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Landcare Research

Pūtaiao

MANAAKI WHENUA SCIENCE SUMMARY / ISSUE 23 / AUGUST 2025

The art of science

Spotlight on our latest research

Pūtaiao

Science for our land and our future

Tēnā koe and welcome to Issue 23 of *Pūtaiao* (Science), our quarterly publication showcasing the work of Manaaki Whenua.

This issue of *Pūtaiao* covers a wide range of impactful social science and climate science, including in the Pacific. This is also the first issue of *Pūtaiao* in which Manaaki Whenua is a constituent group of the newly created Bioeconomy Science Institute (BSI). As part of a once-in-a-generation change to New Zealand's science and innovation system, Manaaki Whenua joined with AgResearch, Scion and Plant & Food Research on July 1, 2025. The new institute will advance innovation, protect and enhance ecosystems and develop new bio-based technologies and products through our combined research capabilities.

We look forward to the shared science and research opportunities the Bioeconomy Science Institute will bring – to grow New Zealand's sustainable, export-led bioeconomy and deliver positive environmental and social outcomes.

If you wish to be included on the mailing list for *Pūtaiao*, or to find out more about any of the stories, contact Dan Park on parkdj@landcareresearch.co.nz

You may also like to sign up to our popular online webinar series LinkOnline, a series of webinars to share our science with stakeholders: landcareresearch.co.nz/events/linkonline

Mark Piper, Bioeconomy Science Institute Transition CEO.

Cover image: Lily Duval (artist) and Joyce Yager (researcher) with Lily's artwork Whakaraupō Tile Stack *as part of Know Your Place: environment + art project, Lyttelton.*

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Benchmark results from the national soil carbon monitoring system for agricultural land in New Zealand

Soil organic carbon (SOC) is critical to soil health. It's the basis of the soil food web and it plays an important role in maintaining soil structure, retaining water and nutrient cycling. Soils are also large reservoirs of carbon, and globally contain more carbon than the atmosphere and vegetation combined.

It's important we know what's happening to soil carbon stocks in New Zealand, because a small increase or decrease could have significant impacts on carbon footprints at farm, industry and national scales.

The National Soil Carbon Monitoring Project, a collaboration between Manaaki Whenua and the University of Waikato, and funded by the Ag Emissions Centre, is currently assessing whether soil carbon stocks under New Zealand's agricultural land are increasing or decreasing, and whether land use influences any change that may be occurring. Data will also improve our ability to predict how SOC stocks are likely to change when land use changes and these will inform improvements to the national soil carbon inventory model.

In previous issues of *Pūtaiao* we have reported on progress in benchmarking SOC stocks across New Zealand. Samples were collected from 500 representative agricultural sites across the country, and analysed using consistent methods over a period of 6 years, which is an impressively constrained timeframe especially given interruptions to data collection caused by COVID and by extreme environmental events such as Cyclone Gabrielle during this time.

Now, we are pleased to report, the full results of the benchmark sampling are in! For the first time, spatially representative measurements of SOC stocks for agricultural land on mineral soils are available for New Zealand, separated into five broad land-use classes.

Mean slope-corrected SOC stocks for the 0–30 cm depth for all agricultural land on mineral soils in New Zealand are 101.3 tC/ha. The 30–60 cm layer contributed on average a further 36.9 tC/ha. Stocks for the 0–30 cm layer were highest under dairy pasture (110.7 tC/ha), followed by hill country drystock pasture (104.3 tC/ha), flat-rolling drystock pasture (98.7 tC/ha), and perennial horticulture (84.8 tC/ha), and were lowest under cropland (80.1 tC/ha). The differences between broad land use classes cannot be attributed to land use alone, since the location of different land uses is often related to soil type and climate. For example, there are proportionally more dairy farms on Allophanic Soils than for the other land-use classes and Allophanic Soils have naturally high background soil carbon stocks.

Soil coring on agricultural land.

These data provide a crucial benchmark against which to compare future sampling, to determine whether SOC stocks are changing in agricultural land on mineral soils across the country.

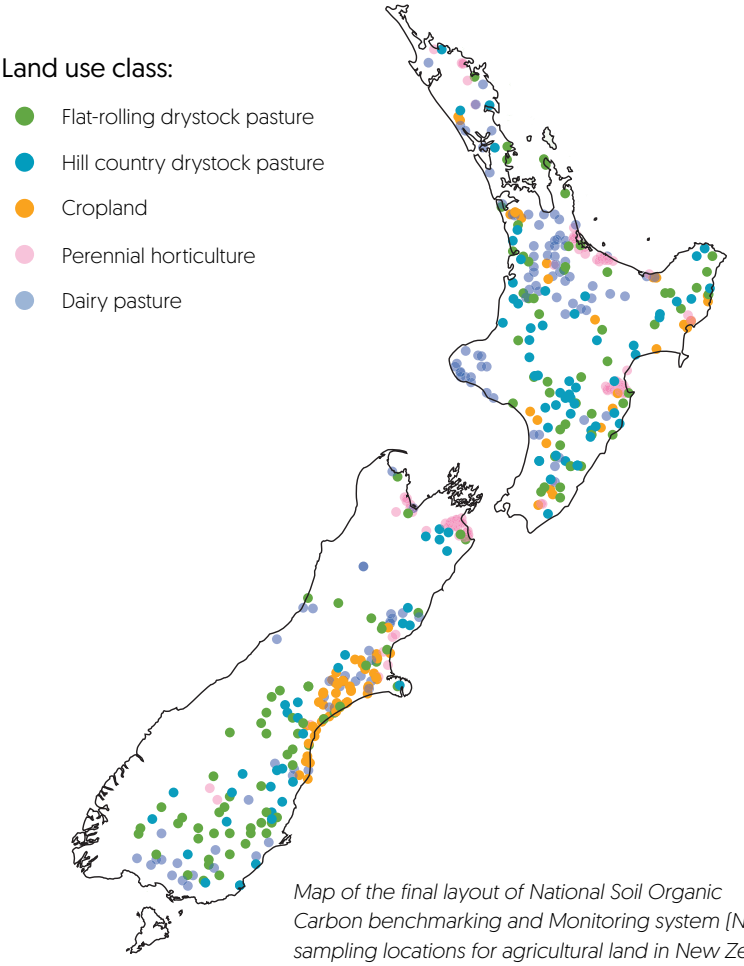
Having reached this milestone, the intended next steps will be:

- Resampling all 500 sites by 2028 (4–6 years after the benchmark sampling) to determine whether SOC stocks are changing through time.
- Retaining the samples in the National Soil Archive to allow further analyses as new questions and technologies arise.
- Consider expanding the scope of the survey to include carbon stocks on drained Organic Soils used for agriculture in New Zealand.

Contact: Paul Mudge
mudgep@landcareresearch.co.nz

Full results are published online in the open access journal *Geoderma*:

HTTPS *doi.org/10.1016/j.geoderma.2025.117354*



Map of the final layout of National Soil Organic Carbon benchmarking and Monitoring system (NSCM) sampling locations for agricultural land in New Zealand.

The effect of rising CO_2 levels on carbon stocks in pasture and forest ecosystems

Primarily as a result of fossil fuel burning, the amount of CO_2 in the atmosphere continues to rise far above pre-industrial concentrations of 280 parts per million (ppm)– it is currently around 422 ppm and increasing by about 2.5 ppm per year. Increasing CO_2 concentrations influences plant growth and water use, with potential important and wide-reaching consequences for ecosystem function including carbon storage.

Work involving Manaaki Whenua's scientists has been underway since the 1990s to quantify the effects of rising CO_2 on plant growth. At a field site near Bulls in the Rangitikei, established in 1997 by AgResearch, pasture productivity under elevated CO_2 levels (via free-air CO_2 enrichment) has been consistently monitored and measurements of soil carbon were also made. This was the longest-running study of CO_2 enrichment in a grazed pasture system (23 years) making it unique. Measurements revealed that elevated CO_2 increased pasture production by about 10% but there was no detectable effect on soil carbon stocks. Aligned modelling also showed increased pasture production but minimal changes in soil carbon stocks.

Our researchers have also recently completed a wide-ranging review and modelling study for the Ministry for Primary Industries (MPI) on the potential effects of rising CO_2 concentrations on forest growth (*Pinus radiata*) in New Zealand. Simulated responses to CO_2 concentrations of 800 ppm at 25°C were translated into minor growth stimulations and minor increases in future carbon storage potential, notably in currently wetter and colder parts of the country. However, limiting factors brought about by climate change, such as acute water limitation and nutrient availability, would act to reduce these gains.

Contact: Miko Kirschbaum
kirschbaumm@landcareresearch.co.nz

For more details see the published paper at:

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Recognising kaitiakitanga responsibilities in climate change resilience

Ki te kore te tāngata e manaaki i tōna taiao,
Ka kore te tāngata e whai oranga
If people do not take care of the environment,
We are not taking care of our own health and well-being

There is a Te Tiriti o Waitangi obligation on the part of agencies and institutions, including local and central government, to include mana whenua as genuine partners in any climate change adaptation approach, plan or policy. Kaihautū Māori Research Impact Leader Dr Shaun Awatere leads a team of researchers developing tools that support Māori communities make more informed climate adaptation decisions through a te ao Māori lens.

The *Huringa Āhuarangi, Huringa Oranga: Changing Environment, Changing Well-being* research programme recognises hapū and iwi in their role as kaitiaki by using both mātauranga Māori and science to build locally grounded climate resilience. Shaun says the research enables Māori to make informed decisions about climate change adaptation from a te ao Māori approach.

A te ao Māori perspective acknowledges the connections between people and te taiao and considers issues such as intergenerational equity. This includes mātauranga Māori and its implementation through Māori technologies such as maramataka, tohu-based indicators, and locally embedded monitoring systems that inform policies for climate adaptation and are often context-specific, as part of an enduring legacy and a commitment to future generations in contrast to short-term exploitation.

Recent research (see the links below) proposes a disaster risk reduction and emergency management framework grounded in te ao Māori values and practices, addressing the legal and institutional barriers that inhibit the restoration of mana and tino rangatiratanga in current legislative settings. Their work highlights the need for a shift away from technocratic models towards mana-enhancing, place-based responses shaped by hapū and iwi leadership.

Shaun adds it's important to engage with whānau, hapū, and iwi on a local basis to understand what the community needs to be resilient to a changing climate. This is consistent with recent work he co-authored in the journal *Disasters*, which demonstrates that adapting to climate change through nature-based solutions grounded in Indigenous knowledge – such as ecosystem regeneration at the landscape scale – provides not only ecological benefits but also strengthens cultural identity and intergenerational well-being.

The following two projects in the *Huringa Āhuarangi, Huringa Oranga* research programme support the empowerment of mana whenua by using te ao Māori approaches for natural resource management and climate change adaptation. The projects are centred around what whānau, hapū and iwi need to build resilience through using adaptive strategies.

Contact: Shaun Awatere (Ngāti Porou)
awateres@landcareresearch.co.nz

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landcareresearch.co.nz/haho

PROJECT ONE

He Ngahere, He Korowai: Resilient land use strategies for whenua Māori

Noho tahanga a Papatūānuku kia whakakorowai i ai ia
Papatūānuku (the Earth Mother) lays bare; we must recloak her
Keita Ngata (Ngāti Porou)

Senior researcher Dr Suzanne Lambie leads *He Ngahere, He Korowai*, a project focused on resilient landscapes on highly erosion-prone whenua Māori (Māori land) for future generations.

"Our life-giving soils are being eroded. With every storm event, more of the land is washed into streams and rivers, compromising the whenua's ability to support communities," says Suzanne. "Our future native forests will be vital for the protection of highly erosion prone land and facilitation of the next generations aspirations.

"The work in *He Ngahere He Korowai* has progressed well, and we have gathered the first glimpse of what post-pine-harvest native regenerating forest looks like. We have established nine plots across study sites in the North Island, from Northland to the Manawatu regions. The sites have a range of weed and pest animal pressures including the usual suspects (pampas, gorse, deer, and pigs).

"We will compare the post-pine native tree diversity with native tree diversity under a range of pine tree densities to test the relationship between pre- and post-harvest native diversity. We will also estimate the carbon accrual in our post-harvest native regenerating forests, with species-specific scaling where possible.

An interactive online map: Post-pine-harvest native regenerating forest.

"We identified that the current frameworks for valuing native forests were considered a barrier by mana whenua, being solely carbon focused. Our future work will include working with mana whenua to build a holistic framework for determining what a successful native forest restoration looks like. This will highlight the key indicators for restoration outcomes and provide on-the-ground accessible assessments integrating mātauranga Māori and other scientific measures."

Contact: Suzanne Lambie
lambies@landcareresearch.co.nz

landcareresearch.co.nz/haho/whenua-maori

PROJECT TWO

He Whenua Kanorau, He Whenua Manawaroa: Diverse and resilient landscapes

Te toto o te tangata, he kai; te oranga o te tangata, he whenua
While food provides the blood in our veins; our health is drawn from the land

Environmental social scientist Dr Susanna Finlay-Smits leads *He Whenua Kanorau, He Whenua Manawaroa*, together with Dr Sarah Edwards (environmental social scientist) and Jade Hyslop (kairangahau).

"Through in-depth interviews with kaitiaki and pūkenga (whenua Māori practitioners and experts) who care for their whenua in different ways, we examine the social, cultural and historical factors that impede transitioning towards more diverse whenua Māori. Through these narratives, we reveal complex and often unseen interactions between people, colonial legacies, bureaucracies, and the environment, and show why diversifying whenua Māori is not as simple as it may appear in standard environmental guidelines," says Susanna. "Despite the challenges, we showcase how key concepts and practices can support progress towards more resilient whenua Māori.

"We use the artistic symbolism of a thriving Kahikatea tree to represent these concepts.

"The concepts represent the unseen but integral elements that create fertile conditions necessary for seeds to germinate (te ao Māori, mātauranga Māori, tikanga, whakapapa, Papatūānuku).

"The roots, where life is sustained through nutrient and water transfers,

An interactive online tool: Me Uru Kahikatea (Let us be like the Kahikatea).

represent the many unseen actions and activities that are driven by social and cultural obligations and responsibilities (manaakitanga, kaitiakitanga, trusting relationships, kotahitanga, ahi kā, challenging regulation, disrupting systems). Without roots, the tree cannot be sustained.

"The words scaling the trunk speak to the more visible/seen social elements and actions (weaving knowledges, secure resourcing, empowered tāngata, effective governance).

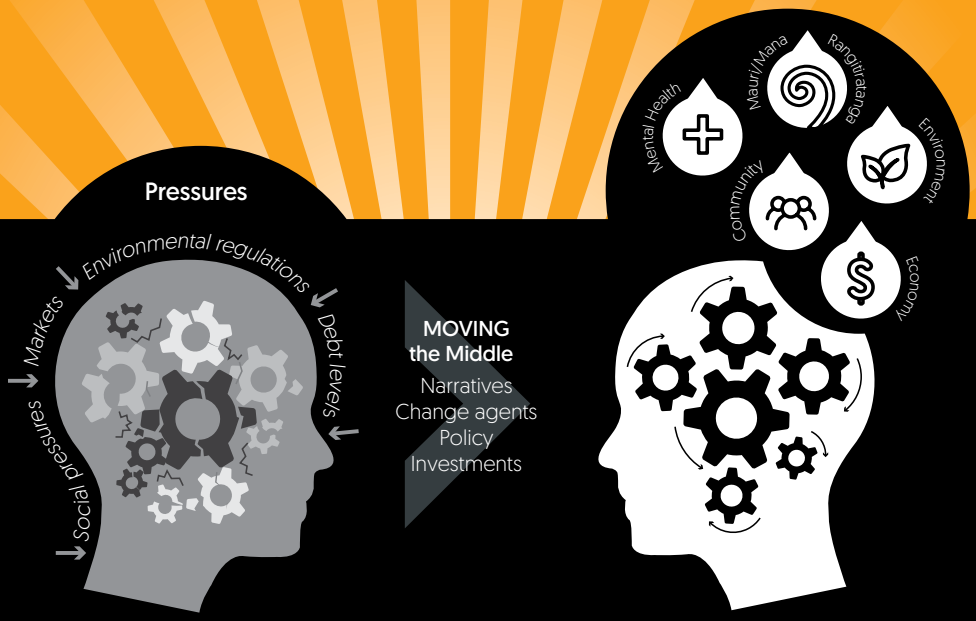
"Finally, the 'canopy' represents visions for a thriving whenua, encompassing both environmental and human well-being (mana motuhake, flourishing mauri, thriving community, healing).

"By recognising and resourcing these complex sociocultural factors, alongside the more evident physical and environmental factors, policy-makers will gain a more complete picture of what it will take to support the journey towards diverse and resilient whenua Māori."

Contact: Susanna Finlay-Smits
finlay-smitss@landcareresearch.co.nz

landcareresearch.co.nz/haho/whenua-manawaroa

Moving the Middle – a progress report



Led by Manaaki Whenua, the 5-year Endeavour research programme *Moving the Middle* (2021–2026) aims to give rural land managers greater confidence to improve their environmental performance voluntarily. While many farmers are willing to make the changes needed to protect the environment and sustain their businesses, others are overwhelmed by information overload and the complexity of the multiple systems and pressures they face.

Providing more information, tools or technologies will not bring about the scale of change required. To empower real change, our research looks at the often-ignored human dimension of the systems affecting farmers and growers (e.g. financial, market, policy, societal/community) to identify places in these systems to intervene (leverage points) that will reduce pressures coming from these interacting systems.

Moving the Middle includes five research areas looking at different ways to influence the willingness and ability of those on the land to take voluntary pro-environmental action.

- Systems and agency. Describes the complex mix of systems that influence farmer/grower decision making and investigates the source of conflicting pressures.
- Policy interventions. Tests effective, low-cost voluntary interventions to influence environmental decision making.
- Investment practices. Explores potential alternative financial lending models, and maps how to better facilitate successful transitions for Māori agribusiness from establishment to commercial sustainability.
- Agents of change. Examines approaches used by 'non-traditional' change agents to improve their efficacy.
- Narratives. Understands social/community narratives so as to positively reframe them to encourage greater environmental action.

The following stories highlight some of the most recent progress in *Moving the Middle*.

landcareresearch.co.nz/moving-the-middle

1 AGENTS OF CHANGE

This research area looks at a wide range of different agents of positive environmental change on land. It is particularly interested in potentially powerful, but indirect change agents, such as artists, who influence what happens on the land. Our research investigates what such agents do and how it might ultimately lead to positive environmental impact.

To collect evidence about these relationships, the Agents of Change team worked with Holly Cunningham and Sarah Amazinnia to design a programme of events based on art and science collaborations aimed at building the relationship that people have with their place, as a generator of positive change.

Run from 20 November to 1 December 2024 in various locations around Lyttelton and its harbour, *Know Your Place* was a key test of the influence that artists may have as agents of change, and also a chance to research how experiencing art might lead to pro-environmental change.

Events during that time included a (literally immersive) underwater sound experience, displays of original art and sculpture, exhibitions, a harbour cruise and foreshore clean-up, speakers, and even themed restaurant menus. Throughout the event our researchers gathered data on art and artists as agents of positive environmental change.

knowyourplace.nz

Upper: Nightly projections of marine invertebrates filmed by Dr Joyce Yager.

Middle: Underwater sound experience at Lyttelton Pool. Underwater symphony by artist Dr Jo Burzynska.

Lower: Community-made ceramic kororā (white-flippered penguins). Penguin making workshops by artist Nikki Wallace-Bell.

Community engagement at Know Your Place environment + art, Lyttelton.

2 HOW SCHOOLS HELP INFLUENCE POSITIVE ENVIRONMENTAL ACTIVITY ON LAND

Also acting as agents of change, schools and their teachers play an important role in building foundational skills that will support pro-environmental activity throughout life. Helping schools build such skills, or supporting them where they exist, will help improve pro-environmental attitudes in the future.

Schools may have the potential to make more profound changes to how people manage the land, but it will take longer to see them. This research looks at how those with a mandate to protect the environment can better understand and support less obvious agents of change.

Three schools were studied, each with strong and distinct relationships with the land: Hauraki Plains College, a state high school situated in an agricultural area, with many students from farming backgrounds; Climate Action Campus, a satellite school that students visit a few hours per week to spend time outdoors, building confidence to take tangible actions in the face of climate change; and Pūhoro Science, Technology, Engineering, Maths, and Mātauranga (STEMM) Academy, a virtual high school/academy that seeks to enable and inspire rangatahi Māori to pursue STEMM careers.

Several unifying themes emerged from the research:

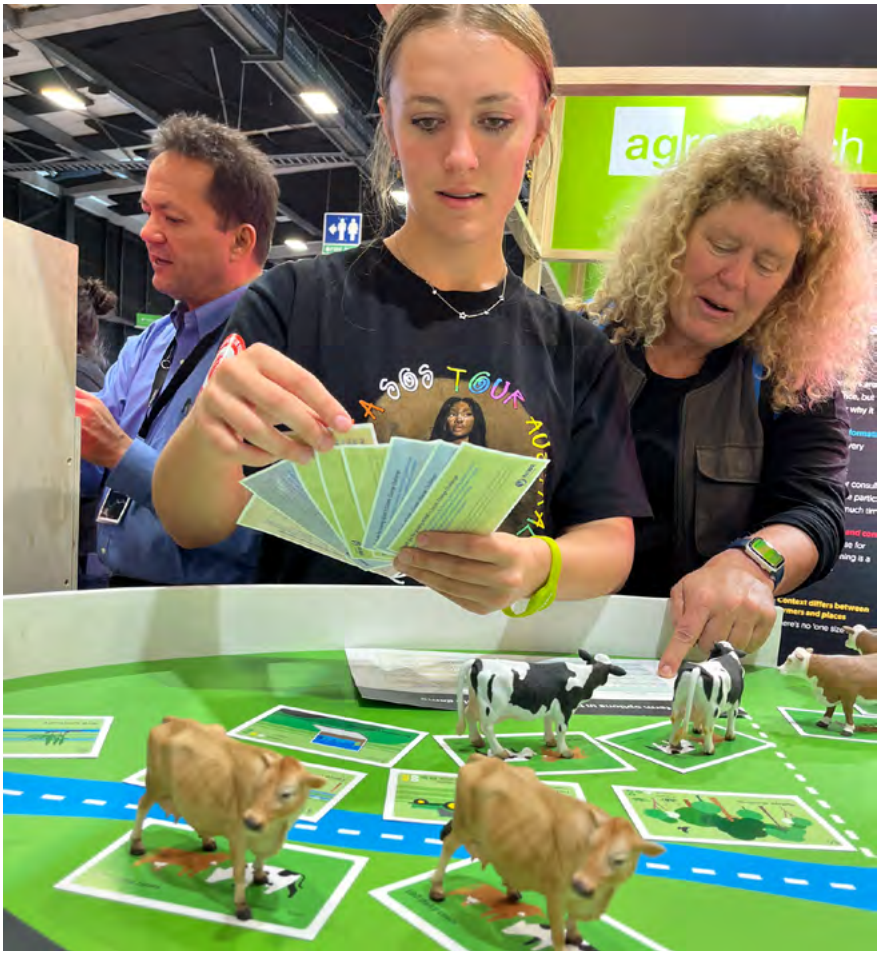
1. The more supportive a school's wider community is of pro-environmental attitudes and action, the more likely such attitudes and skills will be developed in the school.
2. Critical thinking is an important foundational skill and nurtured in schools. In some cases the desire to take a 'balanced' view appears to lead to weighting all sides as equal and substitutable when this may not be the case, and may lead to inadvertently justifying damaging actions.
3. Schools whose mission or values align with pro-environmental action find it easier to nurture pro-environmental attitudes and action in their students. To amplify positive environmental change, schools, such as the Climate Action Campus, could be encouraged or supported to succeed (e.g. funded) and to work with mainstream state schools, creating room in the curriculum for what is currently seen as extra-curricular activity.
4. Younger students will take time to progress into the workforce, so the impact of school initiatives is long-term, although their potential impact is high. Other interventions (outside schools) with more immediate effects are also needed to achieve pro-environmental impacts on land.

Engaging future environmentalists starts early in life.

3 STRATEGIC, TACTICAL, COMPLEX AND SIMPLE: A FOUR-WAY SCHEMA FOR MEASURING ON-FARM CHANGE

In the face of climate and other environmental change, regulatory and economic changes, farmers are always under pressure to redesign and improve their systems and to adopt new practices. Some change in practice (e.g. doing something completely different to existing ways) are more complex than other simple enhancements. And some changes are strategic because they involve changing outputs to make better use of critical inputs while others are tactical because they involve finding other inputs that can substitute for critical inputs. An input is critical if access to it is crucial to the viability of the farm (e.g. pastures are a critical input for a livestock operation).

To test this four-way schema to measure on-farm change, our researchers surveyed a sample of New Zealand dairy and drystock (sheep/beef cattle) farms on the type of change entailed in adopting four practices commonly recommended to reduce the damaging effects of livestock agriculture on water quality and biodiversity. The four practices were: fencing of streams to exclude livestock, fencing of wet areas (wetlands) to exclude livestock, the use of cover crops to reduce nutrient losses following winter grazing, and the creation of ungrazed laneway buffers to prevent nutrient emissions.



On-farm change can be expressed via game-playing and scenario testing.

As might be expected, the researchers found that more farmers adopted simpler practices than more complex ones. Adopting a practice that entails strategic or tactical change was far less common than adopting a practice that does not.

It's been common in research, and when designing policy extension programmes, to resort to "personality type" arguments about the likelihood of farmers adopting change on farm. Some farmers are inherently innovative, and others are not, it's said. But this framework suggests that "early adopters" are able to adopt a practice quicker than others because they only have to make a simple change to their farm system, whereas for those who lag behind, adopting the same practice may entail a complex, or even a tactical or strategic change. These kinds of changes are more costly, more difficult and take much more time to consider and implement. The early adopters are not necessarily so-called "leading" practitioners or "innovative" farmers.

The researchers conclude that if the likely magnitude of the impacts of change is not adequately understood, the role of other determinants, such as personality, is likely to be overstated. They also conclude that those that adopt a practice later because it is a complex change are unlikely to be able to learn much from the early adopters for whom the change is simple.

HTTPS *doi.org/10.1002/sres.3164*

Tell us what you want, what you really, really want

Surveys that include measures of people's well-being are widely used at the national scale to measure social progress and to inform environmental, social and economic decision-making. Well-being frameworks generally encompass aspects of housing, income, personal health, access to green space and recreational opportunities, social links to community and family, and people's own opinion of their well-being. Aspects of well-being are important to include in studies of, for example, the impacts of conservation projects on communities, because healthy levels of well-being tend to correspond with political support for and participation in those projects.

But national-scale, aggregate data are not so helpful when trying to apply them at a smaller scale, to local projects or community programmes. Also, there is a wide array of survey and data collection techniques, and it may be unclear which is best to use.

The underlying problem is that people's individual well-being is multidimensional, contingent, hard to pin down. This raises an important question: can measures of well-being really help policy-makers to make better, more equitable and sustainable policy decisions that more closely match what people want to happen, at the local level?

In response to this question, social researchers Dr Geoff Kaine and Dr Dean Stronge have tested a different approach to measuring people's varying preferences and motivations, known as judgement analysis.

An online panel of New Zealanders was asked to identify the three cues they considered most important in judging five aspects of well-being: green space, water quality, social connectedness, cultural identity and governance. These cues were then used in a second online questionnaire asking about people's preferences and judgements in various scenarios relating to those five well-being measures. Just over 1,000 people completed the tasks. Results were mapped as lens diagrams, in which the relative importance of factors such as closeness to family and friends and membership of clubs were shown as a function of social connection, which were then combined to give an overall well-being score.

As an example, judgement analysis was able to differentiate between people depending on how their well-being was influenced by the characteristics of green spaces (parks and reserves). For some people their well-being depended on the degree of biodiversity in those spaces. So, these people would be happier with fewer, larger more biodiverse parks even if the parks are relatively distant. For others, their well-being depended on how easily they could access green spaces and how well maintained they were as well as the degree of biodiversity in those spaces. These people, then, would be happier with closer, smaller and less biodiverse parks.

The researchers conclude that the judgment analysis method has good potential at the local scale to quantify differences in how people think about their well-being. The lens diagrams, in particular, were good at making this diversity of perspectives explicit.

Contact: Geoff Kaine
kaineg@landcareresearch.co.nz

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Survey of Rural Decision Makers 2025: a vital tool in the ag-sector toolbox

The Survey of Rural Decision Makers (SRDM) is the leading source of information about New Zealand's primary sector. Conducted every 2 years, thousands of farmers, foresters, growers, and lifestyle block owners from Cape Reinga / Te Rereanga Wairua to Halfmoon Bay complete the survey. The SRDM is one of the largest and longest-running rural surveys in the world.

This year sees the seventh SRDM survey, beginning in early June and running until mid-August. It's designed to build a better picture of decision-making at the farm level. Economic, social, and environmental data are integrated to provide research and advice to benefit policy makers, industry, and the rural sector alike.

Results from the survey are distilled into information sheets (see link at the end of the story).

The survey also informs research into New Zealand's agricultural sector, including a recent paper by Dr Tsegaye Gatiso of Manaaki Whenua and Dr Jorie Knook from Lincoln University on how the public perceive farmers' environmental performance.

The study investigated whether farmers over-rate their own environmental performance, their expectations of public perception, and actual public perception of farmers' environmental performance across the country. Results showed that while 87% of farmers rate their own environmental performance highly, only 43% expect the public to rate their environmental performance positively.

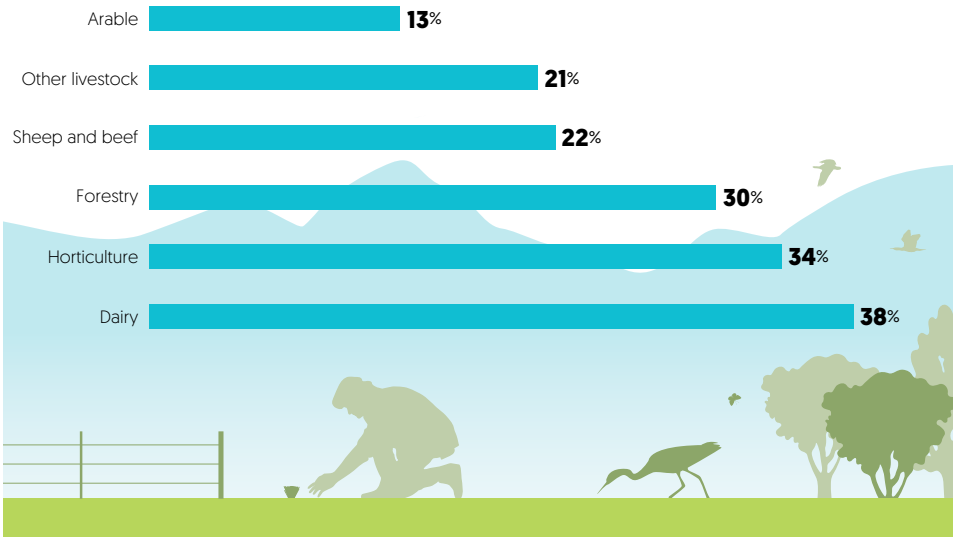
But in fact, it turns out that farmers should give themselves more of a break. The survey also shows that nearly half of the public actually holds favourable views on farmers' environmental practices. Moreover, farmers perceive their peers' environmental performance more critically than their own.

This perception gap may contribute to the urban-rural divide, making environmental policy dialogues challenging. Gender also plays a role, with women generally viewing farmers' environmental performance more critically. There is a need to understand perception differences and their drivers more deeply, to foster meaningful discussions and more effective policy development, and to ensure a more sustainable future for farming in New Zealand. And that, in a nutshell, is why the SRDM is so important!

Contact: Tsegaye Gatiso
gatisot@landcareresearch.co.nz

Rural Decision Makers SURVEY2025

landcareresearch.co.nz/srdm-key-results-sheet-4



Percentage of respondents to the Survey of Rural Decision-Makers 2023 who rated their focus on greenhouse gases over the next 2 years as 4 or 5 (out of 5)

Turn and face the change: what drives primary sector risk-taking?

The future importance of transformative adaptations in the face of climate, technological, economic and other future changes is familiar rhetoric – including in the primary sector.

Transformative change involves wholly new systems, processes or locations for activities, for instance when a farmer converts from one land use to another, e.g. from sheep and beef to forestry or from growing fruit to growing wine grapes. Transformative change differs from incremental change in which livestock farmers change grazing practices and horticulturalists shift from one apple variety to another.

The Survey of Rural Decision Makers (SRDM) is the leading source of information about New Zealand's primary sector. Conducted every 2 years since 2013, thousands of farmers, foresters, growers, and lifestyle block owners complete the survey online and the results are widely disseminated among industry and government bodies to help inform future policy and decision-making.

In 2017, the survey included specific questions about farmers' preferences for risk, their patience, their indebtedness and their beliefs about changing climate. The responses from 4,458 participants enabled researchers from Manaaki Whenua, the University of Vermont and the University of Otago to robustly identify factors that explain farmers' willingness to undertake transformative changes vis-à-vis incremental change.

The analysis showed that transformative land-use changes are rare in New Zealand – only around 15% of farmers had implemented any transformative changes in the past 10 years, and only 11% intended to make any such changes in the next 10 years. Incremental changes were much more common. Risk-takers were, not unexpectedly, more likely to undertake transformational change – and disproportionately so if they also believe in changing climate.

However, patience – i.e. being willing to wait longer for an investment to pay off – was not associated with willingness to undertake transformative change. High indebtedness was often correlated with having invested in on-farm changes but also signalled a potential limited capacity to actually implement changes.

The socioeconomic challenges of making transformative changes on-farm may be exacerbated in New Zealand, which has the lowest level of agricultural subsidies in the OECD, where subsidies and incentive programmes in agriculture were abolished in 1984 and where economic assistance for transformation is largely unavailable. The researchers suggest that additional forms of financial and technical assistance may need to be considered to enable the sector – especially older, more risk-averse farmers and growers – to navigate the upcoming challenges of climate change, and technological and economic changes in the years ahead.

Contact: Pike Stahlmann-Brown
brownp@landcareresearch.co.nz

www *landcareresearch.co.nz/srdm*

Transforming Pacific agriculture for a resilient future

Hon Dr Shane Reti and soil scientist Dr Sam Carrick during CALM.

In April 2025 the cross-party New Zealand Government 2025 Pacific Mission visited Tonga, announcing the MFAT-funded CALM programme (*Climate Smart Agriculture and Sustainable Land Management*). Tonga, alongside Fiji, Vanuatu, Samoa, Niue, and the Cook Islands, is partnering with Manaaki Whenua on the CALM programme. Each partner country has set their own country-specific priorities to build climate-resilient agriculture and sustainable land-use capacity.

A first initiative under the CALM programme followed in May 2025, with soil and plant scientists from Manaaki Whenua travelling to Tonga to take part in the 4th Pacific Week of Agriculture and Forestry (PWAF), supporting a vital regional collaborative push toward more resilient, inclusive, and climate smart agriculture across the Pacific.

The week included a Regional Research Symposium, hosted by the Pacific Community (SPC), which drew researchers from across the Pacific to share their work on themes such as soil degradation, crop protection, and the intersection of indigenous knowledge and innovation. Whether the focus was on cacao, kava, or climate-ready crops, the message was clear: localised science must underpin regional transformation. Our team contributed two key presentations. Caroline Mitchell presented on taro genetic characterisation – part of an effort to improve germplasm management at the Centre for Pacific Crops and Trees (CePaCT) – and Dr Ana Podolyan shared our work on taro virus indexing, a crucial step toward securing healthy CePaCT planting material for the region.

Our team also participated in the Mainstreaming of Rural Development Innovation (MORDI) Tonga Trust event – an example of community-led innovation. MORDI distributes hundreds of plants, free of charge, to rural women across Tonga, creating both food security and financial opportunity. Women in Tonga, and across the Pacific, face systemic barriers in land ownership, market access, and technical training. Yet, they are also the heartbeat of agricultural resilience.

The event enabled open dialogue between researchers and community developers, bridging the gap between science and on-the-ground action. Manaaki Whenua's Jane Lattimore assisted in facilitating this process, helping co-design a framework to ensure research doesn't just end in reports but grows into tangible, equitable change. MORDI shows what's possible when those most often excluded are instead empowered.

Hosted by the Government of Tonga, the SPC and the FAO, PWAF aimed to address key challenges and innovations in Pacific food and forestry systems. Dr Sam Carrick co-hosted a Pacific Soils Partnership session, working on a Pacific work plan for soil analysis and sustainable soil management. The workplan aims to coordinate resources and projects, strengthening regional collaboration and knowledge sharing to address persistent gaps and barriers for soil health management across the Pacific. Dr Thomas Caspari showcased the Pacific Soil Portal website, which has made soil and crop suitability information readily available for six Pacific countries. PWAF also included the 10th regional meeting of Pacific Heads of Agriculture and Forestry Services, at which New Zealand is officially represented by MPI and by donor representation from MFAT.

There was also time for a visit to the Vaini Research Station, operated by Tonga's Ministry of Agriculture, Food, and Forestry (MAFF), which highlighted the station's efforts to build capacity in soil testing, plant health diagnostics, and the establishment of a tissue culture collection for key crops. Manaaki Whenua can offer future targeted support in these areas, particularly to strengthen diagnostic services and laboratory infrastructure, and improve record-keeping for the station's herbarium and insect collections.

Contact: Jane Lattimore
lattimorej@landcareresearch.co.nz

Separating truth from fiction in AI

Environmental messages can be embedded in AI-generated pictures.

Did you see the US election images of Swifties for Trump? Hear Sir David Attenborough narrating the moment an ant falls into someone's fish tank? Or the talkshow clip of Greta Thunberg – yes, her! – talking about vegan grenades? Unbelievable!

Well, absolutely. All the above were generated by AI. Just a bit of harmless fun, right?

Or not. A moment's reflection will show that there are serious problems with these new, powerful online content-creation tools. Legal questions of identity theft, copyright and deception aside, it is becoming more and more difficult for people to discern what is real, trustworthy, dependable environmental information and what is not. In the upside-down world of improbable political alignments, media personalities sounding not-quite-themselves, and climate-change activists apparently spouting bizarre nonsense, what counts is engagement, not accuracy. The more outlandish, the more successfully it is spread through social media. As a result, research is urgently needed to understand the influence of such generative AI (GenAI) content on how people, particularly environmental decision-makers, think and act in the real world.

Writing in the Nature journal *npj Climate Action*, landscape ecologist Dr Dan Richards and economist David Worden outline a typology of the ways in which GenAI is currently being used to create and spread climate misinformation.

Three main ways to create misinformation stand out – impersonation of a real, often trusted, individual using text or voice-cloning; creation of complete synthetic identities of people who do not exist but are realistic enough to convince human decision-makers; and the rapid creation of vast volumes of content such as images and videos.

Amplification of this misinformation online occurs at all scales, from the individual to the society to the global, and is used to promote diverse perspectives including pro-environmental ones. Not all amplification has malicious intent, but it has the power and the potential to persuade (e.g. that climate change is a hoax), to coerce (e.g. to force votes for candidates with particular environmental views), to cause non-physical or even physical assault (e.g. by targeted harassment or incitement to violence), and to deceive (including to obtain information).

In the technical arms-race against unsanctioned AI use of material, initiatives are well underway to improve image watermarking and to develop methods to post "poisoned" (deliberately falsified) material that then appears in data scraped by AI. The content-related research gaps that need to be filled most urgently, say the researchers, are twofold: a systematic analysis is needed of the key actors who are using GenAI to influence real-world climate decision-making, and secondly it is important to understand how GenAI is contributing to the polarisation and radicalisation of opinions about climate change on both sides. Without such work, it will be increasingly difficult to separate environmental truth from fiction and make sound management decisions.

In the meantime, if you hear Sir David talking about your neighbour's fish tank online, you can be fairly sure that it is a deepfake stolen voice clone: please do him a favour and don't pass it on.

Contact: Dan Richards
richardsd@landcareresearch.co.nz

HTTPS *https://doi.org/10.1038/s44168-024-00202-5*

Green streets: measuring the many benefits of urban trees

The health, social, amenity, climate and ecosystem benefits of urban trees are well-known – from flood mitigation to carbon sequestration to air quality improvement. A view of trees from the workplace even contributes to reducing the average number of days of sick leave that people take.

But many studies of the benefits of trees generally consider just one dimension of well-being, such as urban cooling, shade amenity, or access to green spaces.

In new research using Singapore as a model, environmental social scientist Dr Peter Edwards and colleagues have brought together a large and varied dataset to better understand the benefits and impacts of trees in urban areas. The work proposes an alternative "environment-well-being analysis framework" for urban green spaces, integrating remote sensing, ecology, and social science measures at a range of scales, from the entire urban area to a zoomed-in residential block. It combines several well-being measures including proximity to green spaces, experience of green spaces, visual exposure, and noise exposure.

To create the framework, land-use and tree cover data for Singapore were sourced from Sentinel satellite imagery and from street and planning maps, including networks of trees maintained by Singapore's National Parks Board. Cellphone data were used to track visits to green spaces, Singaporean census data provided socioeconomic statistics, and an acoustic modelling program was used to map likely patterns of traffic and ambient noise. This program could outline the effects on noise levels of layering tree species of different sizes, canopy heights and shapes, and distance from roads or housing blocks.

"This compendium of seemingly unrelated work highlights the critical role that urban trees and green spaces play in enhancing human well-being," says Peter.

At the city scale, Singaporeans are highly mobile thanks to a great public transport system, and are frequent visitors to green spaces and parks no matter how close they live to them, underscoring the importance of green spaces to well-being.

"Our modelling at the very local scale showed that strategically placed trees can significantly reduce environmental noise levels, with layered greenery providing the best results."

The work has implications for urban planning, especially in densely populated areas where noise pollution may pose a significant threat to public health. It also highlights the importance of adopting a holistic approach to urban development, where all the potential benefits of layered, carefully located tree plantings are recognised and integrated into city planning.

Contact: Peter Edwards
edwardsp@landcareresearch.co.nz

Hive talking: fewer winter losses in 2024 for the nation's beekeepers

Conducted annually since 2015, the New Zealand Colony Loss Survey is based on the survey of beekeepers developed by the international COLOSS honey bee research association.

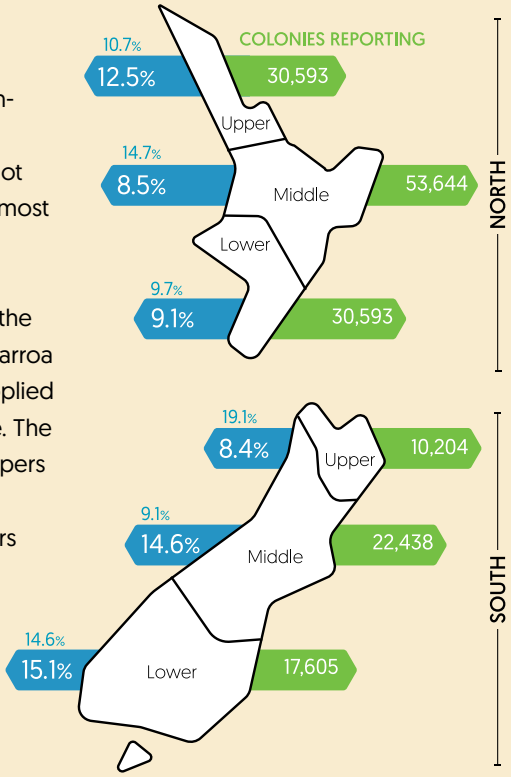
Survey topics include the number and nature of over-winter colony losses, queen health and performance, indicators of diseases and parasites, treatment of varroa, supplemental feeding, and colony management. Because the challenges facing New Zealand beekeepers differ from those facing beekeepers in the northern hemisphere, the survey also includes questions that are specific to the New Zealand context, e.g. apiary crowding, predation by wasps, and nectar flow from native trees.

In 2024, we surveyed 2,828 beekeepers, who collectively managed 153,856 colonies. We estimate that 10.8% of New Zealand's colonies were lost in New Zealand during winter 2024. This means 57,800 colonies died over winter, from a total of 535,185. It is the second year in a row where winter loss rates have fallen, and reverses a long trend of increases. Loss rates were lower this year because varroa did not kill as many hives. Only 4.6% of all colonies died from varroa during winter 2024 compared to 6.4% during the previous winter.

Commercial beekeepers (those with more than 50 colonies) represent approximately 10% of all registered beekeepers and manage approximately 94% of all registered colonies. However, the majority of beekeepers are non-commercial (1–49 colonies). About 10% of registered beekeepers do not currently keep any bees, although most plan to return to beekeeping.

Non-commercial beekeepers said the main reason they lost colonies to varroa during winter was that they had applied varroa treatment at the wrong time. The main problem commercial beekeepers had with varroa was reinvasion of their hives. Even though beekeepers generally considered their varroa treatments were effective, 19% of non-commercial and 16% of commercial beekeepers said they lost colonies over winter because the products they used were ineffective. If a product had failed, most beekeepers said they did not report it to anyone (e.g. authorities or manufacturers).

Questions about beekeeper perceptions of biosecurity were new in the 2024 survey. Most beekeepers were at least somewhat confident that they could identify the signs of European foulbrood or small hive beetle. However, beekeepers were less certain that they could identify the signs of tracheal mites or tropilaelaps mites. Overall, beekeepers had some confidence that the biosecurity system (described as a collaborative effort in which every New Zealander has a role to play) could detect exotic pests and diseases, but beekeepers were much less confident that these exotic pests and diseases could be eradicated.



Estimated regional colony loss rates in 2024 (2023 figures also shown above for comparison).

Pollination was an important activity for commercial beekeepers. More than 102,000 colonies were used for commercial pollination during the 2023/24 season, with each colony pollinating an average of 1.5 commercial crops.

Contact: Pike Stahlmann-Brown, brownp@landcareresearch.co.nz

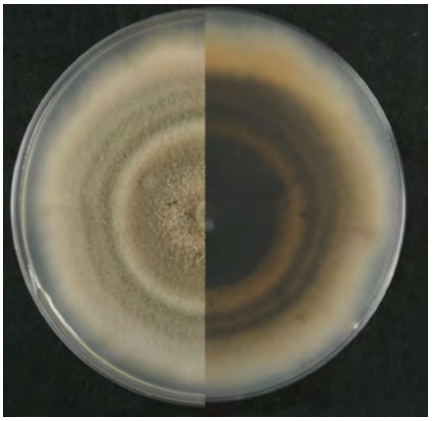
NZ COLONY LOSS SURVEY

landcareresearch.co.nz/colony-loss-2024

Major step forward in understanding facial eczema in livestock

Facial eczema (FE) is a disease of livestock that causes liver damage, lowered production, skin irritation and peeling, and sometimes death. It is caused by a toxin (sporidesmin) produced primarily by the spores of a fungus growing in the dead litter at the base of pasture in warm moist conditions.

Sporidesmin, when ingested by cattle, damages the liver and bile ducts. The damaged liver cannot get rid of phylloerythrin, a breakdown product of chlorophyll, which builds up in the blood causing sensitivity to sunlight, which in turn causes inflammation of the skin. FE has cost New Zealand's economy an estimated $332 million annually.



Pseudopithomyces toxicarius – *the causal agent in facial eczema in livestock.*

Now, a significant breakthrough in understanding FE in livestock has brought New Zealand closer to reducing the disease's devastating impacts. Until recently, sporidesmin, the toxin responsible for FE, was thought to be made by the fungus *Pseudopithomyces chartarum* (formerly *Pithomyces chartarum*).

Earlier this year, a consortium of researchers from AgResearch, Manaaki Whenua, Beef + Lamb New Zealand (B+LNZ) and the Livestock Improvement Corporation were able to show that in fact few *Pse. chartarum* strains appear capable of making sporidesmin, and a new species, *Pseudopithomyces toxicarius*, is the primary sporidesmin producer. *Pse. toxicarius* resembles *Pse. chartarum* closely and is easily misidentified.

The research reclassified the fungus using global data, which was made possible through the International Collection of Micro-organisms from Plants (ICMP) fungal collection, including a critical 1958 specimen. Providing a clearer understanding of the disease's causes will also enable better tracing of where it has spread, as well as paving the way for more effective control strategies.

Senior scientist Dr Bevan Weir, an expert on fungi, was a lead researcher in the identification process. "This breakthrough is the result of years of hard work and dedication from our research teams and the farming community," says Bevan. "Identifying *Pseudopithomyces toxicarius* as the primary cause of facial eczema is a critical step forward and a testament to the commitment of everyone involved."

FE risk is currently assessed on-farm using spore counting methods, but because of the above problems of misidentification, the counts may have included non-toxic spores, leading to inaccurate risk assessments. However, the researchers urge farmers to still keep monitoring and participating in studies like the B+LNZ Sheep Poo study, because spore counting remains an important tool for farmers to understand and manage FE risk in their regions.

With a clearer understanding of the fungus that produces sporidesmin, researchers are now better equipped to develop tools and diagnostics that will help eliminate the effects of FE on New Zealand's farming industry. The work also showcases the long-term value of New Zealand's scientific collections in guiding future management and control.

Contact: Bevan Weir
weirb@landcareresearch.co.nz

HTTPS *doi.org/10.3114/sim.2025.112.02*

News in brief

Cats among the pigeons

We are continuing to investigate the potential for cat owners to adopt control measures for their cats, to help reduce predator pressure on native birds (see *Pūtaiao* issue 22). Our researchers have recently provided evidence-based advice to the Zealandia ecosanctuary in Wellington to help them develop a communications strategy to engage effectively with cat owners living close by. The strategy aims to minimise owned-cat impacts on spillover native birds that travel into and out of the sanctuary.

Advice on transition forest management for the PCE

Simon Upton, Parliamentary Commissioner for the Environment (PCE), has released a new report, *Alt-F Reset: Examining the drivers of forestry in New Zealand.* In the report, the PCE discusses how current policies are shaping our forest estate and looks at which alternative forestry systems could play a greater role in afforestation.

Drs Norm Mason, Insu Jo and Narkis Morales contributed expertise on the management of transition forests (transitioning from exotic to native over time), beginning with faster growing short-lived exotic species that can provide canopy closure to suppress weeds, including for short-term carbon income within the Emissions Trading Scheme. The transition from existing "derelict" forests (e.g. *Pinus radiata*) that are uneconomical or unsafe to harvest, to native forests was also considered. Several management scenarios were tested, covering combinations of exotic canopy disturbance interventions, with or without supplementary planting of native canopy-dominant species.

This enabled the researchers to assess which were most successful in restoring native dominance, and to estimate the potential carbon consequences of transitioning from exotic to native species. The work depended on models of native forest dynamics and exotic plantation growth, because there is almost no empirical data on carbon change in transition forests.

"Given the large area of existing forests unsuitable to harvest, as well as widespread landowner interest in using exotic species to initiate native reforestation, this is an area that could be prioritisedfor future data collection," says Norm.

New Zealand Plant Checklists published

In May 2025 the latest editions of the New Zealand Plant Checklists were made available for download from the Manaaki Whenua DataStore – Checklists. Extracted from the New Zealand Plant Names Database and maintained by the team at the Allan Herbarium in Lincoln, these nationally and internationally cited checklists are indispensable resources for anyone working with New Zealand's flora.

The updated checklists cover the following groups: Seed Plants; Ferns and Lycophytes; Hornworts, Liverworts and Mosses; and the Annual Checklist of Vascular Plant Names with NVS Codes (for the Department of Conservation).

Each checklist includes a hierarchical taxonomic list, biostatus information (e.g. indigenous, endemic, naturalised), an alphabetical listing of genera and species, and statistical summaries for each group.

The checklists serve as critical reference tools for biodiversity research, policy development, conservation planning, and biosecurity efforts. They're actively used by agencies such as DOC, MPI, EPA, and regional councils, and are among the most frequently cited New Zealand botanical resources worldwide.

The New Zealand Plant Names Database now contains over 50,000 scientific names, and is continuously updated by a team of expert taxonomists, with data refreshed hourly to the Biota of New Zealand platform.

HTTPS *datastore.landcareresearch.co.nz*
biotanz.landcareresearch.co.nz

Contributing our science to the Treasury's Living Standard Framework

Environmental Perceptions Survey

Our biennial Environmental Perceptions Survey (EPS) monitors changes in New Zealanders' environmental attitudes, perceptions, and preferences over time through repeated measurement. The survey also provides independent commentary on environmental issues of public concern, both as a contribution to public debate and as a way to alert government and other interested parties to these issues. We have led this project since 2022.

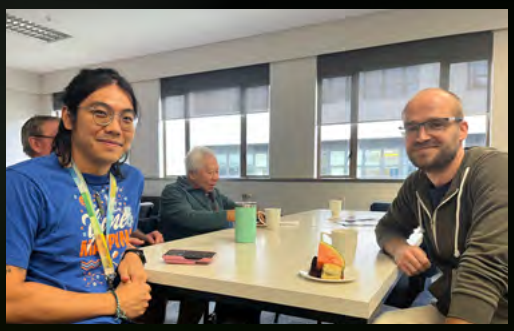
The EPS has now been chosen and used by the Treasury as their long-term indicator for "perceived environmental quality" within their Living Standard Framework.
The Framework is a national and well-referenced tool that tracks changes in key metrics about New Zealand's environment and the well-being of New Zealanders.

www *landcareresearch.co.nz/eps*

A selection of liverworts, ferns and seed plants.

Celebrating our achievements

Geospatial analyst **Richard Law** and GIS analyst **James Ardo** won one of only three Best Paper Awards from the UK-based *Big Earth Data* journal for their 2024 paper on using discrete global grid systems (DGGS) for land use mapping. The Journal Award Committee selects papers on the basis of scientific merit and broad impact, originality of the research objectives, novelty in the opinions or in the research approaches, quality and accessibility of the data set and software tools, significance to the research filed and interest to readers, clarity of presentation, and citations and downloads. The paper is at https://doi.org/10.1080/20964471.2024.2429847



James Ardo and Richard Law.

Ecologist **Marion Donald** was recently shortlisted for the L'Oréal UNESCO for Women in Science Australian & New Zealand Young Talents Fellowhips. These are very prestigious fellowships intended to provide practical financial help for the Young Talents to undertake research in their chosen fields, for example buying scientific equipment, paying for childcare costs, conference and travel costs – and to be shortlisted is a notable accolade.

Marion Donald.

The Fungal Foray is an annual event at which fungi specialists from around the country meet to discover the fungi in our native forests and other environments, documenting new records of fungi, new host relationships, and possibly species new to science. As part of the 36th Foray, held this year in the forests near Ureni, Taranaki, a Fungus of the Year promotion was developed by **Peter Buchanan** and **Karen Scott**. Over 4,000 members of the public voted for their favourite fungus – with Te Matakupenga/the basket fungus announced as the clear winner, live on Radio New Zealand.

Te Matakupenga/the basket fungus.

Our soil scientists assisted NZ Post with a new set of four soil-themed stamps issued nationwide in June 2025. Thanks to **Thomas Caspari**, **Kirstin Deuss** and **Ursula Jewell** for their technical input on the stamp designs and on the accompanying materials for collectors.

Endings and new beginnings: a story of Manaaki Whenua

On 1 July 2025, Manaaki Whenua - Landcare Research became part of the new Bioeconomy Science Institute alongside AgResearch, Plant & Food Research, and Scion. This ended a chapter in the remarkable story of science in New Zealand, which began in 1992 with the formation of the Crown Research Institutes (CRIs).

What was to have been called the National Institute of Land Environments Research was renamed Manaaki Whenua following a discussion between the establishment team and a kuia in Northland, who said this Māori name fitted the purpose as described to her. The ethos of manaaki whenua, manaaki tangata became embedded, meaning the reciprocal care between people and the environment.

In time, the link between Manaaki Whenua's kaupapa and te ao Māori worldview became the backbone of many partnerships. More recently, we formally acknowledged the principles of te Tiriti o Waitangi and built them into our ways of working, focused on Māori partnership, participation and active protection of taonga, including the nationally significant collections and databases that we curate.

Manaaki Whenua achieved an exceptional reputation for excellence in land-based science. Our credibility with our clients comes from applied work based on a foundation of highly cited research in the international literature.

The importance of our social science is also well-recognised. Understanding people, their attitudes, motivations and actions, is critical if pathways are to be found to better environmental management.

As New Zealand's lead agency for ecosystems research, we provide benchmarks against which change can be understood and therefore managed. We also use evidence from the past to inform land management in the future, increasing resilience to change. Protecting New Zealand's natural environment and restoring its biodiversity may seem like an extravagance in a cost-of-living crisis. But it matters critically. New Zealand's natural ecosystems underpin our bioeconomy – which is of course New Zealand's economy.

Our scientists' skills are deep and broad, working across sectors and making connections across many disciplines at landscape scales. We bring all of this expertise, backed by our valued and knowledgeable support staff and the trust of our many partners and collaborators. into the new Bioeconomy Science Institute.

We look forward to working with you there.

Manaaki whenua, manaaki tangata, haere whakamaua.

landcareresearch.co.nz/putaiao

BIOECONOMY SCIENCE INSTITUTE

Manaaki Whenua Landcare Research