Scion Connections

TRANSITIONAL FORESTRY
DESIGNING FORESTS WITH PURPOSE

COLLECTIVE DATA
DRIVING INDUSTRY TRANSFORMATION

BEYOND THE RHETORIC
BIOTECH'S BRAVE NEW WORLD


scion

Could methane-munching microorganisms in our forest soils help New Zealand cut harmful emissions? Fascinating new research by Scion scientists is trying to find out.

The project, led by Kathryn Walker, will reveal just how important planted forest soils are to New Zealand as part of efforts that seek to better understand the country's total net emissions and ways to mitigate climate change. *Read more on page 37.*

Kia ora,

We're pleased to share this edition of *Scion Connections* with you, just in time for Fieldays.

Every year, we look forward to connecting with our primary industry peers at what is the Southern Hemisphere's largest agriculture event. Scion has always had a presence at the four-day fixture at Mystery Creek, but for the first time last year, we joined the forestry industry inside the new Fieldays Forestry Hub. We're back there in June, showcasing our breadth of research that supports the growth of the forestry and wood processing sectors, and the development of new technologies that use trees and fibre to create biobased products that can replace those made from fossil fuels.

When research is shared, everyone benefits and at Fieldays we can't wait to share with both experienced and new growers information about planting trees and the options available. There is more to forestry than pine, and this is best illustrated in the new booklet, *A New Zealand Guide to Growing Alternative Exotic Forest Species*. Co-created with industry and with research input from Scion, the booklet provides small landowners and key players with information about the different exotic commercial species available.

Other events have created opportunities for us to highlight our research and we cover their impact in this issue. Our biotechnology capabilities were in the spotlight at the Life Sciences Summit and, earlier in Wellington, our Scion Symposium stimulated discussion about the benefits for New Zealand in taking the bold steps needed to transition to a circular bioeconomy.

More recently, we hosted the inaugural Indigenous Plant Fibres Symposium at Te Puia in Rotorua. Connecting people across the spectrum of indigenous fibres, it reminded everyone of the value of mātauranga Māori, and the meaningful discussions that happen when people have the space and time to come together for a common purpose.

More can be achieved for New Zealand when we work together. *Scion Connections* celebrates the partnerships and collaboration that demonstrate that.

We hope you enjoy this issue and the remarkable and diverse work of our scientists who are helping create a more sustainable future.

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What's inside

COVER: Forests can deliver benefits to multiple users. (Designing forests with purpose story, page 8).

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Unlocking the value of processed wood

Efforts to grow our regional economies and respond to climate change were given a boost in April when the Government announced a new $57 million fund to provide support for wood processors and new research and technology that will see wood processed to create more low-carbon alternatives to products made from fossil fuels.

Starting in July, the Wood Processing Growth Fund will provide about $3 million a year for research, business cases, pilot studies and market development around onshore wood processing projects.

The rest of the money will be available for companies wanting to build plants or co-invest in equipment and technology.

Minister of Forestry Peeni Henare made the announcement in Rotorua at the annual conference of the wood processing and manufacturing sector. For many, including Scion, it signals a step towards unlocking the sector's potential through investment that will increase New Zealand's onshore wood processing capacity.

By processing more logs onshore, the sector can produce more high-value wood products like sawn structural timber and engineered wood for projects, including sustainably driven multi-storey buildings. It's these timber products that store carbon for a long time and delay carbon dioxide being released back into the atmosphere. Onshore processing also produces residues that can be made into low-carbon biofuels and other high-value biobased products. This compares to the large amounts of logs currently exported long distances overseas full of water. Not only is the water not wanted at the destination, the wood deteriorates due to the water content and the time taken to get to processing.

As a Crown Research Institute that's focused on harnessing the power of forests to support New Zealand's transition to a circular bioeconomy, we applaud the announcement and look forward to working with our industry and iwi partners to turn this vision into a reality. By producing more high-value products onshore, the forestry sector can actively support New Zealand's commitments to decarbonise our economy. These investments will deliver better outcomes for the regions through increased jobs and ensure a more productive and sustainable future that we can all benefit from.

We've long held the view that there is value in forestry and fibre not simply for the ability of trees to capture carbon. There are considerable economic opportunities provided by plantation forests when they are well managed, rotated and harvested. By making use of the whole tree after it's harvested, including its residues, we have the ability to extract new value through the manufacturing of wood-derived products that become substitutes for those made from fossil fuels. Timber is a carbon-friendly alternative used in construction but, as part of a more sustainable future for New Zealand, we will require fuels, packaging, biochemicals and pharmaceuticals to be sourced from trees and fibre as well.

As a country, if we're serious about meeting our net zero carbon goals by 2050, we must act with greater urgency and use the scale of our renewable forests to produce low-emissions materials and fuels. While growing trees for carbon sequestration will always have its place as part of efforts to mitigate climate change, we'll accelerate our progress much faster by reducing our dependence on fossil fuels and creating renewable alternative products that leave a greener footprint.

At Scion, our research, innovation and development of new technology is committed to helping New Zealand meet these objectives. This issue of *Scion Connections* highlights some of our most recent activity and shows the benefits that come from partnerships and the sharing of ideas. The solutions to climate change won't be achieved by working in silos. We're committed to working across the forestry sector, with government and iwi to lead the transition to a circular bioeconomy so the environment, economy and communities can prosper.

DR. JULIAN ELDER.
CEO, SCION.

Change in the Chathams

A journey of self-sufficiency and restoration

Stitching together the unique environment, people, culture and economy of the Chatham Islands to create circularity, sustainability, and rejuvenate and restore its unique native flora and fauna.

Creating self-sustainability and restoring an ancient landscape takes time, patience and partnerships.

Particularly when it's a remote cluster of islands 800km off the coast of New Zealand with 600 inhabitants, unforgiving weather, and challenging infrastructure and logistics for even the basic necessities.

The journey began in 2016, when a visionary trust, the Hokotehi Moriori Trust, put the call out to New Zealand's Crown Research Institutes (CRIs) for help building a sustainable Chatham Islands.

But not just any help – the Chatham Islands has a long and proud history of being home to the Moriori. The trust, then led by Maui Solomon, wanted to boost sustainability and restoration alongside indigenous innovations, and strengthen Moriori culture and heritage.

A pan-CRI approach, including Scion, kicked off in 2017 and has resulted in a number of projects being created in partnership with the trust and wider island community, with funding support through Ministry of Business, Innovation and Employment's (MBIE's) Vision Mātauranga Capability Fund and Ministry for Primary Industries (MPI's) One Billion Trees programme.

The trust is spearheading this work, under its strategy *Destination Rēkohu 2040: A Sustainable Chatham Islands*, with Scion honoured to be working alongside local communities and other CRIs such as AgResearch, to contribute expertise around creating circular bioeconomies and nursery capabilities.

Included in the overall vision for economic growth on the island is expanding eco-tourism opportunities and higher-value food products.

The wider projects

The projects Scion has been involved with, through close partnership with the local community, have involved three workstreams: a waste stocktake, a One Billion Trees (1BT) planting programme and science partnership for Recloaking Rēkohu (the largest island in the Chathams) with exotic and indigenous forest, and the establishment of a micro-abattoir for creating higher value premium products to support the islands' primary industries of fishing and sheep farming.

All three workstreams are at different stages of action and completion, with 2023 marking the second year of an initial five-year work programme.

Recloaking Rēkohu

The science partnership, titled Recloaking Rēkohu, and funded by the 1BT planting programme is an essential body of work currently happening. This includes looking at enablement through infrastructure, for example holding nurseries and water

Trust spokesperson Levi Lanauze (left) inspects the growth and quality of young plants indigenous to the Chathams grown in the Scion nursery.

supply; planting an initial 284ha of Rēkohu in indigenous and exotic trees; and establishment trials testing optimal growing environments for several species.

Ultimately, it's hoped the science partnership and its learnings will inform a long-term forestry management plan for the next 30 – 50 years to restore the Chatham Islands landscape.

Hokotehi Moriori Trust on-island farm and forest manager Levi Lanauze has many hats, including T'chieki (guardian) of Farms and Forest for the trust, and guardian of the Imi's Farms and Forest. He also manages the 1BT programme.

Lanauze says the biggest value-add for this work is the community involvement.

"Whether that's through supporting the island's nine micro-nurseries, island logistics or fencing contractors, through to employment of our own nursery staff. It may be a trust project, but the island benefits.

"For the trust, it's putting the cloak back on Rēkohu and adding a habitat for the island birdsong to return. It has both cultural and environmental benefits.

"I am an eighth generation Chatham Islander and proud to be part of such a great team and project. Farming has always been my passion and growing up on the Chathams, you always have conservation values at heart."

Part of the cultural impact is regenerating culturally significant native species to the Chathams such as the sacred kopi (NZ Karaka) which, until recently, was thought to be dying out.

Scion project leader Elizabeth Dunningham says restoring the landscape is about more than just planting trees.

"Restoration of a landscape is a long-term prospect and the vision for self-sufficiency is also long-term.

"It's about restoring the landscape so the soils aren't degraded, there's not vast tracks of scrubby, underutilised land, bringing back greater biodiversity of the Chathams' endemic species, and native flora and fauna, and becoming self-sufficient so there's exotics for the likes of timber production."

In the first year of the 1BT programme, Lanauze oversaw the planting of 52ha – that's 52,000 trees, double the year one target. Ultimately the trust would like to continue recloaking the henu (land) with future projects.

The 1BT planting programme is also providing the propagation support and endemic seedling supply. Scion's role is to receive seed collected on the islands and grow plants that are delivered back and planted on the main island of Rēkohu.

> "Restoration of a landscape is a long-term prospect and the vision for self-sufficiency is also long-term."
>
> ELIZABETH DUNNINGHAM

The first year of the programme has included learning and developing processes and techniques to propagate and deliver the first species, hakapiri, at scale in the Scion nursery.

Scion technologist for Elite Trees, Toby Stovold, says the majority of the six species being looked at have never been grown at scale before, or at Scion for that matter.

"There's been lots of learning for us around what's the optimal way to take a native seedling and ensure it survives, and then grows well back on the island. The Chathams is a unique landscape, with harsh winds and polar blasts, and notoriously unfertile soil."

The science partnership looks at developing scaled seeding production, establishment trials both on the island and at the Scion nursery, to build greater knowledge about the endemic Chathams species and building capacity so that further land can be planted.

Trials this year will include planting on the island in different locations, such as in scrub or grasses, or next to companion trees, as well as differing levels of weed control, to help gauge what is most successful to inform future planting.

Stovold says part of Scion's contribution also involves knowledge-sharing and training nursery workers based on the island to one day be self-sufficient in seedling production. With limited resources and freight and logistics challenges, the importance of supporting the nurseries on the island is seen as a main ingredient for success.

Creating circularity

What has helped set the self-sufficiency scene is the waste stocktake, completed in 2022, which collected information on the biological and inorganic waste on Rēkohu. This data and resulting work will have far-reaching impacts for the Chathams, both environmentally and economically.

The trust's vision for change includes building indigenous innovations and contributing to the economic growth of the island through better environmental practices.

With almost all goods and products imported from New Zealand via air or sea freight, plus an economy largely reliant on primary industries, packaging and inorganic waste are a real issue for the Chathams. On-island capabilities are also a challenge due to isolation and limited infrastructure.

Scion's portfolio leader for Distributed and Circular Manufacturing, Marc Gaugler, headed the waste audit. He says the stocktake was about understanding the unique situation of the Rēkohu community.

LEFT TO RIGHT:

- *Colin Faulds, former Scion nursery technician, examines recently planted Hakapiri at Kaingaroa station, Rēkohu.*
- *Colin Faulds and the trust's Levi Lanauze, collect seed.*
- *Dani McQuarrie from Hokotehi Moriori Trust surveys plants in the ground.*

CLOCKWISE FROM ABOVE:

- *Ngaio seed collected near Jim Barker reserve, Rēkohu.*
- *A team effort: Scion senior nursery technician Anita Wylie (front) speaks with trust members about seedling progress.*
- *Shining Karamu loaded with seed, and former Scion nursery technician Colin Faulds, on Rēkohu.*

"Currently end-of-life options other than landfill or open-field burning don't exist, not only for single-use items such as packaging and the likes of plastic fishing equipment, but also local bio-waste from fishing and farming.

"While these waste products pose a health and wellbeing issue for the community, it also highlights a loss of economic value and opportunity."

The waste audit, which also included beach plastic pollution, established that 300 cubic metres of landfill waste was collected on Rēkohu each month, as well as 1.5 tonnes of potentially recyclable material.

Gaugler says potential benefits exist around circular economy principles and associated technologies through rethink, refuse, reduce, reuse, recycle and replace. His team also identified a key opportunity around bio-waste.

"The available biomass residue from future forestry operations and existing seafood processing and farming is a potential resource for future value-add initiatives and economic and environmental benefits for the community.

"Some of these have the potential to replace imported plastic goods and materials, for example the use of local wool as weed mats or agricultural textiles.

"The main challenge is the reliance on New Zealand mainland initiatives to drive change, for example the dependency on freighted packaged goods while no packaging return options or recycling options exist."

The waste audit highlighted key circularity and sustainability options that could sit alongside planned infrastructure investment on Rēkohu.

These options focus on the transition of the Chatham Islands to a circular economy where waste is minimised or used as a resource to utilise for economic and health and wellbeing benefits.

Gaugler says the project also highlights benefits for New Zealand. By demonstrating circular bioeconomy principles in remote, distant communities, work carried out on Rēkohu has the potential to inform future policy and funding decisions in the transition to a low carbon economy and ensuring no community is left behind.

Restoring the landscape and creating increased self-sufficiency will involve partnering with the right people and technology, in a way that honours the Moriori way of life.

Back to the future

The Chatham Islands community is passionate and engaged with bringing about increased self-sufficiency and restoring the landscape to how it used to be.

Partners involved recognise that long-term change will only be enabled by understanding the environment from a holistic and indigenous point of view.

With Scion and other partners still working deeply in these projects, there is still much to be done, including looking at establishing a micro-abattoir in partnership with AgResearch.

Restoring the landscape and creating increased self-sufficiency will involve partnering with the right people and technology, in a way that honours the Moriori way of life.

Designing forests with purpose

Scientists (from left) Andrew Cridge, Yvette Dickinson, Alan Jones and Richard Yao are among 11 researchers who have contributed to a thought-provoking new research paper.

Thought-provoking new research is challenging New Zealand to re-think how we design, manage and value our forests. And if we get the transition right – we can be world leaders.

Working from an office with Whakarewarewa Forest on your backdoor, it's not hard to be inspired.

Although it is primarily a commercial forest and managed for its export quality radiata pine, the forest still features a range of indigenous plants and other exotic tree species. Over many decades, the likes of Douglas-fir, Tasmanian blackwood, European larch, Japanese cedar and Californian redwood have grown to provide an upper canopy of exotic tree species that shelters a kaleidoscope of ferns, shrubs and fungi. The understory of mostly native plants is an integral part of the forest ecosystem and adds to the scenic value of the forest.

Its value as a mountain biking mecca is also well-documented. Many economic impact studies have highlighted the value of Whakarewarewa Forest to Rotorua's economy, with the most recent report commissioned by RotoruaNZ showing that more than $103m was spent in the city by visitors who came for the sole purpose of exploring its mountain biking trails in 2021.

The contribution of mountain biking to the Rotorua Lakes economy by Benje Patterson (Aug 2022) suggests the total spend by mountain biking will increase to more than $213m in 2026 when international visitors are expected to arrive in greater numbers as their appetite for travelling resumes following the global pandemic.

The forest's popularity and value as a mountain biking destination almost overshadows its value for commercial timber production. But the fact that Whakarewarewa Forest can be managed in such a way that it serves recreational users, a citizen scientist pest control community, iwi relationships and the planted forestry industry at the same time illustrates how forests can simultaneously deliver multiple benefits.

For Scion scientist Alan Jones, Whakarewarewa Forest is proof that a mixed use, mixed species, mixed age forestry model works well.

"Looking out my window, the forest is a useful case study and is an example of the range of values that we could attach to New Zealand's forestry landscapes in the future."

It's a view shared by 10 other researchers at Scion who have combined their thinking in a paper, *Transitional forestry in New Zealand: re-evaluating the design and management of forest systems through the lens of forest purpose.*

It reappraises what forests are for and how they are being used, suggesting New Zealand could benefit from a shift away from the current binary management focus of production or conservation. As well as these two extremes, Jones and his colleagues are proposing that we also think about the opportunities 'in the middle.' In other words, as a country looking to plant more trees to lock in carbon and meet our net-zero emissions goals by 2050, researchers are challenging us to not be so black and white in our approach. Because, according to Jones and his colleagues, there's a lot to be gained by thinking about the grey.

Realising forestry's potential

The concept of transitional forestry has been a topic of discussion among forestry researchers for some time. The Scion paper explores the opportunities of adopting a transitional forestry model in New Zealand - a country that has created an excellent productive and exotic forestry system but may not be fully realising its potential to develop forests that generate a full range of benefits for society and the environment.

> "There's a lot of work being done on how to transition existing plantation forests to native species forests, but there's still a lot to learn about forest dynamics and species interactions."
>
> ALAN JONES

Their research touches on the challenges involved in transitioning existing monoculture forestry into something more diverse, and the need to better understand forest dynamics and how species interact. The idea of ecological forestry, which proposes using the benefits of sympathetic relationships between different species in a productive commercial forestry setting, is also discussed.

Continuous cover forestry is another model touted as a lower impact type of forestry that could be increasingly adopted in the future. This is where individual trees are selectively harvested over time from a mixed species plantation and a certain percentage of tree canopy is always left intact.

Of course, any kind of change to the status quo has its challenges and there is still a lot to learn about how to manage a range of different species mixed in one forest.

For Jones, who is the lead author, the research reinforces how New Zealand has the chance to lead the way in demonstrating how to transition existing plantation forests to indigenous species forests – while still being able to maintain forests for their economic, conservation and biodiversity values simultaneously.

"In New Zealand, our forests tend to have been designed with one goal in mind. The management of our native species has tended to focus on only a few objectives and looking at landscapes more broadly, whether they're used for agriculture, horticulture or forestry, we've always managed them for maximum productivity," Jones says.

"There are benefits on multiple levels if we were to value our planted forests or conservation estates for more than one purpose because, right now, they aren't delivering all the benefits that they could be by virtue of the limitations that a single-minded approach has."

> Managers can't afford to wait decades for scientists to resolve all of the knowledge gaps before they take action, but we can work together to learn iteratively as we go.
>
> YVETTE DICKINSON

A time for change

While thought-provoking, the research is also timely. Despite demonstrated economic and social benefits for regional communities, and the ability for planted pine forests to sequester carbon and reduce erosion, there are growing calls for New Zealand's forestry sector to become less reliant on *Pinus radiata* for revenue.

And in an uncertain climate future, particularly alongside wildfire risks and rising biosecurity concerns due to expanding international trade and travel, there's recognition that the industry needs to diversify.

"Climate change or biosecurity impacts may eventually necessitate rapid changes away from a *Pinus radiata*-focused model," Jones says. "There will always be a place for highly productive pine forests, but more forest diversification may be a beneficial de-risking strategy, providing resilience to climate change while maintaining the important functions of productive forests to protect timber yields as well as develop their recreation, cultural and economic values."

The research also reflects discussions happening between forest scientists around the world about the best ways to design new forests. There's a push internationally to see more landscapes, especially degraded landscapes, planted with trees; the Bonn Challenge is a global initiative to have 350 million hectares planted in trees by 2030. In 2018, the New Zealand government launched its One Billion Trees scheme, directly offering subsidies for tree planting. And in 2021, our Climate Change Commission recommended that New Zealand should aim to reforest 680,000 hectares, including both exotic and native species, as part of efforts to meet our net-zero emissions targets.

Having become a mecca for mountain bikers and other recreational users, Whakarewarewa Forest serves as a useful case study for how forests can deliver multiple benefits simultaneously. PHOTO CREDIT: GRAEME MURRAY

Whakarewarewa Pest Free Trust volunteers, including children from the Saathof family, carry out checks of pest traps set among tawa trees in Whakarewarewa Forest. PHOTO CREDIT: JAKE SAATHOF

Jones argues this momentum for afforestation is an opportunity to move away from the traditional business as usual fixed models of forest management towards integrated forested landscapes with greater functionality.

Designing forests from the start with better public infrastructure to support accessibility for recreation, community-led pest management or citizen science-type surveillance work, for example, could also help achieve greater public buy-in as these new forests become established.

For anyone looking for a circuit-breaker or reasons to do things differently, climate change and social licence are it.

Building knowledge and expertise

So, if there's recognition that change is needed, what are the options and how can we adopt them?

Jones and his co-authors agree that, currently, there are significant challenges in implementing transitional forestry approaches that may take several decades to resolve.

For example, transitioning even-aged monoculture pine forestry stands to uneven aged stands that feature both a mix of exotic and native species would take multiple harvest rotations and several decades for successful establishment, potentially with initial reductions to timber yields.

Technically, New Zealand is still learning how to make these transitions, Jones says.

"There's a lot of work being done on how to transition existing plantation forests to native species forests, but there's still a lot to learn about forest dynamics and species interactions.

"If we want to encourage native species to establish within an existing plantation forest, we need to understand what sort of conditions they are going to flourish in. That's factoring in things like light availability, what's the speed of their growth during that transition, and what's the window of establishment within that system for those native species."

Supporting the forestry sector to overcome large research gaps is silviculture scientist and portfolio leader for Designing Forests – Mahi Tahi Whaihua Yvette Dickinson. A co-author on the paper, she has been advocating for an adaptive forest management approach where scientists collaborate with land managers.

"Managers can't afford to wait decades for scientists to resolve all of the knowledge gaps before they take action, but we can work together to learn iteratively as we go," she says.

"By applying management that is informed by the best available science and closely monitoring the outcomes, we can learn from our actions. When we can apply the lessons we learn to future management actions, our land stewardship should improve over time."

The learning process is also factoring in international research which supports the idea that within a planted commercial forest, foresters can get increased timber productivity from having companion planting.

"We know that increased productivity happens with some combinations of species but not others," Dickinson says. "But we don't yet have enough knowledge about why overyielding occurs to be able to reliably predict when it will happen."

Researchers are also still developing their understanding about how to manage a range of species in one plantation, how to harvest them and then process that timber.

Native forests, such as Whirinaki Te Pua-a-Tāne Conservation Park, are managed by the Department of Conservation.
PHOTO CREDIT: FORIS ECO-TOURS/ROTORUANZ.

Expanding forest access for conservation

In New Zealand, about 8.6 million hectares of New Zealand's land area is managed specifically for conservation by the Department of Conservation (DOC). Representing 33% of New Zealand's land area, the country has one of the highest proportions of conservation land worldwide.

All forest conservation within New Zealand is subject to the devastating and ongoing impacts of invasive pests and weeds, with DOC spending $73.5 million each year on pest control alone – around 20% of its 2015 revenue.

Climate change brings new burdens to the already limited resources of capital, labour and materials available for conservation practice. As climatic conditions negatively impact native flora, the spread of tree diseases, invasive pests and weeds will accelerate.

Due to a combination of their remote geographic locations and relatively low level of funding to maintain infrastructure, including trails and roading access, Scion researchers say the public has very limited access to large areas of DOC-managed forests. They argue there's a strong case for opening them up to enable better public engagement for pest trapping and weed management.

"We know the public already has a strong appetite for conservation work – more than 600 community groups are involved with voluntary pest and weed control, together with tree planting," Jones says.

"We believe there's a huge opportunity to support the conservation management of our native forests in the future by making it even easier for citizen scientists to engage, with further resourcing for support of mana whenua in kaitiakitanga (land guardianship)."

DOC management could be supported by 'app'-based citizen science monitoring schemes that can provide early warning of biosecurity incursions, such as the Kauri Dieback App.

"Increased engagement and greater access to our existing and emerging native forests will only stimulate further investment in activities to preserve their value," he says.

> "Increased engagement and greater access to our existing and emerging native forests will only stimulate further investment in activities to preserve their value."
>
> ALAN JONES

Harnessing data

But what about commercial planted forests? And, with the Forestry and Wood Processing Industry Transformation Plan (ITP) outlining a future where we grow and process more logs to increase the production of value-added wood products, how does it align with a transitional forestry model where economics aren't the only driver?

Very easily, according to Jones. "Within this paper we're not saying highly productive forests aren't needed. In fact, we see a future where production efficiencies will be enhanced with the increasing adoption of precision forestry techniques – think data-gathering technologies and automation.

"These will be necessary to support silviculture management and harvesting decisions."

Production-focused transitional forestry systems would use data to increase productivity and build ecological resistance to climate risks. In this way, some areas of planted forest could be optimised for generating timber yields at a high intensity while freeing up land for other uses such as forest conservation or recreation.

"Using smart technologies, we'll understand at a greater level how the forests are growing and responding to different environmental conditions. Then we can optimise our management and planning to increase our productivity of those forests. This will enable us to increase production for short rotation crops grown, for example, as a feedstock for bioenergy."

Published as a discussion document, Jones and his colleagues hope the paper will stimulate further debate across the industry and government, and spark conversation about how a transitional forestry model could be supported by changes to the Emissions Trading Scheme (ETS).

"Right now, the scheme rewards landowners for carbon storage. But perhaps we could modify the ETS so that it recognises other values, so built into it are values for biodiversity or payments for specific habitat types or species mixes.

"We have a huge opportunity in New Zealand to do things differently and address major environmental, economic and social challenges, as well as create landscapes that people want to be surrounded by."

Research paper authors: Alan Jones, Andrew Cridge, Stuart Fraser, Lania Holt, Sebastian Klinger, Kirsty McGregor, Thomas Paul, Tim Payn, Matthew Scott, Richard Yao and Yvette Dickinson. Their paper is freely available here:

Technology offers hope
in the fight against myrtle rust

New research using remote sensing technology has delivered promising results to scientists looking for innovative ways to help nurseries combat the spread of myrtle rust.

A collaborative research team at Scion has found a way to quickly detect myrtle rust days before plants show signs of infection, providing hope that nurseries in the future can start control treatment much sooner and stop disease outbreaks in their tracks.

Working in a containment laboratory, the team, led by data scientist Elizaveta Graevskaya, used high precision equipment to detect myrtle rust infection in leaves of rose apple plants deliberately inoculated with the myrtle rust pathogen.

Using thermal imaging the team detected decreases in leaf temperature in infected plants at least a day before symptoms could be seen. Transpiration measurements showed the temperature drop was caused by higher rates of water evaporation from the leaves as the fungal infection punctures individual cells, which cooled the leaves down.

The researchers also used a hyperspectral sensor to look at changes in the wavelength of light reflected from infected leaves. Measurements made using hyperspectral cameras can include visible light to shortwave infrared and have proved particularly useful for early detection of diseases. For example, the ratio of blue/green light reflected by infected leaves was noticeably different from healthy leaves up to three days before symptoms were visible. This change suggests that myrtle rust reduces the amount of chlorophyll in infected leaves. Chlorophyll is the green pigment that gives leaves their colour, and which absorbs energy from the sun during photosynthesis.

These exciting results have prompted the team to expand their research to include other vulnerable species from the myrtle family, starting with eucalyptus in spring.

The lead author of this research and Scion principal scientist Mike Watt presented the findings as part of a webinar series delivered by Beyond Myrtle Rust – a collaborative research programme that Scion contributes to.

"This sophisticated technology has allowed us to detect myrtle rust infection before it can be seen visually in leaves," Dr Watt says. "We hope this research can be used to develop a robust detection methodology that will benefit commercial nurseries in the future."

A major step forward

Scion pathologists, who are some of New Zealand's leading experts in myrtle rust, have been involved in research to understand the impact of the disease since it was first detected in mainland New Zealand in 2017.

> We can see a time when nurseries will be using hand-held, mobile technology that will be able to detect myrtle rust infections before they are visible.
>
> DR HEIDI DUNGEY

While myrtle rust will be impossible to eradicate, Scion forest geneticist Heidi Dungey says this latest research is a major step towards arming nurseries with the tools they need to make better disease management decisions.

"We are several years away yet, but we can see a time when nurseries will be using hand-held, mobile technology that will be able to detect myrtle rust infections before they are visible," Dr Dungey says.

The technology also has potential to be used in the field, and at a much larger scale.

Because the thermal and hyperspectral equipment used by the Scion researchers can be mounted on drones, the team hopes to one day develop field-based methods to detect myrtle rust infections rapidly and remotely.

Forest pathologist and research group leader Stuart Fraser leads the Ecology and Environment team investigating myrtle rust. He describes the latest research as "incredibly promising".

The research team included (clockwise from top) Michael Bartlett, Peter Massam, Dilshan de Silva, Honey Estarija, Elizaveta Graevskaya, David Cajes and Michael Watt.

"As part of a wider programme of research, we've been monitoring myrtle rust's impact and seasonal progression across the North Island for several years," he says.

"It's important that we throw everything at it and use a range of available technologies to accelerate research and management, so we can reduce myrtle rust damage to our most vulnerable plants and landscapes."

Myrtle rust poses a threat to the country's most iconic plants, including pōhutakawa, mānuka, and rātā, as well as commercially grown species such as eucalyptus.

Currently, myrtle rust has an uneven distribution across the North Island, and on the top part of the South Island. It has also been reported from Christchurch. It is most likely to be seen during warm, wet conditions.

The disease causes bright yellow-orange powdery pustules on young leaves, shoots, fruits and flowers in the myrtle family, causing deformation of the leaves, and twig dieback. Repeated severe infection can cause decline or death of large trees.

Beyond Myrtle Rust programme leader Mahajabeen Padamsee says the research illustrates how technology is an important tool for the detection and monitoring of plant pathogens, which is vital for disease management.

The research findings have been published in the respected international journal *Phytopathology*.

Learn more about the research here:

Indigenous thought and fibres the way forward

An inaugural symposium aimed at forming connections across the spectrum of indigenous fibres with the hope of seeding relationships to seed innovation was held in Rotorua in May.

"Māori must lead because we're aligned to this. We know this, it's in our DNA."

Whenua Oho chief executive and Ngā Pou o Tāne chair Te Kapunga Dewes (Ngāti Porou, Te Arawa, Te Whakatōhea) emphasised these words at Scion's inaugural Indigenous Plant Fibres Symposium.

It was a fitting start to the symposium held at Te Puia on May 9 and attended by about 50 people.

The symposium, 'Supporting an Indigenous Plant Fibres Value Chain in Aotearoa,' aimed to support new and innovative Māori-led opportunities by connecting the value chain of growers, processors, and end products.

Scion is already collaborating with Māori partners to explore mātauranga Māori and kaupapa Māori approaches in indigenous fibres, alongside scientific research and development.

Dewes said Māori were naturally aligned with the concept of a circular bioeconomy because katiakitanga (guardianship) was an underlying concept.

"Balance, harmony with the environment, our people, and our community. All of these are important and a natural cultural fit for us."

He said because Māori aligned with a circular bioeconomy, they needed to be part of conversations to ensure their input was heard and executed.

"If we want our great grandkids to prosper, to thrive, we're going to have to make change.

"We will need to reduce consumption and have political and societal willpower to make sure these actions are enacted long-term. Māori must lead because we're aligned to this. We know this, it's in our DNA."

Scion general manager biobased products Dr Florian Graichen said attendees were there for solutions and indigenous and natural fibres have a big role to play.

"Using this knowledge unlocks enormous environmental, social and economic opportunities."

Scion's Bioproducts and Packaging portfolio leader Dr Alec Foster said the symposium aimed to create a space for people to develop connections organically.

"By seeding relationships, we hope to seed innovation.

"There are benefits to growing this community through the creation of greater economic activity and jobs."

> "It wasn't just learning how to weave. It wasn't an economic exercise. It's whanaungatanga and whakapapa at its best."
>
> KARL LEONARD

Foster hoped the symposium would lead to further collaborations, research and showcase what was needed to start new businesses, create new jobs and provide an economic boost for communities.

Taonga heals land and people

Harakeke (flax) and muka, the fibre extracted from harakeke, were the focus of most of the other speakers at the symposium.

Utakura 7 Incorporation chair Tamalene Painting (Ngāpuhi) said the trust had partnered with Scion and the Ministry for Primary Industries to restore wellness to their Northland whenua.

She said the trust wanted to introduce more taonga species with rongoā (medicinal) benefits, and timber to reinstate biodiversity.

"Reinstating that taonga is going to involve our community and by involving our community it's going to create a level of wellness.

"If we heal our whenua and heal our wai we'll heal our people."

Operations manager Simon Tanner said he enjoyed working with Scion and it had opened new opportunities not previously considered. With research ranging from economic models, developing a new nursery, harakeke processing right through to looking at different product and textile opportunities.

In their journey Utakura 7 have overcome hurdles with MPI and working together they have developed a template for future Māori-led research.

"It's a piece of research that's going to help us but also others."

Te Kapunga Dewes (Ngāti Porou, Te Arawa, Te Whakatohea), who is Whenua Oho chief executive and Ngā Pou o Tāne chair.

Harakeke textiles

Māori textiles specialist Dr Rangituatahi Te Kanawa (Ngāti Maniapoto) spoke about her work on the Ministry of Business, Innovation and Employment-funded project Te Aho Tapu Hou – a new sacred thread.

The project aims to develop technology and processes to create an industrially spun yarn from muka.

A thread, made with muka, water and no other additives, has been created, but isn't at a commercial scale yet.

Kharl WiRepa, chief executive of KW Fashion, spoke about his work and Scion's assistance turning harakeke into a durable and modern textiles fabric.

He said the goal was for this to be released in 2030 and a Māori spin could be put on a revitalised textiles industry.

Harakeke for the environment

In a government-funded programme, Te Arawa Lakes Trust trialed weed mats (uwhi) weaved in three ways, to control lake weeds.

The uwhi outperformed traditional hessian mats in both condition over time and penetration of weeds.

One year after they were placed in lakes Rotoiti, Tarawera and Rotomā, they are still firm and secure while the hessian mats have disintegrated, trust biosecurity operations manager William Anaru (Te Arawa) said.

The mats also sheltered taonga such as koura and native aquatic plants.

The project involved over 20 Te Roopu Raranga ki Rotorua weavers across Te Arawa iwi and Ngāti Rangiwewehi also created mats for their own awa.

Representative Karl Leonard said all aspects of the iwi were involved and visited while they were being created to "imbue mauri".

"It wasn't just learning how to weave. It wasn't an economic exercise. It's whanaungatanga and whakapapa at its best."

Roland Kingi (Te Arawa) spoke about research in 1994 with Scion, Landcare NZ and Te Runanga o Ngāti Pikiao into creating a wall using muka as a reinforcing agent in housing.

The research was picked up by the University of Auckland in 2003 and looked at low-cost flax fibre reinforced earth housing.

"All the material that you need to use to build your house should be on your whenua or around your whenua."

Scion wants to continue working together with Māori to grow the conference into an annual Te Ao Māori-led event.

> "All the material that you need to use to build your house should be on your whenua or around your whenua."
>
> ROLAND KINGI

A local signature

Closing the symposium, award-winning designer and environmentalist David Trubridge said the model of multinational corporations was causing climate change, global warming, marginalisation of poor people, species extinction and it all had to stop.

"And it's all for stuff … it's mindless consumption".

He said moving away from multinational corporations would require going local.

"We're shutting out the mass-produced model that is killing the world and hopefully trying to change the hold capitalism has on us."

"The future lies with indigenous thought not with global capitalism."

Scion previously developed a biopolymer, with a local element, to replace Trubridge's use of polycarbonate.

"If you have a local material intrinsic to the thing you're making then it can't be copied. It's like a local signature."

Joining forces for impact

Teams from Scion and Callaghan Innovation are working together on projects to deliver greater impact for New Zealand.

Scion scientists and the Commercialisation and Construction Innovation groups from Callaghan Innovation have come together to explore new collaboration opportunities that will create greater impact for New Zealand.

Scion hosted the team from Callaghan Innovation during a series of workshops at Te Whare Nui o Tuteata in Rotorua in March. The focus was on accelerating the development and commercialisation of technology in key areas like high-value wood product manufacturing, bioplastics, sustainable construction, forestry management, wood processing, biofuel and waste-to-value initiatives.

Callaghan head of construction and innovation Nick Sterling says the workshops were an excellent opportunity to collaborate more closely on impactful and converging technologies that everyone is aware of today, and also build awareness and alignment on what technologies are coming over the horizon.

"This shared intel allows both organisations to build our capabilities to support businesses and ecosystem partners and better tackle their future challenges and opportunities."

Partnerships across the New Zealand innovation system are critical to Scion's mission and vision – transitioning New Zealand to a circular bioeconomy.

Scion general manager for Forests to Timber Products Henri Bailleres says working together will drive positive change in the forestry sector. The partnership aims to find innovative solutions to increase the efficiency of timber processing and to create sustainable building products and systems.

"With our combined knowledge, we look forward to seeing positive outcomes."

Scion general manager for Forests to Timber Products Henri Bailleres helps to facilitate discussion during a joint workshop.

Callaghan Innovation Commercialisation and AgriTech sector expert Nicky Molloy and Scion portfolio leader for Integrated Bioenergy Paul Bennett.

Collective data
driving forestry's transformation

Precision forestry is helping forest owners and managers to realise new value across the supply chain.

Scion researchers are working closely with the forestry sector to help them realise the value of using data collectively as the means to drive efficiencies and revenue growth.

If the Forestry and Wood Processing Industry Transformation Plan (ITP) is a roadmap for the future of New Zealand's forestry sector, then precision forestry must be the turbo engine under the hood of the most competitive vehicles lining up at the start of the journey.

The plan, unveiled at Fieldays in November last year, sets out actions to increase New Zealand's onshore wood processing capacity and capability, maximising the value of wood and supporting the development of new industries, products, and markets – both domestic and international.

In 2021, the sector contributed $6.7 billion in export earnings, employing more than 35,000 people.

The ITP's goal is to grow the sector and see New Zealand become a world-leading producer and exporter of high-value wood-fibre products.

How fast New Zealand can achieve all this will depend on how quickly the sector and its workforce can embrace research, innovation and new smart technologies.

Making informed decisions using data

Investment in forest technology is already super charging New Zealand's forestry sector by enabling the workforce to create higher-value products more efficiently. Precision silviculture is advancing at pace, and the tools available to foresters is arming them with more information for decision-making than ever before.

With the sector hungry for ways to gain a competitive edge, it was no surprise that an event devoted to forestry technology attracted a record number of participants just two weeks before the ITP was launched. The ForestTECH two-day conference in Rotorua brought together forest managers, technology providers and experts in the growing field of remote sensing and geospatial mapping from across Australasia.

During the conference, autonomous systems scientist Robin Hartley shared insights from Scion's operational trials using remote sensing, spray UAVs and nutrient modelling, and participants heard from Scion principal scientist Dr Brian Richardson, who is heading Forest Growers Research's $25.5 million, seven-year Precision Silviculture Programme.

The Government's backing of the programme, with $10.2 million from the Ministry for Primary Industries' Sustainable Food and Fibre Futures fund, shows it has confidence in the latest technology to create new value from planted forests and make highly manual and labour-intensive tasks more manageable.

The programme is focused on integrating mechanisation, automation, digital technology and robotics in the areas of planting, pruning and thinning, as well as creating efficiencies in the nursery where seedlings start their journey through the value chain.

In announcing the programme in May last year, Agriculture Minister Damien O'Connor said the timing was right and emphasised how much the sector had to gain for the investment.

"A large number of forests planted in the 1990s are due for harvesting in the mid-2020s, so it's an ideal time for this overhaul.

"The programme has the potential to deliver $530 million of value to the plantation forestry sector and $190 million worth of innovative technology sales until 2035. Other benefits will be an improved pruned log supply for domestic wood processors, and use of the technology in indigenous forest establishment."

Scion portfolio leader for New Value from a Digital Forest and Wood Sector Claire Stewart is equally passionate about the ability for precision forestry to deliver at scale and increase productivity for the sector.

She delivered the keynote address at ForestTECH, stressing how vital it is for the sector to keep evolving using data collectively as the means to drive efficiencies.

"The value that's created in businesses that are valuing their data is considerable. In the future, and as we come under greater regulation for environment impact, we need to consider how we create new value. A data-driven, optimised system is the place to invest."

She says the agriculture sector has seen productivity gains of between 5% and 25% each year after adopting smart technologies.

"Following agriculture's lead, even if we took a conservative 5% annual increase in productivity, based on current sector revenue, that would translate to revenue growth of $316 million per year for the New Zealand forestry sector."

Extracting value through the life cycle of a tree

The demand for more high-value products from trees, coupled with the growth of carbon farming through incentives, is driving demand for more trees in the ground, especially in more marginal and harder to reach locations.

Scion and Hawke's Bay forestry company Pan Pac Forest Products have been testing a range of precision forestry technologies to optimise their forestry management operations. From using remotely sensed data to predict the optimal planting locations for a radiata pine stand, to trialling a large model UAV for precision aerial applications of herbicide, Pan Pac is among a growing number of companies turning to technology to solve labour challenges or help foresters better understand tree and soil health, their crops' nutritional needs and growth rates.

> Following agriculture's lead, even if we took a conservative 5% annual increase in productivity, based on current sector revenue, that would translate to revenue growth of $316 million per year for the New Zealand forestry sector.
>
> CLAIRE STEWART

For Stewart, however, there is exponential value to be unlocked right through the life cycle of a tree, which she says is pulsing with data, starting with its genetics.

"In the lab, we can apply advanced tissue culture techniques to multiply our best trees by the tens of thousands and use genetic preselection to ensure they have the greatest tolerance to future adverse conditions, such as drought and disease.

"We can also use artificial intelligence in the lab for monitoring of mature somatic embryos to predict their germination success."

AI is also being applied to the process of grading seedlings to maximise quality control. Scion has partnered with Contempo Lab under the Precision Silviculture Programme to build a prototype AI system for seedling grading that will accept or reject seedlings based on client specifications.

Contempo Lab chief executive Dr Brian Russell says AI decision support systems are sufficiently mature to enable teams to grade seedlings in real time, using manual sorting expertise at scale.

"This should allow us to individually sort and store every tree at the start of its data lifetime, leading to healthier forests now and more understanding for the next generation of forests."

PF Olsen, a significant supplier of both seed and seedlings to the New Zealand forest industry, is also investing in the latest UAV and AI technologies to detect and quantify a wide range of growth indicators to increase nursery profitability.

The technology includes measuring seed germination rates when seedlings reach 5cm in height to detect plant stress. Business improvement manager Hamish Macpherson says that in the future, the data being collected at an individual seedling level will not only benefit nursery operations but will also improve treestock quality for forest owners.

"It will also enable the creation of traceability systems to potentially track seedlings from our nursery through to the forest and beyond."

Deploying young trees in the market at scale, applying precision management technologies as they grow, and using data to inform harvesting decisions for wood processing to generate timber optimised for building are all areas where precision forestry can add value, Stewart says.

"We must make every tree count using smart technology. We have the ability to connect genetics, environment, growth, management, performance into the built environment and back again. An intentional focus on connecting these steps and the data that flows within them has the potential to deliver significant new value for the forestry sector."

Scion portfolio leader for New Value from a Digital Forest and Wood Sector Claire Stewart.

Aerial images and AI answer questions about forest loss

Scion's Remote Sensing team is combining aerial images and artificial intelligence (AI) to map the impact of Cyclone Gabrielle on forestry.

Scientists are harnessing the power of AI and deep learning technology to help local authorities, such as the Gisborne District Council, understand damage Cyclone Gabrielle caused to planted forests and help the forestry sector battle climate change.

The research is part of Scion's Digital Forest Project, which has pivoted following the cyclone to map out its effects, with Gisborne and Hawke's Bay the first to be mapped using the technology.

Scion portfolio leader for New Value from a Digital Forest and Wood Sector, Claire Stewart, says Cyclone Gabrielle was the first opportunity to use their technology to measure the impact of a natural disaster on New Zealand's planted forests.

"The aim of our project is to create a national-scale digital inventory of our forests in New Zealand. Long-term, we plan to have the whole country mapped out.

"In the short term, we see immediate value in repurposing our AI model to quantify the forest loss and damage in these areas using a range of imagery sources," she says.

> "The information we collect can be used by councils, forestry companies and other stakeholders to help them understand what's happened and support them to make more informed land and forest management decisions."
>
> CLAIRE STEWART

Pre Cyclone Gabrielle

AI generated forest boundaries pre and post-cyclone on a tributary of the Tutaekuri River, Waiwhare, Hawke's Bay.

Credit: Illustration by Melanie Palmer (Remote Sensing & GIS) using imagery sourced from the LINZ Data Service and licensed by Hawke's Bay Regional Council for reuse under CC BY 4.0.

"The information we collect can be used by councils, forestry companies and other stakeholders to help them understand what's happened and support them to make more informed land and forest management decisions."

The Gisborne-Tairāwhiti region was one of the worst hit areas during Cyclones Hale and Gabrielle. An immediate assessment of the region showed that many closed canopy forests had suffered significant damage with many landslides and a considerable amount of woody debris sitting on slopes or on the river margins.

Gisborne District Council is now working with Scion to rapidly assess the loss of net stocked area in these forests. As the normal stocking area in a pine forest is known, council principal scientist Dr Murray Cave says the measurement of loss will provide "an excellent indicator of the volume of woody debris likely to migrate downstream over time".

"If we can establish this volume, it would allow for the council to quantify the risk and thus help plan for measures to mitigate the risk to critical bridges and the water supply pipeline in the future."

Building on the model's foundations

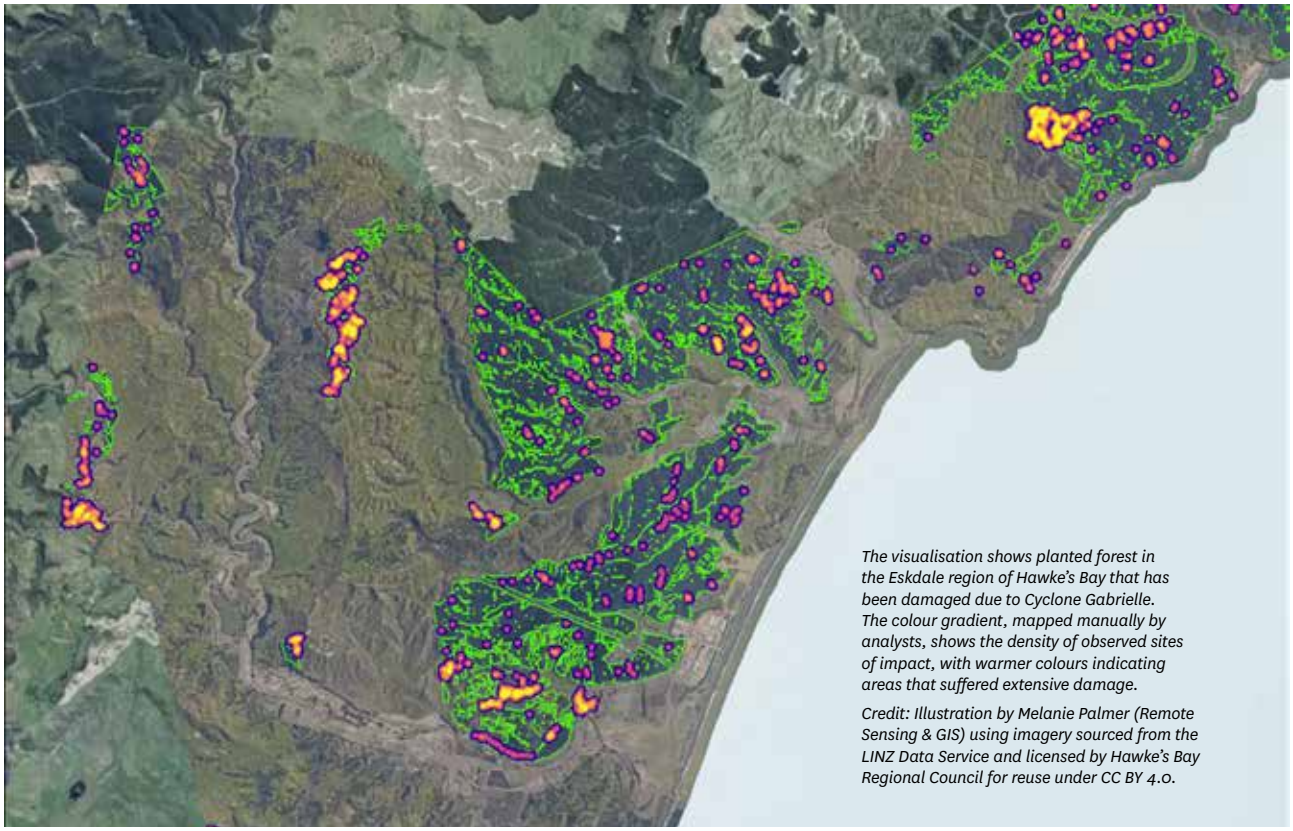
The SmartForest AI model uses high-resolution aerial photography to detect exotic tree species and map forest stand boundaries. Researchers are using this data to assess forest loss and damage caused by Cyclone Gabrielle such as windthrow and slips, as well as gaining insight into associated hazards such as woody debris.

The SmartForest AI model uses data to assess forest loss and damage caused by Cyclone Gabrielle such as windthrow and slips, as well as gaining insight into associated hazards such as woody debris.

Developing a comprehensive digital replica of the productive forests in New Zealand on a national scale is ambitious, but it's work that, at its core, will allow for a more accurate description of the location of New Zealand's forests and the valuable resources they contain, such as timber and carbon.

Remote sensing technology plays a vital role in this mission. To create a high-resolution map of the planted forests, Scion's Data and Geospatial Intelligence team has developed a deep learning-based model that can accurately detect, and map planted forests using only RGB aerial imagery.

The AI model targets planted exotic forests and can map stands as early as two to three years after planting, once a minimum canopy size is reached. Although the model can also identify multiple exotic species, the results for radiata pine and Douglas-fir are shown as these species currently make up most forests planted in New Zealand.



The visualisation shows planted forest in the Eskdale region of Hawke's Bay that has been damaged due to Cyclone Gabrielle. The colour gradient, mapped manually by analysts, shows the density of observed sites of impact, with warmer colours indicating areas that suffered extensive damage.

Credit: Illustration by Melanie Palmer (Remote Sensing & GIS) using imagery sourced from the LINZ Data Service and licensed by Hawke's Bay Regional Council for reuse under CC BY 4.0.

AI generated forest boundaries pre and post-cyclone, near Glengarry Rd, Puketapu, Hawke's Bay.

Credit: Illustration by Melanie Palmer (Remote Sensing & GIS) using imagery sourced from the LINZ Data Service and licensed by Hawke's Bay Regional Council for reuse under CC BY 4.0.

To build the model, the team has collected and labelled more than 500km^2 of aerial imagery – making it one of the largest datasets for high-resolution landcover mapping. The advantage of this model is that it produces very accurate forest boundaries.

This work has proven to be even more significant after Cyclone Gabrielle. The team has combined Land Information New Zealand's (LINZ) existing high-resolution imagery with data collected from fixed-wing aircraft and satellites after the event to produce a highly detailed online map of the Hawke's Bay region. To allow people to easily explore these datasets and view the impact of the cyclone, a before-and-after slider has been embedded on the SmartForest website.

The research is already revealing valuable insights into where forest was standing pre-cyclone, what species it was, and what forest is now lost. This tracking of information is critical to determining what happened after the cyclone as well as support authorities to understand why it might have happened.

Cyclone Gabrielle's impact on the productive forests across the East Coast was plain to see, Stewart says.

"Slips and wind have resulted in extensive damage to forests, with a significant loss of trees, ranging from productive forest, native trees and shrubs, and riparian species. In many areas, this vegetation has been swept downstream along with large amounts of silt from landslides.

"The force of the floodwater and the debris caught within it has had a devastating impact on homes and infrastructure downstream."

Information for decision-making

The redeployment of Scion's AI model will give forest companies and councils unprecedented insight into what happened before and after the cyclone and will support informed management and risk mitigation decisions across the slip-prone and dynamic landscape.

It could also serve as a tool to help authorities plan for future disaster responses, Stewart says.

Looking ahead, the team is wanting to combine the high-resolution forest boundaries with LiDAR. Standing for Light Detection and Ranging, LiDAR is a remote sensing method that uses light in the form of a pulsed laser to measure ranges, or variable distances, to the earth. This work will be carried out in Gisborne's planted forests first, to estimate attributes such as age class, stand density, height, timber volume and carbon.

By partnering with LINZ to access their cloud-based imagery and LiDAR data warehouse, the team aims to extend this approach to the rest of New Zealand as the national elevation programme progresses.

Ultimately, this work will feed into the national-scale 'digital twin' of the productive forest estate in New Zealand. This will allow mapping and monitoring of the forests using remote sensing.

Stewart stresses that the 'twin' will need regularly updated data flowing into the model, and her team is currently exploring the best ways to achieve this.

"As forests are a critical tool in our fight against climate change, it's important we understand how they will adapt under current and future conditions in a range of locations. It's data we need to capture and analyse to increase our knowledge about drought and disease resistant trees, as well as learn more about our forests' ability to capture carbon at a national level.

"Sensed data inside our digital forest can help us simulate the future and improve decision-making in the forestry sector."

Following Cyclone Gabrielle, Stewart sees further benefits to the forestry sector if the AI model could source data from additional agencies that are currently focused on rainfall and soil mapping.

"This could evolve into a landscape-level model to better understand what's happening not only in the forest, but in the wider ecosystem."

Seeking validation data

For the team to achieve its vision, the next step is to collect ground validation data for forest species, age class and other forest attributes. Scion is seeking to partner with companies and entities willing to share this data. An accuracy assessment will be conducted in due course and Scion welcomes all public feedback.

If you are keen to partner with us on this important initiative, email grant.pearse@scionresearch.com.

Learn more about Scion's Digital Forest Project here:

When the rain pours,
where does the water flow?

Extreme weather events are becoming more commonplace. Knowing where the water is, where it is going, and who gets to use it are the three main questions Forest Flows researchers aim to answer.

Now more than ever, New Zealanders are looking for answers about the environment we live in. How do we utilise our natural resources in the most sustainable way in the face of a changing climate? Water is one of our most precious taonga and this resource is increasingly put under pressure due to climate change and land-use intensification. The MBIE Endeavour-funded Forest Flows research programme is investigating how we can create and maintain water-resilient landscapes to provide beneficial outcomes to all New Zealanders.

Preliminary insights

The research programme is in its fourth year and preliminary results from recent storm events are now available. Scion's Forest Flows programme leader and senior scientist, Dean Meason, in collaboration with NIWA, analysed data from the Auckland Anniversary weekend flood event.

"The Forest Flows programme provides ground-breaking new insights of extreme weather events on planted forests.

"Data from the ground-based sensor networks has provided, for the first time, direct measurements in unprecedented detail from sensors continuously recording data at five-minute intervals."

Rainfall, soil moisture, stream flow and groundwater recordings have been used to create a picture of where the water went during and after these storm events.

Forest Flows data is well-positioned to answer post-cyclone Gabrielle questions. Two of the primary research catchment areas, located in Mahurangi Forest in the Auckland region and Titoki Forest in the Tararua district, experienced the worst of the recent storm events in 2023 and this data is still being analysed.

Despite extraordinary levels of rainfall over 60 hours at Auckland Anniversary weekend, and although the soil is shallow at the Mahurangi (229mm) and Titoki sites, it didn't reach saturation point.

"This means that almost all the rainfall that reached the ground directly infiltrated into the soil and most of the rainfall did not move directly to the stream," Meason says.

These small research sites are on erodible soils in planted forest catchments of radiata pine but are representative of much larger areas. Inspection of these sites showed little evidence of small-to-medium hillslope failures (slips) and woody debris movement off side slopes.

Soil moisture sensor placed 1m deep at Mahurangi Forest.

"This research will help to identify markers for sites that are vulnerable to hillslope failure and could be applied to other forests," Meason says. "An improved understanding of the site conditions that trigger flash floods from forested catchments and what could be done to mitigate it will support decision-making."

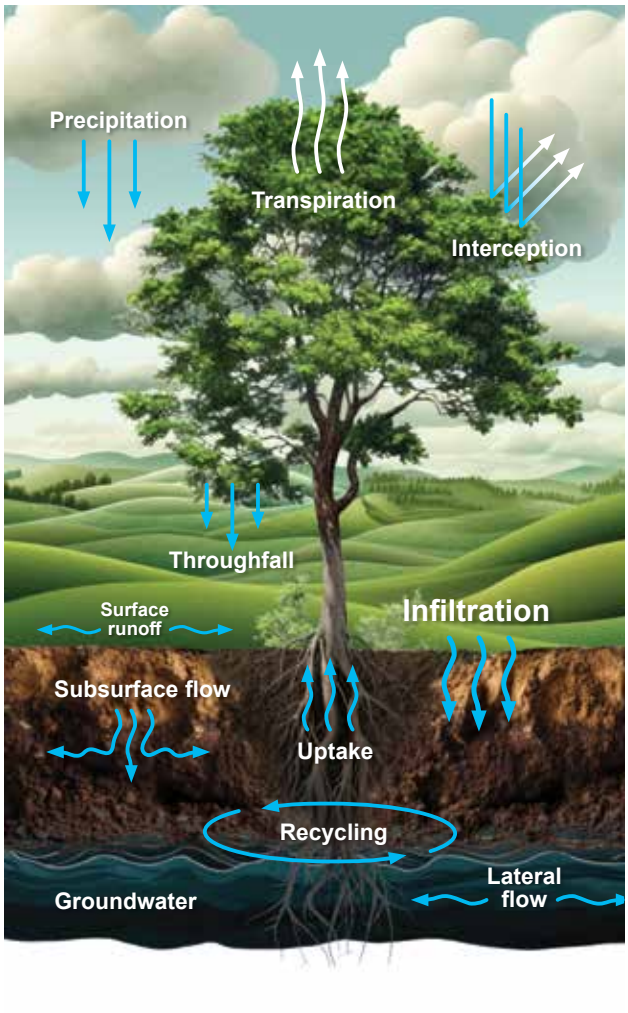
Karen Lucich, spokesperson at Summit Forests appreciates the effort Scion and partners are putting into Te Hiku Forest to gain greater understanding of water movement and availability.

"The forest achieved its original goal of providing employment and stabilising the sand, after the indigenous vegetation was removed. As values evolve and we strive to improve land use practices it's essential to have sound knowledge to base decisions on. This research will give a greater understanding of the whenua."

Digital twin – pulse of the forest

The intensive Forest Flows wireless sensor networks cover 10 forest research sites around the country and capture millions of data points each year. A total of 1717 sensors record information about soil moisture, tree canopy water stress, rainfall, water age, stream flow, tree growth and water use, plus many more. Real-time data from Scion's sensor networks, NIWA meteorological stations and remote sensing data from the University of Auckland and XERRA together provide a world-leading picture of the hydrological processes occurring within planted forests.

Digital twins have been used in other industries, such as the manufacturing industry, however a virtual copy of forest environments in a forest management setting is novel. Forest Flows data enables a forest digital twin model to be built, which will connect and integrate the different data from various sources. This breakthrough new biophysical hydrology model of the forest provides capability for cutting-edge analysis and modelling tools to understand how planted forested catchments respond to extreme storm events and other less extreme climatic conditions. The model will be able to predict what happens in a forested environment across different soils and geology throughout New Zealand, identify correlations and forecast for a wide variety of scenarios, enhanced by machine learning and artificial intelligence.



Forest Flows programme leader Dean Meason

Collaboration

Answering the last question of the Forest Flows programme, 'Who gets to use the water?' is arguably the most challenging. Scion's research group leader of Economy and Society, Dr Grace Villamor, has undertaken virtual and in-person workshops, engaging with farmers, foresters, iwi, non-government organisations (NGOs), local councils and other interested community groups to find out what is most valuable to them. Views on water, trees and planted forests were collected, as well as views on how informed these groups feel. Earlier stakeholder engagement in 2022 highlighted the importance these groups placed on conservation of streams and rivers for future generations.

"In this research drought was perceived to be the main environmental risk. It will be interesting to see in upcoming workshops, movement in peoples' views and concerns over time," Villamor says.

Gleaning this insight helps Scion to tailor research outcomes for interested parties based on need.

What's next?

The research teams are busy analysing the large amount of data collected so far. The programme plans to share first results with local communities in late 2023 and use this feedback to inform further engagement.

"Regular and active engagement with our communities throughout the final year will help us convey the most meaningful research insights – each group has different values and requirements for information. Rather than dictating what results we believe are important, we seek to understand what is important and valuable to the community and provide them with the answers that they seek", Villamor says.

Forest Flows programme is a collaboration of 13 local and international institutes, universities, and industry partners. MBIE contributed $13.7 million in funding from the Endeavour Fund.

For more information, please contact dean.meason@scionresearch.com

NZ's largest timber office building

Building a more sustainable future

Scion and Tauranga City Council are united in putting sustainability at the forefront of design. Together, they are inspiring others to build a sustainable future using wood.

A desire to build more sustainably is driving change across the construction sector, with multi-storey timber buildings in both Rotorua and Tauranga evidence of the growing enthusiasm for using wood.

A living, breathing example of both the performance and aesthetics of timber is Scion's innovation hub, Te Whare Nui o Tuteata, which has pioneered sustainability and design using engineered wood products.

The structure won 14 domestic and international awards in 2021, making it an international timber architecture icon.

Scion sustainability architect and portfolio leader Andrea Stocchero says Te Whare Nui o Tuteata represents a gateway for engaging with what is possible to build with engineered wood products.

"Scion pushed the boundaries with this commercial building in terms of showcasing innovations in timber engineering and how the future can be more bio-based and renewable, which is important for us as a Crown Research Institute. It's significant for New Zealand because it will help inspire others to see and experience what's possible and begin their own journeys."

Building with wood is a great option, both for long-term carbon storage and for the broader social, economic and environmental advantages that wood provides on top of other technical, functional and biophilic benefits, he says.

Te Whare Nui o Tuteata's wood products store enough carbon to offset the emissions from all the building's materials.

Trees sequester carbon from the atmosphere while they're growing, and as long as the wood is in use, that carbon is stored, so it's not going back into the atmosphere. If the timber is sustainably certified it means that the forests are re-growing after each harvest, and the carbon sequestration cycle continues.

> "Mass timber technology will become an integral part of our development toolkit for constructing exceptional, environmentally sustainable buildings, both now and in the future."
>
> WAYNE SILVER,
> WILLIS BOND MANAGING DIRECTOR – FUNDS AND FINANCE

Reaching new heights with wood

Tauranga City Council's new administration hub for 90 Devonport Road is set to be the country's largest mass timber office building at 10,000 square metres.

Tauranga City Council commission chair Anne Tolley says the decision to pursue a wood-based structure came from the council's ongoing commitment to sustainability.

"When developing our city, we hope to leave a legacy for future generations, not only in terms of the spaces we create, but the present and future footprint those buildings will have.

"Early on in this project, we committed to putting sustainability at the forefront of design, targeting a 6 Green Star rating, which reflects world leadership in sustainability. Adopting a mass timber hybrid structure allowed us to achieve that aspiration by minimising the building's carbon impact and helping create a better built environment for the future."

Tauranga City Council chose property development and investment company Willis Bond to deliver this mass timber build.

90 Devonport Road represents how mass timber technology will become the way of the future.

Willis Bond has partnered with Warren and Mahoney Architects and construction company LT McGuinness to design this extraordinary office building.

Tolley says, "Apart from the obvious environmental outcomes, the Scion building has a great feeling. As New Zealanders, we are very familiar with wood. There's something quite homely and welcoming about it and that's what we want to achieve for our team who will work in the new building at 90 Devonport Road.

"We're delighted at the opportunity to help lead the way in terms of mass timber office buildings, to show others how it can be done and encourage more organisations and businesses to use this approach for other developments throughout New Zealand."

Council commissioners, along with Willis Bond and LT McGuinness, visited Scion in March to gain insights into the design and construction of Te Whare Nui o Tuteata.

Willis Bond managing director – Funds and Finance Wayne Silver says 90 Devonport Road will set a new precedent for projects of scale that can be delivered with an environmentally sustainable building methodology.

"Mass timber technology will become an integral part of our development toolkit for constructing exceptional, environmentally sustainable buildings, both now and in the future.

"Our goal is always to keep as much carbon in the ground as possible and moving to mass timber construction methodology where possible is a great way to achieve this. The Scion building's low-carbon timber structure and resulting seismic resilience are key features that align with our design objectives."

Stocchero says council engaging with Scion and Te Whare Nui o Tuteata represents an alignment of journeys towards building a more sustainable future and how that can look.

"Tauranga City Council choosing to build with wood aligned with their quest for sustainability and we were able to share our experiences with them. It is our hope that together we can inspire others to do the same."

Amidst the diagrids: Scion's Andrea Stocchero (right) and Mark McGuinness, executive chair at Willis Bond discuss the many benefits of wood.

Biotechnology solutions

for a sustainable tomorrow

Biotechnology is creating a paradigm shift across all supply chains and its impact on our global economy could be bigger than the disruption of the Industrial Revolution. At an event in Wellington, Scion scientists shared how our R&D is leading this rapidly evolving area and where rules governing it are long overdue for change.

Recent global developments in genetic engineering (GE) are beginning to effectively address society's most pressing challenges – climate change and sustainability. Scion is now taking a leading role in the GE space in New Zealand by leveraging its expertise in industrial fermentation and plant biotechnology to provide innovative solutions.

Scion's capabilities and track record with GE were in the spotlight at the Life Sciences Summit in Wellington in March, hosted by Biotech NZ. Our researchers took centre stage at the two-day event, leading discussions in three distinct sessions: *Genetic Engineering and its place in New Zealand*, *Creating sustainable products from biotech*, and *Synthetic biology for New Zealand's future*. These sessions highlighted the benefits, opportunities, and challenges of genetic engineering in the future for industry professionals and government officials.

Due to the impact of climate change, expanding and ageing populations, and an expectation that food and fibre sectors must increase production and operate more sustainably, industries are recognising the critical need to adapt and move on from the thinking and infrastructure of the past.

The Scion team, led by portfolio leader for Bioproducts and Packaging Dr Alec Foster, joined other leaders in the biotechnology and life science fields to highlight how genetic modification provides a way forward.

Colleagues, including microbial biotechnology team leader Dr Christophe Collet, molecular physiology team leader Dr Mathias Sorieul and plant biotechnology lead scientist Dr Glenn Thorlby emphasised how GE research can lead to new medicines and therapies, tackle challenges in food and fibre production, preserve nature while eliminating invasive species, provide alternatives to petrochemical products, and reduce CO_2 emissions.

"Genetic engineering is one of the primary mechanisms to save the planet and improve our lives," Foster says.

Genetic engineering is one of the primary mechanisms to save the planet and improve our lives.

LEFT TO RIGHT:

- *Dr Alec Foster uses a Rio Red grapefruit to illustrate the polarity of opinions around genetic technologies.*
- *Dr Alec Foster presents a roadmap for New Zealand's future.*
- *Scion scientists, Dr Christophe Collet, Dr Mathias Sorieul, and Dr Glenn Thorlby ready to discuss genetic engineering technologies with attendees at the Biotech NZ Life Sciences Summit.*

Leadership and a desire for change

During his presentation that pointed to perceptions of GE risk, Foster held a grapefruit and explained how today's technology is far more precise than those used in the past to develop new foods. Organic red grapefruit, widely sold in supermarkets today, were developed in the 1960s and 1970s using radiation to create random mutations in grapefruit to produce new varieties. There was no way to predict what the mutations would be – it was luck whether the desired changes, in this case a sweeter flavour and red flesh, would occur.

With the advent of CRISPR technology, a targeted form of genetic engineering with the ability to make small changes at a pre-selected site in the genome, now we can choose a desired outcome. Scion are world leaders in utilising CRISPR in conifers and the first to sequence the *Pinus radiata* genome.

> "Years of worldwide experience has shown genetic technology is as safe as conventional breeding."
>
> FOA PRESIDENT GRANT DODSON

Dr Christophe Collet, Industrial Biotechnology leader at Scion with a fermenter.

Scion is also leading New Zealand in fermentation technology, utilising bacteria and yeast to convert industrial waste streams and greenhouse gases into high-value products. Scientists are developing bioplastics from sustainable sources, reducing the need for petrochemical products. Genetic tools are also being developed to modify new types of bacteria – all under strict legislative framework that is now nearly 20 years old.

In New Zealand, laws governing new organisms, including genetically modified organisms (GMOs) fall under the 1996 Hazardous Substances and New Organisms Act (HSNO). It established a process for assessing and controlling the environmental risks of GMOs.

As time has marched on, New Zealand's laws are now some of the most restrictive for the use of genetic technologies in the world. Scion is the only organisation conducting field trials with genetically modified (GM) plants in the country.

Although the tough regulatory environment has created barriers for research, New Zealand is able to import various products made with genetic engineering, including washing powder, insulin and almost all products made from cotton. GE is already a part of our daily lives, and more transparency about it is needed, Foster says.

Internationally, GE research has progressed rapidly. Regulations in the United States and United Kingdom were updated as the technology evolved, allowing research and products to be trialled and progress to the market. The European Union is expected to follow shortly.

With concern mounting that New Zealand isn't keeping pace with global GE trends, Scion has joined other research institutes calling for debate on genetic technologies.

Earlier this year, Science New Zealand, an organisation representing the seven Crown Research Institutes (CRIs) and Callaghan Innovation, published a paper on GE technologies and the need for an informed debate about how the country is placed, pointing to how they have a legislative mandate to undertake research of benefit to New Zealand and to promote and facilitate technological developments.

CRIs are using genetic editing as a tool in their research to develop novel product concepts. Gene editing allows for simple and predictable changes compared with older technologies – as Foster referenced with the Rio Red grapefruit.

In its paper, Science New Zealand noted, "the Productivity Commission and the Climate Change Commission have both said that New Zealand is going to need to use modern genetic editing technologies to meet the challenges facing us".

Foster says a collective sense of urgency for change has emerged, with more open and candid discussions about genetic technologies.

"The debate has evolved from preliminary stages and hypothetical possibilities to tangible products that offer real-world advantages for both consumers and the environment. There is an increasing realisation that if we don't move with the rest of the world, there will be economic consequences."

Modern genetic technologies in 2023 and beyond

While debate continues, it's clear genetic technologies will impact modern society and New Zealand. Foster, together with Scion colleague Dr Glenn Thorby, contributed to a reference document produced by Te Puna Whakaaronui, NZ's independent food and fibre think tank. The report *WELL_NZ: Modern Genetic Technology* describes the rapid advancements and changes in genetic technology, as well as the potential impact of these technologies for food and fibre in the coming decades.

Te Puna Whakaaronui was established to support the government's *Fit for a Better World* roadmap to transform the food and fibre sectors.

Foster and Thorlby made several contributions that are referenced in the report. Scion data from an independent survey gauging public understanding and opinions on genetic technologies also features.

In response, and in keeping with the collective shift in thinking about GE, the Forest Owners Association (FOA) called for New Zealand to urgently update its legislation to bring management of the risks surrounding genetic technology, and the opportunities it provides, into the modern era.

The FOA is backing Scion's development of a sterile Douglas fir – research that is currently restricted to the lab. If allowed to progress, it could lead to the development of trees which can't seed, immediately ensuring that no wilding trees could spread.

FOA president Grant Dodson says the current legislation governing genetic technology is "outmoded, inconsistent and out of step with the rest of the world".

"The HSNO is nearly two decades old, and in the meantime, how to guarantee the safety of genetic technology has become well known," he says. "Researchers can now target gene rearrangements with technology such as CRISPR-Cas9.

"Years of worldwide experience has shown genetic technology is as safe as conventional breeding."

Foster adds that an informed discussion on GE is key to the future of New Zealand and its bioeconomy.

"Without an informed public, genetic engineering will remain a polarised issue lacking nuance, and constructive dialogue, which is crucial to harnessing its potential for the betterment of society, the environment, and New Zealand's global competitiveness."

> "There is an increasing realisation that if we don't move with the rest of the world, there will be economic consequences."
>
> DR ALEC FOSTER

Open book for new wave of growers

A team of scientists and industry experts have made it easier for growers looking to plant to see all their options in a move to meet industry goals.

There is more to forestry than radiata pine.

That's the message a team of scientists and industry experts wants to get across to farmers and growers – both new and experienced – looking to plant.

A New Zealand Guide to Growing Alternative Exotic Forest Species is a booklet funded by the Ministry for Primary Industries (MPI) and created by Scion in partnership with Te Uru Rākau, Forest Growers Research, New Zealand Dryland Forests Innovation and New Zealand Farm Forestry Association.

The booklet pulls together existing knowledge from research and experience of experts and growers amassed over decades.

It outlines commercially available, exotic alternatives to radiata pine ready to plant at a commercial scale and describing the suitability and management conditions for each species.

It's designed to support both experienced growers looking to diversify and new growers looking for information about commercial species available and could be used by everyone from small landowners through to industry key players, Scion silviculture and forest carbon scientist Alan Jones says.

The booklet has been created through partnership including (from left) Toby Stovold, Andrea Stocchero, Marco Lausberg, Tripti Singh and Alan Jones.

"The idea behind this booklet was to give potential growers of different shapes and sizes … a bit of an idea of the ways they could go about planting the species."

The booklet was launched at the end of March by Te Uru Rākau at the New Zealand Farm Forestry Association annual meeting in Timaru and its 1000-copy first print run has been so well-received there are plans to print thousands more. Many have been shared with visitors to the Forestry Hub at Fieldays 2023.

At last year's hub, Te Uru Rākau launched the Forestry and Wood Processing Industry Transformation Plan.

According to the plan, the forest industry relies largely on radiata pine.

One goal in the plan is to increase planting of alternative species (non radiata pine) from about 10% to 20% of all planting by 2030 – something the booklet directly plays into.

The benefits to this include increasing the resilience and productivity of forests, improving resilience to climate change and biological and economic risks, and increasing the wider environmental benefits of forestry.

Jones says there is an obvious need in New Zealand to diversify forests because a more diverse forest inventory improved resilience to climate change, pests and diseases and resulted in diverse timber products.

"If you have a range of species, you have a range of biological traits that enable them to adapt to different conditions.

"The idea is to enable transformational change in industry and part of that is enabling cultural change and the way people think about trees and the forest. This enables that to take place by giving people the information or the roadmap they need to start thinking about other species."

Most of the plants in the booklet are considered ready to plant, Jones says.

"We know a lot about their growing criteria, we know where to plant them, how to plant them, what we can do with them … and how to process them."

Scion's Trees to High Value Wood Products portfolio leader Andrea Stocchero says the book would also help a "new wave" of growers such as those not yet interested in planting or seeking alternatives to radiata pine.

"It's pointing potential new growers or alternative growers to talk to the experts.

"It's not the end of the journey - it's the beginning."

Scion scientist Toby Stovold and Wood Science Design team lead Tripti Singh also authored the book alongside Jones and Stocchero.

Ministry for Primary Industries project lead Jurgen Muller said MPI was pleased with the approach Scion took and how popular the booklet has been.

"It has been very pleasing to collaborate with industry like this and it could provide a blueprint for future projects. That this booklet has proven to be so popular, both in the online and the printed version, has been an unexpected bonus and shows the need for this kind of information."

Marco Lausberg, Forest Growers Research Specialty Wood Products Partnership programme manager helped bring the team together to include their knowledge. He says this is the first time all this information was in one place and the booklet was "almost like a menu".

"It's enough to get people into it but then they have to go talk to the experts."

He says there is a lot of information available about radiata pine but information about other species was harder to come by. The work of this team has helped break that barrier.

A downloadable copy of the booklet is available on the Ministry for Primary Industries website.

Back to our roots:
Visiting the original home of *Pinus radiata*

Getting down and dirty in California, Scion researchers have completed a trip sampling soil from *Pinus radiata* in parts of its native range – all in a bid to answer some important questions.

The relationship between trees, their root microbiomes, and the environment directly influences their health, productivity and resilience to climate change.

While a lot is known about the genetics of pine trees, scientists are still discovering how influential their soil microbiome is and what role it plays in helping forests thrive.

The five-year Scion-led Tree Root Microbiome Programme is on a fact-finding mission to learn more. By taking soil samples from pine trees around the world, they hope to better understand the microbial properties that exist underground to support their growth and overall health.

Discovering what they have in common and what may be different between countries and individual sites will build knowledge around how to best support pine forests with an optimal microbiome, which is particularly helpful at sites where they are endangered or performing poorly.

Pinus radiata, also called Monterey pine, is endemic in the United States and Mexico. For millions of years pine trees have been sustained by its native soils, however, this species is now endangered in its home range due to pests, diseases and wildfires.

In contrast, radiata pine in New Zealand is an introduced species and now makes up 90% of our planted forests. Only a small proportion of the genetic material available was introduced when it arrived here. These pine trees currently thrive in New Zealand soils, and understanding why is important to their long-term survival, especially in the face of climate change.

In March, Scion scientists visited the United States to collect soils from *Pinus radiata* in California. The trip was a success with sampling carried out across the western seaboard in Año Nuevo, Monterey (hence Monterey pine), and Cambria.

In collaboration with the Rúa laboratory at Wright State University in Ohio, the soil samples were processed and DNA extracted to identify what microbes make up the tree microbiome in sampled locations. Soil samples were also sent to collaborators at Woodwell Climate Research Centre to understand the differences in soil properties.

Scion lead scientist on the Tree Root Microbiome Programme, Dr Steve A. Wakelin, says the aim is to understand the role that microorganisms on and in plants have on influencing ecosystem outcomes.

Steve Wakelin and Sarah Addison collected soil samples in California, United States.

"Whether this is plant disease, nutrition, carbon storage, biodiversity, or productivity, microbes have an important role to play.

"The Human Microbiome Project revealed how vitally important gut microbes and function are to human health. Now where the gut has gone, soil will follow."

Sampling of soils from the roots of *Pinus radiata* in New Zealand got underway in early 2022. With support from local companies, sampling is also being carried out in Australia to understand how the microbiome has helped *Pinus radiata* flourish under different climatic conditions across the Tasman.

Scion molecular ecologist and PhD candidate within the programme, Sarah Addison says microbes co-evolved with *Pinus radiata* roots, and they've always existed. "Our challenge is that we just don't know enough about them, and we need to change that.

"The microbiome represents a way for plants to expand their natural capabilities, using the microbes to adapt to changing environments more quickly than the plant alone can. This will allow trees to grow and thrive in conditions beyond their natural ranges, hopefully extending their survival in the face of climate change."

Paul Adams, research and development director at Forest Growers Research, shares his thoughts on this research. "Improving our understanding of how microbes have evolved with *Pinus radiata* roots is fascinating and exciting. It feels like a new frontier. The application of this science could lead to improvements in drought tolerance, wood quality and disease resistance in our key plantation forestry species in New Zealand."

The Tree Root Microbiome Research Programme is jointly funded by the MBIE Endeavour Fund and Forest Growers Levy Trust. It is a partnership between Scion, Western Sydney University, Wright State University, Victoria University of Wellington, Woodwell Climate Research Centre, the Australian Plant Phenomics Facility and Lincoln University.

Forest soils to the rescue

Scientist and project lead Kathryn Walker is measuring how fast soil microbes are consuming methane by taking gas samples from field chambers installed in forests.

New research is investigating if methane-munching forest soils can help us tackle climate change.

Scion scientists have embarked on important new research to find out how much methane is being gobbled up by microorganisms in New Zealand's planted forest soils.

Forest soils are good habitats for bacteria that eat and breathe methane (CH_4) as a source of carbon and energy. By quantifying how much methane is consumed by the bacteria, known as methanotrophs, at targeted field sites, the research project will reveal just how important planted forest soils are to New Zealand as part of efforts that seek to better understand the country's total net emissions and ways to mitigate climate change.

Once complete, the research is expected to provide valuable insights for policymakers examining greenhouse gas emissions, as it can be used to paint a more accurate picture of the country's total net carbon budget.

Due to agricultural activity, methane production in New Zealand is disproportionately high on a per capita basis – about six times the global average. Understanding the potential for other land uses, such as forestry, to mitigate these agricultural emissions is critical, Scion senior scientist Dr Steve A. Wakelin says.

"We know that forests are great for storing carbon from carbon dioxide, but this research is helping us learn about forestry's capability to offset methane emissions as well. We believe it is a first step in a future programme of work that will demonstrate how different land uses in New Zealand are all interconnected, and how to manage these holistically for win-win outcomes."

The research, funded by the Ministry for Primary Industries, follows international studies proving that forest soils create optimal conditions for methanotrophs.

As methane in the air passes over and diffuses with forest soil, methanotrophs consume the methane.

"We find methanotrophs are abundant in our DNA-based surveys of planted forest soils," Wakelin says. "Indeed, based on overseas systems, it turns out that planted forest soils are pretty good habitats for methanotrophs; we just haven't looked at this in New Zealand before."

Scion's Microbial Ecology – Soil Systems team, in a project led by scientist Kathryn Walker, is now collecting New Zealand's first field-based measurements of methane flux – how fast the soil microbes are consuming methane.

In February, researchers installed methane flux chambers at two field sites near Christchurch: Orton Bradley Park and McLeans Island. At both sites Scion already collects environmental DNA and measures environmental properties; this information will now be integrated with the methane flux data. In March, chambers were also installed in Kaingaroa Forest in the central North Island, New Zealand's largest commercial pine plantation.

Sampling of these field chambers will reveal how much methane the forest soil microbiome is consuming over an entire year.

"If rates of consumption are high, we need to know as this data will be important for our national carbon budget," says Wakelin. "Given the importance of methane as a greenhouse gas for agriculture, it could just be a case of forests to the rescue."

Lincoln University is also supporting the project with specialist capability. Professor Tim Clough says the collaborative research with Scion will reveal important data in 12 months' time.

"With Scion's expertise in forestry aligned with Lincoln University's facilities for trace-gas sampling and analysis provided through the New Zealand Greenhouse Gas Centre, we have a great partnership in place to assess the big opportunity of forest methane consumption."

Scientific cooperation extends biobased research

A new agreement is boosting opportunities for scientists to engage with researchers in France and take meaningful action on climate change.

Dr Claire Mayer-Laigle (left), pictured with Dr Marie Joo Le Guen, has been working at Scion on a three-year research programme exploring the use of plant material in 4D printing.

An agreement signed between Scion and one of France's key research organisations creates fresh opportunities to extend Scion's research exploring biobased products and supports New Zealand's transition to a circular bioeconomy.

Scion formalised a new agreement with the French National Research Institute for Agriculture, Food and the Environment (INRAE) at a special function held at the French Embassy in March.

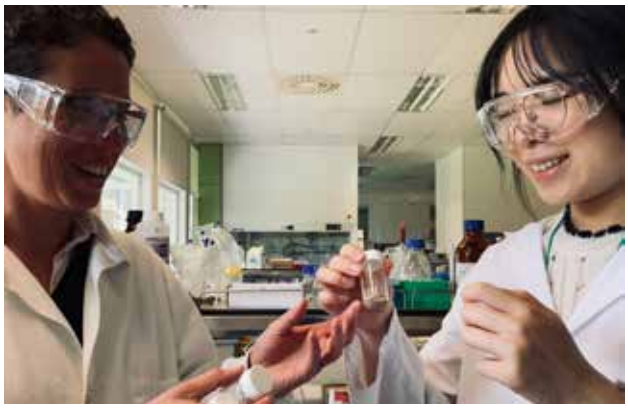
Scion's agreement with INRAE will enhance cooperation on research and innovation to accelerate biorefineries and biomaterials research – work that is developing alternative products to those made from fossil fuels as part of efforts to mitigate climate change.

Scion chief executive Dr Julian Elder says the agreement is a welcome boost to scientific cooperation between France and New Zealand.

"As a Crown Research Institute, we've had the pleasure of collaborating with INRAE for more than 20 years across many research areas," he says.

"In the last decade, we've particularly benefited from our work with INRAE's Transform division and research that has helped to characterise plant materials before their transformation into biobased products and materials used for 3D and 4D printing.

"Our intention with the new agreement is to build on this work and create an Associated International Laboratory. This will contribute to further bioproducts research, with a focus on advancing our knowledge and capabilities with biorefineries and plant materials that can be used to design fossil-free materials for the future."



Dr Claire Mayer-Laigle and Scion summer student Yandeng (Amy) Xu.

Scion's biorefinery research is exploring new ways of creating high-value products from plant-based waste products, such as pine bark. It's part of a wider programme of research focused on the circular bioeconomy that seeks to get the most value out of renewable biological resources while minimising waste.

The agreement with INRAE to create the Associated International Laboratory, known as LIA, also involves collaboration with two higher education partners in Montpellier, France: the University of Montpellier and the Institut Agro.

Scion general manager for Forests to Biobased Products Dr Florian Graichen says the agreement is timely and follows February's announcement that New Zealand researchers can now participate in the Horizon Europe innovation and research programme.

The arrangement makes New Zealand one of the first countries outside Europe eligible to participate in the programme with more than €90 billion (about NZD$153 billion) of funding available over seven years.

"We believe that INRAE will become one of our key European partners working with us on unlocking New Zealand's opportunities around biorefineries, biomanufacturing and bioproducts. This will allow New Zealand to meaningfully mitigate and take actions against climate change, while being able to benefit from the global transformation of economies to circular bioeconomies."

Opportunities ahead

The signing in March was one of four agreements signed at the French Embassy in the presence of Research, Science and Innovation Minister Hon Dr Ayesha Verrall, the French Ambassador to New Zealand Laurence Beau, the President of INRAE Philippe Mauguin, and senior executives from Science New Zealand, AgResearch, and Scion.

The Scion team included Dr Claire Mayer-Laigle, an INRAE researcher from the Joint Research Unit in Montpellier. She first visited Scion in 2018 for a one-week exchange with Scion's Dr Marie Joo Le Guen who was subsequently invited to present at Mayer-Laigle's laboratory. These successful interactions led to a joint conference presentation and research publication – proof of how scientific exchanges evolve and benefit both parties over time.

In 2020, Mayer-Laigle was awarded a prestigious Marie Skłodowska–Curie fellowship in partnership with Scion. This has supported her to work at Scion on a three-year research programme exploring the use of plant material in 4D printing.

During her involvement with the INRAE-Scion partnership, she has also hosted other French scientists in New Zealand, contributed to a patent, scientific articles, conference papers and jointly supervised Masters and PhD students.

Although she's returning to France in July, Mayer-Laigle will stay involved in the evolving work programme and says she's excited by the opportunities ahead.

"The greatest part of the collaboration for me is how all the scientists involved get to create something new, simply by coming together and sharing our knowledge with each other.

"Science goes faster and further when we collaborate."

The Associated International Laboratory (LIA) is named BIOMATA for Biorefinery for Sustainable Materials and Technical Applications and will accelerate the development of biobased research. It will also strengthen Scion's bids for research funding available through Horizon Europe and the Ministry of Business, Innovation and Employment, and provide the framework to secure more scientific exchanges including Early Career researchers and PhD students.

> The agreement will accelerate biorefineries and biomaterials research.

Le Guen says extending the partnership will accelerate learning in what is an already rapidly advancing research area.

"By working with INRAE, an internationally recognised institute of more than 11,000 people and its network, we're able to combine more resources and technology so we can develop biobased, functional materials much faster and explore new sustainable processes in manufacturing.

"Our goal is to make collaborating easier so we can accelerate innovation and inspire and motivate everyone, including young researchers entering the science sector."

Scion board chair Dr Helen Anderson and the president of INRAE Philippe Mauguin sign an agreement to strengthen science exchanges and collaborative projects between their two organisations.

Joining them at the event was (back row, from left) Research, Science and Innovation Minister Hon Dr Ayesha Verrall, Dr Marie Joo Le Guen, Dr Claire Mayer-Laigle, and Scion chief executive Dr Julian Elder, as well as the French Ambassador to New Zealand, Laurence Beau.

Driving the circular bioeconomy forward

At a special event hosted by Scion, various leaders were invited to weigh in on the challenges and opportunities for New Zealand in shifting to a circular bioeconomy.

Education, advocacy and courage will be needed to challenge and replace linear economic models that are currently hindering New Zealand's progress on climate change action.

How New Zealand can take advantage of the opportunities to transition to a circular bioeconomy was explored at the Scion Symposium in Wellington in February, held as part of events to commemorate Scion's 75th Anniversary.

Scion hosted the event at the Wharewaka Function Centre to spark conversations about the circular bioeconomy as momentum builds nationally and globally for ways to mitigate the effects of climate change and reduce the dependence many countries have on fossil fuels.

Forestry is already recognised as a vital means of tackling climate change, and with Scion's focus on research for the forestry and biobased sectors, Scion has become a leading voice in the circular bioeconomy approach. This is a model that addresses social, environmental and economic sustainability by designing out waste, keeping materials in use for longer, and regenerating ecosystems.

Business commentator Rod Oram facilitated the symposium's discussion involving six expert panellists: Prime Minister's chief science advisor Dame Juliet Gerrard, Oji Fibre Solutions chief executive and Scion board member Dr Jon Ryder, Whenua Oho chief executive Te Kapunga Dewes, He Pou a Rangi Climate Change Commission chair Dr Rod Carr, Fit for a Better World chief transformation officer at MPI Jenny Cameron, and Scion general manager for Forests to Biobased Products Dr Florian Graichen.

Four pillars

Carr noted the transition would need to solve four critical pillars to be successful: energy, mobility, the built environment and agriculture. With 60% of New Zealand's energy sourced from fossil fuels, energy needs to be addressed first.

"In our built environments, if we haven't reduced the amount of travel required to get from work to home and home to where we learn by 2050, then we won't get anywhere closer to where we need to be in a circular economy. But we need to solve all four pillars, or we will only have a circular economy with a big hole in it."

Business commentator Rod Oram facilitated the symposium's discussion involving six expert panellist (from left) Fit for a Better World chief transformation officer at MPI Jenny Cameron, Scion general manager for Forests to Biobased Products Dr Florian Graichen, Oji Fibre Solutions chief executive and Scion board member Dr Jon Ryder, Whenua Oho chief executive Te Kapunga Dewes, Prime Minister's chief science advisor Dame Juliet Gerrard, He Pou a Rangi Climate Change Commission chair Dr Rod Carr.

MC Rod Oram helped to generate lively debate.

Whenua Oho chief executive Te Kapunga Dewes [centre] highlighted how principles of the circular bioeconomy are already embedded in Te Ao Māori, which takes an intergenerational view to caring for whenua and people.

> If we take a more intergenerational approach and ensure all aspects of society are given a voice, we'll be better off.
>
> TE KAPUNGA DEWES

Progress, however, is being made, and central government has launched plans that serve as a catalyst for transformation across multiple sectors, including primary industries. These include the Fit for a Better World roadmap and the Forestry and Wood Processing Industry Transformation Plan – both aim to drive sector growth and reduce emissions.

Cameron said while central government could influence the pace of New Zealand's transition to a circular bioeconomy, communities and businesses could adopt more circular practices without waiting for regulation first.

AgriSea and Ecogas are shining examples of New Zealand companies that have embraced research and technology as they've looked to repurpose and turn waste into a resource, she said.

"We need to get behind these exemplars so we can show other businesses what's possible and how it can be achieved."

Learning from past mistakes

Dewes highlighted how principles of the circular bioeconomy are already embedded in Te Ao Māori, which takes an intergenerational view to caring for whenua and people, as guided by the principle of kaitiakitanga (guardianship and protection of the environment).

However, he reminded participants that in creating a national circular bioeconomy strategy for New Zealand, how the priorities are set are just as important as what they are.

"The way we've done things in the past haven't worked and history shows us we lurch from one priority to the next. If we take a more intergenerational approach and ensure all aspects of society are given a voice, we'll be better off.

"But do we have the political and social will to make that happen? Our current structures don't support this."

Graichen agrees existing mindsets and systems that accelerated the linear economy are no longer fit for purpose in a world feeling the effects of a climate crisis.

> We are talking about unlocking a generational and transformational opportunity for the country through mitigating climate change and creating prosperity.
>
> FLORIAN GRAICHEN

"On top of that we have a world that is moving towards a population of 10 billion people – 10 billion people that require food, clothing, housing or transport. We must rethink on a systems level, which includes the need to source materials from sustainable – not fossil – feedstock.

"We need to look through a different lens and for us at Scion, we look at all the benefits to a society that come from a circular bioeconomy – more sustainable environment and better community wellbeing. Not all the drivers are simply economic.

"But we need speed and urgency around our national bioeconomy strategy. We are talking about unlocking a generational and transformational opportunity for the country through mitigating climate change and creating prosperity."

Nearly 60 countries have national bioeconomy strategies, and more are expected to be unveiled this year. It's believed bioeconomies contribute as much as US $30 trillion to the global economy annually.

For the love of trees

Indigenous forestry researcher Greg Steward reflects on career highlights after nearly 50 years in the field.

Like a mighty tōtara tree that stands tall and strong, Greg Steward has been celebrated for his resilience, endurance and passion for advancing New Zealand's knowledge of indigenous forestry over nearly five decades.

The Scion scientist, who is the first to admit he failed science and left school at 16, was farewelled by dozens of current and former colleagues at a special function at Te Whare Nui o Tuteata in April to mark his retirement – 49 years after joining the New Zealand Forest Service as a trainee woodsman. During the event many people paid tribute to Steward's unrivalled expertise that saw him carve out an extraordinary research career that focused on managing kauri, tōtara and indigenous hardwoods in plantations.

The turnout reflected the standing in which Steward is held as Scion's and possibly New Zealand's longest serving indigenous forestry researcher. His legacy will be built on through the work of other scientists who are now 'picking up the baton' and championing the value of indigenous trees for their economic potential and special timber qualities.

But despite entering retirement, Steward's expertise won't be lost. He has agreed to serve as an Emeritus scientist – a mentoring role that enables him to keep sharing his considerable knowledge.

Scion chief executive Dr Julian Elder made the announcement at Steward's farewell to a round of delighted applause.

"We're so pleased that Greg will be joining our growing cadre of Emeritus researchers who, while officially in a new phase of their lives, continue to serve our science community," he said.

During the farewell, people shared fond recollections of working with Steward in the field and stories of how his research had changed the way people view indigenous forestry in New Zealand.

"Through Greg's research, we've been able to appreciate indigenous trees for reasons other than conservation; to make that difference is amazing," principal scientist Dr Brian Richardson said. "It's remarkable to see how that has benefited our organisation, New Zealand forestry and society."

Scientist Dean Meason added that Steward's passion for indigenous trees and for their timber was strongly evident.

"When you spent time with Greg, it was very clear that everyone looked to him for his knowledge. He was hugely admired by iwi and the community wherever he was. The findings of his research trials and papers will benefit us for years to come."

During his career, Steward authored and co-authored papers on indigenous tree species looking at their qualities, and timber production modelling, with specific emphasis on managing kauri, tōtara and indigenous hardwoods for production.

In 2020, his contributions were acknowledged with a Science New Zealand Individual / Lifetime Achievement Award.

His thesis on the growth and yield of New Zealand kauri awarded him with a Master of Forestry Science (Hons) in 2011 and dispelled many myths around the growth potential of plantation kauri. His research showed that kauri stands aged 20 to 60 years were 20 times more productive than natural stands – work that blew the estimated kauri crop rotations of hundreds of years out of the water.

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Projects he has both led, and been involved in, have strongly influenced the position that indigenous forestry is now moving towards, as demonstrated in the successful Tōtara Industry Pilot programme in Northland.

Relating to that project, and as a parting gift from Scion, Steward was presented with a carved hoe (paddle) carved from tōtara by Grant Hamarama Smith Marunui (Ngāti Hurungaterangi, Ngāti Te Kahu, Ngāti Rangiteaorere, Ngāti Rongomai, Ngāti Manawa and Ngāti Rangitāne) and Kawana Waititi (Te Whānau-ā-Apanui).

Scion general manager for Te Ao Māori and Science Services Hēmi Rolleston said he was privileged to present the taonga as Steward 'rows off' into his next phase.

"A legend in indigenous forestry, Greg is a rangatira who has been dedicated to his work and is going out on top.

Scion's general manager for Te Ao Māori and Science Services Hēmi Rolleston presented Greg Steward with his special taonga carved from tōtara.

"Like the tōtara, he has weathered storms but stood strong and seen lots of growth around him. Because it so highly valued, tōtara is a symbol of chieftainship and nobility in Māori culture, so it is very fitting that his taonga reflects those special values.

"And just as the tōtara tree provides shelter for all those who seek refuge under its branches, Greg has been a source of comfort and guidance for many people at Scion over the years. It's wonderful that can continue in his new role as an Emeritus scientist."

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> HĒMI ROLLESTON

From trainee to scientist

Reflecting on his career, Steward acknowledges the researchers who came before him who were generous in their support, allowing him to grow and take on new responsibilities.

"Almost everybody you come across adds to your store of knowledge, and it's sometimes the people you least expect it from.

"The person I most want to acknowledge is Tony Beveridge who was a very kind and intelligent person – one of those old-fashioned gentlemen. He took me under his wing in my early days.

"He was very respected and knowledgeable about indigenous trees, having worked in Pureroa in the 1950s. But he was always interested in our observations as younger people in the forests as he knew that how we saw things would add to his observations."

Steward grew up in South Auckland and was first exposed to forestry when, at 16, he joined the Woodsman Training School in January 1975. One of 50 trainees in his intake, he learned about silviculture with the idea that after three years, he'd be qualified to supervise forestry silviculture gangs.

His first two years were spent living in a hostel at Kaingaroa and felling trees and cutting logs. He says the worst jobs were planting young trees in the middle of winter or working in the nursery with bare hands during frosty mornings when temperatures plummeted to as low as -4°C.

By contrast, his favourite job occurred during his group's first summer together. "About 30 of us were driven out by bus to the middle of Kaingaroa where there was about 200ha of dry cutover pine forest. We were given litres of diesel, boxes of matches and they told us to set fire to it all.

"We looked at each other and thought, 'And we get paid!' It was a teenage boy's dream."

He was one of four trainees who, in their third year, continued their training at what is now Scion. Exposed to different research areas, it was the Indigenous Silviculture research group that impressed Steward the most.

After completing his training he joined the group and worked alongside indigenous forestry scientists in the field. Steward recalls how they'd spend Monday to Friday in forests like Pureroa west of Taupō, living out of huts and sleeping bags, only returning home at weekends.

"We were doing everything from indigenous production forestry research through to identifying reserves and mapping forest types. A lot of logging and planting trials; it was very physical work and I'd never been so fit."

Occasionally, it could even be dangerous work. "We were working in some of the most remote forestry areas of the North Island," he says. "There shouldn't have been anyone else around but occasionally you'd get the odd hunter come through poaching, most often during the roar. We were shot at by certain people who didn't want us there."

Having spent so much time in New Zealand's indigenous forests, studying rimu, mataī, kahikatea and kauri, Steward has mentally mapped the landscape they grow in.

He recalls working in Minginui during selection logging trials when he and a group of science trainees challenged themselves to deliberately get lost in the forest. "It was pointless, we knew those forests so well that after five minutes of walking, we knew exactly where we were."

Even now, Steward can be shown a tree on a computer that has been assessed using LIDAR technology and, due to its shape or the way its trunk swells, he'll know it's exact location.

Greg Steward admiring a mature Agathis lanceolata, a conifer species related to kauri, during an exchange trip to New Caledonia with Sud Foret.

Greg Steward, who failed science and left school at 16, has become Scion's and possibly New Zealand's longest serving indigenous forestry researcher.

Sharing his knowledge

In becoming an Emeritus scientist, Steward will continue providing support to the next generation of indigenous forest researchers. "As you get to a senior position, you shouldn't become a roadblock to other people coming through with new ideas," he says.

"Ki-Taurangi Bradford in Te Ao Māori at Scion and researchers within David Pont's research group are all showing interest so I'm looking forward to mentoring those who are coming through."

After dedicating his life to his love of New Zealand's indigenous forests – from his first days as a trainee woodsman in Kaingaroa, to being the driving force for indigenous forestry at Scion, Steward is satisfied he's stepping away from the coalface having left enough research for others to build on.

"There's enough stuff out there now to go away quite confident that people should be able to harvest indigenous trees if they get good quality seedlings and look after them, that it's something they can do within their lifetime.

"When I started we were talking in rotations from planting to harvest of about 250 years. We were trying to replicate the old forests because that's what we thought we had to do.

"Then we started to do more intensive research. Now I would say relatively confidently that you can get down to 80 years, and with silviculture and breeding we can probably get down to 50 or 60 years to produce a harvestable tree and a useable product.

"We must unlock the economic potential of these indigenous species. In that way, people become more likely to invest."

Breaking down matters

As more people strive to live eco-friendly lives, understanding how to properly dispose of compostable packaging has become increasingly important. Scion is lending a hand with research to optimise composting conditions in industrial facilities, paving the way for a future where less contaminated food packaging ends up in landfill.

Single-use compostable food packaging, contrary to public understanding, is not widely composted in New Zealand. Food waste going to landfill, often found in combination with the packaging, is a bigger problem due to the production of methane as waste breaks down.

As eco-consciousness increasingly influences consumer behaviour, there is a need to introduce compostable packaging that is truly biodegradable and improve understanding about how to dispose of and compost such materials. Achieving this ensures New Zealand will be better placed to meet its sustainability goals.

To shed light on the performance of compostable products in industrial composting facilities, Scion conducted a series of trials of certified compostable products across several industrial composting sites in New Zealand. Evaluating disintegration of compostable, single-use products in a real-world composting setting, Scion compared these with the composting standards they are tested against in the laboratory setting. The research only focused on the compostability of the material and did not test for any harmful chemicals often associated with compostable packaging.

> We need to be careful about making sure the right materials go into the right bins.
>
> KATE PARKER

The research revealed key degradation variability across and even within sites. While all the materials were technically compostable, the conditions at each facility significantly impacted their disintegration rates. Factors such as temperature, mixing protocol, and shredding timings played a role, with moisture content emerging as a critical element.

Scion's team leader of Sustainable Materials, Kate Parker, shared some of the team's findings.

"Optimal moisture content of the compost pile during composting is key. Too dry and nothing biodegrades. Too wet and the whole pile becomes anaerobic.

Research has shed light on the performance of compostable products, including single use packaging.

"Interestingly, our analysis revealed that fibre-based packaging didn't degrade to the same degree as the plastic-based packaging. Likely due to their thinness and lack of additional moisture barrier coatings, biodegradable plastic materials generally disintegrated faster than fibre-based packaging," Parker says.

The findings highlight concerns among New Zealand composters, as laboratory tests don't always accurately replicate real-world composting environments. Although industrial composting facilities offer a potential solution, contamination with non-biodegradable materials remains an ongoing issue.

Parker emphasises: "We need to be careful about making sure the right materials go into the right bins.

"With this research, Scion hopes to enable more composting of packaging materials, but only when it is appropriate, such as when it is contaminated with food. It is the food residues that provides nutrients for the composting process, not the packaging."

Ministry for the Environment's director Waste Investments Michelle Kazor says the research generated valuable insights.

"There's an increasing number of packaging items on the market that producers claim are 'compostable'. Scion's research is an important step in helping product manufacturers, retailers and consumers understand what they're buying, and how accurate these claims are."

As the only certified compost testing facility in Australasia, Scion continues to explore the complexities of compostable packaging, aiming to contribute to a more sustainable future.

The study was funded by the Ministry for the Environment's Te Pūtea Whakamauru Para Waste Minimisation Fund. The WMF is focused on accelerating New Zealand's transition towards a low emissions and low waste circular economy.

Read the research in full here:

Fostering creativity in young minds

Students get the opportunity to tinker with the 3D printers and the new flexible 4D printing filament, Morph.

Enthusiastic tamariki gathered around the 3D printers at Te Aka Mauri to learn about the world of 3D printing and Morph, a new flexible 4D printing filament developed at Scion and now commercially available through Imagin Plastics.

A group of Rotorua kids returned to the classroom during the April school holidays to work alongside the Scion team behind the innovative technology, with the opportunity to create something of their own.

Held at Te Aka Mauri l Rotorua Library, the sold-out event saw 25 intermediate and high school students learn the ins and outs of 3D printing during a three-hour interactive workshop. The workshop was the official launch of the new filament.

Scion scientist Dr Angelique Greene says launching Morph to a group of school-aged kids wasn't coincidental.

"At this age, kids readily absorb information and have the impressive ability to develop more imaginative designs."

Morph is believed to be the only flexible filament of its kind globally. Its thermochromic properties give the filament its fourth dimension, changing colour when it senses a temperature shift.

During the workshop, kids learnt how to set up 3D printers, how to build 3D models, how to slice those 3D models, what G-code is, and how to initiate printing. Students were also given the opportunity to show off their design skills during a two-week competition using the free 3D CAD tool, *Tinkercad*.

Greene says young people show us what is possible with this more artistic filament, producing designs that we couldn't even imagine.

"The true potential of Morph is in the hands of whoever holds it."

Morph is the result of another successful research collaboration between New Zealand's leading filament manufacturer Imagin Plastics and Scion.

Imagin Plastics sales and technical manager Ben Blakley says Morph continues a long-standing relationship that began with the development of a wood-filled PLA 3D printing filament in 2018.

"Supporting Scion in the community education space adds another string to Imagin Plastic's bow, and the Morph team should be proud of the educational impact they've made in their community and the steppingstone it could create."

During the interactive workshop, creative juices flowed as a squid with wings, an alien tower, and tumbling doughnuts started to take shape within moments on computer screens.

Greene says the workshop was about giving back to the community and providing young people with an opportunity to interact with this new filament and meet the people working in science fields they never would have thought existed.

"If these kids weren't interested in STEM subjects before, they might be interested in it now."

Scion mechanical engineer Rob Whitton adds that the goal is to create awareness, so when people drive past the Scion sign, they're familiar with some of the work.

"It's not all test tubes and lab coats (although there's plenty of that too), but it's developing products and innovation, and technology is a big part of that.

"3D printing will be a part of most people's lives in one way or another in the future, already infiltrating the education sector and commercial industry. In the coming years, 3D printers will be used by the general population, not just by those who like to tinker."

View the new flexible 4D printing filament on Imagin Plastic's website:

Action on the oval

The performance from Te Kapa Haka o Ngāti Whakaue was a crowd-pleaser following their success at Te Matatini, a significant cultural festival and the pinnacle event for Māori performing arts held every two years.

In March, we were privileged to have been a part of the Ngāti Whakaue Whānau Day, a special day that unfolded on the Scion oval. A highlight was hearing Te Matatini co-runner-up Te Kapa Haka o Ngāti Whakaue. Their performance and waiata inside Te Whare Nui o Tuteata were truly breathtaking.

It was wonderful for the whole community to celebrate with whānau and recognise the partnership between Scion and the tangata whenua, Ngā Hapū e Toru.

Whānau and organisations enjoyed connecting in the relaxed setting.

A performance inside Te Whare Nui o Tuteata.

Te Whare Nui o Tuteata provided a stunning backdrop to festivities on the oval.

Snow on the hills leading up to Aoraki Mount Cook provided a spectacular icy backdrop for Scion's fire and atmospheric scientists in May. They were part of an international research team who burned wilding slash piles as part of a world first experiment aimed at protecting firefighters and communities from the devastating impact of future wildfire events. Read more about this exciting research in our next issue of Scion Connections.

IMAGE CREDIT: Samuel Aguilar.


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