NOTES ON THE SILVICULTURE OF MAJOR N.S.W. FOREST TYPES

2. MOIST TABLELAND HARDWOOD TYPES

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2. MOIST TABLELAND HARDWOOD TYPES

1. INTRODUCTION

The Moist Tableland Hardwood (MTH) forest types are among the most widespread of the better quality eucalypt forests in N.S.W., extending in a sometimes discontinuous band through the better watered parts of the tablelands (and sometimes even at lower altitudes) from the Victorian to the Queensland borders. They are typified by such species as Messmate[1], Brown Barrel, Manna (or Ribbon) Gum, Mountain Gum, Mountain Grey Gum, Shining Gum, Narrowleaved Peppermint, New England Blackbutt, Yellow Stringybark, Silvertop Stringybark and Diehard Stringybark, often with a rather open, grassy understorey.

These types, or variants of them, form the predominant forest vegetation over much of Victoria and Tasmania, and extend into South Australia. Perhaps because of this proximity to southern population centres, and of their popularity as background subjects by generations of Australian painters (e.g. works of McCubbin and the Heidelberg group of artists), these types appear to serve as the archetype of the Australian eucalypt forest for the majority of our population.

Over the years large areas of these types have been cleared for agricultural and pastoral use, and on a lesser, though sometimes locally significant, scale for pine planting. A few areas have long histories of timber harvesting and forest management (e.g. Styx River, Forest Land and Monga State Forests), but in most areas harvesting on any scale has really only developed over the past quarter century or so. This can largely be attributed to the timbers obtained from these types being commonly regarded as inferior to, and refractory compared with, the previously readily available coastal hardwoods. Only as supplies of the coastal timbers started to diminish did large scale logging get under way in these tableland stands.

One result of this delayed interest in the use and management of these MTH types is a general dearth of research into their silviculture in N.S.W., creating a void that has only recently started to be filled by the work, in particular, of R .G. Bridges from Eden. On the other hand, their importance in the southern States has meant that they have attracted a lot of research interest elsewhere, so that much information of relevance to N.S.W. is available from work carried out particularly by the Forests Commission, Victoria, and the University of Melbourne. In addition, of course, considerable information and experience have been accumulated by numerous foresters who have had the responsibility of overseeing the management of these types in N.S.W.

The main purpose of these notes is to bring this information together in form that, hopefully, will be both accessible and useful.

2. FOREST ECOLOGY

2.1 The Types

The forest types that constitute the Moist Tableland Hardwood communities are essentially those included in the Messmate-Brown Barrel league in “Forest Types in N.S.W.” (Forestry Commission of N.S.W., 1965). The description given there of this League is:

> *“This league is essentially the higher altitude or latitude extension of the Sydney Blue Gum/Bangalay league, and like that league it produces a usually high-quality forest*

[1] For botanical names, see Appendix 1.

stand on well-watered sites with good soils. It is most widespread in the Tableland districts but certain of the types descend to low altitudes on the South Coast, where they occupy extensive areas and form valuable forest stands."

"The types within this league characteristically occur as wet sclerophyll forest, though on certain more adverse sites they may approach dry sclerophyll forest structure. Some 17 different types are recognised within the league, a number of these being capable of further division into sub-types if required. The types are rather variable in composition, but most of them commonly contain one or more species of two closely related groups of Gums, the Southern Blue Gum group (Mountain Grey Gum, Maiden's Gum, Eurabbie) and the Mountain Gum group (Mountain Gum, Manna Gum, Candlebark). However these Gums are by no means invariably present."

Summarising from "Forest Types in N.S.W.", features of the individual types recognised in this league are:

151. **Brown Barrel-Messmate**: Height range from rarely under 30m up to 50m; numerous associates may occur. Occurs on drier aspects in areas with fertile soil and adequate moisture. Found in all Tableland districts towards eastern escarpment, at altitudes from above 600m in south to above 900m in north.

152. **Messmate-Gum**: Height range usually 25-40m. Mountain or Manna Gum usually co-dominant with Messmate, with other associates. Same general range as type no. 151, but usually in sites that are drier or have more shallow soils.

153. **Messmate-Silvertop Stringybark**: Height range 30-50m. Good quality soils in generally favoured sites. Confined to Northern Tablelands.

154. **Brown Barrel**: High quality stands, with Brown Barrel alone or with various associates. Height up to 60m on best sites. Occurs in sheltered situations on deep, moist, fertile soils. Often, though not always, is associated with a dense understorey, e.g. Blanket-bush in southern sites; rainforest species in north. In all Tableland districts, on most favoured sites.

155. **Brown Barrel-Gum**: Similar to previous type, but on slightly less favoured sites; height up to 50m. Again may occur with fairly dense understorey. Occurs in all Tableland districts, but extends to west of previous type.

156. **Brown Barrel/Messmate-Silvertop Ash:** A common variant of the previous types on the higher topographic positions (e.g. upper slopes of ridges) in the Southern and Central Tablelands. Height range 20-40m.

157. **Yellow Stringybark-Gum**: (Mountain Grey Gum is the normal co-dominant, but other species may occur). A lower altitude type occupying favoured sites (often gullies) on parts of the South Coast and adjacent escarpment. Height range 25-45m. Merges into Brown Barrel and Messmate types at higher altitudes.

158. **Southern Blue Gum**: Dominated by Mountain Grey Gum, Maidens Gum or Shining Gum, with various associates. A rather variable type up to 50m in height, usually in rather favoured sites along the escarpment in southern and central districts, and as an oddity in the north.

159. **Mountain/Manna Gum**: A widespread type occurring under a wide range of conditions, though usually where moisture conditions are favourable. Commonly in the height range 25-45m, but occasionally exceeding 60m and at the other extreme sometimes appearing as woodland. Found in all Tableland districts, extending to sea level on the far South Coast, and also appearing in parts of the Slopes districts. Narrowleaved Peppermint is commonly associated with the Gums, particularly in parts of the Southern Tablelands (e.g. Batlow

district), where at times the Peppermint may become the dominant tree in the stand.

160. **Manna Gum-Stringybark**: Widespread in the drier parts of the Tablelands where the Messmate-Brown Barrel league occurs, with Red, Silvertop, Diehard or Broadleaved Stringybarks as the main co-dominants. Height range usually 20-30m. Extends into the Slopes districts.

161. **Roundleaved Gum**: Roundleaved Gum as a species is more typical of the Moist Coastal Hardwood forest types, sometimes occurring in very high quality stands with Sydney Blue Gum, Tallowwood, Brush Box, Turpentine and Silvertop Stringybark. However it also occurs on the Northern Tablelands as a much drier community, commonly in the height range from under 20-35m and associated with Manna Gum and various Stringybarks.

162. **White Ash**: Typically a ridge top community from the escarpment of the Southern Tablelands, occurring in pure stands or with associates from adjacent communities. May reach 40m in height, but often less. Although usually associated with other types from the Messmate-Brown Barrel league, this type has characteristics that relate it more closely to the Silvertop Ash-Stringybark types.

163. **New England Blackbutt**: A widespread and somewhat variable type of the Northern Tablelands, ranging from under 25-55m in height. May occur in pure stands or with a wide range of associates. It is typical of the higher topographic positions, thus replacing the Grey Gum-Grey Ironbark league of lower altitudes or the Silvertop Ash stands of more southerly locations. In the escarpment zone it occurs with the Moist Coastal Hardwood types, but it extends to higher altitudes and further west.

164. **Eurabbie**: A scattered and usually very localised type, occurring in all Tableland districts, where it is generally regarded as a botanical oddity.

165. **Gully Peppermint**: A southern type, usually associated with the Yellow Stringybark-Gum and Messmate and Brown Barrel types, from the escarpment zone, forming stands up to 40m.

166. **River Peppermint**: A typical creekside community, common in parts of the South Coast and extending to the escarpment zone of the Southern Tablelands. May exceed 40m in height, though often less than 30m.

167. **Silvertop Stringybark**: A type of the Northern Tablelands (with one occurrence in the Central Tablelands at Nullo Mountain S.F.), usually on fertile soils. It can occur from very moist areas (where, however, the species is more usually an associate or co-dominant with other species) through to the rather drier parts of the Tablelands. Height may range from under 30m in the drier areas up to 55m in the most favoured areas.

The understorey in these types is variable, and often undoubtedly reflects the past frequency of fire. Stands from the moister and somewhat warmer areas, in particular, usually possess a shrubby understorey, often with widespread Tree Ferns, and sometimes there is evidence of an advance of rainforest into adjoining MTH stands. Blanketbush, with other tall shrubs, may form a dense understorey and in sites sheltered from fire for long periods these may ultimately occur as localised thickets, lacking a eucalypt overstorey (but with fallen stems on the ground) and reaching a height of up to 8m and with stem diameters up to 15cm. Such stands occur on Glenbog S.F. and are recorded as “small rain forest communities” by Costin (1954) from Mt. Tennyson (Bondi S.F.).

However over much of their occurrence the MTH types are characterised by an open understorey with a ground cover of tussocky Snow Grass. Shrubs or small trees (including several wattles, Blackwood in moister sites, and sometimes Black She-oak and Native Cherry) may occur scattered through the stands.

Another common feature, presumably related to the cool conditions and consequent slow decay, along with a relatively low incidence of fire, is the presence on the ground of old logs - from natural blow down or past logging - lasting there for many decades. Interpretatively, these can provide a graphic picture of the constant change present in any forest.

The MTH types vary considerably in composition and form, and merge into each other. They nonetheless form a generally fairly distinct grouping of good quality forest stands growing in the cool, but moist, parts of the State. They have been recognised and to various degrees studied and subdivided in a number of ecological reports, including those of Pryor (1939), for the A.C.T. (as *E. fastigata - E. viminalis* association); Fraser and Vickery (1939), for the Barrington Tops area (as *E. viminalis - E. obliqua* association and *E. fastigata* consociation); Pidgeon (1942), for eastern N.S.W. generally (as *E. viminalis - E. obliqua* association); Costin (1954), for Monaro district (as *E. fastigata - E. viminalis* alliance); Story (1969), for the Queanbeyan-Shoalhaven area, (for what he termed the Mountain, *E. robertsonii, E. viminalis* and Gum communities); Black (1974), for the Boyd Plateau (as the Brown Barrel-Mountain Gum-Manna Gum and the Mountain Gum-Snow Gum types of Open Grassy Forest); and Austin (1978), for the South Coast (as the *E. fastigata* and *E. muellerana* groups).

Some of the major work in Australia in nutrient cycling in native forests has been carried out in a Victorian Messmate stand by P. Attiwill (various publications over a lengthy period; see, for example, Attiwill, 1979). The site used for much of Attiwill's work, at Mt. Disappointment, was included in the International Biological Programme as an area representative of "Mediterranean Woodland". Details of this site have been presented in a report on part of the I.B.P. by Reichle (1981), and some of this information is shown in Table 1.

2.2 Ecological Relationships.

The Moist Tableland Hardwood types adjoin and merge with a number of other forest communities.

At higher altitudes on the more exposed sites, or where drainage is impeded, they give way to Snow Gum communities, with the Manna/Mountain Gum type (no. 159) often providing the link. However on more sheltered sites in the Southern Tablelands the change with altitude is to Alpine Ash, which appears above about 1100m.

With increasing warmth and high rainfall the MTH types merge into the Moist Coastal Hardwood types. The boundary between these tends to be far from clear cut, with a number of species, including Sydney Blue Gum, Silvertop Stringybark and New England Blackbutt, linking the two. In southern districts the MTH types themselves move to the lower altitudes through such types as Yellow Stringybark-Gum (no. 157) and River Peppermint (no. 166).

Table 1
FEATURES OF MT. DISAPPOINTMENT. VIC., IBP SITE
(from Reichle, 1981)

Overstorey:		Messmate
Understorey:		Sparse: Grasstree, Wattles, Hakea, Kangaroo Grass.
Soil:		Krasnozem on Silurian sediments
Climate:		Rainfall 962 mm/an. Mean average temperature 11ºC. Frost free.
Altitude:		545m
Stand Height:		21.7 - 29.1m
Age of Stand:		51 years
Stems/ha:		704 - 976
Leaf Area Index:		4.1 m^2/m^2
B.A:		54.1 - 63.3 m^2/ha
B.A. Increment:		0.55 m^2/ha/an.
Standing Crop -	Above ground :	31.2 kg/m^2

- Below ground :	7.5 kg/rn^2
Depth of Rooting Zone:	100cm
Productivity - above ground :	852 g/m^2/an
- below ground :	148 g/m^2/an
Litterfall - leaf :	189 g/m^2/an
- branch :	101 g/m^2/an
- bole :	47 g/m^2/an
- epiphytes:	19 g/m^2/an

In the north, New England Blackbutt type (no. 163) typically occurs on the well-drained ridges, while in the south this role is often taken by stands of Silvertop Ash and, more locally, of White Ash (no. 162). Soils of generally lower fertility are marked by the broad mixture of stands, of limited capacity for timber production, carrying such species as Scribbly Gum, Brittle Gum and various Peppermints and Stringybarks.

Like probably all eucalypt forests, the MTH types experience occasional fire, though the incidence of fire is usually much less than for many other communities. The role of fire also appears to be considerably less important in the maintenance of most of the MTH types than is the case with, say, the Moist Coastal Hardwood types, but nonetheless in the moister phases (particularly some of the stands with Brown Barrel) it appears to be a major factor in determining the relationship between the hardwood types and some other forms of vegetation. Rainforest (often of the Negrohead Beech type in the north or Pinkwood in the south) may occur along creeks and gullies running through these stands, and usually shows some tendency to expand into the adjacent eucalypt forest. Fire limits this spread; conversely, these bands of rainforest tend to limit the spread of fire. As previously noted, absence of fire results in the creation of Blanketbush thickets in some southern areas.

While the MTH forest types often occupy substantial tracts of land in the one area, it is not unusual for them to appear as a complex mosaic with other types - a ridge of Snow Gum or Silvertop Ash, a west-facing slope of Peppermint, an intruding gully of rainforest - or with each other.

2.3 Environment

Features of the **climate** of the MTH types are indicated in Appendix 2, which gives monthly averages from nine typical stations. All except Bega are from tableland areas: Bega is for an area where some of the types regularly occur in gully sites, though the station itself is rather drier than the nearby forest sites.

Major features of the climate of these areas include:

- Mild summers and cold winters with frequent and often heavy frosts;
- On the tablelands, occasional snowfalls most winters, though the snow rarely lies for more than a few days;
- Annual rainfall above about 850 mm;
- Over most of the range in N.S.W., rainfall fairly evenly distributed throughout the year; but in the Northern Tablelands (Styx River and Mt. Mitchell) with a clear summer-autumn maximum and winter-spring minimum, and in the southwestern highlands (Laurel Hill) with a tendency to the reverse pattern. (In Victoria and Tasmania similar types occur under conditions of dry summers and wet winters.)

The areas are not generally subject to severe fire conditions, but such do occasionally occur.

The types are found on a variety of **soils**, including those derived from basalt, granite and usually the finer textured sedimentary rocks. Soils are generally moderately deep and well drained.

Where depth diminishes, as on ridges, the MTH types are usually replaced either by other communities, such as those dominated by Silvertop Ash or Peppermint, on else by more xeric types within the MTH group, such as New England Blackbutt and White Ash. In a study in the A.C.T., Lamb and Florence (1973) have shown how the relative distribution of Brown Barrel and Narrowleaved Peppermint is delimited by variations in soil properties affecting root movement and the penetration of light summer rains.

The soils are commonly of moderate to high fertility, a factor that has been responsible for their wide conversion to agriculture in many districts. Variations in nutrient availability influence changes in species composition, and some examples of this related to phosphorus availability and also elevation, have been reported from the Eden area by Turner, Kelly and Newman (1978). The presence of fauna is also influenced by nutrient availability, and recent studies (L. W. Braithwaite et al., unpublished) indicate that the largest numbers of species and of individuals of arboreal marsupials are found in communities growing on the most fertile sites, and containing species with higher nutrient requirements such as Manna Gum, Narrowleaved Peppermint and Brown Barrel, which have high foliage concentrations of nitrogen, potassium and phosphorus.

MTH types occur on various topographic situations, ranging from steep gully sides to broad, gently undulating plateau surfaces. Composition and structure are clearly influenced by topography (e.g. changes to drier and to lower quality phases or to other communities on ridges or exposed north - and west-facing slopes and to moister phases in the lower valleys), though related changes in soil conditions sometimes make it difficult to determine whether the major influence is soil or topography.

Some of the major tree species are restricted to part to the MTH range only, while others have extremely wide ranges, occurring throughout the extent of the types in N.S.W. and on into other States. Besides having obvious effects on composition (e.g. restriction of New England Blackbutt and Silvertop Stringybark types to Northern Tablelands), this **biotic factor** is important where artificial regeneration is involved, since many of the species show very distinct provenance differences, sometimes reflected by sources occurring in close geographic proximity. These differences include frost resistance in Brown Barrel (Sherry and Pryor, 1967) and Manna Gum (Paton, 1972); tolerance to calcareous soils (Ladiges and Ashton, 1977), tree form, bark and botanical characters (Ladiges and Ashton, 1974), seedling establishment and the development of lignotubers (Ladiges, 1974 a), and drought tolerance (Ladiges, 1974 b) all in Manna Gum; and growth rate in Shining Gum (Pedenick, 1976; 1979), Messmate and the Southern Blue Gums (Pederick 1976).

The MTH types tend to support a relatively rich fauna. Among the mammals, several species of wallabies are common, and utilise the productive ground and shrub layers as a grazing and browsing resource. Some sites are particularly rich in arboreal mammals, notably the more productive forest types on good soils with a rich mosaic of trees species and an element of Peppermint present. Where the tablelands forest types extend towards the coast, veteran stands of Mountain Grey Gum are particularly important for arboreal mammals. MTH types provide a “very rich habitat for birds” (Frith 1969). ‘Bassian’ or Tasmanian species, such as the Pink Robin, are at the northern limit of their distribution in some of the tableland forests of southern N.S.W. (Shields and Boles, 1981). The multi-storied structure of the forest types provides a variety of resources for birds, harbouring most forest species that occur in except those with rainforest requirements. Reptiles and amphibians are poorly represented due to the climate, although there are some interesting species adapted to high altitude and low temperatures. The clear, rapidly flowing streams characteristic of the general area where MTH types occur support a variety of endemic aquatic life, and are heavily used for the production of the introduced trout.

Insects that are present and that influence the silviculture and management of these stands include the phasmatids, *Podacanthus wilkinsoni*. and *Didymuria violescens* (Campbell and Hadlington, 1967) and the termite, *Porotermes adamsoni* (Greaves, 1959).

Fire is undoubtedly a feature of the MTH in the breakdown of litter and creating conditions for regeneration, but probably only in stands with a dense understorey is it essential for regeneration establishment. These latter stands apparently rely on the occasional extreme fire to destroy the understorey (and often much of the eucalypt overstorey as well), allowing a new, even-aged crop to establish: this applies particularly to some of the Brown Barrel stands with a Blanketbush or similar shrub layer. It is also important in some of the drier, ridge-top stands which have a greater capacity to carry fire than most MTH types, and these (e.g. New England Blackbutt, White Ash) typically regenerate densely following severe fire.

However, unlike the Moist Coastal Hardwood types, over much of the MTH stands it appears that regeneration occurs in the absence of fire, relying on gaps caused by tree death and blow down to maintain the recruitment of younger stems into the stand.

3. OCCURRENCE

The Moist Tableland Hardwood types extend in a moderately continuous swathe throughout the tablelands of N.S.W., mostly at elevations between about 900 and 1 400m. Particularly in the south, some types occur at lower elevations: Yellow Stringybark-Mountain Grey Gum type is the typical vegetation of the sheltered gullies or better soils in the coastal forests of the Eden district; a stand of Manna Gum adjoins Twofold Bay in the same area; an extensive band of Maidens Gum occurs in 500 to 700 in altitude band south from Brown Mountain (Glenbog S.F.); and there is an occurrence of White Ash type at an altitude of 450m only 10km from the coast on Nadgee S.F.

While the major occurrence is towards the eastern edge of the tablelands, some extensive stands are found in more westerly sites. The largest of these occurs in parts of the western A.C.T. and adjacent areas of the Tumut region, where it runs into Alpine Ash types, extending west and south to Green Hills and Maragle S.F.s. Others of note include remnants in the Mt. Canobolas area, and the unexpected basalt plateau stands on Warung and Bundella SF.s along the Liverpool and Warrumbungle Ranges east of Coolah.

Discontinuities in the distribution of these types reflect unsuitable climatic conditions or soils.

The types occur in virtually all tableland management areas with hardwoods, and in the western parts of management areas on the South Coast.

The general distribution of the types is portrayed on the 1:4 000 000 Forest Types map (Forestry Commission of N.S.W., 1978), under the category “Moist Tableland Eucalypt”, though this category also includes Alpine Ash types in the occurrences in the western parts of the Southern Tablelands. This map omits portrayal of the Warung-Bundella occurrence of these types (wrongly shown as Western Box).

The inventory, which provided the data used in the production of that map (Hoschke, 1976), gave the following estimates of forest areas carrying these MTH types (and excluding Alpine Ash types, which were separately recognised in the inventory, though not in the subsequent mapping):

Types	**Res. Note 17 No’s**	**State Forest** (ha)	**Areas National Park** (ha)	**Total** (ha)
Messmate - Brown Barrel	151 - 162, 164 - 167	236 000	158 000	886 000
New England Blackbutt	163	144 000	5 000	421 000
Total		**380 000**	**163 000**	**1 307 000**

The total area of these types - 1.3 million ha makes them the most widespread of the better quality forests occurring in N.S.W. Large areas are held as freehold or leasehold, and at the time of the inventory there were still substantial areas of vacant Crown land; much of these has subsequently been added to national park (e.g. Wadbilliga N.P.).

4. UTILISATION

Over the past two decades or so the Moist Tableland Hardwood types have developed as one of the major sources of native timbers in N.S.W., and currently supply about a quarter of the total sawlog production from Crown-timber lands in the State. Species making the largest contributions to this production (though not in all cases coming only from the MTH types are (Forestry Commission of N.S.W., 1980):

Species	% of Total	Rank in State
Messmate	6.9	5
Brown Barrel	5.8	7
Silvertop Stringybark	4.0	8
New England Blackbutt	3.4	9
Manna Gum	2.3	12
Yellow Stringybark	2.0	15
Mountain Grey Gum	1.3	19

An outline of the properties of the more common species in these types is given in Appendix 3. Most have pale coloured timbers, often with rather indistinct, but Lyctid-susceptible, sapwood; they have medium strength ratings, but show rather low durability for eucalypts; most are prone to collapse during seasoning and will require reconditioning, and are liable to surface checking when backsawn; some exhibit considerable tangential shrinkage. They are used particularly for general building construction, though some have more specific uses. Silvertop Stringybark and Manna Gum have been successfully used in the Dorrigo district for producing veneers (for formply).

Some species are unpopular for use green in general building construction, due to the collapse and distortion that occurs as they season in service. Investigations with Brown Barrel, Messmate and Manna Gum/Mountain Gum indicate that they can be dried and reconditioned in thicknesses of at least 38 mm. This upgrades their strength, avoids subsequent problems caused by collapse in service, and should enable them to be used as high-strength components in engineered structural systems.

As is not unusual, attitudes to different species vary considerably from place to place. White Ash is rarely used as a sawlog in some districts, but is highly regarded in others; in parts of the Northern Tablelands Brown Barrel is regarded as a consistently poorer species than Messmate; and so on. This may reflect genuine differences in timber quality from different locations.

Old growth stands commonly contain many trees that are unsuitable for use as sawlogs because of defect. Frequent causes of defect include damage from past fires, termites and Ambrosia beetles (Neumann and Harris, 1974): the incidence of attack by Ambrosia beetles has been sufficient to stop logging on some areas (e.g. parts of Banshea S.F.) in the past, and studies by Ghali and d'Espaignet (1981) have shown that, when sufficiently severe, both pinholes and black stain associated with Ambrosia beetle attack in Shining Gum can reduce the strength of structural timber produced.

Virtually all species are suitable for paper pulp, and in southern districts contribute considerably to the input of the woodchip plant at Twofold Bay: input is either as forest material unsuitable as sawlogs, or as sawmill residue. Particularly where forest material can be used, this market is extremely useful in providing for improved utilisation of the forest.

Regrowth stands provide a well regarded source of mining timber, and at a later stage are suitable for preservatised poles. Although the species are not among the, best of the eucalypts for burning, deadwood on forests close to major population centres is receiving increasing use as firewood both by individuals after fuel for their own use and by commercial operators.

Because of their commonly extensive grassy ground cover, the types are highly regarded for stock grazing and large areas are held under lease or permit. The types receive some use by apiarists, though the species present are not among the prime honey producers; often the main use is to take advantage of wattle flowering in late winter as a reliable source of pollen when little other blossom is available.

Occurring in relatively high rainfall areas at high altitude, the MTH types have an important catchment protection role. The types also provide a useful source of wildlife habitat as a whole, and in some districts provide almost the only remaining significant wildlife habitat, other similarly productive sites having been converted to pastoral use. Some sites are known to be particularly valuable for the richness of their tree-dependent fauna. Areas close to major population centres or reliable access routes may receive fairly high recreational use. Because of their environment, features such as brooks and waterholes are not uncommon within MTH types, and walking is often relatively easy due to the frequently open nature of the understorey. Many of the streams are stocked with trout and are popular with anglers.

As earlier noted, areas formerly carrying these types have been cleared over large tracts for the development of agricultural and pastoral land and substantially smaller (though sometimes locally significant) areas have been converted to pine plantations, often following an earlier period of farm use. Considerable areas are also held in national parks.

5. HISTORY OF USE AND MANAGEMENT

The Moist Tableland Hardwood forest types have in many cases been used for timber production for long periods. A number of forests were the source of operations for bush mills that were functioning in the early decades of this century, and sometimes even last century: these include Bondi, Badja, Monga, Tallaganda, Konangaroo, Styx River and Girard S.F. In probably all cases, most of the production was used locally. Logging was selective, often with the same areas, particularly those most accessible to the mill, being picked over on repeated occasions.

Because of the nature of these stands and except in the most moist sites where the undergrowth was excessive, regeneration would usually have appeared in the gaps following logging, though its subsequent growth must have been hindered by the remaining overwood. Silvicultural treatment by way of culling was rarely if ever applied to these tableland forests prior to World War II, and in only a few areas subsequently. Fire, though rare compared with most coastal forests, would periodically occur and certainly in some cases (e.g. the Styx River “Chook Fire” of about 1941) would damage large areas, degrading the older stems and killing the younger ones back to ground level. One result of such fire was to even out the age of regrowth: sites previously carrying a range of age classes, resulting from a succession of logging operations plus natural stand dynamics, would have many of these eliminated and replaced by a new crop of seedlings and coppice dating from the fire. In the case of those stands with a dense understorey, such fires would represent the natural mechanism for regeneration.

In a few areas a new factor imposed itself on the management of these stands during the late 1940’s. This was an outbreak of phasmatids in plague proportions, with severe outbreaks repeated over a number of years in the Nundle and Oberon districts (and subsequently also in Alpine Ash stands in the Batlow district). The repeated attacks caused the death or deterioration of many of the larger trees, and logging, of heavy intensity, was carried out to salvage these stems. On Konangaroo S.F. (Oberon District) the effects of the phasmatid attack were such as to convince the Commission that it would not be practicable to manage this forest for continued hardwood production, and instead the area was marked for conversion to pine plantation; this in turn led to the environmental controversy

over pine planting on the Boyd Plateau, and the subsequent incorporation of Konangaroo S.F. into the Kanangra-Boyd National Park. At Tomalla S.F. (Nundle District), the insect-ravaged and heavily logged stands now carry an excellent crop of Messmate, Silvertop Stringybark and Manna Gum regrowth approaching small pole size.

In most districts where pine planting was under way the better quality eucalypt stands were excluded from the sites allocated for conversion to pine. However there have been exceptions. The most notable were probably in the Bombala district, where some of the finest hardwood stands carried a dense, shrubby understorey and had proved very difficult to regenerate. Elsewhere some isolated better quality stands were converted to pine in the Bathurst area (notably Sunny Corner S.F.), while part of the planting programme in the Nundle - Walcha zone continues to be on land that also has a potential, for hardwood production.

From the 1950's onwards, the MTH types were subject to both increased and more intensive harvesting operations as logging moved into less accessible areas and accepted a wider range of species and log qualities. This has led to the current position where these types are producing about a quarter of the sawlog production from Crown-timber lands in N.S.W., though, in the longer term, in few districts will it be possible to sustain these present levels of log production.

6. REGENERATION REQUIREMENTS

6.1 Seeding Habits

Information on the times of flowering and optimum seed collection of a number of species in the Moist Tableland Hardwood forest types has been tabulated by Boland et al. (1980), and is summarised in Table 2.

In the case of Brown Barrel, flowering does not occur for nearly 2.5 years after the inflorescence buds first appear, with the seed maturing about a year following flowering (Fielding, 1956; Cremer, 1978). Brown Barrel is usually noted as a spasmodic seeder, though in Fielding's study "*large numbers of seeds were disseminated in both years*," with estimated yields of 5.36 million and 1.48 million seeds per hectare in the two years recorded.

However most reports suggest heavy flowering, and subsequent heavy seed crops, less regularly. Bridges (1980a), from southeastern N.S.W., records major flowerings in 1977 and 1980, and possibly also in 1974 and 1968: an average of about once in 3 years. However, since then, R. G. Bridges has recorded another major flowering in 1981 and successive large flowerings in 1982 and 1983, thus improving the average. Cremer, on the basis of a rather fleeting visit, has suggested: *"Flowering probably occurs every year somewhere in the forest, but not in every tree, and possibly not in any tree. Most trees showed no crops or almost no crops for several years. It seems that good crops are produced only about once in four years. Although the production of good and nil crops seems to be strongly synchronised amongst trees in some parts of the forest, other patches only 2 to 10 km away showed different years of poor and good flowering."* Seed is shed gradually for a period of possibly 4 years after it matures, unless its release is accelerated by fire, felling or similar agency. This means that there is usually a reserve of seed held in capsules in the crown of Brown Barrel: Bridges estimates that *"heavy flowering on a 3 year cycle gives a period of about 6 months when the trees carry a low viable seed crop. This is the period just prior to viable seed production by the new capsule crop."* On the other hand, Cremer notes that *"although abundant fruits were found in some parts of the forest, other parts had only meagre or modest crops, and some parts had definitely not enough mature seed at the time of felling to regenerate the coupe."*

As with most eucalypts, the crown class will influence seed production in Brown Barrel, with dominant stems usually the best producers. Fire damaged crowns are poor producers and Jacobs (1955, para. 195) notes that in the A.C.T. the first heavy flowering of Brown Barrel since the 1939 fires occurred in 1954.

Messmate, like Brown Barrel, carries several years crops of capsules in the crown at any time: Pederick (1960) recorded three seasons fruits, and possibly some from the fourth. At the time of Pederick's study (February), the most recent capsules were still green, though containing viable seed; whilst most seed had already been shed from the earlier capsules, some remained. Other Victorian work (Anon, 1963) noted flowering of Messmate in December-January, with peak seed fall about 14 months later. A heavy flowering one year was followed by a light flowering the next.

Bridges (1980a) observed that Shining Gum *"has carried a regular seed crop with viable seed available all year",* in comparison with the more spasmodic seeding of Brown Barrel. However the Victorian studies (Anon., 1963) infer less reliability for Shining Gum, with heavy flowering in January-February 1961 and a moderate flowering in 1964, and presumably poor years in between; peak seed fall occurred in March 1963 (and some shed during the previous summer), i.e. 2 years after flowering.

Table 2

FLOWERING & SEED COLLECTION TIMES: MOIST TABLELAND HARDWOOD SPECIES

Species	Flowering	Seed Collection	Notes
Ash,			
Gully	Dec - Feb	Dec - Feb	Light seeder
Silvertop	Sep - Jan	Dec - Feb	More than 1 crop present on tree
White	Dec - Jan	Sep - Feb	More than 1 crop present on tree
Brown Barrel	Dec - Feb	Dec - Feb	More than 1 crop present on tree Good crop every 4 years
Eurabbie	Sep - Jan	Mar - May	
Gum,			
Manna	Jan - May	Jul - Jan	
Mountain	Mar - May	Dec - May	
Mountain Grey	Dec - Feb	Jan - Jun	
Shining	Jan - Mar	Nov - Jan	Difficult to extract if seed not mature at time of collection
Messmate	Dec - Feb	Dec - Feb	More than 1 crop present on tree
Peppermint,			
Gully	Jan - Mar	Sep -Feb	
Narrowleaved	Oct - Jan	Dec - Feb	More than 1 crop present on tree
River	Sep - Nov	Dec - Feb	More than 1 crop present on tree
Stringybark,			
Yellow	Nov - Mar	Dec - Feb	More than 1 crop present on tree

Silvertop Stringybark appears to resemble Brown Barrel in producing heavy seed crops at irregular intervals. By contrast, those species such as Silvertop and White Ash and New England Blackbutt, occupying ridge positions in sites prone to frequent fire, appear to carry large crops of seed at all times, though detailed information is only available for Silvertop Ash (Bridges 1980b).

For Yellow Stringybark, a Victorian report (Anon., 1966) suggests a fairly constant production of seed, contrasting with the periodicity of seed of most other species being studied.

Information on seed weights for various MTH eucalypts, and on the optimum temperature for germination tests, is given by Boland et al (1980), and is summarised in Appendix 4.

As with most eucalypts, capsules of the MTH eucalypts contain relatively few viable seeds, with an average of about one seed per cell. Figures quoted by Grose and Zimmer (1958) include:

Species	No. Seeds/Capsule		No. Seeds/Cell	
	Average	Range	Average	Range
Ash, Silvertop	1.5	1.4 - 1.5	0.5	0.4 - 0.5
Eurabbie	7.2	2.6 - 11.0	1.8	0.9 - 3.7
Gum, Mountain Grey	2.1	0.8 - 2.5	0.6	0.5 - 1.5
Messmate	3.0	0.3 - 4.8	0.8	0.1 - 1.3
Peppermint, Narrowleaved	2.5	2.3 - 2.7	0.8	0.7 - 0.8

Little information on total seed availability has been published. As noted, Fielding (1956) recorded falls 1.5 and 544 millions seeds per hectare of Brown Barrel on two separate years, and a fall of 1.2 million seeds per hectare was recorded in Victoria in a mixed Messmate - Mountain Grey Gum stand following sap-ringing (Anon, 1964).

Similarly there is little information on seed dissemination, though in laboratory studies Cremer (1977) has found dispersal distances of from 23.9 to 28.9m for a range of MTH species released 40m above ground in a 10 km/h breeze. These are median values in dispersals determined for a larger number of commercial eucalypts.

6.2 Germination

Laboratory studies on the germination of a number of MTH eucalypts have been carried out in Victoria and discussed by Grose (1957 and 1965) and Grose and Zimmer (1958), and the results of some of their work are included in the information summarised by Boland et al. and presented in Appendix 4.

Many of the species present in the MTH types exhibit partial dormancy. In dormant seed, germinative capacity is low (often under 20 percent of the possible), and the time to achieve that germination is slow, unless the seed receives a preconditioning period of moist cold storage (stratification). With stratification, the same seed will show the rapid and complete germination typical of most eucalypts. Partially dormant seed shows delayed germination unless the seed is stratified: germination is slow to start, and may continue for well over a month, whereas with most eucalypts, or with partially dormant seed that has been stratified, germination is virtually complete within a week. From the Victorian work, Brown Barrel, Shining Gum and River Peppermint show partial dormancy, whereas Maidens, Manna and Mountain Grey Gums, Silvertop Ash, Eurabbie, Narrowleaved and Gully Peppermints, Yellow Stringybark and Messmate are not normally dormant. However Grose (1965) showed some improvement in the speed of germination with Narrowleaved Peppermint, Silvertop Ash and Eurabbie following stratification, and in his 1957 paper he referred to the showing by Messmate and Narrowleaved Peppermint of evidence of dormancy in collections from the higher altitudes.

In field trials at Glenbog State Forest, Bridges (1980a and 1981) has observed that Brown Barrel appears to germinate at any time of the year when conditions are favourable though there are two peak germination periods, in spring and late autumn. A (probably small) proportion of the seed exhibits some dormancy mechanism, and seeds may germinate up to a year after the main germination period. From some Victorian trials (Anon., 1964), it was reported that some Shining Gum germination occurred in late autumn - early winter, but that the main period was in the spring; with Messmate, where the seed trees were ringbarked to induce seed fall, all seed (over 1 million per hectare) fell with 4 weeks of the ringbarking in April, most seed germinated almost immediately, and no new seedlings appeared after July.

6.3 Regeneration Establishment

Regeneration can be established by either natural or artificial means, and both have been used in the management of the MTH types. Natural regeneration relies upon the establishment of seedlings from seed fall either at about the time of logging or previously (advanced growth), or upon

coppice.

Coppice normally receives little deliberate use in these types in N.S.W., though shoots will not uncommonly develop on stumps following logging. Coppicing is more likely following mining timber or pole operation in younger stands. Cremer (1980) records coppice after logging in a Brown Barrel stand aged about 100 years, and the phenomenon appears more common with some of the other species, e.g. Manna and Mountain Grey Gums, Messmate. In some of the drier Messmate stands in Victoria, coppice is regularly relied upon for regeneration, though seedling regeneration is preferred (Hodgson, 1962).

Other forms of natural regeneration depend ultimately on seedling establishment, which in turn requires an adequate seed source, a suitable seedbed, conditions favouring germination and subsequent survival and growth, and protection from various damage agencies. These will be looked at further below.

Artificial regeneration can be obtained either by sowing seed over the area to be regenerated or by planting. Planting has been used on a relatively small scale in N.S.W. Silvertop Stringybark has been planted as a routine operation in the Dungog district, using jiffy-pot seedlings raised in the manner described by Home (1979). More recently open-root seedlings of Brown Barrel and Shining Gum have been raised at Bombala Nursery, using a technique similar to that for *Pinus radiata,* but with a more rigorous root-wrenching regime (Bridges, 1979-80). The plants have then been used for winter planting on ripped log dumps or on logged coupes where natural regeneration is regarded as unsatisfactory (Dobbyns, 1979). Of the two species, Shining Gum is considered the hardier and easier to handle. This species has also been planted in Victoria, where May et al. (1975) have reported significant increases in survival and growth (in sites carrying heavy bracken) as a result of fertilising with Magamp, a mixed fertiliser containing N, P and Mg. A number of species from the MTH types are planted to varying degrees overseas, including especially Maidens Gum (Italy and Iberian Peninsula) and Brown Barrel (New Zealand) (F.A.O., 1979).

Seeding has not been used on a routine scale for artificial regeneration of the MTH types in N.S.W., but is the standard method of treatment for the moister types in eastern Victoria. Here (e.g. Bendoc area), coupes are logged out, the debris heaped and burnt, and then the sites aerially seeded, using a pelleted mixture of Messmate, Brown Barrel and Shining Gum seed at a rate of about 4.5 kg per hectare (Bridges, 1980a). An account of the development of this technique was given in an earlier Victorian report (Anon., 1967).

6.4 Seed Source

The source of seed for natural regeneration has been reviewed previously (section 6.1). Whilst the evidence is incomplete, it appears that in some types, particularly those of the drier, fire-prone sites, ample seed resources are present at all times.

In the moister stands, including those carrying Brown Barrel, Shining Gum or Silvertop Stringybark, some seed will usually be present in the crowns, though not infrequently this may be inadequate to provide for immediate, extensive regeneration and occasionally it may be virtually absent. At other times it will occur in abundance. This is the pattern of species that are not dependent on occasional cataclysmic disturbance for their regeneration, but rather are opportunists, taking advantage of favourable conditions as and when they appear.

Seed for natural regeneration following logging may be provided either from remaining standing trees or from the heads of felled trees. Certainly with the heavier logging operations, the heads tend to be the more important source.

6.5 Seed Bed

For eucalypts to germinate and then establish themselves as healthy seedlings, the young

germinate needs access to the mineral soil, in an environment where there is sufficient light and freedom from competition for the seedling to survive. Heavy litter, dense ground cover (e.g. grassy sward) or heavy shading are factors that render a potential seed bed unsuitable for seedling establishment.

In Nature, the problems of heavy litter and undergrowth are overcome by periodic fire. Apart from White Ash, and to a less extent Shining Gum, the MTH eucalypts, as established trees, appear fairly resistant even to severe fire, so the result is rarely extensive, even-aged regeneration, but rather a scattered filling of isolated gaps and openings, to maintain an uneven-aged stand.

Logging causes much disturbance of the undergrowth and litter to create suitable seed beds, but also leaves piles of heavy logging debris that can inhibit regeneration establishment. In one study by Bridges (1981), 49 per cent of the block area was disturbed by logging, but only 35 per cent was disturbed and free of debris, while Cremer (1978) notes that with intense logging, islands of debris may cover 10 to 30 per cent of the total area.

The extent of disturbed ground can be increased by a post-logging burn, either in the form of top disposal or as a broadcast burn, though the latter is often difficult to obtain in these MTH stands except under unacceptably dangerous conditions, or else it may destroy regeneration which has become established since logging. The results from post-logging burns are rather contradictory.

Bridges' (1980a, 1981) study, in a Brown Barrel-Shining Gum stand, produced by far the better results with burning (Table 3). Similarly in a Victorian study involving Shining Gum (Anon., 1964) twice as much germination occurred on burnt as on unburnt sites, while in heavy Snow Grass germination was negligible. Bridges (1980a) notes that with direct seeding in Victoria, growth is usually very good on severely burnt seedbeds.

On the other hand there are many examples where burnt sites have given poorer results than disturbed, but unburnt, sites. Bridges (1980a) observes that with the Victorian aerial seeding, unburnt, disturbed soil gives better survival than a burnt seed bed; other visitors to these Victorian sites have suggested that burning often seems to inhibit the regeneration and that there are many failures on burnt areas. Referring to Brown Barrel-Shining Gum type on the Anembo Section, Tallaganda State Forest, Bridges (1978) wrote: *"Burning had destroyed either existing regeneration or the ground seed supply; sites were examined where regeneration 0.5 m to 1.0 m tall existed right round a burnt area carrying no regeneration. It appears that at the time of burning the residual overstorey did not carry an adequate seed source because the seed bed created by the fire was excellent".* Six years after logging, these burnt patches are still deficient in regeneration. Other examples of regeneration results on both burnt and unburnt sites are given in the site inspection summaries in Appendix 5.

Table 3

REGENERATION ESTABLISHMENT - BURNT AND UNBURNT BLOCKS
(Brown Barrel - Shining Gum Stand)

Time Since Burn	Unburnt Block		Burnt Block	
	% $4m^2$ Plots Stocked	Total Stocking/ha	% $4m^2$ Plots Stocked	Total Stocking/ha
Under 1 month	15	400	6	700
5 months	17	500	35	1530
12 months	27	2500	55	6100
18 months	29	2680	51	6790
24 months	32	2920	57	7750
36 months	29	2700	55	6770

Weeds often invade burnt sites. Wattles are common, and although they may not significantly reduce the amount of eucalypt regeneration they undoubtedly retard its growth. Bridges

(1980a) records three times as much wattle on burnt blocks as on unburnt blocks. Other weeds may appear, and with their rapid growth and dense formation rapidly reduce the receptivity of the seedbed or even smother much of any existing regeneration. *Goodenia ovata* behaves this way in some of the stands, and it has been suggested that this species also has a positively inhibitory effect on regeneration.

In general, fire should be used with caution in these moister MTH sites. Bridges (1980a) suggested that its use should be avoided unless the retained trees carry a good seed crop or a decision has been made to regenerate the site artificially. This appears a sound conclusion. If used with artificial regeneration, the sowing or planting should closely follow the burn since burning stimulates shrub development.

In some areas, burning ahead of logging has been suggested as a means of removing or reducing the heavy understorey that may be present in the moister stands. The problem here is that such sites are only likely to burn under fire-dangerous conditions, so that pre-logging burning, in the sites where it is potentially most beneficial, is rarely a realistic proposition.

One feature of the MTH sites is that a suitable seedbed appears to remain receptive for germination for much longer than in many of the coastal forests. This is possibly, at least in part, a reflection of the generally rather slower weed growth. The figures in Table 3 show that germination was still occurring on both burnt and unburnt sites for more than 2 years. However, most of the total stocking had germinated by 12 months and it appears that the total stockings peaked in the period between 2 and 3 years. Observations by a number of local foresters suggest that in many areas it is not unusual for regeneration to continue to appear for 5 to 15 years after logging, so that an area that initially appears as a failure will ultimately end up well stocked. Whilst this is unlikely in the sites supporting a dense shrubby understorey that rapidly reforms after logging, it appears to apply to most MTH sites.

Snow Grass, growing as discrete tussocks, is common in many MTH sites. Even without disturbance, sufficient bare soil usually exists between tussocks for regeneration to appear if other conditions are suitable. However on occasions the Snow Grass will develop into an almost continuous sward that is a very effective inhibitor of regeneration. This usually seems to have occurred on fertile sites (e.g. basalt soils), where the stand has been heavily opened; such sites become very frosty, while the grass attracts grazing animals, both factors further inhibiting regeneration establishment. Restoration of forest cover on these sites could be long in occurring, as it will probably have to rely on the few remnant trees and occasional seedlings developing to the stage that the grass close by is weakened and thinned out before further eucalypt regeneration can appear. The grassy sites sometimes attract feral pigs, that root about seeking plant roots and tubers: the resultant disturbed soil may at times produce a favourable seed bed for some eucalypt regeneration.

Besides the Snow Grass swards and fire weeds, Bracken may sometimes become densely established in the more heavily opened sites. Again this inhibits regeneration, though it appears that, if seedlings can become established immediately after logging, sufficient will survive under the shelter of the fern and ultimately poke through to provide a new crop. Up to 8 - 10 years may elapse before such regeneration is evident above the ferns.

6.6 Seedling Establishment

Besides seed source and seedbed, there are other factors involved in the successful establishment of seedlings. Some of these are subject to little control by the forester: e.g. suitable temperature and moisture conditions for germination and subsequent rooting. In the generally fairly reliable weather conditions of the tablelands, these are usually not a major factor, although dry spells may kill off large numbers of seedlings and, during protracted droughts, may preclude regeneration establishment some years.

Some other relevant factors are more amenable to control, and the most important of

these is the forest canopy, which not only affects light reaching the ground, but which is closely related to the degree of root competition and can also directly influence temperature at the ground.

Most eucalypts are light-demanding species, but there are degrees of light requirement, and many of the MTH species show an ability to establish and persist, if not to grow vigorously, in small gaps or under reasonably shaded conditions. This is a distinct feature of most unlogged stands that lack a dense understorey. It suggests that such stands might be successfully managed by a selection or a shelterwood system. Selective harvesting was in fact initially employed on most tableland forests that have been harvested over long periods, and even though these early operations represented a creaming, rather than a genuine attempt at selection management, they appear to have been fairly successful in obtaining regeneration.

In Victoria, many of the Messmate stands are managed under a shelterwood or uniform system, and Hodgson (1962) has provided an interesting comparison of regeneration under shelterwood with that under clearfelling, with and without seed trees. Five years after treatment, the results were as shown in Table 4. Clearly the shelterwood has provided the most prolific regeneration, though the subsequent development of this has been best where there is least overwood.

Table 4
REGENERATION 5 YEARS AFTER TREATMENT:
MESSMATE, CRESWICK
(after Hodgson, 1962)

Treatment	Overwood Trees (/ha)	% Milacres stocked	Stems/ha	Seedling Height	
				%-30cm[1]	%>1.2m[1]
Uniform	50	69	6 700	75	2
Clearfelling, Seed Trees	10	48	4 400	50	13
Clearfelling	0	47	1 900	6	47

Note([1]): Percentages of regeneration in height classes are derived from rather uncertain graphs, and provide a relative, rather than an accurate, picture.

Contrary to these results, Incoll (1979) records a study by R.0.Squire and J.G. Edgar with Messmate in Victoria where gaps 20m wide were unsatisfactorily stocked with regeneration (less than 65 per cent of 16 m^2 quadrats stocked), but in gaps 40m wide stocking was satisfactory. The reference is tantalising, and appears to contradict common experience with such stands.

Retention of an overwood infers stronger root competition as well as less light, and this must be expected to retard growth of regeneration. At the same time the greater root competition will normally hold grass growth in check, thus preventing the formation of regeneration-inhibiting swards such as sometimes occur in large openings, particularly on the more fertile soils. The overwood will also reduce the incidence of frost at ground level: frost heave, particularly on disturbed soil that provides the best seedbed conditions, is a major cause of seedling mortality (Bridges, 1980a). A further benefit of retaining an overwood in these sites is to ensure an adequate seed source over a longer period.

The regeneration inspection summaries in Appendix 5, probably fairly representative of conditions in the MTH sites, show that satisfactory regeneration may be obtained under a range of logging and treatment histories; there can also be some notable failures. In frost-prone sites, or areas with a potential for heavy grass growth, the retention of a shelterwood is one means of ensuring that adequate regeneration will be obtained; its subsequent partial or complete removal ensures that growth in the regeneration will be maintained.

Several species of the MTH types, including Brown Barrel, White Ash and Shining Gum, have seedlings that lack lignotubers, though most of the tableland eucalypts form them. However they

do not seem as significant in maintaining a pool of suppressed advance growth as they are in some of the lower altitude forest types. Exceptions to this statement would be some of the Gum-Peppermint stands, usually of limited use for hardwood production, but in some areas used for conversion to pine.

6.7 Damage to Regeneration

A number of agencies, some already mentioned, can interfere with the establishment and subsequent growth of regeneration in the MTH types.

Seed can be attacked within the capsules by the larvae of certain wasps and weevils, though the extent of this is probably rarely significant (Grose and Zimmer, 1958; Pederick, 1960). A trial reported by Jacobs (1955, para. 187) with Brown Barrel in the A.C.T., and recent studies by R.G. Bridges at Glenbog S.F., have failed to demonstrate the significance of seed loss by ants and other ground insects, but it is possibly more important in rather drier stands than those studied.

As mentioned (section 6.6), frost can cause heavy loss in young regeneration, particularly on friable, disturbed sites which, otherwise, provide an excellent seed bed. Late spring germinates may develop sufficiently to avoid damage the following winter, while retention of a shelterwood tends to reduce the risk of this type of damage. Although the tableland seed beds tend to remain receptive and weed-free for longer periods than most coastal forests, some weeds can occupy the site at an early stage, preventing further germination, sometimes smothering existing seedlings, and retarding the growth of established regeneration. Among the species that can cause problems are sward-forming grasses, *Goodenia* thickets, regrowth of dense understorey scrub (such as Blanketbush, which regenerates largely through coppice; Cremer, 1978), Bracken and some other ferns, and wattle.

Browsing by native herbivores can be surprisingly heavy in some of the MTH sites. Fenced plots, established by R.G. Bridges at Glenbog S.F. in a very high quality Brown Barrel-Shining Gum area, show extremely vigorous growth of both weeds and eucalypts where protected, compared with more moderate growth of both outside the plots. Bridges has observed that, during drought conditions, browsing (primarily by wallabies) tended to remove weed species ahead of the eucalypts. Young regeneration throughout the tableland forests commonly shows signs of browsing, and the damage is likely to be accentuated where domestic stock is also present in the area.

6.8 Early Development

As already noted, regeneration in the MTH types often appears over a lengthy period, and it is only in the most weedy sites that there is likely to be a restricted period of recruitment. Some results by Bridges (1980a) show this continuing recruitment in a moist forest area: these results, updated, are shown in Table 5.

Table 5
EARLY REGENERATION DEVELOPMENT: GLENBOG S.F.

Treatment	Time from Treatment (months)	% 4 m^2 plots stocked	Stocking/ha	Mean Ht (m)
Logged: Mar. 77	7	4	125	-
	16	19	687	0.5
	25	23	1 125	0.5
Logged: Jan. 79	4	15	366	0.3
	16	27	2 500	0.4
	29	32	2 926	1.0
	41	29	2 700	2.4
Logged: Jan. 79	1	6	714	0.01
Burnt: Apr. 79	13	55	6 122	0.2
	26	57	7 755	144
	38	55	6 770	3.6

Appendix 5 summarises the state of regeneration on a number of coupes, of varying ages, inspected by the Silviculturist during 1982. Estimates of height are included for some of these - usually those showing the most successful development. There are some poor establishment results, usually for reasons that can be logically explained, but in general regeneration is ultimately, if not immediately, established in ample quantity. Growth of the regeneration is uneven, ranging from Shining Gum saplings approaching 10m in height at age 5 years on one site (Glenbog), to Brown Barrel only just emerging from heavy Bracken on Dampier S.F., with the tallest about 1.5m 8 years after logging. Although there is great variability within stands and between species and sites, on average 10 years after logging in these sites regrowth can be expected to be rather under 10m in height.

Composition of regeneration usually tends to reflect the make up of the original stand, though in regrowth following logging, as in Nature, chance can undoubtedly play a big role in determining relative proportions of species, based upon seed availability at the time of treatment and other similar factors. In a Victorian study, Eddy (1963) has observed some such changes in composition: in a stand where half the original stems were of Messmate, Messmate only contributed 15 per cent of the regeneration, with Manna Gum making up 77 per cent. It is possible that longer-term development may alter the ultimate composition back to something closer to the previous stand in such cases.

7. GROWTH AND YIELD

Little information is available on the growth of MTH stands in N.S.W., though hopefully this situation will improve as permanent growth plots are established in regrowth areas.

Summaries of growth information on a range of species from various Australian sources have been compiled by Borough et al. (1978), and include figures for the following MTH species: Eurabbie, Shining Gum, Messmate, Silvertop Ash, Brown Barrel, Silvertop Stringybark, Yellow Stringybark and Manna Gum. The information is variable as to coverage and applicability to MTH conditions in N.S.W. The more relevant figures are included in appendix 6; unfortunately, none are for Brown Barrel, though Borough et al. quote a regrowth plot at Errinundra, Victoria, carrying 638 m^3 in a 51 years old mixed stand of Shining Gum and Brown Barrel. Comparative figures on five species (3 tableland, 2 coastal) planted in the one area at Chichester S.F. are also given by Borough et al., from information supplied by the Commission, and updated figures for this site are shown in Table 6, together with figures for New England Blackbutt.

Although some of these figures show very high volume MAIs, which may indeed be achieved in intensively managed plantations or carefully selected plots of natural regeneration, results on a routine basis are likely to be substantially lower. This is indicated in part in Appendix 5 by the estimates of regeneration height, which tend to be much less than the height figures quoted in Appendix 6.

Borough et al. also include a few results from thinning trials, but it is difficult to draw any significant conclusions from their figures other than the usual one that thinning increases mean diameter at the expense of total volume.

Merchantable yields obtained from these stands vary greatly. At the upper level, integrated logging for sawlogs and pulp at Glenbog S.F. averages about 120 t/ha, with some areas reaching 200 t/ha and with 70 t/ha representing the lowest yields, while a particularly high quality stand on Dampier S.F. is estimated to carry 100 m^3/ha of sawlogs. At Monga S.F., in forest that has largely had a long history of logging, the best sites yield about 50 m^3/ha of sawlogs and the average is about 35 m^3/ha; mining timber operations on this same forest yield about 4 m^3/ha as thinnings from regenerating stands.

Table 6
COMPARISON OF PLANTED PLOTS, CHICHESTER S.F.
(Elevation about 800m; age 21 years; planted 1 740/ha)
(PAI figures refer to period 15-21 years)

Species	Stocking/ha	Mean DBH (cms)	BA (m^2/ha)	Dom. Ht. (m)	Volume (m^3/ha)	MAI (m^3/ha)
Messmate	667	40.2	93.5	29.6	416	19.8
PAI		1.1	4.9	0.9	41	
Flooded Gum	1205	22.9	57.6	35.2	577	27.5
PAI		0.4	2.1	1.1	32	
Silvertop Stringybark	1 424	24.1	78.0	29.5	472	22.5
PAI		0.4	2.7	0.6	24	
Brown Barrel	709	27.7	55.2	25.7	294	14.0
PAI		0.7	2.7	0.9	30	
Sydney Blue Gum	1 371	19.6	46.5	30.0	433	20.6
PAI		0.3	1.2	0.6	22	
New England Blackbutt	622	26.2	40.1	25.0	168	8.0
PAI		0.8	2.2	0.8	15	

Brown Barrel is a species that retains its branches to a greater extent than most eucalypts when growing under open or partially open conditions. In this it behaves as a higher altitude analogue of Tallowwood, and the feature makes it a very desirable, and attractive, species to use for shade and shelter in pastures. However the feature is a disadvantage in the case of rather scattered regeneration in forest openings, where they may remain excessively branchy and of much reduced value for timber production. Similar comments apply to Narrowleaved Peppermint (ssp. *robertsonii*) growing in good quality stands.

Some of the MTH species can reach large size, and the dimensions of some of the more outstanding measured trees are given in Table 7. Species excluded from this table are not necessarily smaller; they just have not been accurately measured. Thus Manna Gum is believed to exceed 70m in height on Styx River S.F. (a tree of this species near Fingal, in Tasmania, is 89.9m in height; Anon., 1976), Brown Barrel on Glenbog S.F. exceeds 2m in diameter (Cremer, 1978), and Silvertop Stringybark also reaches large size.

Table 7

OUTSTANDING SPECIMENS OF MTH SPECIES IN N.S.W.

Species	Location	Height (m)	DBH (m)	Notes
New England Blackbutt	Gibraltar Range S.F.	47	1.19	
New England Blackbutt	Wiangaree S.F.	44	2.54	
Maidens Gum	Murrabrine S.F.	52	1.62	"Lure Tree"
Manna Gum	Marengo S.F.	68	2.00	
Mountain Grey Gum	Nadgee S.F.	56	3.36	
Mountain Grey Gum	East Boyd S.F.	61	5.85	Vol. 49.9 m^3
Roundleaved Gum	Gibraltar Range S.F.	49	1.16	
Shining Gum	Bondi S.F.	50	2.02	
Shining Gum	Badja S.F.	55	2.00	Vol. 50.4 m^3
Messmate	Gibraltar Range S.F.	46	1.20	
Messmate	Stewarts Brook S.F.	57	1.50	Vol. 28 m^3
Yellow Stringybark	Nadgee S.F.	52	3.30	

Trees in the MTH types frequently produce fairly reliable annual rings, so that ages can usually be determined, although not many workers have made the effort. Borough et al. state that Shining Gum can reach 55m in height and 1.50m DBH in 200 years, and carry 300 m^3/ha in mature stands; the giant Manna Gum near Fingal is estimated at over 300 years of age; and Cremer (1978) notes that the oldest Brown Barrel trees whose ages were determined by ring count at Glenbog S.F. were about 1.2m in diameter and 300 years old; he observes that in the vicinity were *"trees over 2m thick, and presumably older. Possibly this area could produce the oldest eucalypt on record".* (Well, perhaps by ring count). He also notes that Shining Gum tends to be slightly faster in growth, and may approach 1m in diameter at 100 years.

8. DAMAGE TO OLDER STANDS

The MTH forests of N.S.W. have been subject to two major damage agencies, fire and phasmatids, as well as to several others of more local *or* less spectacular effect.

Fire is of less common occurrence in these tableland forests than it is in more coastal areas, but it is nonetheless a regular feature of their environment. Cremer (1978), on the basis of cursory ring counts on stems at Glenbog S.F., suggests that fires had occurred about 10, 16, 25, 59, 100 and 300 years previously, and he adds *"The ridge areas evidently burnt more often than the gullies, but even these seem to rarely escape burning for more than 50 years".*

Most of the eucalypts can withstand fire damage well (White Ash is a notable exception) Shining Gum is also rather susceptible to fire; Cremer refers to Brown Barrel's being *"very fire resistant except when it is young .... generally with very little sign of injury ...."*. Such comments could apply to many of the species, though sometimes the visual evidence of past fires is more readily apparent. Even young stems can withstand fire damage; Cremer refers to young Brown Barrel's forming epicormic crowns following defoliation, while Messmate regeneration, heavily burnt at age 5, has been seen to coppice vigorously. However the smooth-barked species would be less resistant while young.

Nonetheless severe fires leave their mark. Parts of Glenbog S.F. are marked by large dead trees, killed in the 1952 fires, while gum veins can be prevalent and fire scars are often more common than Cremer infers. Messmate, at least in Victoria, tends to carry fire into its crown by flaring of its loose, rough bark - a feature not appreciated by firefighters.

Hazard reduction is practiced fairly widely in the MTH forests, using both aerial and ground ignition techniques, though areas actually burnt are often limited because of climatic factors.

Phasmatids, in plague numbers, have severely damaged stands in a number of areas, including the Oberon and Nundle districts, and when regularly repeated have caused the deaths of many trees. A considerable amount of research has been carried out into these outbreaks, and this has been summarised and reviewed by Campbell and Hadlington (1967) and, more recently but more briefly, by Came and Taylor (1978). Campbell and Hadlington suggested that causes contributing to phasmatid outbreaks are protection from fire over large areas for lengthy periods; ample food supply; even-aged stands of favoured species of medium to large-sized trees; and egg parasites out of phase with much of the phasmatid population. The first and third of these, at least, are subject to some silvicultural control.

The overall significance of the phasmatid plagues has probably been rather less than their spectacle might lead one to believe. Chemical spraying has been used successfully, mainly in Victoria, but is now generally limited to small areas of special importance.

As previously noted, termites and Ambrosia beetles are common in many areas, and can be a major cause of timber degrade.

Although windstorms are normally a minor cause of damage in these stands, some areas (e.g. Anembo) show signs of significant past wind damage.

Some areas in the Southern Tablelands possess gully sites (often towards the heads) that are treeless but carry the relics of long dead trees, usually Manna Gum. The treeless areas do not appear to be expanding; their ground cover is often heathy or swampy vegetation. Various local theories have been put forward about the cause of these, including *Phytophthora* (apparently no positive evidence). One plausible suggestion is that they were forested during the generally drier first half of this century, but with rising water tables associated with the higher rainfall of the 1950's and subsequently, the eucalypts were killed.

9. PRESERVATION

As noted in Section 3, the MTH types are well represented in the State's national parks. Parks containing significant examples of these types include Barrington Tops, Blue Mountains, Budawang, Deua, Gibraltar Range, Guy Fawkes, Kanangra-Boyd, Kosciuszko, Morton, New England, Wadbilliga, Werrikimbe and Wollemi.

The types are widely sampled in the Forestry Commission Native Forest Preservation programme (Forestry Commission of N.S.W., 1981). Excluding areas that contain New England Blackbutt type only in association with Moist Coastal Hardwood types, there are 5 Flora Reserves and 30 Forest Preserves that contain examples of these communities. These are summarised in Appendix 7. These 35 sites have a total area of over 7 000 ha (3 500 ha each in Flora Reserve and Forest Preserve). All forest types included within the Messmate-Brown Barrel league (Section 2.1) are represented within these preserved areas.

Trees of outstanding size preserved in these types have been previously discussed in Section 7 and listed in Table 7.

10. MANAGEMENT ASPECTS

10.1 Objectives

In its discussion of management policy for the Tableland Hardwoods forests, the Indigenous Forest Policy (Forestry Commission of N.S.W., 1976) considers at some length areas intended for conversion to plantation, and then looks at the specific case of Alpine Ash. It then states:

> *"Where softwood plantations are not definitely planned, management should aim at logging the existing crop to the limits of economic accessibility at a rate which could be sustained under extensive management, involving no investment in silvicultural treatment. This management will require the retention of good growing stock which could become merchantable within the next 30 years."*

This, essentially, is the current management policy for the MTH types, and it is then translated for more immediate application by way of the objectives and provisions of individual management plans, and by the other prescriptions and guidelines that influence management practice in the field.

10.2 Management Guidelines

The MTH types are among the most amenable eucalypt forests in N.S.W. for management.

With a few, usually readily recognised, exceptions, regeneration is rarely a problem, though it may be necessary to have patience for a number of years before full stocking is obtained. The exceptions are those types that possess a heavy, shrubby understorey (and these include some of

the, highest quality sites), and those with a heavy grass cover, particularly on frosty sites and basalt soils.

Again with a few, essentially the same, exceptions, stands can be managed under systems ranging from clearfelling to selection.

Growth is relatively fast and productivity can be high. Fire is less of a problem than in most eucalypt forests, and most species withstand its effects well. Many forests carrying the types in N.S.W. have fairly easy topography. The timbers, though not the State's finest, can be used for a range of purposes, including not only sawn construction wood but pulpwood, mining timber and preservatised poles.

The following points are put forward for consideration in the management of these types:

1. In those stands possessing a dense understorey, successful regeneration requires as much disturbance of the undergrowth and exposure of the mineral soil as possible.

2. Unless regeneration is to depend on a visible and maturing seed crop in the standing overwood, it seems desirable to avoid the use of fire in regenerating these sites: fire will largely destroy seed in the heads of felled trees (often the main source), and is likely to promote more vigorous weed growth, reducing the receptivity of the seed bed to delayed seedfall from overwood trees. Site disturbance to create a suitable seedbed should primarily depend on mechanical disturbance at the time of logging.

3. Some of the ridgetop stands, such as those containing White or Silvertop Ash or New England Blackbutt, tend to prefer fairly heavy opening of the canopy for regeneration establishment. Normal logging operations, with or without subsequent burning, usually provide adequate opening, and it is unusual for there to be problems in obtaining adequate regeneration in these stands.

4. Other stands, and these constitute the bulk of the Moist Tableland Hardwood types, normally have an ability to establish regeneration on sites subject to limited canopy opening or specific site disturbance, though establishment is likely to be faster and more prolific on disturbed areas, and subsequent development more vigorous under more open conditions.

5. Heavy logging, resulting in virtual clearfelling, should be approached with considerable caution in these stands, notwithstanding its having been the most widely used form of logging for at least the past two decades in the N.S.W. tableland forests.

6. Particularly on areas that are already fairly heavily grassed and are in fertile sites liable to heavy frost, excessive canopy opening allows the grass to spread into a complete sward, while frost will kill most, if not all, eucalypt seedlings that do manage to become established. The heavy logging usually destroys any advanced regeneration already present on these sites. On these sites stands should be managed either by some form of selection system, aiming at maintaining a mixed-age stand, or by a two-stage logging in which the initial partial canopy opening enables regeneration to become established under a shelterwood, which also restricts grass spread. Once the regeneration is well established, the overwood can be removed in a further, careful operation that does not excessively damage the regeneration.

7. The systems outlined in para. 6 may appear rather too technical or uneconomic for an organisation that, for a generation of foresters, has relied on variations of clearfelling as the answer to all eucalypt silvicultural problems. They are nonetheless merely adaptations of the approaches that were successfully used in many of these forests over the first half of this century, and that are still employed in many similar Victorian stands.

8. Any stand will contain a number of trees - often many - that are unacceptable as sawlogs: trees in many MTH stands are notorious for their high defect, and frequently it is very difficult to forecast the merchantability of a tree in advance of felling. Access to a pulp market will usually mean that these can be profitably sold, giving the forester good control over what he or she wants to retain on the site for silvicultural or environmental reasons. Except perhaps for trees to be retained for habitat (the so-called "possum trees"), it is preferable to remove these low value trees, and to retain better quality stems with a capacity for further growth.

9. Where there is no market for such trees, consideration needs to be given to their removal in a culling operation. Failure to remove them means that a proportion of the stand, and often a large proportion, is rendered unproductive. Although silvicultural treatment has been applied to few MTH forests in the past, the results where it has been given are most favourable, the stands themselves have the appearance of being able to respond well to treatment, and certainly some of the forests have good economic locations that appear to warrant some direct silvicultural expenditure.

10. Opportunities should be developed and taken to allow the thinning of regenerating stands (or the selective removal of stems in mixed-age stands) for mining timber, pulpwood, poles or other suitable products, in the interests of promoting and improving the growth of the remaining stand.

11. Where sites have failed to regenerate, usually due to the absence or loss of seed at the time of logging, thought should be given to artificial establishment by planting. However there seems little benefit in planting if the site has already become covered in weed or other undergrowth unless this can first be removed.

10.3 Further Research

A major result of a review of this type is to indicate those areas where information is deficient: in this case, most of them. Some of the major needs at the present time appear to be:

- Data on seed production and its seasonal variation, particularly for Messmate and the Gums in the south of the State and for all major species in the north.
- Better understanding of germination and establishment requirements in the N.S.W. stands.
- Demonstration of different approaches to management in one forest area.
- Growth and thinning information in regrowth stands.
- Closer observations on the growth processes and dynamics of virgin stands.

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Appendix 1

PLANTS MENTIONED IN TEXT

Common Name	Botanical Name
Ash, Alpine	Eucalyptus delegatensis
Gully	E. badjensis
Silvertop	E. sieberi
White	E. fraxinoides
Bangalay	E. botryoides
Beech, Negrohead	Nothofagus moorei
Blackbutt, New England	Eucalyptus andrewsii ssp. campanulata
Blackwood	Acacia melanoxylon
Blanketbush	Bedfordia salicina
Box, Brush	Lophostemon confertus
Bracken	Pteridium esculentum
Brown Barrel	Eucalyptus fastigata
Candlebark	E. rubida
Cherry, Native	Exocarpos cupressiformis
Eurabbie	Eucalyptus globulus ssp. bicostata
Grass, Kangaroo	Themeda australis
Snow	Poa spp.
Grasstree	Xanthorrhoea spp.
Gum, Brittle	Eucalyptus mannifera
Flooded	E. grandis
Grey	E. propinqua and related spp.
Maidens	E. globulus ssp. maidenii
Manna	E. viminalis
Mountain	E. dalrympleana
Mountain Grey	E. cypellocarpa
Ribbon (= Manna)	E. viminalis
Houndleaved	E. deanei
Scribbly	E. rossii and related spp.
Shining	E. nitens
Southern Blue	Group (Note 1) including E. globulus, E. cypellocarpa and E. nitens
Snow	E. pauciflora
Sydney Blue	E. saligna
Hakea	Hakea spp.
Ironbark, Grey	Eucalyptus siderophloia and E. paniculata
Messmate	E. obliqua
Peppermint	(Group name (Note 2), various related eucalypts)
Gully	E. smithii
Narrowleaved	E. radiata (especially ssp. robertsonii)
River	E. elata
Sydney	E. piperita
Pinkwood	Eucryphia moorei
She-Oak, Black	Allocasuarina littoralis
Stringybark	(Group name (Note 3), various related eucalypts)
Broadleaved	Eucalyptus caliginosa
Diehard	E. cameronii
Red	E. macrorrhyncha
Silvertop	E. laevopinea
Yellow	E. muellerana
Tallowwood	E. microcorys
Tree Fern	Especially Dicksonia antarctica
Turpentine	Syncarpia glomulifera
Wattle	Acacia spp.

Notes:

1. Covers eucalypts of Pryor and Johnson subseries Globulinae, excluding superspecies Goniocalyx (code SPIFE - SPIFL).

2. Covers eucalypts or series Piperitae (MAT), excluding subseries Haemastominae.

3. Covers eucalypts of' series Capitellatae (MAH).

Appendix 2

CLIMATIC DETAILS - STATIONS IN AREA OF MOIST TABLELAND HARDWOOD FOREST TYPES

MT. MITCHELL FOREST CAMP. Latitude: 29º40'S **Longitude:**152º6'E **Elevation:** 1 000m

Temperature (Cº)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Daily Max. Mean	25.1	23.9	22.5	19.8	15.6	13.4	13.1	14.4	17.4	21.0	23.0	24.6	19.5
Daily Min. Mean	13.3	12.7	10.7	6.8	3.5	1.5	-1.8	0.9	3.0	7.2	9.0	11.6	6.5

Rainfall (mm)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Rainfall Mean	176	161	137	64	60	74	69	51	55	96	95	137	1175
Raindays Mean (No.)	13	14	14	9	9	8	7	7	7	10	10	12	120

STYX RIVER. Latitude: 30º37'S **Longitude:** 152º11'E **Elevation:** 1 036m

Temperature (Cº)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Daily Max. Mean	25.4	21.4	20.9	19.3	13.5	11.8	11.9	13.8	13.4	17.2	21.9	22.9	17.8
Daily Min. Mean	14.6	13.2	11.9	9.2	5.7	3.4	2.8	4.9	3.0	8.8	11.2	11.6	8.4

Rainfall (mm)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Rainfall Mean	204	208	207	106	81	120	81	81	62	105	112	149	1516
Raindays Mean (No.)	15	14	15	11	9	10	7	8	7	10	11	13	130

CANOBOLAS S.F. Latitude: 33º29'S **Longitude:** 149º2'E **Elevation:** 945m

Temperature (Cº)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Daily Max. Mean	25.5	26.2	22.6	18.9	13.5	10.2	8.0	9.9	12.8	17.1	20.3	22.9	17.3
Daily Min. Mean	13.0	13.3	11.0	7.4	4.0	2.6	0.9	2.2	3.7	7.3	8.9	11.3	7.1

Rainfall (mm)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Rainfall Mean	88	91	67	70	98	96	113	126	88	120	92	78	1127
Raindays Mean (No.)	8	7	5	6	9	6	9	16	10	9	14	6	105

KIRCONNELL. Latitude: 33º25'S **Longitude:** 149º50'E **Elevation:** 1 067m

Temperature (Cº)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Daily Max. Mean	24.2	22.9	20.8	17.8	12.8	10.1	9.4	10.1	12.5	17.1	19.3	22.5	16.6
Daily Min. Mean	10.0	10.6	8.6	4.4	2.2	1.0	-0.5	0.8	0.9	4.0	5.3	7.9	4.6

Rainfall (mm)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Rainfall Mean	111	102	62	61	72	78	77	94	74	111	85	99	1026
Raindays Mean (No.)	12	14	7	8	10	9	12	14	10	12	13	10	131

BLACK SPRINGS. Latitude: 33º51'S Longitude:149º44'E **Elevation:** 1 204m

Temperature (Cº)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Daily Max. Mean	23.0	24.3	20.7	16.4	11.4	8.2	6.2	8.4	12.5	16.6	18.7	21.4	15.7
Daily Min. Mean	10.1	11.0	9.3	6.0	2.3	1.0	-0.9	0.4	2.7	5.5	6.3	8.8	5.2

Rainfall (mm)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Rainfall Mean	83	68	57	53	79	81	76	87	68	84	75	79	890
Raindays Mean (No.)	7	7	6	6	9	10	9	10	8	9	7	7	95

MOSS VALE P.O. **Latitude:** 34º33'S **Longitude:** 150º22'E **Elevation:** 672m

Temperature (Cº)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Daily Max. Mean	24.5	24.4	22.4	19.3	14.6	12.1	11.3	12.7	15.9	18.9	21.1	23.4	18.4
Daily Min. Mean	13.0	13.3	11.4	8.0	4.7	3.2	1.6	2.8	4.6	7.3	9.2	11.2	7.5

Rainfall (mm)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Rainfall Mean	96	95	90	84	89	99	84	63	59	77	71	83	990
Raindays Mean (No.)	11	11	11	10	10	10	9	9	9	10	10	10	120

LAUREL HILL PRISON CAMP. Latitude: 35º39'S **Longitude:** 148º4'E **Elevation:** 1 006m

Temperature (Cº)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Daily Max. Mean	23.5	23.2	20.7	16.1	11.6	8.9	7.7	8.7	11.0	15.1	17.2	22.4	15.5
Daily Min. Mean	12.3	13.3	10.8	7.9	4.1	2.1	1.5	2.1	3.2	6.7	8.0	10.8	6.9

Rainfall (mm)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Rainfall Mean	134	66	67	140	118	108	115	169	132	106	122	83	1360
Raindays Mean (No.)	7	9	6	10	10	10	12	15	13	15	12	7	126

BEGA. **Latitude:** 36º40'S **Longitude:** 149º50'E **Elevation:** 13m

Temperature (Cº)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Daily Max. Mean	26.1	26.7	24.9	23.2	19.3	16.7	16.6	17.6	19.6	21.7	22.6	24.8	21.7
Daily Min. Mean	14.0	14.6	12.2	7.8	4.4	2.0	0.7	2.6	4.2	8.1	10.1	12.3	7.8

Rainfall (mm)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Rainfall Mean	86	91	89	69	76	85	55	56	52	66	65	81	871
Raindays Mean (No.)	8	7	8	6	7	7	5	6	7	8	8	8	85

BONDI S.F. **Latitude:** 37º9'S **Longitude:** 149º9'E **Elevation:** 914m

Temperature (Cº)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Daily Max. Mean	22.9	25.3	21.8	18.4	14.0	10.6	9.8	10.0	13.6	17.2	19.9	21.2	17.1
Daily Min. Mean	7.0	8.4	6.1	1.5	-0.9	-2.6	-4.1	-2.0	-0.1	3.9	4.8	5.7	2.3

Rainfall (mm)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Rainfall Mean	79	93	69	85	90	121	88	85	71	85	96	99	1061
Raindays Mean (No.)	10	9	10	10	12	14	13	14	12	14	13	12	143

Appendix 3

PROPERTIES OF MAJOR TIMBER SPECIES: MOIST TABLELAND TYPE
(Derived from K. R. Bootle: "Commercial Timbers of N.S.W. and Their Use")

Abbreviations: L-S, Lyctid susceptible; G, green; S, seasoned; B, basic (re density)

Common Name	Ash, Silvertop	Ash, White	Blackbutt, New England	Brown Barrel
Botanical Name	Eucalyptus sieberi	Eucalyptus fraxinoides	Eucalyptus andrewsii ssp. campanulata	Eucalyptus fastigata
General Properties	Light brown. Distinct growth rings. Occasionally interlocked grain.	Straw to light brown. Moderately coarse, but uniform texture. Straight grained.	Light brown. Moderately fine texture. Gum veins common.	Light brown. Straight grain. Rather coarse texture. Moderately hard. Gum veins common. Growth rings not prominent.
Density kg/m³	G: 1200 S: 830 B: 670	G: 1040 S: 670 B: 545	G: 1150 S: 900 B: 690	G: 1120 S: 820 B: 610
Durability	3 L-S	4 L-S	2-3 L-S	4 L-S
Strength	B/S3	C/S3	B/S3	C/S4
Sawlog Group	C	B	B	B
Uses	General construction, flooring, handles, pulpwood.	Joinery, flooring, general construction	General building construction.	General construction.
Other Notes	Surface checking on back-cut surfaces. May need re-conditioning.	Liable to check on back-sawn surfaces.	Prone to surface checking on back-cut surfaces. Re-conditioning required.	Prone to collapse and seasoning. Re-conditioning required.

Appendix 3 (cont.)

PROPERTIES OF MAJOR TIMBER SPECIES: MOIST TABLELAND TYPE
(Derived from K. R. Bootle: "Commercial Timbers of N.S.W. and Their Use")

Abbreviations: L-S, Lyctid susceptible; G, green; S, seasoned; B, basic (re density)

Common Name	Gum, Maidens	Gum, Manna	Gum, Mountain	Gum, Mountain Grey
Botanical Name	Eucalyptus globulus ssp. maidenii	Eucalyptus viminalis	Eucalyptus dalrympleana	Eucalyptus cypellocarpa
General Properties	Light brown. Grain sometimes interlocked. Coarse but uniform texture. Easy to work.	Light pink, with distinct sapwood. Straight grain. Moderately coarse texture. Relatively easy to work.	Straw to pink . Sapwood not easy to distinguish. Growth rings distinct. Moderately coarse texture. Generally straight grain.	Light yellow-brown. Grain straight. Medium texture.
Density kg/m³	G: 1110 S: 930 B: 690	G: 1075 S: 740 B: 545	G: 1075 S: 740 B: 580	G: 1090 S: 960 B: 705
Durability	3 L-S	4 L-S	4 L-S	3 L-S
Strength	B/S3	C/S4	C/S4	B/S3
Sawlog Group	B	C	C	C
Uses	General construction.	Flooring, panelling, joinery. Regarded as good peeling timber on Northern Tablelands.	Flooring, panelling, joinery, handles.	General construction.
Other Notes	Slow to dry. Checks on back-cut surfaces. Collapse occurs.	Relatively slow drying. Liable to warping, checking and excessive collapse. Re-conditioning needed.	Slow to dry. Some collapse. Back-cut surfaces check. Considerable collapse. Re-conditioning needed.	Warping, checking and collapse may occur.

Appendix 3 (cont.)

PROPERTIES OF MAJOR TIMBER SPECIES: MOIST TABLELAND TYPE
(Derived from K. R. Bootle: "Commercial Timbers of N.S.W. and Their Use")

Abbreviations: L-S, Lyctid susceptible; G, green; S, seasoned; B, basic (re density)

Common Name	Gum, Roundleaved	Gum, Shining	Messmate	Peppermint (various)
Botanical Name	Eucalyptus deanei	Eucalyptus nitens	Eucalyptus obliqua	Eucalyptus radiata Eucalyptus elata and others
General Properties	Light red to brown. Easy to work, takes good finish.	Straw to pale pink. Straight grain Easy to work. Growth rings well defined.	Light brown, wide distinct sapwood. Moderately coarse texture. Growth rings not distinct. Relatively easy to work.	Light brown, often wide sapwood. Moderately coarse texture. Generally straight grained. Gum veins common.
Density kg/m³	S: 900 B: 610	G: 1120 S: 720 B: 510	G: 1190 S: 830 B: 660	S: 720 B: 580
Durability	3 L-S	4 L-S	4 L-S	3 sometimes L-S
Strength	B/S3	C/S4	C/S3	C/S3
Sawlog Group	C	B	C	D
Uses	Flooring, panelling, general construction where shrinking can be accommodated.	Handles, joinery, panelling.	Joinery, furniture, flooring, panelling, general construction.	General construction, where heavy shrinkage can be tolerated.
Other Notes	Can experience severe checking, distortion and collapse. Re-conditioning may be required.	Relatively slow drying. Liable to warping, checking and excessive collapse. Re-conditioning needed.	Prone to checking and collapse. Re-conditioning needed.	Liable to distortion and collapse. Re-conditioning needed.

Appendix 3 (cont.)

PROPERTIES OF MAJOR TIMBER SPECIES: MOIST TABLELAND TYPE
(Derived from K. R. Bootle: "Commercial Timbers of N.S.W. and Their Use")

Abbreviations: L-S, Lyctid susceptible; G, green; S, seasoned; B, basic (re density)

Common Name	Stringybark, Diehard	Stringybark, Silvertop	Stringybark, Yellow
Botanical Name	Eucalyptus cameroni	Eucalyptus laevopinea	Eucalyptus muellerana
General Properties	Light brown, sapwood not easily distinguished. Moderately coarse texture.	Light brown, indistinct sapwood. Moderately fine texture. Grain sometimes interlocked.	Light yellow-brown. Moderately coarse texture. Grain sometimes interlocked. Not suitable for bent work.
Density kg/m³	G: 1010 S: 750	G: 1040 S: 690 B: 530	G: 1105 S: 870 B: 690
Durability	3	2-3 possibly L-S	2
Strength	B/S3	C/S4	B/S3
Sawlog Group	C	B	B
Uses	General building construction.	General building construction.	General building construction, flooring.
Other Notes	Slow drying; May distort and require re-conditioning.	Slow drying; some collapse. Re-conditioning usually required.	Care needed to avoid checking in early stages of drying. Some collapse may occur.

Appendix 4

SEED WEIGHTS AND GERMINATION TEMPERATURES: MOIST TABLELAND HARDWOOD EUCALYPTS.

(from Boland et al.: "Eucalyptus Seed")

Species	Viable Seed/kg		Optimum Temp. for Germination Tests (^{0}C)	Notes
	Mean	Highest		
Ash, Gully	630 000	—	25	
Silvertop	110 000	210 000	25	
White	120 000	208 000	25	
Blackbutt, New England	1 145 000	516 000	25	
Brown Barrel	914 000	325 500	15 or 20	
Eurabbie	98 000	236 000	25	
Gum, Maidens	15 800	3 214 000	25	
Manna	353 000	1 220 000	25	
Mountain	201 000	630 000	20 or 25	
Mountain Grey	157 000	304 500	20 or 25	
Shining	2 614 000	560 000	15 or 20	Or, stratify 3 weeks, then 20^0
Messmate	814 000	157 500	15	
Peppermint, Gully	204 000	1 420 000	20 or 25	
Narrowleaved	97 000	154 000	15 or 20	
River	247 000	—	20	
Stringybark, Diehard	234 000	455 000	25	
Silvertop	51 000	96 000	25	
Yellow	60 000	1 140 000	15	

Appendix 5

REGENERATION FOLLOWING VARIOUS STAND TREATMENTS MOIST TABLELAND HARDWOOD SITES

Area	Years Since Logging	Species Present	Treatment	Results
Tallaganda - N	c.0.25	MM, BR	Selective logging	Excellent regen., but slow.
Tallaganda - N	10	BR, MM	Heavy logging (for plantation, but no salvage)	Regen. poor in some heavily logged patches. Usually good regen., but often suppressed by residual overstorey.
Tallaganda - N	General	Various	Various	Usually good regen. but often suppressed by residual overstorey.
Tallaganda - S	-40	BR, maG	Heavy logging	Very dense regen.
Anembo	20 (fire)	wA	Killed most prior trees	Dense regen. to 20m
Anembo	1.5	BR, maG	Heavy logging, no burn	Gen. good on tracks, little on undisturbed sites; on basalt (?)area, few even on tracks.
Anembo	9	BR, shG	Medium logging, wind damage 2 yrs later	Slow to appear but now gen. good; some grass patches poor.
Anembo	7	BR, shG	Heavy logging, some burn	Poor regen. where burnt, elsewhere good.
Monga	Current	BR, mgG, gPM	Heavy, little overwood	Heavy slash, intend burn when dry.
Monga	2 - 4	BR, mgG	Heavy logging and slash burn	Mostly very good regen. Some bare patches. Wattle sometimes dense.
Monga	5	stA with BR, mgG, MM	Heavy logging and slash burn	Excellent stA to 4m less other spp.
Yadboro	3	BR, stA, sPM	Heavy logging, heavy burn	stA good on ridges; gen. poor regen. on S slopes - some on snig tracks; dense weed growth.
Dampier	7	yS, mgG	Heavy logging	Excellent regen. on ridges.
Dampier	2	BR, P14, mgG	Heavy logging, burn	Good recent regen: mostly BR.
Dampier	4	BR, MM, mgG	Heavy log, some burning	OK some sites (partic. on tracks) but most poor. Heavy bracken.
Dampier	5	BR	Heavy logging	Dense bracken; good regen. present.
Dampier	8	BR	Heavy log, burn	Dense bracken; regen. only now appearing: under 1.5m.
Glenbog - N	Current	BR & others	Heavy pre-logging	Much seed in heads. burn, heavy log.
Glenbog - N	3	BR, wA	Heavy logging; no seed trees. Maximum site disturbance.	Excellent regen: wA on ridge, BR lower - to 2m.

Area	Years Since Logging	Species Present	Treatment	Results
Glenbog - N	3	BR & others	Heavy logging; post-log wildfire	Some extensive bare patches with wattle, bracken. Elsewhere fair regen.
Glenbog - N	5	BR, shG	Heavy logging, few seed trees	Dumps excellent; elsewhere patchy but still coming. Oldest shG to 10m.
Glenbog - S	c.12	BR, MM	Selective logging	Scattered regen. in openings; some Blanket- - bush patches.
Glenbog - S	10	BR	Heavy logging (for plantation); some overwood.	Excellent regen. Some small blanks.
Mt. Werong	10?	BR	Clearing trig. sight lines	Excellent regrowth.
Mt. Werong	11	MM	Heavy logging, no burn	Excellent regen: 5-10m, nPM less.
Mt. Werong	8	MM	Heavy logging, no burn	Gen. very good, plus advance growth; best regen. to 4 - 5m.
Banshea	8	MM	Heavy logging	Excellent regen., 3 - 4m; advance growth taller.
	21	MM	Medium logging	Very dense regen, best to12m +.
Gloucester Tops	3	MM, BR	Very heavy logging, Light burn	Excellent regen. 2 - 3m, except where overwood a bit heavier.
Gloucester Tops	1	eBB, stS	Heavy log	Good where disturbed, otherwise poor regen.
Barrington	6	MM, maG	Fuel heavy, no burn	Excellent regen. to 5m (much less); some fern patches poor, also where less heavy log.
Barrington	5	BR, MM, maG	Fuel heavy, no burn	Slow, but regen. coming.
Barrington	11	MM	Medium log, some burn	Regen. generally good, excellent in some unburnt patches; to 10m. Heavy wattle where burnt, now dying out.
Enfield	22/11	MM & others	Heavy mill logging then salvage 11yrs ago	Excellent regen. to 12m. Scattered overwood
Enfield	8/2	MM, BR, maG	Salvage logged 2 yrs ago, then wildfire	Very heavy Snow Grass, some bracken. Virtually no regen. Basalt soil.
Enfield	7	MM, maG	Heavy logging, top disposal burn	Heavy Snow Grass, bracken. Very little regen. (mostly coppice or old lignotubers).
Enfield	10+	MM, maG	Light selective logging	Scattered regen. - not always in gaps; Snow Grass heavy, but not excessive.

Area	Years Since Logging	Species Present	Treatment	Results
Enfield	Current	MM, maG	Previous, selective logging; now remove all merchantable	Much advance growth present; little need for further regen.
Enfield	Various	eBB	Various	Never a problem: always excellent regen.
Enfield	7	MM	Part burnt 1 yr. ago	Excellent regen. to 8 - 9m; where burnt some killed, much coppicing.
Enfield	3?	MM, diS, maG	Moderate, logging, no burn	Good regen. wherever disturbed
Styx River	c. 40	maG, S, sbG, eBB, occ.TW	Heavy logging, TSI	Very good mixed stand of pole size. Large areas similar (various ages) throughout forest: generally excellent regen.
Tomalla	c.25	MM, stS, maG	Phasmatid, fire and virtual clearfall	Excellent regen. to c. 20m.

Species Abbreviations:

Wa - White Ash
stA, - Silvertop Ash
eBB - New England Blackbutt
BR - Brown Barrel
maG - Manna Gum
mgG - Mountain Grey Gum
sbG - Sydney Blue Gum
shG - Shining Gum

MM - Messmate
gPM - Gully Peppermint
sPM - Sydney Peppermint
S - Stringybark
diS - Diehard Stringybark
stS - Silvertop Stringybark
yS - Yellow Stringybark
TW - Tallowwood.

Appendix 6

INFORMATION ON GROWTH OF SOME MOIST TABLELAND HARDWOOD SPECIES

(from Borough et al., 1978)

Shining Gum: Plantation, Tasmania.

Age (Yrs)	**Stocking** (/ha)	**B.A.** (m^2/ha)	**Mean Ht.** (m) (50 tallest/ha)	**Volume** (m^3/ha)	**M.A.I.** (m^3/ha/an)
8	1025	12.9	10.14	514	6.7
12	1025	27.6	17.3	176	14.7

Messmate: Broadford, Victoria; high quality sites.

Age (Yrs)	**Before Thinning**				**Thinnings Removed**			**After Thinning**			
	Stocking (/ha)	**Mean DBH** (cm)	**B.A.** (m^2/ha)	**Volume** (m^3/ha)	**Stocking Removed** (/ha)	**Mean DBH** (cm)	**Volume** (m^3/ha)	**Stocking Remaining** (/ha)	**Mean DBH** (cm)	**B.A.** (m^2/ha)	**Volume** (m^3/ha)
15	1235	12.1	114.2	78.14	830	6.3	11.3	1105	19.1	11.6	53.1
25	1405	26.5	22.3	171.6	193	19.0	25.I	212	31.8	16.8	146.2
35	212	140.3	27.0	271.7	79	31.4	44.2	133	44.7	20.9	227.5
45	133	53.8	30.2	355.2	40	44.8	54.8	93	57.2	23.9	300.4
55	93	67.1	32.9	426.8	71	66.0	315.0	22	70.5	8.6	111.8
60	22	76.5	10.1	133.5	-	-	-	-	-	-	-

Total Yield: 584.2 m^2/ha; MAI: 9.7 m^3/ha/an

Silvertop Ash: Eastern Victoria; site index 30m at age 50 years.

Age (Yrs)	**Stocking** (/ha)	**Mean DBH** (cm)	**BA** (m^2/ha)	**Volume** (m^3/ha)	**MAI** (m^3/ha/an)
20	5162	11.1	50.3	221	11.1
30	2953	16.3	61.5	341	11.4
40	1969	21.5	71.4	453	11.3
50	1371	26.8	77.4	538	10.8
60	1003	32.0	80.8	601	10.0

Silvertop Stringybark: Chichester S.F.; plantation.

Age (Yrs)	**Stocking** (/ha)	**Mean DBH** (cm)	**BA** (m^2/ha)	**Mean Dom Ht.** (m)	**Volume** (m^3/ha)	**MAI** (m^3/ha/an)
7	1741	15.0	30.9	15.6	143	6.1
9	1709	17.8	42.4	18.5	92	10.2
11	1709	19.8	52.9	21.3	165	15.0
15	1551	22.5	61.9	25.4	327	21.8

Manna Gum: Toolangi, Victoria.

Age (Yrs)	**Stocking** (/ha)	**Mean DBH** (cm)	**BA** (m^2/ha)	**Mean Ht.** (m)
14	646	25.0	31.7	26.7

Appendix 7

REPRESENTATION OF MOIST TABLELAND HARDWOOD TYPES IN NATIVE FOREST PRESERVATION PROGRAMME

Flora Reserves

Brown Mountain F.R. No. 73032. Glenbog S.F. 955 ha. Typical examples of Brown Barrel - Shining Gum and associated types.

Kerripit Beech F.R. No.79931. Barrington Tops S.F. 243 ha. Brown Barrel - Messmate, Silvertop Stringybark.

Mt. Dromedary F.R. No. 799118. Bodalla S.F. 1 255 ha. Includes Brown Barrel, Maidens Gum, Yellow Stringybark, Gully Peppermint and White Ash.

Norfolk Falls F.R. No. 79965. Warung S.F. 6 110 ha. Westerly outlier of Silvertop Stringybark and Manna and Mountain Gums.

Tennyson Creek F.R. No. 79968. Bondi S.F. 380 ha. Brown Barrel, Shining Gum, Messmate and Mountain Grey Gums.

Forest Preserves

16. Blicks River. Hyland S.F. 244 ha. Messmate - Gum and others.

23. Georges River. Styx River S.F. 400 ha. Messmate, Brown Barrel and Gum. Manna Gum up to 70m high.

30. Warrawolong. Watagan and Olney S.F.'s. 118 ha. Easterly occurence of Brown Barrel.

59. Ovens. Sunny Corner S.F. 100 ha. Some Brown Barrel - Gum.

60. Splitters Gully. Vulcan S.F. 14 ha. Brown Barrel and Gum.

62. Banshea Messmate. Banshea S.F. 40 ha. Pure Messmate.

107. Middle Creek. Marengo S.F. 1 511 ha. Includes New England Blackbutt - Silvertop Stringybark.

116. Nullica. Nullica S.F. 211 ha. Gully Peppermint, Yellow Stringybark, Mountain Grey Gum.

123. Kingsgate. The Brothers S.F. 53 ha. Silvertop Stringybark, Roundleaved Gum.

124. London Bridge. London Bridge S.F. 115 ha. Silvertop and Diehard Stringybarks, Messmate.

125. Crown Mountain. Warra S.F. 270 ha. Includes New England Blackbutt, Silvertop Stringybark and Messmate.

127. Plateau Beech. Mt. Boss S.F. 259 ha. Various types with rainforest.

133. Little Sugarloaf. Dampier S.F. 30 ha. Brown Barrel - Messmate.

134. Boot Hill. Dampier S.F. 100 ha. Brown Barrel, Messmate, Silvertop Ash, White Ash.

140. Native Orchid. Yadboro S.F. 18 ha. High quality Brown Barrel, Messmate.

144. Pinkwood. Dampier S.F. 57 ha. Brown Barrel -Messmate.

145. Parkers Gap. Tallaganda S.F. 96 ha. Messmate, Brown Barrel, White Ash.

146. Milo. Monga S.F. 81 ha. Brown Barrel, Mountain Grey Gum, White Ash.

147. Monga Catchment. Monga S.F. 611 ha. Brown Barrel, Messmate.

149. Wallaby. Currowan S.F. 70 ha. Brown Barrel, River Peppermint.

157. Carrai. Carrai S.F. 139 ha. Eurabbie (northernmost occurrence); Manna Gum and New England Blackbutt.

158. Illawamba. Murrabrine S.F. 83 ha. Maidens Gum and other types.

159. Wandella. Murrabrine S.F. 70 ha. Brown Barrel - Gum.

163. Eurabbie. Bago S.F. 55 ha. Eurabbie, Manna Gum, Peppermint.

169. Laurel Hill. Bago S.F. 150 ha. Manna and Mountain Gum and Narrowleaved Peppermint.

173. Daisy Patch. Enfield S.F. 560 ha. Various Messmate types.

183. Jerrabattgulla. Tallaganda S.F. 32 ha. Brown Barrel, White Ash.

184. Munns Creek. Mt. Werong S.F. 60 ha. Messmate.

185. Watergums Creek. Nadgee S.F. 242 ha. Includes Mountain Grey Gum -Yellow Stringybark type.

191. Paddys Creek. Wandella S.F. 130 ha. Includes Brown Barrel type.