Pūtaiao

MANAAKI WHENUA SCIENCE SUMMARY / ISSUE 13 / FEBRUARY 2023

Loess is more

Science for our land, water & soils

Pūtaiao

Science for our land and our future

Tēnā koe and welcome to Issue 13 of *Pūtaiao* ('science' in te reo Māori), our quarterly publication showcasing the work of our scientists at Manaaki Whenua.

We are the Crown Research Institute for our land environment, biosecurity and biodiversity, action on climate change, and people's relationship with the environment. We have a clear responsibility to Aotearoa New Zealand: this land, and everything that shares it with us, is our future.

Each issue of *Pūtaiao* shares the benefits and outcomes of our science in helping to ensure a sustainable, productive future for Aotearoa. This issue shows the progress we are making in science for our land and soils. We begin with a new Endeavour research programme, which aims to discover ideal configurations of trees in pastoral agriculture. We also outline new and exciting work in modelling urban tree species using remote sensing. We describe several different aspects of progress in online soil mapping tools, including to help Māori landowners to achieve their aspirations for their land. We also report on the nation's environmental perceptions, and on cultural environmental reporting.

Cover image: Scott Fraser (left, Manaaki Whenua), Victor Mazutti Said (centre, JS Ewers Ltd), and Matt Oliver (right, Marlborough District Council) take part in the National Soil Judging Competition held as part of the biennial New Zealand Soil Science Society conference in Blenheim in November 2022. Soil Judging Competitions provide an opportunity to learn more about soils in the landscape, their characteristics, and their capacity to perform under different land use and management practices.

ISSN 2703-3864 (Print)   ISSN 2703-3872 (Online)

Can mosaics of trees help to reach Aotearoa's carbon targets?

Increasing carbon stocks in woody vegetation will be a major contribution to Aotearoa New Zealand reaching its zero-carbon emissions target by 2050. Plantation forestry has previously been promoted as the best way to achieve large-scale carbon sequestration, but a new MBIE Endeavour research programme now underway and led by Manaaki Whenua will investigate an ingenious alternative with additional co-benefits.

The research programme, *Integrating trees to target zero carbon and add value to rural landscapes*, led by principal researcher Dr David Whitehead and researcher Dr Sam McNally, aims to quantify the enhanced biomass and soil carbon stocks associated with edge effects from small clusters of trees, and additional co-benefits, compared with continuous plantation forestry.

Field measurements at sites across the country will be combined with innovative metagenomic approaches, isolating and analysing DNA from environmental samples, to provide new insights into the role of specific microbial processes that regulate ecosystem carbon cycling at the edges of tree clusters. The research will seek to prove the benefits to biomass and soil carbon stocks from planting low-density mosaics of trees within grasslands.

Combining the field measurements with modelling will show how the optimal spatial arrangement of trees in grasslands matched with soil and climatic conditions can increase carbon stocks and lead to additional co-benefits including increasing diversity of products (e.g. nuts, honey), provision of alternative animal fodder, providing shelter for animals, improving water quality and enabling of kaitiakitanga in rural landscapes. Our researchers will be working with national partners from AgResearch, Scion, NIWA, Lincoln University, University of Canterbury, Māori organisations including an ahuwhenua Māori Trust at Te Whaiti, existing Māori special interest groups (e.g. the Kānuka Entity, Ngā Pou a Tāne / National Māori Forestry Association) and Māori agents of change in the agribusiness sector, plus international collaborators from France, the Netherlands, the USA and Australia.

First steps for the research are to co-develop the research plan with end users and identify the criteria that will be used for selection of 32 sites for field measurements across the country.

Implementation of the programme's recommendations will be wide-ranging and inclusive, to ensure relevance for landowners and policy makers. The work will assess the economic and cultural values of improved carbon stocks, and will identify constraints on landowner decision-making. Research results will be co-developed and shared with landowners, Māori organisations, regional councils and relevant government departments.

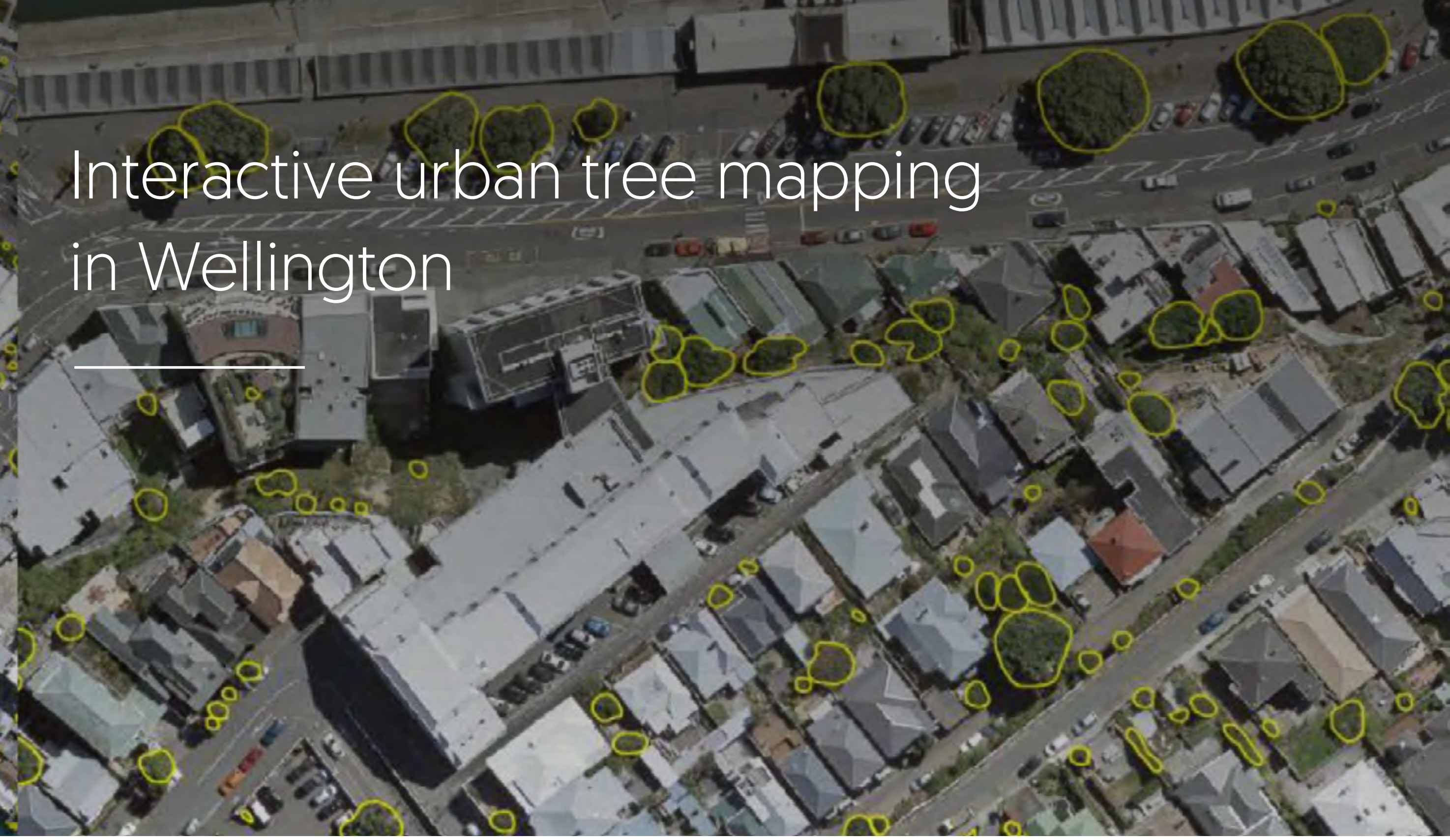
Compared with plantation forestry, over 30 years, the researchers initially estimate that establishing mosaics of tree clusters on low-productivity grasslands on 25% of the land area currently recommended for forestry could result in additional biomass and soil carbon stocks equivalent to offsetting 1.5 years of Aotearoa New Zealand's current gross greenhouse gas emissions, or 3 years of the country's agricultural emissions – a very significant contribution to emissions reduction.

"This is an exciting opportunity for research to recommend new approaches to landscape design for Aotearoa New Zealand to reduce net greenhouse gas emissions, while enabling kaitiakitanga and enhancing well-being for rural communities", says David.

Contact: David Whitehead
whiteheadd@landcareresearch.co.nz

Katie O'Hagan, an honours student at the University of Canterbury, taking a soil core at the Manaaki Whenua site in Lincoln.

Interactive urban tree mapping in Wellington



"Bridging the gap between remote sensing and tree modelling with data science" – an exciting collaboration between New Zealand and Singapore – has achieved an important milestone with the launch of an interactive urban tree map of New Zealand's capital city.

The Wellington Urban Tree Explorer, available at https://wtree.landcareresearch.co.nz, contains a map layer of individual tree crowns across Wellington. The data were produced by a deep learning model called Mask R-CNN (Region-based Convolutional Neural Network), which identifies individual tree objects from top-view aerial imagery.

Dr Jan Schindler leads a joint New Zealand-Singapore Data Science research programme that uses data science, remote sensing and 3D modelling for extracting tree species information from multi-resolution, remotely sensed data.

The aims of the programme are to advance our current methods for measuring individual trees by developing and applying novel deep-learning algorithms and to model their interactions with the human and physical environment. "As the world becomes increasingly urbanised, urban trees and forests become increasingly important for overall human well-being," says Jan. "There are plenty of studies showing the benefits of urban trees and forests from a number of perspectives – health, climate and ecology."

However, sustaining and enhancing biodiversity and healthy living environments requires careful management of trees in urban areas and forests. But these decisions are currently limited by the quality of available data, tools, and techniques.

"With the information we gather using these new deep-learning techniques, we can detect trees and identify species in greater detail than ever before, moving towards analysing the socio-economic impacts of trees in cities," says Jan. "The methods are transferable to non-urban areas and are already being successfully applied to a number of tree mapping projects in pastoral hill country and native forests."

Features of the website include sliders for layer transparency, coloured maps showing tree heights and diameters, selecting data based on attribute ranges, and being able to zoom in to get information on individual trees, such as their crown dimensions and height.

The project team consists of researchers from Manaaki Whenua, Scion, the University of Canterbury, Victoria University of Wellington, the Institute of High Performance Computing Singapore and Nanyang Technological University.

Contact: Jan Schindler
schindlerj@landcareresearch.co.nz

New soil research priorities for Antarctica

Most of Antarctica is covered in a thick layer of ice, but its ice-free regions, representing less than 0.5% of the continent, are scientifically very significant and have surprisingly diverse soils.

These ice-free areas host most of the biomass of all Antarctic terrestrial systems, and are also essential breeding grounds for macrofauna such as seals and seabirds. The relative simplicity of those ecosystems make Antarctic soils a great model for studying broader ecosystem functioning. Some of the highest elevation ice-free areas and their dry permafrost conditions represent the closest Mars analogue on Earth.

However, as a result of human activities and climate change, ice-free Antarctic soils are increasingly under complex pressures.

The Protocol on Environmental Protection to the Antarctic Treaty (1991) requires assessment of the impacts of ongoing human activities in Antarctica. Many non-binding guidelines and codes of conduct have been developed and adopted over time as practical management tools to further minimise environmental impacts. These are particularly important in the ice-free areas, where impactful human activities are undertaken.

Manaaki Whenua's current commitment to Antarctic soil research builds on many decades of work by the Soil Bureau, later part of the DSIR, which began soil research there in the late 1950s. To advance soil science research in Antarctica, we suggest four priorities:

1. **Soil information in Antarctica needs to be improved,** including soil chemistry and physical properties, scaled up from sparse field observations over many decades to a continental scale using modern remote sensing techniques.
2. **The impacts of climate change on Antarctic soils needs to be monitored.** Modelling based on IPCC climate forcing scenarios suggest that ice-free areas could expand by almost 25%. More precipitation as rain and more liquid water in soils will affect many aspects of Antarctic soils, including the release of salts previously locked in by the cold, arid conditions. Changes in Antarctic permafrost will need to be better monitored – it is much less well understood than Arctic permafrost. Radical changes in air temperature and water availability will also increase the risk of spread of invasive non-native species, but the exact impacts of habitat expansion on Antarctic soil biology are largely unknown. The risk of species spread is further increased by human activity and movement around the continent and between Antarctic and sub-Antarctic regions.
3. **Specific indicators of soil quality need to be defined and monitored.** Useful soil indicators for native polar ecosystems are lacking. Due to geographic remoteness and isolation, Antarctic soils are assumed pristine, but evidence is emerging of degradation by contaminants such as microplastics, persistent organic pollutants and heavy metals. If representative soil regions across the continent are delineated, a suite of soil health indicators and targets can then be proposed and trends monitored.
4. **Improved science-policy linkages are needed to better manage Antarctic soil ecosystems.** To make scientific observations impactful requires a powerful science-to-policy framework. In non-polar regions, holistic, transdisciplinary frameworks have been used with success to address issues such as climate change. Some authors have suggested using the ecosystem services framework, or an indigenous lens, to improve the environmental management of Antarctica. Policy-makers need a more complete picture of the different roles soils play, across scientific disciplines, to better manage and preserve Antarctic soils.

Contact: Pierre Roudier
roudierp@landcareresearch.co.nz

An integrative approach to silvopastoral system designs

Poplars and willows can provide a practical solution for slope stability, but is this the only benefit of low-density tree-pasture systems on farms?

That's the premise behind new research into silvopastoral system design – or what happens when you combine "space-planted" trees (trees planted at low density) with the production of livestock.

"At the moment there is a very one-dimensional approach to planting trees," says Dr Thomas Mackay-Smith, a Massey University researcher.

"Poplar and willow are easily planted, survive grazing livestock and perform well in terms of soil erosion, but there could be other tree species out there that provide additional value to farmers. The challenge is selecting the right tree species to provide a holistic suite of benefits.

"In New Zealand, there has been little formalised research comparing the impact of different tree characteristics – or 'functional traits' – on farm outcomes, or the processes that govern these interactions."

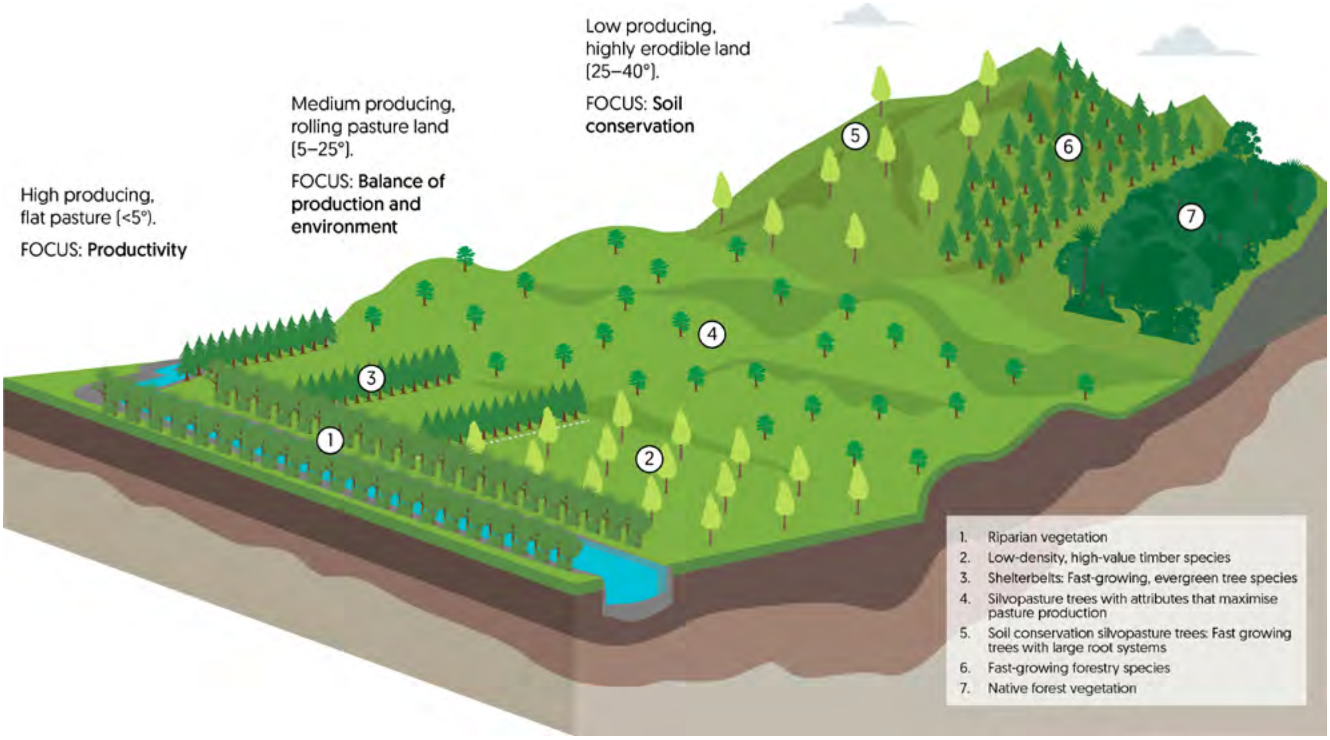
Manaaki Whenua's Raphael Spiekermann agrees. He says while traditionally trees have been removed from the landscape to allow farming to happen, and are now planted for soil conservation, it is challenging to predict the outcomes of planting new trees due to the complexity of the relationships within a silvopastoral system.

"We undertook a review of ecological research from around the world to find evidence for the influence of key tree attributes and processes on silvopastoral outcomes."

The evidence showed livestock can have overriding influences on the silvopastoral environment, and livestock activity needs to be an essential consideration when comparing outcomes between systems. "More work is required to measure livestock preferences for different tree species, in what situations livestock preferences exist, and how the impact of livestock activity as a process compares to direct tree processes like litter decomposition or competition for water," says Thomas.

"More research is also needed to explore the impact of a broader range of tree functional traits and silvopasture processes on farm outcomes, such as tree size, tree architecture, tree water use efficiency, livestock preferences for different tree species, leaf smother and inhibition of other plant species (allelopathy). This information will allow us to better design silvopastoral systems using an integrative and holistic

Participants at a workshop held as part of the silvopastoral system design research.



Silvopasture – a graphic representation of an ideal landscape.

approach to maximise their positive impacts for farms."

The researchers held a successful workshop with around 35 farmers as part of the study. Poplar (*Populus* spp.), followed by willow (*Salix* spp.) and eucalyptus (*Eucalyptus* spp.) trees, were the most common silvopastoral trees planted, but other species were also planted such as tagasaste (*Cytisus proliferus*), cork oak (*Quercus suber*), acacia (*Acacia* spp.), chestnut (*Castanea* spp.), Tasmanian blackwood (*Acacia melanoxylon*), maple (*Acer* spp.), radiata pine (*Pinus radiata*), ginkgo (*Ginkgo biloba*) and mānuka (*Leptospermum scoparium*).

"We found landowners already had considerable knowledge of the future potential of silvopastoral systems," says Raphael. "But there are barriers to the future adoption of these systems."

These barriers include the regulatory environment for New Zealand's Emissions Trading Scheme, timescale issues such as the time lag until the trees become effective, difficulties protecting seedlings, and the costs involved with planting and management.

"There is great promise for silvopastoral trees to provide a range of benefits to farms," says Thomas. "While many farmers are already planting trees in their paddocks, it is important future research covers a broader range of tree species to increase our knowledge as to which trees will be important for different functions on the farm."

Contact: Dan Richards
richardsd@landcareresearch.co.nz

S-map reaches 10 million hectares mapped

S-map has reached the halfway mark for mapping the farmable land area of Aotearoa New Zealand.

Over the past four years, and thanks to a partnership between the Ministry for Primary Industries, Manaaki Whenua, and 12 regional councils, 2 million hectares were added to the database. A further 1.5 million hectares are expected to be completed by 2025.

Manaaki Whenua science portfolio leader Dr Sam Carrick says that within the farmable land area, the land that has the potential for multiple types of use now has 68% of its soils mapped.

Sam acknowledges the many staff who have contributed to this latest update for S-map, released at the end of August. In this past year, staff from the Hamilton, Palmerston North, Wellington and Lincoln offices have had significant involvement.

S-map is more than a soil map, it's a soil information system, with a comprehensive database and modelling research platform (led by Dr Linda Lilburne), delivering data and information across a number of platforms and tools (led by Dr David Medyckyj-Scott).

Alongside the soil scientists and laboratory staff, who do the mapping and soil attribute characterisation, the modern soil information system includes staff across a range of disciplines, such as spatial and data science modellers, database informatics, software and website developers.

Linda says more than 5,500 different soil types have been mapped so far, with information on each soil type freely available on the popular S-map Online website.

S-map information is extensively used across a range of sectors to enable more informed decisions to manage our land within environmental limits. In the past year alone, users downloaded 54,000 soil information sheets.

In this latest update 680,000 hectares of new soil mapping was released. Newly mapped areas are located in Northland (near Moerewa), Manawatu (Horowhenua), Wellington (Wairarapa) and Canterbury (upper Rakaia) regions.

A new improved map was also published to replace five separate legacy maps, completed at different times by different people. The new map covers an area across the Hauraki Plains, Coromandel Peninsula, and the west side of the Kaimai ranges and Mamaku Plateau.

Other S-map Online updates include three new layers of soil attribute information. A new soil carbon concentration layer is available for all of New Zealand, replacing the existing soil carbon stocks layer. This layer is only suitable for viewing the spatial pattern at a regional scale; it is not accurate at the farm scale. Two layers of soil susceptibility or vulnerability are also available: nitrate leaching and by-pass flow susceptibility.

Contact: Sam Carrick
carricks@landcareresearch.co.nz

www *S-Map Online*
smap.landcareresearch.co.nz

Dr Balin Robertson surveying in Mokoreta during the October 2022 late spring snow, for the Southland S-map extension.

Refining ecological soil guideline values

Soil is home to zillions of terrestrial biota, including microbes, plants and invertebrates, all of which support the functioning of soil and land ecosystems. These ecological receptors play a critical role keeping our soils healthy, and with that, the ability to grow healthy food and protect the environment.

However, biota both need and are vulnerable to other elements that occur in soil, tiny concentrations of elements such as copper, zinc, cobalt, boron or lead. While some, such as copper and zinc, are essential for biological growth and function, others, such as lead, are not.

But if you work in land-use planning and management or for any regional council in a consenting role, how do you know if what's in the soil is safe or not? If soil concentrations of trace elements have been modified through deliberate or unintentional actions, how do you safeguard its life-supporting capacity?

Manaaki Whenua researcher Dr Jo Cavanagh is working on an Envirolink Tools-associated project that is evaluating the implementation of soil guideline values for a suite of commonly encountered soil trace elements. "There is an intimate link between protecting soil quality, and the management of contaminated land," she says.

While there are chemically mineralised areas with naturally elevated concentrations of trace elements, contamination follows inappropriate disposal of industrial waste as well as general human activity through industrial, agricultural and residential land use. Increasing regulatory changes and a focus on ecological integrity have raised awareness of the importance of looking after soils through understanding ecological receptors and protecting them.

Jo started developing soils guideline values to protect terrestrial biota for 11 priority contaminants as part of the Envirolink Tools project in 2014. These Soil Guideline Values (ECO-SGVs) have been refined and updated.

The focus of the work is on understanding how these numbers can be applied, particularly in changing regulatory environments, and with a greater drive to incorporate Māori perspectives.

Jo and Manaaki Whenua's toi rangahau Māori Garth Harmsworth have been leading workshops with end-users, and central and local government to get feedback into a guidance document they are developing.

"What we're looking to do within the project is have a tool that can inform land usage under current conditions, but with an eye on the future that will enable us to identify opportunities where we can connect with the future legislation, including the Natural Environment Act," says Jo. "The guideline values can be used to support contaminated land management, discharge to land activities, usage in agriculture and for state of the environment reporting."

Contact: Jo Cavanagh
cavanaghj@landcareresearch.co.nz

New evidence shows the effects of irrigation on soil

Once the butt of jokes because of its 70 million sheep, New Zealand now has less than half the number of sheep it had in the 1980s. That's because, echoing a global trend, agricultural land in New Zealand has undergone rapid changes in usage to keep pace with growing demands for food. Dry grassland areas once home to sheep are now modern sprinkler-irrigated pastures, often grazed by dairy cows.

But what this means for the soil is still unclear. "The effects of modern irrigated pastoral farming on soil physical properties are not well quantified internationally, particularly for temperate climates," says Manaaki Whenua senior researcher Dr John Drewry as part of a regional study led by Veronica Penny and Dr Sam Carrick to evaluate the effect of irrigation on soil physical properties across Canterbury.

"Stock and nutrient management practices change as irrigation is expanded to allow land to become more intensively farmed," says John. "With that comes changing soil physical properties, such as increased occurrence of compaction and its effects on water storage capacity."

For the study, 24 paired sites in Canterbury were sampled, consisting of a spray-irrigated paddock and an adjoining part of the same paddock that was dryland (unirrigated), with other management the same for each pair. Sites were sampled across the region from Tekapo to Waiau.

Thirteen of the sites were located on dairy farms, with the remainder on farms with sheep and beef, 'dairy support', and beef land uses. Sites were selected on deep soils (> 60 cm depth of stone-free soil) so that cores for soil physical measurements could be taken at six increments to 60 cm depth. The 60 cm depth was chosen as this is used for irrigation scheduling and is the depth modelled by the OVERSEER nutrient budget model.

John says the results from the study showed that under irrigation there was a shift towards smaller soil pores. "This was reflected in macroporosity and readily available water capacity being significantly lower under irrigation, while semi-available water capacity (water held between stress and wilting points), and unavailable water (held below permanent wilting point) both increased."

The study concluded these differences reflect increased compaction under irrigated grazed pasture, which was also consistent with findings in other, similar studies. This study quantified changes in both the topsoil and subsoil but most differences were confined to the top 20 cm of soil. The changes are likely due to grazing when the soil is wet post-irrigation.

For irrigation management, the study indicated the lower readily available water capacity on irrigated pasture is significant, with farmers potentially having to irrigate more frequently. Adopting deficit irrigation could help minimise the impacts of compaction.

Manaaki Whenua researchers are partners in a follow-up project over the next four years to investigate options for co-ordinating grazing management and timing of irrigation, to minimise or mitigate soil compaction under irrigated grazed pastoral systems.

The project was a collaboration between Federated Farmers, Manaaki Whenua, the AgriBusiness Group, IrrigationNZ and Canterbury irrigators. Funding was through the Ministry for Primary Industries Sustainable Farming Fund, and the MBIE Next Generation S-map programme. Further information and results are available from the recent publication at the link below.

Contact: John Drewry
drewryj@landcareresearch.co.nz

HTTP *publish.csiro.au/sr/SR21254*

Giving whakamana back to Māori landowners through land science tools

A potential new kānuka industry is emerging thanks to Māori landowners partnering boldly with Manaaki Whenua to better understand their land through a te ao Māori-led approach to using land science tools.

Hikurangi Bioactives Limited Partnership (HBLP) is a majority community-owned entrepreneurial enterprise, set up to create economic opportunities for the communities of the Waiapū valley in the North Island. It is currently working with 14 Māori landowners to commercialise the bioactives in taonga species.

Kānuka oil is the first product in the commercialisation pipeline, with a phase-two clinical trial of a kānuka oil cream recently showing excellent results in the treatment of eczema. The Māori directors, staff and partners in HBLP and the Hikurangi Group predominantly identify as Ngāti Porou. Their activities are focused on the rōhe of Ngāti Porou.

From macadamia, kānuka, sheep farming and even blueberries under cover – the enterprise is rich with thriving resources and the potential to work with the whenua in ways that deliver to landowner aspirations. Manaaki Whenua kaihautū Māori research impact leader Dr Nikki Harcourt has worked closely with Māori in the region to understand their ambitions, then worked to uncover the characteristics of their land to help kaitiaki make decisions that will ensure good biodiversity on the land. "There is a critical need for Māori communities in the Waiapū valley to feel connected to the science and innovation system.

"In kaupapa Māori methods, knowledge sharing is most effective when skilled experts work alongside communities, and landowners/hapū can learn – and be motivated to use – scientific skills and processes."

Nikki and her team have achieved this using Manaaki Whenua tools such as S-map and Whenua Viz.

S-map is designed to help landowners understand soil type – its depth,

The white flowers of kānuka trees can be seen blooming from valleys across Tairāwhiti on the East Coast of the North Island.

stoniness, texture, and its capacity to hold water, and Whenua Viz is a visualisation tool for Māori landowners to access biophysical information about their whenua.

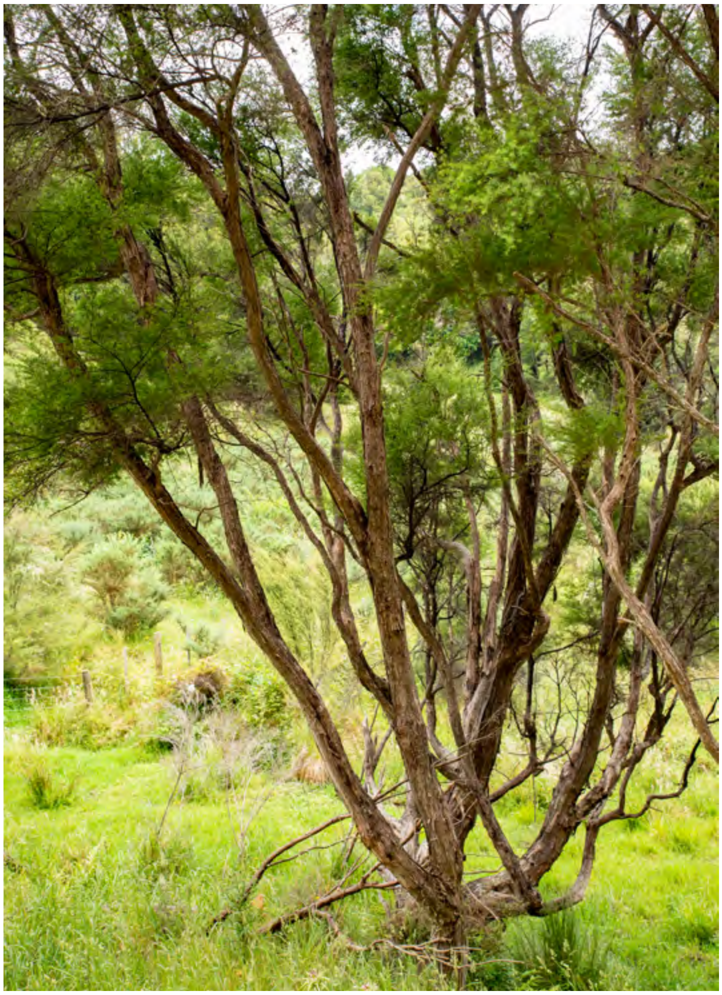
“Our core kaupapa is giving whakamana (empowerment) back to Māori landowners. “We gather the data that they want, and for their purposes so they can achieve success for their land and for their people.”

Kānuka thriving

The land on the east coast north of Gisborne is heavily eroded after much of the native bush was cleared for forestry and farming in the early twentieth century. However, tracts of kānuka have re-established on the land blocks and the plant is now prolific across the region.

“Kānuka is a pioneer plant. It helps stabilise the ground which is critical to stopping erosion. In a kānuka-dominated ecosystem, communities of plants, soil life, insects and birds encourage more permanent, mixed native forest and gradually restore the land to its original health,” says Nikki.

This has allowed landowners to embrace kānuka as an environmental asset and economic opportunity, making it a useful crop in areas where nothing else will grow. In addition, working with HBLP, Manaaki Whenua has helped farmers in the Waiapū Valley set up a team to investigate using kānuka as a natural health product.



HBLP co-founder Manu Caddie says that partnering with Manaaki Whenua has been critical in understanding and beginning to realise the potential of kānuka products for Māori.

“As well as the scientific tools and knowledge that this relationship has made available to us and landowners, we have benefited from the credibility that Manaaki Whenua brings in our discussions with funders and scientists.”

Contact: Nikki Harcourt
harcourtn@landcareresearch.co.nz

New trends in environmental perceptions

In December 2022 the 10th New Zealand Environmental Perceptions Survey (EPS) found that New Zealanders as a group rated the current state of the environment overall as "adequate to good".

Researchers from Lincoln University conducted the EPS biennially from 2000 to 2010 and then triennially from 2010 to 2019. Manaaki Whenua undertook the 2022 survey, in partnership with the original researchers.

For the first time, respondents identified climate change as the most critical environmental issue facing New Zealand. This is a change from all previous surveys, when fresh water was considered the most important issue.

Another of the notable findings in the 2022 survey shows how we perceive our environment overall is significantly better now than in 2016. However, when it came to beaches and coastal waters, the researchers found there was "some disconnect" between perception and reality.

More people believed the state of marine areas had remained the same or improved, when in fact their condition had worsened in the past 10 years due to human activity.

Manaaki Whenua co-lead researcher Pam Booth says while people's perceptions didn't quite match the actual state of the environment, people were happy to take an active role in improving their environment. "Respondents were increasingly aware of how intensive development and urbanisation activities put pressure on the environment and they were willing to actively engage in mitigating some of these pressures by, for example, recycling and growing their own vegetables," she says.

Recycling household waste was the most popular pro-environmental activity in 2022, although overall, participation rates for environmental activities have dropped.

The survey asked questions about what people think are the main pressures on the health of our air, land and water. The responses provide a rich data source to supplement biophysical data about how our environment is actually faring.

They show New Zealanders are concerned about the pressure sewage and stormwater have on coastal water and beaches, and people believe weeds and pests are the biggest threat to protected natural areas, wetlands, native bush and terrestrial animals.

Researchers were able to identify key trends that have emerged since the 2010 survey. This included the finding that the perceived state of air, natural environments in towns and cities, rivers and lakes, wetlands, and native bush and forests has improved significantly since 2010, despite the fact that people think how the environment is being managed has stayed the same.

At least half of respondents across all regions believe farmers are doing at least an adequate job looking after the environment.

A full copy of the report is available at www.landcareresearch.co.nz/eps

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

Environmental Perceptions Survey


Cissy Pan

Proceed with care: Decolonising cultural environmental monitoring

For Māori, the presence of ripe miro berries in the ngahere (forest) would traditionally indicate the health of a forest and the imminent arrival of the kererū, a significant food source for hapū.

This is an example of a cultural indicator – a tohu – as part of a wider cultural monitoring system – an intergenerational knowledge approach, based on Māori values, used by mana whenua and deeply rooted in te ao Māori ways of thinking and interacting with the natural world (taiao).

In a recent paper on decolonising cultural environmental monitoring in Aotearoa New Zealand, Manaaki Whenua toi rangahau Māori Garth Harmsworth and his colleagues argue that while cultural monitoring is increasingly prominent in environmental policy and reporting, there is a need to proceed with caution about how institutionalisation of Māori approaches can reduce its integrity, value and meaning.

Use of cultural environmental monitoring

Central and Local Government authorities are required through environmental legislation and policy to engage proactively and meaningfully with Māori.

"This has put Māori researchers and practitioners at the forefront, with the creation of methods such as the Cultural Health Index (CHI) and mauri compass, where mātauranga Māori (Māori knowledge) is increasingly used to inform many aspects of environmental assessment, decision-making and reporting," says Garth.

To date most investment in cultural monitoring has focused on freshwater. However, approaches have also been developed for the marine environment (moana, takutai), forests (ngahere), soils (oneone) and land (whenua).

Of Aotearoa's 16 regional councils, 12 reported using CHI in their regions, 11 reported using cultural mapping, over half reported cultural monitoring of taonga (treasured) species and every region reported use of at least one cultural monitoring framework.

The challenges

Garth is part of a core group of Māori researchers (kairangahau) who work across Aotearoa to develop cultural monitoring that enables local groups such as whānau, hapū, and kaitiaki to clarify their values and priorities and undertake environmental monitoring and reporting.

"While it is important to include cultural monitoring requirements in policy and planning, there needs to be equal importance placed on ensuring we have the enablers to tautoko (support) Māori at the grassroots level," says Garth.

With widespread use of cultural environmental monitoring, Garth points to several challenges that risk jeopardising these kaupapa Māori approaches.

There is a risk that Government agencies will 'cherry pick' Māori data outputs to match their formatting and evidence-based requirements.
In the paper, a Māori researcher describes that councils that are now monitoring native fish, for example, sometimes think "right, I've done all my cultural indicators and now I can comment on tuna [eel] health" without considering the broader holistic te ao Māori knowledge base."

The paper comments: "What happens is that those beautiful concepts get put into policy, and then it's up to interpretation, most of the time by non-Māori to actually apply it into strategy or action."

"The next steps in the national Māori environmental performance indicators work will be telling: will the state try to fit cultural monitoring into a small box, or will they try to incorporate the wider

Mahuru Wilcox

Kairangahau Māori Jade Hyslop and Manaaki Whenua researchers take part in a Rangitāne iwi/hapū cultural monitoring wānanga on the Manawatū River.

plethora of socio-cultural and socio-ecological indicators recommended as more consistent with te ao Māori?" Garth says at its essence, decolonising cultural monitoring requires listening to Indigenous voices and concerns, and placing these at the heart of cultural monitoring, locally and nationally.

Contact: Garth Harmsworth
harmsworthg@landcareresearch.co.nz

HTTPS onlinelibrary.wiley.com/doi/full/10.1111/nzg.12325

Celebrating our achievements

Manaaki Whenua's **Weeds Biocontrol team** had a successful evening at the NZ Biosecurity Awards in late October 2022. Members of the team contribute to B3: Better Border Biosecurity, which won the Science Award. **Ronny Groenteman** and **Quentin Paynter** joined the group who accepted the award.

Weeds Biocontrol team.

At the annual Science New Zealand Awards in Wellington in December 2022, **Surinder Saggar** was awarded an Individual/Lifetime Achievement award for his research over four decades of agricultural greenhouse gas sources and sinks, and the microbial processes regulating the loss of agricultural nitrogen to the atmosphere. **Patrick Garvey** was recognised as an Early Career Researcher for his work on the role of smell in predator interactions and how this can be used in pest management, and our **Mycology and Bacteriology team** received a Team award for their invaluable and wide-ranging expertise in biosecurity and biodiversity.

Mycology and Bacteriology team.

Wildlife ecologist **Grant Norbury** has won the 2022 Outstanding Publication for New Zealand Ecology from the New Zealand Ecological Society, for a paper in *Science Advances* – Misinformation tactics protect rare birds from problem predators – for which Grant was the lead author.

Catriona Mcleod, an ecologist at Manaaki Whenua, has received the Cranwell Medal for excellence in science communication from the New Zealand Association of Scientists. Catriona was nominated for her work leading the Trustworthy Biodiversity Indicators programme, creating an exciting yet respectful conversation between scientists and people in diverse communities, applying creative ways to engage on a range of platforms, from social media channels through to group discussions kanohi ki te kanohi (face to face).

At Fieldays, New Zealand farming's annual showcase event at Mystery Creek outside Hamilton, held in December 2022, Manaaki Whenua joined colleagues from AgResearch and NIWA on a stand in the Pavilion where we demonstrated our soil mapping resource S-map Online and let visitors play a virtual drone game to profile our remote sensing work. Kaihautū **Nikki Harcourt** was also on the stand to profile a case study highlighting Manaaki Whenua's support of Māori landowners in the Waiapū Valley, North Island, to make land-use decisions best suited to the characteristics of their land blocks.

John Dando, who recently retired from Manaaki Whenua's soil physics laboratory in Palmerston North after 30 years' service, was awarded the New Zealand Society of Soil Science's biennial national award (the Blakemore Award) in December 2022, in recognition of his significant technical contribution to soil science.


Grant Norbury.


Surinder Saggar.

Catriona Mcleod (left).


Patrick Garvey.

Our stand at Fieldays 2022.


John Dando.

Science to underpin stewardship of our highly productive land

Aotearoa New Zealand is internationally renowned for its high soil diversity. Although our national soil survey, S-map, is only halfway through mapping the farmed soils of New Zealand, already over 5,500 unique soil types have been identified, from the sub-tropical clay soils of Northland to the volcanic ash soils of Taranaki and Waikato, and the stony, glacially-derived soils in Canterbury and Central Otago.

Within this great variety, not all soils are equal; some are more versatile than others for supporting food production. Highly versatile soils occur in different locations, such as vegetable production in Pukekohe, dairy in Taranaki and Waikato, citrus in Gisborne, or seed production in Canterbury. Recognising the vital role these soils provide for our export economy, as well as domestic food supply and employment, the New Zealand Government has just released a significant policy to protect the most versatile soils from ongoing urban sprawl and rural residential developments. The National Policy Statement for Highly Productive Land (NPS-HPL) came into effect from 17 October 2022.

In New Zealand the capability of different areas of land is evaluated through the Land Use Capability (LUC) classification system, which at its highest classification level assigns areas of land to one of eight LUC classes. LUC class 1 is the most versatile land, whilst LUC class 8 is the least versatile (i.e. conservation or mountain lands). The LUC is widely used to support a number of government policies, from infrastructure and land use planning through to farm management. As such it is recognised as part of the nationally significant databases and collections. Maps of the LUC can be viewed through Manaaki Whenua's Our Environment website, whilst the complete dataset can be downloaded from the LRIS (Land Resource Information Systems) portal. In order to enable easier access to LUC-related documents and information, a new web portal is expected to be launched by mid-2023.

The NPS-HPL recognises highly productive land as belonging to LUC classes 1 to 3, which in its original state comprised around 14% of New Zealand. However, the *Our Land 2021* national state of the environment report highlighted that cumulatively, large areas of HPL have been lost to urban sprawl and rural residential developments, with a significant impact on the past 20 years alone. To monitor the effects of land fragmentation on HPL availability, a new environmental indicator for HPL was developed by Manaaki Whenua in collaboration with the Ministry for the Environment, Stats NZ and Waikato Regional Council. A full description of the land fragmentation indicator is available from Stats NZ. A brief summary of the science underpinning this indicator is available in our *Soil Horizons* newsletter.

These actions to improve the stewardship of New Zealand's highly productive land through the NPS-HPL and the land fragmentation indicator require national coverage of geospatial datasets such as the LUC, S-map, the Land Cover Database, and Protected Natural Areas. All of these datasets represent significant public investment, often over generations, that the nation cannot afford to lose. This highlights the invaluable contribution of nationally significant databases and collections to the intergenerational availability of fundamental knowledge about our natural environment.

Contact: Sam Carrick
carricks@landcareresearch.co.nz

HTTPS lris.scinfo.org.nz/layer/48076-nzlri-land-use-capability-2021/data/

ourenvironment.scinfo.org.nz/

stats.govt.nz/indicators/land-fragmentation/

landcareresearch.co.nz/publications/soil-horizons/soil-horizons-articles/monitoring-change-in-the-availability-of-new-zealands-highly-productive-land-resource/