)
And down came the whip with a will,
For his hair I think he tore,
And I'm much afraid he swore,
When he got stuck up at the mill.

These folk items demonstrate the creation of an idiom by ordinary people to illustrate how they saw the lives that they led and how they gave a meaning to everyday events.

Researching this kind of folk material, and, indeed, any kind of oral history, is both rewarding and frustrating. The quality of the tape recording you are listening to can be poor, the interviewer may be inexperienced and cut the interviewee off before they have finished relating an interesting collection, or the interviewee will decide that they have simply had enough.

Oral history is really like the anecdote about the two women eating in the cafeteria at Sydney's Central Station. One woman remarks to her companion 'Isn't this meal awful' and her friend replies 'Yes, and such small portions!'.

That is often the way it seems with oral history recordings - especially those made in the early days of tape-recording machines. However, at its best, oral history brings us closer to the experiences and conceptions of people who were involved daily in making a living in our forests or in any other pastime.

When listening to, or reading the transcripts of, most oral history relating to Australian forests, it becomes clear that the timber cutters and their families cleared the forest to survive, and if possible earn a living, often with the intention of establishing a family farm which would be passed on to future generations. In many cases the forest was cleared rapidly to create pasture for the timber-hauling bullocks. It is important to understand the motivation that drove the early settlers in search of timber, although it is not a justification for the kind of timber felling which has destroyed many of our rainforests.

The recollections of a timber cutter's day-to-day life tell us more about the reasons for the clearing of the forests than the sometimes romanticised written interpretations or guilt-driven cultural criticism from our own perspective of forest history.

The Northern Rivers area of NSW is rich in documents which describe the history of the impact of the timber industry on its forests.

Recent oral history research has revealed interesting patterns in the way in which timber getters combined their search for timber with the establishment of farming properties. In one interview, Sid Duncan, a Queenslander and a relative of Cyril Duncan, talks about two of his uncles who worked together using the proceeds from the sale of their dairy farm to keep their timber-getting operations going.

> They was timber men, though they owned a couple of farms, they cleared a couple of dairy farms and they sold their farms; they had bullock teams ... they had a bullock team, like the two of them worked together, they'd fall the timber and pull the timber out and take it to Nerang, take it down to Gilston and they'd load it on a wagon down here near Advancetown and when they got a wagon load they'd take it in to Nerang and send it up to Brisbane on the train. That was how they made their living ... sell a few bullocks or cows and that if they had a bit of grass to spare. They was great

> timber men, dressed girders for bridges and sleepers and all sorts of timber where it required dressing with the broad axe.[7]

Dick Rummery, born in Casino in 1901, describes his earliest recollections of his father's farm at Tomki:

> It was just dug out of the jungle on a big bend of the creek like that; it was all just thick rain forest jungle in those days all round it and one of the happy recollections of it is that the place was everywhere, around the fences, around the trees, all the scrub and around the trees, and only a quarter of a mile up the road there was a little road into the real rainforest - passionfruit grew wild ...[8]

This was his grandfather's original selection taken up in the 1880s or 90s.

Both Dick's father and uncles were farmers and timber men and he recalls his father's far-sighted advice to his uncles about the danger of over-clearing their land:

> I heard him going crook on them. 'You cut one bloody tree down on the slope ... to put one more cow in the herd or something like that ... and the time'll come', he says, 'when you'll get a few more down', he says, 'you'll get erosion from there', he says, 'and you'll have bare hillsides' ... which is borne out because I've been up at Back Creek and ... in those days when we were kids, the creek was deep ... clean, clear water, nowadays I think you'd be flat out to find more than two or three feet of water in most of that creek it's all been eroded - its all silted up.[9]

Oral history reveals the impact of technological change in human terms. Mrs Pascoe of Tooloom, in her interview with Ms Inga Reibe, describes her life on the property of her husband's family where she moved in 1938. She went out camping with her husband when he went clearing timber on either his father's property or on forestry department land until her son was born. Her greatest anxiety for her husband grew out of the introduction of the chainsaw. She recollects:

> I never used to worry so much when he had the crosscut saw because you used to hear the tree cracking before it fell. But once they got chain saws there was no noise; too much noise from the saw to hear the tree and he was frightened himself a lot of times then.[10]

Mrs Pascoe's son Terry began working with his father when aged 15 or 16. He made an unsuccessful attempt at cutting timber himself and went to work for the local timber mill. He supported himself and his family by working for the mill while running cattle on his father's property which he had inherited as the home for his family.

Another interesting part of Mrs Pascoe's recollections refers to her father-in-law's activities on the original selection. She believes that he did only a small amount of timber getting, selling the logs he felled to a partnership who used bullock teams to pull the logs to Koreelah.

A possibility for this pattern of logging on the farm is that until the forest was cleared there would not be sufficient grass to feed a bullock team. Probably financial constraints kept him at work for other cutters or at the mill away from home. It was not until the second or third generation in some cases that a family finally cleared their own property entirely.

Mr Foreman Crawford from the Nerang area describes an interesting migratory trend explaining why settlers moved up the narrow coastal land strip in the late 19th century into Queensland, rather than spreading inland from the north coast of NSW:

> ... see, Queensland was a newer place and when land got scarce here, for selection, well, they'd go up to Queensland and they could get land a lot cheaper. See, the land began to get too dear for people to buy here; people were coming from other places with money and they could buy from the original selectors here; and so the family of all the people who settled here in the Big Scrub, they had to look further afield, and up the coast they would go, some of them went to Maleny and Caboolture, and a lot of those places, you see.
>
> When do you think that move to Queensland started, about?
>
> Oh, I would say about 1900, somewhere around about 1900.

The exciting thing about oral history is that a 'source' can be just about anyone you care to talk to. While interviewing people about their careers in early Australian aviation, I was introduced to Mr Nigel Broadsmith. On visiting him, I discovered that his father, Harry Broadsmith, had travelled the east coast of Australia in the early 1920s in search of native timbers suitable for manufacturing aircraft.

> He chose mountain ash (<u>Eucalyptus gigantea</u> [<u>E. regnans</u>]) for mainplane spars, interplane struts, fuselage longerons and front fuselage struts, cudgerie for rear fuselage struts, blue fig for secondary members and fairings; and Queensland maple and rosewood for propellers.

Journeys to the timber mills were made by train to the nearest country town, then by car along the bullock tracks to the sawmills, and by horseback along the ranges. As well as transport difficulties, Broadsmith had trouble communicating with mill owners once back in Sydney. As he soon discovered, some mill owners were illiterate and depended on school children to read customers' letters. At isolated mills, letters often lay unacknowledged until someone who could read passed by.

Some of the mill owners' responses to Broadsmith's inquiries make amusing reading now, but at the time, when the company was bound to a time limit, they must have been extremely frustrating, as the following example highlights:

> Mr HE Broadsmith
> Dear Sir
> Your letter of 20th ins. to hand & I note all you say. Re the test that doth please me much - but when I read you want such big timber - doth anger me. I cannot do it at that size. It would take a log three feet diameter to cut them on the quarter, and they don't grow that big ... So, I am sorry to say there is no business doing ...[12]

Unfortunately the government refused to purchase the original number of aircraft they had commissioned. Broadsmith never fulfilled his dream of utilising native Australian timbers to establish an Australian aircraft building industry. However his extensive notes documenting his timber testing and the correspondence relating to his search for ideal timber specimens remain as an interesting element of Australian forest history.

Oral history interviews often result in other documents such as journals, letters and photographs coming to light. These are very useful additions to the information recorded during an interview as they enable the researcher to cross check dates, clarify the order of events and correct the spelling of place names or of people's names.

Local historical societies are the ideal starting place for locating names of people to interview or for finding tapes of transcripts of those who have already been interviewed. Community Oral History Projects are rapidly becoming more popular throughout Australia.

New material is constantly appearing or resurfacing from archives, like the McQuilty tape, which resides with the Northern Rivers Historical Society. It is an interview conducted in 1954 at Kyogle with Frank McQuilty, who was then aged about 90. He grew up in the Big Scrub in the early days of rainforest clearing and was a fluent speaker of Bandjalang - the local Aboriginal language.

The McQuilty tape epitomises the value of oral history as the record of spoken information which provides unique material for historical analysis of our forests.

REFERENCES

1. Havins, P.J.N., The Forests of England, London, 1976.

2. O'Farrell, P., 'The Great Oral History debate Revisited', Quadrant, July 1987. p.10.

3. Allen, J., in Peeps into the Past, Reminiscences of the Blacks: Pioneering Days on the Manning by F.A. Fitzpatrick, Taree, 1986. p.74.

4. Sullivan, C., Interview with Mr Tom Roberts of Coralis, TRC 2189, Oral History Collection, NLA.

5. Clark, A. (Cornstalk) 'Stories of the Pioneering Days'; in J. Greenhalgh, 'A Cedar Getter's Life', ed. E. Bray, Richmond River Historical Society: quoted in Men and a River by L.T. Daley, Melbourne Univ. Press, Carlton p.38.

6. Fahey, W.: J. Field Collection. TRC 321/36 Cyril Duncan sings 'Bullocky-O!' and 'Stuck Up at the Mill'.

7. Sullivan, C., Interview with Sid and Len Duncan, TRC 2189/28219, Oral History Collection, NLA.

8. Sullivan, C., Interview with Dick Rummery, TRC 2189/1&2, Oral History Collection, NLA.

9. Ibid.

10. Reibe, I., Interview with Mrs Pascoe of Tooloom, Oral History Collection, NLA.

11. Reibe, I., Interview with Foreman Crawford, NSW Council on the Ageing No. 139.

12. Gall, J., Bullocks to Boeings, AGPS, Canberra, 1986, pp.13-14.

13. Daley, L.T. & Stitt, R., Interview with Frank McQuilty, Richmond River Historical Society, 1954. Held by the Australian Institute of Aboriginal Studies and Richmond River Historical Society.
(It was estimated that McQuilty was 90 years old at the time of recording.)

Acknowledgement

This paper draws on information researched by Dr. Edgar Waters for his report concerning the oral history of communities who have worked or lived in the northern rainforests of NSW, recently prepared for the NSW National Parks and Wildlife Service. I am grateful for his assistance.

THE AUSTRALIAN BICENTENNIAL HISTORIC RECORDS SEARCH AND SOURCES FOR FOREST HISTORY

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> I'd like to see the guns that were firing that evening at Armentiers turned onto your paddock they would clear plow and subsoil it in no time besides there would be a small fortune in steel and copper strewn about.

This unorthodox approach to forest clearing was proposed by Alfred Horatio Weatherhead and was written in the trenches somewhere in France on 29 September 1916. Alf belonged to the Weatherhead family, which operated sawmills at Lyonville and North Tynong in Victoria. Letters by Alf and his oldest brother, Horatio (see quote below), are similar to those located by the Australian Bicentennial Historic Records Search (ABHRS) which will provide a new range of sources for forest history-sources which will, in particular, put people into forest history: their attitudes, their world view, their personalities.

The ABHRS is a major heritage project funded by the Australian Bicentennial Authority with assistance from the National Library of Australia through the provision of accommodation for ABHRS project staff and general support. Additional grants, bringing total funding to $1.5m, were received from the Tasmanian, New South Wales and ACT and Island Territories Councils of the Australian Bicentennial Authority and from a private trust. These enabled pilot searches during the planning phase in 1986, the employment of extra field officers, a target search for business records in Adelaide, and the extension of the search to Cocos, Christmas and Norfolk Islands.

The aim of ABHRS has been to locate and describe records held by individuals, families, businesses and community organisations and to list the descriptions in the Australian Historic Records Register if the owners are willing to allow researchers access to the records. In addition the search has endeavoured to raise consciousness of the important contribution privately owned records can make to a better understanding of our past and of the need to ensure that such records are properly cared for. All of the records listed in the Register remain with their owners. Consequently, all owners were given a leaflet titled 'Caring for Your Records', which provides simple advice on the storage and handling of records, and they were shown a range of archival materials suitable for storage and display.

SEARCH STRATEGIES

During the search, which ran from 1 May 1987 to 30 April 1988, two major strategies were used to record information about privately held records:

- appraisal and description by field officers
- description by contributors.

Appraisal and description by field officers

Thirty-seven field officers were employed across Australia and ABHRS staff members visited the Island Territories. All of the field officers had a sound knowledge of Australian history and, especially, of the regions in which they worked, although not all of them held formal qualifications. Many of them had worked as teachers, archivists or librarians and the contacts they had already established, together with organising skills, proved invaluable. Our experience during the pilot searches had shown that owners took time to become used to the idea of the search and to accept that we did not wish to take their records away. Therefore most of the field officers were employed part-time over a longer period rather than full-time over a short period.

The tasks of the field officers included:

- promoting the search through public speaking, personal contact, the print media, radio and television and by distributing brochures by all means possible
- visiting owners to appraise their records
- describing records according to a specified format and vocabulary.

The field officers underwent a short but intensive period of training covering all these aspects and were provided with a handbook to reinforce the training and act as a reference when they began work in their regions. All were visited at least once by a project officer and they attended State Advisory Committee meetings during which they had opportunities to raise problems, give each other moral support, and seek advice from project officers or committee members. In addition, telephone calls to the ABHRS office, monthly reports, and Off the Record (an occasional newsletter) kept field officers and ABHRS staff in contact.

The method of description used by the field officers is basically that used for describing archives: identification and description of record groups on the basis of provenance. Some minor adaptions were made to accommodate problems encountered, particularly in family records. The basic elements of information sought were:

- name of the creator/accumulator of the records

- the type of record (e.g. minute books, annual reports, diaries, maps, photographs, sketchbooks, technical drawings)

- the dates or date range covered by the records

- quantity.

In addition, some idea of the context in which the records were created and of the subject of the records was noted, although, in the limited time available, it was not possible for the field officers to read all letters and diaries or to note the subjects of all photographs. Structured work sheets were provided to prompt field officers to record these elements of information for each record they described.

Contributor description

To enable us to target specific types of records, and to ensure that owners whom time or distance prevented field officers from visiting could still take part in the search, a range of contributor description forms was developed. These aimed to elicit the same elements of information recorded by the field officers. Inevitably, the consistency with which contributors filled them in varied so that often the information was incomplete and sometimes so minimal that the forms had to be abandoned. Time constraints meant that our editors could not give contributor descriptions the intense level of checking and follow-up needed to ensure accuracy and completeness. Hence they do not conform to the record groups and series format of records described by the field officers, and contributor entries in the Register begin with a reminder that the information was supplied entirely by contributors.

The majority of contributor entries have resulted from targeting specific types of records or specific populations, such as professional and business women and men, politicians and political parties, Vietnam veterans, and the records of people from non-English-speaking backgrounds. Several of these targets were undertaken in co-operation with other organisations. The Australian Science Archives Project at Melbourne University and the Archives of Business and Labour at the Australian National University assisted with surveys of science and business records, and the RSL offered co-operation in locating military records.

THE ABHRS DATABASE

The information supplied by field officers and contributors is being compiled on a Compaq 386 microcomputer using microCAIRS software which has been adapted to ABHRS specifications. MicroCAIRS is an information retrieval system which has thesaurus and indexing facilities.

Originally an online database was envisaged. However, in view of the wide range of projected users of the Register and in the light of the Australian Bicentennial Authority's wish that the Register be readily available in all of the areas across Australia from which information has been received, we decided that a hardcopy product would be more appropriate. However the database is compatible with upgrading to an online system in the future.

Researchers wishing to obtain a special report listing, for example, all the timber industry business records for the inter-war years, 1919-1934, or all the records, regardless of type, relating to the year 1860, will be able to contact the National Library. Such in-house online searches are possible.

THE ABHRS THESAURUS

Access to the information in the Register will be via the index. To ensure uniformity in the descriptors (index headings) proposed by the thirty-seven field officers, and to provide them with inspiration, a thesaurus was provided. As there was no adequate thesaurus of terms suited to the description of Australian historical materials on a nation-wide basis and covering the concerns of 200+ years, we compiled one, drawing for inspiration on the APAIS and NSW Government Printing Office thesaurus[1] and the indexes of specialist publications. Advice was also sought from experts in particular fields: Dr John Dargavel provided a list of terms pertinent to forest history which were structured and integrated into the thesaurus.

The thesaurus is an in-house working document which will continue to grow and to be refined throughout the life of the project. At present there are no plans to publish it.

THE AUSTRALIAN HISTORIC RECORDS REGISTER

The Australian Historic Records Register will be available as a fiche publication in early December 1988. One thousand copies will be distributed free; one to each local government authority, each state library and public record office and each major research library. Additional copies will be available for purchase.

The Register will consist of:

- an introduction outlining the way in which the information was gathered, the scope of the Register, and how to make best use of it

- the entries describing records

- an extensive index listing names of individuals, other proper names and place names, and subjects.

The Register will contain at least 3 500 entries, describing collections ranging in size from a single letter or diary to thirty shelf metres of business records. Not all the records appraised by our field officers or described by owners will be listed. Excluded are common published items, and records that were incompletely described or which do not in some way add new insights into our understanding of the past. In judging what should be included, we agreed that the Register should be of use to the wider community of historians (academic historians, regional and local historians, family historians and genealogists), journalists and creative writers, students, advertising agencies and TV producers.

Access to the entries is via the index headings. The possibility of listing the entries under regional or major subject headings was considered but rejected because of the complexity of the records. Take, for example, a family which migrated from Scotland to Victoria during the goldrushes then, after success at the Ballarat diggings, took up grazing land in East Gippsland; one son set up a timbermill at Mirboo North, another worked on the draining of the Kooweerup Swamp and their descendant, who has records of her own and of each preceding generation, is a professor in the education faculty at the University of Queensland.

ACCESS TO RECORDS

Owners were asked to grant researchers use of the records under open, restricted or special access. Under each category of access the owner retains the right to refuse access to specific people or categories of people, and has no obligation to allow researchers to borrow the records, to provide copies of the records, or to provide answers to research queries by letter or telephone. Researchers wishing to see records listed under open access will write directly to the owner; all other requests must be directed through the National Library of Australia.

THE REGISTER AND FOREST HISTORY

Records held in private hands and listed in the Register will complement those held in libraries and archives. Where possible we have endeavoured to note relationships between privately owned records and those held by institutions. Listening to the extracts presented by Jenny Gall at the conference (see paper this volume) has shown that some of the records will complement oral history archives: a small quantity of records reflecting the involvement of the Pascoe family in the timber industry in the Urbenville-Tooloom area are described in the Register.

Compared with the records mentioned by Charles Fahey and Michael Saclier, they will often be frustratingly fragmentary - a few letters, two or three ledgers (all that remains to document the operations of a sawmill over thirty years), or a small box of photographs. And, given that it has been impossible for us to fully index all collections, researchers may still need to follow hunches by, for example, matching known individuals with location.

On the other hand there will be certain strengths, especially putting people into forest history and recovering the responses of early settlers to the landscape and the way in which they altered the landscape by clearing the land.

Appendix A gives a description of a collection of photographs by now well known to many of you through Jinkers and Jarrah Jerkers[2] and Sawing, Selling and Sons.[3] Appendix B gives brief indications of some of the other records described in the Register.

To finish, I would like to return to the Weatherhead family and a letter written by Horatio Weatherhead to his mother. Apart from discussing the education of his children and commenting on the tardiness of the Rabbitcatcher (mid-wife) in her arrival for a recent birth, Horatio gives a summary of the progress of his Musk Creek steam sawmill near Daylesford.

Extracts from letter, Horatio Weatherhead to his mother, 12 October 1884.

> About business matters - well things are going on very fairly. Our mill has proved a good paying business and now that everything has got cleared off and no debt or dangers hanging about we are in a position [to] make monthly dividends. I can handle a nice little bit of money each month, in August my share of profit £38 - and September the same amount (£38) that is very good wages. Of course the sums mentioned is over and above all working expenses being clear cash for my wife's own benefit. The mill turns in on an average about £250 per month while the working expenses do not exceed more than £125 which leaves a fair margin of profit. We always take £2 per week come what may for household expenses and when there is a reasonable sum exceeding £150 in the Bank we divided it but £150 is always kept as a working capital to meet current expenses. Since we started two years ago with nothing save £100 we have put between six and seven thousand pounds through the Bank. We got everything on Credit to start with a friend of Paterson's bought the engine and let us have it on our terms to pay him when and how we could. Altogether the mill must have cost over £600 which is all paid long ago - then we have bought 8 heavy horses varying in price from £32 to £50 each, costing altogether with harness about £320. One old beggar died in 3 weeks after buying him but the rest are all to the good. Then we have bought 3 jinkers costing £95 and two waggons costing over fifty pounds and in the harvest we bought nearly 1000 bushels of oats for horse feed and it was luck we did so for oats are nearly twice the price now. We got most of them @ 2/4 per bushel and have enough to last till next harvest. You will see that now we have got everything nicely - in addition to the above items mentioned we have at least £200 of timber in the yard and over £200 out in accounts which will be in, in a months time and over £100 in the Bank, and we don't owe five pounds nor £2 to anyone as Saturday was pay day and we squared up everything ...
>
> I spent a few pounds lately in household improvements - a chest of drawers - cost £5.5/- - an iron bedstead - £4.10/- a very nice one - but still I can't sleep any better on it than I did on a wooden of my make, a clothes wringer & a sausage machine to

make some of the carion the butcher sends go down a little pleasanter.

APPENDIX A

RECORD GROUP	Trautman family records
DATE RANGE	1879-1980
SERIES	Gustav A. Trautman: miscellaneous records and certificates relating to birth and his period as a seaman, 1879-1911 (20 items).
	Gustav A. Trautman: miscellaneous records and certificates relating to immigration, naturalisation, land ownership and employment, 1911-1926 (8 items).
	Gustav A. Trautman: glass plate negatives, negatives and photographs recording technical and social aspects of Reids Mill, Collie, WA, forestry work and farm improvement, 1913-1940s (c550 items).
	Gustav A. Trautman: photographs of Aborigines, Jimmy and Mary Mears, and their bush dwelling near Collie, WA, c1915 (2 items).
	Gustav A. Trautman: records kept while a forestry worker at Arklow, WA - daily work journal, Nov. 1927-Feb. 1931 and fortnightly expenditure Nov. 1927-Aug. 1929 (2 vols).
	Elizabeth Ann Trautman: miscellaneous personal and domestic records, 1908-1952 (10 items).
	Edward and Jean Trautman: miscellaneous education, Sunday School and employment certificates and references, 1915-1967 (20 items).
	Edward and Jean Trautman: research files, drafts, correspondence and agreements re the publication of <u>Jinkers and Jarrah Jerkers</u> (Fremantle, WA, 1980) (1 file).

HISTORICAL CONTEXT

Latvian born Gustav Trautman was a farmer, seaman, timberman and amateur photographer. He married Englishwoman Elizabeth Ann Clampit in 1908 and, together with their nine month old son, they immigrated to Fremantle on the SS Gneisenau, in 1911.

Trautment bought land, ran cattle, worked in mills and in the jarrah forest. He photographed all aspects of the timber industry in the areas around Collie and Brunswick Junction and recorded developments such as the start of the Wellington Weir and Mangalup Dam. He photographed the social events of the mill towns and took portraits of personalities and families for Christmas cards.

Notes on the technical details in some of Gustav Trautman's photographs were written by his son, Edward, who with his wife, Jean, published Jinkers and Jarrah Jerkers in 1980. This book is based on information contained in the photographs listed and on family and personal experiences in the area.

Edward, Jean and their family moved to Geraldton in 1949. Jean has served as a member of the Geraldton Town Council and was appointed a Justice of the Peace in 1967 - the second woman to hold this position in Geraldton and the first for approximately 100 years.

DESCRIPTORS

Names

Trautman, Gustav A.; Trautman, Elizabeth Ann (nee Clampit); Trautman, Edward G. (Ted); Trautman, Jean (nee Rothnie); Piggott, Herbert; Finch, R.W., solicitor; Mears, Jimmy; Stoate, T.N., Deputy Conservator of Forests; Bray, Horace A., teacher; H.R. James & Co., publishers; Mears, Mary.

Places

Collie, WA; Reids Mill, Allanson, WA; Lewis and Reids Mill, Collie, WA; Brunswick Junction, WA; Arklow, Collie, WA; Geraldton, WA; Fremantle, WA; Wellington Weir, WA; Mangalup Dam, WA; Arklow Forest District, WA.

Subjects

merchant seamen; farming; Aborigines; sawmills; jinkers - timber; grasstrees; timber workers; saddleries; stables; Afghans in Australia; jarrah; Latvian migrants; hawkers; timber getting; pioneer women; women in rural communities; swampers; bullockies; wheelwrights; social events; publication - Jinkers and Jarrah Jerkers; schools, government, WA, Reids Mill School, Allanson, WA; Reids Mill School see schools, government, WA.

REFERENCES

Bibliographic Edward and Jean Trautman, Jinkers and Jarrah Jerkers, Fremantle, WA, 1980.

John Dargavel, ed. Sawing, Selling and Sons: Histories of Australian Timber Firms, CRES, ANU,Canberra, 1988.

NOTES

Some of the records are in Latvian and German. The Australian National University, Centre for Resources and Environmental Studies, Canberra, has made photocopies of notes and information on technical and social details of mill towns and jarrah forests in WA to 1940s.

ACCESS

Restricted access: contact Historical Records Office, National Library of Australia

LOCATION

Town of Geraldton

APPENDIX B

The Thompson family purchased 'St Andrews' property near Minto, NSW, in 1858. Their income for many years derived from timber. A family history compiled in 1980 gives details.

Erica Winstone's biographical sketches of her forebears includes one of George Noakes (1848-1917), a sometime sawmiller at Murray Creek, Qld.

The logbooks kept by Captain Tom Bynon for the barge 'Whaler' and the paddle steamer 'Wagga Wagga' detail the cargoes of timber he transported on the Murray River in the years 1884 and 1892.

Thomas Charles Taylor started a sawmill at Ensay some time after 1907 to supply timber for the construction of soldier settlement homes. His son, Arthur, took photographs with a folding Kodak camera and developed his own films among which are shots of the sawmill.

James and Mabel Pascoe lived in a number of timber camps in the Urbenville-Tooloom district in NSW. They have a small collection of annotated photographs depicting the timber industry in the area.

Records relating to Charles Pulfer and his shipping agents business in Hobart and Port Esperance. Pulfer at some time also operated a sawmill at Dover, Tasmania.

Personal records and research files of Eric Rolls, author of A Million Wild Acres.

John Munro, a Salvation Army Officer, who during 1937 visited many of the timber towns in the Harvey, WA, district and assembled a photograph album entitled Memories of My Term at Harvey.

Photographs of the Derby Sawmill, Derby, Tas., in an album of the area.

Records of three generations of timber merchants and builders, each generation bearing the name David Williams. The first generation set up in Battery Point in 1870. Records cover the period 1887-1957. For part of the period they also had a joinery works.

Since 1958, Klaus Hueneke has spent much time researching the Snowy Mountains area. Among his files are some 11 000 photographs and 7 file boxes of research papers. Although his primary focus is not on forest history, his photographs may well include many that are relevant. The photographs cover the years 1880-1987.

A sketch book relating to the Pieman's Track and Mount Magnet areas in Tas. probably by Frank Elliot who cut the first Pieman track in 1888.

Clyde River and Bateman's Bay Historical Society Records, 1880-1976, of Albert Perry and Sons - previously known as Guys Mill; Espermans Mill and the Spoke Factory. Paysheets, sales records and plans.

Geraldton Building Co. Pty Ltd which grew out of a building and contracting business started by Alfred Edward Crothers in the 1920s. Also timber merchants and have their own joinery.

Whittakers was established in 1894 by Arthur George Whittaker in Subiaco, WA, as a joinery and timber business. It was incorporated in WA as Whittaker Bros Ltd on 6 April 1938. The name changed to Whittaker Bros Pty Ltd in 1948, then to Whittaker Investments Pty Ltd in 1949, with the current name being adopted in 1975. The company manufactures and trades in timber, joinery and building products, with its major area of operations being in the home building industry. It owns and operates sawmills and builders' hardware outlets and has investments in Softwood Products Pty Ltd (pine sawmilling), South West Forest Holdings Pty Ltd (afforestation) and Bristile Ltd (roofing tiles, pipes, crockery, building products).

Stephen Spurling, photographs and glass negatives of Tasmanian landscapes, especially the west coast, 1890-1930 (560 items).

Arnold Diers, photographs of Geeveston port and forestry operations in the Geeveston area, c1902-c1925 (c150 photographs).

M.C. Davies & Co Ltd: business records of the Davies family timber mill company in the Karridale and Katanning districts, WA, including minute book, shipping ledger, maps and family photograph album showing timber mills, scenery and family, 1880s-1902 (5 vols).

Alexander MacDonald: photograph of Alexander's Timber Mill also showing horse drawn timber drays, c1920 (1 item). Alexander Macdonald: ledger relating to Alexander's Timber Mill including price list for rail-delivered wood, 1923-1925 (1 item). Alexander MacDonald was a long time resident of Violet Town, Vic. He was a timber mill owner and one time Shire President.

Pasquale (Percy) Ganza, account book for saw mill at Mt Fox, near Ingham, Qld, 1938 (1 vol.).

Research files, containing research notes, newspaper articles, land records and photographs relating to the settlement of the Mumballup and Noggerup district of WA, 1890-1920. Subjects include pioneer settlers, farming, the railway, town buildings, businesses, Sextons Timber Mill, Preston Valley Saw Mill and Bunning Brothers.

G.L. Ross, sawmiller and wood merchant, Avoca, account book of wood deliveries, 1930-1931 (1 vol.).

NOTES:

1. We are grateful to the NSW Government Printing Office for allowing us access to their thesaurus.

2. Trautman, E. and Trautman, J., 1980 Jinkers and Jarrah Jerkers (Cannett Press, Fremantle).

3. Dargavel, J. (ed), 1988 Sawing, Selling and Sons: Histories of Australian Timber Firms (Centre for Resource and Environmental Studies, ANU, Canberra).

KEEPING THE FOREST HISTORY: THE MANAGEMENT OF THE CULTURAL HERITAGE OF FORESTS, A TASMANIAN EXAMPLE

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INTRODUCTION

The cultural heritage of Australian forests is particularly valuable. Compared to other parts of the Australian environment, the archaeological sites have been, until recently, well preserved due to a protective vegetative cover, promoting low visibility and inaccessibility. Increasingly, careful management of these sites is needed in the face of development in forested areas.

The management of cultural resources in forests requires an integrated approach, and not simply the identification of archaeological sites. Poor site visibility, and developments which result in microenvironmental change and widespread superficial and subsurface disturbance, pose particular forest specific management problems.

Tasmania has a wealth of archaeological sites, both Aboriginal and historic, within its forests. It provides an example of an approach to the comprehensive management of cultural resources in forests. Consideration of cultural heritage values has been incorporated into a Forest Practices Code. An evaluation of cultural resources and management prescriptions for sites are included in Forest Management Plans, surveys of specific areas subject to forest operations have been commissioned and a major study of the Aboriginal archaeological resources of the forests for predictive modelling purposes has been completed. As well as accepted aspects of cultural resource management, research into the effects of forestry operations on the cultural resource is also being initiated.

In considering forest history it is important to look at how the forest history can be kept, as well as what it can tell us. In Australia, both Aboriginal people and the European settlers used forests extensively and have left a rich legacy of that use in the form of archaeological sites. These sites provide important data, complementing documentary and other archival sources, about where the forest occupants were, how they lived and how they utilised the forests. Unless action is taken to effectively manage these archaeological sites, current developments in forests may result in the almost complete loss of the forest heritage.

This paper briefly explores the need to protect and manage the archaeological sites in forests and how this can be best achieved.

The management of archaeological sites is generally termed 'cultural resource management' (CRM) and the paper focuses on the approach being adopted by the Tasmanian Forestry Commission.

THE WHY AND HOW OF KEEPING THE FOREST HISTORY

Why is it important to specifically consider cultural resource management in forests?

Apart from the generally accepted worth of conserving the cultural heritage for its scientific, historic, educational, public and aesthetic values, more specific reasons are as follows:

- There is a rich and significant cultural heritage in Australian forests (Allen et al. in prep.; Anderson, 1984; Bowdler, 1983; Byrne, 1983; Cosgrove, 1987) which is valuable for interpreting what happened in the past both with respect to forest ecology and past human behaviour.

- Given the minimal disturbance that has occurred until recently in forests, archaeological sites are generally in an excellent state of preservation, unlike sites in most other areas where land utilisation has significantly degraded sites. Archaeological sites in forests therefore have enhanced scientific and cultural significance.

- The accelerated rate and degree with which archaeological sites in forests are being destroyed or disturbed. This is due to recent changes in the nature and scale of logging, namely clearfelling, development of a major woodchip export market in the last 15 to 20 years, and the improvements in technology that now allow logging in previously unloggable areas.

Given that there is a need to protect and manage the cultural resources of forests, how can this be most effectively achieved?

In theory the protection of archaeological sites in forests can be approached in the same way as cultural resource management elsewhere in Australia. However forests, particularly in Tasmania, pose particular problems for cultural resource managers, viz:

- The dense vegetation and plant litter resulting in low site visibility, particularly for Aboriginal archaeological sites.

- The nature of forest operations which result in widespread, intense, and thorough surface and subsurface disturbance. This is due mainly to clearfelling, compaction by heavy equipment, landing formation, burning for slash removal and seed bed preparation, and burning and ripping for plant establishment, as well as subsidiary operations such as road construction.

The obvious approach then is to adopt a standard CRM methodology but tailor it to take into account the peculiar nature of forest archaeology. This approach has generally been adopted elsewhere where forest CRM is being carried out, for example in New Zealand and the USA (Coster, 1979; Schiffer, 1979). Such an approach has three main components. These are the identification and location of sites, their assessment, and their management (Bowdler, 1983). These steps can be described as follows:

Identification and location of sites

The aim of this step is to establish a detailed record of the resource. This is normally achieved by survey, but because of the 'visibility problem' in the majority of forested areas, survey may not be effective or adequate. An indirect solution is to survey, on an environmentally representative basis, more limited areas where visibility is better, then use the data generated for predictive modelling.

Identification of archaeological sites has been frequently thought to be all that is required for the protection of sites where there is some ongoing development. This is not the case, and detailed data are required for assessment of sites and as a basis for making recommendations for their management.

Assessment of sites.

Assessment is essential for determining whether a site needs to be protected, and how this should be done. Assessment is made of the preservation of, threat to, and significance of sites. The information required for assessment is a detailed record of a site and an understanding of the broad heritage context of that site. With respect to assessing significance, factors such as scientific value, heritage or historic and cultural value, educational value, uniqueness and representativeness, and value to special groups of people are considered. In the case of Aboriginal sites, importance to Aboriginal people needs to be taken into account.

Management.

Management can be divided into a number of sub-components:

Planning - This is the stage where the archaeological data are incorporated into a regional planning framework. This step is not usually singled out from management, but in forests is particularly important, given that there is usually a complex, multiple-use land management strategy applied. This type of planning can enable a number of problems to be avoided, particularly crisis management, the holding up of forest operations, and the disturbance of sites through ignorance.

Site Management - In this step recommendations, guidelines and/or prescriptions for the management of individual sites or archaeologically important areas are set out. Such requirements might include the creation of reserves, the physical protection or conservation of sites (such as fencing or treatment of site materials), or promotion of the cultural heritage. Site management can be partially achieved through appropriate planning.

Education - This is required at two levels; the education of personnel who are involved in forest management and operations; and the promotion of the archaeology, including actual sites, to the general public. This latter level of education is an 'endpoint' and a vital aspect of CRM. Education of forestry personnel is an important means of achieving effective CRM because (1) it helps avoid site disturbance during forest operations, and (2) no amount of site data, planning, management or advising will be effective if there is no understanding of, or commitment to, the conservation of cultural resources by those directly working in, or developing, the forests.

Where the administrative/management responsibility for forest archaeology lies will also partly determine how effectively the forest CRM is carried out. This aspect is not discussed here because the land managing authorities and cultural heritage legislation are different in each state in Australia and each situation needs to be assessed separately.

Suffice it to say that there is some advantage to the CRM of forests being the responsibility of forest managers rather than the state CRM manager. For forest managers it is easier to have input into planning, to know what is happening and react quickly when necessary, and to encourage other staff of the organisation to understand the value and need for protecting the cultural heritage (Bowdler, 1983; Coster, 1979).

CULTURAL RESOURCE MANAGEMENT IN TASMANIAN FORESTS

In Tasmania, the Forestry Commission has taken on the role of protecting and managing the cultural heritage values within wood-production forests and is developing a forest-specific and integrated approach to CRM in these forests. Aspects of this approach which are being developed to meet the special requirement of CRM in forests are outlined below. Those aspects such as assessment, physical site protection and promotion of sites to the general public, which have not been specifically developed in the Commissions approach, are not discussed.

The Forestry Commission's involvement in CRM began with a National Estate funded study which showed the impact of forest operations on the Aboriginal archaeological sites in east-coast forests (Cosgrove, 1982). In the subsequent five years the Commission employed contract archaeologists to carry out surveys to assess the impact of logging on the Aboriginal archaeology of specific 'archaeologically sensitive' areas. Since the formalisation, with the Forest Practices Code, of the Forestry Commission's role in CRM, a full-time archaeologist has been employed. The position is jointly funded by the Commission and the timber industry through the Tasmanian Forest Research Council.

The Forestry Commission is responsible for managing some 24% of the land area of Tasmania. This is a considerably larger percentage than for any other Australian state. Previous archaeological work has shown that Tasmanian forested areas contain numerous archaeological sites, both Aboriginal and European. Cosgrove (1987) estimates that the mean density of Aboriginal archaeological sites in forests is c. 20 sites/km². These sites are varied in environmental context, in type and in age. The oldest dated site in Tasmania lies within state forest (Cosgrove, pers. comm.), as do many significant occupation, art and quarry sites. With respect to historic or European archaeology, Tasmania has a particularly long and interesting history. Many convict, pastoral, mining, exploration and forest industry sites occur within the forests.

In Tasmania Aboriginal cultural resources have general protection, similar to that in other states, under the <u>Aboriginal Relics Act 1975</u>. There is no legislative protection for historical sites except by declaration under the <u>National Parks and Wildlife Act 1970</u>. The Department of Lands, Parks and Wildlife is the state government agency responsible for administering the legislation which protects Tasmanian cultural heritage. This was, until the implementation of the Forest Practices Code, the only government body in Tasmania with a legislative role in the protection of the cultural heritage of the state.

<u>Legislation</u>

The Forestry Commission took a major step towards the protection of cultural resources in forests with the creation of the <u>Forest Practices Act 1985</u> and its prescriptive accompaniment, the Forest Practices Code, which took effect in November 1987. Under this legislation, 'non-wood' values, including the cultural resource, are given special protective consideration. The general principles recognised in the Code are that:

- the location and recording of archaeological sites are important and provide the opportunity for site significance to be assessed; and

- the protection of significant sites is important and can be achieved by management prescriptions, including special reservation on public lands.

The archaeology requirements which follow are essentially that :

- areas or features likely to contain archaeological sites are to be identified in the planning stages;

- pre-logging coupe and road-line surveys are mandatory in areas where there is the potential for sites; and

- any sites located in the course of forestry operations are to be recorded and/or brought to the attention of the appropriate authorities.

Forest Practices Officers have also been appointed under the Code and their main task is to see that the Code is applied.

The prescriptions in the Code at present are not comprehensive; however provision for periodic revision of the Code is built into the legislation.

Survey and Predictive Modelling

Archaeological surveys have been carried out in the past in specific areas as the need to locate and assess sites prior to forest operations has been recognised. These surveys have generally been short-term investigations and the results have been used at the planning level. It is intended that such surveys will continue.

Systematic surveys in areas of high archaeological sensitivity, e.g. areas of shelter development in carbonate rock and sandstone, will also be undertaken as the need arises. However, given the problems of extremely poor visibility in Tasmanian forests generally, predictive modelling is seen as being an important technique for providing site location data for planning and management for much of the forested areas.

A three-year project was set up, in co-operation with the Dept of Lands, Parks and Wildlife, to conduct surveys which would enable predictive statements to be made about the situation and types of Aboriginal archaeological sites in forested areas. Additional aims were to improve the understanding of the Aboriginal use of forests and to produce management guidelines for cultural resources in the state's wood-production forests. This project (Cosgrove, 1987) has now been completed and is used as a basis for CRM within the Forestry Commission.

This work however needs to be extended and developed as-

- there are too few data because not all regions and environmental zones of wood-production forests have been adequately surveyed. Current evidence (Allen et al., in prep.) demonstrates that there are major regional differences in Tasmanian Aboriginal archaeology and hence past land use patterns. Hence it is necessary that 'regions' be considered independently.

- more importantly, predictive modelling, although a popular concept and often advocated, has inherent in it some largely untested assumptions. Chief among these is the theory that past Aboriginal behaviour is fundamentally environmentally determined. As Cosgrove (1987: 2) states, 'people react in a predictable way when faced with a variety of resource options ... and ... that settlement strategies were organised around subsistence availability'.

To redress these problems further research needs to be undertaken. It is proposed-

- to build on Cosgrove's (1987) work through additional archaeological survey, following the same strategies. This involves survey of areas of relatively high visibility, but expanding into different regions, particularly the south of the state, and expanding the range of environments surveyed in each region.

- to test the validity of predictive modelling for cultural resources of Tasmanian forests by conducting a trial project. This will also provide an opportunity to test the level of resolution that can be achieved in predictive modelling in these environments. The trial will entail the construction of a predictive model of an area for which there is adequate archaeological data and use of the Forestry Commission Geographic Information System (GIS). This model will be tested by comparing predicted site situation and type with that of a second, environmentally similar area. A major limiting factor for such high resolution predictive modelling in Tasmania may be the lack of sufficiently detailed environmental data.

Although historic archaeological sites in Tasmanian forests are as important an aspect of the cultural resource as Aboriginal archaeological sites, they have been largely ignored to date. Historic site data can be acquired through both field survey and archival research. Historic sites are often subject to the same 'visibility' problem as Aboriginal archaeological sites, although to a lesser degree. Given the poor direct correlation between environment and European settlement and development in Australia, predictive modelling is not an appropriate strategy, unless socio-economic variables can be taken into account. Adequate inventories of historic sites can be compiled through archival research, with some field checking of the information. The Forestry Commission intends to take this approach to establish the location and nature of historic sites in Tasmanian forests.

Planning

This is a particularly important area of CRM, and forest managers traditionally undertake long-term and comprehensive planning, primarily for wood-production but in which non-wood values can be considered. Because of this, a mechanism for incorporating archaeology into forest planning already exists.

Planning within forestry happens at many different levels and in Tasmania provides an ideal opportunity to -

- flag at an early stage areas which are likely to contain sites or are known to contain important sites, for example in 10-year plans, Forest Management Plans, and Working Plans. This planning is done well ahead of development, with sufficient time to carry out archaeological surveys if required;

- establish areas of archaeological importance to be excluded from logging. These areas can then be discounted in calculations of the available timber resource and quotas;

- allow the protection of archaeologically higher sensitive areas through zoning;

- establish regional archaeological site management guidelines, to be used at the 3-year or 5-year plan level; and

- provide site protection prescriptions in Timber Harvesting Plans. These plans are drawn up for individual coupes and are the final planning and approval stage prior to logging.

Management Research

Research in two areas is seen as a priority. Acquiring more data on site location and type is seen as one priority area, as indicated above. The lack of data in this area results primarily from the comparative youthfulness of archaeological research in Australia, the difficult nature of surveying in forests compared to other environments, the lack of CRM experience which has had time for feedback and, by necessity at present, the largely reactive nature of CRM.

The second area requiring research is the effects of forest operations on site preservation. Alternatives to particularly destructive forest operations, such as burning and ripping, need to be considered and evaluated. Indirect effects, such as site destabilisation with removal of the protective vegetative cover, and the effect of tree root growth on sites in regenerating areas, also need to be studied.

Education

In forest archaeology, not only is the promotion of sites to the public important, but it is also vital to have educated forestry personnel. Given the role of the Forest Practices Officers, it is important that they are cognisant of the principles of CRM and the archaeological requirements of the Forest Practices Code, have some understanding of Tasmanian archaeology and can recognise and, ideally, record sites. To meet these requirements a Resource Manual is being written, which includes an overview of Tasmanian archaeology, legislative requirements, CRM principles and relevant procedural guidelines, and technical information. As archaeology cannot be learned adequately without field experience, training courses and field sessions are being conducted to provide experience in site identification, survey methods, site recording and impact mitigation.

CONCLUSION

That the cultural resources of Australian forests need protection from the increasing scale, and consequent increasing impact, of forest utilisation is unquestionable. CRM procedures were, in general, developed for the management of cultural resources in non-forest areas, areas which were previously more heavily impacted. These procedures are not entirely adequate for the protection of the archaeology of forests, given the nature of the sites in forests and their poor visibility. Therefore forest-adapted measures need to be developed.

The New South Wales Forestry Commission has carried out a review of the CRM requirements of NSW forests (Bowdler, 1983), but has not actively developed it. Now in Tasmania, however, there is the framework of a forest-specific CRM programme emerging within the Forestry Commission. There are still general CRM problems, such as application of reliable predictive modelling, and the difficulty of significance assessment. Hopefully, with time and the development of expertise and knowledge, which will require the co-operation of archaeologists in every sphere of the discipline, the framework that is emerging will develop, and the effective protection and management of archaeological sites in wood-production forests will become a reality.

ACKNOWLEDGEMENTS

The ideas in this paper have derived to some degree from my recent experiences working as an archaeologist with the Tasmanian Forestry Commission, and from discussions with staff of that organisation. Many of the ideas had already been partly developed by previous CRM work by many archaeologists, and in particular in the recent work by Richard Cosgrove in Tasmania. These researchers and their work must be acknowledged for paving the way. My thanks also to Steve Brown, Mick Brown and Humphrey Elliott for helpful comments on this paper.

REFERENCES

Allen, J., Cosgrove, R. and Brown, S. in prep. New archaeological data from the southern forests region, Tasmania: A preliminary statement.

Anderson, J., 1984 Between Plateau and Plain. Occasional Papers in Prehistory No. 4 (Australian National University, Canberra).

Bowdler, S., 1983 Aboriginal Sites on the Crown Timber Lands of New South Wales. A report to the Forestry Commission of New South Wales.

Byrne, D., 1983 The Five Forests: An Archaeological and Anthropological Investigation (National Parks and Wildlife Service New South Wales, Sydney).

Cosgrove, R.C., 1982 The effects of logging practices on the archaeology of east coast forests: A pilot study. Unpublished report to the Tasmanian National Parks and Wildlife Service.

Cosgrove, R.C., 1987 The Archaeological Resources of Tasmanian Forests: Past Aboriginal Use of Forested Environments. Draft of a report to the Tasmanian National Parks and Wildlife Service, Tasmanian Forestry Commission and Australian Heritage Commission.

Coster, J., 1979 Exotic forestry and site management in the Auckland region, New Zealand. In McKinlay, J.R. and Jones, K.L., Archaeology and Cultural Resource Management in Australia and Oceania, pp. 89-94, New Zealand Historic Places Trust, Wellington.

Schiffer, M.B., 1979 Some impacts of cultural resource management in American archaeology. In McKinlay, J.R. and Jones, K.L., Archaeology and Cultural Resource Management in Australia and Oceania, pp. 1-11, New Zealand Historic Places Trust, Wellington.

Remnant savannah woodland and radiata pine plantation, A C T

FOREST HISTORY IN NORTH AMERICA

THE FOREST HISTORY OF NORTH AMERICA: METHODS AND MEANS

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It is fitting at this first Australian forest history conference to examine the now four-decade old effort in North America. In retrospect, we can see that the field of North American forest history took its first uncertain steps toward identity in 1946. University of Minnesota historian Theodore C. Blegen and third generation lumberman Frederick K. Weyerhaeuser worked with others to establish a forest history project at the Minnesota Historical Society, located in the upper Midwest. This region, during the latter part of the nineteenth century, was the jumping-off point to the Far West and South as the forest industries began their growth into the large corporations of today. For several generations, it would serve as the financial nerve-centre for the forest industries and was still important in the 1940s, as thoughts turned to history.

The primary thrust of this effort, in the decade that followed, was to seek out records of the forest industries and to assure their permanent safeguarding under the care of professional archivists. This small and narrowly focused project would evolve into the Forest History Society, which became independent from the Minnesota Historical Society in 1955 and, following several moves, is now headquartered in Durham, North Carolina, in association with Duke University. Its programs would expand to include research, publication, the maintenance of a bibliographic database, and sponsorship of conferences. The scope would broaden as well to include all of the forest conservation movement, of which the industrial sector is a part.

But the interest in records would remain strong, for the archive is to the historian what the laboratory is to the scientist - a vital source of data. However, unlike the scientist who can generate new data in the lab., the historian is limited to that which has been saved, and good history will not be written without good records to study and interpret.

Let's begin with a sketch of North American forest history, which has parallels with Australia. An obvious parallel is that both continents began white settlement as British colonies; probably it is a toss-up to choose the more preferred between convicts in Australia and outcast religious zealots in North America as building blocks of new nations. I don't know which remnants of this beginning are still evident in Australia, but one of the most heated topics for political debates in America today is whether time for prayer will be allowed in public schools, a bit of tradition recently declared unconstitutional by the U.S. Supreme Court.

England of the time ruled a vast and expanding empire through the might of its navy, one that floated on wooden ships. When the endless series of European wars threatened supplies of masts and naval stores from the Baltic, England turned to its North American colonies. White pine trees over 24 inches in diameter were reserved for the Royal Navy under the various Broad Arrow Acts, for the comparatively tall, straight trunks made superior masts. Although American naval stores were inferior to those from Scandinavia, certainty of supply from across the Atlantic Ocean prompted a large and important commerce in this forest product. In fact, so many naval stores were shipped from the southern colonies that my home state of North Carolina is still called the 'Tarheel State'.

Reservation of the best white pine, and the Navigation Acts, which allowed the colonies to trade only with England, were on the list of grievances that prompted a minority of radicals to incite the Revolution of 1776. As a nation struggling with independence, the United States mimicked the ousted British and quickly set aside certain forests as naval reserves and, of course, outlawed revolution. Canada would remain British for some time yet; settlers from the States would be viewed as undesirable aliens, and trade in forest products across the 49th Parallel would then, as now, be a contentious topic for diplomats to ponder.

Land! Early settlers on both continents looked westward at vast expanses of land upon which to extend a European civilization. These expanses were already peopled, of course, and both continents share a bleak history in the treatment of their original inhabitants. Nonetheless, the land was to be settled.

The United States surveyed and began selling its western domain as a major source of revenue for a government saddled with Revolutionary War debts. Parcels of public land were granted to military veterans as rewards for service and to newly formed states to in turn sell to finance schools, roads, and other public programs. Eventually, western land would be given to anyone willing to settle on it, and huge blocks were granted to encourage the building of railroads to the far western states of California, Oregon, and Washington. In broad terms, disposition of Canadian lands was similar, except that the provinces were much more significant partners in the decision-making process than were the American states.

North American land history is especially pertinent to its forest history, for obviously land is where the resources are. And as resources were transferred into private ownership, opportunities for public regulation were lessened, an issue that has been central to the conservation movement throughout the twentieth century.

There are two other aspects of land history that should be touched upon. First, under the law, land was available only in small parcels to those who would farm it. Thus, lumbermen could not acquire forested public land directly but had to negotiate with settlers plot by plot. The inefficiency of these multiple transactions became significant during the later nineteenth century, as small sawmills grew into large corporations with equally large appetites for timbered land. It would be the enormous grants to railroads to which lumbermen turned; one of the most famous examples is the purchase in 1900 of 900 000 heavily timbered acres of railroad land in the Pacific Northwest by Frederick Weyerhaeuser, the grandfather of one of the Forest History Society founders. In no other way than buying from railroads could Weyerhaeuser and his contemporaries have acquired so much timberland. So a national policy to expand the transportation system also provided the means for a broader industrial landbase.

Second, land grants to states after the 1860s supported colleges of agriculture and the mechanical arts - the so-called A & M schools - that began to create an infrastructure of trained professionals to staff the future conservation movement. The traditional universities of the time offered a classical education; the newly created state colleges would train students in engineering, geology, agronomy, and, by the twentieth century, forestry. Engineering, by the way, had been taught only at the military academy, and the Army Corps of Engineers would become the nation's official surveyors. General Douglas McArthur, who Australians may remember from World War II, graduated from the military academy in 1903 and took a forestry course while a student, for it was then generally part of a young army officer's career to be stationed in the Wild West to fight Indians and protect the nation's forests and parks. From these state colleges, initially financed by federal land grants, came the personnel who shifted so many resource decisions from the federal government to the state and private sectors as the twentieth century evolved.

We American forest historians have been trying to pin-point the beginning of the conservation movement, without much success. The problem is one of definition - what indeed is conservation? The first national park was established in 1872, the American Forestry Association (a citizens' group) in 1875, the U.S. Forest Service predecessor in 1876, the first national forest in 1891, the Sierra Club in 1892, the first four-year forestry school in 1898 - the list goes on but does not explain what conservation is or is not. However a useful definition is that conservation means resource utilization - not preservation; in recent decades, the environment movement would question this human-centered concept.

A movement needs focus, and that focus would be provided by a young aristocrat named Gifford Pinchot. Born to wealth - 'my life's wages were paid in advance', he used to say - Pinchot graduated from Yale University in 1890 and, with his father's blessing, he studied forestry for a year in France and Germany. He returned to the States and for the next half-dozen years worked as a consulting forester. One of his assignments took him to New York State to study spruce; during the visit he met and became closely acquainted with Governor Theodore Roosevelt.

All U.S. forest historians agree that this warm relationship between the man who would become president in 1901 and the man who would become the nation's leading forester was enormously important to the focusing of the conservation movement. Only 33 years of age in 1898, Pinchot was appointed head of a small and obscure forestry division in the Department of Agriculture, with scarcely a dozen staff and no forests to manage. But the fate of conservation was running on a strange track, and New York's governor was now vice president of the United States; when an assassin's bullet ended the life of President William McKinley in 1901, chief forester Pinchot's friend moved into the White House.

It is difficult today to imagine Ronald Reagan boxing with the chief of the Forest Service, but Roosevelt and Pinchot both were young (Roosevelt was a younger president even than John Kennedy), athletic, and suitably macho for the time. Even more significant, Roosevelt would break with the American tradition of a president looking to Congress for leadership and aggressively assert his own programs. These programs included Pinchot's blueprint for an extraordinarily expansive conservation effort - one that involved forests, water, and many other resources. Pinchot used to say that there were only two things in the world - people and natural resources. Clearly, resources were to be used for the benefit of people, but prudently, by reducing waste, husbanding inventories, and reproducing those resources that were renewable.

By 1905, Pinchot's forestry agency had expanded sixty-fold and had jurisdiction over 150 million acres of national forests. An astute manager with presidential backing, Pinchot wielded broad influence over the conservation movement. He was a master of public relations and maintained a mailing list of 600 000, to whom he sent concise reports on forestry and conservation events - there are twenty-six volumes of scrapbooks containing newspaper clippings in the Pinchot papers at the Library of Congress.

Canadians turned to Pinchot for advice on how to activate a conservation movement of their own. Recent scholarship has looked at this international interaction in some detail, and is rather critical. We Yanks are often described as being insensitive to the significance of political boundaries; but it seems that Canadian forestry leaders looked at the U.S. model and failed to understand that the United States was a foreign country. Canadian efforts at establishing a co-ordinated approach to forest conservation, the authors tell us, fell short of the potential in part because of a failure to adapt the U.S. model to the Canadian situation. By the 1920s, Canadians would decide to rely more on their own experiences.

There is much more to the conservation movement than Pinchot and his various doings, but he does offer a convenient point of comment. Legislation, for example, tells us much of changing attitudes toward conservation, but there are far too many laws for a single telling. Four U.S. and two Canadian laws, however, need to be listed for context. In the U.S. there is: 1) a 1891 Act allowing forest reserves to be withdrawn from public land; 2) a 1897 Act determining that the reserves were to be managed for wood and water resources; 3) a 1911 Act that authorized the purchase of land for addition to the federal system; and 4) a 1924 Act that resolved intense debate over the need to regulate private forest practices in favor of co-operative efforts to encourage voluntary practices. Not until the 1970s did Congress enact detailed forest management prescriptions, thus reducing the forester's discretion in the field.

In Canada, the 1884 Dominion Lands Act expressed overall policy for developing western regions, including forest fire protection, reforestation, and establishment of parks. In 1906 the Dominion Forest Reserves Act provided for management of the reserves.

There is one more historically important topic that should be mentioned - that of industrial forestry. During the late nineteenth century, before there was much federal conservation activity, some lumbermen joined the American Forestry Association and in other ways supported what little was done. In the Far West at the beginning of the twentieth century, lumbermen formed associations to protect their lands from fire and also vigorously advocated that state governments establish forestry departments, largely for the same purposes. This association would include British Columbia, as all landowners were concerned about protecting their investments.

Industrialists also proposed more favourable property taxes for forest land. In fact, stripped to its essentials, fire and taxes were the central features of the conservation effort in the private sector, for prudent investors would be put off if fire was likely during the next rotation or if tax assessors might hold a thrifty plantation hostage. As we understand, few things frighten capital more than uncertainty, and until fires were under control and the future of taxes known, most logged-off land was simply abandoned.

It is especially ironic that concern over scarcity was the engine that drove the broader conservation movement, for the practical problem was just the reverse. There was too much timber for the market to absorb without driving prices too low, and this glut had to be dealt with before conservation measures would be applied. On the private side, industry openly engaged in production controls until anti-trust enforcement eliminated this option. On the public side, federal forest reserves were withheld from the market-place in order to create adequate scarcity to keep prices up. Not quite as blatant as buying food surpluses to keep farmers on the land, but the value foregone by withholding a large percentage of the nation's forest inventory - to encourage voluntary conservation practices - has obviously been very expensive. Americans are clearly willing to pay a high price for their so-called free markets.

With that briefest of sketches about American/Canadian forest history, let me turn to how that history has been preserved. I began some minutes ago with reference to the Forest History Society. Historians are generally loath to claim that something was first, for it is too easy to get involved in haggling over definitions. Thus, the creation of the Forest History Society in 1946 only symbolizes the start of something that since 1946 has been called forest history. Before then, economists, political scientists, and sometimes even historians, wrote about topics related to forests, and now we include these early works in our online bibliographic database.

Asians and Europeans have studied forest history much longer than the North Americans, and I notice that there are forest history societies or institutes in France, Japan, and China. I'm sure that there are others, such as one in Sweden, that are tucked away within something labelled Economic Research. Just as there are other institutions, there are at least two approaches to the subject, and North America fairly well stands in contrast to the other countries. This conference will show whether Australia is with us or them.

In North America forest history is practised primarily by historians, while in other nations foresters dominate the field. (To keep the point simple, I'm deliberately ignoring the existence of geographers, economists and others). Historians see forests as an organic extension of social, political and economic systems. Foresters see forests as places where trees grow and other resources occur. An English forest historian might write about management on the New Forest since the fourteenth century. An American forest historian might write about the impact of wilderness preservation on Forest Service timber management policies. The English model is site-specific; the American model is topic-specific.

It is the way of an academic world fuelled by selection, promotion and tenure that authors write for their peers and not their audiences. Thus, American forest historians write for historians, and it seems that European forest historians write for foresters. Even a scanning of bibliographies will bear this out; American forest history appears in history journals, and European forest history appears in forestry journals. Therefore, many potential readers are missed, for they do not routinely examine journals in other disciplines. Further, financial support is lessened, for both approaches to forest history appear to be arbitrarily narrow. As with most generalizations there are many exceptions, but the different models help explain what we have been trying to do in North America, and how we have or have not been as successful as we would like.

Probably because many of our major forest industries were started by families and continued for several generations, it was the private sector, with an eye on heritage, that led the way in forest history in the 1940s. Fortunately for charitable institutions like the Forest History Society, this corporate interest has continued; unfortunately, the new generation of managers of what are now publicly owned corporations have less enthusiasm for history.

During the late 1950s and 1960s, the profession of forestry showed some interest in history, largely in response to the fiftieth and sixtieth anniversaries of the founding of the Society of American Foresters. By the 1970s, as its centennial approached, the U.S. Forest Service got involved in a major way by sponsoring a series of scholarly works on aspects of its history and by establishing a History Office to oversee all of the historical work that the agency did. Also in the 1970s, the American Society of Environmental History started up and still fills a niche. There are local forest history societies in Wisconsin and British Columbia - largely foresters - and many forest history museums across both nations.

The Forest History Society began with a private gift of money and for the first twenty-five years all funds came from private sources - individuals, companies, or foundations. Then the Forest Service wanted some of its patriarchs interviewed and a full history prepared. These were the first significant public monies to the Society. Until President Reagan set things straight - or turned them around, depending upon your political biases - federal money in support of humanistic research was plentiful and the Forest History Society shared in the bounty. In the most recent years, our research program has operated at about one-fourth its highest level.

During the last decade, the Forest History Society established an endowment to stabilize programs that were battered by fluctuating external support. Given the current shortage of grant money, we are rethinking our research program to one that is more catalytic, rather than creative. In this way, we can stretch our scarcer resources in co-operation with others.

Although an independent charitable institution, the Society functions best in affiliation with a major university. Our Board carefully studied options and decided that becoming an official university program would include costs that would exceed benefits. Most of the Society's programs are service-oriented and take the long view. But in the four short years we have been affiliated with Duke University, there is a new chairman of the history department, a new dean of the forestry school, a new dean of the Graduate School, a new head of the university library, a new head of the manuscrips division of that library, and a new head of Canadian Studies. These are our main contact points with the university, and although the multiple transitions have gone smoothly, being an integral part of the university could have caused difficulties if these various shifts of personnel had brought in individuals who didn't share their predecessors' view of the importance of the field of forest history. So, we are both affiliated and independent.

We believe that the sort of understanding of our forest heritage that the historical view can provide is essential to good citizenship. But how to reconcile the academic affection for arcane analyses with the decision-maker's need for more general studies? Obviously, this tension is not unique to forest history but is common to all branches of knowledge where theory is needed before there can be useful applications. At the Forest History Society we strive for a balance between the extremes, a position sometimes appreciated and sometimes not.

One final point to ponder. Some years ago, C.P. Snow wrote a perceptive book about the two cultures of science and humanities. The two cultures still exist for, at a recent Duke conference, ecologists and historians huddled for three days to determine how they might jointly study the environmental past. The sessions were lively and generally cordial, but it seemed unlikely that full collaboration would be possible in a world where disciplinary purity was deemed essential for career advancement. Ecologists recalled having their manuscripts rejected by scientific journals on the grounds of being 'too historical'. Historians had suffered the same fate when they had tried their hand at science. Interdisciplinary research may be fashionable in concept - perhaps even essential if we are to understand what has happened - but is probably unlikely to any general extent. I hope that Australian forest history proves better able to cope with hostile disciplinary boundaries than has been the case in North America.

Selected References

Cox, T.R. et al., This Well-Wooded Land: Americans and Their Forests from Colonial Times to Present (Lincoln: University of Nebraska Press, 1985).

Davis, R.C., Encyclopedia of American Forest and Conservation History 2 vols. (New York: Macmillan Publishers, 1983).

Davis, R.C., North American Forest History: A Guide to Archives and Manuscripts in the United States and Canada (Santa Barbara, California: Clio, 1977). This book has been brought up to date and is online at the Forest History Society.

Fahl, R.J., North American Forest and Conservation History: A Bibliography (Santa Barbara, California: ABC-Clio, 1977). This work has been brought up to date and is online at the Forest History Society.

Gates, L.F., Land Policies of Upper Canada (Toronto: University of Toronto Press, 1968).

Gates, P.W. and R.W. Swenson, History of Public Land Law Development (Washington: Government Printing Office, 1968).

Gillis, R.P. and T.R. Roach, Lost Initiatives: Canada's First Industries, Forest Policy and Forest Conservation (New York: Greenwood Press, 1986).

Lillard, R.G., The Great Forest (New York: Alfred A. Knoft, 1948).

Nash, R., Wilderness and the American Mind (New Haven: Yale University Press, 1967).

Robbins, W.G., Lumberjacks and Legislators: Political Economy of the U.S. Lumber Industry, 1890-1941 (College Station: Texas A & M University Press, 1982).

Steen, H.K., The U.S. Forest Service: A History (Seattle: University of Washington Press, 1976).

Williams, M., Americans and Their Forests: An Historical Geography (Cambridge: Cambridge University Press, in press).

APPENDIX 1

PROPOSAL TO FORM AN AUSTRALIAN FOREST HISTORY SOCIETY

The proposal to form an Australian Forest History Society is based on the assumptions: (1) that there are now enough people interested in the pursuit of forest history in Australia to make the formation of a society viable (this has been demonstrated by interest and participation in the conference) and (2) that forest history is an identifiable field of historical inquiry worthy of separate development (though it will necessarily have close links to history, geography, forestry, ecology, political science, economics, etc.).

The broad compass of the Forest History Society of North America which states that it is 'dedicated to advancing historical understanding of human interactions with the North American forest environment' seems appropriate for Australia also. The aim of an Australian Forest History Society could be stated in similar terms:

> ... to advance historical understanding of human interactions with Australian forest and woodland environments.

Within this, the following topic areas would be included ('forest' subsumes forest and woodland):

- Aboriginal use and management of forests
- European removal and modification of tree cover for agriculture and pasture, environmental impacts of such use
- reservation and management of forest lands for various purposes (e.g. timber supply, catchment protection, wilderness, habitat protection)
- public and private forestry, reforestation
- ecological effects of human actions in the forests
- forest products and the forest industries, industrial and labour aspects
- forest management and public policy, environmental politics
- forest conservation, conservation philosophy
- forests and society/culture
- biographical studies
- materials and methodologies in forest history research

The proposal is that the society be formed initially as an informal body without membership fees and be open to any interested person or organization. The society would commence therefore more as an information and contact network rather than a formally structured organization which required detailed preparation for setting up (formulating a constitution, electing office bearers, becoming incorporated, deciding who could become members and in what form, etc.). It is our intention that the society be free of, and be seen to be free of, any particular interest group. Initially, it is suggested that two or three convenors be elected or appointed from the conference. It would be useful if at least one of these was from an institution or organization where the small cost involved in operating the society could be internalized.

It is suggested that the convenors be responsible for (1) calling another conference in 2-3 years, and (2) producing a bi-annual newsletter which will provide the main communication between members. The newsletter would also be distributed to libraries, public land management agencies, professional associations, interest groups, and the forest industries etc. It would include information supplied by a correspondent from each State and from circularizing members. **We would hope to determine State correspondents at this meeting.** The publication might be entitled the Australian Forest History Newsletter and include material such as:

. research currently under way or planned
. publications by members and others
. meetings/conferences of interest
. grants available
. book reviews

Another purpose of the newsletter would be to raise the level of awareness of the field of forest history amongst public agencies, the private sector, conservation organizations, funding bodies and academic institutions.

With the foregoing in mind, it is hoped that the meeting will resolve to form an Australian Forest History Society, with the aim of advancing historical understanding of human interactions with Australian forest and woodland environments, and with membership open to any person or organization supportive of that aim.

(This proposal prepared by Kevin Frawley and John Dargavel was accepted unanimously by conference participants.)

Membership applications may be sent to:
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The first newsletter was distributed to members in November 1988.

Enquiries regarding Special Publications of the Department of Geography and Oceanography, Australian Defence Force Academy should be addressed to:

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AUSTRALIA'S EVER CHANGING FORESTS

This volume contains the edited papers from the First National Conference on Australian Forest History held at the Centre for Resource and Environmental Studies, Australian National University in May 1988. Papers span a range of themes: long ecological transitions, Aboriginal use of the forests and woodlands, their rapid transformation since European settlement, the structures of government, industry and labour, and changing perceptions of the values of forests. There is also a treatment of sources and a review of forest history in North America.
The collection shows that there is a lively cross-disciplinary interest in Australian forest history with much that is relevant to understanding not only the past but also today's conflicts and dilemmas in managing the remaining forests and woodlands.

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