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Editor

Trevor Best
Email: Editor@nzif.org.nz

Assistant Editor

Helen Greatrex

Subscription inquiries and changes of address

Administrator
NZ Institute of Forestry
PO Box 10-513
Level 9, 93 The Terrace
Wellington 6143
Phone: 04 974 8421
Fax: 04 473 9330
Email: admin@nzif.org.nz

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Jenny Palmer Graphics

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Advertising

The Administrator
Email: admin@nzif.org.nz
Phone: 04 974 8421
Fax: 04 473 9330

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Front cover photo: Plantation forest harvesting. Photo courtesy of Meg Buddle, Adderley Head

Back cover photos: (top) Kereru (New Zealand wood pigeon). Photo: Andrea Lightfoot (unsplash.com); (bottom) Karearea (New Zealand bush falcon). Photo courtesy of Bryce McQuillan

Editorial

Trevor Best

Traditionally, the November issue is the conference edition. While COVID-19 might have put paid to this event this year, we can still reflect on the key messages those within the conference committee were looking to emphasise in what will now be next year's conference. The idea behind the Masterton conference was to use the passion and engagement we all have in the sector to exhibit some of that pride in what we do. No-one captures this better than loggers. In my day job I spend a bit of time listening to loggers talk about their work and what it means to them. Evident in every conversation is a love for logging and pride in what they can do in the most difficult of circumstances. It reflects something that is consistent in the profession and sector – the people who spend considerable amounts of time beavering away on their own contribution to the advancement of the forest sector generally do so because they love the environment, the people, and the work.

However, as has been the subject of previous conferences and journal papers, that enthusiasm is not necessarily shared by some of our other stakeholders. The aim of the conference was (and now is) to start addressing the differences that arise within rural communities when forestry activity increases. In this issue, Michelle Harnett and Tim Payn address how communication works in the era of social media and what this means for the forest industry. Differences in viewpoints over the benefits of afforestation have, like many other differences in perspectives, become distorted by vested interests using the power of social media to coerce. The authors highlight the benefit of changing the narrative to one of forests delivering a range of ecosystem benefits while introducing some new tools for assisting the process. In introducing the work Scion has done in helping the NZFOA put together evidence promoting the benefits of afforestation beyond the economic, they also put it back on us to change perceptions through kitchen table discussions and personalising the message. No more small talk at parties or hiding in the kitchen.

Of course, none of that will matter if the sector does not prove itself capable of being trusted to manage challenging landscapes at scale. Steve Urlich and Sean Handley, in the second paper in their ongoing look at the impacts of afforestation on the benthic environment in the Marlborough Sounds, review the history of afforestation within that landscape. They highlight how once planting reaches a certain critical scale within a catchment, the window of vulnerability to erosion created by clear felling is always open somewhere in that catchment. Forestry is no longer a minor player in that landscape and must assume the responsibility that goes with that position.

How the Government intends to manage the potential effects of land use through the freshwater reforms, proposed national direction for indigenous biodiversity, and the proposed overhaul of the Resource Management Act (1991) is outlined by Chris Fowler and Meg Buddle. Having an impact on these proposals will be something of a test of how politicians and their constituents see the relative benefits and costs of afforestation. It will be a pity if failure to manage the real and perceived negative impacts of 20–25% of a rotation eventually outweigh the real gains made over the other 75–80%.

Fortunately, as a profession we do have some history of regulating our own activities and acting in pursuit of lofty goals. Bruce Manley presents the findings of the annual survey of valuation assumptions and practices, while Bill Libby has submitted a reprint of a presentation to the 2016 Redwood Symposium held in Eureka, California. In this op-ed, he argues for the establishment of coast redwood and giant sequoia 'colonies', to ensure the protection of these species from the changes likely to their natural range as a result of increased climate volatility. Given the recent elevation of the current fires in California to the newly created classification of 'gigafire', Bill was right to be concerned. Finally, as a reminder of where the industry has come from there is a photo history essay from Scion's archives and obituaries for two legends of our own: the late Tony Beveridge and Richard Woollons.

Pride in what we do well, honesty and transparency about what is not done well, and enthusiasm for best practice are at the core of the profession's (and sector's) sustainability. Another consistent theme from the loggers is the role an influential person has in their choice of work and getting the all-important first job. People generally arrive in forestry through someone else. If the sector is to meet its potential contribution to the nation, then the people already here must be able to speak with enthusiasm and have a belief in the value of what they do. We as a journal and an Institute can support that by providing space to celebrate where we have been, where we are now, and where we could go.

Major environmental law reform affecting the plantation forestry sector

Chris Fowler and Meg Buddle

The Kawarau River, one of the many freshwater bodies to be improved by the freshwater reforms

Abstract

This paper discusses three major changes that are occurring to the way natural and physical resources are managed in New Zealand. These are the package of freshwater reforms recently announced by the Government, the proposed national direction for indigenous biodiversity and, most significantly, the proposed overhaul of the Resource Management Act 1991 (RMA).

The freshwater reform package is intended to achieve a paradigm shift regarding freshwater management. There is tension between the new regime that is intended to be implemented locally by regional councils and the objective of national consistency embodied in the National Environmental Standards for Plantation Forestry (NES-PF). Failure to resolve this tension raises the prospect of multiple planning processes as each regional council seeks to establish new water quality standards for freshwater bodies within their respective regions. This would present a real challenge for the forestry sector and could lead to fragmentation of the NES-PF.

The proposed national direction for indigenous biodiversity as currently worded will lead to new regulation designed to manage the potential adverse effects of harvesting activities on indigenous

biodiversity. Such regulation could potentially impose significant additional costs on the forestry sector.

The Resource Management Review Panel has released its report on resource management reform. It recommends significant and wide-ranging changes to our current resource management law and processes (Resource Management Review Panel, 2020). Key recommendations include repealing and replacing the RMA with three new enactments, and combining and replacing regional and district plans with a single plan for each region. Overall, the Panel recommendations appear to be favourable for the forestry sector.

Introduction

Major changes are occurring to New Zealand's system of environmental management. Longstanding and deep-seated environmental issues are being tackled head-on and the RMA itself seems likely to be replaced. Each of these changes has potentially significant implications for regulatory control and management of day-to-day forestry activities. This paper presents an overview of these major reforms, considers the implications of these changes for the plantation forestry sector, and comments on how the sector might respond.

Current RMA controls affecting forestry sector

Environmental management of plantation forestry activities primarily occurs under the NES-PF. In brief, the NES-PF regulates eight core forestry activities, as well as ancillary activities such as clearance of indigenous vegetation.

Council plans can (in limited circumstances) contain more stringent rules controlling forestry activities, including rules that give effect to a freshwater management objective and rules that protect indigenous biodiversity. Some activities related to plantation forestry are outside the scope of the NES-PF, such as vegetation clearance prior to afforestation (including spraying) and logging truck movements.

Although not perfect, the NES-PF provides for consistent regulation of plantation forestry activities throughout New Zealand, which has reduced the need for foresters to participate in local planning processes and obtain resource consents under local plan rules.

Freshwater reform package

Degradation of our freshwater resources is a chronic, widespread and deep-seated problem (Cabinet Paper, 2020). Many interested parties consider the current framework is inadequate to cope with the scale of the problem. In response, the Government has recently released the Healthy Freshwater reform package that is intended to achieve a paradigm shift regarding freshwater management in New Zealand (freshwater reform).

The National Policy Statement for Freshwater Management 2020 (NPS-FM) and the National Environmental Standards for Freshwater 2020 (Freshwater NES), coupled with changes to the RMA passed earlier this year, are collectively intended to set New Zealand on a new pathway regarding freshwater management. Most of these changes took effect on 3 September 2020.

Key concept and objectives

The freshwater reform is guided by the concept of Te Mana o te Wai, which is about restoring the balance between the water, the wider environment and the community. The reform package is intended to deliver on this outcome through objectives that seek to:

- Stop further degradation of freshwater resources within five years, and
- Reverse past damage to bring freshwater resources, waterways and ecosystems to a healthy state within a generation.

Streamlined freshwater planning process for regional councils

Regional councils are responsible for implementing the freshwater reform and promoting changes to regional planning instruments. Earlier this year the RMA was amended to include a streamlined process for creating or amending regional freshwater plans, which includes independent hearings panels convened by the newly established Chief Freshwater Commissioner to hear submissions and make recommendations. New provisions deal with the composition of panels, the procedure for hearing submissions, and recommendations by hearings panels.

How will the freshwater reform affect forestry?

The Freshwater NES

The Freshwater NES is primarily directed at managing the effects of pastoral, horticultural and dairy farming activities on freshwater bodies. The Freshwater NES is subject to the NES-PF, which means that the NES-PF regulations will apply instead of the Freshwater NES where there is overlap between the two. The objective is to avoid duplication. So in situations where the NES-PF and the Freshwater NES overlap, such as commercial forestry activities around streams, wetlands, and culverts, the NES-PF takes precedence.

The NPS-FM

In contrast, the NPS-FM is a higher-order document that will apply to plantation forestry activities. The key provisions most likely to affect the forestry sector are discussed below.

Requirements for fish passage

The NPS-FM includes requirements for regional councils do a number of things in order to better provide for fish passage, including inserting the following objective directly into their regional plan(s) without following the usual RMA process for amending plans:

The passage of fish is maintained, or is improved, by instream structures, except where it is desirable to prevent the passage of some fish species in order to protect desired fish species, their life stages, or their habitats.

In addition, regional councils must:

- Provide fish passage for desired fish species within the region's waterbodies, and prevent fish passage for undesired fish species
- Change their regional plans so that decisions on consent applications for instream structures take into account how well the structure will provide for fish, as well as the maintenance and monitoring proposed for the structure
- Change their regional plans so that remediation of existing structures is encouraged, and
- Identify instream structures throughout the region and promote remediation of existing structures where they do not currently provide for fish passage based on the ecological criteria described in the New Zealand Fish Passage Guidelines 2018 (Fish Passage Guidelines) (New Zealand Fish Passage Advisory Group, 2018).

The NES-PF already requires that new river crossings must provide for the passage of fish. At this stage it is unclear whether regional council implementation of the NPS-FM will create additional requirements beyond what is already contained in the NES-PF.

It seems likely regional councils will encourage foresters to remediate existing river crossings that do not meet recommended design specifications in the Fish Passage Guidelines, particularly in waterways containing prioritised fish populations or species. If the design specifications cannot be met, foresters may need to upgrade the river crossing in question to ensure fish passage is preserved (e.g. by the addition of ramp fishways, baffles, mussel spat ropes or bypass structures).

Threatened species

The NPS-FM emphasises the need for regional councils to recognise and provide for threatened freshwater species, being species that meet the criteria for nationally critical, nationally endangered or nationally vulnerable species in the *New Zealand Threat Classification System Manual*. The specific directives in the NPS-FM are for regional councils to:

- Identify the location of habitats of threatened species within the region's freshwater management units (FMUs)
- Identify and map any wetland that is known to contain threatened species (even if that wetland is very small or ephemeral), and
- Manage the aspects of the relevant ecosystem that provide the habitat or conditions for that threatened species to survive.

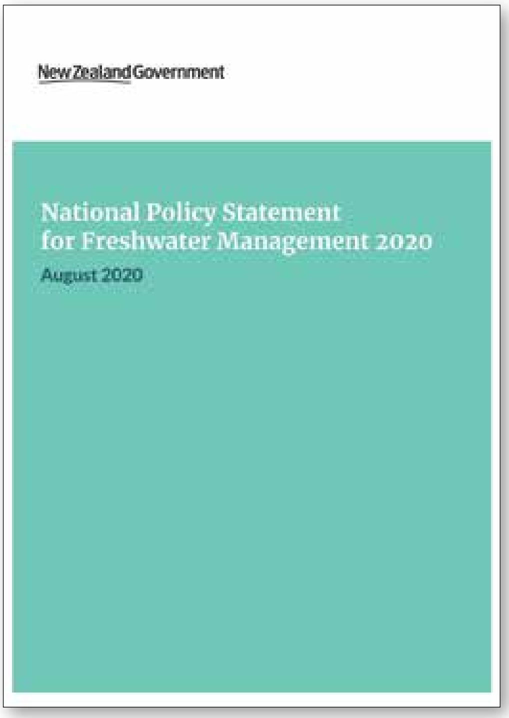
It is likely that regional councils will focus on those waterways that are identified habitat for threatened species. Where land use activities are adversely impacting the health of those threatened species or their habitats, regional councils may require management improvements of those activities.

Suspended sediment and deposited sediment

Sediment is widely viewed as one of the most prominent environmental stressors facing New Zealand's freshwater and estuarine environments (Cabinet Paper, 2020), and was identified as a significant gap in the former NPS-FM. That has been addressed by the introduction of two new attributes with National Bottom Lines for the following types of sedimentation:

- Suspended sediment (measured either by visual clarity or by converting turbidity measurements), which will require regional councils to limit resource use via regional freshwater rules to achieve outcomes specified in the NPS-FM, and
- Deposited sediment (measured by proportional coverage), which will allow regional councils to work towards desired outcomes through non-statutory action plans (that do not necessarily limit resource use).

Both sediment attributes account for natural variation between different river types



New Zealand Government

National Policy Statement for Freshwater Management 2020

August 2020

Reprint as at 28 August 2020

Resource Management (National Environmental Standards for Freshwater) Regulations 2020

(LI 2020/174)

Patsy Reddy, Governor-General

Order in Council

At Wellington this 3rd day of August 2020

Present:

The Right Hon Jacinda Ardern presiding in Council

These regulations are made under section 43 of the Resource Management Act 1991—

(a) on the advice and with the consent of the Executive Council; and

(b) on the recommendation of the Minister for the Environment made in accordance with section 44 of that Act.

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These regulations are administered by the Ministry for the Environment.

through environmental classification systems and incorporate exceptions for naturally occurring processes.

Government officials estimate that about 31% of monitored sites will require reductions in sediment load to meet the suspended sediment bottom lines (Cabinet Paper, 2020). They note that the new sediment policy will likely lead to some land use change (hill country pasture to forestry).

Water quantity and environmental flows

The new NPS-FM now includes water quantity (water flows and levels) as one of the five key components of freshwater ecosystem health that must be managed and reported on. Consequently, every regional council must include rules in its regional plan that set environmental flows and levels for each FMU and may set different flows and levels for different parts of the FMU. In doing so, regional councils must have regard to (among other matters) the foreseeable impacts of climate change.

The wording of the NPS-FM is broad enough to allow regional councils to consider the effects of afforestation on water yield in flow-sensitive catchments. This may cause some regional councils to introduce new planning rules (or revisit existing provisions) to manage the effects of afforestation on water quantity.

Summary of potential impacts for forestry

In summary, the NPS-FM requires each of the 16 regional councils to develop objectives, policies and rules about sediment discharges, water quantity, threatened species and fish passage. This work must occur through a process of engagement with affected communities followed by notification of new freshwater provisions in regional policy statements and regional plans by December 2024.

This raises the prospect of wave-after-wave of planning processes as each regional council seeks to establish new water quality standards for FMUs within their respective regions. It presents a real challenge for the sector to meaningfully engage in these processes, which will be time-consuming and potentially complex.

Plantation forest harvesting

In addition, there is a real risk that new regional freshwater rules will fragment the consistent approach currently provided by the NES-PF and lead to a situation where foresters need to comply with both the NES-PF and freshwater rules within different regional plans across the country. This outcome would undermine one of the key objectives of the NES-PF, which is to increase the efficiency and certainty of managing the environmental effects of plantation forestry activities.

Tension between regional implementation and national consistency

Against this context, how can the NPS-FM be implemented in a way that works effectively for the forestry sector? The answer to this question lies in developing a pathway forward that resolves the tension between the new freshwater regime that is intended to be implemented locally by regional councils and the objective of national consistency embodied in the NES-PF. This is ultimately a matter for central government to resolve, but a possible response is discussed below.

Under the NES-PF plantation forestry activities are generally permitted where permitted activity conditions are complied with, unless the activity is in a high-risk area, as described by the risk management tools incorporated by reference in the NES-PF (e.g. the Erosion Susceptibility Classification tool, the Wilding Tree Risk calculator and the fish spawning indicator). The risk-based permitted activity approach already embedded in the NES PF could be extended in response to the NPS-FM.

Those parts of the NPS-FM that require identification of high-risk areas and environmental features could be implemented locally. For example, the identification of FMUs, values and attributes within specific waterways, the location of threatened species, outstanding water bodies and natural inland wetlands that require protection under the NPS-FM could occur at the local level through regional planning maps. These maps, which are essentially a risk management tool, could then be incorporated by reference into the NES-PF.

Those parts of the NPS-FM that require setting of rules or limits on resource use to manage the effects of plantation forestry activities on these identified high-risk areas and features could be implemented by amendment to the NES-PF. The NES-PF provides a ready-made vehicle for this approach with regulations already directed towards fish passage, fish spawning, sediment discharges, and setbacks from wetlands and waterways. These could be revised and updated to give effect to the NPS-FM.

Under this approach, the NES-PF would be amended to include new NPS-FM regulations and new NPS-FM risk assessment tools based on regional planning maps

An example of the biodiversity found in New Zealand's plantation forests. Photo: Andrea Lightfoot (unsplash.com)

that are incorporated by reference into Schedule 2 of the NES-PF. The regional maps would provide a spatial database that enables site-specific assessments of risk to be undertaken regarding values, features and attributes that are protected under the NPS-FM. Regional councils, in the usual way, would have responsibility for processing any resource consents triggered by forestry activities that do not comply with the NES-PF permitted activity standards.

There are several advantages with this approach. It retains the integrity of the NES-PF as the primary planning instrument governing plantation forestry activities and achieves coherence between different national direction documents. It also enables a robust suite of regulations to be developed at the national level, recognising that the potential adverse effects of plantation forestry are the same or similar throughout the country, and avoiding unnecessary churn in regional planning processes for the forestry sector.

Finally, scope would remain for regional freshwater rules to be more stringent than the NES-PF, subject to the existing and important proviso that greater stringency must be justified in the specific circumstances of the region.

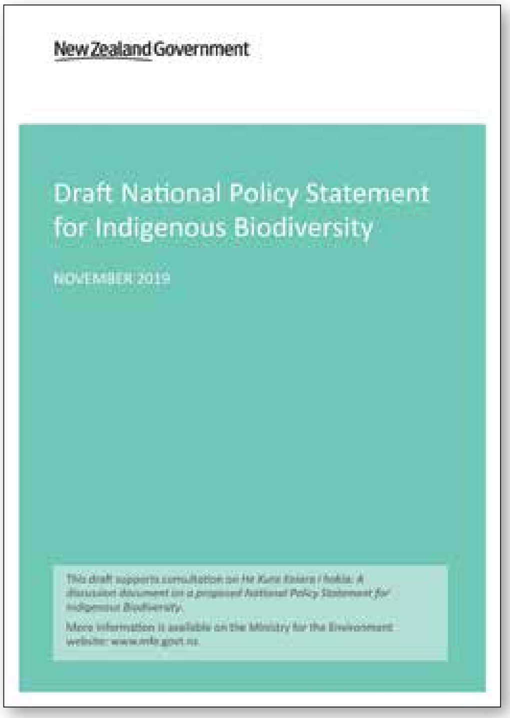
Indigenous biodiversity reform

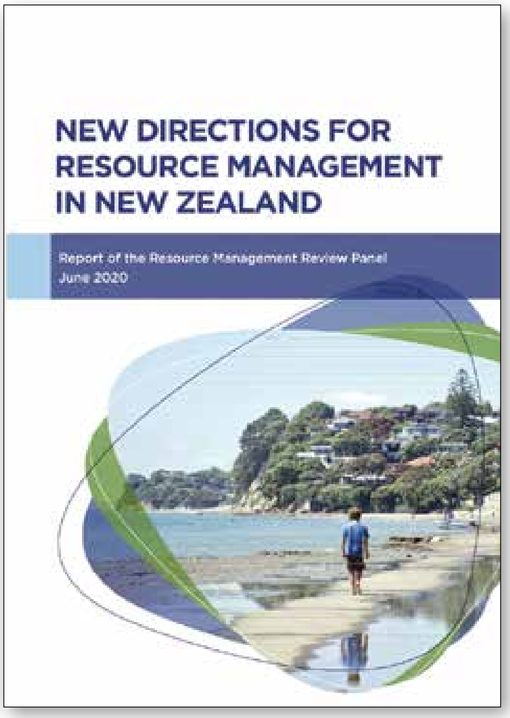
Indigenous biodiversity protection through the RMA has been a slow-burning issue for many years. Successive governments have grappled with how to arrest the serious decline in native species and naturally uncommon ecosystems. In November 2019, the Government notified a proposed National Policy Statement for Indigenous Biodiversity (the proposed NPS-IB). It is intended to provide clear national direction to address key gaps and inconsistencies in the management of terrestrial indigenous biodiversity under the RMA.

The proposed NPS-IB requires that local authorities must identify significant natural areas (SNAs) using specified ecological criteria. All SNAs within plantation forests must be identified and mapped within district plans. Plantation forests that are identified as containing SNAs are deemed to be 'plantation forest biodiversity areas' (PFBAs).

Within PFBAs, the adverse effects of plantation forestry activities on both (a) threatened or at-risk flora must be managed and (b) significant habitat for threatened or at-risk indigenous fauna must be managed, to maintain long-term populations of such fauna.

Local authorities are required to maintain indigenous biodiversity outside SNAs, including indigenous vegetation that does not qualify as SNA and highly mobile fauna. Policy statements and local plans must be amended to manage adverse effects of land use, including plantation forestry activities, on such indigenous biodiversity.





How will the proposed NPS-IB affect forestry?

It appears inevitable the proposed NPS-IB as currently worded will lead to new regulation designed to manage the potential adverse effects of harvesting activities on indigenous biodiversity. Such regulation could potentially impose significant additional costs on the forestry sector.

The proposed NPS-IB notes that the NES-PF has rules for indigenous biodiversity and plantation forests. The accompanying Cabinet Paper states that the management approach promoted in the proposed NPS-IB would be mainly implemented through changes in the NES-PF once the NPS-IB is finalised (Cabinet Paper, 2019).

At present, the NES-PF contains rules about clearance of indigenous vegetation that does not qualify as an SNA. Rules relating to SNAs are currently included in numerous district plans because the NES-PF allows district plans to be more stringent where such rules relate to the protection of significant natural areas.

As currently worded, it appears that the proposed NPS-IB would likely require amendment to the NES-PF to:

- Manage the potential adverse effects of plantation forestry activities on threatened or at-risk flora and fauna within PFBAs, and
- Manage the adverse effects of plantation forestry activities on indigenous biodiversity and highly mobile fauna outside mapped SNAs.

The New Zealand Forest Owners Association and many foresters lodged submissions on the proposed NPS-IB, seeking substantial changes to make the document more workable for the plantation forestry sector. Due to the COVID-19 pandemic, the timeframe of the delivery of the document has now been extended to April 2021, after the general election. At the time of writing it remains unclear whether the incoming government will persevere with the NPS-IB and, if so, how it will respond to these submissions.

Major RMA reform – the Randerson Report

The Resource Management Review Panel (the Panel) chaired by Mr Tony Randerson Q.C. has released its report on resource management reform (known as the Randerson Report). It recommends significant and wide-ranging changes to our current resource management law and processes via a transitional process over 10 years. The Randerson Report has received initial support from both major political parties and most of the recommendations seem likely to be implemented.

The Panel recommended repealing and replacing the RMA with three new enactments: a Natural Built Environments Act (NBEA); a Strategic Planning Act (SPA); and finally a Managed Retreat and Climate Change Adaptation Act (CCA).

The purpose of the NBEA, expressed by the Panel, is to enhance the quality of the environment to support the wellbeing of both future and present generations. The recommended SPA seeks to address a shortcoming the Panel identified by providing and setting long-term strategic goals to enable land and resource planning to be better integrated with the provision of infrastructure as well as associated funding and investment.

Another recommendation from the Panel is that regional and district plans should be combined and replaced with a single plan for each region, described as a combined plan. Effectively, this would reduce the number of resource management plans from over 100 to just 14 – one for each planning region in New Zealand. Linked to this is the recommendation that mandatory environmental limits be set for biophysical aspects of the environment including freshwater, coastal water, air, soil and habitats for indigenous species.

The Panel also identified the lack of national direction to support the purpose and principles of the RMA as a key issue in the implementation of the Act. This has resulted in duplication, and led to inconsistencies in the way the environment is being managed across different parts of the country. The Panel recommend the retention of national direction and propose improvements so they may be more used more effectively to achieve intended outcomes. In particular, the Panel proposed that all existing and new national direction should be brought together into a coherent combined set and any conflicts between them resolved.

How will the proposed RMA reform affect forestry?

Overall, the Panel recommendations appear to be favourable for the forestry sector. The increased focus on national direction underscores the importance of the NES-PF. The proposed consolidation of all national directions into one coherent package would address uncertainty about the relationship between the NES-PF and other national directions such as the NPS-FM and NPS-IB.

In addition, the proposed reduction in the number of planning instruments would simplify planning processes and create efficiencies for the forestry sector. The spatial planning recommendations would potentially allow foresters to promote locations at a regional level that are best suited for plantation forestry.

Further, the promotion of activities that mitigate or sequester carbon through the proposed NBEA is likely to favour the forestry sector given that plantation forestry can assist New Zealand achieve its commitment to reduce greenhouse gas emissions under the Paris Agreement.

Conclusion

Not since the introduction of the RMA in 1991 has environmental reform occurred on this scale. Overall, the forestry sector is reasonably well placed to accommodate these changes. The NES-PF has helped the sector become ‘match-fit’ to national direction so that it is generally in good condition to adapt to further changes that will inevitably flow from these reforms.

Many of the wider RMA system reforms appear to be favourable for the forestry sector. However, the NPS-FM and the NPS-IB will potentially lead to increased regulation of forestry activities.

Accordingly, it is important that foresters take opportunities to engage in discussions about freshwater management and indigenous biodiversity at the national and regional levels. Consistent and workable regulation of forestry activities seems a sensible goal, ideally via refinement to existing provisions within the NES-PF rather than through myriad new regional rules.

Disclaimer

This is a brief summary for information purposes only and is not legal advice.

References

Cabinet Paper. 2019 (November). *Public Consultation on the National Policy Statement for Indigenous Biodiversity*. Wellington, NZ: New Zealand Government.

Cabinet Paper. 2020 (May). *Action for Healthy Waterways – Decisions on National Direction and Regulations for Freshwater Management*. Wellington, NZ: New Zealand Government.

New Zealand Fish Passage Advisory Group. 2018. *New Zealand Fish Passage Guidelines for Structures Up to 4 Metres*. Wellington, NZ: NIWA and Department of Conservation.

New Zealand Government. 2017. *Resource Management (National Environmental Standards for Plantation Forestry) Regulations 2017*. Wellington, NZ: New Zealand Government.

New Zealand Government. 2019 (November). *Proposed National Policy Statement for Indigenous Biodiversity*. Wellington, NZ: Ministry for the Environment and the Department of Conservation.

New Zealand Government. 2020. *National Policy Statement for Freshwater Management 2020*. Wellington, NZ: Ministry for the Environment.

New Zealand Government. 2020. *Resource Management (National Environmental Standards for Freshwater) Regulations 2020*. Wellington, NZ: New Zealand Government.

Resource Management Review Panel. 2020 (June). *New Directions for Resource Management in New Zealand – Report of the Resource Management Review Panel*. Wellington, NZ: Ministry for the Environment.

Chris Fowler is a partner and Meg Buddle is a solicitor at Adderley Head – dedicated environmental lawyers and forestry specialists. Corresponding author: chris.fowler@adderleyhead.co.nz

Communicating forestry facts via hearts and minds

Michelle Harnett and Tim Payn

Planted forests play an important role in improving and maintaining water quality and in modifying water flows

Abstract

To combat some of the common misconceptions about plantation forests, the current science and knowledge around some of their lesser known benefits have been summarised in a series of fact sheets hosted on the New Zealand Forest Owners Association (NZFOA) website. The fact sheets focus on the environmental benefits (ecosystem services) provided by New Zealand plantation forests, and on the need to protect the environment through sustainable forestry practices. The information is accessible to anyone who is interested – landowners, owners and managers of small, medium and large forests, district and regional councils, and the public.

The environmental fact sheets are just one communication tool. Different approaches are needed for different audiences. Conversations between peers that place science (or the facts) in the context of what people value are one of the most effective and influential tools we have to change attitudes, opinions and behaviours.

Introduction

Pandemics, elections, or even whether or not to plant trees – who is telling the true story? Fake news, misinformation, carefully edited video clips, and other sources purporting to reveal a 'truth' that 'they' are trying to keep from you have been part of our daily information diet for most of 2020.

The ability of any one of us to generate and post content online allows people around the world to share collective interests and worldviews. However, there is no quality control. Blogs, social media, specialist websites and so on contribute to an environment that aids the spread of everything from unverified rumours to malicious lies. Just how (mis)information spreads through social media and other platforms is a rich field of study. Researchers are finding that information related to conspiracy theories, for example, generates homogenous and polarised communities (echo chambers) (Del Vicario et al., 2016).

People are more likely to share with internet friends influenced by similar social norms. The information shared also tends to be content that fits a specific narrative, or an individual's belief system (confirmation bias), regardless of whether it is true or not. Also, false beliefs, once adopted, are very difficult to correct. Social homogeneity is the primary driver of content spread and one frequent result is the formation of echo chambers (Del Vicario et al., 2016).

The narrative around the afforestation of less productive farmland in New Zealand is also heavy with misinformation. The claims of opponents to this practice range from food-producing land being blanket-planted in a sterile monoculture, to carbon plantings that will be ring-barked and left to rot away while 'foreign owners' take their profits out of the country.

The forestry industry is addressing some of the common misconceptions around plantation forests by looking at the national economic impacts of forestry. In the case of 'hard hill' country, plantation forestry and permanent carbon forestry generally offers greater returns than sheep and beef farming (PWC, 2020). However, this work does not consider some of the lesser known benefits of planted forests. Scion scientists working with the NZFOA and others have summarised the current science and knowledge around some of these in a series of fact sheets.

The fact sheets focus on the environmental benefits (ecosystem services) provided by New Zealand planted forests, and on the need to protect the environment through sustainable forestry practices. The information is evidence-based but, for ease of reading, key links and references have been included in a separate section. The information is accessible to anyone who is interested – landowners, owners and managers of small, medium and large forests, district and regional councils, and the public.

The environmental fact sheet series

The series of environmental fact sheets can be found at www.nzfoa.org.nz/resources/file-libraries-resources/environment/factsheets. Selected fact sheets are summarised below.

An introduction to forest ecosystem services

Forest ecosystem services are worth far more in total than the value of wood, fibre and fuel alone. Forest ecosystems are bring increasingly recognised in New Zealand for providing services that include climate change mitigation, habitats for native species, recreation, improved water quality, avoided sedimentation and flood mitigation. Together, ecosystem services contribute to prosperity and improved human wellbeing (Yao et al., 2019).

The less tangible ecosystem serves are often invisible in discussions around land use and in decision-making. These values can be used to represent ecosystem service values in planning and land management and use policy. For example, Scion, working with Wenita Forest Products, demonstrated the carbon sequestration and avoided erosion values of their forest estate relative to timber. The sum of the contributions of different services to the total value of the forest shows that the full value or benefit of planted forests can be greater than that of timber alone. This information has helped Wenita renew their product certification under the Forest Stewardship Council (Yao et al., 2017).

Forest soils and fertiliser use

Planted forests are typically located on low-fertility or steep terrain land that is not ideal for agriculture. It is important to look after planted forest soils as they provide benefits such as water filtering and regulating flooding by storing water. It is also important to maintain soil fertility. Fertiliser is not often used in forestry, but its use may increase in the future to boost productivity and/or maintain soil nutrient sustainability over successive rotations. There are also challenges in reducing soil loss through erosion in steep, erodible country, particularly during harvesting.

Forest water dynamics

Our forests provide sustainable sources of high-quality water. Water is an essential resource providing a wide range of economic, ecological, cultural, social and recreational benefits to all New Zealanders. The demand for water is increasing with the intensification of New Zealand's primary sector and the country's growing population and urbanisation. With government tree planting initiatives and the forestry industry's desire to intensify production, planted forests are increasingly seen as a competitor for water resources by downstream users.

The country's 1.7 million ha of planted forests contain an estimated 24,220 km of streams. For most of the forest growing cycle, forested catchments provide downstream benefits, with the potential to supply water during the spring and summer and regulate streamflow during storm events. Water use research shows that even in the driest parts of New Zealand, there is still available water in catchments planted in radiata pine. The water dynamics of planted forests is an area of intense study and the focus of the Scion-led Forest Flows programme – www.scionresearch.com/forestflows

Debris flows

A debris flow is a rapid surging flow of saturated woody debris in a steep channel. They contain very high sediment concentrations by weight and are much more powerful and destructive than water alone. More sediment and water can be accumulated along the flow path, enabling debris flows to 'grow'. Recent highly visible debris flows have drawn media attention and increasing concern about the environmental effects of debris flows and steepland planted forestry.

Landslides and debris flows are natural processes and it is not feasible to stop them completely. However, the New Zealand forestry industry is responding to the challenge of managing debris flows to minimise impacts within and beyond the forest (see, for example, NZFOA, 2020) using a combination of strategies. These include narrowing the window of vulnerability through:

- Rapid replanting
- Targeted riparian zone management, especially on the lower parts of slopes, fans or where steep channels flatten out as they become unconfined on fans or flood plains
- Retiring areas recognised as having a very high risk of debris flows into permanent forest cover
- Better data and models to assess risk and mitigation options.

Response of a stream ecosystem to debris flows

Coincidentally, the opportunity to study the recovery of a riparian and stream ecosystem after harvesting and extreme rainfall has given us an insight into how forest waterways recover in a worst case scenario (Baillie et al., 2020). Five years after an unexpected debris flow, the invertebrate community in the stream was similar to that prior to harvest. Some fish species had thrived post-event, but others were rare or absent, showing that recovery is a dynamic process. Management practices that enhance and protect riparian vegetation recovery and the re-introduction of large stable pieces of wood into the stream can assist the stream recovery process.

Biodiversity in planted forests

The mix of planted forest stand and native ecosystem remnants that make up New Zealand planted forests are home to many other species, including kiwi, karearea and at least 120 other threatened indigenous species (Pawson et al., 2010). The flora and fauna include shade-tolerant and understorey plants, aquatic organisms, insects, carnivorous snails, other invertebrates, lizards, frogs, birds and bats. Planted forests can function as a haven for some species in highly modified landscapes where they are often the only forest habitat. In fragmented landscapes, planted forests can become parts of corridors that facilitate species movement between otherwise isolated native forest patches and other habitats.

The number of species recognised in planted forests will increase with further research and observation, as will our knowledge of how they contribute to and interact in the planted forest environment. Forest owners and managers can identify, map and manage areas of significant indigenous biodiversity, and develop programmes that take into account local environmental, ecological and cultural conditions.

Planted forests and carbon

Planting trees and forests is one of the best immediate responses to climate change. Sustainably grown trees capture carbon dioxide from the atmosphere to grow and the carbon is stored in the forest biomass. Wood products and buildings continue to store carbon

The largest population of the karearea (or New Zealand bush falcon) is found in Kaingaroa Forest. Planted forests are favoured for their high prey density and the availability of nesting sites in clear-felled pine blocks. Photo courtesy of Bryce McQuillan

Timber buildings are carbon stores. Scion's new building constructed around diagonal grids of laminated veneer lumber (LVL) is storing approximately 0.418 Mt of CO_2-e, the equivalent to the emissions from 160 return flights from Auckland to London

for their lifetime. Trees also provide energy alternatives that can substitute for fossil fuels. Also, timber and other wood products are low carbon footprint materials compared with concrete and steel. The carbon uptake by forests can also be used to offset emissions from other sources. Society needs sustainable sources of energy and raw materials and trees are a sound, sustainable option that we can put into service right now.

Overall, forestry is a net benefit to New Zealand's emissions profile. The industry does emit some carbon dioxide (0.51 Mt CO_2-e), mainly from harvesting, transport and processing, but this is less than 1% of New Zealand's total annual emissions. Emissions of nitrous oxide and methane are very low compared with other primary sector land uses. New Zealand wood processing is also the largest user of solid biofuels for energy generation in the country. Sawdust, bark, shavings and forest residues are used or heat generation in mills and other plants. Some of the larger mills have combined heat and power plants and produce some (or all) of their electricity as well.

Carbon uptake by forests planted since 1989 has also offset about 30% of New Zealand's total emissions between 2008 and 2017. The One Billion Trees programme is calculated to contribute around 20% of the net emissions reductions needed for New Zealand to reach its Paris target by 2030.

Better communication

The environmental fact sheets are just one communication tool. Taking lessons from those involved with communications around childhood vaccination (Leask et al., 2012), different approaches are needed for different audiences. The first is to avoid reflexively correcting what you believe is wrong, an approach that can have the opposite effect and entrench beliefs even further. The second is to decide whether or not it is worthwhile to engage. It is very hard to change fixed beliefs and your energy may be better spent elsewhere. Sometimes it can be best to just agree to disagree if your relationship with the person is important to you.

What is recommended is starting with common ground, listening and asking questions. Acknowledging that someone's concerns are real and that this shows they care about an issue can go a long way. For example, when it comes to afforestation, most people want to look after their land and pass it on to future generations. Concerns that a way of life might be lost with increased tree planting are valid. Then, offer to share factual information and make it personal if possible.

An example could be: 'I believe planting trees is important because my steeper land is eroding badly.' This could be followed by an invitation to talk further. This is neatly summed up by Taylor and Harnett (2020): '… to drive behaviour change … will require conversations around the dining table.' Having conversations between peers that place science (or the facts) in the context of what other people in our social networks value and do is one of the most effective and influential tools we have to change attitudes, opinions and behaviours.

References

Baillie, B.R., Evanson, A.W., Kimberley, M.O. and Bergin, D. O. 2020. Combined Effects of an Anthropogenic (Forest Harvesting) and Natural (Extreme Rainfall Event) Disturbance on Headwater Streams in New Zealand. *Freshwater Biology*. https://doi.org/10.1111/fwb.13584.

Del Vicario, M., Bessi, A., Zollo, F., Petroni, F., Scala, A., Caldarelli, G. … and Quattrociocchi, W. 2016. The Spreading of Misinformation Online. *Proceedings of the National Academy of Sciences*, 113(3): 554–559.

Leask, J., Kinnersley, P., Jackson, C., Cheater, F., Bedford, H. and Rowles, G. 2012. Communicating With Parents About Vaccination: A Framework for Health Professionals. *BMC Pediatrics*, 12(1): 154.

New Zealand Forestry Owners Association (NZFOA). 2020. How We Aim to Prevent Debris Floods. *New Zealand Forestry News Bulletin* (Spring): 6–7.

Pawson, S.M., Ecroyd, C.E., Seaton, R., Shaw, W.B. and Brockerhoff, E.G. 2010. New Zealand's Exotic Plantation Forests as Habitats for Threatened Indigenous Species. *New Zealand Journal of Ecology*, 342–355.

PWC. (2020). *Economic Impact of Forestry in New Zealand*. Report prepared for Te Uru Rākau, PWC, Wellington, NZ.

Taylor, S. and Harnett, M. 2020. Landowner Attitudes to Afforestation in the Hawke's Bay Region of New Zealand. *New Zealand Journal of Forestry*, 65(2): 21–27.

Yao, R.T., Harrison, D.R. and Harnett, M. 2017. The Broader Benefits Provided by New Zealand's Planted Forests. *New Zealand Journal of Forestry*, 61(7): 7–15.

Yao, R., Palmer, D., Hock, B., Harrison, D., Payn, T. and Monge, J. 2019. Forest Investment Framework as a Support Tool for the Sustainable Management of Planted Forests. *Sustainability*, 11(12): 3477.

Michelle Harnett is Senior Communications Advisor at Scion based in Rotorua. Tim Payn is a Principal Scientist at Scion and Professor of Forestry at the Toi Ohomai Institute of Technology in Rotorua. Corresponding author: michelle.harnett@scionresearch.com

Discount rates used for forest valuation – results of 2019 survey

Bruce Manley

Abstract

A total of 22 forest valuers responded to the survey and provided information on 33 New Zealand and two Australian transactions in 2018 and 2019. The average reported implied discount rate (IDR) for the New Zealand transactions is in the range 3.2% to 8.5% for current rotation post-tax cashflows and 4.1% to 11.5% for pre-tax cashflows. Overall, averages are 6.1% (post-tax cashflows) and 7.3% (pre-tax cashflows), compared to 7.0% and 7.6% in the 2017 survey. IDRs for the transactions of medium or large forests are, on average, lower than for small (<1,000 ha) forests; 6.0% vs 7.8% for current rotation pre-tax cashflows.

Forest valuers also provided the discount rate they use to estimate the market value of a forest. Valuers apply an average discount rate to current rotation pre-tax cashflows of 7.3% for medium/large forests and 7.9% for small forests. Some 20 of the 22 valuers included in the 2019 survey also participated in the 2017 survey. There has been an average reduction of 0.4 percentage points in discount rate for 19 valuers of New Zealand forests and 0.3 percentage points for six valuers of Australian forests. However, on average, valuers are using higher discount rates to value medium/large forests than is evident from the IDRs of transactions.

Introduction

Forest valuers were surveyed during the last quarter of 2019 about the discount rate used for forest valuation. The survey is an update of similar surveys carried out every two years since 1997. Although the last full survey was carried out in 2017 (Manley, 2018), a much simplified survey was undertaken in 2018 (Manley, 2019) to clarify the effect of forest size on discount rate. Some 22 forest valuers were surveyed.

Responses to survey questions

1. Method used to determine the market value of a forest

All 22 valuers use the Income (Expectation Value) approach to determine the market value of a forest. Many valuers use a suite of approaches and also the Cost approach and, in some cases, the Sales Comparison approach. One valuer noted that:

'If and where useful comparable sales material is available, that would be considered. However, it usually is not available or is not readily comparable apart from through IDR calculations.'

Four valuers blend the Income and Cost approaches for young stands, including one between ages five and 10 years, and another between ages five and 15 years. Five valuers make some use of the Liquidation approach for mature stands. This is essentially the same as using the Income approach with all harvesting at time zero.

Use of the Cost approach

The Cost approach is sometimes used by 18 of the valuers for valuing young stands and in other limited circumstances. For example:

'When there is a significant component of young trees and at least some of the inputs to the future cashflows (yields, costs, log prices and markets) have a relatively high degree of uncertainty. Also as a sense check on discounted cashflow (DCF) for young forests/stands – seeing how the two curves align.'

'Only used if crop replacement cost is greater than expectation value; i.e. cost is used as the minimum value.'

'When net present value (NPV) is negative.'

'Limited to predominantly young under-developed areas from a market perspective.'

'Only used when considering the value of very young stands within a forest estate that is predominantly immature. If considering a more normalised forest estate, then the young stands are valued as part of the overall DCF.'

'In young stands where the value derived by Income approach is less than replacement cost (does not meet willing buyer/willing seller expectations). Minor species if there is a lack of established markets to evidence costs and revenues.'

'Young radiata pine forests and young or mid-rotation alternative species.'

'Rarely used. Only when an investment is a greenfield plantation for an emerging market crop like exotic hardwoods.'

Follow-up questions were answered by the 18 valuers who sometimes use the Cost approach (Table 1).

Table 1: Components included by valuers who use the Cost approach to forest valuation

Component included	Yes	No	Sometimes
Indirect costs (e.g. supervision)	16	1	1
Overhead costs	15	2	1
Cost of using land	13	4	1
Cost of time	17	1	

Thirteen of the valuers use pre-tax costs, four use post-tax costs, while one uses both. One valuer uses post-tax costs because 'the tax benefit has crystallised and been realised.'

All valuers who include the cost of time use a lower rate to compound costs than they do to discount cashflows in the Income approach. However, a wide range of rates is used. Respondents reported using rates of 1.0% to 6.0% on pre-tax costs and 1.0% to 5.0% on post-tax costs. The average rate was 3.4% (3.8% in 2017) for pre-tax costs and 3.5% (3.4% in 2017) for post-tax costs.

2. Discount rate used to estimate the market value of a tree crop (or forest)

Some 20 of the 22 surveyed valuers value New Zealand forests, while eight value Australian forests. Of the 20 valuers of New Zealand forests, three apply the Income approach using only post-tax cashflows, 12 use only pre-tax cashflows, while five use both.

Average discount rates are presented in Table 2. There is only a small number of responses for some of the 16 combinations of country, forest size, type of cashflows and number of rotations. The most precise comparison is when responses are considered only from valuers providing a response for both discount rates in each comparison. These comparisons indicate that:

- Lower discount rates are generally used for medium/large forests compared to small forests (Table 3)
- Lower discount rates are generally used for multiple rotations compared to current rotation (Table 4)
- There is no consistent difference between the discount rates used for New Zealand forests compared to Australian forests (Table 5). One valuer noted that 'the rates applied to Australia have typically been very similar to New Zealand but recent fire events are likely to require a reassessment of this.'

Table 2: Discount rates being used to value forests by country (New Zealand vs Australia), size (small vs medium/large), type of cashflow (pre-tax vs post-tax) and number of rotations (current rotation vs multiple rotations)

New Zealand	Discount rate applied to post-tax cashflows		Discount rate applied to pre-tax cashflows	
	Current rotation	Multiple rotations	Current rotation	Multiple rotations
Small forests (<1,000 ha)	7.1 (6) 6.0–9.0	6.9 (2) 6.25–7.5	7.9 (14) 6.0–10	7.7 (7) 6.0–10
Medium/large forests (>1,000 ha)	6.2 (6) 5.0–6.7	6.3 (3) 6.0–6.7	7.3 (14) 6.0–9.0	7.2 (9) 6.0–8.5

Australia	Discount rate applied to post-tax cashflows		Discount rate applied to pre-tax cashflows	
	Current rotation	Multiple rotations	Current rotation	Multiple rotations
Small forests (<1,000 ha)	7.5 (1) 7.5–7.5	7.0 (1) 7.0–7.0	8.8 (3) 6.5–10	7.3 (3) 6.0–8.5
Medium/large forests (>1,000 ha)	6.9 (2) 6.5–7.25	6.6 (2) 6.0–7.25	7.8 (6) 6.0–9.0	7.3 (7) 5.5–9.0

Note: The results presented for each cell are the average with the number of respondents in brackets. The second row in each cell contains the range across all respondents. Some valuers provided a range of values.

Table 3: Differentials in discount rate for forest size using paired comparisons from valuers who provided a response for both discount rates in a comparison. Differentials are calculated as discount rate for small forests (<1,000 ha) minus discount rate for medium/large forests

	Post-tax		Pre-tax	
New Zealand	**Current**	**Multiple**	**Current**	**Multiple**
Differential	1.05	1.50	0.80	0.51
Respondents	5	1	12	7
Australia				
Differential	1.00	1.00	0.50	0.17
Respondents	1	1	2	3

Table 4: Differentials in discount rate for rotations using paired comparisons from valuers who provided a response for both discount rates in a comparison. Differentials are calculated as discount rate for current rotation minus discount rate for multiple rotations

	Post-tax		Pre-tax	
New Zealand	**Small**	**Large**	**Small**	**Large**
Differential	0.50	0.25	0.25	0.19
Respondents	1	2	6	8
Australia				
Differential	0.50	0.25	0.50	0.52
Respondents	1	2	2	6

Table 5: Differentials in discount rate for country using paired comparisons from valuers who provided a response for both discount rates in a comparison. Differentials are calculated as discount rate for Australian forests minus discount rate for New Zealand forests

	Post-tax		Pre-tax	
Small	**Current**	**Multiple**	**Current**	**Multiple**
Differential	−0.50	−0.50	−0.25	−0.17
Respondents	1	1	2	3
Medium/large				
Differential	0.28	0.28	0.15	−0.06
Respondents	2	2	5	6

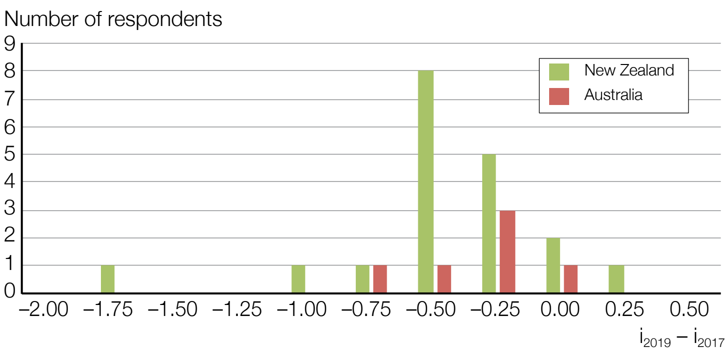


Figure 1: Frequency of change in discount rate from 2017 to 2019 for individual valuers

Has the discount rate used by valuers changed since 2017?

Some 20 of the 22 valuers included in the 2019 survey also participated in the 2017 survey. Figure 1 gives the frequency distribution of the change in discount rate. The average change for the 19 valuers of New Zealand forests is a reduction of 0.4 percentage points, with a reduction of 0.3 percentage points for the six valuers of Australian forests.

3. How is the discount rate selected?

Valuers base discount rate on a range of information sources, with many valuers using multiple sources:

- Nine valuers use IDRs, while another four use unspecified ‘market evidence’
- Seven valuers use the results of this survey, while another two use opinions from other valuers
- Five valuers use investor input or expectations
- Four valuers use CAPM/WACC
- One valuer uses consistency as the basis for deriving discount rate
- One valuer uses discount rates from company reports
- One valuer uses the cost of funds.

4. How are log prices determined?

Some valuers (eight out of 22) use constant prices for all years when forecasting cashflows. These are based on a 12Q average (six valuers), a 6Q average (one valuer) or the current price (one valuer). However, most valuers (14 out of 22) transition over two to six years from current prices (or a 4Q or 12Q average) to a 12Q/20Q average (eight valuers) or forecast prices (six valuers). Examples of the latter include:

‘Start with current prices with an index applied for the first five to six years, then flat. The index is derived for China A grade and based on a CFR forecast with forecast FX and shipping. Domestic prices are assumed to move at 50% of the export index. A separate index is determined for small logs.’

‘Current prices are a 12 month inflation adjusted average of actuals, future trends are derived from econometric forecasting models for export and domestic markets.’

‘Future price projection is based on estimated supply and demand.’

‘The price assumed in the first period of the model is our expectation of what prices will be over the next 12 months. Longer-term prices (five + years) generally return to trend or return to historic average (three to five years, real). We also have developed a supply-demand ‘first principles’ econometric model as a further check on the assumed prices.’

'Australia domestic pricing typically follows an indexation formula – our price projections will then be based on forecasts of the individual components of the formula (fuel, CPI, log price indices, lumber prices indices etc). Generally, though, these will be close to flat real.'

5. How is the cost of land accounted for in valuing a tree crop?

Most valuers (19 out of 22) include the opportunity cost of land for all tenures. On leasehold land, the actual rental is commonly used as the cost of land, whereas for freehold land a notional land rental is applied. Twelve valuers calculate land rental as a percentage of land market value (LMV). The percentage varies from 3.0% to 7.5%, with an average of 4.4%. Two valuers calculate the land rental as a percentage of land expectation value (LEV), while another uses a notional rental of \$150/ha/yr.

Seven valuers, including three who also sometimes use a percentage of LMV, estimate the notional land rental using a range of sources including:

- Forest land rentals for leases, forestry rights and Crown Forestry Licence rentals
- Land valuers.

Three valuers do not include a notional rental for freehold land. For example, one said: 'Actual rentals are used for lease and forestry rights. Freehold assets are assumed to have no land costs other than direct costs such as land rates.'

6. Do you include cashflows from only the current crop?

When estimating the market value of a tree crop, 10 valuers only include cashflows from the current crop. A further three valuers only include cashflows from future rotations in special circumstances:

'When there are replanting obligations and for sense checking future rotations.'

'If undertaking feasibility analysis or instructed to do so.'

'If the owner is looking for a long-term investment or there is a 99-year lease for example.'

While one valuer only does multiple rotation valuations, eight valuers routinely undertake both multiple rotation as well as single rotation valuations:

'Our approach is to attempt to mirror the practice of market participants. In most cases, transactions are on the basis of an ongoing investment model. For a TIMO this may be a 10–20 year horizon, with a terminal value, i.e. a perpetual model is applied. In other cases, the investment may be a single rotation forestry right, or a rational decision may be to convert the land to an alternative land use. In this situation future rotations will not be considered. Even if we use a perpetual model, we are required to examine the cashflows arising from the current rotation only in order to fulfil the requirements of the financial reporting standard.'

'The market value of the forest estate is determined based on the land use rights for the property – freehold will be perpetual, one-rotation forestry rights will be existing rotation. The tree crop is then derived by deducting land value. For IFRS-compliant tree crop valuation, the current crop only is used with the discount rate derived by imputation to ensure that tree crop value plus LMV = multi-rotation market value of estate.'

'Multiple rotations are valued where the property interest being appraised is the freehold interest; that is, the property owner owns both the land and the timber. In this case, for IFRS purposes, the value of future rotations contributes to the land value, whereas the value of the value of biological assets is limited to the current rotation.'

'Multiple rotations are valued if there is a legislative requirement to replant or the future rotation is expected to be NPV positive. The current rotation is only considered if the land is planned to be sold or returned to the land owner.'

Nine valuers include a terminal value in multiple rotation valuations. These are typically calculated by assuming that the average of cashflows for a period prior to termination apply. The averaging period varies from the last year to the last rotation. One valuer noted:

'Forecasts cashflows for 60 to 80 years with a terminal value included where the land use right permits ongoing forestry. The terminal value is based on an average cashflow and is dependent on the estate. For a regular constant harvest the average of the last five years of cashflows is used. For irregular harvest, the term used to estimate the average cashflow can be up to the forecast horizon.'

7. Do you separately distinguish the value of roads and buildings from the value of land?

Only two valuers distinguish the value of roads and buildings. One values roads at depreciated construction cost, while the other uses a market estimate at the start of a rotation in cutover state. Four valuers stated that the value of roads was not included with the value of land. Rather, the value of roads was captured in the crop value through avoided costs. For example, one valuer stated:

'The value of the land is separated, but we do not generally separate out the value of roads, buildings etc. Their value is intrinsically embedded in the value of the asset by way of an avoided cost (so is typically

part of the tree crop value). In principle, a notional rental could also be included in the cashflows for these components, but this is infrequently applied.'

8. When do you assume that cashflows occur?

Different conventions are assumed for the timing of cashflows:

- Start of a period – four valuers
- Middle of a period – 12 valuers
- End of a period – three valuers
- Mixture – three valuers:
  - – Start (annual costs), end (revenues), whenever they occur but usually start (operational costs)
  - – Throughout the year
  - – Start for costs, middle for revenues.

9. Do you apply a stand-based or estate-based approach?

Seven valuers follow a stand-based approach, while seven valuers adopt an estate-based approach. Eight valuers use both approaches depending on the nature (size, age-class distribution) of the forest being valued.

10. Treatment of risk

Twelve valuers primarily (and a further three valuers occasionally) include risk in the cashflows by adjusting areas, yields, costs or prices. For example:

'Factor risk into cashflows: area attrition, yield adjustment, costs and revenues, and include insurance.'

'We consider the following key value drivers:

- *Stability of existing cashflows*
- *Status of market access arrangements*
- *Market risk*
  - *– Price volatility*
  - *– Lack of existing log or chip sales evidence*
- *Robustness of resource description (area, yield)*
- *Biotic and abiotic risk*
- *Stumpage margin (low margins more sensitive to changes in prices or costs).*

Where these inputs can't be effectively accounted for in the forest estate model inputs, then the discount rate is adjusted.'

'We use @Risk modelling to place a range around the main variable assumptions usually discount rate, roading costs, logging costs, log pricing, log yields.'

'We project cashflows according to our perception of what typical buyers would project, assuming they are prudent but nevertheless optimistic enough to win the bid.'

Eight valuers use discount rate as the principal means of adjusting for forest-specific risk. A further six valuers use the discount rate as a secondary means to adjust for risk. Some examples include:

'We apply lower discount rates for larger estates that are well described, close to maturity and markets compared to a younger, poorly described small forest a long distance from markets.'

'Where the property suffers (or benefits) from above- (or below-) average risk due to markets, political risk, reputation as a world class investment, or other factors.'

'The discount rate is adjusted to compensate for non-quantifiable risk, usually in the order of 0.5% to 1.0%.'

'Discount rate is applied to factor in unknowns for the forest – better defined forests are valued with a lower discount rate.'

11. Method used to determine the market value of the carbon trading opportunity

Fifteen valuers have valued the carbon trading opportunity (i.e. the value of the opportunity to receive NZUs and the liability to surrender NZUs as carbon stocks increase or decrease) associated with a tree crop on post-1989 forest land. Another valuer noted that it is, 'currently not relevant for Australia – may change with the Plantation Forestry Method introduced into the Emission Reduction Fund.'

The Income approach is the method used by 13 of the 15 valuers. The other two valuers consider only carbon immediately available for sale. One valuer said, 'Mostly looking at what is available for sale immediately. Legislation change has made future-looking a little nervous.'

12. Discount rate used to estimate the market value of the carbon trading opportunity

Discount rates used vary:

- Seven valuers use the same discount rate for valuing the carbon trading opportunity as for valuing the tree crop. One of these valuers noted that:

  'We have used a similar rate to that used for valuing the forest (7%) but believe in some circumstances there is an argument for using a lower rate equivalent to the cost of financing. This is because trading carbon can be more akin to a loan which needs to be paid back in the future. Averaging assumptions and the choice of harvesting strategy can however negate that.'

- Two valuers use a discount rate similar to that used for valuing the tree crop:

  '6.5% for established Carbon Accounting Areas, 7.5% for land not yet in the NZ-ETS.'

  'We assume a discount rate of 7–9% based on the risk associated with forward pricing contracts,

ongoing long-term costs, and carbon volume calculations.'

- Three valuers use a discount rate for carbon that is higher:

'15% to reflect the additional risks associated with the volatility in the NZU market, and the element of political and legislative influence on the ETS.'

'10% to 12% based on the analysis of blocks sold for carbon.'

'Have used 10%, but may lower this as ETS gets more certainty. Possibly will use same as that for tree crop.'

- One valuer uses a lower discount rate for carbon:

'Discount rate reflects the rate a forest owner could earn on the money invested in a risk-free investment. Generally use government bond rates of the appropriate term.'

13. How do you determine the carbon prices used?

Carbon prices are based on:

- Current prices or spot and forward contract prices by nine valuers
- 12 quarter averages by two valuers
- 'Growth history over last five years, projected on same track forward, but constrained by price caps or price floors' by one valuer
- 'Proprietary carbon pricing curve' by one valuer.

14. What carbon trading strategy is assumed?

Ten valuers normally assume that only 'safe' units are sold, including two who stated:

'The trading strategy depends on the strategy of the forest owner – if simply a reporting valuation then will assume safe carbon only is sold.'

'Tend to present several options, but don't typically attach much weighting to the scenario of trading all units. New legislation imposes an averaging approach on all new planting.'

Three valuers assume that all carbon units are sold. One of these assumes that 'all NZUs are traded subject to the constraint that stumpage revenue covers surrender liability.'

15. How is the cost of land accounted for in valuing the carbon trading opportunity?

Only four valuers partition land rental between the tree crop and carbon trading opportunity. One assumes that the 'Cost of land (removing any value associated with carbon to the land) has a market rental assigned to the tree crop, with the carbon opportunity valued separately.'

Two of the valuers who don't normally partition the land cost commented that:

'No, we generally assume the carbon trading opportunity is tied to the tree crop and in particular the first rotation. Future rotations will have no carbon trading opportunity, and this is what we would base our land rental on.'

'We have done this in isolated examples – should be applied to all.'

Another valuer likened the partitioning of land rental between crop and carbon trading opportunity to 'angels on the head of a pin stuff.'

16. Discount rate implied by recent transactions

Information provided by nine valuers on estimates of the IDRs for 33 New Zealand and two Australian transactions is collated in Table 6. In summary, for the New Zealand transactions:

- The range of IDRs (applied to current rotation post-tax cashflows) in the 2019 survey is 3.2% to 8.5% (14 transactions), with an average of 6.1%. In the 2017 survey the range was 4.0% to 9.2%, with an average of 7.0%
- The range of IDRs (applied to current rotation pre-tax cashflows) in the 2019 survey is 4.1% to 11.5% (23 transactions), with an average of 7.3%. In the 2017 survey the range was 4.8 to 13.6%, with an average of 8.6%.

One valuer provided two IDRs for some transactions of small forests. This was where the vendor negotiated a price, subject to due diligence, then found more volume/area etc. The discount rate reported here is the IDR calculated from the initial information used to determine the price paid, rather than the higher IDR subsequently calculated using the higher volume/area.

Replanting and new planting

17. What discount rate do you use to evaluate replanting or new planting investments?

All but one of the 17 valuers who responded to this question use the same (or a similar) discount rate to that for forest valuation.

18. What is your estimate of the IRR on new planting?

Results are shown in Table 7. There is variation between valuers and regions, although one valuer argued that, 'There is no real regional variability as the returns are equalised by varying land costs.'

The estimated increase in IRR from carbon trading is generally in the range 2.0% to 4.0%. However, one valuer stated that, 'Carbon return is competed into land price so returns are the same or below those without carbon.'

Table 6: Estimates of the discount rate implicit in the transaction price of forests or interests in forests sold during 2018 and 2019. Forests are described by location and size class (small <1,000 ha; medium 1,000 to 10,000 ha; large >10,000 ha). Where there are multiple respondents for a transaction the average is reported together with the range

	Size	Location	Number of respondents	IDR applied to post-tax cashflows		IDR applied to pre-tax cashflows	
New Zealand				Current rotation	Multiple rotations	Current rotation	Multiple rotations
1	Small	Northland	1			6.5	
2	Small	CNI	1	3.5		4.8	
3	Small	CNI	2	6.9		9.1	7
4	Small	CNI	1	6.7		8.3	
5	Small	East Coast	1	8.2		9.4	
6	Small	Hawke's Bay	1				7.5
7	Small	Hawke's Bay	1			5	
8	Small	Hawke's Bay	1			7.5	
9	Small	Wairarapa	1			7.7	
10	Small	Wairarapa	1				7.1
11	Small	Wairarapa	1				7.5
12	Small	SNI	2	4.5		6.1	7.7
13	Small	SNI	1				7.5
14	Small	SNI	1	5.5		7.5	
15	Small	SNI	1	8.3		11	
16	Small	Marlborough	1				8
17	Small	Marlborough	1				7.7
18	Small	Marlborough	1				7.5
19	Small	Marlborough	1	8.5		11.5	
20	Small	Marlborough	1	8.1		10.4	
21	Small	Nelson	1	5.4		7.4	
22	Small	Nelson	2	7		8	
23	Small	Canterbury	2	3.2		5.2 (3.7–6.8)	6.1
24	Small	North Island	1			7	7.4
25	Medium	CNI	1			6.2	
26	Medium	Wairarapa	1				7
27	Medium	SNI	1				6
28	Medium	SNI	2			5.4	6.1 (5.4–6.8)
29	Medium	Otago	4	4	5	4.5 (3.6–5.5)	5.9 (5.2–6.5)
30	Medium	Southland	2			7.5	6.5
31	Large	East Coast	4	4.9	4.6	4.1	6.6 (5.8–7.4)
32	Large	Otago	1				7.2
33	Large	NZ wide	2			8.1	7.3 (6.7–7.9)
Australia							
1	Medium	Hardwood	1			7.4	
2	Large	Hardwood	1				6.9

Table 7: Estimates of IRR of radiata pine replanting or new planting by region – the carbon add-on column gives the estimated increase in IRR when carbon trading costs and revenues are included

	New Zealand											Australia	
Valuer	NZ	North Is	North -land	CNI	East Coast	Hawke's Bay	SNI	Nelson/ Marlbor.	Canter -bury	Otago/ Southland	Carbon add-on	Radiata pine	Eucalyptus
1	5–7												
2	3–5										2–3		
3			5–7	7–9	5–7		6.5–7						
4	6										2		
5						7–11					11		
6								3.5–4.5			2		
7			6–7	6.5–8			6–7	6–7.5	4–5	5–7			
8				6							4		
9						6					2		
10	5–7												
11								6–8			4		
12	6–8										2	4–6	
13													3–10
14	6.5												
15								4			1.5		
16	4–5												0–12
17					4–7	5–8	4–7						

Discussion

Trends in IDR

Figures 2 and 3 show the IDRs (applied to current rotation post-tax cashflows and pre-tax cashflows respectively) of transactions reported in all 12 surveys to date. Note that IDRs for each transaction have been averaged in the cases where there was more than one respondent.

The average discount rate implied is:

- 6.1% for post-tax cashflows in 2019 compared to 7.0% in 2017:
  - 4.5% for medium/large forests in 2019 compared to 5.8% in 2017
  - 6.3% for small forests in 2019 compared to 7.2% in 2017
- 7.3% for pre-tax cashflows in 2019 compared to 7.6% in 2017:
  - 6.0% for medium/large forests in 2019 compared to 5.9% in 2017
  - 7.8% for small forests in 2019 compared to 8.4% in 2017.

The differences in IDR between the medium/large and small forests in the 2019 survey are most evident in Figure 3, where the IDRs for six medium/large transactions are all in the bottom half of the range. Obviously, caution must be exercised. Although nine medium/large transactions were reported in this survey, IDRs for current rotation pre-tax cashflows were provided for only six transactions, while IDRs for current rotation post-tax cashflows were provided for only two. However, the reduction in the average discount rate for all forests is a continuation of the trend in recent years from 8.9% in 2013 to 8.6% in 2015 to 7.6% in 2017 to 7.3% in 2019 for pre-tax cashflows. For post-tax cashflows the trend has been from 7.3% in 2013 to 6.9% in 2015 to 7.0% in 2017 to 6.1% in 2019.

Figure 2: IDRs (applied to current rotation post-tax cashflows) for transactions reported in each of the discount rate surveys. Forests are identified by size class (small <1,000 ha; medium 1,000 to 10,000 ha; large >10,000 ha)

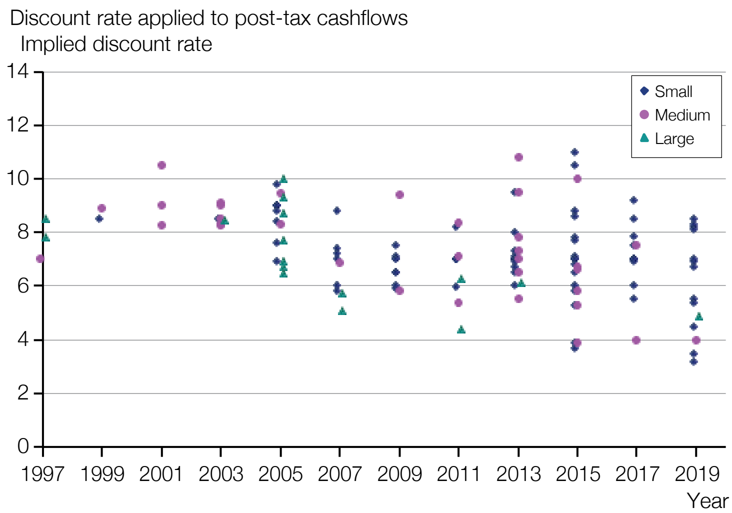
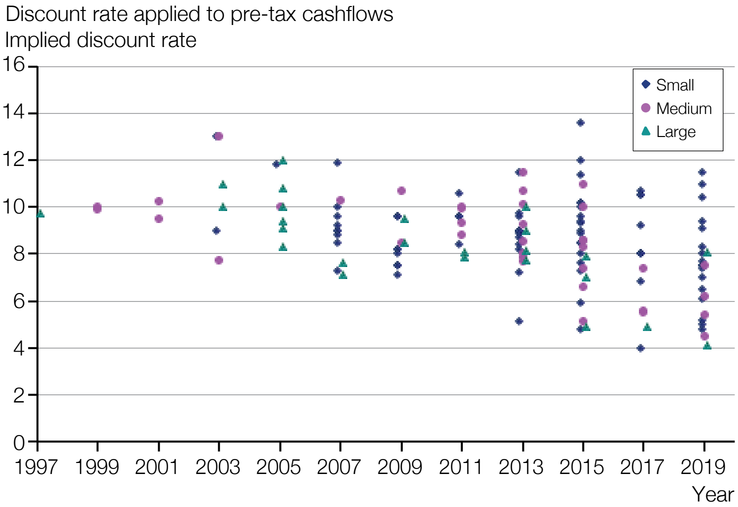


Figure 3: IDRs (applied to current rotation pre-tax cashflows) for transactions reported in each of the discount rate surveys. Forests are identified by size class (small <1,000 ha; medium 1,000 to 10,000 ha; large >10,000 ha)



Discount rates declared in financial reporting

Discount rates being used for financial reporting have also reduced further since 2017 (Table 8). Average reported discount rate for pre-tax cashflows for the 16 companies documented in Table 3 has reduced from 7.5% in 2017 to 7.1% in 2018 to 7.0% in 2019.

Comparison to Sewall survey

US forest valuation company James W. Sewall Company regularly carries out its own survey of discount rates. In the last Sewall Investor Survey undertaken in March/April 2019 there were 28 responses from active investors to the question 'What is the "base" discount rate (real, pre-tax, before TIMO fees & expenses) required to acquire generic timberland investments in the U.S. now?' The mean response was 5.07%, lower than the average of 5.23% for the Sewall December 2017 survey.

Respondents were subsequently asked to 'Provide the discount rate premium over the U.S. base rate' for a range of international forest investments. For New Zealand pine the premium was 0.91% (mean), similar to 0.95% in 2017. For Australian planted pine the premium was 1.18%, compared to 1.05% in 2017. For Australian planted eucalypt it was 1.31% compared to 1.83% in 2017.

The discount rates in the Sewall Survey are applicable to multiple rotations, rather than just the current rotation. IDRs for multiple rotation pre-tax cashflows were reported for eight New Zealand and one Australian medium/large forests in the 2019 NZIF discount rate survey. The IDRs for the New Zealand transactions are 5.9 to 7.0%, which just overlaps the mean of 6.0% for the Sewall survey. The IDR for one Australian hardwood transaction is 6.9% compared to the Sewall mean of 6.4%.

IDR vs IRR

Table 4 indicates that valuers are generally using lower discount rates when valuing cashflows from

Table 8: Discount rates declared in financial reporting for New Zealand-registered companies with annual reports in the public domain. All rates are applied to current rotation pre-tax cashflows (apart from City Forests which uses current rotation post-tax cashflows)

Company	Reporting	2014	2015	2016	2017	2018	2019
China Forestry Group	31 Dec	8.2	8.2	8.2	8.0	7.5	7.5
Greenheart NZ	31 Dec	8.5	8.5	8.5	8.5	7.5	7.5
GTI 8 New Zealand	31 Dec	8.5	8.5	8.0	7.5	7.0	7.0
Invercargill City Forests	30 June	9.5	8.5	8.0	7.5	6.75	6.5
Kaingaroa Timberlands	30 June	7.5	7.5	7.0	6.5	6.25	6.25
Matariki Forestry Group	31 Dec	8.5	8.5	8.0	7.75	7.5	6.5
Nelson Forests	31 Dec	8.5	7.5	7.5	7.0	7.38	7.5
Oregon Group (Ernslaw One)	30 June	8.5	8.0	8.0	8.0	7.5	7.25
OTPP	31 Dec	8.0	7.75	7.75	7.5	7.37	7.06
Pan Pac Forest Products	31 March		8.0	7.5	7.25	7.0	7.0
SunChang Forestry NZ	31 Dec	8.7	8.7	8.6	8.6	7.6	7.6
Taumata Plantations Ltd	30 June	8.5	7.5	7.5	7.25	7.25	7.0
Te Waihou Plantations	31 Dec	8.5	8.5	8.0	8.0	7.0	7.0
Tiaki Plantations	30 June	7.5	7.25	6.75	6.5	6.5	6.5
Timbergrow Plantations	30 June	9.0	8.5	7.5	7.5	7.5	7.25
Wenita Forest Products	31 Dec	7.5	7.5	7.0	7.0	6.5	6.5
City Forests (post-tax cashflows)	30 June	7.0	7.0	6.5	6.5	6.5	6.0

multiple rotations compared to just valuing cashflows from the current rotation. Closer examination of the 17 paired comparisons for New Zealand forests reveals that:

- In eight cases the valuer uses a lower discount rate for multiple rotations than the current rotation
- In eight cases the valuer uses the same discount rate for multiple rotations
- In one case the valuer uses a higher discount rate.

In the case of Australian forests, in nine of the 11 paired comparisons valuers use a lower discount rate for multiple rotations than current rotations. In the other two cases the same discount rate is used.

The tendency to use a lower discount rate for multiple rotations indicates that valuers expect the IRR of subsequent rotations to be less than the discount rate used for the current rotation, i.e. that they expect subsequent rotations to produce a negative NPV if the current rotation discount rate is used.

However, the IDRs reported in Table 6 suggest otherwise. Of the nine forests for which IDRs for both current and multiple rotations are reported for pre-tax cashflows (albeit involving different valuers), the average IDR for multiple rotations exceeds that for the current rotation in six cases.

This survey indicates that the IRR on replanting is getting closer to the IDR for the current rotation. Given the IRRs in Table 7, and the reduction in IDRs since 2017, there will be fewer cases of subsequent rotations having a negative value.

Alignment of discount rates

There is good alignment between the discount rates that forest valuers use for large forests and the discount rates companies declare for financial reporting. For example, the average reported discount rate used (for pre-tax cashflows) in 2019 for the 16 companies documented in Table 3 is 7.0%. This is similar to the average discount rate of 7.3% used by forest valuers for medium/large forests (for current rotation pre-tax cashflows). This alignment is not surprising given that the declared discount rates are those used by the independent valuers appointed by the companies. These valuers are respondents to this survey.

However, the alignment between the discount rates being used by valuers and the IDRs of transactions of medium/large forests is not so close. On average, valuers are using discount rates to value smaller forests that are similar to IDRs, i.e. 7.9% vs 7.8% using current rotation pre-tax cashflows. However, valuers are using higher discount rates to value medium/large forests than is evident from transaction IDRs, i.e. 7.3% vs 6%, which is the average of the six IDRs estimated using current rotation pre-tax cashflows.

Acknowledgements

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References

Manley, B. 2018. Discount Rates Used for Forest Valuation – Results of 2017 Survey. *New Zealand Journal of Forestry*, 63(2): 35–43.

Manley, B. 2019. Interim 2018 Discount Rate Survey. New Zealand Journal of Forestry, 64(2): 46–47.

Bruce Manley is Convenor of the NZIF Forest Valuation Working Party. He is also Head of School and Professor of Forest Management at the School of Forestry at the University of Canterbury in Christchurch. Email: bruce.manley@canterbury.ac.nz

Why are coast redwood and giant sequoia not where they are not?

William J. Libby

Abstract

Models predicting future climates and other kinds of information are being developed to anticipate where these two species may fail, where they may continue to thrive, and where they may colonise, given changes in climate and other elements of the environment. Important elements of such predictions, among others, are: photoperiod; site qualities; changes in levels and yearly patterns of temperature, wind, fog and precipitation; the effects of these on interactions with other biota at each site; the effects of changes in fire frequency and intensity; the availability of seeds and seed vectors; and the effects of human activity. Examples are presented, with a focus on fire and human activity. Natural migration may need assistance and establishing groves far from the native ranges is advocated.

When preparing this paper, it became increasingly clear that it is more of an Op-Ed than a comprehensive review, and is meant for people interested in and familiar with coast redwood (*Sequoia sempervirens* (D. Don) Endl.) and giant sequoia (*Sequoiadendron giganteum* (Lindl.) Buchholz). Thus, five background references are provided, and they in turn provide detail on many of the topics covered. The final two references provide background on future speculative scenarios. Possible responses to such future scenarios are suggested.

Odd and contrasting natural ranges of both species

Coast redwood's current natural latitudinal range begins with discontinuous canyon-bottom populations near the southern Monterey County border, extends north through increasingly continuous coastal and generally separated interior populations, and stops just north of the Oregon/California border. Where a gradient in ecological conditions becomes limiting for a species, individuals near that edge of the population usually grow less well than individuals growing in more optimal conditions. But rather than its trees being less healthy near that northern edge, those redwoods are among the largest and most robust in its entire range, suggesting that conditions just beyond the current northern species edge would also support healthy and vigorous growth of redwoods.

Pollen deposits and other fossils indicate that redwood used to live south of its current southern population, with extirpated populations near Santa Barbara and even La Brea, and also farther north on the Oregon coast. A few planted redwoods are currently growing reasonably well in the Los Angeles Basin, and although its native range stops abruptly at its northern edge, planted redwoods are thriving in some favourable locations as far north as Vancouver Island, British Columbia.

Giant sequoia's native range has a similar but latitudinally inverted pattern. Its closely-spaced native groves and largest trees are in the southern Sierra Nevada, where the climate is hotter (and apparently drier) than in the northern native groves where sequoia grows more widespread and in fewer numbers.

Recent fossil evidence, mostly layers of pollen deposits, indicates that sequoia has been at higher elevations during the warmer period 6,000 years ago, and lower than it is now during the last Ice Age. But there is no evidence of it recently or ever being north or south of its present groves within California. And like coast redwood, planted sequoias are thriving over a substantially greater latitudinal range, from southern Spain to part-way up the coast of Norway in Europe, and in many locations in western North America from southern California's San Bernardino Mountains to northern Oregon and beyond. Yet, there are no native sequoia groves in the Cascades and northern Sierra, and only a few in the central Sierra.

Permissive climates are not sufficient for successful colonisation

Using climate data from the native ranges of these two species, and from sites with observed performance of their planted trees in other climates, we now have a pretty good idea which climates are permissive for redwood and sequoia to survive and thrive, which are marginal for them, and which of the much larger range of climate conditions are exclusionary. If even just modest summer rainfall is reliably well distributed through the summer months, both species can thrive with as little as 700 mm of annual precipitation. But if summer rains are inadequate, redwood may rely on summer fogs and both species thrive on apparently good soils with favourable hydrology supplying groundwater. Perhaps surprisingly, many well-established planted sequoias exposed to temperatures of –28°C have survived in northern Europe, as have a few planted redwoods in southern and central Europe, and planted redwoods in California's Central Valley exposed to brief episodes of +50°C have also survived.

So why don't they naturally occur in more of those permissive climates? First, they have to get there and, if the colonists establish, they have to successfully reproduce. For example, redwood plantations are thriving in several locations between about 1,000 and 2,000 m elevation in Hawaii. However, in remote Hawaiian plantations, thriving redwood trees fail to produce cones and (apparently) pollen. (Nearby redwoods do produce abundant cones in the presence

The Long Mile Redwood Grove, Rotorua. These redwoods, of unknown seed source, were planted sometime between 1899 and 1901 at approximately 6 x 6 m spacing. Early survival and growth were patchy, depending on soil, slope and competition. European larch (*Larix decidua* Mill.) was interplanted at approximately 2 x 2 m spacing during the 1920s as a nurse crop. Photo courtesy of Michelle Harnett, Scion

of light breaks from buildings or automobile headlights during the night, so photoperiod seems to be important for redwood's sexual reproduction.) And, of course, it would have taken a strong wind or bird to get some viable redwood seeds to Hawaii naturally.

Having arrived, and successfully reproduced, there may be resident insects and pathogens that harm them. For example, planted sequoias are often deformed or killed by redwood canker, a stress disease caused by the fungus *Botryosphaeria dothidia* that infects them in near-coastal California. For reasons still unclear (to me, at least), the severity of *Botryosphaeria* damage on planted sequoias decreases with increases in elevation and latitude in both Europe and North America. It is quickly lethal on planted sequoias near sea-level in southern France, but is either benign or absent near sea-level in Denmark and Norway. In California and southern Europe, *Botryosphaeria* is not a problem for native or planted sequoias above about 800 m elevation.

Colonising seedlings have to compete with the local vegetation. Serious competitors sequentially range from ferns, forbs and grasses to aggressive brush to other tree species, especially those trees that start faster from seed or can thrive in more shade than redwoods and sequoias can. (Small established redwoods and sequoias can endure many decades of overtopping shade, but unless root-grafted to overstorey trees they do not thrive unless they have full or nearly-full sunlight.)

Early attempts to convert redwood forests to pastures

The following observations were told to me several decades ago by Jim Rydelius (the first manager of the New Zealand Redwood Company in Christchurch), and were catalytic in my thinking about why these two species are not occupying apparently permissive sites near their current native ranges. In the late 19th and early 20th centuries, as extensive areas of redwood forests were increasingly being harvested, ranchers often attempted to convert the newly-cut forests to grazing lands by burning the logging debris and sowing grass seeds. But many of the redwood stumps vigorously sprouted, and in typical cases many seedlings of Douglas-fir (*Pseudotsuga menziesii* (Mirb.) Franco), plus a few of redwood and other conifers such as grand fir (*Abies grandis* (Dougl. ex D. Don) Lindl.), western hemlock (*Tsuga heterophylla* (Raf.) Sarg.) and western red cedar (*Thuja plicata* Donn ex D. Don) established in spite of the grass.

After a few years, the ranch-hands cut the encroaching young trees and then again burned the site after the grass and felled slash had dried. Each such fire killed the seedlings of the other conifers, but the redwood stump-sprouts resprouted, the larger ones producing 'fire columns' sprouting from their scorched boles. The recently established redwood seedlings also sprouted, usually from the root-collar burl below their burned-back stem. New seedlings of Douglas-fir, redwood and other conifers often established the following spring, but the redwood sprouts were already vigorously growing in advance of the new germinants. This process may have been repeated several more times before the rancher gave up, and in most cut-and-burn cycles additional redwoods had survived the fires. In this way, the percentage of redwood in the new forest became increasingly greater than it had been in the previous native stand, and the new redwoods enjoyed a root-size and sprout-vigour advantage over the competing conifers, which had to start over with new seedlings after each fire.

Insights applied to rancher-free natural colonisations

It seems possible, even likely, that as climate warms fire severity and frequency will increase in both coastal Oregon and in the Sierra-Cascade Mountains, and the monsoons that sometimes bring useful summer rains to the southern Sierra may also become more frequent farther north. Intense stand-replacing fires may more frequently be followed by repeated mild fires that retard competing conifers, while colonising seedlings of both redwood and sequoia thus gain a competitive edge by sprouting and then resprouting following the subsequent fires. Increased fire intensity and frequency resulting from a rapidly warming climate may facilitate the recolonisation of redwood into coastal Oregon, as well as the recolonisation and new colonisation of sequoia not only onto additional sites in the central and southern Sierra, but even into the northern Sierra and southern Cascades.

Both redwood and giant sequoia have migrated great distances in the past, and fires have probably been important facilitators of those migrations. A new natural colonisation would not happen after every intense stand-replacing fire near an established population, because seeds would have to blow in, or maybe be brought in cones by such animals as squirrels, followed by favourable weather for their successful germination and establishment. Germinating seedlings of both redwood and sequoia are unusually susceptible to damping-off fungi, which are common in many soils and are killed by hot fires. Giant sequoias, in particular, retain many years' production of seeds in closed cones, which open and massively release seeds following hot fires.

It is pretty clear that natural migration by colonisation of new sites is a hit-or-miss process that operated over long periods of time. Redwoods and giant sequoias have been able to thus far survive several events or conditions that led to the extinction of many other species. They have repeatedly migrated when necessary to places where they then continued to thrive. Very recently, they produced forests that inspire pleasure and awe in the humans that visit them.

Can humans help?

Native Americans have lived among or near redwoods and sequoias for over 10,000 years, and some of them have done a pretty good job of managing the native groves with

Shortly after a major wind event in the Canterbury region, when radiata pine and Douglas-fir were widely uprooted or snapped off, but no large sequoias were seriously damaged, NZFRI established five trials of sequoia in the South Island in 1977 and 1978. This 2007 photo shows (left to right) Bob Rogers, retired US Forest Service giant sequoia specialist, Bill Libby, and Lance Freer of Ernslaw in front of a then-30-year-old sequoia in Ernslaw's Beaumont replication of that trial. Photo courtesy of Phil de la Mare, Ernslaw One

frequent burning. But there are now (mostly European origin) American humans in the picture. Some of them create new problems, as important examples, by: converting (particularly redwood) forests to such things as vineyards and/or permanent structures; emitting greenhouse gases that rapidly warm the climate; and having forest practices that favour shade-tolerant species that then out-compete and thus replace redwoods and sequoias. But some people in that high-impact invasive population of (particularly, but hardly exclusively, American) humans are concerned about the future of redwoods and sequoias, and are or could be doing something about it. Knowing what seems to impede their natural colonisation and range extension helps some of the current humans who care about them help them continue on Earth.

There is no doubt that humans can successfully plant and husband redwoods and sequoias outside of their current native ranges. Some, most notably Sierra Pacific Industries with sequoia and, more modestly, Archangel Ancient Tree Archive with redwood, have recently been doing that with samples of sequoia and redwood from known origins of both single and multiple native populations. They and others have the stated intention of providing and then planting new locations for redwoods and sequoias to grow and thrive, and doing so in time-scales of decades rather than the centuries or millennia it historically has taken these two species to migrate long distances naturally. We have been calling such dedicated planting programmes 'assisted migration', and even 'assisted colonisation' when the trees successfully reproduce and a population naturalises on and near the planted site.

It seems that it may take unacceptably long times for redwood and giant sequoia to naturally migrate to safer sites in response to unusually rapid climate change and other changing environmental stresses, even if a warming climate results in more fires that facilitate their migration. However, helpful humans could and are successfully assisting in their migration and sometimes colonisation, including locations far outside of their current natural distributions. So why do we need to be concerned about the natural ability of redwood and giant sequoia to migrate?

What could possibly go wrong?

One answer is that we cannot be sure that active planting of these species will always be done in the future. It is conceivable that, following some catastrophic disaster, few or no surviving helpful humans will be available to continue planting forests. The effects of such a catastrophe may last for centuries or even millennia before the survivors reorganise and again establish the social and technical ability to plant and husband redwood and sequoia. Today, though, some humans have the knowledge and ability to expand these species' distributions, to thus add to their natural migration and better ensure their survival in the uncertain future.

How might entire regional forests be destroyed, or altruistic forest management be abandoned, either regionally or worldwide? Since the 1945 nuclear bombing of Hiroshima, apocalyptic worriers have accumulated some pretty realistic scenarios. We have learned that a collision with an asteroid has caused widespread loss of species and might do so again. And here are two (among several) examples of possible new self-inflicted catastrophes with contrasting implications for the future of redwoods and sequoias.

A massive use of nuclear weapons between or among the current nuclear powers may occur. Such madness will likely kill most or all humans and other living things in targeted regions, including redwoods and sequoias. The current distribution of nations with nuclear capability makes it likely that such madness will mostly affect the northern hemisphere, and people and forests in the southern hemisphere will survive. It may then take many decades or even centuries before people can again safely inhabit the northern half of Earth. There is already a magnificent 120-year-old grove of redwoods in Rotorua, New Zealand, and a younger but faster-growing redwood grove near Taumarunui, New Zealand. Other such planted groves might be found and dedicated, and assisted migration could establish additional groves of redwoods and sequoias in Chile, Pategonia, Australia, New Zealand and South Africa in advance of such a hemispheric extirpation.

A historical example is the 14th through 18th century black plague pandemics, which not only killed a lot of people but also disrupted the social, political and commercial structures of nations and regions. The black plague is even credited with saving European forests. Many 14th century European forests were being converted to other uses by rapidly growing human populations and the resulting commercial exploitation. The plague pandemics greatly reduced those human populations and their needs for agricultural land and wood, and forests then reclaimed much of the land. An engineered weaponised pathogen, if it is released or escapes, would likely be more efficient than the black plague was in quickly spreading and then killing humans. But, like the black plague, it would probably leave most of Earth's biota essentially intact, and perhaps even better off. And, as in most pandemics, a few humans might be resistant or escape the disease, begin to repopulate Earth, and their progeny would eventually again visit and appreciate groves of enormous redwoods and sequoias. In this scenario, conserving and perhaps expanding the redwood and sequoia populations in North America, plus some additional groves in Europe and Asia, would have been good enough.

Such an apocalyptic catastrophe may not occur for a long time, or at all. Meanwhile, in the near future, Earth's human population will continue to increase, as will population-related problems and stresses. It is noteworthy that the United Nations held one of its founding ceremonies in a Muir Woods redwood grove, probably because humans find not only pleasure and awe in such groves, but many also gain perspectives on time and feelings of peacefulness and wellbeing. Additional magnificent long-lived groves of redwood and sequoia in many places on Earth could serve its hopeful future in possibly important ways.

Two options for new human-assisted groves

There are at least two options for new human-assisted groves. One is to sample and thus nearly duplicate only one redwood population or sequoia grove per new planting, thus conserving the genetic structures of the different native populations and groves. A second is to combine samples of many populations or groves per new planting, thus increasing the genetic variation in the new plantations and thereby increasing their ability to better adapt to different environments.

There are many locations far outside of their native ranges where redwood and/or giant sequoia could thrive and grow to become magnificent groves. Why they are not now on such sites has until recently been because they could not get there naturally. But now that assisted migration is technically possible, human motivation and competing demands on those sites will guide the future. If enough new groves are established, it is likely that some will be in the right places to thrive and reproduce even in substantially changing conditions. Such assisted colonisation seems like a good thing to do, whether or not humans survive (or other sentient creatures evolve) to appreciate these two magnificent species.

Acknowledgements

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References

Harvey, H.T., Shellhammer, H.S. and Stecker, R.E. 1980. Giant Sequoia Ecology. Fire and Reproduction. *Scientific Monograph Series No. 12*. Washington DC: Department of the Interior, National Park Service. US Government Printing Office.

Libby, W.J. 1981. Some Observations on *Sequoiadendron* and *Calocedrus* in Europe. *Cal. Forestry & Forest Products*, 49. Berkeley, CA: University of California, Forest Products Laboratory/California Agricultural Experiment Station.

Low, C. 2002. Giant Sequoia Provenance Trials in New Zealand. *New Zealand Tree Grower* (Aug): 32–33.

Noss, R.F. (Ed). 2000. *The Redwood Forest. History, Ecology, and Conservation of the Coast Redwoods*. Washington DC: Island Press.

Rydelius, J.A. and Libby, W.J. 1993. Arguments for Redwood Clonal Forestry. In Ahuja, M.R. and Libby, W.J. (Eds). *Clonal Forestry II. Conservation and Application*. Heidelberg: Springer Verlag: 158–168.

Torres, P. 2016. *Three Minutes Before Midnight*. An Interview with Lawrence Krauss About the Future of Humanity. *Free Inquiry* (Jun/Jul), 36: 27–31.

Worland, J. 2016. The Anthropocene Should Bring Awe – And Act as a Warning. *Time Magazine* (Sept): 10.

Addendum to reprinted paper

During 1905 through to 1920, New Zealanders absorbed the news from their 1909 and 1913 Royal Commissions on timber and forestry that their native forests would not be able to meet their demands for timber and other wood products, and there was a plan to do something about it. New Zealand soon became a world leader in plantation forestry, and many exotic species were trialed for its plantations. Redwood was among the favourites, but its nursery and planting requirements were not well known and it had many failures (see first photo for an example of an apparent early failure). On the slope in this photo the larch were mostly suppressed by the redwoods, while on the frosty flats the larch suppressed most of the redwoods. Dense areas of larch were thinned in 1967. By 2020, most of the remaining larch have been overtopped by the redwoods, the tallest of which are now over 70 m tall. This grove is already a reserve and a unique redwood/New Zealand native ecosystem is developing. There is a suspicion the redwood seed source may have been a single tree. While most of the current redwoods are healthy, seedlings from them have not done well and are probably mostly inbred. This grove would not be a good source of seeds.

Similarly, giant sequoia became known to the western and scientific worlds in 1852, and by 1860 arboretums, parks and tree enthusiasts in Europe, the US and New Zealand had planted many small groups or single trees of this charismatic species. However, substantial well-designed research plantations were rare (see second photo showing a tree bole in one of the few well-designed trials of sequoia available in New Zealand). Remarkably, Lance Freer (mentioned in the photo caption) helped establish the Ernslaw replication in 1977–1978, later measured and then thinned out the poorer 50+% of trees in each included population sample (thus converting the trial to a sequoia seed orchard), and tended it until his 2015 retirement. The high percentage of inter-population wind-pollinated matings likely make the resulting seeds the best sequoia seeds on Earth. This is a grove that might be allowed to grow on for 3,000 or more years.

In 2020, a lack of knowledge about nursery and silvicultural practice is no longer the obstacle it once was, and there are a number of solid arguments for Kiwi foresters considering both redwood and giant sequoia as part of their afforestation strategies. While having longer rotation lengths than radiata pine, volume growth over the rotation is greater than Douglas-fir and, in California at least, prices for redwood logs and boards are much higher than for Douglas-fir or any pines. Very few insects or diseases damage giant sequoias and even fewer damage coast redwoods. Following logging, redwood root systems remain alive and the stumps quickly sprout so they are pretty good on erosive sites. Finally, redwood is a lot easier to clone than radiata pine and we are learning to clone sequoia effectively as well.

It is my impression that a case for redwood, as a plantation crop with multiple uses that is potentially more valuable and less risky than radiata pine, is already being ably made by several New Zealand foresters and landowners. The case for giant sequoia as a valuable plantation crop in New Zealand is less clear. Giant sequoia is now being massively planted on good sites in six-species mixtures in several of California's interior mountain ranges, and substantial older plantations including (or exclusively) sequoias are now growing well in Germany and two regions of France. It might be better to watch the sequoia literature for a few decades as their foresters gain experience and solve problems before giant sequoia is extensively tried in this country.

However, as New Zealand is (apparently?) recently relying less on financial analysts (who tend to like short rotations and accept lots of core wood) and more on economists (who also consider long-term values and so-called externalities), both species have a place in what New Zealand might be in 2120 and beyond. Future Kiwis may find not only better wood, but such things as better water, cleaner air, good wildlife habitat, and also feelings of wellbeing and awe about redwood groves allowed to grow for 1,000 or 2,000 years, and sequoia groves that will have some trees older than 3,000 years. Such groves will be particularly valuable if human foolishness or catastrophic bad luck wrecks the northern hemisphere.

William Libby is Emeritus Professor, Forestry & Genetics at the University of California Berkeley in California, US. Email: william.libby0@gmail.com

History of pine forestry in the Pelorus/Te Hoiere catchment and the Marlborough Sounds

Stephen C. Urlich and Sean J. Handley

Extant remnant of woodlot planted in 1910s. According to Owen Couper, three woodlots of 100 trees spaced ca. 10 feet apart were planted on the Couper farm in the Rai Valley. Photo courtesy of Gemma Coutts

Abstract

The harvesting of radiata pine (*Pinus radiata*) plantations in the Pelorus/Te Hoiere catchment and the Marlborough Sounds is contributing to excessive sedimentation into coastal waters, although the timing of when this commenced is subject to debate. Here we present a history of radiata pine to document trends in forest establishment in the Pelorus/Te Hoiere catchment and the Marlborough Sounds derived from the scientific literature, newspaper articles, local histories and recollections of retired foresters. We identify that radiata pine trees were planted primarily as ornamentals, shelterbelts and woodlots from the late 1800s, with plantings increasing after the 1913 Royal Commission on Forestry.

The first commercial plantations were Farnham Forest in Queen Charlotte Sound/Tōtaranui in the 1930s and the Rai State Forest in the Pelorus/Te Hoiere catchment in 1940. Commercial plantings expanded with forestry encouragement loans from the 1960s. There are now ca. 26,420 ha of radiata pine plantations in the contributing catchments to the Marlborough Sounds. We identify that the majority of radiata plantations are on Class 7 land in the Pelorus/Te Hoiere and Kaituna catchments, which are the largest contributing catchments to the Marlborough Sounds. These areas have soils highly susceptible to erosion, which is exacerbated by vegetation clearance. The industry has reached a point of near continuous harvest over extensive areas on steep hillsides. This means that the window of vulnerability to erosion (five to eight years after harvest) is always open somewhere across the landscape.

Introduction

Sedimentation from landslides and other forms of erosion is a natural process, to which coastal ecosystems have adapted over time. However, what has changed since human settlement in New Zealand is the accelerated rate of sedimentation caused by historical and current land uses. Excessive sediment into waterways can smother intertidal and marine benthic habitats, and thereby change ecosystem structure, composition and function by killing and displacing macrofauna and causing long-term degradative change (Thrush et al., 2004).

Rai Valley township looking east along State Highway 6, ca. early 1920s. Photo courtesy of Spittal Collection 0000.900.1572, Marlborough Museum

In Pelorus Sound/Te Hoiere, annual sediment accumulation rates have increased five to 20 times since the 1860s (Handley et al., 2017). Isotopic analysis of seabed sediments reflected historical changes in resource exploitation from indigenous forest clearance, gold mining, pastoral farming and radiata pine forestry (hereinafter 'forestry'). In recent decades, both forestry and the inflow of the Pelorus and Kaituna rivers have disproportionately contributed to sediment deposition onto the seabed compared to other sources (Handley et al., 2017).

The Marlborough Forest Industry Association (MFIA) has challenged the timing of the contribution from forestry to sediment deposition (Hemphill, 2019). The MFIA concluded the Compound-Specific Stable Isotope (CSSI) method (Gibbs, 2008) was unreliable as forestry was not extensive enough in the first half of the 20th century to generate sufficient sediment after harvest for deposition onto the seabed. Swales et al. (2020) provided a detailed rebuttal, including reference to the international acceptance of the peer-reviewed CSSI methodology.

This paper does not seek to clarify the CSSI methodology and its precision, rather the aim is to document the history of forestry in the Marlborough Sounds and contributing catchments. In a companion paper (Urlich, 2020), the environmental effects of forestry harvesting and associated earthworks on coastal ecosystems of the Marlborough Sounds were explored, along with the effectiveness of past and current regulatory regimes in mitigating adverse impacts.

Methods

We searched the National Library's Papers Past database using relevant search terms. Local histories in the Marlborough District Library's reference collection, and the Marlborough District Council's (MDC) technical report library, were examined for forestry references. We also gathered information from ex-Forest Service employees with direct knowledge of the establishment of forestry in different areas from the 1950s.

Results

Late 1800s–1920s: Woodlots and shelterbelts

Radiata pine plantings in the Marlborough Sounds date back to the second half of the 19th century. One of the first records in Marlborough was from Picton in 1891 (Handley, 2015). This was a mature flourishing tree with 'huge branches', illustrating that pine had been planted since the 1870s. Photos by the Tyree brothers during the 1890s (Nelson Museum, National Library) show ornamental mature pines in Havelock and a woodlot on slopes above the township and estuary.

Advertisements in the *Marlborough Express* in 1893, and the *Pelorus Guardian and Miners Advocate* in 1895, reflected the sale of radiata pine (formerly *Pinus insignis*). Articles and advertisements in the 1910s extolled pine's versatility, including fruit boxes, construction and shelterbelts. Planting on 'poor land' for firewood and timber was advertised in 1920 with a density of 1,000 stems to the acre, thinned down to 100 stems per acre in the sixth year. The versatility of pine can be traced to the 1913 Royal Commission on Forestry (Hegan, 1993).

Bowie (1963) refers to many farmers planting pine in Pelorus Sound after 1919, following the Commissioner of Crown Lands advocating for such. We were unable to quantify the area planted during this period, but we did locate an example of what Bowie suggested was common at that time. The first photo shows remnants of a 1910s planted woodlot in the Rai Valley. These trees were planted in pasture sown down after the clearance of native forest for timber harvest in the early 1900s, at 10 foot spacing in 100 tree woodlots by the Couper family (Owen Couper, pers. comm.). The second photo shows woodlots, shelterbelts and ornamentals on the terraces and lower slopes around and in Rai Valley township ca. 1925, indicating early acceptance of pine's versatility for family farms.

1930s–1960s: First plantations and commercial woodlot milling

In 1925, Director of the State Forest Service L. McIntosh Ellis announced that 15,000 acres (~6,070 ha) would be afforested with pine in the Marlborough Sounds by 1935 (Ward & Cooper, 1997). This was part of a national planting programme to replace the projected depletion of indigenous timber by the late 1960s. The first large plantation in the Marlborough Sounds was Farnham Forest, established in 1934 over ca. 136 ha in Queen Charlotte Sound/Tōtaranui (Johnston et al., 1981; Sutherland, 2011).

Aside from Farnham Forest, extensive plantations did not eventuate in the Marlborough Sounds. Aerial photos from 1958 verify this, although there were several large woodlots in Tuna, Elaine and Clova Bays (www.marlborough.govt.nz). Bowie (1963) noted pines were used to stabilise slips on hill country farms in places such as Hallam Cove, and also in Pelorus Sound. Bowie observed that woodlot and shelterbelt trees were reaching millable age in the Marlborough Sounds. This accords with the reminisces of John Harvey who, along with his brother Hylton, started milling pine in 1957 (John Harvey, pers. comm.). Timber from shelterbelts (e.g. six trees wide by 300–400 yards) around Sounds homesteads were used for construction in Blenheim and Wellington. The first batches were from North West Bay and Titirangi, and pines ca. 70 years old from South East Bay were also milled. A newspaper article recorded 236 m^3 of pine milled at the Manaroa Mill in 1960 (Harvey, 2008).

Pine comprised 56% (2,613 m^3) of all timber species milled in Marlborough (4,660 m^3) in 1950 (Entrican, 1950). The eight mills operating in the region primarily produced rough-sawn timber. It is likely that woodlots and shelterbelts from the Kaituna and wider Pelorus catchments contributed to this (see first and second photos). Leov (1974: 43) noted that the two mills operating in the Rai Valley '... are having to cut a good deal of *pinus* [radiata] which is poor timber compared with the good [native timber] ... that the first mills sawed.'

In the wider Pelorus catchment, planting of the Rai State Forest began in 1940 (Entrican, 1950). By 1950, 272 ha had been planted, which included 122 ha in the previous year. Huddleston recalls in the late 1950s planting *P. radiata* at 8 feet by 8 feet (~2.4 m) spacing and Douglas-fir (*Pseudotsuga menziesii*) at 6 feet by 6 feet (~1.8 m) spacing. *Pinus nigra* (Corsican pine) was also planted. It is important to note that the forest was planted for timber production, as evidenced by the 27 ha low pruned in 1950 (Entrican, 1950). Concurrently, soil erosion was a serious issue on hill country in the Rai, Pelorus, Kaituna and Cullens Creek catchments (hereinafter the 'key catchments') under pastoral farming (McIntosh, 1940; Bowie, 1963).

1960s–1980s: Expansion of plantations and first harvesting

In the 1960s, the Forest Service began planting hillsides within the Tinline Valley in the Upper Pelorus, which had at least 80 ha planted in radiata by 1979 (Clout & Gaze, 1984), and then the Whakamarino in the 1970s (Eric Huddleston, pers. comm.; Marlborough

Table 1: Area (ha) in production forestry by LUC class in the Rai, Pelorus, Kaituna and Cullens Creek catchments, and proportion of each LUC class in production forestry. Data courtesy of MDC, derived from LCDB 5

LUC catchment	Class 1–3	Class 6	Class 7	Class 8	Forestry area	Catchment total area	Proportion in forestry
Rai	263	621	2,649	0	3,533	20,873	17%
Pelorus (excl. Rai)	345	882	5,508	280	7,015	67,173	10%
Kaituna	67	192	2,322	368	2,949	14,602	20%
Cullens Creek	11	87	514	0	612	2,068	30%
LUC area in forestry	686	1,782	10,993	648	14,109	104,716	13.5%
LUC total area	9,269	7,190	64,955	23,302	104,716		
% LUC in forestry	7.4%	24.8%	16.9%	2.8%	13.5%		

District Council (MDC), 1992). The state also planted forests on steep hill country above Tory Channel and around Port Underwood from the 1960s to 1986 (MDC, 1992; Fahey & Coker, 1992). The clear-fell harvesting of Farnham Forest commenced in 1970 and continued into the early 1980s (Johnston et al., 1981; Coker, 1994). The first rotation of the Rai Forest occurred ca. 1979, with the trees going to Burleigh Mill in Blenheim (Eric Huddleston, pers. comm.).

The 1960s also saw the establishment of commercial forests on private land. Planting on marginal lands was encouraged by loans, authorised by the Forestry Encouragement Act 1962 and brought in by regulation in 1967. Loans upon application by local authorities and landowners were repayable at harvest. Farm blocks (up to ca. 100 ha) were planted in the key catchments, and land preparation for afforestation included burning off scrub (Eric Huddleston & Vern Harris, pers. comm.; Sutherland, 2011).

An upsurge in new forest plantings on hill country in the key catchments and the Marlborough Sounds occurred in the late 1980s due to taxation concessions, favourable returns for forestry, and less profitable pastoral farming (MDC, 1992; Sutherland, 2000).

1990s–2020s: Continuous harvest

By 1992, 9,500 ha were planted in the Marlborough Sounds and 9,100 ha in the key catchments (MDC, 1992). MDC (1992) projected a threefold increase in harvested log volumes (sawlog and pulp) from the late 1990s as the upsurge in plantings from the 1960s and 1970s matured (Figure 1). The volumes were projected to remain elevated into the 2000s.

By 2018/19, plantings in the key catchments had increased by ca. 5,537 ha and by ca. 2,811 ha in the Marlborough Sounds (Land Cover Database (LCDB) version 5, MDC unpublished data). Forestry (predominantly radiata pine) covered ca. 12,311 ha in the Marlborough Sounds (Pelorus and Queen Charlotte Sounds, and Port Underwood), and ca. 10,548 ha of the Pelorus (including the Rai), 2,949 ha of the Kaituna and 612 ha of Cullens Creek (Figure 2).

Forestry is predominantly situated on steepland yellow-brown soils, prone to slips and sheet and rill erosion once the vegetation cover is removed (Johnston et al., 1981; Laffan & Daly, 1985). Most forestry in the key catchments is on LUC Class 7 (Table 1, Figure 2a), and in the Marlborough Sounds (Figure 2b). These areas are primarily zoned orange (high risk) for erosion susceptibility in the National Environment Standard for Plantation Forestry (Basher & Barringer, 2017).

The risk of soil loss is elevated in the five to eight-year 'window of vulnerability' between the decay of harvested tree root systems and the establishment of the next tree crop and/or seral plant species (O'Loughlin & Watson, 1979). Google Earth time-lapse imagery shows extensive areas of clear-fell harvesting throughout

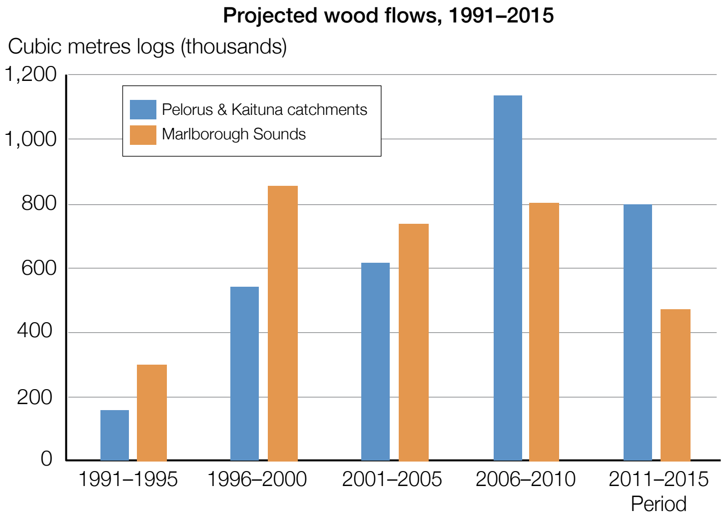


Figure 1: Projected plantings in the main contributing catchments to Pelorus Sound/Te Hoiere (Zone 7 in MDC, 1992) and the Marlborough Sounds (Zones 3–6). Redrawn from MDC, 1992 (Appendix Figures 3–7)

the Marlborough Sounds and the key contributing catchments at any one time over the last 20 years. Across the landscape, the window of vulnerability is always open, representing a plausible and ongoing source of high sediment volumes into coastal waters (Johnston et al., 1981; Fahey & Coker, 1992; Handley et al., 2017).

Summary

Radiata pine has a history in the study area dating back to the late 1800s as ornamentals, woodlots and shelterbelts. The first commercial plantation in the Marlborough Sounds was established in the 1930s. The Forest Service planted forests in the Rai, Upper Pelorus, Whakamarino, Tory Channel and Port Underwood between the 1940s and 1980s. Planting increased on privately-owned hill country with forestry encouragement loans from the 1960s, with an upsurge after the cessation of pastoral farming subsidies in the late 1980s.

Commercial harvesting commenced in 1970 in the Marlborough Sounds and ca. 1979 in the Rai Forest. From the late 1990s, widespread harvesting has occurred throughout different parts of the Marlborough Sounds and key contributing catchments, meaning the window of vulnerability is perpetually 'open'. This represents a plausible source of high sediment volumes into coastal waters after pine harvesting on the predominant erosion-prone hillsides.

Acknowledgements

We would like to thank Matt Henderson of the Marlborough District Council for kindly providing LCDB data and for drafting Figure 2. We thank the Marlborough Library Friends for their diligent searching through the Marlborough Library Collection. We are grateful to John Harvey and Owen Couper for sharing their reminisces, Eric and Joan Huddleston

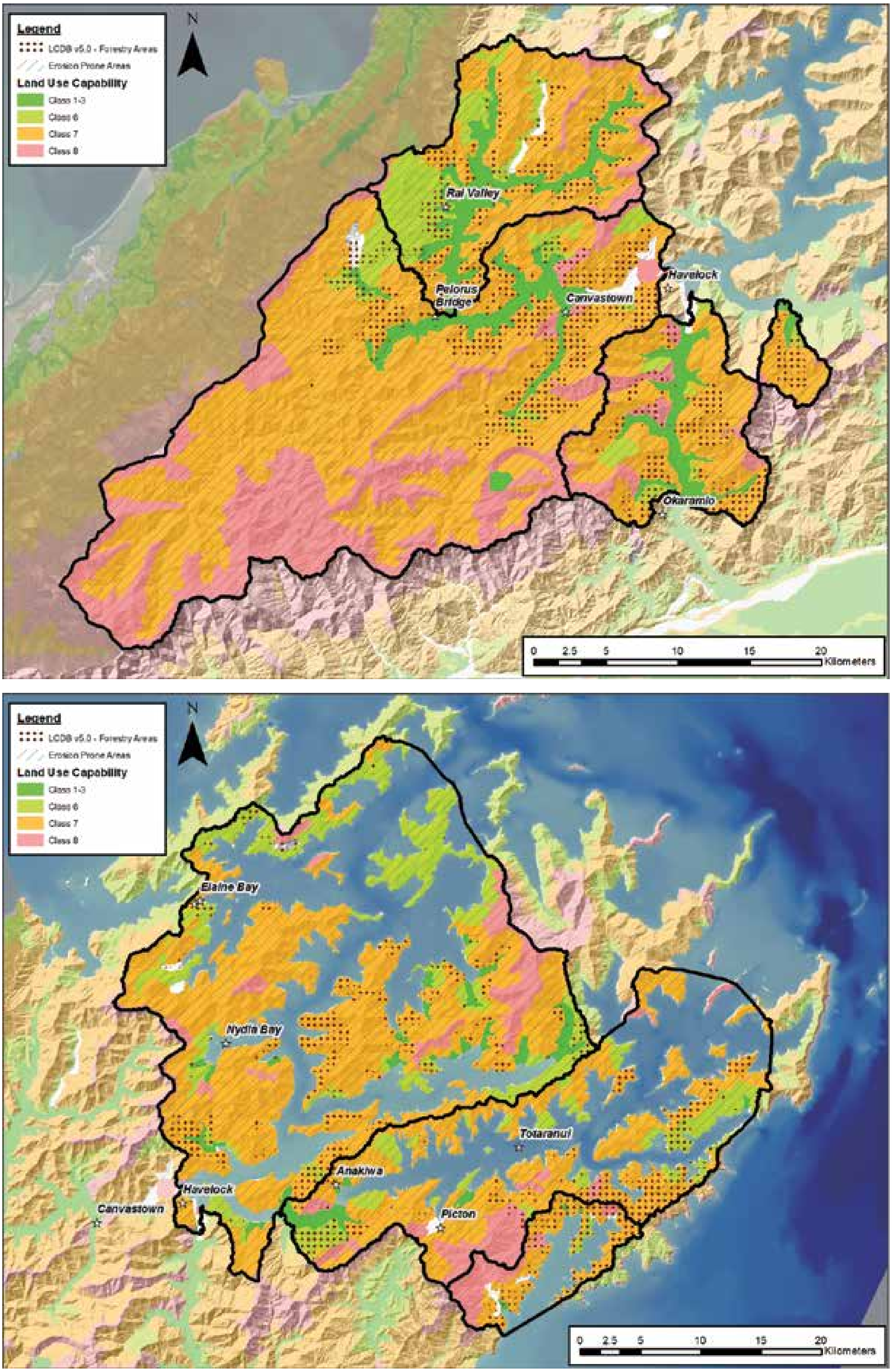


Figure 2: 2(a) Top – Plantation forests in the main contributing catchments to Pelorus Sound/Te Hoiere (black dots) overlaid on LUC classes; (2b) Bottom – Plantations in the Marlborough Sounds. Data derived from LCDB 5 courtesy of MDC

for information on historic catchment plantings and photos, and Vern Harris for information on Forestry Encouragement Loans. We are grateful to Dr Mark Bloomberg, Ron Sutherland and an anonymous reviewer for comments that improved this article. This study is under the auspices of Lincoln University's human ethics approval 2019–89.

References

Basher. L. and Barringer, J. 2017. *Erosion Susceptibility Classification (ESC) for the NES for Plantation Forestry, Landcare – March 2017*. Landcare Research Report 2744 prepared for the Ministry for Primary Industries. MPI Technical Paper No. 2017/47. Wellington, NZ: MPI.

Bowie, L.J.S. 1963. *Land Utilisation in the Marlborough Sounds*. MA (Geography) Thesis. Canterbury, NZ: University of Canterbury.

Clout, M.N. and Gaze, P.D. 1984. Effects of Plantation Forestry on Birds in New Zealand. *Journal of Applied Ecology*, 21(3): 795–815.

Coker, R.J. 1994. *Sedimentation and Forest Harvesting in the Marlborough Sounds*. MSc (Forestry Science) Thesis. Canterbury, NZ: University of Canterbury.

Entrican, A.R. 1950. *Annual Report of the Director of Forestry for the Year Ended 31st March 1950*. Presented to both Houses of the General Assembly. Wellington, NZ: NZ Forest Service.

Fahey, B.D. and Coker, R.J. 1992. Sediment Production from Forest Roads in Queen Charlotte Forest and Potential Impact on Marine Water Quality, Marlborough Sounds, New Zealand. *NZ Journal of Marine and Freshwater Research*, 26(2): 187–195.

Gibbs, M.M. 2008. Identifying Source Soils in Contemporary Estuarine Sediments: A New Compound-Specific Isotope Method. *Estuaries and Coasts*, 31(2): 344–359.

Handley, S. 2015. *The History of Benthic Change in Pelorus Sound (Te Hoiere), Marlborough*. NIWA Report NEL2015-001. Prepared for the Marlborough District Council. Nelson, NZ: NIWA.

Handley, S. Gibbs, M. Swales, A. Olsen, G. Ovenden, R. and Bradley, A. 2017. *A 1,000 year History of Seabed Change in Pelorus Sound/Te Hoiere, Marlborough*. NIWA Report 2016119NE. Prepared for the Marlborough District Council, Ministry for Primary Industries and the Marine Farming Association. Nelson, NZ: NIWA.

Harvey, G.J.C. (John). 2008. *Where There's a Will, There's a Way; Memories of My Childhood and Sawmilling Days in the Marlborough Sounds*. Blenheim, NZ: Self-published.

Hegan, C. 1993. Radiata, Prince of Pines. *New Zealand Geographic*, (Oct–Dec): 20. Retrieved from www.nzgeo.com/stories/radiata-prince-of-pines/ on 21 November 2019.

Hemphill, D. 2019. *History of Pine Forests in Pelorus Sound 1900–1970*. Unpublished report for the Marlborough Forest Industry Association. Blenheim, NZ.

Johnston, A. Mace, J. and Laffan, M. 1981. The Saw, the Soil, and the Sounds. *Soil & Water*, (Aug/Oct): 4–8.

Laffan, M.D. and Daly, B.K. 1985. Soil Resources of the Marlborough Sounds and Implications for Exotic Production Forestry. 1. Soil Resources and Limitations to Exotic Forest Growth. *New Zealand Journal of Forestry*, 30: 54–69.

Leov, L.C. 1974. Rai Valley Sawmills. *Nelson Historical Society Journal*, 3(1): 36–43.

Marlborough District Council (MDC). 1992. *Issues and Options for Forestry and Farming in the Marlborough Sounds*. Blenheim, NZ.

McIntosh, A.D. (Ed). 1940. *Marlborough: A Provincial History*. Marlborough Provincial Historical Committee. Blenheim, NZ.

O'Loughlin, C.L. Watson, A.J. 1979. Root-Wood Strength Deterioration in Radiata Pine After Clear-Felling. *New Zealand Journal of Forestry Science*, 9(3): 284–293.

Sutherland, B.K. 2000. *The Effects of Changing Resource Use in the Marlborough Sounds*. MSc (Geography) Thesis. Canterbury, NZ: University of Canterbury.

Sutherland, R. 2011. Forestry: Seeing the Wood for the Trees. In (Eds) Brooks, C. McKendry, L. and Olliver, D. *Marlborough – Celebrating 150 Years*. Blenheim, NZ: MDC and Marlborough Electric Power Trust.

Swales, A. Gibbs, M. and Handley, S. 2020. *The CSSI Sediment-Tracing Method – NIWA Response to the Marlborough Forestry Industry*. Prepared for the Marlborough Forestry Industry Association. Hamilton, NZ: NIWA.

Thrush, S.F. Hewitt, J.E. Cummings, V.J. Ellis, J.I. Hatton, C. Lohrer, A. and Norkko, A. 2004. Muddy Waters: Elevating Sediment Input to Coastal and Estuarine Habitats. *Frontiers in Ecology & Environment*, 2(6): 299–306.

Urlich, S.C. 2020. Opportunities to Manage Sediment from Forestry More Effectively in the Marlborough Sounds and Contributing Catchments. *New Zealand Journal of Forestry*, 65(2): 28–35.

Ward, J. and Cooper, D. 1997. *Seventy Years of Forestry: Golden Downs Forest – Nelson 1927–1997*. Nelson, NZ: Forest History Trust.

Dr Steve Urlich is a Lecturer in the Department of Environmental Management at Lincoln University. Dr Sean Handley is a Marine Ecologist at NIWA in Nelson. Corresponding author: steve.urlich@lincoln.ac.nz

The push to plant pines – a photographic history

Michelle Harnett

Ranger W. Montgomery

Early 20th century afforestation boom

New Zealand saw an afforestation boom in the 1920s and 1930s with the establishment of around 288,000 ha of plantation forests. An old photo collection that I have acquired through Scion and others sources shows what life was like then in new forests around Canterbury.

Pinus radiata is one of the most successful forest plantation species in the world. It tolerates a wide variety of conditions, grows quickly, the timber is versatile, and the economics of growing it are attractive. The Royal Forestry Commission of 1913, charged with allaying 'early 20th century "timber famine" fears in New Zealand', identified radiata pine as one of the choices for commercial forestry (Roche, 2013).

The Commission estimated the likely future demand for timber in New Zealand at 1.68 million m^3 by 1948. At the time, the wood supply from state plantations was calculated to be enough for just four months. A near tripling of the planting rate was recommended with large-scale state tree planting in Otago, Canterbury, the volcanic plateau, the Rangitikei sand dunes and the Northland gum lands. Eucalypts were favoured for durability, and pines for building timber, including *P. radiata* (Roche, 2013).

The declaration of World War One threw a spanner in the works, but by the mid-1920s the great afforestation boom of the 1920s and 1930s was underway. Annual plantings were an order of magnitude greater than the scale recommended by the Commission (Roche, 2013).

Between 1925 and 1936, about 288,000 ha were planted. Initially this was a government undertaking, but once the financial rewards and technologies were firmly established, the private sector quickly responded and contributed significantly to the planting boom. Between 1927 and 1932, exotic pine production increased from 17,500 to 32,000 m^3, although still only representing 6% of total production. Twenty percent of this exotic production came from government forests and was typically used domestically for poles, sleepers, mine props, posts, battens and fuel (Rhodes et al., 2004).

The backbreaking work of planting tussock and scrubland, Balmoral Plantation, September, 1927

The first plantations were grown with seed collected from farm shelter belts. Ideally, only the cones from tall, well-formed trees were collected; practice may have been a little different

Preparing beds: horse-drawn discs, Hanmer, October 1927

Life as a 1920s forester

An old photo find shows what life as a nurseryman and forester was like during the intense planting period. These photos were taken by Ranger W. Montgomery, who was good with a camera and even better at labelling his photos (his labels are shown underneath each one).

Conclusion

The original trees planted at Balmoral and Eyrewell are long gone, with the land being converted into pasture, but their legacy lives on. Intensively managed radiata pine forests form the backbone of New Zealand's forestry industry, stretching across 1.5 million ha, meeting the country's needs for timber, fibre and fuel, and supporting a thriving export industry. Sustainably grown radiata pine will also likely underpin the development of a wider bioeconomy in New Zealand. As well as delivering tangible products and profits, the other services provided by growing forests, such as carbon capture and storage, improved water, soil and air quality, habitats for native species, and physical and cultural benefits, help us look after our environment and people.

References

Rhodes, D., Novis, J., Enters, T. and Durst, B. 2004. Impact of Incentives on the Development of Plantation Forest Resources in New Zealand. *What Does It Take?* 151.

Roche, M. 2013. The Royal Commission on Forestry 1913 Viewed from 2013. *New Zealand Journal of Forestry*, 58(1): 7.

Seed sowing: Fordson tractor and multiple sower, Balmoral, September 1927

Sown seedlings: one year old machine line sown radiata at Balmoral, sown October 1927

From nursery to forest: 205,000 from Hamner Nursery are loaded for Eyrewell Plantation, August 1928


Separated seed

Planting scrub country, Balmoral

Forcing cones to open with kiln drying

Anthony Erskine Beveridge

MSc (NZ), BA (Oxon), BA (Auck), HonMNZIF, HonMCFA

17 July 1925 – 27 July 2020

With the passing of Anthony Erskine (Tony) Beveridge on 27 July 2020, another leading light of the Forest Research Institute of yesteryear has departed. His long career in native forest research was overshadowed by changing national attitudes to, and policies for, native forests and their role in timber production and nature conservation.

Family history and education

Tony was born in 1925 in Hamilton, in those days a large country town with mostly gravel streets and an early generation of automobiles, a far cry from today's busy metropolis. His father's family came from the ancient Scottish capital and abbey town of Dunfermline, across the Firth of Forth from Edinburgh. Earlier generations there were bakers and town councillors. A first cousin once removed, William Beveridge, later Baron Beveridge of Tuggal, wrote in his book about his parents that 'the spreading of these children and their children outwards from the British Empire and upwards from small trades into professions and large business is typical of the nineteenth century efflorescence (flowering) of the British people.'

Tony's Scottish father, Alexander Watt Beveridge, was the first ophthalmologist in the Waikato and his English mother, Florence Marguerite Fletcher, came from a family of grain merchants in the pretty Midlands village of Pentrich in Derbyshire. They lived in some style in 'Cardrona', a rather grand house on 11 acres above the Waikato River – a favourite swimming spot – near the northern edge of town in Jersey Street, Whitiora, later the site of the Fairfield Bridge.

Tony began his education at Whitiora Primary School, later enrolling at Southwell, an Anglican preparatory school across the river in Enderley. He maintained a lifelong interest in it and its remnant stand of kahikatea forest, being on the board of governors for many years, becoming a fellow of the school, and visiting whenever the opportunity arose. His abiding interest in the natural world began on weekend cycling visits to Ngutunui on the southern slopes of Mt Pirongia, where he stayed with the redoubtable Valder sisters on their small holding with stands of native bush.

The Valders were daughters of one of the founders of Ellis & Burnand, the biggest native sawmilling company in the North Island, and passionate conservationists. Lilian was a long-time patron of the Waikato branch of Forest & Bird. I had the pleasure of taking Tony back to the property some 70 years later, the original house and acre of bush behind it still there, replete with king fern and other treasures. The brilliant night skies over Mt Pirongia, seen from the backdoor of his Hamilton home, inspired childhood wonder.

At the age of 14, Tony was sent to board at Rutherford House, Nelson College, where he was taught largely by veterans of the Great War. The beech forest of nearby Maitai Valley, then alive with the chorus of yellowheads and now home to the Brook Waimarama Sanctuary, provided further stimulus for his interest in natural history. Five years at Auckland University College followed, culminating in a Master of Science with Honours in Botany, his thesis being on marine algae at Piha.

A Colonial Service Scholarship enabled Tony to spend two years studying forestry at one of the world's great institutions of learning, the University of Oxford. He boarded in nearby Iffley and attended Keble College where he met fellow New Zealander and forestry student G.C. (Graham) Weston, who later became a colleague at the Forest Research Institute in Rotorua and lifelong friend. They shared a memorable post-graduation holiday in Norway. Interestingly, he refused to pay 20 pounds – or whatever the fee was – to convert his BA into an MA, considering that a rort.

Overseas work and Forest Research Institute

The seven years that followed in the Malayan Forest Service, mostly as a District Forest Officer and later at the Malayan Forest Research Institute in Kepong, led to a life-long interest in tropical forests and forestry. On a visit home he met Mary Rae Macky, daughter of a pioneering Auckland orthopaedic surgeon. They were married in 1955 and spent their first year in Kepong where she enjoyed the comfortable life of an expatriate's wife while Tony was an instructor at the Malayan Forest School of Silviculture.

Returning to New Zealand in 1957, Tony joined the Forest Research Institute, then only a decade old and expanding steadily with the arrival of new personnel from Britain and the Continent as well as locals with forestry degrees from overseas universities. He was posted initially to Pureora Forest, a remote sawmilling village in the northern King Country, where he spent two-and-a-half years as a research forester. Pureora it was, because when they arrived earlier at equally remote Minginui, his original posting, no staff house was available.

Logging was in its heyday, with two big mills in the village and several others nearby churning out truckloads of sawn rimu, matai and tawa for the post-war building boom. Here began the first of what was to become a groundbreaking series of management trials in selective harvesting, an alternative to the destructive logging practices of an era when most cutover forest was destined for clearance for agriculture. The great pity is that it was implemented too late. By the time selective management became the national policy for indigenous State Forests in 1977, the public appetite for timber harvest from them had largely evaporated, with strident demands for a total end to native logging. All this and more has been skillfully described by Professor Kim King in her book *The Drama of Conservation. The History of Pureora Forest, New Zealand.*

In 1960, the Beveridges shifted with their first son in what was to become a long sojourn in Rotorua, ending weekend trips there from Pureora Forest in the Rover 75 they had bought new in Malaya and regular punctures on coarse gravel roads. Their second gracious home at Kawaha Point became the scene of many hospitable social occasions. Three more sons followed.

Tony began work at the Forest Research Institute in the first of several offices he occupied in Silviculture House, built originally in 1905/1909 for Halbert Goudie, the nurseryman who ran the original Lands Department forest nursery at Whakarewarewa, and who later became the first Conservator of Forests, Rotorua. Mamaku, Rotoehu, Pureora and to a lesser extent, Whirinaki, were the main forests of focus. Alas, in 1962, a new Director, Dr A. Denis Richardson, ordered the dismemberment of the Indigenous Silviculture group and he re-assigned colleagues like Roger Cameron and David Preest to other areas of work. Only Tony and John Nicholls survived in a mere token investment in indigenous forest research in the North Island.

Another blow fell in 1969 when the first Forestry Development Conference recommended the conversion of large areas of cutover native forest to exotic plantation and this became government policy. Already with years of research on rehabilitating logged forest behind him, Tony was given the odious task of finding the best way of replacing diverse tall forest of tawa and hinau and 101 other plant species with an apparent monoculture of radiata pine. Subsequent research has revealed a surprising diversity of native flora in older plantations of exotic conifers, but they are no match for ancient natural forest.

As a Research Field Leader from 1968, Tony's purview included oversight of research work in native forest throughout the country, including Northland kauri forests and South Island beech and rimu forests. Visits to other parts of the country and a series of silvicultural and botanical visits to tropical forests in Australia, southeast Asia and the Pacific from 1964 provided some relief from the rather depressing domestic outlook for indigenous forestry at the time.

The flowering of the conservation movement in the mid-1970s brought native forest management into the spotlight more sharply than at any time in New Zealand's history. By the late 1970s, Tony found himself and others embroiled in bitter national controversies over the future of iconic forests such as Pureora and Whirinaki. With his love of native forest and his personal and professional integrity, Tony found them particularly traumatic. Relief came with government decisions to end logging at Pureora in 1978 and Whirinaki in 1984, and the renewal of his research field, now renamed Indigenous Forest Management, from 1980. A band of enthusiastic young researchers, myself included, arrived fresh from university and research expanded into exciting new areas, such as predator impacts on native birds and comprehensive vegetation surveys of the large conservation reserves designated somewhat curiously as Ecological Areas.

Retirement

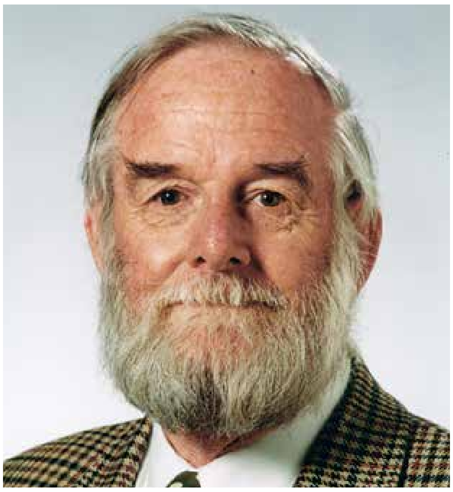
After retirement in 1985, Tony worked part-time for some years with disadvantaged youth at a charitable trust at Te Amorangi while still enjoying forays into his favourite haunts. I have fond memories of visits to his first logging trial at Pureora, crawling around in the scrub in the nearby Taparoa Clearing looking for this transect or that planting, and dinner on summer evenings under a marquee at the former maternity hospital in Mangakino. Relocation to Auckland in 1996 enabled him to spend more time with family and to also pursue his long-standing interest in southeast Asian languages, culminating in a BA degree in Indonesian. Recognition of his professional achievements came with honorary membership of the Commonwealth Forestry Association and of the New Zealand Institute of Forestry.

With his extraordinarily observant eye for and catholic interest in the natural world, Tony was very much in the mould of the natural historian. His leadership was marked by unconditional support and endless encouragement for younger scientists, in stark contrast to the often unprincipled and self-serving managers of today's science world. His concern for the personal and professional welfare of his staff never wavered. Neither did his passion for native forest, particularly his beloved tall podocarps: rimu, miro, matai, kahikatea and totara.

Tony died on 27 July aged 95, just a few short weeks after Mary. He was described as a person to whom the term a 'gentleman' was aptly applied, in all senses of the word. Tony will be greatly missed by those who knew and worked with him.

Obituary written by Mark Smale (Landcare Research) and Greg Steward (Scion).

Richard Charles Woollons
29 March 1942 – 19 July 2020



Richard Charles Woollons was born in Staines, Middlesex in 1942. He arrived in New Zealand in 1950 with his family aboard the P&O Rangitane on its maiden voyage via Panama. He was then cast into the near feral beach-bronzed tribe resident on Scarborough Hill, Sumner. He survived … and later married the girl next door.

Like many before him and since, Richard failed his first year at university, but recovered to develop a world-wide reputation in forestry science and growth modelling. After graduating in 1968 from the University of Canterbury, he found work as a hydrologist measuring streamflow on West Coast rivers in flood, but soon found long-term employment with NZ Forest Products (NZFP) and moved to Tokoroa.

Career with NZFP

Richard joined NZFP at a time when the Forestry Department at Kinleith was grappling with the challenges associated with keeping the newly expanded Kinleith Pulpmill supplied with wood. He was recruited by Brian Allison and Jack Henry to develop growth models and volume tables for radiata pine and various eucalypt species in conjunction with the development of NZFP's forest simulation model RMS 80. One of his first tasks assigned by Jack Henry was the evaluation of existing research trials. He soon began his own trials on establishment techniques and on the application of nitrogen fertiliser to thinned stands. He brought rigour in experimental design and analysis to a wide series of silviculture trials, including the mid-rotation fertiliser investigations that became the subject of his PhD thesis in the mid-1980s.

Richard recognised that field experimentation in forestry is an expensive undertaking and that inconclusive results can easily lead to lost management opportunities and profits. He advocated that the objectives of the experiment should be clearly defined and that all that followed worked to minimise the likelihood of inconclusive results. This involved the use of adequate experimental design followed by 'local control' of all aspects of treatment application and experimental maintenance to eliminate as far as possible extraneous factors that might confound the results. Accurate measurement, recording an d data management were essential, and close attention was needed to ensure that statistical analysis was made with due care. He saw the use of covariates to reduce experimental errors as an essential part of this process. He considered that methods for significance testing were robust, but that the underlying statistical assumptions were not usually met. Consequently, he tended towards a conservative approach by using tests stronger than the commonly used $p < 0.05$. His emphasis was on the magnitude of the response and its associated error terms. He also recognised the need for the long-term repetitive measurement of trials, so that greater understanding of growth processes in stands could be made and then utilised by incorporation into various growth and development models.

Richard's involvement in growth model development extended from Kinleith to Northland as NZFP grew its forest holdings near Warkworth and Whangarei and, in a joint venture with Shell, north of Dargaville. Following his secondment to the School of Forestry in 1986, he continued his association with NZFP and Carter Holt Harvey Forests, including the development of new growth models for CHH's Hawke's Bay forests. His work for NZFP and CHH resulted in numerous publications in a wide variety of academic and professional journals.

Richard is remembered by his Tokoroa colleagues for a mild level of eccentricity and a fiercely competitive approach to the morning smoko crossword school in the Kinleith field room, not to mention office chess and Battleship competitions. He was a member of the Tokoroa Operatic Society and a classical music enthusiast with a truly remarkable collection of LPs and CDs, and a stereo system that must have dimmed the lights of Christchurch whenever it was powered up.

His favourite toy at Kinleith was the IBM 360 mainframe computer which replaced older CDC equipment in 1978. At the time this was said to be the largest IBM computer in the southern hemisphere. It came with gaming software to entice new users, including a version of Dungeons and Dragons at which Richard became rather skilled. It also frustrated him greatly due to the frequent 'upgrades' in job control language which required regular recompilation of his beloved growth models.

Australian collaboration

In 1972, Richard spent a year at the University of Melbourne where he studied Theoretical Statistics under the tutelage of Professor E.J. Williams, which stood him in good stead for the development of his career. He also became an avid Collingwood AFL fan.

In Australia, he introduced the use of optical dendrometers for the assessment of stem profiles since part of the volume response to fertiliser in thinned stands could be attributed to changes in stem shape. Collaboration with Hugh Waring and Wilf Crane confirmed that this phenomenon occurred over a range of Australian sites. He was also able to explore the utility of multivariate techniques to examine forestry problems.

He collaborated with Peter Snowdon on the development of hybrid models wherein indexes of annual growth derived from process-based models using soil conditions and meteorological data were incorporated into stand projection models used to predict stand growth. In New Zealand, he developed some of these concepts by incorporating soil, topographic and broad-scale meteorological trends into his models.

School of Forestry

Richard started his PhD at the University of Canterbury School of Forestry in 1986 at the age of 44 – with the degree conferred in April 1989. In 1990, he was appointed Visiting Lecturer and in 2001 he became Senior Lecturer. After he retired in 2006 he became Adjunct Associate Professor.

Richard and Graham Whyte were a magnificent team, jointly supervising up to 10 postgraduate students at various times. Richard was a formidably competent biometrician who created immense value for the forestry sector during his career. He helped make the first growth and yield model in New Zealand, and no statistical problem was ever too boring or difficult to escape his attention. He contributed to the idea of using reverse Weibull distributions to model and project sample plot diameter distributions, and also single-handedly crafted two-stage representations of mortality modelling to finally allow us to have reasonably well-distributed residual patterns with mortality models. He had a wide network of like-minded research colleagues and collaborators, and his work is greatly appreciated internationally. During meetings he would pass the time by solving complex equations, and whatever the statistical issue he could effectively communicate excellent advice. Many researchers owe their proper analyses of experiments to him, and large numbers of students learned biometry and forest mensuration through his excellent teaching.

Every discipline has its hard subject – and with forestry the mantle of teaching biometrics fell to Richard. Funnily all students – both undergraduate and postgraduate – were a bit intimidated and in awe of what was required. He enjoyed the 'apocryphal' tale of the lecturer who asked first-year students to look at the two people sitting either side of them and then advised that one of the two will fail his course. The purpose was to electrify the idle and the somnolent, and demonstrate that mastery required a commitment to study.

In forestry, virtually every student had to turn to Richard whether for the dissertation or their thesis to turn their fluid ideas into a decent rigorous piece of work. … and, in the process, they got to appreciate his passion and warmth – and empathy. Richard offered his help willingly to undergraduate and postgraduate students, colleagues at UC, and others in need of good statistical advice.

Richard possessed a laconic, abstract kind of humour that often invited you into his world of mensuration, but was also extended to his tenure on the biscuit committee at the School of Forestry. The School possessed a wooden box which staff were required to keep flush with biscuits. Birthdays, promotions, papers published, holidays, marriages, anniversaries and assorted other events were all deemed by the biscuit committee to be reasons for donating biscuits. 'Grappling' to reach underlying chocolate biscuits was strictly forbidden. He was always positive, ebullient and engaging, and is greatly missed by his colleagues. He was an enthusiastic and regular attendee at UC Staff Club events and a keen choir member.

Richard is survived by wife Anne, née Ferguson, son Andrew (Australia), daughter Jenny (England), and grandchildren Jamie, Max, Oscar and Felix.

Obituary written by Peter Snowdon, Jeremy Fleming, Devon McLean, Barry Poole, David Evison, Euan Mason, John Walker and Bruce Manley.

Last word

David Evison

Erection of CLT panels, Hornby Club site, 10 September 2019


Hornby Club, 28 September 2020

Economic commentators (e.g. Giles Beckford on Radio New Zealand) have been suggesting that as we recover from the COVID-19 pandemic there is an opportunity to shape a different economic future, where we are less dependent on dairy, tourism and immigration. The latter two of these have been hit hard by the COVID-19 pandemic and that doesn't look like changing any time soon.

Greater domestic use of timber can contribute to reshaping and diversifying the New Zealand economy and will mitigate GHG emissions at the same time. The potential to use wood in a wider range of construction projects has been proven by New Zealand timber engineers. Multi-storey buildings, which have traditionally been built out of steel and concrete in this country, have been designed and built using a range of engineered timber products, particularly laminated veneer lumber (LVL), glu-lam and cross-laminated timber panels (CLT).

CLT panels can be used in a number of applications where tilt-slab concrete panels are currently used. Tilt-slab concrete panels are climate-unfriendly and weigh about four times as much as the equivalent timber panel. CLT has been used recently to build rest homes, student accommodation, community centres, multi-unit housing, university buildings, commercial and office buildings, and social venues in New Zealand. But a significant proportion of the CLT used in these buildings is imported, mostly from Europe, and there is currently no domestic supplier of this product in New Zealand.

This situation is slowing the adoption of timber engineering technology in New Zealand. Why are local suppliers important? When developers are considering what materials to use, and when lenders are considering whether or not to fund these projects, they will favour products with multiple local suppliers because this minimises the risk of supply disruption. Also, of course, radiata pine is an excellent material from which to make CLT, and local supply also provides greater opportunities for prefabrication.

We urgently need to invest more in local processing capacity. Red Stag are in the process of building a CLT plant in Rotorua, but we need more than one supplier to meet New Zealand's needs (and potentially those of Australia and other countries).

NZIF FOUNDATION

Appeal for Funds



Please help us to help NZ Forestry?

The NZIF Foundation was established in 2011 to support forestry education, research and training through the provision of grants, scholarships and prizes, promoting the acquisition, development and dissemination of forestry-related knowledge and information, and other activities.

The Foundation's capital has come from donations by the NZ Institute of Forestry and NZIF members. With this, the Board has been able to offer three student scholarships and a travel award each year. It has also offered prizes for student poster competitions at NZIF conferences.

To make a real difference to New Zealand forestry, including being able to offer more and bigger scholarships and grants, the Board needs to grow the Foundation's funds. Consequently it is appealing for donations, large and small, from individuals, companies and organisations.

The Board will consider donations tagged for a specific purpose that meets the charitable requirements of the trust deed. A recent example has seen funds raised to create an award in memory of Jon Dey who was known to many in New Zealand forestry. Donations for that award are still being sought.

The Foundation is a registered charity (CC47691) and donations to it are eligible for tax credits.

To make a donation, to discuss proposals for a targeted award or for further information, please email foundation@nzif.org.nz or phone +64 4 974 8421.

Make a donation today.