Pūtaiao

MANAAKI WHENUA SCIENCE SUMMARY / ISSUE 5 / FEB 2021

Ground truths:

How land and soil underpin New Zealand's future

Pūtaiao

Science for our land and our future

Tēnā koe and welcome to issue 5 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. We have a clear responsibility to New Zealand: this land, and everything that shares it with us, is our future.

Each issue of Pūtaiao will share the benefits and impacts of our science in helping to ensure a sustainable, productive future for New Zealand.

In this issue, many of the stories focus on the research we do for our land environment. We provide much of the underpinning data for land-based science across Aotearoa New Zealand, including fundamental information about our soils, land uses and land use changes over time and incorporating Māori perspectives wherever possible. This information is vital for our land-based primary industries and to enable sustainable land management.

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

Cover image: S-map Online now covers over a third of New Zealand's total land area.

For peat's sake!

The Waikato Region has about 90,000 ha of peatlands – around 40% of New Zealand's peat resource – formed over the past 10–14,000 years from the slow accumulation (in mm per year) of peat derived from wetland vegetation under saturated conditions.

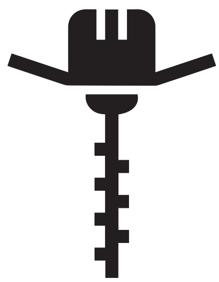
Before human interventions, these peatlands represented unique hydrological and ecological environments, but around 80% of their original extent has now been cleared and drained, mostly for pastoral agriculture. Those areas that remain support threatened endemic flora and fauna in a unique ecosystem, mostly act as carbon sinks, represent a taonga for iwi, and provide recreational opportunities.

Drainage of peatlands for agriculture changes their hydrology, stops accumulation of peat, and results in ongoing land subsidence through shrinkage and consolidation, as well as increased CO_2 emissions

1920s - 2010s

Depth measurement used

SOIL AUGERS



The monitoring network now uses

AIRBORNE LIDAR

Peat soils close to sea level after rainfall in Hauraki.

through biochemical oxidation. These losses pose environmental, economic and social challenges for future land management. Some areas of drained peat are up to 12 m thick, and so the losses could continue for a long time.

The amount of subsidence varies depending on time since drainage, land use, land and drainage management, and peat type. Research by Manaaki Whenua and the University of Waikato, supported by Waikato Regional Council, has shown that surface subsidence can be as much as 2 cm per year, or 20 cm per decade.

Of course, under drained management these peatlands provide considerable economic value to the Waikato region. However, the consequences of ongoing subsidence and peat loss include increased risk and frequency of flooding and inundation, reduced wetland sustainability, ponding in catchments due to uneven peat subsidence, and reduced drainage gradient. The impact of subsidence may be exacerbated by climate change including sea level rise.

Until recently, monitoring for peat soil subsidence in the Waikato region used simple peat depth probing. Peat depth measurements were taken in the 1920s and again in about 2002 and 2012. These were point measurements and, whilst useful, did not adequately represent the different peat soil types or the drainage and land management on peat soils across the region.

Over the past two years, Waikato Regional Council has commissioned our scientists, in collaboration with the University of Waikato and the University of Canterbury, to design and implement a robust regional peatland subsidence monitoring network for their state of the environment monitoring, to support implementation of the Waikato Regional Policy Statement and to inform long-term planning.

To fully understand the vulnerability of peat soils to subsidence, we have now designed and tested a monitoring network for the Waikato region across multiple strata of interest, including dairy, drystock, horticulture, and maize cropping land uses, different peat depths and drainage management. The monitoring network, which uses airborne lidar, covers a much greater area than the historic points and includes the large, raised bogs of the Hamilton and Hauraki Basins as well as the peatlands found in the lower Waikato.

Data from this robust measurement network could underpin possible future work to mitigate the effects of peat subsidence and carbon emissions. This may include investigations into better water and land management that could inform the development of decision-support tools for drainage and land managers, and feed into good practice guidelines.

We are also actively developing a research proposal to advance knowledge of interactions between, plants, microbes and hydrology in New Zealand peatlands. The ultimate aim is to inform targeted reconstruction of peat wetlands, which could offer significant potential for greenhouse gas mitigation and multiple aligned co-benefits such as improved water quality and biodiversity.

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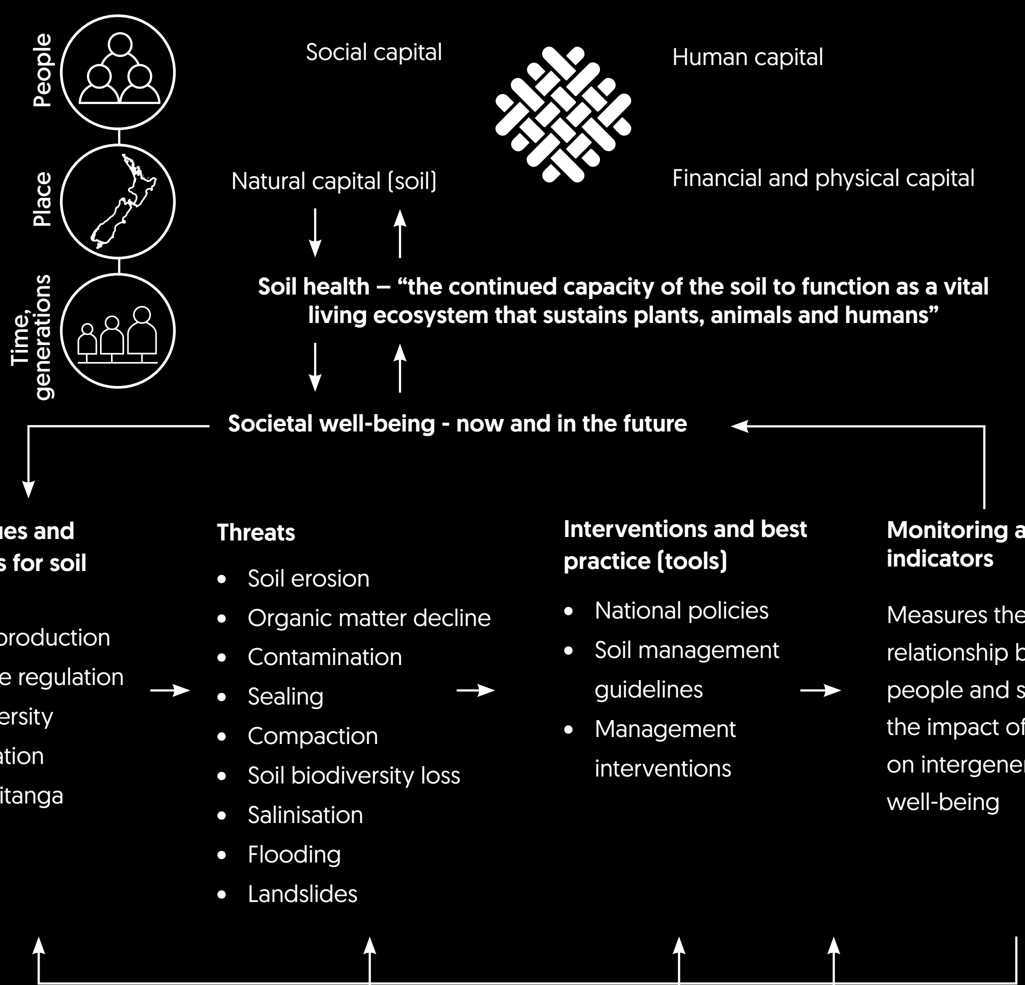
Progress in soil health – a new framework for policy development

In issue 2 of *Pūtaiao*, in May 2020, we outlined the MBIE research programme 'Soil health and resilience: Oneone ora tangata ora' – exploring how the current conventional knowledge of soil health, mainly based on soil chemistry and physical properties, can be made more meaningful by developing a broader understanding of the social and cultural values and perspectives people hold about soils.

Since then, further progress has been made to understand soil health by using a wider focus on values and well-being, along with an in-depth understanding of Te Ao Māori (Māori worldview) concepts of soil health. This work has been encapsulated in a recent journal paper in *Sustainability*, written by Dr Dean Stronge and others in Manaaki Whenua's soil health team.

The paper describes a shift in thinking, moving away from a conventional, utilitarian soil science view that defines soil health in terms of increases in yield, to one that is much broader and holistic, as shown in the diagram. The more recent emphasis in soil science on ecosystem services and sustainable use is welcomed, but these still largely concentrate on the biochemical and physical aspects of soil systems, such



as carbon sequestration and buffering, and their filtering capacity.

A new approach is recommended by the Oneone ora programme – to broaden the soil health ecosystem focus to one informed by values and well-being, emphasising both natural science and societal insights that include a long-term vision of sustainable use of our land and soil. To this end, the programme has devised a framework for future policy-making that draws on elements of the current research into social well-being, as recognised by the Aotearoa New Zealand Treasury's Living Standards Framework (the top half of the diagram opposite). The framework is based on the core values people hold about soil and soil health (the lower half of the diagram opposite).

An essential perspective in New Zealand is the inclusion of indigenous values and knowledge systems. Fundamental to indigenous knowledge is that people are an intrinsic part of the natural environment, and that the benefits and values people derive from nature are not just cultural but occur across all ecosystem services. Thus, for New Zealand, work into soil health should be inclusive of an indigenous Māori perspective of soil ecosystems and soil health derived from traditional beliefs, values, and concepts, based on mātauranga Māori (ancient/traditional, historical, and contemporary Maori knowledge), elucidating the values, uses, and aspirations Māori have for soils, and the practices they wish to follow aligned to their values (e.g. kaitiakitanga – guardianship of the natural environment; tikanga – values, customs, interventions).

Applying a well-being lens to soil health provides an innovative way of thinking about the long-term management of land and soil ecosystems. It will be important to determine how to bring this thinking into a policy domain, to ensure policies are designed to fulfil desired societal goals based on values, and that policies are sustainable, equitable, socially cohesive, resilient, manage risk and support economic growth and prosperity.

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Sustainable land-use policy

(adapted from Karacaoglu 2015)

Good policy manages and maintains natural capital in ways that are:

- Sustainable: capital assets are not eroded by current generations at the expense of future generations
- Equitable: access to capital assets is shared across all groups in society
- Socially cohesive: no particular social group(s) impose their concepts of well-being on others
- Resilient: capital assets are protected against major systematic risks
- Supportive of economic growth: the material well-being generating potential of capital assets is enhanced.

Karacaoglu G 2015. The New Zealand Treasury's living standards framework–exploring a stylised model (WP 15/12) Wellington, New Zealand: NZ Treasury.

S-map Online: next-gen updates to national soil data

S-map Online, a tool developed and updated by Manaaki Whenua, provides the best available soil resource data for New Zealand and, in doing so, underpins the government's roadmap for the food and fibres sector, *Fit for a Better World.*

S-map is extensively used, with over 33,000 soil information sheets downloaded over the last year from the S-map Online website. It is used by rural consultants, councils, landowners, and others for crop/pasture management, nutrient budgeting, erosion control, irrigation management, drought resilience, and land valuation.

Although other, more spatially complete sources of soil information exist (for example, the New Zealand Land Resource Inventory, Fundamental Soils Layer), S-map operates at a higher resolution (a minimum of 1:50,000), combines on-the-ground soil sampling with digital mapping technologies, and incorporates a wider range of soil properties. This makes S-map a more accurate input for environmental modelling, farm environment planning and on-farm decision-support tools.

Among its many applications, S-map supports OverseerFM, an online software platform that enables farmers, including dairy, livestock, fruit, viticulture, and arable/vegetable farmers, to model and report on their on-farm nutrient balances, greenhouse gas emissions and carbon sequestration. Some 11,000 farms across New Zealand are users of Overseer.

In August 2020 S-map had a significant nationwide update, especially to its soil hydrology information, as part of an MBIE-funded Endeavour science programme running from 2016 to 2021, which has focused on the science that underpins S-map to enable continual improvement in soil information.

Dr Linda Lilburne, who co-leads the programme, says that there are many benefits to the new update. 'Much richer soils data mean much better modelling assumptions, which in turn support better decision-making. More accurate soil moisture information will lead to better knowledge of irrigation demand and nutrient losses.'

The main changes to S-map, which users are now seeing online, are:

- increased coverage of New Zealand. With an additional 5,000 km^2 of soil data, S-map now covers 36.6% of New Zealand, including 67.3% of our 'multiple use land'.
- a new model for estimating soil hydrological properties (including available water), based on a vastly increased amount of background laboratory data. The number of samples in the model is up from 1339 (over 313 sites) to 4641 (over 684 sites).
- three new national maps of soil chemistry attributes (carbon, pH, P retention).
- two new tools that help land managers and consultants find the S-map soil type that best matches on-farm field observations.

In a major new funding boost for S-map, in early December 2020 the government committed $6.25 million for a nation-wide project to expand S-map, with funding allocated by MPI under the Budget2019 Productive and Sustainable Land Use initiative.

This new investment is enabling significant co-investment partnerships with regional councils, and is 'a real step-change in understanding the unique soil types and spatial variation in one of New Zealand's key strategic natural assets', says Dr Gerard Grealish, who leads the S-map soil mapping programme at Manaaki Whenua.
In this first year of the programme, Gerard's team has active soil mapping in Waikato, Bay of Plenty, Hawke's Bay, Horizons, Wellington, Tasman, Marlborough and Canterbury regions. The aim, says Gerard, is to continue working with MPI and councils over the next 5 years to add approximately 1.5 million hectares of land to S-map.

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S-map Online: predicted soil carbon stocks in the middle North Island.

Monitoring paddock-scale changes in land-use – from space

For over a decade, scientists at Manaaki Whenua have been developing and improving methods to map agricultural land-use and crop type using satellite imagery. This work is vital to the setting and assessment of environmental plans, as it enables land-use changes and their likely consequences to be measured over time.

As an example, winter grazing of forage crops is a key land-use practice in southern New Zealand, providing important feed for livestock. In recent national research, Manaaki Whenua's scientists identified Southland as the region with the most winter-forage cropping in hill country, as a percentage of all hill-country agricultural land. This practice has been identified as risky if not managed well, especially on slopes of 7 degrees or more, potentially resulting in soil degradation and nutrient losses. However, the extent of repeat cropping of winter-grazed forage crops is a knowledge gap.

In new research, we used an existing time series of winter-forage maps, derived from satellite imagery, to identify how often paddocks are re-used for winter forage. The work built on a series of evaluations for Environment Southland Regional Council and a nationwide exercise for MfE to assess the potential impacts and policy implications of the 2016 Southland Water and Land Plan. Principal funding was provided by MBIE under the Advanced Remote Sensing Aotearoa programme.

We examined maps derived from satellite images of the Gore-Mataura area, Southland, for the winters of 2013, 2014, 2017, and 2018. Within the 32 km × 32 km study site (67,618 ha), 8,925 ha were classed with high certainty as winter forage in one or more of the source maps. These winter-forage crops were generally grown on well-drained Brown soils (63%), followed by Pallic and Gley soils.

Although the study was limited by its pilot scale and by differences in mapping methods of the source maps, valuable data were derived. Only 15% of the total forage area was used in more than 1 of the 4 years mapped, and just 1% was used in 3 or 4 of the years. In terms of consecutive use, 21% of the forage crop area in 2017 was also used in 2018. This new knowledge will be useful when designing and developing best management practices across different soil types, and for regional policymaking.

If regular whole-region or nationwide land use mapping is undertaken in the future, the multi-year analysis method we have demonstrated could be applied widely for monitoring.
It will also be valuable to investigate whether management practices such as strategic grazing and catch-cropping are detectable in time-series satellite imagery.

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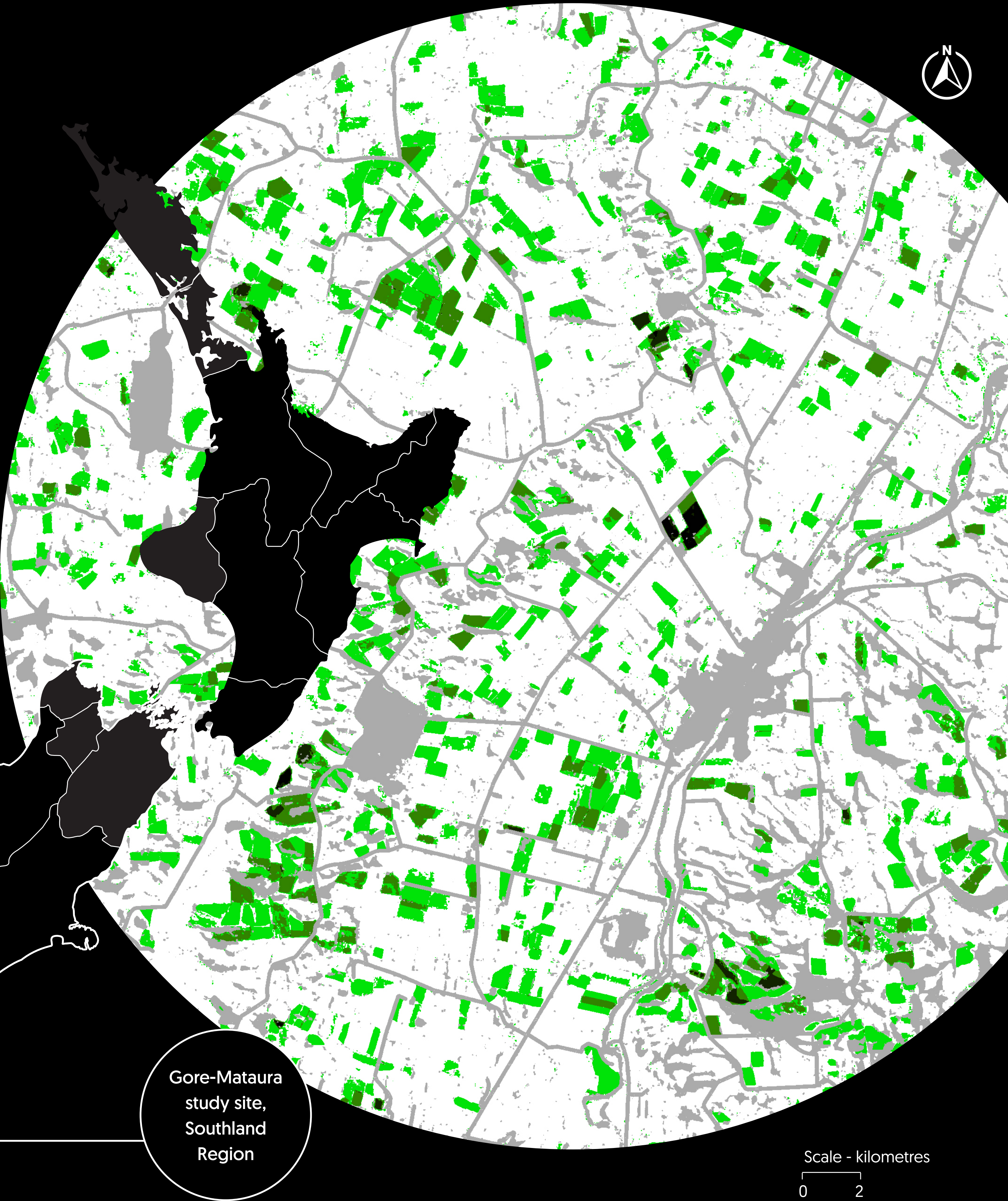

Mapping of winter forage frequency, paddock by paddock, in Southland, in 2017-18.

Pathways across Antarctica: 200 years of human impact

Antarctica is usually viewed as a large, pristine wilderness area, untouched by humans, with little settlement and no agriculture or industry. Yet since its formal discovery 200 years ago, the continent has seen accelerating and potentially impactful human activity.

Until recently, little work has been done to map where humans have been, how much of the continent remains untouched or largely unaffected, and to what extent these largely unaffected areas serve to protect biodiversity.

An international team of researchers led by Monash University, including Dr Fraser Morgan of Manaaki Whenua, has now shown exactly how extensive human use of Antarctica has been over the past 200 years.

Reporting in the journal *Nature*, and using a dataset of 2.7 million human activity records, their work has revealed that apart from some large areas, mostly in the central parts of the continent, humans have set foot almost everywhere.

Although many of these visited areas have only been negligibly affected by people, ice-free areas (such as the McMurdo Dry Valleys) that have most of the biodiversity found on the continent, have seen significant visitation. Only 16% of the continent's Important Bird Areas, areas identified internationally as critical for bird conservation, are located within negligibly impacted areas. Moreover, little of the total negligibly impacted area is represented in Antarctica's Specially Protected Area network. Areas of high human impact, for example where people build research stations or visit for tourism, often overlap with areas important for biodiversity.

Dr Morgan worked on the development of a comprehensive database of the New Zealand and American scientific activities within the Ross Sea region, New Zealand's specific area of interest in Antarctica. The work was part of an MBIE Endeavour grant that focused on the use of data-driven approaches to understanding the pressures on the Ross Sea region environment. This project utilised the unique skills of the Informatics team within Manaaki Whenua to unpack,

Panoramic photo of Bull Pass, within the Wright Valley. The buildings house refuges and science equipment.

analyse, and visualise these pressures for the Antarctic Science and Policy communities.

Dr Morgan notes that 'with the rise in the ability to access and quantify historical information, these types of large-scale informatic approaches are enabling new insights into Antarctica for both science and environmental management'.

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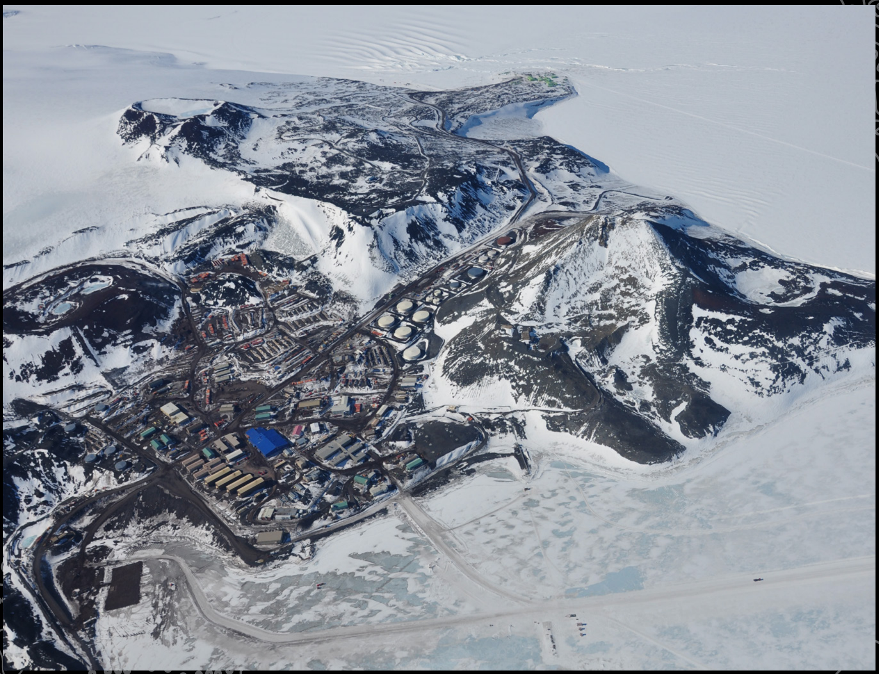
www *nature.com/articles/s41586-020-2506-3*

Aerial photograph of McMurdo Station (US, foreground) and Scott Base (New Zealand, green buildings at top).



A new soil pH map for New Zealand

Soil pH indicates the relative acidity or alkalinity of a soil, and significantly influences various soil functions, soil quality and fertility. Considered a 'master variable' in soil science, pH affects soil in almost every way – its physical structure, patterns of carbon, nitrogen, and phosphorus cycling, its biological activity and regulation, the bioavailability and mobility of nutrients, and the uptake of trace elements such as cadmium.

Understanding soil pH is critical for farmers, for the fertiliser industry, for soil ecology, for land-use classification, and for effective land management. Manaaki Whenua's online Land Resource Information Systems (LRIS) database already includes a soil pH data layer, mapping the whole of New Zealand at a scale of 1:50,000, as part of the Fundamental Soil Layers (FSL). Those layers were based on a combination of stereoscopic analysis of aerial photographs, expert knowledge, and field measurements built up over the past 30 years. However, they are known to need refinement – particularly because their measurements of soil pH are largely confined to the 20–60-cm soil depth.

In response to a growing need for better soil pH information, Pierre Roudier and colleagues at Manaaki Whenua have developed a new method to digitally map soil pH at high resolution (100 m) across New Zealand. The work was supported by SSIF funding from MBIE.

To create the new maps, soil pH information for New Zealand was collated from a wide range of datasets, including soil surveys, soil quality programmes, wetland monitoring programmes, and soil biodiversity research programmes. The main dataset was the National Soil Data Repository, which contributed around half of the 12,000 soil sampling points. The complete dataset was then processed through data augmentation, a statistical technique that is also used in machine learning. The process created a much larger and more robust master dataset for a soil pH model to be calibrated, including richer information about depth variations. The process also took into account uncertainties within the data.

> *The new layer has allowed us to explore new ways to model soil properties in 3D.*

Comparison with existing soil pH maps showed that this new digital soil mapping method significantly out-performed existing soil pH information for the country. It is now available in LRIS alongside the original data layers, as well as on S-map.

According to Dr Roudier, this new soil pH map is a significant improvement on the currently available soil pH information for New Zealand. 'The new layer has allowed us to explore new ways to model soil properties in 3D, not only across the landscape, but also with depth, which will benefit future modelling of other important soil properties.'

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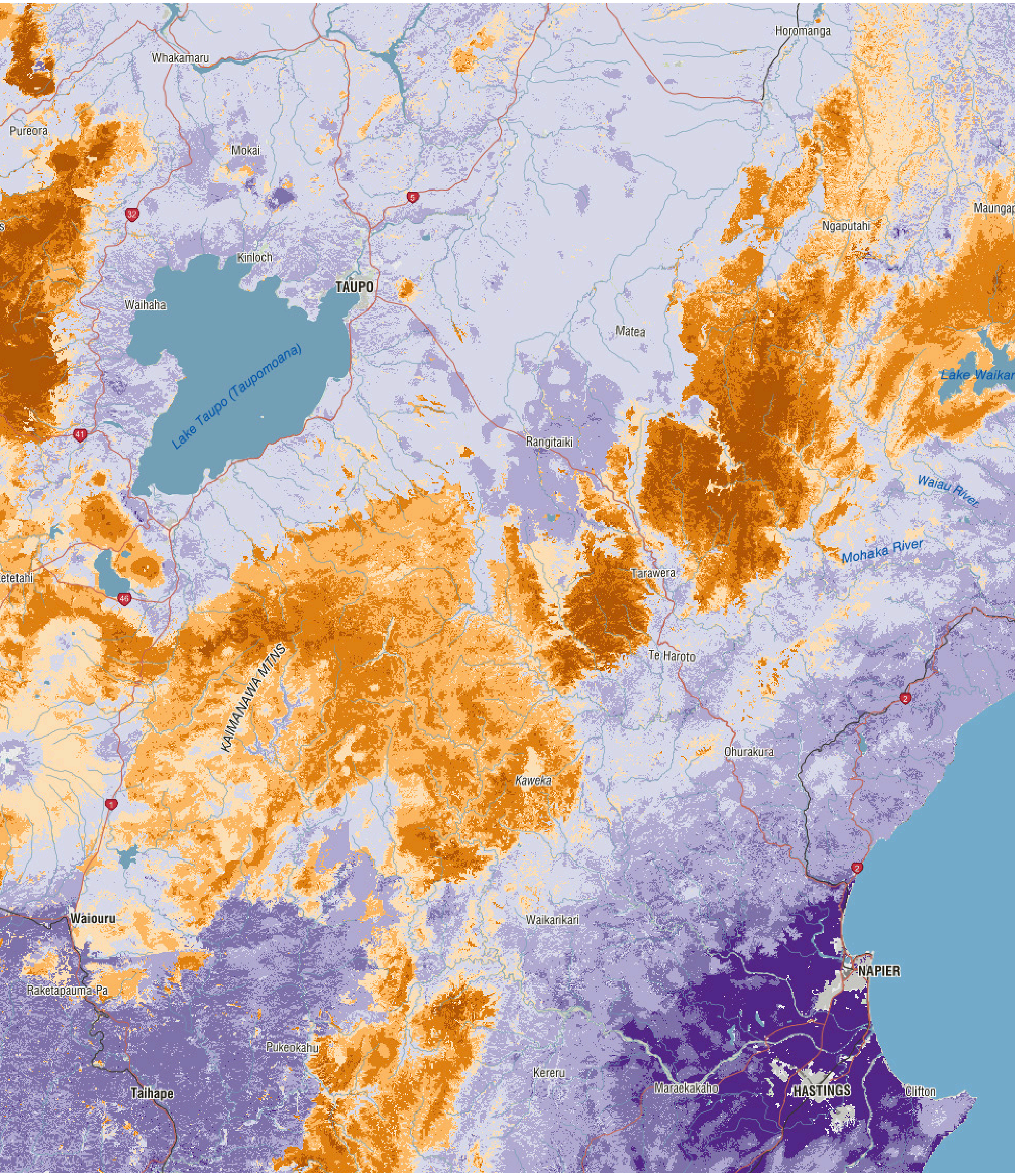

New maps show soil pH for New Zealand at a variety of soil depths.

Soil biota in productive landscapes: improving our understanding

At Manaaki Whenua, we aim to improve knowledge of how the land responds to human pressures, and to understand the potential limits to land-use intensification and other development. Our work in this area encompasses cutting-edge soil science to improve the primary sector's economic and environmental performance.

The more closely we study soil systems, the more dynamic and complex they appear. At Lincoln University's Ashley Dene Research & Development Station, our soil science capability includes real-time measurement and modelling of greenhouse gas exchange and water, carbon and nitrogen inputs and losses for a lucerne crop to estimate paddock-scale water use, changes in soil carbon, nitrogen leaching, and the impacts of effluent use.

Our scientists are also now getting to grips with soil micro-organisms and their contributions to ecosystem functioning and carbon and nitrogen cycling. Little is currently known about the biodiversity, structure, and function of micro-organism communities in the deeper layers of agricultural soils, but the latest DNA metabarcoding techniques (see panel opposite) are gradually closing this knowledge gap.

Dr Andrew Dopheide and others in our Biocontrol & Molecular Ecology Team have recently used DNA metabarcoding and network analyses to investigate how biodiversity varies with soil depth (up to 1.7 m deep) for four key groups of soil organisms: prokaryotes (bacteria, archaea) and three types of eukaryotes: nematodes, fungi, and protists (assorted single-celled eukaryotes, including amoebae, ciliates, diatoms, and slime moulds).

This discovery science aimed to understand several basic, but essential questions. Are there more species of soil organisms closer to the soil surface? Are the species at depth a subset of those at the surface, or different? Does the structure of the soil community networks change with depth and decreasing availability of carbon, nutrients, and water?

Overall, the work showed that species richness of all groups (except for several types of archaea) declined with increasing depth, probably because of the decreasing availability of resources through the soil column. However, prokaryotes were more evenly distributed through the soil profile than eukaryotes. Community networks were more tightly associated and heterogeneous, suggesting increased concentration/congregation of organisms around more sparsely distributed resource hotspots in the deep soil than at the surface.

The findings provide insights for potential implications of farm management practices on carbon and nutrient cycling in the soil. Soil communities process organic material into forms available for plant growth, and determine whether animal wastes escape as greenhouse gases or by leaching. While most studies have focused on the processes in topsoil, this work highlights the contribution of soil communities at greater depth.

Future research could investigate how modifying management practices can be used to enhance the contribution of soil communities throughout the soil profile to reduce losses of nutrients at different soil depths.

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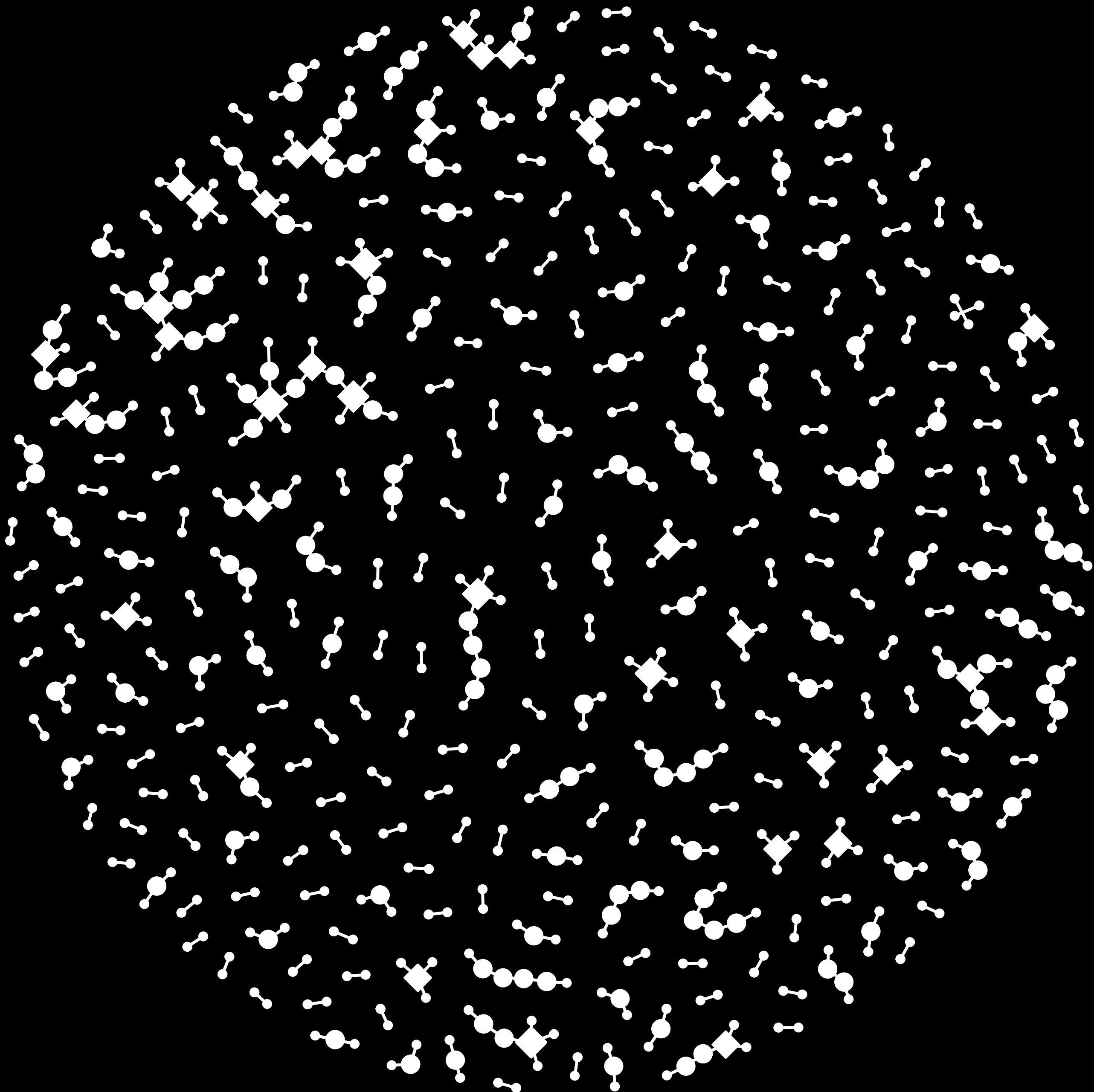

Representation of a multi-taxon soil community network including prokaryotes, fungi, protists and nematodes. Each shape represents a species, diamond shapes represent more important species within the community, and each connection represents a significant co-occurrence pattern between a pair of species.

Metabarcoding explained

DNA metabarcoding extracts of DNA from environmental samples are amplified and sequenced to enable detection of species, for example, animal and plant species in soils and pollen species from air samples. A more recent application is the detection of invertebrates and microbial communities in soil samples, which can be used to assess changes in biodiversity and function of these critical organisms with changes in management practices. This is rapidly becoming an essential tool for ecological monitoring.

Behaviour change: are we willing or not?

Achieving meaningful behaviour change – that is getting people to think and act differently – is one of the most complex and unpredictable aspects of any policy decision. Without effective stakeholder engagement and participation, policies and reports often remain shelved, recommendations forgotten, and progress in solving environmental issues is slowed.

Our social science capability complements our biophysical science by focusing on the social, cultural, and economic processes and information needed to improve policy performance. We design, undertake, and evaluate engagement processes and strategies to better understand people's preferences, their values, and governance processes to improve the management of our natural assets.

Our research in this area spans urban, rural, and conservation landscapes and catchments, the full-range of ecosystem services and natural resources, and a wide array of stakeholders – central and local government, industry, NGOs, community, and Māori organisations.

Recent work by the team has focused on improving the effectiveness of government responses to the Covid-19 pandemic. We surveyed 1,001 Aucklanders to determine their willingness to comply with policy measures to eliminate Covid-19. The analysis was based on the I3 compliance framework, a model of compliance behaviour grounded in social psychology and marketing theory.

The I3 framework reveals the involvement people have with a policy outcome and policy measures, and their beliefs about the outcome and measures. It tells us if someone is willing (or not) to do something, while the belief analysis explains why people are willing (or not) to do something. In this study we measured how strongly people were involved with eliminating Covid-19 (policy outcome) and their willingness to comply with policy measures like wearing face masks, self-isolating when ill, and getting tested. The results were summarised in diagrams like the one below.

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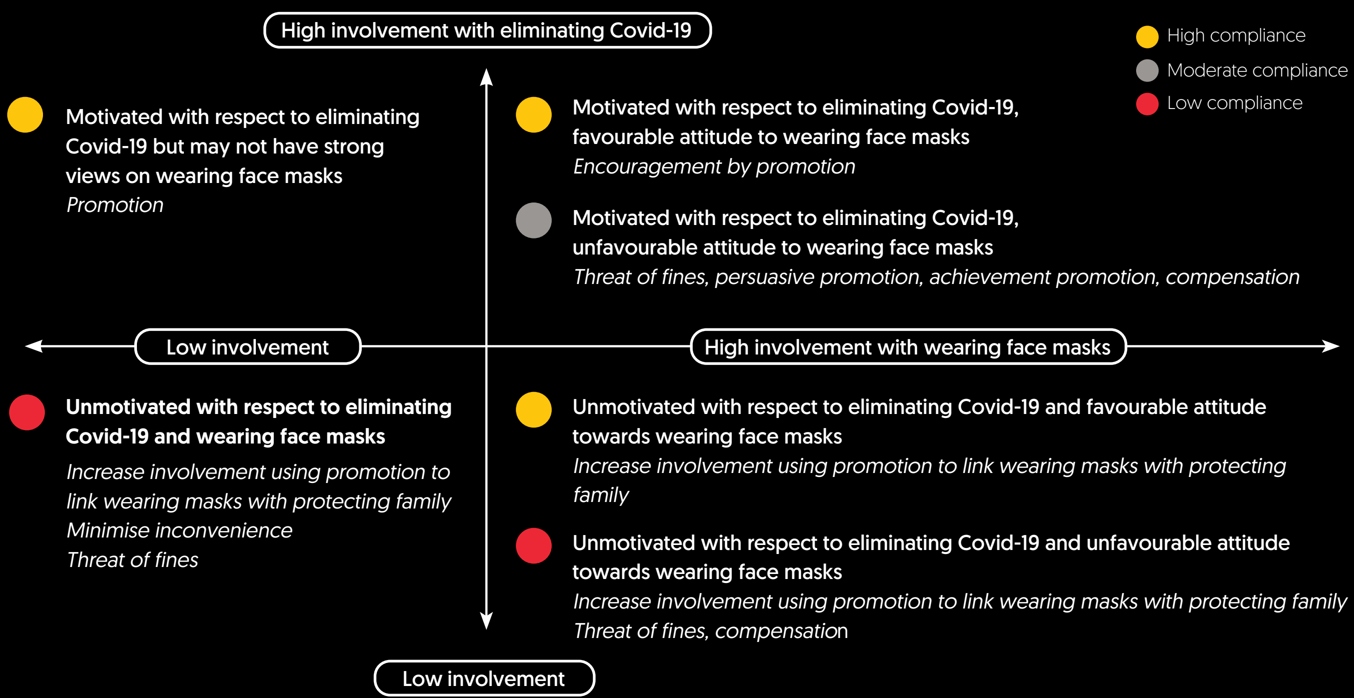
Kaine G, Murdoch H, Lourey R, Bewsell D 2010. A framework for understanding individual response to regulation. Food Policy 35: 531–537.



How one thing leads to another – building long and deep relationships in effective land management

Manaaki Taiao is a rōpū (group) made up of Manaaki Whenua Kairangahau Māori (Māori researchers) working on Māori-led research projects within a range of science portfolios.

We work with iwi, hapū, and communities to develop strategic planning, policy, and monitoring tools informed by Mātauranga Māori and science to support kaitiakitanga. Over time, we are building strategic partnerships with our Māori partners for mutual benefit – our enduring relationship with the Te Awahohonu Forest Trust, Northern Hawke's Bay, is an excellent example.

Dr Nikki Harcourt, a senior researcher in the Manaaki Taiao group, was initially approached by the Trust to provide a Kaupapa Māori land-use opportunities assessment for their Tarawera C9 block, based on Manaaki Taiao's reputation in the land assessment space. Tarawera C9 comprises some 10,000 ha of pristine indigenous forest with lowland podocarp and high-altitude beech. It also has another 15,000 ha of plantation pine and areas of reversion scrub, is bordered by five rivers, and has very high biodiversity.

Further alignment of MWLR capabilities with Trust aspirations has led to the initiation of studies on āwheto (kumara caterpillar), huhu, and social research.

In the spirit of reciprocity, we have created a summer internship for Floyd Walker, one of the Trust's uri (descendants), who is working with Dr Eva Biggs and Dr Claudia Lange on the āwheto project. Dr Harcourt is supporting their rongoā wānanga, having worked with Pa (Rob) McGowan to provide the Trust with advice; together they will be present at the rongoā wānanga in March 2021. The Trust's long-term aspiration is to develop a research hub and wellness retreat, and they are excited about the potential to explore an enduring relationship with Manaaki Whenua. It is also really important for us to be able to whakamana back to the Trust. The core purpose of our Manaaki Taiao rōpū is to empower kaitiaki, and we acknowledge that our partners are not a repository of information and resources for us to mine. We are proud to empower our Māori partners by sharing our knowledge and co-developing new knowledge in ways that are truly useful for them.

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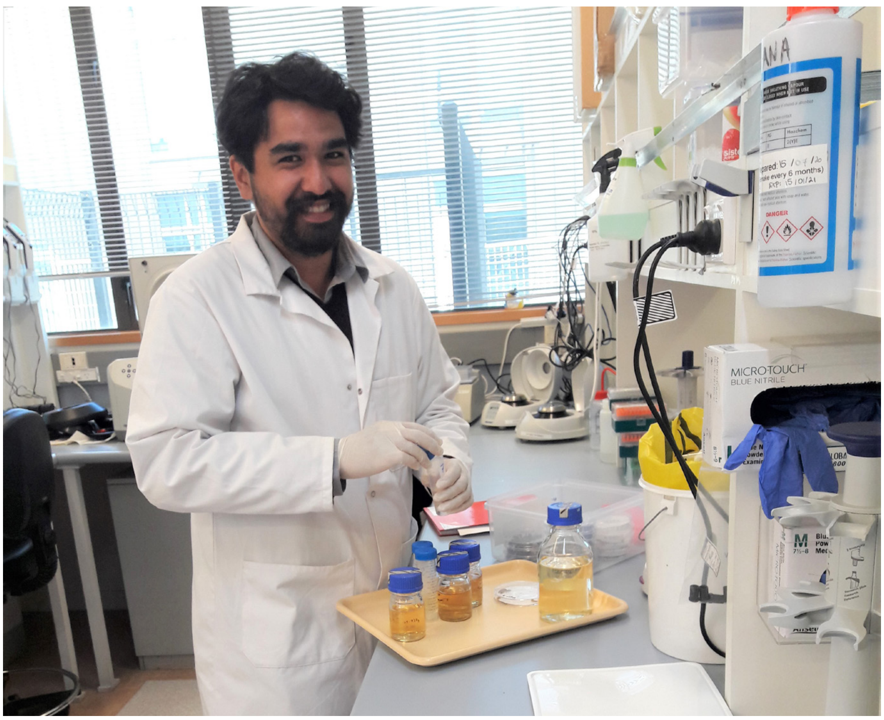

Floyd Walker working on the āwheto project.

Unite against COVID-19

Predator modelling applied to study of Covid health equity

An important part of our biosecurity capability at Manaaki Whenua is the ability to understand the probabilities of pest detection and spread, advising on how best to respond to disease or pest incursions for ecological and economic benefit.

This work depends on detailed mathematical modelling of complex systems and population dynamics.

As reported in issue 3 of *Pūtaiao*, our researchers Drs Rachelle Binny and Audrey Lustig applied their predator-modelling skills to Covid-19 virus epidemiology, working with mathematicians and modellers at Te Pūnaha Matatini: the Centre for Complex Systems and Networks (TPM), University of Canterbury, and the University of Auckland to assess likely patterns of disease spread into the country. Their contributions to this national team were crucial in informing Government decisions about the ensuing national and regional lockdowns.

Since then, the team has applied their modelling skills to other aspects of epidemiology, including – in a recent paper in the New Zealand Medical Journal – questions of Covid disease outcome by ethnicity.

That work, led by Nic Steyn (TPM and University of Auckland) and Prof. Mike Plank (TPM and University of Canterbury), combined existing demographic and health data for ethnic groups in New Zealand with international data on Covid-19 infection fatality rates (IFR) for different age groups. Care was taken to control for differences by ethnic group in unmet healthcare needs, life expectancy, and underlying health issues such as heart disease, diabetes, and high blood pressure.

As an initial guide to the potential scale of Covid-19 health inequity in New Zealand, the results were striking. The IFR for Māori was estimated to be 50% higher than that of non-Māori – and could be even higher, depending on the relative contributions of age and underlying health conditions to mortality risk. Additional risk factors for accelerated disease transmission, which were not factored into the study, include crowded, substandard housing, jobs or workplaces with higher health risks, and multi-generational living arrangements – these, again, are disproportionally experienced among Māori and Pacific people.

With the global pandemic likely to stretch long into 2021, this work continues our vital contribution to future national-scale disease incidence and impact modelling, especially in matters of equitable access to healthcare.

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HTTPS *www.nzma.org.nz/issue-id/vol-133-no-1520-4-september-2020*

Celebrating our achievements

Science New Zealand represents the country's seven Crown Research Institutes, and the annual Awards recognise research excellence at each CRI. In the 2020 ceremony, held at Parliament in December, Bruce Warburton won a Lifetime Achievement Award for his work in wildlife ecology over more than 40 years. Rachelle Binny won an Early Career Researcher award for the application of mathematics to the study and control of vertebrate pests. The Land Cover Database (LCDB) Team – comprising Peter Newsome, David Pairman, James Shepherd, John Dymond, Michelle Barnes, Anne Sutherland and Stella Belliss, supported by wider research and delivery teams including Jan Schindler, Ben Jolly, James Barringer, David Medyckyj-Scott, Andrew Manderson, Robbie Price, and research contractors Michael Speth, Mike Cochrane, Andrew Cowie, and Heather North – took a Team Award for the creation and delivery of the LCDB. The team acknowledges the significant contribution of Deb Burgess at MfE for her work in ensuring that the LCDB meets government and other stakeholder needs.

Members of the LCDB team at the Science NZ Awards.

Ronny Groenteman has been elected as Vice President of the International Organisation for Biological Control (IOBC-Global) for 2020 to 2024. IOBC-Global is an umbrella organisation that brings together globally leading researchers and practitioners in the different disciplines of biological control, with much potential for future collaborations.

Ronny Groenteman

Nathan Odgers has been appointed to the Executive Committee of the Citizen Science Association of Aotearoa New Zealand. The Association is a recent initiative (~12 months old) so is currently in a formative and developmental stage. The Association aims to encourage the development and practice of citizen science in Aotearoa. Nathan's involvement will help shape the direction and development of the Association.

Nathan Odgers

Colin Meurk was awarded the New Zealand Order of Merit for services to ecological restoration in the 2021 New Year's Honours List. Colin's wide-ranging academic interests in landscape ecology and conservation span many decades, and he has served on many environmental committees and advised numerous restoration projects. Colin co-developed the landscape model that drives many catchment-scale restoration plans in New Zealand cities and districts, and was also the founding Chair of iNaturalist New Zealand, Mātaki Taiao, the largest citizen bioscience platform in the country.

Colin Meurk

Regenerative Agriculture in New Zealand: pathways to building the scientific evidence and progressing national narratives

Regenerative agriculture (RA) is proposed as a solution to reverse climate change, biodiversity loss, declining water quality and health of freshwater ecosystems, well-being crises in rural and farming communities, and food system disfunctions. In New Zealand, RA may also open and increase access to overseas premium and niche markets.

RA is a global grassroots farmer-driven movement founded on an ecological paradigm that seeks to address some of the failings of our current global food system. The RA movement acknowledges that farmers can take responsibility and become part of the solution to mitigating the negative environmental impacts of food production. But RA is much more than a system of farming – it is a mindset that sees possibilities and opportunities for different ways of living, working, and farming. RA aligns with growing worldwide societal and consumer demands for safer, healthier, environmentally sound food systems and engages in innovative processing and market pathways.

However, there are divergent views in New Zealand society, with at the extreme ends: some calling for transformation (beyond incremental change), while others point out that many of the real or perceived negative environmental impacts of farming are the consequences of practices not widely employed in New Zealand. Furthermore, while there is a plethora of scientific studies on the impact of individual RA practices, there are few reporting on outcomes from RA systems, and these were for the most part undertaken overseas. Hence there is a lack of clarity about what RA actually is, skepticism about its claimed benefits, and uncertainty as to whether the concept is even relevant to New Zealand.

A collaborative and consultative research project was undertaken from June to December 2020, involving more than 70 New Zealand-based organisations and 200 people, including producers, researchers, private consultants and educators, industry levy bodies, banks, retailers, not-for-profit organisations, and overseas researchers. The project has included representation from a wide range of practitioners in science, scientific institutions, and farming systems of New Zealand – in the hope that the resulting recommendation for the building of scientific evidence will have legitimacy and relevance across all parties concerned with RA.

The project was anchored primarily in a western science worldview because discussions with Māori practitioners and researchers highlighted that tāngata whenua and their diversity of enterprises cannot meaningfully engage in a conversation about RA and its linkage to Te Ao Māori until the time, space, and resource for collective thinking have taken place. This collective thinking needs to be undertaken in the first instance by Māori experts and practitioners and has made a start elsewhere.

The project was funded by the Our Land and Water National Science Challenge, the NEXT foundation, and Manaaki Whenua with in-kind support from multiple research institutions, and governmental and private entities.
The project aimed to: (1) better understand what RA means for New Zealand within-farm, and (2) develop a scientific framework based on current evidence for guiding RA research in New Zealand. A white paper and supporting report, presenting the highlights of findings from this project, will be publicly released in the first quarter of 2021.

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