

Continuous Cover Forestry: A case study



The Entrance to Papaiti Forest
Photo: Richard Thompson

The forestry industry in New Zealand is highly focused on clear-felling radiata and increasing investment in mechanisation is favouring larger harvesting plots. However, this is only one end of a spectrum of production forestry practice: other possibilities exist for earning an economic return from growing trees. At the other end is permanent forestry, whereby the economic return to the forest owner is derived from the carbon sequestered in growing stands of trees.

Between these poles is continuous canopy (aka continuous cover) forestry, whereby the canopy is established and maintained even as selected trees or small coupes are harvested for their timber. The light-wells created by harvesting encourage natural regeneration of the next generation of trees, whether from seed, suckering or coppicing - so generally, planting only happens once, although harvesting can continue indefinitely. The periodic harvest does not exceed the amount of growth across the forest as a whole over the

same time period, making this regime genuinely sustainable.

This style of forestry management offers multiple benefits:

- yields high-grade timber;
- sequesters carbon more effectively than clear-felled radiata forests (although over a longer term);
- protects soil and waterways;
- stabilises micro-climates;
- maintains intact eco-systems; and
- provides opportunities for recreation.

If low-impact harvesting methods are employed (such as portable sawmilling on-site), the cost of road building on private land is greatly reduced and there is less pressure from logging trucks on public roads and rural communities. More and higher-skilled labour is required throughout the growing cycle, creating more employment opportunities compared to clearfelling radiata, particularly the low-grade stands which are not thinned or pruned.

There are also amenity benefits: over time a plantation evolves to become a mixed-age stand



For more information visit www.horizons.govt.nz
or freephone Horizons on 0508 800 800

that more resembles a natural forest. It lacks the monolithic appearance of fence-to-fence even-aged radiata stands, to which diverse opposition is growing.

Continuous canopy forestry is the norm in some places in Europe, particularly Switzerland and Germany. There is also an enthusiastic return to these practices all over Europe. Retired forestry consultant Ian Barton wrote *Continuous Canopy Forestry: A handbook for the management of New Zealand forests* in 2010 and this book remains a very important resource for New Zealand foresters. It is primarily focused on growing native timbers for production purposes, but it also contains valuable information about selected exotic species that are suited to this management approach.

Most of the current interest in continuous canopy forestry in New Zealand is focused on alternative exotic or native species but it is feasible to manage radiata under this regime, as demonstrated by the Wardle family in Canterbury (see Appendix 3A in Barton). However, continuous canopy forestry has higher costs per unit and lower yields at any one time compared to clear-felling, so it is economic only when those costs are offset by higher yields. This is possible even with radiata by pruning and

thinning to produce top-quality logs. It also requires somewhat easier country and prior planning of access to permit ground-based harvesting. This is less expensive than hauler operations, which also risk causing excessive damage to the remaining forest.

It is possible to convert an even-aged stand, cutover or scrub into a continuous canopy framework, as well as establishing a new forest on bare land or grassland. Useable timber can be extracted in as little as 15 years from short-lived species such as *Acacia dealbata* (silver wattle), although 30-40 years is more typical, from species such as macrocarpa, redwood, blackwood and various eucalypts. Production thinnings would generate some return from year 15 onward, providing a market is found.

Research by Scion commissioned by Horizons Regional Council in 2017 highlighted the potential for planting redwoods in this region, in particular on erosion-prone land. Redwoods are suited to a continuous canopy operation.

Two forestry operations in Whanganui illustrate the potential of this management regime in the Horizons region.



Papaiti Forest with Tasmanian blackwoods in the foreground and well-pruned macrocarpa on the ridge
Photo: Richard Thompson



For more information visit www.horizons.govt.nz
or freephone Horizons on 0508 800 800

Papaiti Forest

Papaiti Forest is a 16 ha specialty timber plantation established in the early 1990s by Richard Thompson and Laurel Stowell, in a dry-stock farming area 15 minutes from Whanganui. Their forest covers a south-facing slope that was previously erosion-prone marginal pasture with some patches of scrub and regeneration.

The first plantings focused on Tasmanian blackwood (*Acacia melanoxylon*) and *Cupressus macrocarpa*. Poplar (*Populus deltoides* x *P. yunnanensis* (Kawa)) and (*P. deltoides* x *P. nigra*) x *P. yunnanensis* (Toa)) and silver wattle (*Acacia dealbata*) were planted as nurse species and in shelterbelts but some have been grown to maturity and are already yielding saleable timber.

Willows were interplanted among the blackwoods to encourage the blackwoods to grow tall and straight. They were cut out after about 10 years. Although willows readily coppice, it was by then too dark for regrowth to survive under the closed canopy.

Gums (probably *E. botryoides*) were planted on a dry, steep east-facing slope but they have not done particularly well. Trees that were coppiced have produced shoots with better form.

Tracks weren't established until after planting, which made track-building more difficult but it did reduce the erosion risk while the trees were still establishing. Tasmanian blackwood has great soil-holding capacity, establishing interlocking networks of roots.

Grass and weeds are not much of a problem since the canopy closed after about 10 years. Chemical weed control is employed to keep old man's beard and blackberry in check. Gorse was primarily shaded out rather than poisoned. Deer are an ongoing problem and hard to control as they range freely across neighbouring forests and scrub.

The bulk of the forest was planted by the couple themselves over a four year period, largely using stock they raised themselves (they were running a landscaping business and already had a nursery established). They also did most of the pruning themselves.



Extracting a log along Papaiti Forest's narrow tracks
Photo: Richard Thompson

Macrocarpa and blackwoods require different silviculture. Macrocarpa grow a lot of side branches that quickly get heavy. They create big knots in the core of the tree if not removed in time, so regular pruning is required. The three stands of macrocarpa were originally planted on 4x4m spacings (625 stems per ha (sph)) and are now stocked at between 400 and 550sph. More thinning has produced better diameter trees.

Open-grown blackwoods will turn into shaggy trees with multiple leaders. Trials in the Waikato indicate that genetics don't influence form so a strong silviculture regime is needed to encourage upright growth. Blackwoods were planted in groups of three at 9m spacings and pruned up to 5-6m. Final selection was made at about 10 years old.

Richard has chosen not to graze animals under the trees and a native understorey has naturally established in recent years. Blackwood readily regenerates by coppicing and suckering, so succession will occur naturally when trees are harvested. Macrocarpa grows readily from seed.



The forest was registered in the Permanent Forest Sink Initiative (PFSI) in 2012, although this scheme is being discontinued and a new Emissions Trading Scheme. The forest has accumulated about \$60,000 of carbon credits to date. Richard believes the price will rise dramatically in the years ahead and has no immediate plans to sell any credits.

Production thinning began in about 2012. A national market for speciality timber did not exist and they would have struggled to sell cutting rights or logs. Instead, they established a speciality timber merchant business in 2015 to market their timber themselves—dubbed MacBlack Timber after the principal species grown at Papaiti Forest. They also buy logs and some sawn timber to expand their inventory.



Production thinning of Tasmanian blackwoods
Photo: Richard Thompson

The MacBlack yard is close to the Whanganui city centre and has been expanded, with workshop space doubled and a full joinery workshop set up. A dehumidifying kiln was commissioned in 2018 in order to supply small amounts of kiln-dried timber. A two-man crew run a portable Lucas mill around the district, milling macrocarpa and other speciality species from old farm shelterbelts or woodlots

Spotty Dog Farm at Martin

This property lies 13km east of Whanganui at Okoia and is closely aligned with Papaiti Forest. Owners Hamish Randle and Rachel Rose took Papaiti Forest as their starting point when planning their own high-value, alternative species forest that will be managed under continuous cover. They value the biodiversity and soil and water protection offered by this regime. Hamish has worked at MacBlack timber as a sawmiller and timber hand since

2016, where he's gained experience in pruning, thinning, felling, milling, grading and marketing timber.



Sawmiller Ross Greenbank operating the MacBlack Lucas sawmill
Photo: Rachel Rose

The couple purchased Martins in 2018, a 28 ha block of summer-dry hill country (900-1000 mm/pa). The moderately consolidated sandstone parent material creates a risk of soil slip erosion, particularly on the steeper faces (89% of the farm is strongly rolling to steep country). The freak rainfall in June 2015 that brought a record flood of the Whanganui River also caused a lot of erosion damage throughout the district, with Okoia badly affected. There was significant soil slip erosion on the most exposed face at Martins, which is Class 7 land with seams of gravel and slopes greater than 35%.

Springs are present high on the hillside on both sides of the middle valley, seeping water year-round. Evidence of slips over a long period almost always originate below the springs. Carefully selected species will be planted to stabilise these areas. The wetland along the narrow valley floor will be restored and without grazing pressure, bog species like *Carex secta* are naturally regenerating here and around the springs.

A small top flat has Class 1 soils, the highly prized Westmere loam. It's very exposed to the strong prevailing westerlies and establishing shelter is a priority. The owners are still considering the best land use here; it won't be afforested in timber species.

The six months to prepare for the first planting season was used to gather advice and engage in robust planning. The owners say Horizons Regional Council was very supportive from the outset with a local land management co-ordinator taking a keen interest in their project.



Practical assistance ranged from completing afforestation grant applications to loaning equipment for planting poplar poles and even using a side-by-side to deliver planting material to the back of the farm once the tracks were too wet to allow 4WD vehicle access. An Environmental Property Plan prepared by Horizons provided detailed information about the farm and the different erosion risks associated with various soil types.

The couple also get enormous value from their NZ Farm Forestry Association membership. Their local branch is very active with a full programme of field days throughout the year. By attending these and national events, they met experienced farm foresters with decades of experience and are developing a national network of contacts and mentors.

In 2018 Yeogi poplars (*Populus alba x glandulosa*) were established with final 9m spacings on the Class VII face, along with durable eucalypts (*E. microcorys* and *E. globoidea* on initial 3m spacings). Tasmanian blackwoods were planted on a better site, in groups of four at 9 m spacing, nursed by Kawa poplars.

Macrocarpa, redwood, silver wattle and *E. fastigata* are being planted in 2019. Clonal redwood is being established in carefully selected sites that are sheltered, fertile and moist. Macrocarpa planting stock has been grown by Scion from the most promising canker-resistance provenances and is being sited on south-facing sheltered slopes to reduce stress.

There is some hare pressure but no other pest problems so far. Trees are sprayed with a commercial hare repellent before or immediately on planting. Livestock were excluded in January 2018, as the block doesn't have yards and no longer has a water supply to troughs (it was previously managed as part of a larger farm).

The owners have chosen not to spot-spray given herbicide's effect on soil microbiology. They plant using a more labour-intensive method of skimming turves and manual releasing - pushing grass down rather than cutting it, as once the grass matures it provides less moisture competition. Trees are slower to establish but they expect fewer problems with socketing and windthrow.

A forest in Northland successfully established in this way indicates growth rates largely even out over a 8-10 year period, compared to trees established using spot-spray.

The couple plan to live at the farm and establish small-scale horticulture as another income stream.



This north-facing slope (>35%) at Martins has been planted in *E. microcorys* and *E. globoidea*. The bamboo poles serve as markers, not stakes

Photo: Rachel Rose

Opportunities

The highly erodible soils and steep country in the Manawatū-Whanganui Region call for serious consideration of much more continuous canopy forestry, whether for radiata or alternative species. There is a growing body of knowledge about the local performance of exotic (and native) species for timber production.

While radiata log prices at the wharf have been buoyant in recent years, this is driven by domestic construction in China. Most New Zealand radiata logs are used for concrete formwork on Chinese construction sites. There is no certainty that the demand for this low-grade timber will continue or that New Zealand will continue to be a favoured supplier. For forestry sites not close to ports or railheads - as is the case for much of the Horizons catchment - the earnings from commodity radiata are further vulnerable to hikes in log transport prices, already a significant cost at harvest time. This lack of certainty about future demand for commodity radiata strengthens the case for continuous cover forestry, especially that involving higher-value species which can be put to a range of end uses.

Investment in further mechanisation of harvesting is continuing at pace. This machinery is expensive and is optimised for



felling and processing radiata. It is most cost-effective to use on very large stands. Anecdotal evidence suggests smaller forest owners are having difficulty finding contractors to harvest small or difficult to access blocks.

Planting alternative species deserves serious consideration for smaller sites or more remote areas: both remote farms and forestry blocks at the back of a farm that would require many kilometres of road building across private land. Planting and appropriately maintaining alternative species will produce higher-value timbers that make selective extraction worthwhile. If portable sawmills are used, the pressure on roading is reduced. Large skid sites and high-specification roads are not needed.

Portable sawmills can also mill timber to a landowner's specification for on-farm use. The research into growing ground-durable timber species in New Zealand is ongoing. There is significant interest in ground-durable roundwood from the certified organic agriculture and horticulture sector, where CCA-treated timber is not permitted. This demand is expected to grow (there is also an established demand in Hawkes Bay for poplar battens, fence posts and timber for farm gates. Poplar requires treating for in-ground use, but it is very strong and light and the local sawmillers cannot keep up with demand.)

Continuous canopy regimes are suited to erosion-prone sites where clear-felling is inadvisable or not permitted. Because the periodic harvest does not exceed the growth within the same period, the need to repay carbon credits is removed. Alternative species such as redwood and *E. regnans* are far superior at sequestering carbon compared to radiata.

The aesthetics of a continuous canopy forest and its multiple environmental and economic benefits would likely appeal to a wide cross-section of New Zealanders. This could facilitate investment partnerships between landowners and investors. Legislation and model agreements already exist for forestry rights, which allow for the separate ownership of a forest and the land on which it grows. There are several different ways income can be returned to the landowner.

This creates another option for farmers with marginal land they wish to retire from grazing,

but who may not have time, interest or funding to plant or manage forestry.

The aesthetics of a mixed exotic or native continuous canopy forest may also be far more appealing to live near compared to a radiata monoculture and the resultant clear-felling.

Planting alternative species is somewhat speculative because domestic markets for these timbers are still developing. The strongest demand is for macrocarpa, which is widely known and increasingly appreciated even as supply is falling. But there are already industry participants committed to increasing demand and smoothing out friction between supply and demand. Increasing transport costs will also favour locally grown timber.

It is vital that landowners considering continuous canopy forestry get informed advice about the most suitable species for their particular soils and sites. The NZ Farm Forestry Association's resources and *Continuous Canopy Forestry* are good starting points.

An extraction plan should be developed and tracks established to allow for ground-based harvesting before trees are planted. The value of provenance should be understood; not all planting stock is created equal. For instance in redwoods, form, vigour and heartwood accumulation are all driven by genetics and so clones suited to the site should be selected. Canker has badly affected conifers, macrocarpa in particular, but research into canker-resistant lines is showing progress.

