CHAPTER 2 - TIMBER PROPERTIES and MARKETING HISTORY

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Eucalypt timber has several appealing characteristics as a timber of choice. It is strong, dense, offers attractive colour choices, and the timber of some species has natural durability. The fibres are short, making it ideal for producing high quality printing papers. These wood properties differ between species, although species with similar attributes are often treated as one product line.

Although New Zealand currently mostly imports Australian eucalypts and tropical hardwoods, there is increasing demand for sustainable locally-grown timbers.

In New Zealand, the first processing of substantial quantities of eucalypt timber for solid wood products was carried out in 1950-60. McAlpine's mill at Oakura, south of New Plymouth, used the wood to supply flooring to the Education Department. The plantation was close to the mill and the species was *E. fastigata*. Some *E. obliqua* may have been present as well.

Senton's sawmill, north of Hamilton, owned by Reg Hanson, carried out the next major processing of eucalypts in 1960-70. Once again the product was tongue and groove flooring but this time the species used were *E. saligna* and *E. botryoides*. The company eventually abandoned this part of the business and their hardwood profile was lost. Airest, a furniture firm located in Auckland, also used small amounts of eucalypt timber during the 1960s and 1970s. Most of this was supplied by Neil Barr from his own plantation or obtained from Bartlett's plantations at Silverdale. In spite of the high quality of the product, no marketing was done and production ceased.

In the early 1990s the New Zealand Hardwood Timber Company was formed in Auckland. At the same time, the company that would eventually become Eucqual sawmills started up near Whangarei. Each firm launched a strong promotion of New Zealand-grown eucalypt timber, driven by the promise of international statistics on hardwood supply and demand.

However, a change in the law governing the milling of indigenous timber in this country lead to an oversupply of indigenous timber for a period, which had a major impact on both processing operations. Today, neither company trades in its original format, although eucalypt sawmilling still continues at the Eucqual site.

There are many local sawmillers utilising eucalypt timber, often on a small scale. Contact your local branch of the Farm Forestry Association to locate processors in your region.

Wood properties of New Zealand-grown eucalypts.

New Zealand-grown eucalypts have been shown to have broadly similar wood properties to those of Australian-grown wood, with utilisation interest currently centred on *E. nitens*, *E. fastigata*, *E. regnans*, *E. saligna*, *E. pilularis* and *E. muelleriana*.

The three groups of species used in New Zealand are:

1. The Eastern Blue Gum Group:

E. saligna and *E. botryoides*.

These have been the most commonly-used species for solid wood products, largely because of a concentrated resource in Northland close to active processors.

Density: 450-700 kg/m^3

Colour: Red

End uses: Flooring – tongue and groove, in-sequence, parquet overlay

Joinery - stairs, doors, furniture, panelling etc.

Decking

Outdoor furniture

Sliced veneer

E. saligna

The dark pink to red-brown heartwood colour characteristic of the eastern blue gums is much admired by many consumers but not favoured by wood processors. The sapwood is slightly paler. The timber has a fairly coarse, even texture. The grain is straight or slightly interlocked and gum veins are common. In Australia this species is used for general construction, cladding, flooring and panelling. It has potential for furniture construction and for production of structural plywood. It is suitable for engineering, veneers, decorative flooring, turnery, handles (bending) and knobs, and moderately suitable for panelling, boatbuilding, cabinetmaking and furniture. In recent years it has been much sought after for sliced veneer.

E. saligna flooring

Drying: The wood is easy to dry, but tangential surfaces are prone to surface checking. There may be slight collapse. Kiln drying from the green condition increases collapse, so initial air-drying is recommended.

E. saligna veneer

2. The Stringybark Group:

E. muelleriana, *E. globoidea*, *E. eugenoides*, also *E. microcorys* and *E. pilularis*.

Members of this group have been used successfully for sawn timber in New Zealand. They present fewer growth stress problems than most other eucalypts, and no checking occurs with drying. Their moderately durable, high-quality appearance wood is suitable for flooring and interior joinery. Although not strictly members of the stringybark group, both *E. pilularis* and *E. microcorys* are much sought-after species for their timber quality.

Density:	500 - 600 kg/m^3
Colour:	White-honey
End uses:	Flooring
	Joinery
	Decking
	Cross arms (mainly *E. microcorys*)

E. muelleriana

The heartwood is yellowish-brown with a pink tinge, and the sapwood is paler. The timber has a fine-medium and even texture, and the grain is often interlocked. This is the most popular species of the stringybarks due to the lack of growth stresses, the fine texture and light colour. It is used in Australia for building framework, sleepers, piles, poles, crossarms and flooring. It is suitable for engineering, veneers, decorative flooring, turnery, handles (bending) and knobs, also suitable for panelling, boatbuilding, cabinetmaking and furniture.

Drying: Although this is the easiest of the stringybark species to dry, some collapse occurs and care is needed to minimise checking and splitting. Kiln drying straight from the green condition increases collapse and initial air-drying is recommended.

E. pilularis and *E. saligna* flooring

3. The Ash Group:

E. delegatensis, *E. fastigata*, *E. regnans*, *E. obliqua*.

E. fastigata has been used extensively as a source of sawn timber in the past, even though sawing problems related to growth stress have been experienced. There is also some internal checking and the wood is not naturally durable.

E. obliqua wood has a higher density than that of other ashes, although it is prone to kino (gum bleeding).

E. regnans wood has a lower density than that of other ashes. Growth stress problems and internal checking are common.

Density	400-500 kg/m^3
Colour	White-honey
End uses	Furniture
	Joinery
	Sliced veneer

Considerable Tasmanian Oak is imported from Australia, made up of *E. delegatensis*,

E. regnans, and *E. obliqua*, often sourced from Tasmanian forests. Victorian Ash is also imported, this is usually *E. delegatensis* and *E. regnans* from Victorian forests.

E. fastigata

Heartwood is similar to several other ash group species and is predominantly pale brown with occasional purplish flecks. It has a medium and even texture, and grain can range from interlocked to straight.

E. fastigata staircase

E. regnans

The pale pink or light brown heartwood is sometimes difficult to differentiate from the pale sapwood. It has moderate-coarse texture and straight grain. Uses in Australia include furniture, joinery, plywood, handles, cooperage, wood wool, flooring, panelling and general construction. The wood is suitable for furniture, cabinetmaking, veneers, turnery, panelling, handles, knobs, and moderately suitable for flooring and engineering purposes.

Drying: Considerable collapse may occur during drying, but checking is less severe than in *E. nitens* wood. Logs should be quartersawn for best results.

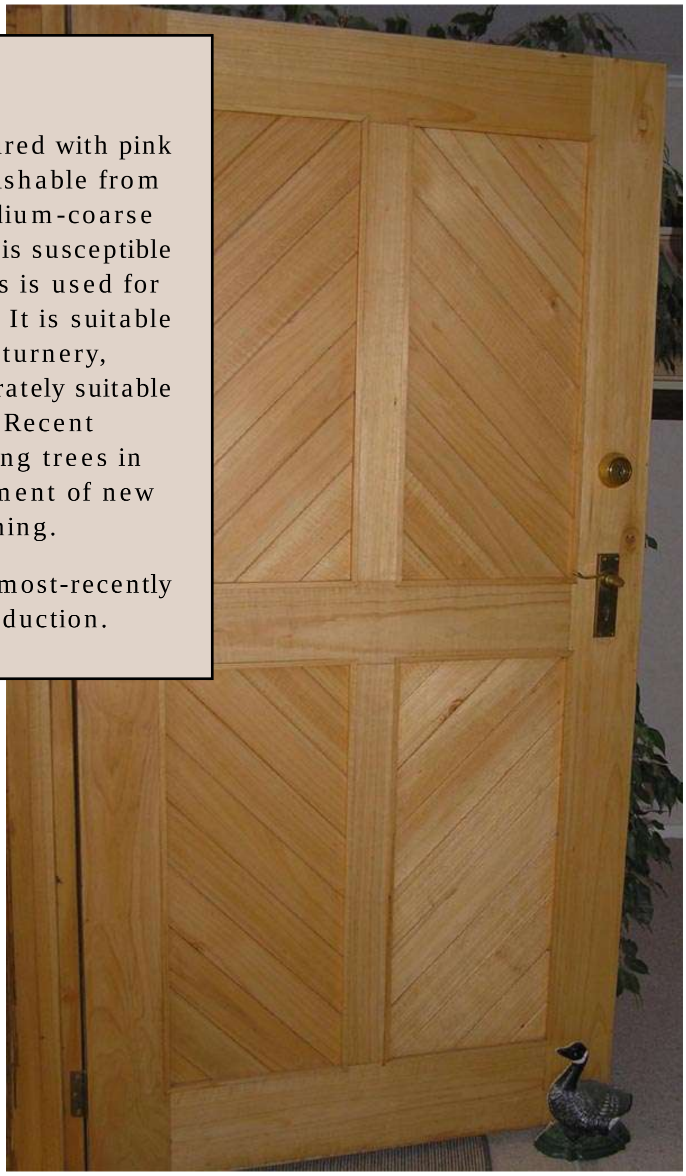
E. nitens

Although it is a southern blue gum, *E. nitens* is commonly grouped with the ash eucalypts because it has very similar wood properties, but is more difficult to process. Recent sawing studies with *E. nitens* have revealed a high incidence of growth stress problems and internal checking during drying.

E. nitens

Heartwood is predominantly straw-coloured with pink or yellow tints. It is not easily distinguishable from the pale sapwood. The timber has medium-coarse texture and straight grain. The sapwood is susceptible to lyctus borer. In Australia this species is used for general construction and some joinery. It is suitable for furniture, cabinetmaking, veneers, turnery, panelling, handles and knobs, and moderately suitable for flooring and engineering purposes. Recent advances in sawing techniques for young trees in Australia have stimulated the development of new solid wood markets, especially for framing.

In New Zealand, *E. nitens* has been the most-recently preferred species for pulp and chip production.



E. nitens solid timber door

Drying: Wood should be dried carefully to minimise collapse and surface checking, particularly in flat-sawn boards. Checking in New Zealand-grown *E. nitens* timber varies considerably with height up the stem. Quartersawing will reduce the incidence of checking on the board face.

Although limited, available information about *E. maidenii* wood indicates promise for sawing. Density is high (higher than that of *E. globulus* wood) and there is little checking. Sawn timber has been used successfully as attractive, pale-coloured flooring. With appropriate silviculture this species could be used for either short rotation pulp or longer rotation sawlogs.

Density

Timber density influences wood strength and the behaviour of timber during drying, pulping and machining. Because of variability between and within trees, values are usually given as the average from a set of samples. They may be expressed in the following ways:

E. nitens veneer door

- Green density describes the wood of a newly-felled tree.
- Air-dry density describes wood dried to a moisture content of 12%.
- Basic density is the average density of wood with a moisture content of 0%. Values are obtained by dividing oven-dry weight by green volume.

The wood of older trees is usually denser than that of younger trees. In some species, such as *E. muelleriana*, density appears to be determined almost entirely by the age at which the wood was formed, because at any stem height values increase from the pith outwards. They remain similar, or decrease, in the sapwood. Basic density increases from about 500 to 560 kg/m^3 over a 30-year period. In other species, including *E. regnans*, density of wood near the pith increases with height up the stem. In *E. saligna* the pattern of increasing density with stem height is only apparent above 10 m.

Nationwide study of *E. nitens* wood density

Whole-tree basic density and internal checking were assessed in *E. nitens* at six New Zealand sites, four in the North Island and two in the South Island, by sampling 15 trees/site, each involving one seedlot of Victorian provenance at a stocking of 1,111 stems/ha. Sites ranged in altitude from 40 to 540 m and in latitude from 35°52´S (Dargaville) to 45°55´S (Drumfern). Site mean whole-tree density ranged from 428 kg/m^3 at Raweka (Whakatane) to 476 kg/m^3 at Mangakahia (Dargaville). Density at Kinleith and Wainui (both central North Island), and Millers Flat and Drumfern (southern South Island) varied little, from 445 kg/m^3 to 459 kg/m^3. From these and previous results, there was some indication that very high rainfall and high levels of foliar nitrogen, phosphorus and magnesium led to extremely low wood density. Whole-tree density increases with age and, after an initial decrease in the lower bole, increases with height up the stem by 50 kg/m^3 and more as age increases, resulting in lower density in the butt log than in upper logs.

Internal checking, assessed in one breast-height disc per tree, was prevalent at all sites, especially in outer heartwood in both slowly kiln-dried and air-dried samples. More checks were found in air-dried discs than in kiln dried. Many more checks were found at the North Island sites at Mangakahia, Raweka, and Kinleith than at the high-altitude Central Plateau site Wainui or the South Island sites. Higher numbers of checked rings and total checks were associated with higher mean annual temperatures, short green crowns, and poor crown health. Far fewer checks were found at cooler sites where trees had much better crown health and longer green crowns.

Checking data was re-analysed from an earlier study of twenty 15-year-old trees from Kaingaroa Forest (altitude 230 m) from four kiln-dried discs per tree at heights of 0, 1.4, 6.4, and 11.4 m, and from a 1-m, air-dried diametral board sawn from the base of each tree. Numbers of checks varied enormously among trees and fell to zero above height 11.4 m. Numbers of checks in the board cross-section correlated moderately with those in the breast-height disc. It is considered that excessive checking in *E. nitens* may seriously reduce its potential for utilisation for appearance-grade lumber, particularly on warmer New Zealand sites where crown health is poor.

Source: Shelbourne *et al*. 2002a

Table 2: Shrinkage from green to 12% moisture content, after steam reconditioning

Species	Tangential %	Radial %
E. delegatensis	6.5	3.2
E. fastigata	5.0	2.7
E. obliqua	4.7	2.4
E. regnans	5.5	3.4
E. nitens	8.2	3.1
E. botryoides	6.0	2.6
E. saligna	7.0	3.8
E. globoidea	4.5	2.6
E. muelleriana	5.2	2.1
E. pilularis	5.2	2.9

Although New Zealand-grown eucalypts can have a lower wood density than those grown in Australia, which are often from older trees, the timber is suitable for the same purposes. New Zealand *E. nitens* has a basic density of 461-474 kg/m^3 at age 15 years and this is similar to the value of 488 kg/m^3 for 20-year-old Australian trees. At age 30 years, New Zealand eucalypt timber has been shown to compare favourably with mature Australian material. A between-tree range of 506-625 kg/m^3 in basic density and a corresponding range of 996-1121 kg/m^3 in green density has been reported at this stage. Within-tree variability was even greater. Values for different species have been reported (Tables 3 and 4) but these should be regarded as a guide only.

Table 3: Density values (kg/m^3) for Australian eucalypt timber)

Australia	Green density	Air-dry density	Basic density
E. nitens	1,050	700	530
E. regnans	1,030	680	520
E. saligna	1,070	850	650
E. muelleriana	1,100	870	690

Source: Bootle 2005

Table 4: New Zealand-grown eucalypts predicted whole-tree basic density (kg/m^3) by 5-year age classes

Species	<7	8-12	13-17	18-22	23-27	>30
E. fastigata	420	450	468	480	490	498
E. globoidea		527	563	588	607	623
E. globulus	434	507	550			
E. maidenii	543	571	587			
E. muelleriana		504	521	532	541	548
E. nitens	411	453	477	495	508	519
E. pilularis			497	563	610	
E. regnans	379	407	424	436	445	452
E. saligna	447	501	533	555	573	587

Source: McKinley *et al.* 2000

Table 5: Strength properties of eucalypt timber

	Modulus of rupture (MPa)		Modulus of elasticity (GPa)		Max crushing strength (MPa)		Hardness (kN)	
	Green	Air-dry	Green	Air-dry	Green	Air-dry	Green	Air-dry
Australia[1]								
E. nitens	62	99	10	13	31	58	4.8	5.8
E. regnans	63	110	13	16	30	63	3.4	4.9
E. saligna	91	140	16	18	44	68	6.4	9.0
E. muelleriana	90	132	14	17	44	72	6.3	8.5
New Zealand								
E. nitens[2]	70.4	116.8	8.5	10.9	27.1	53.3	4.7	6.3
E. nitens[3,4]	68.1	137.5	8.4	15.6	28.5	68.2	-	-
E. fastigata[2]	76.2	120.8	11.2	13.2	35.8	59.6		4.2
E. regnans[3]	-	119.0	-	13.4	-	59.2	-	6.3
E. saligna[3]	56.0	90.9	7.7	11.1	32.7	56.1	3.7	5.2
E. botryoides[3]	65.1	101.0	8.6	11.7	31.9	58.5	4.8	6.4
E. muelleriana[3]	69.1	103.7	8.1	10.1	34.1	57.4	4.6	5.5
E. globoidea[3]	81.0	132.3	11.4	14.6	37.9	66.7	4.5	6.9
E. pilularis[3]	71.2	114.5	10.2	13.4	37.5	67.2	4.2	5.9

Sources: *1.* Bootle 2005 *2.* Miller *et al.* 2000 *3.* Haslett 1988, 1990; Bier 1983 4. One 55-year-old tree only

Strength properties

The following terms are used to define timber strength:

- Modulus of rupture (MoR): This describes the maximum bending strength of wood, which is very important for structural purposes.
- Modulus of elasticity (MoE): A measure of the stiffness of wood.
- Compression parallel to the grain: (Maximum crushing strength.) This is a measure of the ability of wood to withstand loads applied to the end grain.
- Maximum crushing strength: A measure of the ability of wood to withstand loads.
- Hardness: This is a measure of resistance to indentation of the side grain. It is important for the production of furniture and flooring.

The strength properties of eucalypt wood vary between and within trees. A rough guide to species differences is given in Table 5.

Drying/machining properties

The behaviour of wood during drying is described by values for shrinkage. These are given for tangential and radial directions, and express dimensional change when green wood has been dried to a moisture content of 12%.

Eucalypt wood sometimes shows the effects of growth stresses which make it difficult to handle and saw. Ash group species and *E. nitens* are particularly prone to drying degrade especially internal checking, which is a problem for *E. delegatensis* and *E. regnans*.

Natural durability

The term “durability” describes the natural potential of timber to resist decay and is expressed in years of life expectancy (wood integrity) when exposed to moisture and soil organisms in the ground. Sapwood of all species is considered to be perishable, but heartwood contains substances known as extractives which have fungicidal or insecticidal properties. The nature and amount of these substances determine the life expectancy of untreated heartwood. Descriptions of natural durability of heartwood are not precise, but can be allocated to the broad classes shown in Table 6.

Tests of New Zealand-grown trees show similar categories to natural forest grown Australian material, with some species having lower ratings (*E. microcorys*), but others with higher ratings (*E. botryoides, E. globoidea* and *E. saligna*). Several ash group species are categorised in New Zealand as Class 3, but are at the lower end of the range.

Table 6: Classification of the natural durability of timber and species durability rating in Australia and New Zealand

Durability classes	1	2	3	4
Description	**Very durable**	**Durable**	**Moderately durable**	**Non-durable**
Life expectancy **in** ground (years)	> 25	15 - 25	5 - 15	0 – 5
Life expectancy **above** ground (years)	> 40	15 -40	7 - 15	0 - 7

Australia

Class 1	Class 2	Class 3	Class 4
E. acmenoides	*E. andrewsii*	*E. agglomorata*	*E. dalrympleana*
E. bosistoana	*E. amygdalina*	*E. baxteri / blaxlandii / capitellata*	*E. deglupta*
E. cladocalyx	*E. astringens*	*E. botryoides*	*E. delegatensis*
E. cloeziana	*E. camaldulensis*	*E. cameronii*	*E. dunii*
E. crebra	*E. consideniana*	*C. calophylla*	*E. fastigata*
E. cornuta	*E. gomphocephala*	*E. cypellocarpa*	*E. fraxinoides*
E. fibrosa (siderophloia)	*E. guilfoylei*	*E. dives/elata*	*E. nitens*
E. longicornis	*E. leucoxylon*	*E. deanei*	*E. oreades*
E. longifolia	*E. miniata*	*E. diversicolor*	*E. regnans*
E. melliodora	*C. maculata*	*E. globoidea (eugenoides)*	*E. rubida*
E. microcarpa/molucana	*E. marginata*	*E. globulus*	*E. viminalis*
E. microcorys	*E. pilularis*	*E. grandis*	
E. nigra	*E. pyrocarpa*	*E. haemastoma*	
E. propinqua/punctata	*E. resinifera/pellita*	*E. jacksonii*	
E. quadrangulata	*E. robusta*	*E. laevopinea*	
E. sideroxylon	*E. salmonophloia*	*E. macrorhyncha*	
E. tetrodata	*E. sphaerocarpa*	*E. maidenii*	
E. tereticornis	*E. toreilliana*	*E. muelleriana*	
E. wandoo		*E. obliqua*	
		E. radiata	
		E. rummeryi	
		E. saligna	
		E. sieberi	Source: Bootle 2005 and Boland 1984
		E. youmanii	

New Zealand

Class 1	Class 2	Class 3	Class 4
E. cladocalyx	*E. amygdalina*	*E. delegatensis#*	
E. cornuta	*E. botryoides*	*E. globulus**	
	E. globoidea	*E. obliqua#*	
	E. microcorys	*E. regnans#*	
	E. muelleriana	*E. sieberi**	
	E. pilularis	*E. viminalis#*	
	E. radiata~	*E. pyrocarpa#~*	Source: FRI 1997
	E. saligna		

* upper end of range, # lower end of range,
~ provisional, based on incomplete tests

New vineyard development, an opportunity for naturally durable eucalypt posts

Key Points

- Over the years several specialist eucalypt processing operations have been set up, but have not survived in their original form.
- New Zealand-grown eucalypt has similar wood properties to Australian-grown material.
- New Zealand imports Australian eucalypts and tropical hardwoods.
- There is a growing market for eucalypt timber.
- New Zealand has a small dedicated pulp/short fibre resource.
- Depending on species, in ground durability can range from >25 years to 5 years or less.

Suggested reading:

Bier 1999

Black 2004

Boland *et al.* 1984

Bolza 1963

Bootle 2005

Clifton 1994

FRI 1997

Harris & Young 1988

Haslett 1985, 1986, 1988, 1990a

McKinley *et al.* 2000

Miller 1989

Miller & Young 1989

Milne 1991

Mortimer & Mortimer 1984

Shelbourne *et al.* 2002a