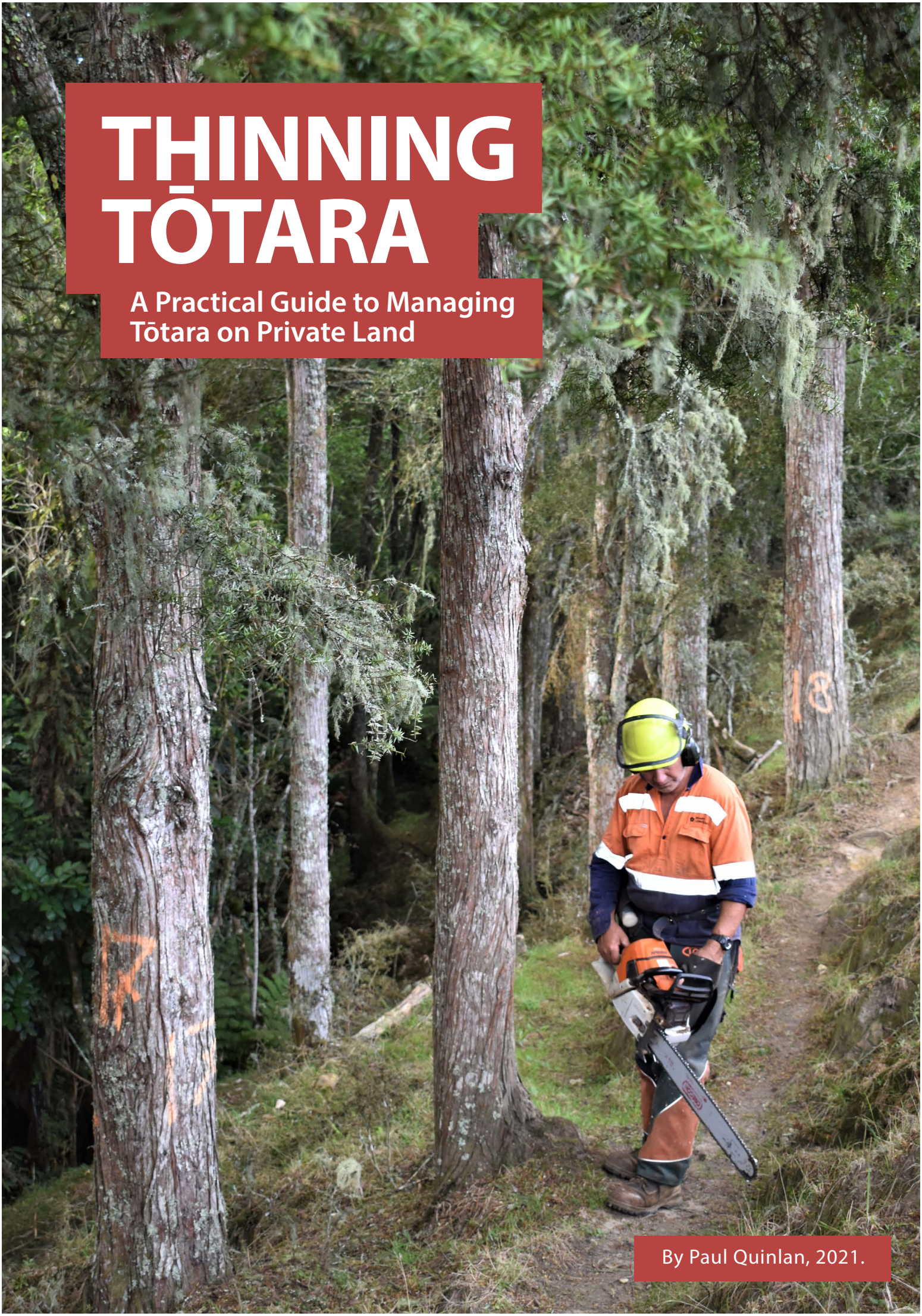

THINNING TŌTARA

A Practical Guide to Managing Tōtara on Private Land

By Paul Quinlan, 2021.

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1. Why thin tōtara?

High density, slow growth, and poor form

Naturally regenerated tōtara forests typically have high stocking rates – sometimes thousands of stems per hectare – and comprise trees with wide ranging characteristics such as size, form (branchy-ness etc.), growth rates, and green crown development. Planted native forests also tend to be established with high stocking rates (often around 2500 stems/ha or more) in order to beat and supress weeds and also to utilise the advantages of competition between the stems to improve the form of the developing young trees. If such forests are left untended, some trees will dominate, others will be suppressed, and there will be fierce competition between the stems. The stands will self-thin over time – i.e., the stocking rate will decrease over time as the weaker, supressed trees, die off. This is a slow and gradual natural process that also slows the growth of the trees within the stand. Moreover, the dominant trees may not be good timber trees.

Thinning manipulates these factors.

Enhancing timber production potential

Although untended natural or planted tōtara forests can still develop into stands with some merchantable timber volume, they will tend to have sub-optimal productivity in this respect. A large portion of the forest's total annual growth increase may be going on trees with relatively poor form (i.e., have little or no merchantable sawlog volumes, or only logs of relatively low timber value, and some growth will be going into supressed trees that are likely to fail). Often the dominant trees have the poorest form. The high stocking rates also slow the average growth rate of the trees. And trees with the best form for timber production may be supressed and never realise their full potential. All this is sub-optimal for timber productivity. However, this can be changed by thinning.

Ironically, thinning involves cutting trees down to grow more and better timber. Essentially, it is about culling out the poor trees, so the better ones have more space and light to grow faster and to reach their full potential. Thinning is a practical way to direct the forest's growth into the individual trees with the best potential for timber production and increase the total productivity from the forest area.

"Thinning is the most effective silvicultural intervention to significantly influence the future sawlog volume and value of a forest."

Timing, intensity, and skilled execution are all significant factors that affect the relative value and benefit of any thinning. Unfortunately, without case-studies and modelling, the economic viability of thinning tōtara forests, (as opposed to doing nothing and leaving things to nature) is not known. However, it is clear that thinning can significantly affect the potential for timber production.

Silvicultural trials by the Northland Tōtara Working Group found the mean annual growth rate of individual trees more than doubles following a thinning (trunk diameter increment at breast height), and total stand productivity can be 5-fold greater than for comparable unthinned stands.

The growth form of tōtara ranges from trees that branch from ground level with large spreading crowns, to thickets of skinny, pencil-straight trees.

The growth rings of this tree clearly show the response to a thinning 4 years previously.

"Thinning can significantly boost growth rates of the potential crop trees"

The necessary complement to pruning

If any pruning has been done, then thinning is an essential complementary operation. Otherwise, the unpruned residual trees may dominate and suppress the pruned trees and the investment in pruning effort will be wasted.

Creating viable trees as replacements

In highly stocked tōtara plantations and natural pole-stands within regenerated forests, many young trees develop excessively tall skinny trunks and very small narrow crowns. It is doubtful whether these trees, even if released from competition by thinning or selective harvests, have sufficient vitality to 'fatten' and ever become viable timber trees. Thinning is a way of developing vigorous potential recruitments that are physically capable of filling gaps and replacing harvested trees. This is important when managing forests with a natural uneven-aged structure, (as opposed to even-aged plantations).

Stand stability

Although to-date, wind-throw in tōtara stands has not been noted as a serious problem by the Northland Tōtara Working Group, it may be an issue in other regions. In theory, trees with healthy and balanced crowns and greater trunk-diameter to tree-height ratios are more resistant to extreme wind events. Thinning is generally recognised as one way of improving the inherent stability of the trees within a stand and their resistance to wind-throw (and snow damage in regions where that is a risk). Thinning to improve stand stability may be relevant for developing tōtara plantations and natural pole-stands in some regions.

Naturally regenerated tōtara stands may have such high stocking rates that it significantly slows the growth of the trees.

Thinning increases the light levels within a stand and often leads to the development of diverse understorey. In contrast, many unthinned natural stands have a comparatively bare understorey.

Long-term stand improvement via new regeneration

Many naturally regenerated tōtara forests are dominated by large trees that occupy significant space yet have such poor form that their timber value may not increase by allowing them grow on and become even bigger trees. Indeed, it may just make them even more problematic to deal with in the future. Removing some of these trees may free up space within the forest for new regeneration that will have better potential to be managed for timber production.

Forest establishment

Sometimes early thinning operations may also be useful in native forest establishment – e.g., releasing suppressed young native trees from a dominating nurse cover, or exotic weed competition.

Biodiversity management

Timber production may not be the only forest management objective. Thinning may be a practical way to influence the species mix and biodiversity of the forest. For example, by releasing around rare or less common non-timber native tree specimens to ensure their survival and to provide them with adequate growing space within the forest. Increased light levels reaching the forest floor following a thinning operation also often results in development of the forest's understorey.

Summary

The potential benefits of thinning include:

- Enhanced timber production potential – growth directed to higher value trees
- Larger diameter harvest trees in a shorter time
- More stable stands
- Improvement of the forest structure (e.g., creating regeneration opportunities and healthy potential recruitments for canopy gaps)
- Biodiversity management (fostering mixed species, and understorey development).

Thinning is a very effective silvicultural intervention to enhance timber production potential. However, thinning is a severe manipulation of a forest's structure. Moreover, cutting a tōtara tree down is an irreversible act. Therefore, it is very important to make good decisions when undertaking such operations.

2. When to thin?

IIdeally forests are thinned gradually, with light and frequent operations over an extended period. Frequent thinning can keep the potential crop trees growing quickly and consistently. It also allows the trees to adjust and compensate to increasing exposure to wind and light. Graduated thinning reduces the risk of wind-throw and epicormic shoots developing on the stems of trees in response to sudden exposure to more open conditions. However, in practice, thinning is often executed in only a couple of severe interventions.

This untended stand of naturally regenerated tōtara had a mean DBH of 14.4cm and a stocking of 2800 stems/ha. It was thinned to 700 stems/ha and the mean DBH of the residual trees was 19.2cm. These were then pruned to 6.5m in one lift. The delayed thinning has resulted in trees with good form, reducing silviculture costs, but has significantly slowed the growth rates of individual stems. The stand is estimated to be 50-60 years old.

First thinnings

Thinning often follows pruning, and depending on the site, and stocking, this may even be necessary during the sapling phase to prevent the unpruned trees, or a dominating nurse-crop, from supressing the pruned trees. However, there may be advantages in delaying the first thinning, or only lightly thinning, until the potential crop trees within the stand are between 7 and 12metres high, and mean DBH exceeds 12cm (ideally 15-18cm). This utilises the effect of competition between the trees within the stand to positively influence the form of the developing trees and reduces the need for pruning. It also reveals natural differences in vigour between individual trees – which is relevant to tree selection. However, it will slow the growth of the trees.

Waiting until thick undergrowth such a gorse and blackberry has started to be shaded out is another practical consideration. Ideally the lower branches of the crop trees will already have started to die-back naturally on the first 3-5m of stem height. Some dense natural pole-stands can be thinned and pruned to 4.0- 6.5m in one single operation. This significantly reduces the costs of silviculture. However, the advantages of delaying thinning like this will come at the expense of growth rate.

"There is a balance to find between maintaining diameter growth on the potential crop-tree stems and maintaining sufficient side competition to develop good tree form and minimise pruning costs."

Many forestry publications suggest that thinning should occur before the green crown is suppressed to less than a third of the tree's height (or average values of a stand). In many highly stocked natural pole-stands of tōtara, individual trees with proportionally smaller crowns are not uncommon. In such instances, tree selection becomes another difficult choice – as the trees with bigger and healthier crowns will often not be the trees with the best stem form.

Maintaining relatively high stocking rates to reduce the need for pruning makes sense. However, if thinning is delayed too long it risks creating tall skinny poles with ill thrifty crowns and potential stability problems. The ability for such 'stretched' young tōtara poles to pick-up their growth rates and become viable timber trees is not known. Some research on this matter would be helpful. However, experience with other species is that past a certain point in the pole-stand phase, even if thinned, unhealthily skinny residual poles with small crowns, will not develop into viable timber trees. Where is that point for tōtara?

Height/diameter ratio

Many European forestry publications refer to a tree height to trunk diameter ratio as a way to determine the timing of thinning operations, or whether a pole-stand has past the point of sensible intervention. The equation is:

$$\text{Height/Diameter ratio} = \frac{\text{Tree height (in cm)}}{\text{DBH* (in cm)}}$$

*DBH = Tree diameter at breast height

Example:

$$\frac{\text{1200cm (12m. Tree height)}}{\text{15.0cm (DBH)}} = 80$$

Height/Diameter ratios of 80:1 or lower are generally considered stable. Ratios between 80 -90 are considered at higher risk of wind-damage etc., and values above 90, to have little chance of becoming viable canopy trees.

Applying it to tōtara

We are unaware of any research testing these assumptions with tōtara.

The above formula would suggest that trees with a DBH of 10cm should not be more than 8m tall. Or trees with a DBH of 15cm should not be more than 12m tall. Based on practical experience with tōtara pole-stands, this seems about right. However, trees in some dense natural pole-stands exceed that recommended threshold. If the height/diameter ratio of a plantation or pole-stand is approaching the 80:1 ratio, it would be prudent to undertake a thinning operation.

"A Height/Diameter ratio of <80:1, may be a useful measure to help guide timely thinning interventions, and individual tree selection, especially in dense natural pole-stands".

A practical approach may be to measure a sample of the trees likely to be selected as 'keepers' (potential crop-trees), ignoring those likely to be culled, and ensure thinning commences well before those potential crop-trees become too skinny (i.e., their height to diameter ratio exceeds 80:1 and/or their green crowns are less than one third of their total height. This may also help decide if a tree is too skinny to keep.

Further thinnings

Subsequent thinnings need to balance the maintenance of good tree form, while promoting fast growth, and maximising the stocking of potential harvest trees. Suggested thinning schedules are set out further on. These are based on Stand Density Index (SDI) analysis work by Tane's Tree Trust and the Northland Tōtara Working Group.

These are relevant to well-stocked plantations and naturally regenerated pole-stands of tōtara. They suggest progressively reducing the stocking to 550 stems/ha before the mean DBH exceeds 25cm and then maintaining that stocking until about a 40cm DBH. This aims to maintain good growth rates, yet hopefully also encouraging the development of some top logs, and maximise the stocking at 40cm DBH to provide an earlier production thinning harvest opportunity.

However, for sparsely stocked and highly variable natural stands a different approach is needed – one based on thinning around individually selected crop trees. This is also outlined further below.

Bole height and top log development

Once a clearwood bole has been formed, the forest manager faces a choice of further thinning options. These are either to thin more heavily for maximum diameter growth on the butt log and the earliest harvest of selected potential crop trees, or to maintain a higher stocking rate in the hope of developing more merchantable top logs (i.e., any sawlogs formed above the butt log).

In young, naturally regenerated stands, and low-stocked plantations, it may be difficult to develop good top logs. The trees with the largest crowns are likely to have relatively short boles and little or no merchantable top logs. In contrast, adjacent pole-sized trees growing between the dominant trees will often have the potential to develop taller boles. This is where production thinning and continuous cover forest management practices provide opportunities to improve the forest structure in the long-term. For example, if the shorter-boled trees are removed first, either through thinning, or selective harvests (production thinning), then over time, the canopy height and mean merchantable bole-length of the forest may be gradually increased.

This untended natural pole-stand should have been thinned earlier. The height/diameter ratio well exceeded the recommended 80:1. The skinniest trees have been thinned out, and mean height diameter ratio of the residual stand is now 78:1. Hopefully this has salvaged the situation in the nick of time. Further thinning will be required as these trees fatten.

3. Production thinning

Early thinnings are mostly dealing with small diameter trees not large enough or worthwhile to mill. This is generally called 'thinning to waste' – as the stems and slash are usually left in the bush to rot.

But as the forest develops, or in older naturally regenerated forests, many of the trees to thin have logs just large enough to mill. If they are extracted for that purpose, or other commercial use, then that is known as 'production thinning', and in theory, such thinnings present a revenue opportunity.

Later thinnings may involve felling trees that are large enough to be milled (usually >30cm DBH). If these are extracted from the forest it is known as production thinning.

Reducing the size of the crown before felling is an effective but time-consuming way to production thin in way that avoids damaging adjacent trees. In this case, the tree with a 51cm DBH and 4.2m long butt log yielded 0.85m3 of saw log volume, and was harvested to the advantage of taller-boled but younger trees around it.

There may be sections of millable timber and top logs even in some of rougher trees that are thinned.

In practice, the costs of extraction may outweigh the value of the logs -especially since it is the poorer-grade trees that are targeted for thinning. However, an important principle is that silviculture is expensive and therefore any opportunities to offset the costs (even only partly) should be fully explored and utilised.

"Silviculture is expensive. Therefore, any opportunities for production thinning should be fully explored and utilised if practicable."

Thinning of plantations or natural pole-stands, should not be delayed in the hope of being able to execute a production thin. However, when starting with an already regenerated natural forest, production thinning will often be an option. Selective harvests should be treated as silvicultural (thinning) interventions – i.e., targeting the removal of poorly formed trees to the benefit of the better-formed residual trees.

Usually, stems with a DBH of 30cm or greater are considered 'merchantable trees' in forest inventories under the Forests Act. However, this is an arbitrary threshold. It is possible to mill and recover merchantable timber from tōtara trees with DBHs less than 30cm. Ultimately, what is 'merchantable' and worth production thinning, will be decided by market economics at the time, or what the forest owners can find a use for.

Legal requirements

Part 3A of the Forests Act applies to any harvesting and milling of any *natural* native forests, including regenerated farm-tōtara on previously cleared land. Various provisions of the Forests Act enable the harvesting and milling of native timber. However, approvals are required before the trees are felled.

The milling of all native timber requires approval from Te Uru Rākau this includes trees harvested from planted native forests which requires a milling statement issued by Te Uru Rākau prior to milling. Contact Te Uru Rākau New Zealand Forest Service for information on this matter: https://www.mpi.govt.nz/forestry/native-indigenous-forests/

4. What to thin

Tōtara trees with obvious significant defects that would affect timber production should be thinned.

Serious defects include:

- **bark damage and rot**
- **misshapen or damaged crowns**
- **forking/multiple leaders with no potential merchantable log sections**
- **excessive heavy branching**
- **unstable trees and poles with ill-thrifty crowns**

Standard criteria to assess acceptable limits (tolerances) to some other common defects in tree form are set out in some forestry publications.

Such defects include:

- **trunks that have sweep, leans and kinks etc.**
- **spiral grain (noticeable in the bark pattern)**
- **large diameter branches**

Weak, stunted and misshapen tōtara saplings in the understories may also be removed, although this is unlikely to boost growth rates of the dominant and codominant trees.

Other species

Unless ecological values or environmental management objectives suggest otherwise, other common species such tree ferns and kanuka, should be thinned if they are significantly supressing the growth rates or deforming potential crop trees, or inhibiting natural regeneration.

Weeds

Woody weed species should also be felled during any thinning operation. Ideally their freshly cut stumps should also be swabbed with herbicide (e.g., the gel called 'Vigilant' – with picloram as an active ingredient). Slash from thinned trees can make access for weed control difficult, therefore, it best to cut and poison woody weeds before felling trees on them.

What not to thin

Native trees should not be thinned where they are holding up stream banks, or on steep scarps, or providing valuable environmental service. Maintaining or fostering a mix of forest species is likely to be an important management objective for most native forests. Therefore, thinning must consider the potential effects on species diversity within the forest. Care needs to be taken to ensure that the falling of thinned trees will not damage valuable non-timber species in the process. In situations where damage appears possible, ringbarking may be a better option than felling.

Wildlife values and safety may also be relevant if larger trees are involved. For example, hollow trunks should be checked for signs of bat or bird roosts, or kiwi burrows at the base - and unsound or multi-leadered trees can be very hazardous to fell. It is desirable to include some non-merchantable trees and tree species within any native forests for many environmental and ecological reasons, and for natural character and amenity values.

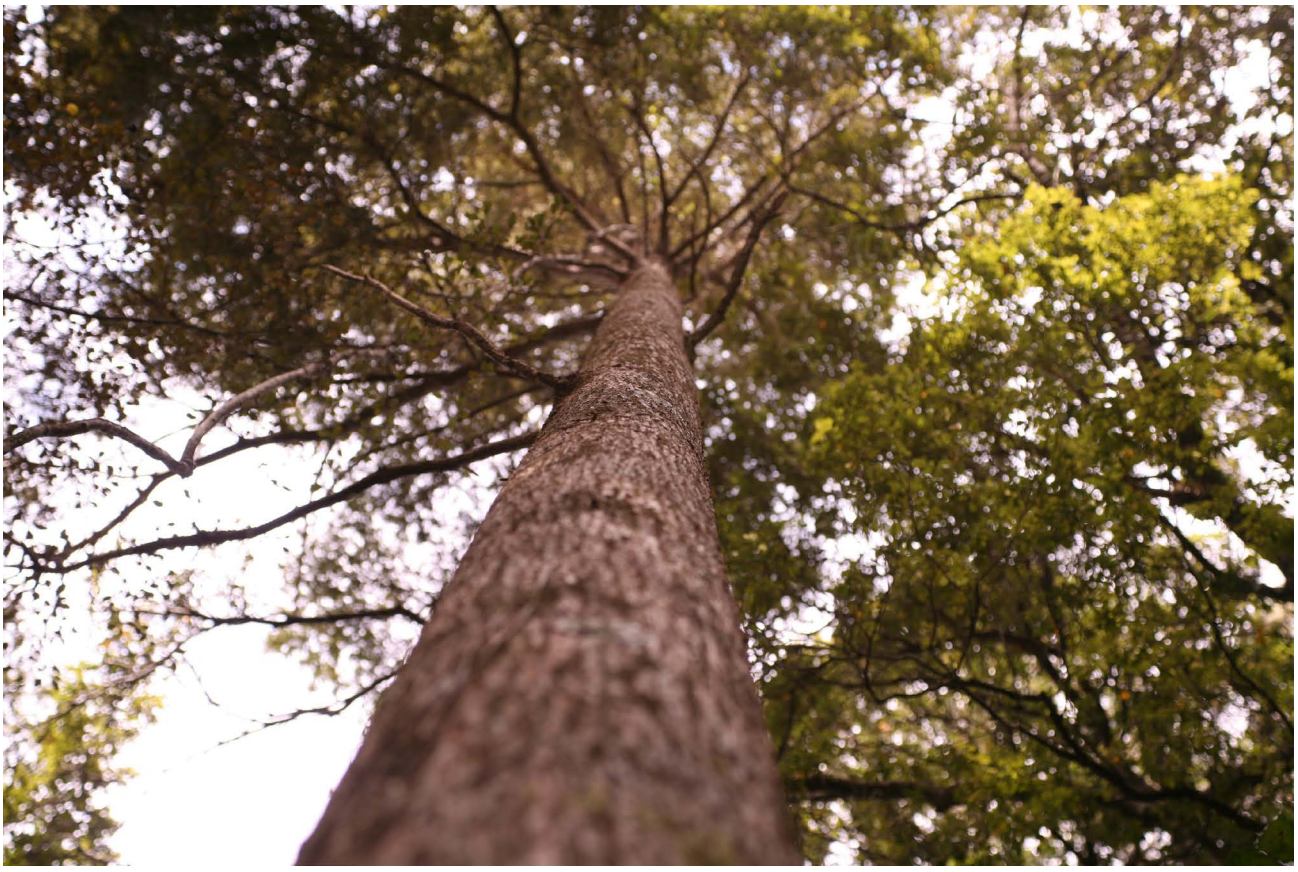
5. How many to thin?

Two approaches

Some areas of naturally regenerated tōtara forest have very plantation-like characteristics. They can be almost monocultures of tōtara and be relatively consistent in terms of tree size – especially in the pole-stand phase (i.e., mean DBH of 10-30cm). Such natural pole-stands can be thinned and managed like even-aged plantations. In contrast, other areas of natural forest have more variable attributes and require a far more flexible approach to silviculture - one that is suited to uneven-aged, variably stocked, and often mixed species within a more natural forest structure. Therefore, two differing approaches to thinning are outlined below.

One approach involves thinning schedules that can be applied to plantations and well-stocked natural pole-stands, the other simply applies some criteria of when to thin around individually selected trees without specifying a particular stocking rate – just working with what you have got.

Because of the variable nature of many forests, both approaches might be usefully applied to different areas within the same forest. Such 'free-style silviculture' will be particularly relevant to naturally regenerated forests and Close-to-Nature forestry practice. See video: still to come



Once potential crop trees have formed an acceptable bole, thin around them so they have space to develop large, healthy crowns, to drive growth.

1- Variable thinning in natural regeneration

This practice is typically adopted in Close-to-Nature, continuous cover forestry situations. It works with what nature has provided and involves individually selecting potential crop trees (sometimes called 'future trees' or 'frame trees'). These potential crop trees must be free of defects, healthy, with vigorous crowns, and capable of developing a suitable bole. They might be pruned, but otherwise their form and growth rate is managed by thinning when needed.

Once a good bole has been developed, the emphasis is developing large and healthy green crowns to optimise the diameter growth of their trunks. The criterion is simple: thin trees when their crowns start competing with the crowns of better-formed potential crop trees – i.e., when their branches touch

"Once a tree has formed a good bole, thin the trees around it when their crowns start to compete – i.e., when their branches touch".

This approach develops high-value, large-diameter trees, as quickly as possible, and with the least cost. It tends to result in lower final stocking rates than plantations systems that seek to optimise volume. In many European forests practising Close-to-Nature forestry, typically less than 150 'Future trees' are selected per hectare, and ultimately, after a series of production thinning harvests, they may end up with only 30-80 large-diameter, but very high-value trees/ha. Therefore, forest owners should not be discouraged if their forest appears to have poor stocking of potential crop trees. Work with what is there and thin to improve the forest for the future.

"Work with the forest you have and thin to improve it for the future."

Obvious cull-trees – trees with defects, can be thinned to free up space for new regeneration that can be managed to have better form and timber potential. Ring-barking non-merchantable trees can be a practical way to do this (see the section on ringbarking further below).

Some thinned trees will be small and thinned to waste. Others might be large enough to harvest as production thinnings. These should not have been pruned because there is unlikely to be sufficient clearwood outside the pruning stubs to have made the pruning a benefit (unless the diameter of the thinned trees exceeds about 45cm).

Note, that harvesting in natural indigenous forests is subject to the Forests Act, and Sustainable Forest Management Permits or Plans will require a nature-based approach to forest management.

"Free-style silviculture suits close-to-nature forestry"

In summary, prescriptive thinning schedules are not applicable to highly variable areas of natural forest. Individual trees should be selected as crop trees, or potential crop trees. Once they have developed a merchantable bole, thinning around them, to keep their crowns free, will optimise their growth. A variable thinning approach is well suited to managing mixed species, uneven-aged forests for multiple objectives.

See video: still to come

2 - Thinning schedules for tōtara plantations

In contrast to the variable natural forest situation described above, more systematic, and prescribed approaches to thinning could be applied to plantations of tōtara and areas of well-stocked pole-stand within natural forests.

Two thinning schedules are set out below. One is a more aggressive *prune and thin* regime, the other a more conservative and/or *unpruned* regime. They are both based on analysis of Stand Density Index (SDI), developed by the Northland Tōtara Working Group, as a practical basis to guide thinning intensities.

Both regimes seek to quickly achieve a site occupancy of 550 stems/ha with a mean trunk diameter at breast height (DBH) of 40cm. This maximises the opportunity for production thinning from this point onwards. From 50cm DBH a clear-fell harvest would be an option or continued selective harvesting.

The 400 *Pruned Regime* anticipates the harvest of up to 400 pruned trees/ha at a DBH of 50cm, or the progressive selective harvesting of those stems. The more aggressive thinning schedule of this regime aims to quickly grow the trees to a production thinning size of 40cm DBH. However, this may mean intensive pruning is required to maintain good tree form in the early stand development phase – and pruning is a significant cost.

In comparison, the *Conservative/Unpruned Regime* retains higher stocking rates up to a mean DBH of 25cm. This hopes to produce trees with better natural form and thereby either reducing or avoiding the costs of pruning. However, comparatively, it is also likely to slow growth rates in the early development phase.

"Aim to progressively reduce plantations to 550 trees/ha before the mean DBH exceeds 25cm".

Silvicultural prescriptions are always a matter of debate and personal choice. Popular schedules are refined and evolve over time and may still need adapting for site-specific use. The following schedules are not presented as the perfect prescriptions. They reflect a best attempt based on current research and considerations. Therefore, they are only offered as possible guides and may be revised in the future.

Implications for thinning of planted totara forests

Native forests are typically planted with a total stocking rate of between 2220-4440 stems/ha including the nurse species, but with the canopy-tree species interplanted at only 625 to 1250 stems/ha amongst the nurse cover. So, although early competition from the nurse or weeds may occur, competition between the canopy-trees species is unlikely to be significantly affecting growth rates until their mean DBH exceeds about 15cm, or 20-25cm, depending on the stocking rate they were planted at.

Therefore, the tables above suggest that apart from minor thinning work (e.g., - just enough to ensure that any pruned trees, or potential crop trees, are not being supressed or deformed by nurse species or non-crop trees), the thinning will mostly only involve the cutting of the nurse and weed species until the canopy tree species exceed at least 15-20cm DBH. This seems to support establishing tōtara plantations with nurse species that will be succeeded and shaded out and will not require physical removal by thinning.

Table: 1 - 400 Pruned regime:

(For production thinning of up to 150/ha unpruned trees starting at 40cm DBH, and then a clearwood harvest of up to 400/ha pruned trees from 50cm DBH)

DBH* cm	**Stocking** (after thinning) **Stems/ha**	**Approx. mean spacing*** m.**	**Action**
10	2100	2.2	Light release from nurse/weeds as required
15	1100	3.0	Thin to waste
25	550	4.2	Thin to waste
40	400	5.0	Production harvest of up to 150 unpruned trees (leaving up to 400 residual pruned trees)
50**	275	6.0	Harvest all 400 pruned trees - or leave 275 & continue production-thinning/selective harvests...
60	120-200	7.0- 9.0	Harvest all 275 trees – or leave 120- 200 and continue selective harvesting…

* Quadratic mean DBH

** N.B. – Harvest pruned trees from 50cm DBH if max. DOS does not exceed 16.5cm. Otherwise target harvest diameter at 3x max. DOS value (e.g., 60cm harvest diameter for 20cm max. DOS)

*** N.B. – Mean tree spacing is a guide only and does not need to be rigidly applied. Overall stocking per hectare is more important than even distances between trees.

Table: 2 - Conservative/unpruned regime:

(Production thinning/harvests of up to 550 unpruned trees starting from 40cm DBH)

DBH* cm	**Stocking** (after thinning) **Stems/ha**	**Approx. mean spacing*** m.**	**Action**
10	3,300	1.75	Light release from nurse?
15	2,000	2.2	Thin to waste
20	1250	2.8	Thin to waste
25	550	4.2	Thin to waste
40	400	5.0	Start of production harvesting up to of 150 trees (leaving 400 residual trees)
50	275	6.0	Harvest all 400 trees - or leave 275 & continue production-thinning/selective harvests...
60	120-200	7.0- 9.0	Harvest all 275 trees – or leave 120-200 and continue selective harvesting…

* Quadratic mean DBH

** N.B. – Mean tree spacing is a guide only and does not need to be rigidly applied. Overall stocking per hectare is more important than even distances between trees.

6. Ringbarking

Ringbarking can be a useful alternative to felling trees that are difficult or dangerous and/or likely to damage valuable adjacent trees or understorey if felled to waste. Other advantages include a slower exposure of the remaining trees to the increasing levels of light and wind than would occur if they were felled. This reduces the risk of windthrow and epicormic growths on the stems of residual crop trees. However, ringbarked trees become hazardous to be around until they have eventually fallen.

Stand improvement

Ringbarking is particularly useful in naturally regenerated stands where large-crowned, and poorly formed trees, with no merchantable timber value, often dominant and suppress adjacent but better-formed younger trees. Thinning by ringbarking can divert the growth to the better-formed supressed trees and help regenerate a forest with better potential for timber production.
See video: still to come

A pattern often seen in regenerated tōtara forests is a ring of pole-sized trees with reasonable form struggling to compete around the drip line of a large, heavily branched, and poorly formed, dominant tree. The larger branchy tree was probably established earlier and in more open conditions. It may even have been the parent tree. In such instances, ringbarking the large, poorly formed tree, enables the area it occupied to infill with new regeneration of seedlings and saplings that can be managed to have better form for timber production, and/or for increased species diversity within the forest. In many cases, the canopy gap created by ringbarked tree will be an ideal environment for new regeneration to naturally develop with good stem form.

"Ringbarking can be a quick and effective way to manipulate the structure of the forest – but it creates a hazard for many years".

Ringbarking is a quick and useful alternative to felling in some situations. Ringbarked trees usually take a couple of years to die and then slowly disintegrate over about a decade.

The disintegrating carcass of a ringbarked tree within a circle of better-formed poles. If it had been left, the poorly formed tree would have dominated this space.

The decaying tree (right of centre) was ringbarked approx. 12 years ago. It had dominated the canopy at the time and supressed the surrounding young trees in this area. However, now the growth is going into the adjacent well-formed and pruned trees, and more diverse regeneration is occurring in the gap. The decaying trunk has been a nesting site for kingfishers over many years.

A new tōtara sapling growing against a ringbarked stem. Regeneration within this canopy gap could be managed to have better form than the tree it is replacing.

Method

Trees with a short section of single trunk, can be ringbarked with a chainsaw. Two parallel horizontal cuts should be made between 100 and 200mm apart, around knee height, and deep enough to ensure the sapwood layer is severed (usually 60 to 150mm deep depending on the size of the tree and its crown). When the tree is actively growing, and the 'sap is flowing', the band of bark between the cuts can be easily levered off with the plug spanner from the chainsaw belt.

Safety hazards with ringbarking

Multi-stemmed trees that branch from ground level may be too impracticable and dangerous to ringbark. At all times ensure only safe and responsible practices are implemented. Ringbarked trees will often take a couple of years to die and a decade or more to disintegrate or fall. It will be hazardous to be within two tree lengths of ringbarked trees until they have fallen to ground. Warn any forest users of the hazard and suspend all forest activities in the vicinity of ringbarked trees as long as the hazard exists. Never attempt to fell a ringbarked tree.

Two parallel cuts through the sapwood band and removal of the bark will ensure a successful ringbarking.

7. Planning of thinning operations

Surveying the forest before thinning

For naturally regenerated tōtara forests, thinning will mostly be a case of responding to what is found at a micro-spatial and individual tree level. This contrasts with even-aged plantations and areas of relatively consistent pole-stands of regenerating tōtara. For the latter, a decision on when to thin in such areas should be guided by a forest inventory – involving at least the measurement of the mean DBH and stocking of the forest, (ideally also the height/diameter ratio). And how much to thin should be guided by a thinning schedule (such as one of the schedules offered above).

Forest inventory

Forest inventory is a quite a specialised task. For large plantations it may be best to be conducted by a professional forester. However, some farm-foresters will have the basic knowledge, equipment, and skills to make suitable assessments themselves. And there are publications[1] that could guide forest owners and managers on how to survey their forests to determine values such as mean DBH, DOS, tree height, and stocking etc. Mean DBH and stocking are critical values needed to apply a thinning schedule.

It is also useful to be able to do some quick sample plots in the field when conducting thinning operations to check/calibrate work in progress or to respond to variation within the forest (see Quick Sample Plots under Practical Tips further below).

[1] For example: Bergin, D. 2009: Assessing regenerating totara on the farm. A preliminary guide for landowners in Northland. Contract Report for the Northland Regional Council (Envirolink 516-NLRC). Contract Report (unpubl.). Scion, Rotorua. 27p.

Forest inventory is needed to determine mean diameter at breast height (DBH) and stocking rates, to guide and check thinning.

Health & safety

Thinning is chainsaw work and dangerous. Moreover, tree felling is a notifiable activity (to Worksafe NZ) and thinning for forestry purposes will mean the forest is defined as a Work Place. Responsibility lies with the forest owner and manager to inform themselves of any and all relevant Acts, regulations, Approved Codes of Practice etc., and to ensure that they are applied and complied with.

The topic of health and safety management is highlighted here as an essential matter to be considered and addressed in the planning and carrying out of any thinning work; however comprehensive coverage of the matter is not attempted here.

Useful information may be found on the following websites and links:

Work Safe:

https://www.worksafe.govt.nz/topic-and-industry/agriculture/tree-work-on-farms/managing-a-safe-and-healthy-small-forest-harvest

NZ Farm Forestry Association:

https://www.nzffa.org.nz/farm-forestry-model/the-essentials/health-and-safety/small-scale-forestry-safety-guidelines

Regulatory impediments

Queen Elizabeth II National Trust, or other bush protection covenants, may preclude thinning within covenanted forest areas.

Regional and District Plans may also have rules that could affect thinning activities within bush on private land – especially if the forest area is mapped as a Significant Natural Area (SNA) or other designation such as an Outstanding Landscape Area etc. The planning maps and rules should be checked when planning a thinning operation, and if necessary, a phone call to the duty planner at your local council should give definitive advice at no cost.

Thinning under part 3A of the Forests Act

Planted indigenous forests are not subject to the Sustainable Forest Management requirements of part 3A of the Forests Act. And thinning to waste in a natural forest does not trigger the involvement part 3A of the of the Forests Act. A Sustainable Forest Management (SFM) Permit or SFM Plan is not required to undertake thinning unless the thinned trees will be milled.

In native forests that are already subject to a SFM Plan under part 3A of the Forests Act, thinning may be specifically provided for. However, such silviculture will still need to at least maintain the starting range of forest's species and natural amenities. This will be easy in many of the highly modified and often almost mono-cultural tōtara stands that have regenerated on farmland. Thinning is likely to help an understory to develop and enhance species diversity in those forest types. However, in more diverse and natural forests, the effects of thinning on species composition and forest structure will need careful consideration. Retaining non-commercial native species for biodiversity and natural values is important.

Trees with trunk diameters of 30cm and above, may be classified as 'merchantable' under part 3A of the Forests Act. Depending on the specifics of your SFM Plan, any thinned merchantable volume may need to be accounted for as harvested volume.

8. Practical tips

The following practical tips may be useful.

Dos and Don'ts

Do:

- **Delay** thinning until weeds and lower branches start to die off and enable access.
- **Schedule** thinning before the green crowns of potential crop trees are supressed (i.e., less than one third of tree height).
- **Prune** before thinning.
- **Apply and obtain** legal approval (e.g., SFM Plan under the Forests Act) before felling trees if production thinning.
- **Notify** Worksafe that tree felling work will be done.
- **Assess and mark-up** trees before picking up the chainsaw! Mark-up the trees to stay.
- **Gradually reduce stocking** over multiple thinning operations to reduce risk of wind throw.
- **Start** felling at the bottom of hills and directional-fell trees into gaps.
- **Free** the trunks of remaining trees from hang-ups, and slash from felled stems especially if under tension.
- **Cut woody weed species** at the same time.
- **Consider i**f ringbarking instead of felling would be appropriate and advantageous.
- **Be flexible** and respond to localised natural variation and values within the forest.

Don't:

- **Don't** apply recommended tree spacing too rigidly. The overall stocking per/ha is more important than even spacing between trees.
- **Don't** leave slash in watercourses.
- **Don't poison** cull tōtara trees - because they may be 'root-grafted' to adjacent tōtara trees.
- **Don't work alone** - but ensure workers are always at least two tree lengths apart when felling.

Quick sample plots

5.64m radius plots

In areas of highly stocked regeneration, sample plots with a 5.64m radius are easy to apply in the field. These can be useful to quickly get a rough indication to check stocking rates. A measuring tape can be tied to a sapling or stake (an electric fence standard is ideal) and used as temporary 'plot centre'. Holding the tape near horizontal, can usually avoid needing to adjust the radius to account for the slope of the ground. A count of the relevant stems within a 5.64m radius can be easily converted to a per hectare stocking rate simply by multiplying the number of stems within the plot by 100 (– e.g., 15 stems in plot equates to 1,500 stems/ha). However, if there are less than 5 or 6 stems in the plot, then a larger radius should be used to get a more accurate estimate.

See video: still to come

9. Conclusion

Thinning can be a very effective silvicultural intervention to enhance the timber production potential of a tōtara forest. Its purpose is to promote quick growth of the potential high-value crop trees, at their maximum stocking, while maintaining just enough competition from other trees to encourage the development of tall boles on the crop trees. It can also help manage other forest values such as stand stability, species diversity and composition.

Various criteria have been outlined above to help decide when, and to what degree, thinning should be carried out. For planted tōtara forests and areas of natural regeneration that have a plantation-like structure, the two thinning schedules based on recent tōtara research using a Stand Density Index approach, may be useful guides to thinning for timber production. For highly variable natural forests, thinning must work with what is there, but it is also an opportunity to initiate new regeneration and 'renovate' areas of poor-quality forest.

Thinning should always be carried out with all relevant management objectives in mind and be flexibly applied in response to localised variations, features, and competing values within a forest. It needs to be well considered, well planned, and safely executed. However, if done well, thinning will significantly enhance a forest's potential for timber production and other values. It is usually the most effective silvicultural intervention. However, the economic case for thinning tōtara forests has not been evaluated.

Thinning is hard physical work, but it can also be gratifying work too. You get to see some instant effect for your effort, as well as the pleasure of observing the more gradual changes that it sets in train. Go on - sharpen your chain!

"And remember, not every tree should be thinned or culled from the forest just because it may be unsuitable for timber production!"

Useful links

The Forests Act

For information on harvesting and milling of any natural native forests contact Te Uru Rākau New Zealand Forest Service.

https://www.mpi.govt.nz/forestry/native-indigenous-forests

Videos still to come

Close-to-Nature forestry practice

Ringbarking

Variable thinning approach

Quick smaple plots

Safety and Health

Work Safe:

https://www.worksafe.govt.nz/topic-and-industry/agriculture/tree-work-on-farms/managing-a-safe-and-healthy-small-forest-harvest/

NZ Farm Forestry Association:

https://www.nzffa.org.nz/farm-forestry-model/the-essentials/health-and-safety/small-scale-forestry-safety-guidelines/

For more information on managing tōtara, see the Northland Tōtara Working Group pages on the Tane's Tree Trust website:

https://www.tanestrees.org.nz/about-us/northland-totara-working-group-ntwg/

To join the Northland Tōtara Working Group (NTWG) visit (membership is free):

https://www.tanestrees.org.nz/about-us/northland-totara-working-group-ntwg/join-ntwg/

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