

HARVESTING TŌTARA

A Practical Guide to Managing
Tōtara on Private Land

By Paul Quinlan, 2022.

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1. Introduction – is harvesting tōtara okay today?

Legendary and divine status

Tōtara – A natural and cultural history is the title of the consummate book on tōtara by Philip Simpson. As the title indicates, tōtara is a legendary pillar of our environment and cultures. The book relates how for Māori, tōtara has divine status as the first big tree created by Tāne following the separation of Ranginui and Papatūānuku and how it is deeply interwoven through a wealth of cultural traditions and part of our combined cultural heritages. It also relates how tōtara is associated with the big win for the conservation movement, with the treetop sit-in protests saving tōtara stands at Pureora, which ultimately led to the end of native logging on state-owned land.

Nowadays it would be sacrilege for anyone to suggest a return of logging to the public conservation estate. And, thankfully, this protected status is unchallengeable.



Others would go further and contend that a sustainable native timber industry will do more to encourage the planting and management of more native forest in our primary production landscapes.

Contemporary views on harvesting

With all this hallowed background it is no wonder that many people ask if you are even still allowed to cut down tōtara anymore? The short answer is yes – but only on private land, (and the various legal processes will be outlined further on). But really, the first question should be is it even appropriate to still be harvesting tōtara today?

In the final statement of Philip Simpson's book, he sets out a plea for the conservation of tōtara, however, it also states his 'support for the development of a sustainable timber industry based on second growth [i.e., the forest resource regenerating on previously cleared or logged land and new planted forests]'. This may recognise that, in some situations, sustainable harvesting can be compatible with conservation, at least at a landscape scale. Or perhaps it just affirms the valuable cultural connections to the forest that come with some continued ability to use native timber.

Actions an expression of values

Either way, **appropriateness** of any harvesting depends on a range of considerations sensitive to both the site and the wider landscape context - and ultimately, at the individual tree level. It is a question of far more than just legalities because forests, especially native forests, are always far more than just wood. Our actions and forestry practices inevitably reflect and express our attitudes, values, and relationship to nature. In many instances, yes, harvesting tōtara and other natives will be okay. However, such decisions and actions should always be made with full reverence, cognisant of the mistakes of the past, and considerate of present and future generations.

Harvest is an opportunity to demonstrate that we can do things right. It can express both restraint and respect.

2. The legal situation

Fortunately, there are legal provisions under the Forests Act 1949 to enable the harvesting and milling of native trees on private land. Several other sets of legislation may also apply to the actual harvesting operation. These include the Resource Management Act 1991 (RMA), the Health and Safety at Work Act 2015, and the Forest and Rural Fires Act 1977. And there may be others.

While some aspects of the current regulations are commented on in this section, no attempt to comprehensively cover all relevant legal and regulatory aspects will be made here. Responsibility lies with the readers to inform and update themselves on all legal matters. And this chapter will not replicate what can be found out from the official channels such as the content and process of preparing a Sustainable Forest Management Plan and Permit applications, etc. Nevertheless, a brief outline, some useful links, and some specific comments on the current legal situation are offered below.

Main contacts for advice on rules and regulation include:

The Forests Act

For official information and advice on all matters to do with the legalities, provisions, and processes of harvesting and milling timber from indigenous forests and trees – planted or natural, contact:

Te Uru Rākau New Zealand Forest Service:
<https://www.mpi.govt.nz/forestry/native-indigenous-forests>

The email address of the Indigenous Forestry Team is: indigenous.forestry@mpi.govt.nz

Useful downloadable resources on this website include guides on how to estimate and measure merchantable volumes of trees and logs for indigenous species.

Resource Management Act

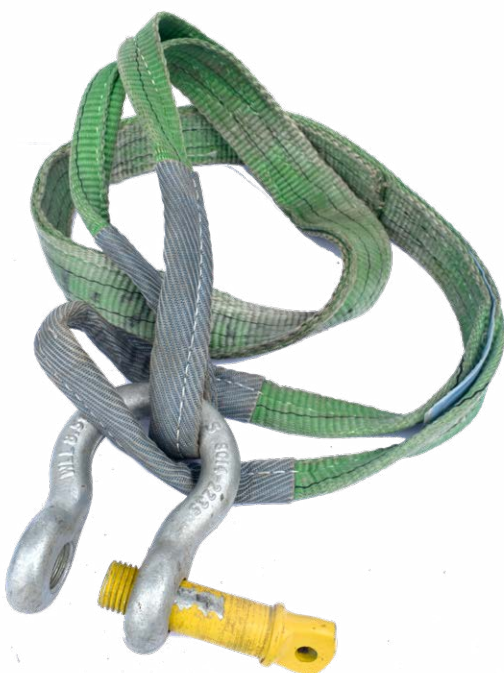
Regarding the RMA and potentially relevant local rules and consent processes, refer to the maps and relevant sections of your respective district and regional plans. Official advice from a duty planner at your respective district/ regional Council is usually provided free of charge.

Safety and Health

In relation to Health & Safety matters, please check your obligations with WorkSafe - Mahi Haumarū Aotearoa: <https://www.worksafe.govt.nz>

Tree felling is a notifiable work. And the WorkSafe website has information, links, and downloads, on many aspects of 'Tree Work' including planning and managing small harvests and safe manual tree felling etc. Some relevant Approved Codes of Practice (ACOPs) are also available. These include:

- Safety and Health in Forest Operations:
<https://www.worksafe.govt.nz/topic-and-industry/forestry/safety-and-health-in-forest-operations>
- Safety and Health in Arboriculture:
<https://www.worksafe.govt.nz/topic-and-industry/forestry/health-and-safety-in-the-arboriculture-industry/safety-and-health-in-arboriculture>



The Forests Act

The purpose of Part 3A of the Forests Act “is to promote the sustainable forest management of indigenous forest land”. However, planted, as opposed to naturally established native forests, are treated differently under the Forests Act.

Planted native forests are exempt from the sustainability requirements of the Forests Act

In short, planted indigenous forests are not required to be harvested sustainably under the Forests Act. In other words, they can be clear-felled just like an exotic woodlot - if the owners choose to do so. Indeed, owners can have their planted native forests certified by Te Uru Rākau, as Planted Indigenous Forests. This will exempt those planted forest areas from being subject to the sustainable management requirements of the Act that otherwise apply to indigenous forests on private land.

However, there are still some obligations for record keeping, etc., to ensure that the timber is legally milled, so it can be legally sold. The milling of any native timber involves the Forests Act even from planted indigenous forests.

“Planted tōtara forests can be harvested like exotic woodlots – but the milling of the timber still involves the Forest Act”

The relative freedom from legal encumbrances for planted native forests will be reassuring for many landowners interested in some long-term timber production. Fear of legal impediments and not being allowed to harvest, has been a disincentive for many landowners contemplating planting native forest, or allowing natural reversion.

Having your planted native forest areas certified and mapped by Te Uru Rākau as a Planted Indigenous Forest, keeps the harvesting options open. Forest owners or managers can still choose to apply continuous cover forestry practices when the time comes.

Natural forests must be sustainably managed

In contrast, harvests from non-planted native trees and forests (i.e., remnants or naturally regenerated forests/trees) are more strictly controlled by Te Uru Rākau - The New Zealand Forest Service (the division of the Ministry for Primary Industries that administers Part 3A of the Forests Act 1949).

Sustainable harvests of indigenous forests on private land are possible via Sustainable Forests Management (SFM) Permits, and SFM Plans. These allow the harvest of indigenous timber at a rate that is no greater than the forest’s ability to replace the harvested timber. At the same time, the forest must retain its natural values and ability to continue to provide a full range of products and amenities in perpetuity. The management of the forest must protect the forest’s flora and fauna through the control of pests and weeds, and through the maintenance of soil and water quality.

There are also some minor miscellaneous provisions in the Act for harvesting and milling small quantities but where sustainability is not a focus (e.g., salvaging dead trees, trees cleared for fence lines, or tracks, etc., or some timber for a landowner’s personal use but not for sale, etc.).

Sustainable harvests under the Forests Act

Sustainable Forests Management (SFM) Permits, and SFM Plans allow:

The harvest of indigenous timber at a rate that is no greater than the forest’s ability to replace the harvested timber. At the same time, the forest must retain its natural values and ability to continue to provide a full range of products and amenities in perpetuity. The management of the forest must protect the forest’s flora and fauna through the control of pests and weeds, and through the maintenance of soil and water quality.



SFM Permits and SFM Plans

Generally, commercial timber harvesting from existing tōtara forests will involve a SFM Permit, or a SFM Plan. The difference between the two is that SFM Permits are simpler, cheaper, and could often be done by the landowner themselves. But they only crudely effect sustainable management. They only have a ten-year life and were really intended for one-off harvests.

In comparison, SFM Plans are more sophisticated. They require greater levels of forest inventory and more detailed forest management prescriptions based on an ecological understanding of the forest. They have a minimum term of 50 years (and can be much longer), and therefore also provide greater protection for the forest as well as enabling ongoing sustainable harvesting.

Although SFM Plans generally cost more than Permits, they should be the preferred option in most instances. They are the only provision to adequately ensure sustainable management and secure confidence in long-term sustainable timber supply. The latter should be important for the landowner and is essential for the development of a sustainable tōtara timber industry.

“SFM Plans should be preferred over SFM Permits”

Farm tōtara – a square peg in a round hole

Unfortunately, many naturally regenerated tōtara forests, particularly on farms, are an awkward fit for the SFM Plan provision of Part 3A of the Forests Act. This part of the Act applies to all native forests, but it was designed and intended for application to discrete areas of remnant native forest. The authors didn't envisage the highly modified, highly variable, sporadic, and spreading, areas of regenerating scrub and tōtara forest on previously cleared land – especially within farmland. Consequently, many tōtara forests are only awkwardly accommodated within the SFM Plan and Permit provisions of the Forests Act. Nevertheless, it can be done.

The Northland Tōtara Working Group has worked with MPI on developing and trialling templates for tōtara SFM Plans, to address those difficulties and reduce the cost and time associated with applications.

Arguably, regenerating tōtara forests on previously cleared land should have a specific provision under the Act. One that better suits the nature and characteristics of the resource. However, that would require an act of parliament to change the legislation. While that may occur one day, it doesn't seem to be a topic of political interest at present. But at least we still have some legal provisions that can be made to work – even if clunky, costly, and very time consuming.

Encouraging SFM Plans

Landowners should be encouraged to prepare and register SFM Plans over their developing tōtara forests. The benefits include securing the legal right to long-term sustainable timber harvesting. It can also help reconceptualise immature reverting scrub areas as valuable developing native forest and affirming that as the land use. This in turn, should encourage greater care, tending and protection of these areas. Furthermore, for the development of a viable tōtara timber industry, it is essential to have confidence that a commercially scaled, sustainable resource, is available and has legal market access.

The collective scale of the tōtara resource across multiple properties is a significant feature. Ultimately, SFM Plans will be the basis of any collective management/processing of the tōtara resource and its marketing, to the advantage of the landowner and industry (e.g., Co-ops etc.).

SFM Plans secure the sustainable management of native forest areas on private land. Therefore, they should be recognised as helping to fulfil obligations of appropriate environmental management, for example, as part of Farm Environment Plans and Significant Natural Areas (SNAs), etc.

“Landowners should be encouraged to prepare and register SFM Plans over their developing tōtara forests. The benefits include securing the legal right to long-term sustainable timber harvesting.”

“For the development of a viable tōtara timber industry, it is essential to have confidence that a commercially scaled, sustainable resource, is available and has legal market access.”

Costs of a SFM Plan

Presently there is no processing fee for a SFM Plan application. However, there are still significant costs involved, and the process takes considerable time – allow at least 6 months and more likely a year. For most landowners, a forestry consultant will be required to help prepare a SFM Plan application.

Once approved by MPI, a SFM Plan still needs to be registered on the land title/s. While some conveyancers can economically provide this service for less than \$300, many people prefer to use their lawyer at greater expense. In addition, an Annual Logging Plan is also required for approval before any harvest can commence. In addition, record keeping during and after harvest is required. However, these are relatively smaller costs.

The total costs of SFM Plans vary considerably. The field inventory work is the biggest variable. The size of the forest and its characteristics will significantly affect the relative cost. It is probably unwise to try and attempt an indication of likely costs. However, two tōtara specific SFM Plans completed and registered in recent years revealed costs ranging from the equivalent of around \$300/ha for a 50ha forest area, to \$600/ha for a 12ha sized forest. Clearly there are economies of scale at play. But perhaps more useful information is that, in theory, the stumpage value of around three to four years' annual harvest allowance could recover the respective costs of each of those SFM Plans.

Indeed, in one case, that was done. A mean stumpage value of \$200/m³ meant that 80 m³ of logs - nearly four year's annual harvest allowance - covered the costs of setting up the SFM Plan. Future harvests do not involve repeating that cost. However, that forest was already well-stocked with merchantable-sized trees.

In summary, there are significant expenses involved with obtaining a SFM Plan for tōtara dominant forests. And while every forest will be different, for many tōtara forests it is reasonable to expect that, in time, those costs could be recouped via income from harvests. This could even be in the first harvest via the provision to allow 'periodic harvesting' whereby up to 10 years' worth of annual harvest allowance may be harvested in a single operation.

Tax implications

Questions have been raised regarding potential tax implications arising from a SFM Plan changing what has traditionally been considered 'worthless' scrub or bush, into a forest that is accruing a valuable

stock of trees. Unfortunately, we do not have any expert knowledge or advice on any potential taxation implications. Landowners should seek qualified advice on that matter.

The Resource Management Act applies via Regional and District Plans

Obtaining approvals to harvest under the Forests Act does not override any other regulations that might also apply. In particular, the Resource Management Act (RMA) also applies and might have implications for harvesting from native forests on private land. This will primarily be through the maps and rules of the respective regional and district plans. These plans need to give effect to the RMA and National Policy Statements, etc.

Therefore, it will be important to check the planning maps to establish if the forest area is within an Outstanding Landscape Area, or Significant Natural Area (SNA), or captured by any other notation to which special rules may apply. Also check general rules pertaining to indigenous vegetation within the given zone.

In some district plans, harvests of indigenous trees under the MPI approved provisions of the Forests Act have had the explicit status of "Permitted Activity". Other district's plans have simply not addressed the matter. And, unfortunately, in some districts, or within certain mapped areas, such as Significant Natural Areas (SNAs), a Restricted Discretionary Consent process is stipulated.

District plans typically have a ten year life. So, the given situation can also change with each review. Naturally, the uncertainty around this created by some district plans, and the potential extra costs and time, is a worrying disincentive for many landowners considering sustainable native forestry.

At the time of writing this chapter, a Draft National Policy Statement on Indigenous Biodiversity has been put on hold for the time being. However, such policy documents are to be given effect through regional and district plans. Requirements for those local authorities to map sensitive landscape areas such as SNAs and apply rules to protect indigenous biodiversity and the environment, may have implications for harvests under SFM Plans and Permits unless they are explicitly afforded "Permitted Activity" status. Landowners should make submissions on such matters whenever a District Plan review and consultation process occurs.

Summary of legal situation

Disincentives exist but plenty of reasons for optimism

At present there are some difficulties, significant costs, and ongoing record-keeping obligations associated with SFM Plans to enable the sustainable harvesting of tōtara from natural forests. Furthermore, there is uncertainty around potential restrictions, additional costs, and processes, imposed by district plans on the activity. The combined effect of these disincentivises native forestry for many landowners. This is a frustrating and perverse situation given that sustainable native forest management is comparably one of the most benign and desirable land uses – indeed, a land use that should be encouraged. However, it is important to keep these matters in perspective and to acknowledge that some regulation is not only inevitable, but also desirable. For it is vital that any native forest industry has robust sustainability credentials.

Ultimately, some regulation is necessary and should be a positive safeguard, to the benefit of all stakeholders in the native timber industry. However, fine-tuning and adjustment of regulatory controls is needed and likely to be a continual process of evolution.

Hopefully landowners can take a philosophical view on this and not be put off by the current imperfections of the regulatory situation. These can be worked on and changed. Government agencies are aware of many aspects that need addressing, and, importantly, policymakers are generally supportive of encouraging indigenous forestry. This augurs well for the development of a more conducive regulatory environment for native forestry generally.

With this optimistic view, perhaps landowners can take heart from knowing that their trees will keep on growing regardless of the regulatory situation at the present – the rules will have to catch up, and they can. It is reasonable to proceed and start sustainably managing native forests now. There is legal provision to do so, and public support for sustainable native forestry is likely to increase. Furthermore, many other land uses, including plantation forestry, are likely to encounter increasingly difficult regulatory controls.



Therefore, in summary:

- There are legal provisions (under Part 3A of the Forests Act) to enable the harvesting of tōtara on private land.
- Sustainable Forest Management (SFM) Plans under the Forests Act and registered on the land title are recommended to secure long-term management rights and outcomes.
- Significant costs and time are involved with obtaining a SFM Plan. However, those costs may be recovered, over time, through harvests.
- The regulatory framework maybe subject to changes in the future.
- Indications are that policymakers are becoming more supportive of native forestry in principle, and aware of the need to encourage it as a land use by creating a more conducive regulatory framework.

“Trees keep growing regardless of regulations. Sustainable management is really doing the right thing - the rules can catch-up later.”

3. Sustainable harvesting concepts

More than just timber

The majority of tōtara harvests will involve naturally regenerated trees and forests on previous cleared land, or 'second-growth' in cut-over bush, or from remnants of older bush. The nature and characteristics of these forest types will vary hugely. Yet, they are all subject to Part 3A of the Forests Act, which promotes an ecosystems-based approach to forest management. This allows a sustainable timber yield, while at the same time requiring the protection of the forest, retention of its natural values, and the maintenance of soil and water quality.

Many tōtara forests are highly modified, such as the almost mono-cultural stands of branchy tōtara seen in paddocks on Northland farms. Nevertheless, the Act still applies, although its requirement to retain the forest's natural values raises many questions. What are the 'natural' values of such modified forest types? What characteristics are to be retained? A pragmatic approach is simply to aim higher than mere maintenance and instead seek to improve the ecological and other non-timber qualities to be more like a natural (less modified) native forest for that area – even if this is slightly at odds with the stipulations of the Act.

Fortunately, management criteria for a sustainable timber yield are more straight forward.

Forest inventory and harvest rates

Sustainable timber yields are determined by calculations. These are based on field measurements of sample plots from within the particular forest (known as a forest inventory). These are used to estimate the total standing volume of merchantable tōtara logs within the forest. They also provide a profile of the size-classes of the tree population (i.e., relative numbers of seedlings, poles, and trees of different sizes). Then, taking into account factors such as natural mortality, regeneration, and recruitment, etc., the forest's likely mean annual growth increment (for standing merchantable volume) is modelled. And a sustainable harvest allowance is set at a rate less than that at which the forest grows, ensuring the volume of the harvested trees will be replaced by the growth of the remaining forest.

Permanent sample plots (PSPs) should be set up within the forest to enable periodic remeasurements to prove the allowable harvest is accurately indexed to the specific forest's growth rate. PSPs also help monitor other changes within the forest over time.

While, in theory, sustainable management is all very measurable, in practice, the natural variation within natural forests makes obtaining an accurate inventory of the tree stocks very difficult. Consequently, a conservative approach to the setting of allowable harvests by Te Uru Rākau (MPI) usually results. It also highlights the reality that sustainable forest management is really a bit of blend of art and science.

Forest management systems

The Forests Act prescribes a selection-system for all podocarp tree species, based on single-stems or small groups (defined, in the MPI guidelines, as 3-5 trees). This is similar to international forest management concepts variously known as **selection forestry and irregular shelterwood systems**. These come under the broader umbrellas of terms such as **close to nature forestry, near-natural forestry, and continuous cover forestry**. Effecting sustainable management is the common objective and some key general principles include:

- The forest is permanent and for long-term, intergenerational benefit.
- Multi-purpose forest management (i.e., it is not just about timber, but all forest values).
- No large clear-fell harvest areas.
- Working with nature – adopting an ecosystems management approach (e.g., utilise the advantages of natural features and processes such as natural regeneration).
- Maintain or create a full and healthy population profile of the target tree species in all size-classes (i.e., sufficient stocks of seedlings, saplings, poles, and immature trees for selection and as 'recruitments' to replace harvested trees).
- Leave some large old trees for wildlife and habitat value.
- An adaptive management approach is necessary, based on measuring and monitoring changes and trends within the forest.

"Native forests have multiple values. They are not just about timber – it is about managing an ecosystem."



3 years after a tōtara harvest in this forest reveals abundant new puriri seedlings in the light-wells around harvested stumps.

Basic principles

More specifically, and regarding sustaining a timber yield, basic principles include:

- Harvesting at a rate no more than the forest can naturally replace itself at – or in the case of young developing forests, at a rate less than the annual net growth increment of the forest, so the timber resource increases to its optimal stocking.
- Not harvesting only the best trees. That would be ‘creaming’ or ‘high-grading’ the forest and over the long-term will rundown the quality of the forest. It would be equivalent of a farmer selling all the best breeding stock and keeping the culls.
- Treating harvest as a silvicultural intervention for stand improvement (e.g., production thinning). Where feasible, target the poorer trees for harvest and removal from the forest – leaving the better ones to grow on, to become higher-value saw logs.
- Harvest mature trees when they reach the point where keeping them longer would not greatly improve their value, and/or they are at increased risk of internal degrade from fungi, etc.

Plenterwald

The single-stem, or small group selection approach stipulated by the Forests Act, is similar to a German forest management approach that results in a mixed species, mixed age and mixed size-class forest structure known as Plenterwald. Harvests in such forests keep targeting the poorly-formed trees so, over time, the forest becomes fully stocked with well-formed, high-quality, large-diameter trees, but also has the full range of size-classes from seedlings upwards, and all in close proximity to each other. However, this selection system best suits shade-tolerant target species.

Adaptive management

Tōtara is a light-demanding, pioneer tree species. At this stage, we cannot be certain that single-stem selection systems will create sufficient light gaps to ensure long-term natural regeneration of tōtara seedlings. It could be that single-stem selection just ekes out the tōtara resource, and ultimately results in forest succession to more shade-tolerant species. Only time will tell. This highlights the importance of monitoring, modelling, and adaptive management.

If sufficient natural regeneration is not occurring, then larger disturbance areas created by the small group selection system may be needed. But, if gaps and light-wells become choked with ferns, shrubs, or weeds, then some active interventions, such as weed control, or planting, may also be required. More tōtara specific research will eventually inform on such matters and help refine recommended management systems and prescriptions. In the meanwhile, harvesting from natural forests must follow the dictates of the Forests Act – and our best efforts in appropriate stewardship.

“Work with nature and develop an intergenerational legacy”.

Plantation tōtara

Planted tōtara are exempted from the sustainable management requirements of the Forests Act. They could be clear-fell harvested like an exotic woodlot. While this freedom should be kept, it is not the only management option. The forest owner might choose to harvest using a continuous cover forestry system.

This could range from clear-felling small areas or coupes at a time, to the type of single-stem or small group selection system mentioned above.

4. Tree selection

Wise selection of the harvest trees is probably the most critical factor to ensure truly sustainable forest management, followed by careful felling and extraction.

Harvest as silviculture

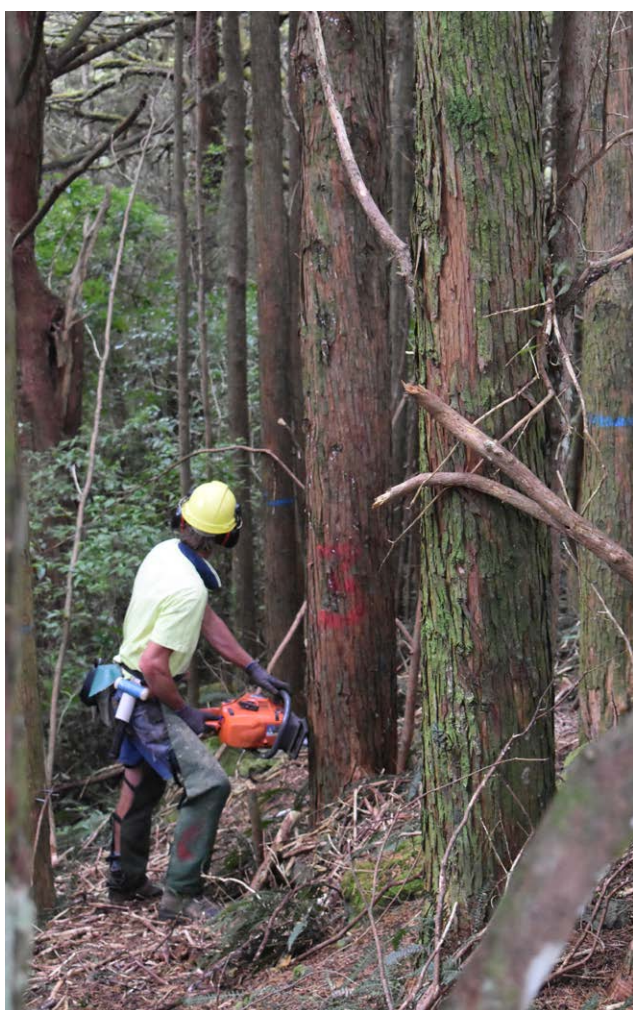
Perhaps the ideal approach to harvesting would be to treat harvest as silviculture – more specifically, as a production thinning intervention – i.e., targeting the poorest trees and leaving the best ones to grow on to increase in size and value. In theory, if that were followed, eventually, there would only be good trees left to choose from. However, in practice, there are often many poor trees with little or no sawlogs of merchantable value and targeting only the poor trees may not be economically viable. Therefore, harvest tree selections may need to include some premium grade trees with more valuable sawlogs too. Nevertheless, the emphasis still needs to be on making wise selections to ensure responsible long-term forest management.

“Harvest should be considered silviculture – it should be tending the forest.”

Focus on what is left behind

What is left behind is more important than what is taken. ‘Creaming’ the best trees must be avoided. There is a saying: “wood only grows on trees” and good wood only grows on good timber trees. If they have been removed, then where is the wood growing and what quality will it be? Appreciable quantities of high-value heartwood are only found in old large tōtara trees. Regular harvests of high-value tōtara in the future, will rely on leaving enough good quality trees to grow on and become the premium-quality heartwood trees of the future.

“Identifying the trees to keep helps select the trees to harvest.”





Identifying the premium trees to stay

European close-to-nature forestry systems typically identify those potential premium ‘future trees’ and harvest any trees around them if they compete with them. The future trees or frame trees are potentially high-value crop trees often grown to large-diameter veneer-grade logs. They are eventually harvested at a diameter of maximum value. Getting them to that size and quality as quick as possible is a management objective – but it may take 150-240 years!

For tōtara in Aotearoa, the equivalent may be identifying trees that have the potential to produce clear heartwood, or become premium carving logs, even waka. Identifying the best trees to stay, is one way of helping to decide which trees to harvest.

Obvious opportunities

Fortunately, it is often possible to find instances where two or more trees with reasonable quality sawlogs are located close together, and removal of one or two of them could be like thinning, and to the advantage of the ones left behind. Often the larger-diameter trees have shorter and knottier boles and large crowns, and their removal may be to the advantage of skinnier, but taller-boled trees, that if freed from competition, have the potential to develop equal or better-quality sawlogs. In such instances, appropriate selection of the harvest trees could help increase the mean bole height of the forest and ultimately increase the timber volume and value in the forest.



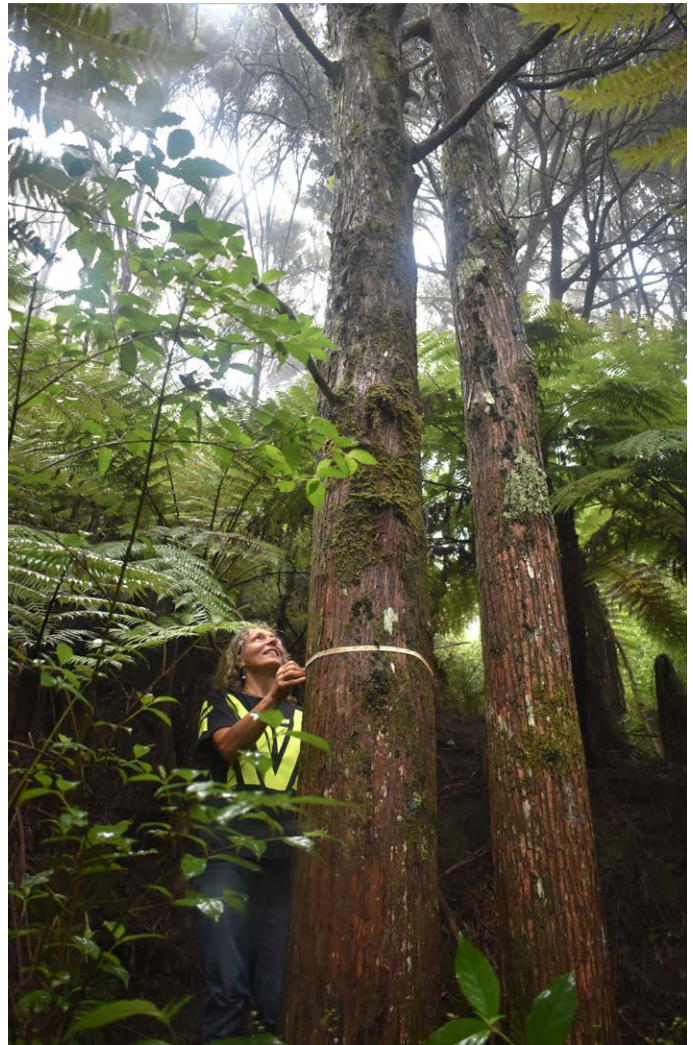
Two excellent trees side by side. But the tree on the right has some dead spike branches. Harvesting that tree would enable the tree on the left, which has an even better, branch-free bole, to grow larger, faster, and become even more valuable.

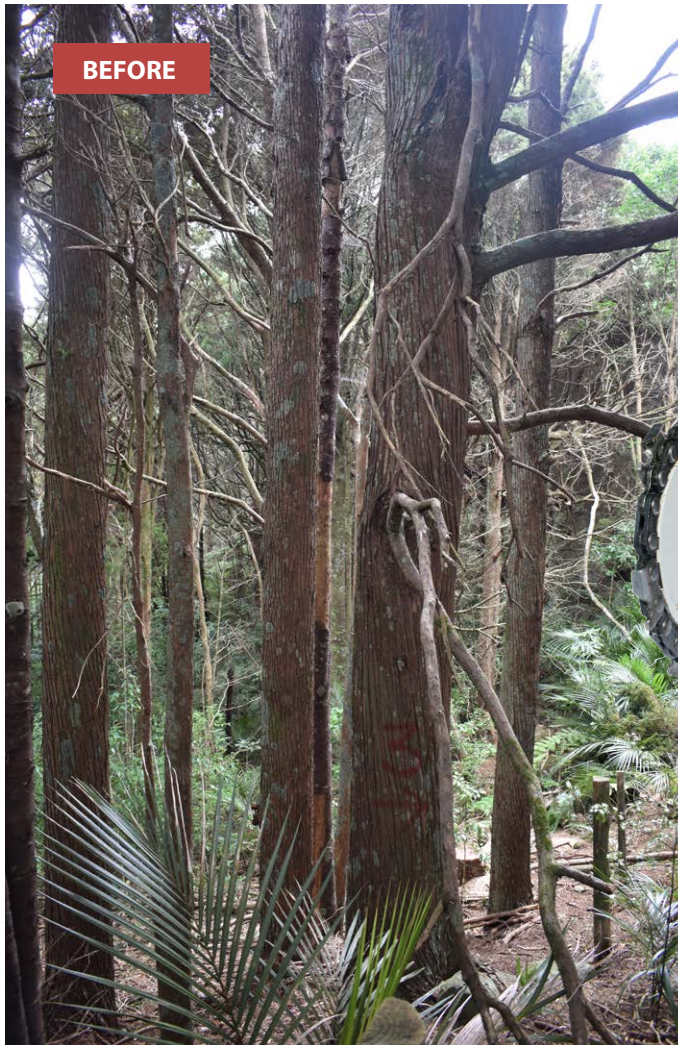
In other situations, it may be advisable to take all of a small group of trees. For example, where all the trees have some merchantable sawlog volume, but none have potential to become excellent timber trees. Or where felling one tree is likely to damage the adjacent trees, or for safety reasons.

In these instances, harvest removes trees of poor/mediocre timber-quality and creates a canopy gap within which natural regeneration might restock that area with new trees that could be managed to have better timber potential.

Right: Some harvest tree selections are easy to make. In this case, harvesting the tree with the shorter, fatter, and branchier trunk, will be to the advantage of one left behind, which has a potential to become a more valuable timber tree. It has a taller, and less branched bole, but a suppressed crown.

Below: In some areas only poor and mediocre trees are present. Leaving them to grow on will not increase their value. Harvesting such trees, as a small group, may create the opportunity for natural regeneration to replace them and restock this area with young trees that could then be managed to have better timber quality.





Left: A dense group of merchantable sized totara trees before harvest using a production-thinning approach.

Below: The same stand after harvest. The trees with the best form and potential to produce high-quality timber are retained. The branchier and shorter-boled trees were production-thinned (harvested). Careful extraction avoided damage to the residual trees.



Stocking rates and tree spacing

Harvests in natural forests will be a case of working with what is there. The stocking rate and tree quality will be highly variable. The practical approach is to thin around the 'future trees' that have been selected to stay, and to create sufficient space for them to develop large green crowns to promote their growth. Depending on the mean size of the trees, the average spacing, or stocking per hectare, will vary.

Residual trees with diameters at breast height of 40cm should be spaced around 5.0m apart. Larger trees require greater spacing. The 60cm diameter trees should have around 7.0 to 9.0m between them, and larger trees up to 14m. However, this should not be applied as a rigid rule. The overall stocking per hectare is more important than the exact spacing between individual trees.

Table: 1 – Guide to post-harvest stocking rates and tree spacing in tōtara plantations

DBH* cm	Stocking (after harvest) Stems/ha	Approx. mean spacing*** m.
25	550	4.2
30	500	4.5
40	400	5.0
50	275	6.0
60	120-200	7.0- 9.0

* Quadratic mean DBH of merchantable-sized trees

** 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.

"Harvest tree selection should be done by the forest owner or manager, not the saw miller!"

Harvesting pruned trees

If the trees have been pruned in the past, it is essential to know what the maximum DOS (Diameter over pruning stubs) was, as this dictates the minimum target harvest diameter. Generally, the target harvest diameter should be three times the DOS value. For example, if the DOS was 20cm (i.e., trees up to 20cm stem diameters were pruned), then the minimum target harvest diameter is 60cm. N.B., See the chapter on Pruning Tōtara: https://www.tanestrees.org.nz/site/assets/files/1234/pruning_totara_-_a_practical_guide_to_managing_totara_on_private_land_by_paul_quinlan_2021.pdf and video: <https://vimeo.com/580207222>

If pruned trees are harvested before they have sufficient clear-wood over the pruned stubs, then the pruning effort will have been wasted and the timber will have defects in it that down-grade its value.

Minimum harvest tree size

For SFM Permits and Plan inventories, trees with a 30cm DBH and above, are generally considered to be of merchantable diameter, and their merchantable log volume is considered to go down to 150mm at the small end diameter. In practice, sawn timber can even be recovered from smaller diameter logs. There is no minimum size for a harvest sawlog. If you can find a market or viable use for the timber, then that will determine what is merchantable or not.



Justifying the harvest of big trees

It is also okay to harvest some big premium quality trees where there are sufficient trees in the forest that are ready to move up into that size class, and replace the volume taken. And at some point, there may be little extra value gained by keeping the tree longer. Moreover, age may increase the risk of pathogens devaluing the stem with rot or discolouration caused by fungal attack such as **Kaikaka** - that peculiar pattern of pocket heart-rot common in old-growth tōtara trees (but not a feature of timber from younger regenerated tōtara trees).

An Austrian forestry book (Handstanger, 2006) warns that a red-brown fungal discolouration of the timber is common in conifers grown on land that had previously been in pastoral use. Much of the regenerating tōtara resource is on farmland, and harvests from Northland farms have noted concerning discolourations at the butt end of large, quickly grown, second growth, tōtara logs. The source or implications of this discolouration are unknown. However, it may be that such trees are more prone to pathogens and early death. They may not have the potential to become large, old-growth trees.

Make decisions in the field

Tree selections should be made in the field – but not with a chainsaw in the hand! Unhurried, carefully considered decisions are needed. This is best done by considering each individual tree within its immediate context and imagining the future growth and structural changes of the forest. All sustainable forest management principles and objectives should be kept in mind. The 'Frame trees' to stay (potential high-quality future crop trees) should be identified not for harvest, but for protection - to grow on. Then the potential harvest trees should be identified, measured, and marked-up in a separate action before felling.



Harvesting this large, 92cm diameter tree, proved to be a good decision. A hidden pocket of heart-rot was revealed. Keeping that tree longer would not have increased its timber value. It could be felled with minimal damage, and there were plenty of regenerating trees around it to replace it, and other old moribund trees for wildlife habitat.

Harvest tree selection considerations

Tree selection is not easy. Complex interrelationships exist between trees that we don't fully understand and can't predict. In addition, conflicts may exist between some of the management objectives and competing considerations may need to be weighed. Some key considerations include:

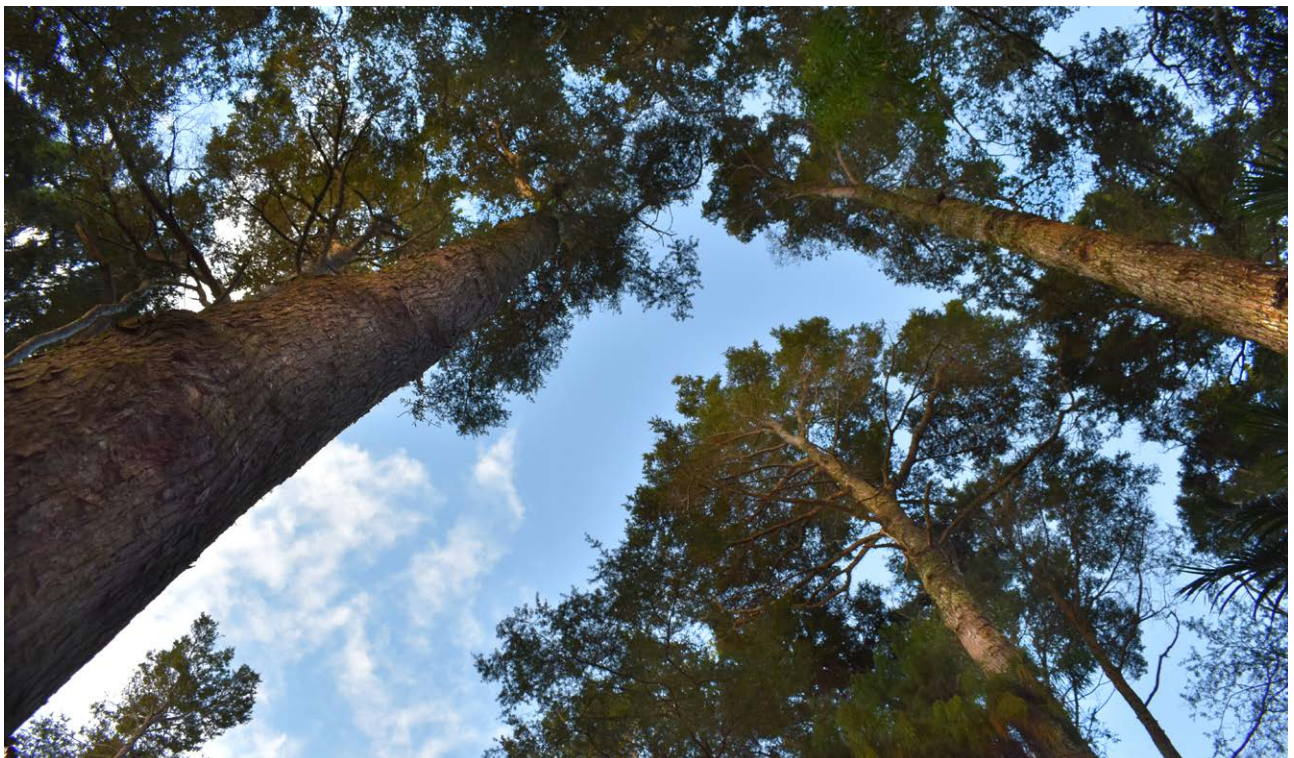
- Retaining and improving sustainable tōtara timber production potential from the residual forest (e.g., selecting premium-quality future crop-trees to stay and grow on and creating space for them to develop large green crowns).
- Reducing the poor-quality or non-merchantable component of the forest and promoting new opportunities for regeneration that can be better managed for quality timber production (e.g., production thinning objectives)
- Keeping very large trees purely for wildlife and habitat value.
- Determining what is merchantable and viable to fell and extract.
- Practicable extraction and machinery requirements/availability.
- Target harvest diameters based on maximum DOS (Diameter over stubs)- if the trees have been pruned.

- Avoiding damage to non-target native tree/shrub species (with priority given to less common species over the more common).
- Avoiding/minimising potential damage to residual tōtara trees from falling, access and extraction.
- Ecological, environmental, and/or cultural values within the fall-zone that need protection (such as presence of rare plants, or wildlife, e.g., kiwi burrows, and bat roost trees).
- Maintenance of a protective edge to stands in respect to adverse effects of wind and light and weeds.
- Minimising risk of damage (breakage) of target tree.
- Avoiding/minimising risks to personnel health and safety, and physical and environmental property damage.
- Chances of weed ingress.
- Inclusion of merchantable tōtara trees accidentally damaged in operations in the harvest volume.

Perfecting the sustainable management of tōtara forests is likely to be a process of continual refinement. But the focus of any responsible harvest should always be on what is left behind.

“Select premium ‘future trees’ to stay, and harvest competing ones around them”

“Don’t cream all the best trees from your forest – good timber only grows on good trees!”



5. Harvest season

On many soil types, extraction of tōtara logs will be practically restricted to summer and autumn, when soil conditions are hard and dry, although a network of good tracks within a forest area may extend the windows of opportunity.

Felling & extraction in one operation

Felling and extraction can be done together in one operation, by the same contracting crew. The advantages of this combination include having extraction machinery on-site to assist with directional felling, or the falling of difficult or dangerous trees, and hang ups, etc. Also, it enables a more accurate assessment of how feasible the extraction of each tree will be before it is cut down. And it reduces the risk of making a mess of tracks and paddocks, or having to leave fallen trees in the bush, because you couldn't get extraction machinery on site before the weather broke.

When the 'sap is down'

Traditional bushman advice was to cut native 'when the sap was down', which is generally inferred to be from mid-winter. This may have its roots in European forest practices where winter logging was preferred for several reasons. These include frozen ground and watercourses affording better access and/or protecting the soil from compaction, the bark of residual trees being less likely to be bruised off or damaged, and the avoidance of sap-stain, fungi, and insect attacks on the harvested logs, but also better-quality timber (less shrinkage when drying, etc.) even alleged better durability of the timber in service.

However, expensive harvesting machinery works year-round - even in Europe. So, presumably the superiority of timber from winter-cut trees over summer-harvested trees, is not so great as to preclude summer harvests. Nevertheless, the question remains – what is the best time to fell tōtara in New Zealand?

Winter versus summer felling?

The potential superiority of timber from winter cut tōtara, particularly for the sapwood, has not been tested. It would be good to have research to inform on the topic. It is easy to imagine that less starch and moisture in the sapwood could result in less food and harder going for fungi and insects – but that remains supposition.

Tōtara logs left lying for extended periods in the bush, or damp conditions, are susceptible to sap-stain and the two-tooth borer (*Ambeodontus tristus*) entering under the bark and tunnelling into the sapwood. It is not known if the sapwood from tōtara trees felled in winter is less susceptible, but if the bark is removed from the logs, and they are stored off the ground, then those risks also appear to be avoided. However, the catch is, that the bark does not peel easily from logs in mid-winter. In contrast, the bark does peel easily from tōtara logs 'when the sap is flowing' – presumably relating to the periods of growth, and usually through the summer.

Certainly, once milled and air-drying, neither sap-stain nor borer appear to be a risk. From experience we know that timber from tōtara trees felled in summer through to autumn, and milled within a month or so of felling, has performed very well without noticeable issues. Minimising the time between felling and milling may be an important factor, and this may be more practicable with summer harvests.

At this stage, no obvious problems resulting from summer harvesting have been observed. In warm, humid weather, black mould can develop on the surface of freshly peeled logs and freshly sawn sapwood timber. However, this does not appear to be anything more than a surface bloom without lasting effect once the timber dries. A spray with a contact fungicide (or anti-sap stain solution – e.g., AP 5, by Churton Pacific Ltd.), inhibits such mould growth. Otherwise, protecting freshly sawn timber from overnight dew, with some roofing iron, will generally avoid the issue.





The larvae of the Two-toothed borer (*Ambeodontus tristus*) can get in under the bark of logs left lying for extended periods in the bush – especially if in damp conditions. However, this does not happen if the bark is removed, or once the log is milled. The larvae feed on starch in the cambium under the bark and then eventually tunnel into the sapwood to pupate.



Tōtara logs stored for extended periods before milling should be debarked and stored off the ground to avoid damage to the timber by the Two-tooth borer and/or, risk of sap-stain. A spray coating of a contact fungicide (e.g., AP5 by Churton Pacific Ltd.), will inhibit mould growth on the surface of the log.



Tōtara logs store best without their bark and in dry locations, with good air flow – preferably off the ground.

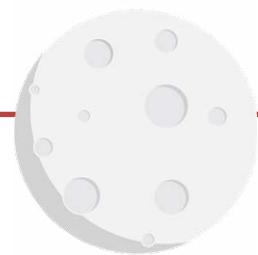
Lunar cycles and Maramataka

There are many cultural traditions concerning the felling of trees for wood use according to seasons and even monthly lunar cycles. Some go back 2000 years or more. Interestingly, many of these traditions generally align to support the felling of trees in mid-winter and in a waning moon phase.

Some European research (Zürcher, E. 1999) purports inexplicable but measurable differences in some physical timber properties between samples of Norway Spruce felled before the full moon, compared to those felled before the new moon (i.e., during a waning moon phase) – with the latter considered to have slightly better properties for construction purposes.

Surprisingly, there seems to be little research investigation of these phenomena even though it is conceivable that there may be some market interest in it. Indeed, an internet search reveals some businesses marketing “moon wood” as a feature and point of difference.

Māori cultural protocols are very relevant to the harvest and use of tōtara in Aotearoa. Where possible harvests should continue local maramataka (Māori lunar calendar) traditions.



Maramataka

Based on the *maramataka* of Ngāti Miro in the Whangaroa area, rongoā practitioner Thomas Hawtin, suggests the best time to fell trees for timber harvest is *Rākaunui* and *Rākautohi* – which are 2-3 nights after the full moon, and otherwise during the waning moon phase.

6. Planning a tōtara harvest

Management

There is a lot involved with planning and managing even a small forest harvest. There are obligations on the forest owner/manager to ensure such things as health and safety are appropriately being managed, and many other aspects need to be well coordinated in advance.

Some useful website links for guidance include:

- Te Uru Rākau: <https://www.canopy.govt.nz/harvest-forest/harvest-land/plans/>
- NZ Farm Forestry: <https://www.nzffa.org.nz/farm-forestry-model/>
- WorkSafe NZ: <https://www.worksafe.govt.nz/topic-and-industry/forestry/>
- Safetree: <https://safetree.nz>

Engaging a professional forest manager

Many landowners would find engaging a professional forest manager the easiest and safest option. However, the cost of engaging a consultant to plan and manage a small-scale native forest harvest will be disproportionately high for the small volumes involved. Few professional forest managers have expertise and experience with selective tōtara harvests or indigenous forest management. Nevertheless, professional forest managers will be well-versed and up to date on generic matters such as health and safety, standard contract documentation, and may know suitable contractors, etc.

Site visits essential

It is essential for the prospective contractors to visit the forest with the forest owner/manager to properly discuss and scope the harvest works.





Contracts

Written contracts with harvest contractors are important for any timber harvest. These should cover the responsibilities and expectations of both parties, timeframes, insurance requirements, payments, etc., and also the many 'what if' scenarios – e.g., damage to property, cleaning up slash, weather caused expenses or delays. Standard template documents may be able to be adapted.

Specific contract details or conditions for tōtara harvests should include the requirements and expectations for low-impact harvest outcomes and avoiding damage to the residual forest and infrastructure. However, defining and evaluating such matters is difficult. How far is a contractor expected to go to avoid potential damage or minimise impacts? This needs to be made explicitly clear. Involvement of the forest owner/manager in the contractor's pre-pricing site visit, and the detailed harvest planning, are ways of addressing this. However, authority and responsibilities for matters such as health and safety, must not become confused or blurred through owner/forest manager's involvement or giving directions on site during harvest operations.

Payment system

Paying contractors for harvest and extraction based on a previously agreed lump sum price, or a value per cubic metre of recovered log volume, is the safest option financially for the forest owner. But an inherent conflict exists between the contractor's interest in efficiency and the forest owner's interest in a careful harvest that protects the residual forest and avoids or minimises damage. For example, there is no incentive for the contractor to spend extra time and care to avoid possible damage if it cost more time and effort (e.g., utilising snatch-blocks, pulling over trees, cleaning up slash, or waiting for tracks to dry, etc.), because it would be at the contractor's own expense.

On the other hand, paying the contractor at an hourly or day rate, runs the risk of an overly costly operation. In either situation, expectations of both parties need to be clearly set out and understood in the written contract agreement. Ideally, the forest owner/manager should be frequently checking the harvest is being carried out according to the contract agreement.

Costs of harvesting

Every situation is different and will need to be priced uniquely. Many factors will cause the costs to vary significantly. However, as a general indication, based on harvests of 30-100m³ (log volume) of regenerated tōtara on Northland farms in recent years, the cost for the felling and extraction to an on-farm milling or loading site, has ranged from around \$100/m³ to \$250/m³ + GST (log volume). That does not include the costs of permitting, harvest planning/management, tree selection and mark-up, or any milling or loading of logs for transport off-site.



Pre-harvest planning check list:

- ☐ Current SFM Plan or Permit registered on the land title.
- ☐ Regional and District Plan rules checked.
- ☐ Potential harvest trees selected by the forest owner/manager and marked-up (numbered).
- ☐ The marked-up potential harvest trees have been individually measured and their estimated standing merchantable volumes recorded.
- ☐ Site visits with prospective harvest contractors, to scope works, discuss equipment and low-impact harvest practice/requirements, identify hazards, and confirm tree selection is practicable, etc.
- ☐ Written contract agreement with harvest contractor signed (evidence of insurances and Health and Safety Plans sighted).
- ☐ Annual Logging Plan submitted and approved by Te Uru Rākau.



Felling, marking, and measuring trees and logs

The following sets out a suggested procedure suitable for adoption in an Annual Logging Plan.

1. WorkSafe NZ shall be notified at least 48 hours prior to tree felling operations.
2. Karakia and best practice health and safety protocols shall be carried out.
3. All personnel shall be made aware of general and specific trees/ items/ values identified for protection immediately around the trees selected for harvest. And before felling, all trees, stumps, and terrain within the fall-zone shall be checked for features and values needing protection (e.g., signs of kiwi burrows, bat roosts, rare trees, natural and cultural heritage features, etc.)
4. Weed control in the fall-zone should occur before felling, if slash/fallen crowns, etc., from harvested trees may restrict access afterwards for such activities.
5. Harvest trees shall be marked (numbered) for clear identification and directional felling.
6. An estimate of standing merchantable volume shall be made before felling and kept as a record and running balance on Schedule 1 (the Tree Felling List).
7. The tree number shall be spray-marked on the stump.
8. GPS locations of each stump shall be recorded on the Harvested Tree Register sheet (Schedule 1 of an Annual Logging Plan) and kept on file.
9. The respective tree numbers shall be sprayed on the LED end of each log. The numbering system shall be: number only (#) for the butt log, #a for the first top log, #b for second top log, #c etc.
10. This number system shall be carried forward with subsequential operations including log-making at mill-site and for the milling records.
11. Merchantable volume of each tree shall also be accurately measured after felling and entered onto an attached Harvested Tree Register sheet. A running balance record of the actual harvested volume shall also be kept during the operation to ensure that the approved harvest volume is not exceeded.
12. Clean up of slash shall include ensuring no large branches are left hanging-up against or touching the stems of residual crop-trees or other native canopy tree species where there is a risk that they may cause injury by rubbing, rot or causing the tree to lean or deform.



7. Harvest contractors, machinery, and equipment

Finding the right crew and combination of machinery to selectively harvest tōtara may be difficult.

Harvest contractors

The Tōtara Industry Pilot project in Northland did not find a perfect set-up or set of machinery and skills for small-scale, low-impact, selective harvests of tōtara. Large forestry contractors had heavy machinery that was expensive to relocate, (i.e., over-size loads requiring an extra 'pilot' vehicle with warning signage to drive ahead of the transporter). And these machines were often too large to comfortably negotiate tight farm gates, tracks, and races.

Dedicated forestry crews were also unfamiliar and lacked equipment for delicate, low-impact, tree work – clear-fell efficiency and productivity are their strengths. It was difficult to even get logging contractors interested in pricing what, for them, would only be a small job with too many complications – especially if pine prices were up and their services were in demand.

In comparison, professional arborists often have the tree skills to execute sensitive low-impact tree felling but lack the suitable machinery, experience and qualifications for log extraction and loading.

Non-professional contractors lack appropriate qualifications, necessary insurances, and health and safety management systems.

There seems to be a lack of contractors with all the suitable skills, experience, and the machinery/equipment to cover the wide range of tasks required for small-scale, low-impact, selective harvesting.

Ultimately, a tōtara timber industry needs specialist harvest contractors, trained, and experienced in selection forestry under the Forests Acts, with suitable machinery and equipment. However, in the meanwhile, engaging a suitable harvest contractor may be a challenge.

Harvest machinery

Logging machinery is expensive and specialised. No one machine can do all jobs efficiently. For example, large >20-tonne grapple diggers are useful for extracting trees from accessible forest margins, and for machine assisted felling, and are needed to load logging trucks. However, they are inefficient in forwarding logs from scattered felling sites to road-accessible loading sites if any significant distances are involved.

Selective harvesting requires very careful tree-felling and low-impact extraction. Machinery should be restricted to skidding tracks and logs winched, with the use of snatch-blocks where practicable, to avoid damaging the residual trees. This is time consuming and results in low productivity in terms of time for recovered harvest volume. Furthermore, sustainable tree selection often involves harvesting trees with defects, or thinning trees with lower-quality logs and value.

Getting multiple heavy machines to site and having them clock up time just to skid out a few small and variable quality logs at a time, or load them, is not cost efficient. Therefore, preharvest planning needs to carefully consider the use of machinery, equipment, and contractor skill sets. These need to be matched to the characteristics of the individual forest (e.g., tracking, accessibility, soil conditions, tree sizes, locations, timber value, and total harvest volume).

The Tōtara Industry Pilot project trialled a range of logging machinery during its harvest operations. These included two-man harvest crews using combinations of:

- D4 TSK skidder (i.e., a 12-tonne bulldozer with winch fitted with 25-30 metres of 25-30mm wire-rope and snagging chains).
- 22-tonne grapple-digger.
- 8-wheeled forwarder.
- Logging trucks with trailer units.

Brief comments on experiences using those machines are set out below.



A D4 TSK skidder is a powerful and safe machine capable of extracting large logs and working in steep terrain.

TSK Skidder/bulldozer

These heavy, tracked machines, are designed and built for forestry purposes. They can make their own tracks, handle large, heavy logs, and turn in tight areas. However, despite their many impressive attributes they are not always the perfect machine for small scale tōtara harvests. Potential disadvantages include:

- Expensive relocation/transport to sites – need significant volumes to warrant the expense.
- Tracked machines are slow at moving logs from felling sites to loading sites. They are an expensive way to skid small logs/volumes over long distances (>250m).
- Large wire rope diameters and powerful winch capacity requires very heavy componentry such as snatch-blocks, shackles, and anchor straps for indirect pulling angles – equipment needed for low-impact extraction. Plus, they are expensive machines to have waiting around while such configurations are set up and adjusted – especially if extracting only small logs and volumes.
- Tracked machines should not enter the forest or travel over tree roots as the grouser tracks easily damage roots – especially when screwing to turn.
- Likewise, repeated travel over paddocks, farm tracks, and manoeuvring at log marshalling areas can also make a mess.





Tracked skidders are built for the job, but they are a slow and expensive way to skid a few small logs over long distances.



Grapple diggers are extremely versatile machines but tracked machines should not enter the forest. They need to stay on tracks or work from paddock edges.

Grapple diggers

Grapple-diggers are extremely versatile. They are perhaps the closest to an all-round machine for well-tracked farm-forestry sites where long skidding distances are not involved. Skilled operators can control large loads safely and avoid damage to infrastructure and the residual forest. The one machine can assist with tracking, felling, extraction, shovel logging, cleaning up slash and debris, stockpiling and loading logging trucks. However, grapple diggers also have limitations. These include:

- Expensive transport/relocation costs to get onsite (oversized and a piloted warning vehicle required).
- They are not well suited to working on steep slopes (e.g., steep paddocks and tracks) especially when wet.
- Unless fitted with a winch, they are restricted to harvesting within practical reach from tracks and paddock edges (N.B. -Tracked machines should not be allowed to enter the forest area except for on forest tracks).
- The boom arm needs greater height clearance than other machinery (from overhanging branches, etc.).
- They are slow at moving logs from the forest to loading sites if long distances are involved.

- The jaws of the grapple bruise and shred the bark from the logs during summer months. Loose bark needs to be removed if logging trucks are used. Logs are handled multiple times when 'shovelling' any distance and there is some risk of damaging the logs with rough handling, especially if trying to grab several small logs at a time.



Forwarders

The Tōtara Industry Pilot project trialed an eight-wheeled forwarder for the harvest of 100m³ of logs from a Northland farm. Efficiently transporting logs from the forest to a log loading site or 'forwarding' is usually one of the most problematic parts of the extraction chain, but that is what these machines are made for. Their advantages include:

- Ability to efficiently transport many logs in one trip.
- Self-loading and unloading.
- Avoids dragging logs over metalled tracks (i.e., keeps logs clean of stones and debris).
- Rubber tyres minimise damage to tracks.

However, in practice, the machine used was a bit too large and too heavy for the farm situation. It had a 3.3m wide wheel-brace, which only just fitted through farm gateways without chains on its tyres. The large, rounded tyres were ill-suited for traction across soft wet paddocks – even on relatively flat

gradients. This meant the forwarder was effectively limited to metalled farm tracks. Logs still had to be shovelled with the digger to suitable collection points – so, another machine is still required for extraction. As with other machinery classed as over-sized, transport to and from site is expensive (often around \$2,000). Small volume harvests wouldn't justify the expense.

Many farm-tōtara harvests will involve properties with narrow access tracks, gates and uncertified (engineered) bridges/infrastructure which may limit the accessibility of large forestry forwarders.



Cost effectively forwarding logs from the forest to a loading or milling site remains one of the problematic steps in the extraction process for many tōtara harvest operations. Forestry forwarders are made for this task.

Logging trucks

Transporting logs offsite to a commercial mill or buyer can be cost effectively done with standard logging trucks and trailers units. Ideally, the loading site should be as close to the forest as possible to minimise the forwarding distances. However, trucks

need a safe access road, with sufficient room to turn and unload trailers etc. They cannot use uncertified bridges or substandard farm infrastructure. A site meeting with the transport company during harvest planning is essential.



Standard forestry machines are often too large for farm infrastructure, such as tracks and gateways

Above: Logging trucks require good access roads for trucks to turn, room to stockpile logs, and a >20-tonne grapple digger to load them. Loose bark is common with tōtara and needs to be cut off before the trucks travel on public roads.

“Various combinations of harvest equipment and machinery should be explored to best suit the site and scale of the harvest”

Other harvest equipment not trialled in the Northland tōtara harvests, but of possible utility, includes:

- Mini skidder (wheeled)
- Self-loading trucks
- Agricultural tractors with PTO forestry winch attachments
- Portable winches
- Helicopters

Comments on these are set out on following page.

Mini skidder (wheeled)

Possibly a small rubber-tyred mini skidder would be quicker and nimbler for skidding logs from scattered locations around a farm than a tracked skidder. Unfortunately, the Tōtara Industry Pilot project couldn't get a contractor with such a machine to trial during the Northland harvests. Mini skidders may be the ideal machines, but they are not so common. It may be difficult to find a willing contractor with the right machinery.

Self-loading trucks

A self-loading crane-truck is the alternative to standard logging truck and trailer units. The advantage of a self-loader is that it alleviates the need for a grapple-digger. However, they usually charge a higher rate for cartage and have some limitations on log diameter, weight, and length, and less total load capacities. Nevertheless, for small-scale harvests (say less than 100m³ of logs), a self-loading truck is likely to be a cheaper transport option than standard logging trucks that require another machine to load them.

Agricultural tractors with forestry winches

Specialised forestry winches as attachments for agricultural tractors are commonly used for harvests in many European forests. However, they have not been widely used in New Zealand. This probably reflects the fact that larger dedicated logging vehicles are usually more effective at doing the tasks required, and safer too. Productivity is a critical factor in clear-fell harvesting of exotic plantations. However, the priorities are slightly different for selective harvests from tōtara forests. Sustainable harvests using continuous cover forestry systems involve more frequent harvesting of small volumes of timber – and often from widely scattered locations. Moreover, low-impact harvesting is required. In this context, it may be time to review the potential roles for tractor-mounted forestry winches.

Unfortunately, few trials or studies have been undertaken to test the relative viability of such equipment for low-impact selective harvesting of tōtara in New Zealand. European experiences suggest that, in some situations, tractor-mounted forestry winches may find practical application here too. To see a film of a recent farm-tōtara harvest trialling such equipment:

<https://vimeo.com/692925422>.



A tractor-mounted forestry winch enabled tōtara logs to be pulled out of the bush from the paddock edge. In this case, a 45hp tractor and a winch with a 4-tonne pulling capacity, managed to extract logs up to 2.2m³ in size, in moderately steep and rocky terrain. Some trees were located at least 50 metres from the paddock edge.



Once logs are winched to tracks or paddocks, they can then be easily skidded to a loading or milling site on the farm.

There are several brands of tractor winches with over half century of history and reputation. Such skidding winches are mounted at the back of the tractor, on the three-point linkage, and driven by the Power Take-off (PTO) shaft. Generally, they have a grader blade-like plate to act as an anchor and protect the back of the tractor and they use wire ropes and choker-chains to pull logs to the back of the tractor.

The size and pulling power of the winch needs to suit the tractor, and typically ranges from 4 to 6.5 tonnes (although up to 9-tonne winches are available). Basic units can be purchased new for around \$7,000 – 11,000 +GST, and remote controls are usually an upgrade option for around \$2,500. Recommended additional accessories include three sets of appropriately rated snatch-blocks, bow shackles, and tree-protectors (webbing straps).

The use of snatch-blocks with at least 50-80m of cable enables tractors to work from safe locations on tracks or paddocks and for logs to be carefully winched and pulled in different directions to avoid obstacles and damaging residual trees.

Tractor winches are useful for more than just the extraction and skidding of logs. They can assist with directional felling, dealing with dangerous trees and hang-ups. The butt plate can also be used for moving or stockpiling logs at a loading site, but a front-end loader on the tractor is an ideal complement.



Snatch blocks can be used to change the pulling direction of a winch line, to avoid obstacles or damaging other trees. They can also be used for winch-assisted directional felling.

Potential advantages of tractor-mounted skidding winches might include:

- A relatively low-cost implement that further extends the utility of an existing 4WD tractor.
- Less transport/relocation costs between properties.
- Vehicle scale suited to farm situations and infrastructure (e.g., gateways, tracks, and bridges), avoiding damage and/or need for costly upgrades.
- Could enable landowner operation (if skilled enough).
- If a portable sawmill, or self-loading trucks are used, then no log loader or other heavy machinery or transport costs required.
- Allows careful felling and extraction (use of snatch blocks, etc.) without the pressure of expensive heavy machinery clocking up hours.
- Reasonably quick skidding speeds possible and suitable for bringing in small volumes from scattered locations.
- Rubber tyres minimise damage to paddocks, metalled tracks, and tree roots.
- Suits frequent and/or opportunistic harvesting and production thinning operations (e.g., when season, weather, and soil conditions, or markets suit).

Potential disadvantages include:

- Large logs and difficult terrain could exceed the capacity of the winch and/or tractor.
- Lack of clarity in New Zealand on suitable training, qualifications, and best practice and safety requirements.
- Lack of experienced operators.

Tractor-mounted forestry winches may be suitable for small-scale regenerating tōtara forests especially where they are integrated within a pastoral farming system.



Roger May has an excellent tractor-logging set up comprising a 4WD Valtra tractor with a front-end loader and 6.5-tonne Tajfun skidding winch that can be operated from a remote controller on the belt. This enables the operator to see the log at all times.

Portable capstan winches

Portable winches could also be a useful item of equipment. With long braided polyester rope, multiple snatch blocks and webbing straps, they become versatile in awkward situations with difficult access. It is not hard to imagine their utility in directional felling, grounding hang-ups, moving obstacles, and manoeuvring logs in dense, inaccessible bush, as a complement to other skidding machinery such as a 4WD tractor.

Arborists familiar with the mechanical advantage that can be gained from pulleys and snatch-blocks will know how to double, or even triple, the effective pulling force of the winch onto the targeted load. The winch pictured below has up to 1000kg of pulling power, however, with a double snatch-block set up on the log, it easily pulled a 1 tonne log up a moderately steep incline. Accessories such as a skidding cone to reduce the chance of snagging on roots and rocks would undoubtedly also be useful.

N.B. – The working load limits of all componentry (ropes, shackles, snatch-blocks, and tree protectors, etc.) must be rated for at least double the possible pulling forces from the winch.

To have such additional equipment available 'in the toolbox', for occasional miscellaneous uses, may increase the flexibility of a harvest crew to carry out low-impact harvests.



Portable petrol-powered capstan winches may be useful for directional felling, manoeuvring logs in the bush or extracting small to medium-sized logs to skid tracks. The use of snatch blocks for mechanical advantage can greatly increase their utility well beyond their basic pulling force.

Helicopters

Heli-logging might be an option in some situations where ground extraction is not practicable or viable. It was not trialled as part of the Northland tōtara harvests. But an attempt to price it as a harvesting option for two properties, indicated it would be around 60% more expensive than quotes for ground-based extraction. However, numerous assumptions and variables were involved.

Maximum lifting weight capacities depend on the machine and varied from 1200 - 1700 kg, and the number of lifts per hour would vary depending on distances involved and skill of the support crew. Relocation costs depend on distance from the home base. Hourly operating rates were around \$3,000/hr or more for larger machines. Skilful cross-cutting of logs to size in the bush and preparation of lifting strops is also necessary.

Potential advantages of heli-logging include:

- Low-impact extraction in sensitive areas.
- A practicable harvest option for areas too remote, difficult, or sensitive for ground-based extraction.
- Year-round harvesting, rather than being restricted to times when the soil conditions are dry enough.

The high cost of heli-logging means it will only be relevant for very high-value logs or lumber. Chainsaw milling logs in the forest may be a way to maximise the value of each weight-limited lift.

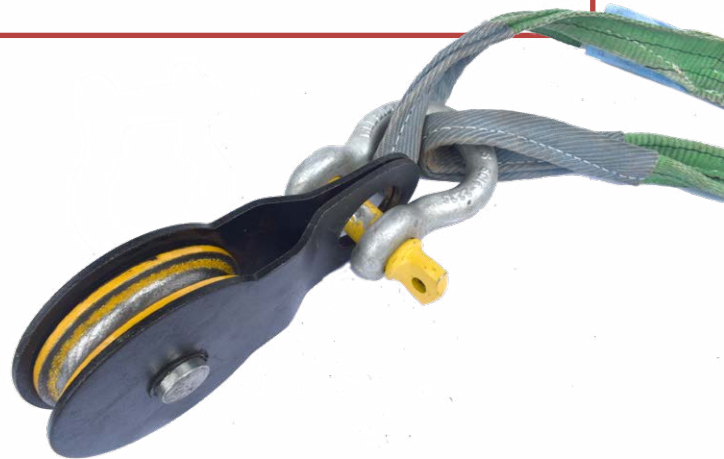


A snatch-block on the log, with one line from the winch, the other to an anchor, doubles the force exerted on the log. A second snatch-block adds even more force on the log. In this instance a portable winch pulled a 1-tonne log up a slope and to a location accessible for a farm tractor. N.B. – Snatch-blocks, shackles and chain all rated for >8-tonne working load limits (more than three times the capacity of the winch).

Snatch blocks

Tips for use of snatch blocks:

- Insist that contractors have always at least 3 snatch blocks and 3 soft webbing tree protectors conveniently available for use.
- Ensure they are utilised wherever practicable to avoid or minimise potential damage to the remaining forest, or to increase safety.
- Always use soft, wide webbing straps to anchor snatch-blocks to trees. These 'tree protectors' must be appropriately rated to exceed the maximum working loads. Never use chains around trees that are not being harvested! Ensure that tree-protectors are carefully positioned so do not move or slip and rub the bark when under load.
- Ensure all componentry (e.g., wire rope, tree protectors, shackles, snatch-blocks) is rated to appropriately exceed the maximum working load that the winch can exert. For straight pulls, without mechanical advantage, this is generally considered to be more than double the theoretical maximum pulling force of the winch.
- Avoid using potential crop trees as anchors for snatch-blocks (unless they will also be harvested at that time). Use non-valuable trees, or harvest trees as far as is practicable for such purposes.





The ever-ingenious Li Legler, with his skidding cone fashioned out of a buoy from a mussel-farm. **Inset:** The D.I.Y. skidding cone enabled tōtara logs to be winched out of a steep and rocky gulley, from the paddock edge and with a small tractor-mounted winch. The choker-chain on the log passes through a hole in the 'nose cone' and is then hooked to the wire rope.

Skidding cones

Rather than sniping the ends of log to help avoid snagging on stumps, roots, and rocks a skidding cone fitted over the lead end of the log can be used. These have the added advantage of helping to avoid or minimise potential damage to the soil, and plant roots and bark of adjacent trees. For these reasons alone, skidding cones should probably be used wherever practicable.

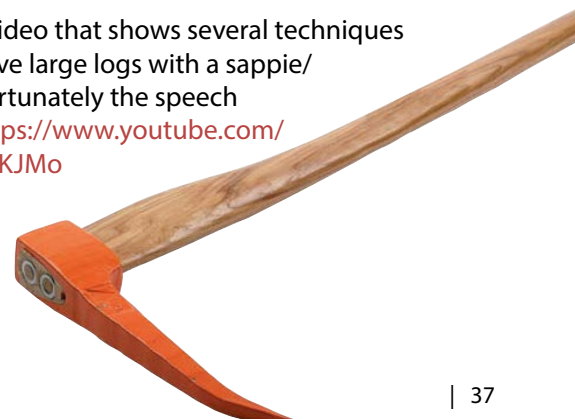
Cant hooks, sappies, and hookaroons

Low impact harvesting requires avoiding damage to residual trees as far as it is safe and practical to do so. Tools such as cant hooks and long-handled hookaroons (sappies), or pickaroons, can be used to roll and manoeuvre logs to avoid the risk of winch ropes and winched logs scuffing the bark off residual trees. Contractors need to have such hand tools on-site and be prepared to stop winching and use them to avoid unnecessary damage to remaining trees. They are also useful tools to ease logs passed snags and obstacles.



Using a cant hook to roll a log to avoid damaging a sapling.

Here is link to a video that shows several techniques to effectively move large logs with a sappie/ hookaroon (unfortunately the speech is in German): <https://www.youtube.com/watch?v=Qfc46l-KJMo>



8. Tidying up

Damaged or dangerous trees and slash should be dealt with before the extraction machinery leaves the site. And stumps from harvested trees should also be cut low to the ground to minimise the chances of them becoming potential snags for future harvests.

Inevitably, harvests result in some localised areas of damage. The crowns of fallen trees may leave branches bending small saplings over, or lying under tension against the stems of other trees. For the health of the residual forest, it is good to ensure the slash is cut up and grounded so as not to impair the healthy growth of the remaining forest. Seedlings and saplings can be freed from slash that might deform their growth. It also facilitates safer and easier future access to the area for monitoring, silviculture, and weed and pest control.

There is an aesthetic and emotional aspect to it too. Tidying up after a harvest can be a pleasant task – part of respecting the forest and evaluating the effects and relative success of the harvest. It is



“The focus of any responsible harvest should always be on what is left behind.”

another opportunity for weed control, pruning, and thinning, and the start of the post-harvest observation process. It is an important part of knowing and tending your changing forest.



9. Conclusions

Tōtara is an iconic native timber species well suited to silviculture and sustainable forest management. There is a significant resource of naturally regenerating tōtara forest developing on private land in several regions of the country. Tōtara is also one of the most popular choices for planted native timber trees in new forests.

Many of these forests can be managed for multiple values, including timber production. Low-impact and sustainable management of tōtara forests can be done and has been successfully demonstrated by the Northland tōtara projects.

Tōtara is fine timber, suitable for many uses, and small markets already exist. However, to properly realise the full value, some form of co-op or coordinated management of the collective regional resources is probably required. Meanwhile, landowners are encouraged to obtain SFM Plans for their tōtara forests so that a commercially scaled supply exist. That will be essential for market development.

There are legal provisions to enable the lawful harvesting of native trees – but it is difficult, costly, and time consuming to apply them. Regulatory impediments and disincentives exist, but many policymakers are aware that sustainable native forest management is an appropriate land use that should be encouraged. The trees will keep growing while a more conducive regulatory framework can be worked on. Meanwhile, it is important that people start sustainably managing forests and develop native forestry as a viable land use option.

Perfecting the management of tōtara and native forests will be a process of continual refinement. There is a lot we don't know. There is a need for research, also training. Ultimately, a tōtara timber industry will not only create jobs, it will also reconnect people with their forests and their landscapes.

There are cultural heritages associated with bush work - some to our shame. But now we have an opportunity to demonstrate that, as a culture, we can make good the past, regenerate the forest, responsibly manage it, and find an appropriate relationship with nature. Sustainably harvesting tōtara could be participating in the creation of an inspirational example for forward-looking industries and land managers. However, realising that potential is still a challenge.

Finally, it can be okay to harvest tōtara. Whether or not it is appropriate, depends on many things. These are mostly site-specific factors and require careful decisions for each individual tree. Hopefully this chapter helps with such deliberations. Remember, forests are always more than just wood, and harvesting is an action and a record that will reflect your values. So, feel the weight of responsibility, but make sure you enjoy it too. The result should be something you can be very proud of.

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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/>