CRC for Forestry Bulletin 13: November 2010

Sawn timber from native forests and plantations in Tasmania

Chris Harwood [1,2]

[1] CRC for Forestry
[2] CSIRO Ecosystem Sciences

Introduction

Sawlogs are logs that can be processed into sawn timber boards. Native forests currently provide almost all eucalypt sawlogs, and all sawlogs of speciality timbers (Huon pine, blackwood, myrtle, celery-top pine and sassafras) currently processed by the Tasmanian industry.

Tasmania has approximately 220 000 hectares of eucalypt plantations. Most of this estate is shining gum (*Eucalyptus nitens*), which grows naturally in Victoria and NSW but is not native to Tasmania. There is a smaller area of blue gum (*Eucalyptus globulus*), which is native to Tasmania. Blue gum plantations are restricted to low-elevation, warmer sites as this species is less cold-tolerant than shining gum. Research carried out over several decades has established that other eucalypt species, including those commonly harvested from native forest, are not commercially suitable for sawlog production from plantations in Tasmania.

Tasmania also has approximately 75 000 hectares of softwood plantations. The only softwood species planted is radiata pine (*Pinus radiata*).

There are important differences in the eucalypt sawn timber produced from native forests and plantations, in part related to species and in part to silviculture (i.e. how the trees are managed). These differences affect the potential uses of plantation eucalypts for sawn timber. This must be acknowledged as Tasmania considers a transition away from the use of native forests towards plantations.

Native forest sawlogs and sawn timber

Eucalypt trees in native forests typically regenerate in dense stands. Intense competition for light between trees during the early part of the growth cycle shades the branches on the lower part of the stem, which die and are shed before the trees reach a large diameter (Figure 1). This shedding minimises knots in the wood that grows in later years. Because of this, most boards cut from a good sawlog have few knots or other defects. However, major wood defects due to fire, wind, decay or other damage may develop over decades of tree growth, making some trees unsuitable for sawing.

Defect-free sawn boards are marketed as ‘select’ grade. Boards with knots, gum veins, holes, discolouration, insect damage or other defects are marketed as ‘standard’ grade, or—if defects are very prevalent—as ‘high feature’ grade, which cannot be sold at prices that recover the cost of production.[1]

The three most commonly-used native forest eucalypt sawlog species, *E. obliqua* (stringybark or messmate), *E. delegatensis* (gum-topped stringybark or alpine ash), and *E. regnans* (mountain ash), are all marketed as Tasmanian oak.

[1] Grading rules are provided in Australian Standard AS2796 Timber – Hardwood – Sawn and milled products (1999).

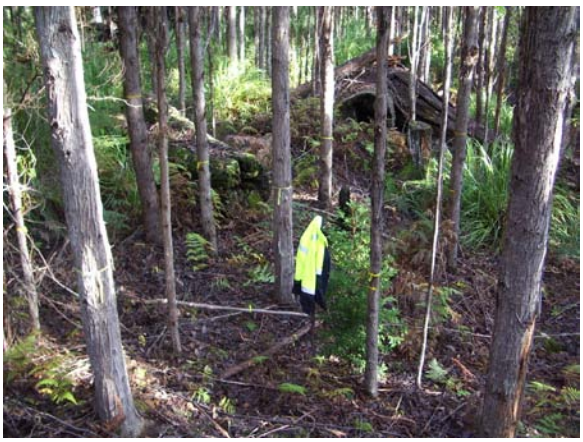

Figure 1.

Eucalyptus obliqua (Tasmanian oak) regrowth at 24 years of age, at Warra in southern Tasmania (photograph: Forestry Tasmania)

Plantations, plantation sawlogs and sawn timber from plantations

Eucalyptus

Eucalypt pulpwood plantations

More than 80% of Tasmania's eucalypt plantations have been established with the intention of producing pulpwood. At the relatively wide (compared to native forest regeneration) initial tree spacing used in plantations, shining gum and blue gum trees develop large branches on the lower stem and hold onto them after the branches die (Figure 2). Without pruning and thinning (see below), such plantation trees neither produce knot-free wood nor attain sufficient log diameter to produce wide sawn boards.

Figure 2.

Dead branches retained in a 13-year-old shining gum plantation

Eucalypt sawlog plantations

About 40 000 hectares (less than 20%) of Tasmania's eucalypt plantations are being grown under 'sawlog' regimes that include pruning and thinning, with the aim of producing large-diameter pruned, knot-free sawlogs (Figure 3).

Pruning: the best 300 or so trees per hectare have their lower branches pruned in three successive 'lifts' to a height of 6.4 m above ground during the first five years of the plantation's life, in order to provide a future sawlog. Pruning requires investment of more than $1000 per hectare early in the life of the plantation. It is not possible to produce knot-free sawlogs by pruning at a later age; once the branches have died, the stem grows around the dead branch-wood.

Thinning: harvesting the smaller and poorly-formed trees early in the life of a plantation enables the retained, pruned trees to grow more rapidly to produce knot-free 'clearwood' and reach the target sawlog diameter of at least 40 cm in 20–25 years. This log diameter is required for quarter-sawing, which reduces defect levels in sawn boards relative to back-sawing, which must be used on smaller logs.

Figure 3.

Taking a wood sample from a pruned tree in a thinned plot 22-year-old research plantation of shining gum in north-east Tasmania. Note the large log diameter and absence of branches in comparison to Figure 2

Sawn timber from unpruned shining gum and blue gum plantations

EcoAsh®, a structural timber product sawn from 9- to 16-year-old shining gum logs from unpruned plantations, has been marketed by FEA Ltd (http://forestenterprise.com/ecoash/index.php). This product contains knots and small cracks that do not affect its utility in construction applications. EcoAsh is slightly stiffer and stronger than machine-graded pine (MGP10), and is sold at a similar price. A specialised multi-saw mill is required to saw these small-diameter plantation eucalypt logs: the sawmills used to mill native-forest eucalypt sawlogs cannot be used.

Logs from unpruned shining gum and blue gum plantations yield very low recoveries of knot-free boards. Most boards from unpruned logs contain dead knots, which are often loose and associated with wood decay and cracking around the knot (Figure 4). This level of knot-related defects reduces the grade of sawn boards to 'high feature' or 'pallet' grade, which are not usable for high-value 'appearance' applications such as furniture, flooring, mouldings or window-frames, for which native forest 'select' grade boards are used.

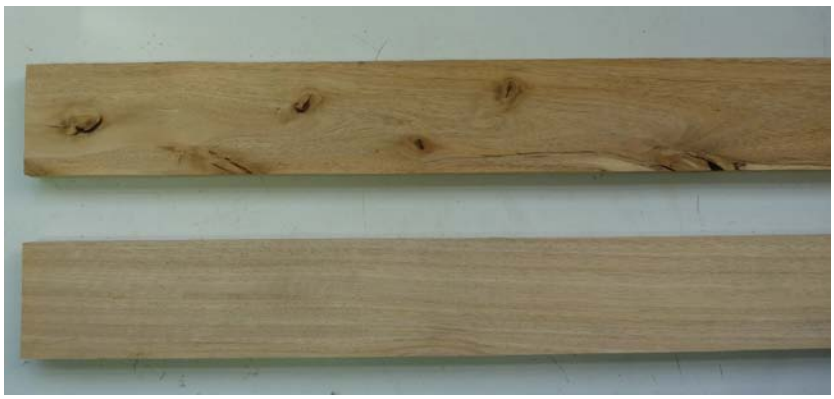

Figure 4.

Boards of plantation-grown *Eucalyptus nitens* from an unpruned log (above) and a pruned log (below)

Appearance-grade timber from pruned shining gum and blue gum plantations

The supply of pruned shining gum and blue gum sawlogs is not yet sufficient to develop commercial processing and sales or to establish prices for sawn boards. A significant supply will not become available until the 2020s.

Processing trials have been carried out on logs from the first pruned plantations of these species established in Tasmania, Western Australia and Victoria in the 1980s, enabling us to get some idea of processing performance, board quality and limitations of the sawn boards. The properties of plantation-grown boards differ significantly from those of boards cut from Tasmanian native forest eucalypt sawlogs. These differences make plantation boards less suitable for some end-uses, as explained below (see page 5).

Radiata pine

Tasmanian pine plantations yield sawlogs that are processed for both structural and decorative (appearance-grade) applications. They also supply large volumes of logs for paper pulp production. Most of the radiata pine plantations in Tasmania are not pruned.

Structural pine timber

MGP10 (machine-graded pine) structural timber is typically sold as 90 × 35 mm cross-sections for house framing. MGP10 refers to the stiffness: MGP10 boards must have an average batch stiffness of at least 10 GigaPascals. MGP12 pine structural timber is stronger than MGP10, and is about 30% more expensive.

Appearance-grade pine timber

Most boards from unpruned radiata pine logs will have knots every metre or so, but knots are usually sound—that is, they are part of the board rather than being loose, decayed and falling out.

Important differences in sawn wood properties of timber from native forest, plantation eucalypt and plantation pine

Checking

Plantation-grown shining gum is prone to checking, which is expressed as small cracks where the wood tears itself apart because of stresses that occur during drying. In many of the processing trials on shining gum, surface checking and checking inside the boards (internal checking) limited product value by lowering the board grade and the likely selling price of boards for appearance applications.

Recent trials carried out by the CRC for Forestry showed that levels of checking in shining gum could be reduced by using appropriate sawing, drying and reconditioning techniques. Following carefully managed steam reconditioning, which is carried out after drying of boards to recover some of the shrinkage, 80–90% of the boards had no surface checking, and 60–70% were free of visible internal checking. However, internal checks had formed during drying, and while the great majority had closed up completely after reconditioning and were not visible, they were still present as hairline cracks inside the board (Figure 5). Closed internal checks may affect re-processing into final manufactured products and product use. For example, if checks are exposed during re-sawing and the wood is then exposed to varying humidity, they may open up and appear as cracks on furniture surfaces. This may limit the range of appearance applications for plantation-grown shining gum. Note that some checking can also occur in boards from native forest eucalypts.

Checking in shining gum can be effectively eliminated by cutting very thin boards, but this would increase processing costs, and there are limited markets for such thin boards.

Figure 5.

Matched cross-sections of three shining gum boards before (left) and after steam reconditioning (right)

Tension wood

Research trials with plantation-grown blue gum show it to be less prone to checking than shining gum. Blue gum is, however, more prone to the formation of tension wood. Bands of tension wood in blue gum cause excessive shrinkage and distortion of boards during drying. This increases processing costs and reduces recovery of saleable boards. Tension wood in blue gum plantations can be reduced to acceptable levels with appropriate silviculture; this is the subject of ongoing research.

Wood stiffness and hardness

Stiffness (degree of bending when under load) of plantation-grown shining gum timber is about 12 GPa, which is slightly stiffer than MGP10 structural pine, but substantially less than Tasmanian native-forest eucalypt boards, which have stiffness levels typically exceeding 16 GPa. Plantation-grown blue gum is slightly stiffer than shining gum. Timber from plantation-grown shining gum has sufficient stiffness and strength to be used for some structural applications such as house framing.

Hardness describes the resistance of the wood to surface denting (critical for applications such as exposed flooring), and is measured in kiloNewtons (kN). 20-year-old plantation-grown shining gum has a hardness of about 4.5–5 kN after drying, which is similar to that of native forest *Eucalyptus regnans* and *Eucalyptus delegatensis*. Radiata pine boards have a lower hardness of about 3.3 kN, while plantation-grown blue gum has slightly greater hardness than shining gum. The most widely-sawn Tasmanian native forest timber, *Eucalyptus obliqua*, has a greater hardness (about 7 kN), making it more suitable for flooring than plantation-grown timber. Greater density and hardness make slow-grown native forest wood more durable and more suitable for uses where it is exposed to outdoor conditions, such as window frames.

Appearance

Because plantation-grown logs are grown much faster than native forest logs, the annual growth rings are further apart. This gives the sawn boards a different appearance to boards cut from slower-grown native forest logs.

Pricing comparison of native-forest eucalypt, plantation eucalypt and radiata pine boards*

Table 1 summarises Hobart retail prices (June 2010) for some of the boards discussed above.

Table 1. Retail prices of sawn boards from Tasmanian native forests and plantations

	Cross-section dimensions	Price per lineal metre	Price per cubic metre of sawn product
Native forest eucalypt			
Select-grade boards[2]	110 x 19 mm	$7–8	$3500–4000
High feature or utility-grade boards			Not sold retail
Radiata pine plantation			
MGP10 structural	90 x 35 mm	$3.00	$940
Standard pine boards	120 x 19 mm	$3.30	$1450
Shining gum plantation*			
EcoAsh structural boards from unpruned 9-16 year-old logs	90 x 35 mm	$3.00	$940
Select-grade boards from 20-25 year-old pruned logs			Price not yet established

*Plantation-grown blue gum has not yet been commercially marketed in Australia

Select-grade native-forest eucalypt boards fetch about four times the price (per cubic metre of sawn product) of structural boards from unpruned plantations of shining gum and radiata pine.

[2] Standard-grade boards sell at a discount of 20–25% relative to select grade boards.

Key messages

- Research has shown that shining gum and blue gum are the only eucalypt species that can be reliably grown in commercial plantations in Tasmania.
- Less than 20% of Tasmania's current eucalypt plantation estate is being pruned and thinned to produce pruned sawlogs suitable for high-value appearance uses. It takes about 25 years to grow these pruned sawlogs, and significant volumes will not be available before 2020.[3]
- The remainder of Tasmania's eucalypt plantations are grown for pulpwood. Small-diameter unpruned logs from shining gum pulpwood plantations can be sawn in specialised mills to produce boards suited to structural (construction) applications. These compete with radiata pine structural boards, and fetch a far lower price than do select and standard grade boards from native forest sawlogs.
- When eucalypt plantations are pruned and thinned, important differences remain between plantation-grown boards and boards from native-forest eucalypts:
    - Plantation shining gum is prone to developing internal checking (small cracks inside the wood) as the sawn boards dry. While they can be closed up by steam reconditioning, closed checks may still limit the use of shining gum boards in certain applications.
    - Plantation timber has lower stiffness, hardness and durability than some native forest eucalypt timber species, making it unsuitable for some applications.
- Clearwood boards suitable for some high-value uses can be produced from pruned plantation shining gum and blue gum sawlogs, provided appropriate sawing and wood drying strategies are followed.

References and useful websites

Australian Standard AS2796 (1999). Timber – Hardwood – Sawn and milled products http://www.saiglobal.com/PDFTemp/Previews/OSH/As/as2000/2700/27961.pdf

Blakemore P, Morrow A, Ngo D, Washusen R, Harwood C, Northway R, Wood M, Volker P, Porada H (2010a). Plantation-grown *Eucalyptus nitens*: Solid wood quality and processing performance on linear sawing systems with a range of commercial and experimental drying schedules. CRC for Forestry Technical Report No. 200 http://www.crcforestry.com.au/publications/downloads/TR200-Harwood.pdf

Blakemore P, Morrow A, Washusen R, Harwood, C, Wood, M and Ngo, D (2010b). Evaluation of thin-section quarter-sawn boards and rotary veneer from plantation-grown *Eucalyptus nitens.* CRC for Forestry Technical Report No. 202. http://www.crcforestry.com.au/publications/downloads/CRC-TR-202-final.pdf

Innes T, Greaves B, Nolan G, Washusen R (2008). Determining the economics of processing plantation eucalypts for solid timber products. Forest and Wood Products Australia Project PN04-3007. http://www.fwpa.com.au/Resources/RD/Reports/PN043007-Final%20revised%20report%20Web.pdf?c=2&pn=PN04.3007

Washusen R, Harwood C, Morrow A, Valencia JC, Volker P, Wood M, Innes T, Ngo D, Northway R, Bojadzic M (2008). Gould's Country *Eucalyptus nitens* thinning trial: Solid wood quality and processing performance using conventional processing strategies. CRC for Forestry Technical Report No. 168 http://www.crcforestry.com.au/publications/downloads/TR168-Washusen-et-al-FORPRINT.pdf

Cooperative Research Centre for Forestry—http://www.crcforestry.com.au

Timber building in Australia—http://www.timberbuilding.arch.utas.edu.au/tbia/default.asp (see particularly the presentations and guides at http://www.timberbuilding.arch.utas.edu.au/tbia/education.asp)

Tasmanian Timber—http://www.tastimber.tas.gov.au/ (see particularly the brochures at http://www.tastimber.tas.gov.au/brochures.aspx)

Forestry Tasmania sawlog supply — http://www.forestrytas.com.au/assets/0000/0113/SustSupply_RevNo3_100.pdf

More information

For more information, visit the CRC for Forestry website (www.crcforestry.com.au) or contact Dr Chris Harwood (chris.harwood@csiro.au).

[3] http://www.forestrytas.com.au/assets/0000/0113/SustSupply_RevNo3_100.pdf