



Manaaki Whenua
Landcare Research

Our Land, Our Future

Tō tātou whenua,
mō āpōpō

G.40 Annual Report (2017)

PART 1

Our Story
Our Ambitions
Our Strategic Focus

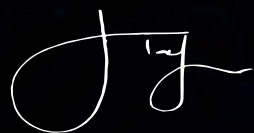
ANNUAL REPORT 17



As New Zealanders we are defined by our land

As the Crown Research Institute for the land, our role is to ensure that all New Zealanders have the knowledge, understanding and tools to truly live in harmony with our land: enjoying its many gifts, preserving its unique diversity, and enriching it through our creativity, care, industry and culture.

We asked our people and partners what they expect of Manaaki Whenua – Landcare Research and in this report we present what we have taken from those conversations. Our commitment to New Zealand lies in our ambitions and our strategic focus and we will report regularly on the progress that we make.



Jane Taylor - Chair



Richard Gordon - CEO



We present our annual report in two parts. Part 1 introduces our new brand, highlights some of our key science and research outcomes, and explores the strategy underpinning our work. In the second part we present our Directors' report, financial statements, and a detailed review of our core funding [SSIF] achievements.

PDF versions of both Part 1 and Part 2 are available for download from the Manaaki Whenua – Landcare Research website: landcareresearch.co.nz

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**Our Land,
Our Future**

OUR PURPOSE

Science for Our Land and Our Future

Ko te pūtaiao mō tō tātou whenua, mō āpōpō

OUR FOUR AMBITIONS FOR NEW ZEALAND

Our Biodiversity

We know, value and actively preserve our unique biota and ecosystems

Our Biosecurity

Our land is protected from invasive biological threats

Our Land

We use our land, soil and water resources wisely

Our Environment

We are an environmentally informed nation taking action together

OUR STRATEGIC FOCUS

World-class science

Our people

Real-world solutions through partnership & integration

Growing our impact sustainably

Science working with mātauranga Māori

Engaged with all New Zealanders

Our National Outcomes

With innovative science leadership and effective collaboration with our stakeholder partners to apply our research, we will:

- >> improve the measurement, management and protection of New Zealand's terrestrial ecosystems and biodiversity, including the conservation estate
- >> achieve the sustainable use of land resources and their ecosystem services across catchments and sectors
- >> improve the measurement and mitigation of greenhouse gases from the terrestrial biosphere
- >> increase the ability of New Zealand industries and organisations to develop within environmental limits and meet market and community requirements.

EACH CRI AGREED A SET OF NATIONAL OUTCOMES WITH SHAREHOLDERS IN 2010/11. WE REPORT PROGRESS AGAINST THESE IN PART 2.

From Our Chair

Jane Taylor

This year marks an important milestone for Manaaki Whenua – Landcare Research as we celebrate our 25th anniversary during what has been a landmark year for the organisation. A strong financial performance in the 2016/17 financial year, exceptional bidding successes, excellent science, development of our Strategy 22, and the development of our new brand all mark this year as one to remember and one that will form a strong foundation for our science over the next 25 years.

Our purpose is to ensure that all New Zealanders have the knowledge, understanding and tools to truly live in harmony with our land. 'Science for Our Land and Our Future' represents our commitment to all New Zealanders to achieve that goal.

In support of our purpose we have developed Strategy 22, which sets our strategic focus and priorities for the next five years. Strategy 22 is built on four foundation goals that are the building blocks of our future: our people, partners, infrastructure and sustainability. These foundations power our science goals, which cover the key ways our science and research need to evolve to meet the needs of New Zealand. Strategy 22 has been designed to deliver for all of our key partners and their diverse needs. The Board and the senior leadership team are pleased to present and endorse this strategy, the result of a highly consultative development process both internally and externally.

Last year the Board and I asked the senior leadership team to create a step-change in our brand image. We saw both an opportunity and a need to connect much more strongly with our internal and external audiences. With this annual report I am excited to launch our new brand and story, and to elevate our Māori name Manaaki Whenua to the fore in our identity.

While this new brand is an important tool, it is our people who will bring it to life. Our strategy is designed to empower and enable our people to deliver excellence across our science, research and support disciplines. I was delighted to see the hard work of the organisation result in a very positive engagement result, up 7% from last year. We have also continued our strong commitment to health and safety with the election of 24 health and safety representatives across the organisation and the appointment of a specialist health and safety role.

Our strong financial performance builds on past years. Total revenue of \$65 million for the year was \$2.9 million better than budget and \$7.8 million up on the previous year, with return on equity of 10.4%. Underpinning this financial performance were highly successful science proposals across numerous funding sources and involving many of our partner organisations. We have accumulated sufficient capital to undertake significant investment in key infrastructure, including the Lincoln re-development, which we plan to commence in the 2018 financial year. This investment will ensure we have the facilities and tools to support great people doing great science and research for New Zealand.

Our science continues a strong trend of internationally recognised excellence while evolving to meet our major sector partner needs. Key science themes include delivering 'user-ready solutions' that address meaningful challenges, increasing Māori-centred research, integrating research across domains, building new partnerships to bring key capability together, and the increasing digitisation of our collections and databases, thereby improving access for New Zealand and global users alike. Our science excellence is reflected in publications that are consistently ranked very highly for their academic impact, and our resulting citation index of 1.69 leads the New Zealand science sector.

As the host organisation we have aligned over \$8 million of funding per annum to support the Biological Heritage National Science Challenge to achieve its goals. Our subsidiary, Enviro-Mark Solutions, continues to support national and international businesses to make credible claims about their environmental performance through internationally regarded certification programmes.

A very special thank you to our people for your commitment and professionalism, and to our shareholding Ministers and the Ministry of Business, Innovation and Employment for your support. And finally, a huge thank you to our client organisations and partners with whom Manaaki Whenua – Landcare Research has formed the key relationships that have underpinned our purpose.

Q & A

Richard Gordon – CEO

It looks like 2016/17 has been a busy year?

We've seen a big upturn in the volume of research, science and technology we are doing, and at the same time we have been planning for the next 5 years. We've been working on who we are as an organisation, our role in the national landscape, and how we make a difference. This annual report presents our ambitions, goals and commitments.

What changes are you seeing in the science that is required from Manaaki Whenua – Landcare Research?

Looking back over 25 years our focus has always been on biodiversity, our environment and our land. We were established the year after the Resource Management Act, and like that world-leading legislation, our work has evolved in response to the changing world, but has never lost its core purpose. What has been changing are the technologies we are using, the ways in which we interact with our partners, and also the role of science delivering impact for society.

Who do you see as your key stakeholders?

I prefer to call them partners because it is only by our working together with central and local government, the primary sector, science sector, Māori and the wider New Zealand public that we are able to achieve real impact and deliver on our ambitions for New Zealand.

How is Manaaki Whenua – Landcare Research's role unique within the NZ science system?

We are the Crown Research Institute [CRI] for our environment, especially our land and biodiversity. Understanding our environment requires a very broad view. We look across economic, social and cultural perspectives. We study different time scales, from thousands of years in our past to multiple future generations, and spatial scales from the microscopic through to national and global. We see ourselves as integrators in bringing all these dimensions together and working with a range of organisations.

As a scientist yourself, what does it really mean for science to work with Vision Mātauranga?

Māori have a deep philosophy and traditional knowledge of our land. The scientific approach of observation, measurement and testing hypotheses is different. The two world-views can inform each other while preserving and respecting their differences. By bringing these two world-views together, we can create new understanding, for example, of the state of our environment and opportunities for sustainable land use.

What did you learn though the development of the new brand?

We were reminded that New Zealanders share our passion for our land, but also that they have a lot of unanswered questions. We found that our organisation is not widely known or understood. These insights highlighted the immense opportunity there is to better connect with

New Zealanders, to share our stories and invite public participation in our science and research.

How does Manaaki Whenua – Landcare Research ensure sustainable business practices?

Our biggest impact as an organisation is through the impact of our science; but we are also an organisation with environmental, economic and social impacts of our own. Our people make Manaaki Whenua – Landcare Research what it is, and so we invest in their skills, safety and wellbeing. We actively seek to manage our environmental impact, reducing our carbon emissions with technology and offsetting the remainder through permanent indigenous forest. We contribute to the economy as an employer, but more importantly through the impact our solutions have for our partners.

Looking to the year ahead, what are you most looking forward to?

We have a fresh vision, purpose and goals, which our staff and partners helped us shape. I look forward most to building our common purpose around those. There's so much really interesting science going on, and much of it is really challenging. But we're up for those challenges, and I'm looking forward to seeing us tackle them with our partners. I'm always excited by the passion that is generated by our people, especially when they are out working with folk from other organisations. I also look forward to more people out there in New Zealand and globally hearing about what we do, getting excited about it, and discovering opportunities to get involved.



Our Story



Finding Our Story

As New Zealanders we are defined by our land, Aotearoa. We are proud of its natural beauty and its unique biology. Our economy is underpinned by the resources this land gives us. Even its size and location shape our psyche as a people: always the challenger, the innovator. Always punching above our weight and delivering beyond reasonable expectations.

Yet we are increasingly aware of the fragility of our land and everything that shares it with us. New Zealanders are asking some big questions, and struggling to find the answers.

In the past year we set ourselves the challenge of better connecting with New Zealanders by strengthening our brand. But we had to start by finding our story, our core reason for being.

The answer is pretty simple, and it links back to the importance of this land, Aotearoa, to all New Zealanders. As the CRI for our land, environment, biosecurity and biodiversity, our role and responsibility are clear: Our Land, Our Future. This land, and everything that shares it with us, is our future.



Science for Our Land and Our Future

Ko te pūtaiao mō tō tātou whenua, mō āpōpō

Our Purpose

We are an organisation of around 330 scientists, researchers and experts who are dedicated to helping New Zealanders understand and live well with this land.

We want to ensure all New Zealanders have the knowledge, understanding and tools to live in harmony with our land by enjoying its many gifts, preserving its unique diversity, and enriching it with our creativity, care and culture.

Kia matomato te tupu a Tāne, a Rongo, a Haumia–Tiketike

Let it be that the land and
all its fruits may flourish

Our Vision

Acknowledging the unique and special relationship that Māori have with Aotearoa and with their land and the environment, we draw on a uniquely Māori perspective of the world around us.

Tāne, Rongo and Haumia-Tiketike are tamariki [children] of Rangi, our sky father, and Papa, our earth mother. Together they hold dominion over the forests and both cultivated and uncultivated food (e.g. kūmara and fernroot) and the land-based realms that they exist within.

If we use the land wisely, then the domains of Tāne, Rongo and Haumia-Tiketike will be in balance. This concept of wise land use is a core purpose of Manaaki Whenua – Landcare Research, and inherent in kaitiakitanga [custodianship] of our natural taonga and resources for future generations.



Holden Hohaia
GM Māori Development

Our Name

Manaaki Whenua Landcare Research

Through clarifying our purpose and vision for New Zealand it became clear there was an opportunity for us to more fully embrace our Māori name, Manaaki Whenua.

These two words hold deep meaning for us as an organisation, describing the role and responsibility we have been given by New Zealanders to care for our land, Aotearoa. 'Manaaki' means to cherish, conserve and sustain; 'Whenua' encompasses the soil, rocks, plants, animals and the people inhabiting the land – the tangata whenua.

This name also challenges us to weave a Māori world-view into our science and research in order to develop deeper insights and realise solutions for all New Zealanders. Manaaki Whenua is also part of our heritage. It is the name we were founded under in 1992.

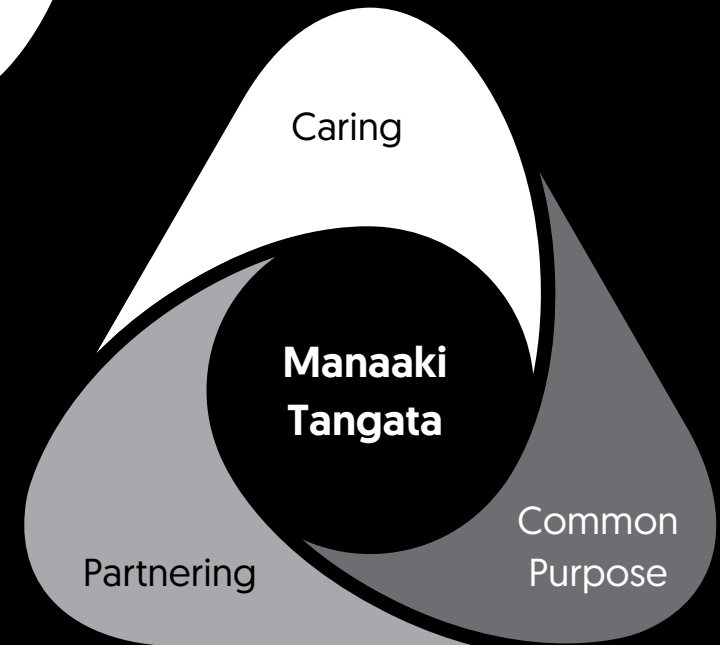
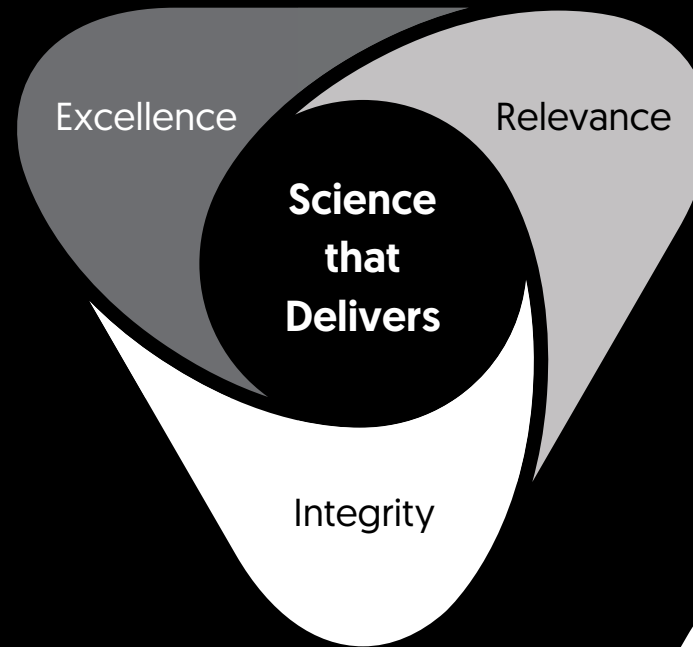
As we look ahead to our role in New Zealand's future we will identify ourselves as 'Manaaki Whenua – Landcare Research' or more simply as 'Manaaki Whenua'.

Our Values

Our identity is underpinned by shared values we collectively cherish in each other.

Science that delivers reflects our shared purpose, and our shared commitment to doing science and research that will result in practical solutions for New Zealand. As fascinating as any research can be, we value research relevant to New Zealand and the challenges we face as a country. Our science must be excellent, and as an independent research institute our integrity underpins our partners' trust.

'Manaaki tangata' means care for the people. Our diversity of skills, experiences, nationalities and knowledge allows us to understand and solve complex problems. By partnering with other people and organisations we can expand that diversity to great effect and still share a common purpose. This unites our action, our resolve and the impact we can have for New Zealand. Our success rests with our people, so we are driven to care for them and make sure they have an environment and support that allow them to succeed.



At a Glance

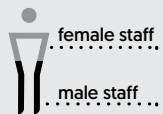
Our nine sites across New Zealand house over 330 permanent staff and another 60 research associates. These locations facilitate science projects that span the length and breadth of New Zealand.

Several sites are also home to five Nationally Significant Collections, and other significant collections which we maintain on behalf of New Zealand.

In addition to our collections, we maintain a number of online databases and tools that provide detailed information about our land, soils, biodiversity, biosecurity and environment for use by our scientists and researchers, and for many other scientists, researchers, post-graduate students, government departments, regional councils, and industries across New Zealand and around the world.

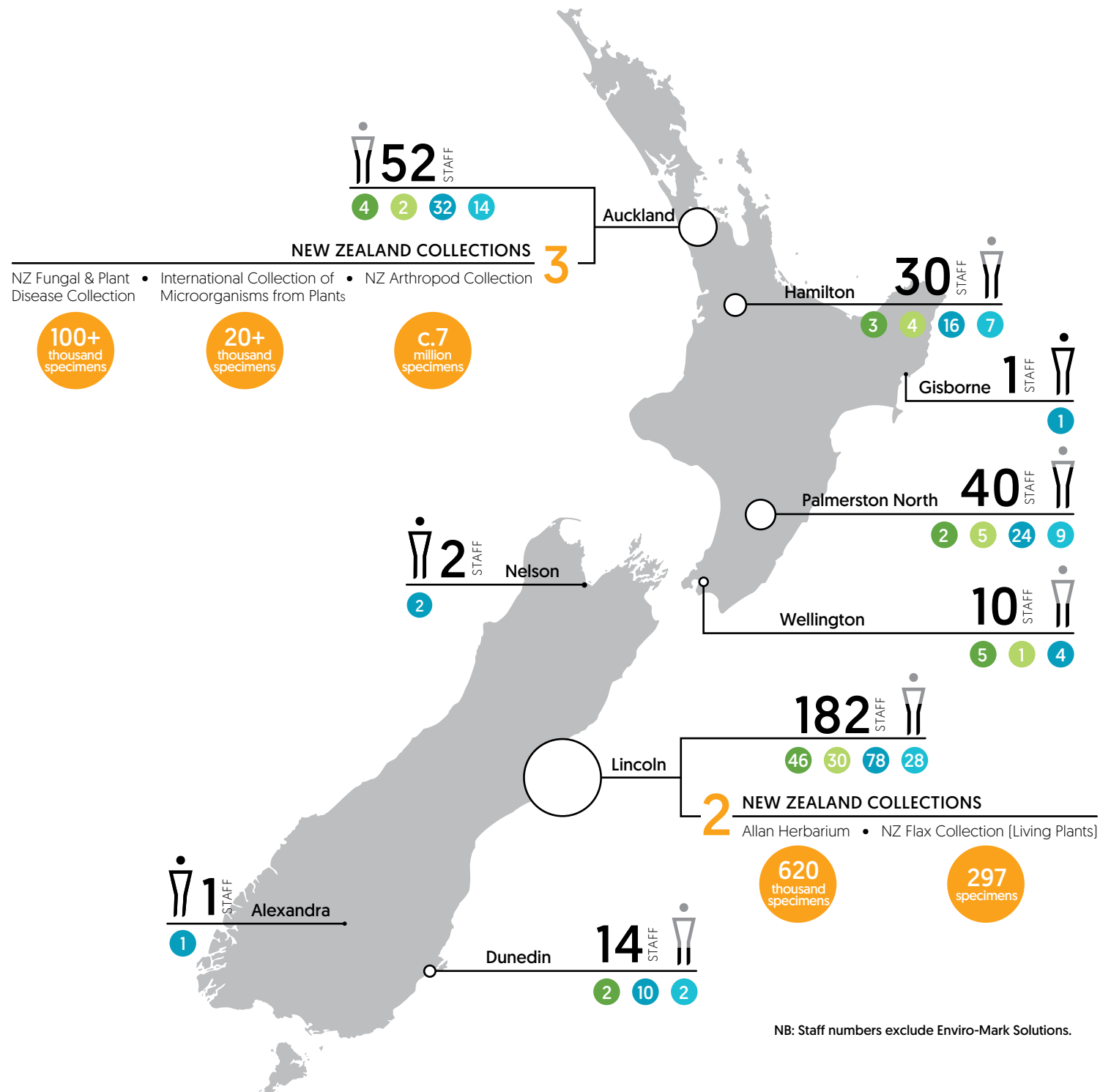
KEY

Gender proportion

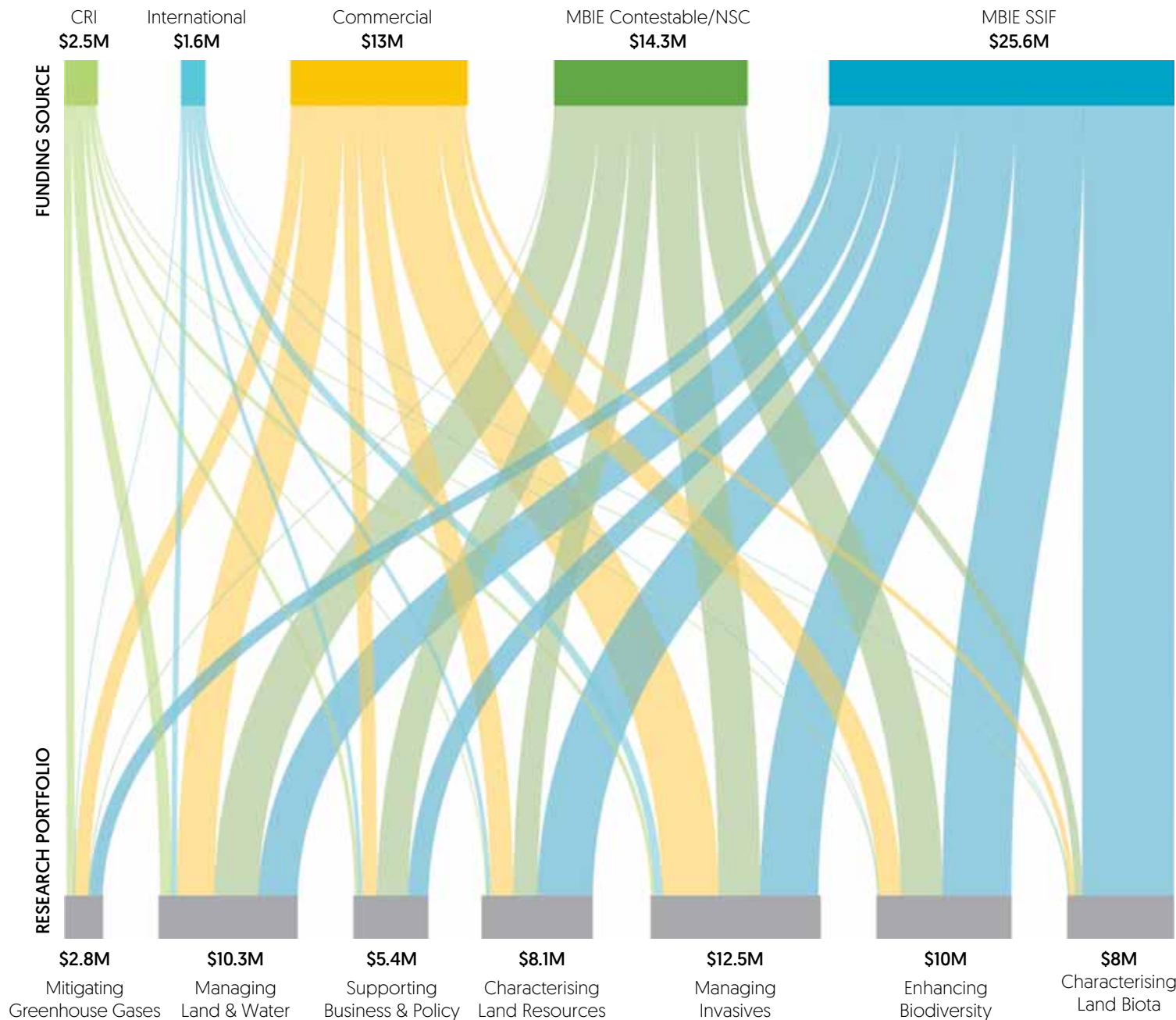


Role

- General support
- Research support
- Scientist
- Technician



NB: Staff numbers exclude Enviro-Mark Solutions.



Our Funding & Impacts

Our science and research is funded from a variety of sources, including the New Zealand Government, industry and international sources. This funding powers research programmes across seven portfolios.

NB: Numbers on the diagram are rounded.

Our Board



Jane Taylor

Chair

Jane is a professional director, with a strong background in both law and finance.

She holds numerous directorships and is also chair of Predator Free 2050 Ltd, a key player in achieving New Zealand's Predator Free 2050 ambition.

She was awarded the Otago Daily Times Business Leader of the Year for 2016.



Dr Paul Reynolds

Deputy Chair

Paul served as Chief Executive of the Ministry for the Environment from 2008 until 2015. He holds a PhD in Biochemistry from the University of Otago.



Prof. Caroline Saunders

Director

Caroline has 30 years' research expertise and over 300 publications specialising in sustainable economic development.



Prof. Emily Parker

Director

Emily is a Professor in Chemistry and Biochemistry at Victoria University, leading a team exploring the understanding and application of complex biomolecules.



Dr Chris Downs

Director

Chris is Research Director for CSIRO's Agriculture and Food Business Unit in Australia. He leads science capability in food innovation and the delivery of science impact.



Ngarimu Blair*

Director

Ngarimu joined us in 2017. He is an elected representative of the Ngāti Whātua Ōrākei Trust Ltd, the elected body of the Ngāti Whātua Ōrākei tribe of central Auckland.



John Rodwell*

Director

John is an experienced director with a background in corporate finance, investment banking and investing in agri-businesses.



The Honourable Kate Wilkinson*

Director

Kate is a former Member of Parliament and Cabinet Minister. She was appointed Commissioner of the Environment Court in May 2015.

Leadership Team



Richard Gordon

CEO

Richard is passionate about good science making a positive difference for society and the environment.

He became Chief Executive in 2011 after 5 years as Science General Manager.



Justine Daw

GM Partnerships

Building successful external partnerships and co-leading our science portfolios



Peter Millard

GM Science

Developing new research collaborations and co-leading our science portfolios



Phil Hart

GM Development

Funding, investment and commercialisation leadership



Nigel Thomson

GM Corporate Services

Ensuring the sustainable and efficient operation of our organisation



Fiona Carswell

Chief Scientist

Leading our high-performing science teams



Holden Hohaia

GM Māori Development

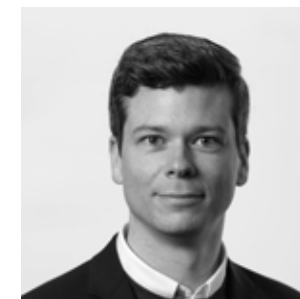
Building strong and mutually valuable partnerships with Māori



Katrina Benedetti

GM People & Culture

Building a great culture with great people



Chris McDermott

GM Brand & Communications

Building one of New Zealand's great brands



Our Ambitions for New Zealand

1 Our Biodiversity

We know, value and actively preserve our unique biota and ecosystems

2 Our Biosecurity

Our land is protected from invasive biological threats

3 Our Land

We use our land, soil and water resources wisely

4 Our Environment

We are an environmentally informed nation taking action together

4 Ambitious Goals for New Zealand

Delivering on our purpose requires the delivery of exceptional science and research spanning a wide array of scientific disciplines. Our four ambitions are designed to present our science and research in an approachable and meaningful way for all New Zealanders to engage with.

Our science contributes to a number of National Goals that are managed by other organisations. Where relevant we have highlighted some of these goals on the following pages as a broader national context for our science and research.

As the CRI for our biodiversity, biosecurity, land and environment, Manaaki Whenua supports the United Nations Sustainable Development Goals. To highlight this we have indicated the Sustainable Development Goals that our research and business activities support in the following sections.

Our Biodiversity



Our ambition is to help New Zealanders know about, value and actively preserve our unique biota and ecosystems.

Aotearoa has a rich biodiversity, from tiny bacteria to the majestic kauri tree, but it is under threat from invasive species, climate change, land-use intensification and conversion, mining, urban development and a variety of other pressures. Discovering, protecting and restoring this precious taonga – our natural biodiversity and the ecosystems that support it – requires exceptional science and infrastructure, practical policy, real-world tools and solutions, and the support and participation of every New Zealander.

Our biodiversity is in decline, and to reverse this trend we must first better understand our native and introduced species. The Nationally Significant Collections and Databases hosted by Manaaki Whenua on behalf of New Zealand form an ever-growing repository of native and invasive species. The knowledge these assets contain underpins our ability to actively manage our biodiversity.

We work with the Department of Conservation [DOC], Ministry for Primary Industries [MPI], regional councils, iwi, wildlife sanctuaries, non-governmental and community groups, as well as business to improve New Zealand's biodiversity management. We also contribute through major national initiatives such as the Biological Heritage National Science Challenge and Predator Free 2050.

Highlights

Protecting New Zealand's most threatened species

Manaaki Whenua's research provides DOC, regional councils, conservation groups and communities the scientific foundations needed to improve their efforts to protect the most threatened species and ecosystems. Spanning decades, these efforts rely on a deep understanding of ecosystem resilience, tipping points and how various threats (from climate change through to invasive species) affect native species. This year, we supported numerous innovations to boost protection of our valued species.

New genetic tools for kauri

We developed a genomic library resource for kauri conservation, and screened *Agathis australis* and several other kauri species. This will be instrumental in work to preserve kauri populations against threats such as kauri dieback.

Storm petrel established on Little Barrier Island

We established a breeding colony of storm petrel on Little Barrier Island. The colony is crucial for understanding breeding biology, dispersal and feeding range, and for identifying reliable genetic markers for sex determination. The research will provide information to use in developing conservation programmes.

More accurate assessment of New Zealand's biodiversity

Many national and international processes report on the state of New Zealand's environment and biodiversity to track the success of conservation efforts. Aotearoa has

many unique species and ecosystems, so getting an accurate understanding of the state of, and trends in, our biodiversity is a key challenge for Manaaki Whenua. This year, our research made a number of major advances in developing consistent biodiversity measures so New Zealand can more accurately and cost-effectively assess the status of its biodiversity.

World-leading, nationally consistent biodiversity monitoring

We developed and rolled out a suite of nationally consistent methods, indicators and templates for biodiversity monitoring by regional councils. The tools were showcased at the prestigious Group on Earth Observations Biodiversity Observation Network (GEO BON) Conference. The culmination of seven years of work, our use of a set of integrated indicators, measured systematically nationwide, was recognised as unique.

Bird research underpins major Parliamentary Commissioner for the Environment (PCE) report

We provided the first spatially explicit, nationally comprehensive, all-species, multi-decade analysis of the state of and trends in New Zealand birds for the report on the state of New Zealand's birds recently released by the PCE. Our research helped show that despite conservation efforts, on the mainland many of New Zealand's bird species have continued to decline in recent decades.

Bicultural biodiversity monitoring system

Working with Tuhoë Tuawhenua Trust, we developed a bicultural forest monitoring system using both community-based and national biodiversity monitoring and reporting

National Context

By 2025, New Zealand's target is a biological heritage that is more resilient and its decline reversed

NZ BIOLOGICAL HERITAGE NATIONAL SCIENCE CHALLENGE

Māori are managing their interests in biodiversity, reflecting different iwi and hapū priorities, and sharing in the benefits of its use, to support their economic and social aspirations and fulfil their responsibilities as kaitiaki.

NEW ZEALAND BIODIVERSITY STRATEGY OBJECTIVE

Manaaki Whenua – Landcare Research supports the SDGs



SUSTAINABLE
DEVELOPMENT
GOALS



approaches. The focus was on forests in Ruatāhuna. The Tuhoe Tuawhenua world-view was the platform used to understand the tangata whenua relationship with the environment, and their values and aspirations for the forest. An important outcome was the creation of a set of prioritised bicultural indicators to assess forest health.

Next-generation biodiversity monitoring

We developed a framework to integrate molecular-based (eDNA) techniques into biodiversity monitoring programmes. These new techniques are critical for helping New Zealand assess biodiversity status at large scales more accurately and cost-effectively. We also lead work in advancing new satellite-based (remote sensing) methods for biodiversity monitoring, with a focus on vegetation.

Populating New Zealand's tree of life

Manaaki Whenua's collections and databases are nationally significant and used to identify New Zealand and exotic species and protect and conserve them. Doing so is a challenge because many species are not yet identified, named, described or characterised. This year our research made a number of major advances in completing the New Zealand 'tree of life'.

High-priority branch of the tree of life completed

Cardamine is one of New Zealand's largest flowering plant genera. This year we completed a taxonomic revision that provides comprehensive information on 40 taxa native to New Zealand, with 31 species newly named and described. This revision represents a culmination of over two decades worth of research, delivers on a priority for conservation

managers, and will inform species recovery plans and conservation planning.

Online information on Veronica

Veronica is a significant genus for New Zealand, containing 144 species that include everything from nationally critical indigenous species through to exotic weeds. A new treatment for the genus was completed and will be published in the eFlora online series.

Two new digital publications for Fauna of New Zealand Series

Noctuidae is a highly diverse and widespread family of moths. Our Fauna revision of this family will enable biosecurity officers to differentiate native species from intercepted specimens. The Fauna on *Ceratomerinae* flies we produced will also enable easier identification of species presenting potential biosecurity risks.



Kōkako

Bird of the year making a comeback.

It's a familiar story: predators and habitat loss taking their toll on yet another vulnerable species. The forest-dwelling kōkako, whose melancholic song makes a lasting impact on those who hear it, was down to 330 breeding pairs in 1999. Fearing this icon would be lost forever, DOC, Auckland Regional Council and several community groups such as the Kaharoa Kōkako Trust took action.

Manaaki Whenua has a long history of providing the science behind these recovery efforts. John Innes, a wildlife ecologist, was instrumental in writing a new recovery plan (2017–25) and is working with DOC to ensure its success. This latest version of the plan is a culmination of 30 years' work by John and others.

Today there are around 1,570 breeding pairs because of efforts to control predators and move breeding pairs to re-establish populations or augment existing populations.

Kōkako can now be found living in 13 translocated populations on the mainland and offshore islands and have gone from 'Nationally Critical' to 'At Risk' – recovering.

This is one of the most successful conservation stories of a New Zealand bird species, achieved through the collaborative hard work of scientists, conservation managers, iwi, agencies such as Forest and Bird, DoC, regional councils and many local communities.





Kiwi DNA

No blood spilt.

The kiwi is an important national symbol and key native species, so every care should be taken to ensure conservation efforts do no harm. Kiwi are delicate creatures, prone to stress, and not surprisingly they do not like giving blood for DNA testing.

Seeing the need for a better method, the biodiversity and conservation team at Manaaki Whenua developed a new kiwi DNA testing tool using feathers and faeces instead.

While DNA has been extracted from bird droppings, and used for mitochondrial analyses and sex determination studies, it is not widely used for population genetics and estimating population size.

Undeterred, Manaaki Whenua gathered 100 feather and scat samples from kiwi at the Westshore Wildlife Reserve [Napier], Auckland Zoo [Auckland] and Kiwi Encounter [Rainbow Springs, Rotorua].

The team used DNA testing methods to develop a comprehensive kiwi marker panel to discriminate between major lineages and provenances within multiple kiwi species, and to retrieve population-level genetic data for conservation management.

They developed a successful extraction method, and the DNA results produced reliable genotypes. Manaaki Whenua population geneticist Daniel White said there's respite in store for kiwi. 'The use of opportunistic kiwi DNA sources is not only less invasive, but could also be particularly suitable in those remote areas that are currently unmanaged and for which less is known.'

Restoring Our Wetlands

We are working with Waikato-Tainui to restore wetlands and clean up the country's longest river.

When the Waikato River Authority recently gave the river a failing grade, it provided a catalyst for all of the river iwi, including Waikato-Tainui, to make a plan to restore this taonga.

For Rahui Papa, then Waikato-Tainui chairman, wetlands are important because of their benefit to the river. 'Wetlands are the kidneys of the river and play a wonderful role in filtering out the stuff we don't want in the main bed of the river.'

As part of the Wetland Restoration Programme, Manaaki Whenua and the Waikato Raupatu River Trust [WRRT] produced an online cultural wetland handbook, *Te Reo o te Repo: The Voice of the Wetland*, to showcase iwi-led wetlands work happening around Aotearoa.

Waikato-Tainui tribal member Yvonne Taura, a Manaaki Whenua kairangahau (researcher) and previously a science research advisor for the WRRT, said the articles in the handbook were written by kairangahau Māori and scientists working with iwi.

'What we're doing is showing how mātauranga Māori and science can work together to develop frameworks, initiatives, or projects that everyone can get involved in. It's not just one telling the other, it's together – they each have a role to play when it comes to the restoration of any ecosystem.'



Our Biosecurity



Our ambition is for New Zealand to be protected from invasive biological threats.

The unique diversity of life in Aotearoa and our ability to live off the land are constantly threatened by invasive weeds, pests and diseases. From insatiable possums to tenacious weeds, controlling these threats and maintaining our biosecurity require vigilance, innovation and commitment.

Manaaki Whenua will need to be innovative and explore new and challenging areas of science to help meet Predator Free 2050 and Biosecurity 2025 goals. Our research focuses on border security for early detection and prevention, and already-established control methods for invasives. Innovative technologies can provide great opportunities, but in our research we also recognise the need to understand the social licence for new and emerging control methods, requiring a focus on effective engagement with New Zealand communities.

We work with a wide range of government, Māori, community and private sector groups to achieve biosecurity goals for New Zealand, as well as contributing to major national initiatives such as Better Border Biosecurity and Predator Free New Zealand.

Highlights

International impact of invasives research leadership

Manaaki Whenua's global reputation as world-leaders in invasive species management continues to grow through our engagement with the IUCN (International Union for the Conservation of Nature).

We are a supporting partner of the 'Honolulu Challenge on invasive species' launched late last year, and co-authored material on the 'Use of biocontrol agents to manage invasive species' tabled for consideration at the 2016 Conference of the Parties to the Convention on Biological Diversity.

Supporting a predator-free NZ

Our science and technology are making good progress in supporting both the technical advances needed to knock out a key predator species, and gaining public approval (social licence) to apply these in New Zealand communities.

Confirming rapid eradication of TB from possums

We demonstrated how intensive monitoring and TB surveillance during a possum control operation over 80,000 hectares in the central North Island could quickly provide near-certainty of TB eradication from possums. By confirming achievement of a very high kill (99.6%) and recording a zero TB prevalence in possums, the trial provided 'proof of concept' for confirming eradication of TB from possums in large areas of difficult terrain (even when TB remained temporarily present in other spill-over hosts). These results boost confidence that national

eradication of TB can be achieved. It also suggests that, with further refinement, the Predator Free NZ goal of 100% possum kill may be attainable using aerial 1080.

Predator Free NZ 2050 Research Strategy Leadership

Dan Tompkins led development of the Research Strategy for Predator Free 2050 Ltd under the Biological Heritage National Science Challenge. This work will support more detailed science planning going forward.

Trojan Female Technique potential in mice

For the newly developed 'Trojan Female Technique' for biological (natural) control of mice to work, the resulting genetic variation needs to affect sperm performance. This year we were able to demonstrate that it does affect sperm performance in mice, which provides greater evidence this approach could be developed for mouse control.

New trapping technologies

For the Cape to City project, we jointly developed, tested and passed a kill trap to kill ferrets humanely that can be easily used by community volunteers.

Science infrastructure plays a critical role in NZ's biosecurity system

Through our nationally significant collections and databases and science infrastructure, Manaaki Whenua provides authoritative, science-based species identification, wildlife monitoring, predator detection and diet analysis, and disease screening for native species.

National context

New Zealand is protected from biological risks through an effective biosecurity system

MINISTRY FOR PRIMARY INDUSTRIES GOAL

New Zealand is rid of its most damaging introduced predators that threaten the nation's natural taonga, economy and primary sector

PREDATOR FREE 2050 OUTCOME

Biological eradication of TB from New Zealand by 2055

NATIONAL PEST MANAGEMENT PLAN – TB PLAN TARGET

Manaaki Whenua – Landcare Research supports the SDGs



**SUSTAINABLE
DEVELOPMENT
GOALS**



Our EcoGene® facility clears seeds for export

New Zealand's seed growing and export industry is worth \$9 billion a year and supplies 35% of the global white clover seeds market, 25% of all national feed grains, and 60% of the seeds for growing pasture. EcoGene® recently worked with one of New Zealand's largest seed pea exporters to overcome new GMO (Genetically Modified Organisms) regulatory barriers in two major markets. We tested and provided GMO-free certificates of compliance for 660 tonnes of pea seeds, ensuring continued market access.

Blackgrass invasion

Blackgrass (*Alopecurus myosuroides*) is a serious invasive weed. Through our science collections, EcoGene® facility,

and molecular capabilities we supported efforts to maintain New Zealand's biosecurity and global market access. Our staff confirmed the identity of three blackgrass specimens grown by MPI from contaminated seeds detected in a consignment of imported ryegrass seeds, as well as three blackgrass populations discovered in the wild. The new blackgrass populations could then be eradicated before spreading further.

Science key in supporting New Zealand's myrtle rust incursion response

Myrtle rust is a plant pathogen that could potentially devastate pōhutukawa, rātā, mānuka, kānuka and other native trees, with significant economic implications for

New Zealand's honey industry. Manaaki Whenua staff continue to support the national myrtle rust incursion response by: providing input to MPI's technical advisory group and the Strategic Science Advisory group; providing provenance data for cultivated samples of Bartlett's rātā (a critically endangered species on DOC's Threatened Species List); developing modelling tools for guiding myrtle rust surveillance and detection; and quantifying the distribution of each native myrtle species to help DOC assess the risk to native honey eaters (e.g. bellbirds, tūī).



Tutsan

Manaaki Whenua reached a key milestone in its war against weeds, releasing a biocontrol agent to tackle the weed tutsan.

Tutsan (*Hypericum androsaemum*) is thriving in parts of the central North Island and is a threat to farmers' livelihood. Traditional control methods are expensive, costing an estimated \$400 per hectare per year.

Biocontrol offers a cost-effective, environmentally friendly and permanent solution to weed control. Carefully selected biocontrol agents target only weeds, and don't harm desirable plants or pollute the environment. They travel to wherever the weed is present and can return again and again to kill off new growth.

In 2014 Hugh Gourlay brought back a moth and a beetle from Georgia, Eurasia, which he bred at Manaaki Whenua's insect containment facility. On 15 February 2017 the team completed the first public release near Taumarunui, marking the culmination of nearly a decade of hard work.

'[Farmers] have turned to science for a solution by forming TAG [Tutsan Action Group], a group of farmers who have dipped into their own pockets and joined forces with the likes of us, Horizons Regional Council and the Sustainable Farming Fund, to come up with a solution,' Hugh said.

Hugh is optimistic the foliage-feeding beetle (*Chrysolina abchasica*) and the seed-eating moth (*Lathronympha strigana*) will eventually be as effective as other biocontrol success stories.

Chemical Camouflage

Messing with the minds of predators like ferrets, feral cats and hedgehogs is showing promising results for New Zealand's birdlife.

In New Zealand, controlling predators is a critical part of preserving our native biodiversity. Ferrets, hedgehogs and (to some extent) cats rely mostly on smell to hunt. For their experiment Grant Norbury and his team smeared Vaseline infused with bird odour (chicken, quail or gull) onto stones at around 700 randomised points across two 900-hectare sites in the braided riverbeds of the Mackenzie Basin.

'Chemical camouflage is a concept of trying to mess with predators' minds,' Norbury said. 'When predators hunt, they cue into signals that represent food. So the idea is to provide signals to them that don't have rewards.'

It was the first time the theory had been tested on such a large scale, and success will be measured by the survival of braided river birds like the banded dotterel and the nationally vulnerable wrybill.

'We measure egg survival because that's the easiest thing to measure, and so far we're getting quite encouraging results. We're finding significantly higher nesting success on the treatment sites compared to untreated sites. To really confirm it, we want to swap the treatments in the coming nesting season. If we reverse the treatments and get the same results that would be very compelling.'



An aerial photograph of a river delta, likely the Okarua River in New Zealand. The water is a vibrant turquoise color, contrasting with the surrounding land which is a mix of dark green, brown, and orange. The land shows signs of erosion and sedimentation, with winding channels and ridges. The overall scene is a complex, textured landscape.

Our Land

Our ambition is for New Zealanders to use our land, soil and water resources wisely.

Finding a healthy balance with our land and ecosystems is critical to ensuring our future prosperity. We can protect the health of our land, freshwater and soils even as we use them to thrive and grow as a nation.

Demand for information and new tools to support effective management of land resources in New Zealand is urgent and growing. Some of our most important natural resources have been over-allocated or have reached critical environmental thresholds because of unsustainable land-use practices.

To enhance the utilisation of the land and soil resources, New Zealand needs improved knowledge of the inherent variability and change over time, and across catchments and landscapes (natural, managed and urban); how the land responds to human pressures; potential limits to land-use intensification and other development; and what drives natural resource management decisions. New and improved tools are required to meet these challenges and support sustainable land management and resource allocation. This will improve the primary sector's economic and environmental performance, and support the provision of wider ecosystem services.

Highlights

Mapping, modelling and characterising New Zealand's land resources

The land supports New Zealand's wealth and well-being, but we still have a way to go to fully map our diverse soils and understand how they function. Manaaki Whenua's soil datasets aid government agencies, regional councils, landowners and iwi to better understand the land and make more sustainable land-use and land management choices. We made major progress this year in advancing knowledge of New Zealand's land and soil resources, for other researchers to use and to support development within environmental limits.

Improving S-map hydraulic data

We made significant progress in overcoming a critical gap in understanding our soils – soil hydraulic properties. Collaborating with Environment Southland, we fully characterised water storage and water movement through the soil for more than 100 unique soil layers. Following deposit of the data in the revitalised National Soil Database Repository, this new information will be used by S-map, the national soil mapping programme, to directly supply improved soil hydraulic properties to end-user tools such as OVERSEER®, as well as boost collaborative research in the Our Land and Water National Science Challenge.

Land resource information more readily available

We provided access to our land and soils data through online services including S-map Online (1,035,072 map views, 56,996 queries and 35,885 soil factsheet downloads), and access to soil data via OVERSEER® (40,200 requests

through the inter-operable web service that automatically extracts S-map data for soil properties). These services are ongoing.

SedNetNZ model improvements

As part of research to enhance our national sediment model, SedNetNZ, we quantified the benefits of Farm Plan actions, showing major reductions in sediment losses are possible on highly erodible land, and developed a new method to relate changes in sediment loads from changes in land management to the effects on water quality. This work will help inform new sediment attributes in the National Policy Statement for Freshwater Management. We also more accurately quantified the role of bank erosion in sediment budgets using new remote sensing techniques.

Enabling more sustainable land-use decisions

Our land-based science focuses on the environmental aspects of the land and soils. Much of our work in this area centres on helping central and regional government make more accurate, science-based policy and regulations.

Erosion Susceptibility Classification (ESC)

In a major report for MPI, we reclassified the ESC for some Land Use Capability (LUC) units in the High and Very High classes (based on erosion terrains), extended the ESC over the whole of mainland New Zealand (including formerly excluded DOC estate), improved mapping along river margins, lakes and the coast (by linking to current LINZ boundaries for these features), and created overlays to identify specific erosion processes (gully, tunnel gully and earthflow) and all class 8e land. This version of the ESC will

National Context

By 2025 New Zealand has achieved a 20% improvement in key indicators of land and water resources at farm and catchment scales

OUR LAND & WATER NATIONAL SCIENCE CHALLENGE

The quality of our natural resource base improves over time, while sustaining the growth needed from key sectors to meet our 40% exports to GDP target

BUSINESS GROWTH AGENDA TARGET

New Zealand realises the potential of Māori-owned natural resources

HE KAI KEI AKU RINGA, THE CROWN-MĀORI ECONOMIC GROWTH PARTNERSHIP OUTCOME

New Zealand's freshwater is well governed and sustainably managed

NATURAL RESOURCES SECTOR OBJECTIVE

Manaaki Whenua – Landcare Research supports the SDGs



**SUSTAINABLE
DEVELOPMENT
GOALS**



be used to set regulatory thresholds for various plantation forestry activities under the National Environmental Standard for Plantation Forestry.

Cadmium loss in stony soils

There is a lack of information on cadmium [Cd] leaching in New Zealand soils. In collaboration with MPI, we provided new understanding of the losses of Cd from stony soils affected by cow urine. Our research showed that urine application increased leaching, with potential under-estimation of Cd leaching from increases in dairying or intensification of farming cattle.

Next-generation diverse pastures

With our results demonstrating that more diverse pastures could reduce nitrogen leaching by up to 40%, with no change in production and more productivity in drier regions of New Zealand, there is potential to use plant functional traits to predict optimal mixes for intensively grazed pasture systems.

More accurate assessment of leaching risk

Manaaki Whenua's research leadership on nitrogen [N] leaching under lucerne in the Taupō catchment was recognised at a celebration of the Sustainable Farming Fund achievements. Waikato Regional Council, in the absence of better data, previously assigned a value of 19 kg N/ha/yr for N leaching from cut and carry lucerne. Our research proved the value is only 4.6 kg/ha/yr opening up new land-use options for farmers previously at risk of breaching nutrient discharge allowances.

Unlocking the potential of Māori land

Manaaki Whenua draws on its strength in mātauranga Māori research, key datasets and models (land and soil resources, and biodiversity), to provide meaningful, tailored advice and information on how to develop land sustainably in line with Māori aspirations.

Arai Matawai Incorporation

Working with Arai Matawai Incorporation, we assessed current land-use/farming options using integrated cultural, ecosystem services and biophysical methods alongside Manaaki Whenua's economic land-use support tool [NZFARM]. This resulted in a practical, kaupapa-based farm assessment methodology with a multi-disciplinary science backing that provides a range of options for owners, so they can balance kaitiakitanga and environmental sustainability perspectives with economic outcomes.

Characterising the honey landscape

In our continuing work with iwi and Māori honey interests to characterise New Zealand's honey landscape, we are progressing several research directions: characterising the floral traits of nectar producing species, looking at environmental drivers of nectar production, modelling nectar flows on the landscape, and establishing the provenance and whakapapa of plant species.



SedNetNZ

A model for calculating landslide erosion rates for SedNetNZ.

Impact from erosion and landslides is familiar to most New Zealanders. They can affect water quality, flood potential and lead to sediment build-up. SedNetNZ provides land managers with tools to realistically simulate erosion processes and predict the impacts of future upstream land management scenarios on downstream water quality. It constructs sediment budgets for regional-scale river networks to identify patterns in the material fluxes. This can assist regional councils and land managers to target catchment and river management actions to improve water quality and habitat.

A paper on the model, co-authored by Manaaki Whenua scientists Harley Betts, Les Basher, John Dymond, Alexander Herzig, Mike Marden and Chris Phillips, was published in *Environmental Modelling & Software*. The model uses the landslide probability for each slope class, slope class area, failure depth, soil bulk density, and sediment delivery ratio to calculate the mass of soil that will be eroded over a defined period. Landslide probability is derived from mapping a time series of landslides intersected with Digital Elevation Model-derived slopes. This approach works well for landslide modelling where rainfall-triggered shallow landslides occur – all too commonly in places such as the North Island hill country, and recently in areas closer to urban centres.





Digging Deep

What are they doing down there?

Nitrogen leaching from fertiliser applied to pasture can contribute to greenhouse gas emissions and contaminate groundwater with nitrates. Finding ways to reduce or prevent this will help farmers protect our environment. This year, in an example of high-impact teamwork, Manaaki Whenua scientists and technicians took a look at nitrogen cycling by microbes deep in the ground.

They collected core samples of undisturbed soil at depths previously unstudied for these microbe processes. Since standard equipment wasn't cut out for the job, Graeme Rogers forged a relationship with the McMillan Drilling group, who designed a custom-made drilling head to plunge PVC pipes to a depth of 1.7 metres into the extremely stony soils of the Ashley Dene Research and Development Station.

The samples were sifted by depth and sent to the lab, where Carina Davis and her crew sorted root, soil and stone samples for DNA sequencing of the microbes.

The team hopes to identify the activities of the specific microbes regulating the nitrogen cycle at depth, and to understand how different deep-rooted plants promote these activities. They suspect the fungi and bacteria are doing all the hard work and are far more active at depth than previously thought.

If confirmed, this could help with developing options for farmers to improve land management and reduce nitrogen losses.

S-map

Enhancing the national soil survey database.

When completed, S-map will provide seamless digital soil map coverage of New Zealand, making it indispensable to land management decision-making at any scale, from farm to nation.

During the year we reinforced the reputation of this essential tool as a leader in its field by completing the important evolutionary steps of extending its geographical coverage and strengthening its partnership with OVERSEER®, which increased user numbers.

S-map's coverage now includes new territory in Waikato, Hawke's Bay [the Tūtaekuri, Ahuriri, Ngāruroro and Karamū catchments], and Canterbury.

The new interoperability with OVERSEER® is the culmination of over 3 years' work developing and applying new technologies and approaches in data standards and web services. The new link between S-map and OVERSEER® removes the risk of error during manual input of data, which could significantly affect the nutrient budget for a property. For the first time OVERSEER® can now auto-populate soil data from S-map, reinforcing Manaaki Whenua's national leadership in soils and informatics. The partnership with OVERSEER® resulted in more farmers using S-map [see statistics in the highlights section]. A new registration system now better tracks S-map Online portal users, and over 5,200 individuals or companies have formally registered as users in the past year.





Our Environment

Our ambition is for New Zealand to be an environmentally informed nation taking action together.

As a nation, New Zealanders are proud of our clean, green image and aspire to lead the world by our example. This is tempered by an increasing awareness of just how fragile our world can be. To make real improvements in caring for the environment, we need reliable data and indicators, decision-making processes that account for the complexity and uncertainty surrounding our environment, and practical action.

New Zealand's economic development can only be sustained if industries and businesses operate in a resilient way within complex environmental limits. They also have to balance the needs of multiple and diverse stakeholders including national and local government, the private sector, Māori, and local communities. Recognising the importance of engaged decision-making, the work done by Manaaki Whenua is increasingly designed to support Māori, business and community groups to be a part of making decisions on the future uses of and values relating to our environment.

Part of caring for the environment is New Zealand's commitment to meet its international greenhouse gas obligations. New Zealand will meet its responsibility targets through a mix of domestic emissions reductions, the removal of carbon dioxide by forests, and participation in international carbon markets. To achieve this, we will need a robust inventory of net emissions and carbon storage at a national scale, and appropriate mitigation tools. Our research focuses on measuring and modelling the environmental and economic impacts of emissions reduction, and developing effective mitigation options for reducing net emissions.

We also support the commitment of a large number of New Zealand (and UK-based) companies to reduce their greenhouse gas emissions and create a low-carbon economy. Our subsidiary, Enviro-Mark Solutions Ltd, offers a set of solutions to meet companies' evolving needs so they can make credible claims when reporting on their sustainable business practices nationally and internationally.

Highlights

Supporting New Zealand's climate change response

Manaaki Whenua has a long tradition of leading research to improve national greenhouse gas inventory reporting and forecasting, required as part of New Zealand's commitments to international climate change legislation. Our research spans forest ecosystems, grasslands and soils, as well as economic and social research. Over the past year, we produced a number of important findings now in use to inform New Zealand's emerging policy response to the international Paris Agreement.

Economics of climate change policy settings

Using integrated economic models, we analysed the impact of the agricultural and forestry sectors on New Zealand meeting its Paris Agreement commitment to reduce greenhouse gases to 30% below 2005 levels by 2030. We simulated eight scenarios to calculate net emissions – either pricing or not pricing agricultural emissions, and either linking or not linking the NZ Emissions Trading Scheme (NZ ETS) with the EU ETS.

Climate change decision-making

We contributed to a recent report on enhancing capacity for, and increasing integration of climate change impacts into natural resource decision-making. The report provides insight into the significance of climate change in making decisions with impact both now and into the future, and the barriers to taking climate change into account.

National carbon stocks dynamics

This year we produced the first objective, national-scale calculation of carbon stocks and stock changes in New Zealand's natural forests. Contrary to common belief, analysis revealed that disturbance, rather than climate or soil fertility, is the primary driver of net carbon change. With climate change forecast to increase both the frequency and intensity of disturbance, this presents a worry for future maintenance of carbon stocks in natural forests.

First full greenhouse gas budget for dairy farms

Dairy farming produces the greenhouse gases (GHGs) methane and nitrous oxide (N₂O). Our study delivered the first national annual GHG budgets of a dairy pasture in New Zealand measuring all three major GHGs continuously, and the first global budgets for irrigated pasture. The aim was to clarify whether or not land use intensification (including irrigation), led to soils gaining or losing carbon (C), which affects the net GHG budget. Our 3-year experiment on a dairy farm in Canterbury constructed net C and net GHG budgets of an irrigated, intensively managed pasture on a well-drained stony soil. We found small net gains of C similar in size to the N₂O emissions, but the net C gains could not compensate for the dairy cows' methane emissions.

National Context

By 2030 New Zealand targets a reduction in its greenhouse gas emissions to 30% below 2005 levels

NEW ZEALAND'S 2030 CLIMATE CHANGE TARGET

People are enabled to make and implement decisions that benefit society and the environment, enabling a prosperous New Zealand

MINISTRY FOR THE ENVIRONMENT OUTCOME

Transforming the primary sector to realise the opportunity for Aotearoa New Zealand to be recognised for our natural environment and products

TE HONO MOVEMENT OBJECTIVE

Manaaki Whenua – Landcare Research supports the SDGs



**SUSTAINABLE
DEVELOPMENT
GOALS**



Mātauranga Māori is key to looking after our special places

Much of Manaaki Whenua's work focuses on integrating Mātauranga Māori into decision-making and management of natural resources, and weaving cultural perspectives together with science. For our living world, te ao Māori concepts are key to protecting Aotearoa's special places in ways meaningful to tangata whenua.

Wai Ora Wai Māori – Kaupapa Māori Assessment Tool

We developed and released Wai Ora Wai Māori, a kaupapa Māori app-based tool to assess and manage freshwater ecosystem health through better care of the land. Produced in conjunction with the Waikato-Tainui Endowment College, the tool offers a mosaic of qualitative and quantitative measures that demonstrate the holistic nature of te ao Māori and mātauranga Māori. The tool can be tailored for use by any iwi, hapū or kaitiaki group.

Māori decision making tools

Working with a selection of Māori organisations, we reviewed and updated Manaaki Whenua modelling tools and data to better incorporate Māori values and decision making processes. Increasingly, Māori values and aspirations are central to land-use decisions, with expectations that these decisions consider biodiversity and ecosystem services.



Riparian Planner

Demand is strong for an award-winning tool that develops riparian management plans for farms.

In the boundary between land and rivers or streams, riparian habitat is essential for native wildlife and plants, and helps mitigate land-use impacts on water quality. Developed by Manaaki Whenua and DairyNZ, and recently recognised with an Outstanding Contribution Award by the New Zealand Association of Resource Management, the DairyNZ Riparian Planner takes the guesswork out of building a riparian management plan. So far 194 rural professionals have been trained to use it, over 653 landowners are registered to use it, and 777 plans have been created.

The planner combines DairyNZ's practical and scientific knowledge of on-farm riparian solutions with Manaaki Whenua's experience in creating automated guidance tools. Manaaki Whenua's Nick Spencer describes how easy it is to use the planner.

'Farmers simply enter in their milk supply number to locate their farm on the map and then highlight their property boundary. They can then use the tool to draw the various waterways they want to work on. It allows farmers to build up a picture of the total task ahead and to spread their efforts and budgets over a number of years. The aim is to match what is ideal for water quality benefits to a timescale that is economical for dairy farmers.'





Scientific Breakthrough

Potential pathway to reduce post-Paris risk in the New Zealand agricultural sector.

Agriculture — mainly through the use of nitrogen [N] based fertilisers — is the principal source of the potent greenhouse gas nitrous oxide [N_2O] and a major contributor to elevated levels of nitrate in groundwater. Research focussed on enhancing soil processes to remove reactive N, such as nitrate, and convert it to harmless nitrogen gas [N_2], usually also involves N_2O emissions. Last year, our scientists discovered a new way of converting reactive N to N_2 that bypasses N_2O emission. The results were published in the prestigious scientific journal *Nature Scientific Reports*.

Manaaki Whenua scientists Rebecca Phillips, Andrew McMillan, Gwen Grelet, Bevan Weir and Thilak Palmada discovered a way to combine reactive N with organic N and create benign N_2 without any formation of the harmful N_2O .

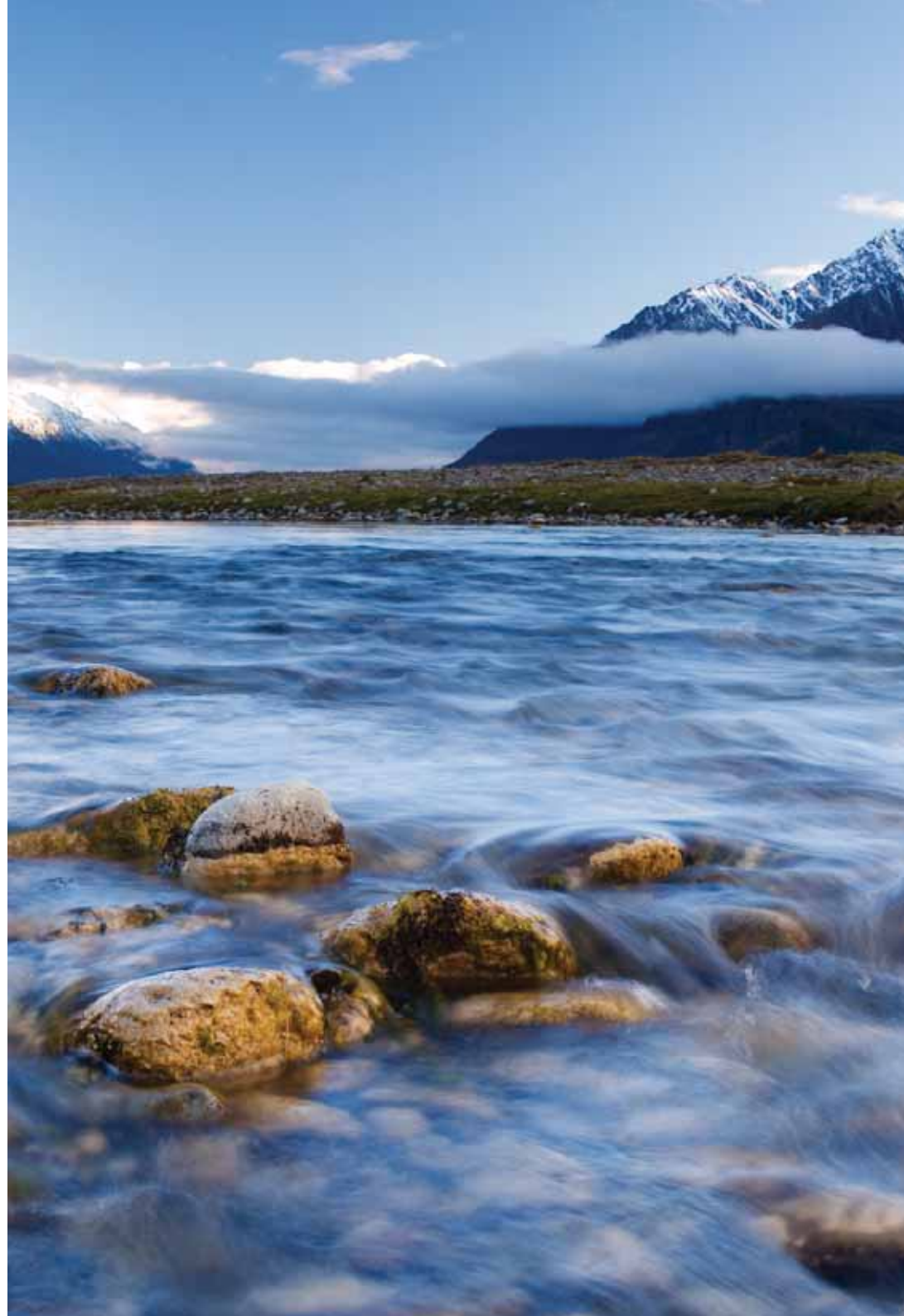
This discovery is a great example of international cooperation, with collaboration from Professor Craig Tobias [University of Connecticut] and Dr Bongkeun Song [Virginia Institute of Marine Sciences]. The next step is to work with our overseas colleagues to investigate the details of how this new process works, and the implications for greenhouse gas mitigation and soil quality improvement. This work has started with funding from MPI as part of the Global Partnership on Livestock Emissions Research fund.

Freshwater Forever

Helping support decisions for better water quality in New Zealand.

Everyone needs safe, clean water – for drinking, washing, growing food, and having fun. It is a resource in high demand, and can become unsafe and unclean if not managed well. Through our Freshwater Values, Monitoring and Outcomes (VMO) Research Programme, Manaaki Whenua and partners developed valuable tools for national and regional government to care for their communities' freshwater resources.

One example is the recent report written for the Greater Wellington Regional Council and the Ministry for the Environment. To evaluate the Whaitua collaborative modelling process with iwi, identify how to incorporate iwi/hapū values in modelling, and support the freshwater limit-setting process, we documented learnings from the Ruamāhanga catchment to guide communities, industry, scientists, government, and local councils in achieving desirable freshwater objectives and outcomes. By developing relevant design management criteria, we can assess how regional policy and catchment management options can best support iwi/hapū and community values.



A young girl with her hair in a ponytail, wearing a dark long-sleeved shirt, striped leggings, and dark boots, is walking away from the camera in a grassy field. The sun is low on the horizon, creating a warm, golden glow and silhouetting the girl. A fence line is visible in the background.

Our Strategic Focus

Over the past year, we have worked closely with our people and our partners to set our direction and strategy for the next 5 years.

Strategy 22 articulates our focus out to 2022. It was developed through careful consultation with all our people, and our key partners and stakeholders.

A requirement of Strategy 22 was to define how we could ensure a sustainable, positive impact for New Zealand

through our science and research. Our strategic goals will drive key initiatives to ensure we deliver on our purpose sustainably for many years to come.

Here we present six key focus areas based on Strategy 22 that shape how we will ensure a sustainable Manaaki Whenua – Landcare Research. These strategic focuses underpin our four ambitions as presented in the earlier section.

By 2022 we aim to be:

- >> respected and valued nationally and globally for our excellent and relevant research
- >> a credible and trusted voice contributing evidence in matters of public concern
- >> recognised for tackling hard issues and science and being innovative, responsive and adaptable in our approach
- >> an employer of choice attracting and retaining exceptional talent
- >> a preferred partner of Māori
- >> a household name known for unique stories that inform, inspire and engage the public
- >> an integrator skilled in bringing together multi-disciplinary teams and stakeholders to solve complex issues
- >> financially sustainable and using integrated reporting against our sustainable development goals

World-class Science

Field Book
405 H2
403 H2
401 Q
398 H2
396 H2
394 H2
392 Q
390 H2
389 Q
387 H2

168 Scientists
60 Technicians

Including
5 Post-Docs
62 Doctorates
28 Masterates

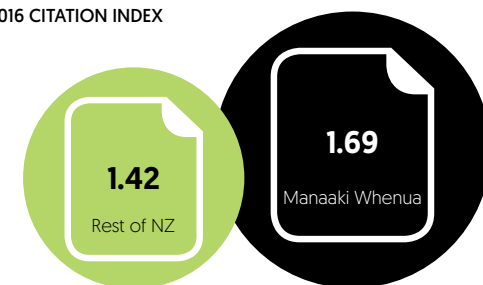
Manaaki Whenua has internationally recognised scientists and researchers who are working to understand our land, biodiversity and environment for the benefit of New Zealand.

The quality of our science is a defining feature of Manaaki Whenua. It gives credibility to our advice and tools, and attracts partners enthusiastic about what we do. Our science is recognised globally. Benchmarked against relevant organisations, we seek to stay in the top 15% both nationally and internationally. We invest in innovative people and push the boundaries for greater impact.

Two of our science goals are to be 'Innovative and Challenging' and 'Valued and Trusted'. Central to achieving these goals is increasing and demonstrating our research excellence while measuring and effectively communicating its impact.

Although excellence at Manaaki Whenua applies across the broad spectrum of our research, from basic to applied, the measured academic impact of our publications is a key indicator of our excellence as a research organisation. Academic impact is a measure of peer recognition of contributions in the global science arena. Our publications have consistently been ranked very highly for their academic impact, meaning that our science is at the forefront and contributing globally.

2011–2016 CITATION INDEX



Collections



NZ Fungal & Plant Disease Collection (PDD)

100,224 specimens
624 specimens sent
19 loan requests responded#
467 identification & taxa enquiries
121 visitors
672 PDD specimens cited*

www.landcareresearch.co.nz/pdd



NZ Flax Collection (Living Plants)

297 selections
250 selections in provenance collection
17 orders sent#
17 enquiries
74 visitors

www.landcareresearch.co.nz/harakeke



Allan Herbarium

c. 640,000 specimens
1,148 specimens sent outwards
51 loan requests responded#
635 identifications & enquiries
478 visitors

www.landcareresearch.co.nz/allanherbarium



International Collection of Microorganisms from Plants (ICMP)

20,878 cultures
144 orders sent#
903 cultures provided
114 identification & enquiries
121 visitors
139 ICMP cultures cited*

www.landcareresearch.co.nz/icmp



NZ Arthropod Collection (NZAC)

c. 7 million specimens
24 loan requests#
413 identification & taxa enquiries
86 visitors

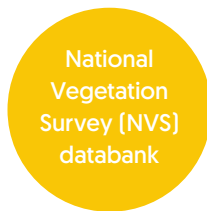
www.landcareresearch.co.nz/nzac



S-map Online

133,460 page views^
70,064 application loads
35,885 soil factsheets generated
2,428 maps printed
56,996 point queries
51,004 visits^

<http://smap.landcareresearch.co.nz>



National Vegetation Survey (NVS) databank

15,781 page views^
10,374,647 records
2,092 datasets supplied
43 users
32 new electronic datasets
1,525 plots added

<http://nvs.landcareresearch.co.nz>



Land Resource Information Systems (LRIS)

139,960 page views^
5,243 data downloads
6,017 users
28,487 visits^

<http://lris.scinfo.org.nz>



Ngā Tipu Whakaoranga Ethnobotany

75,436 page views
2,408 database records
c. 20 requests for cultural plant information (not flax)
23,257 visits

<http://maoriplantuse.landcareresearch.co.nz>

Databases

Our Databases and Collections

Manaaki Whenua is custodian for almost a third of New Zealand's Nationally Significant Databases and Collections. These include biological resources [e.g. reference species collections], cultural knowledge, and soil and land resources. They are important scientific, cultural, and historical public-good assets. These collections provide base knowledge critical to improving the conservation of New Zealand's land-based biodiversity including species of importance to Māori. They also provide important reference collections for identifying biosecurity risks.

We have made significant progress in digitising [and putting online] science information, images and other valuable information from our collections. This information is easily accessed and is being used in conservation, biosecurity, land management and environmental sustainability in New Zealand.

* in scientific publications (based on Google Scholar)

^ courtesy of Google Analytics

100% service delivery

Major Science Publications

Here we celebrate some of the work of our people that was accepted for publication in the world's top science journals.

Al Glen co-authored a manuscript in *Proceedings of the National Academy of Sciences* that showed that invasive mammalian predators played a role in 58% of bird, mammal and reptile extinctions globally in the past 500 years. *Nature* later picked this up as one of the year's ecological highlights.

We published (including Paul Mudge, Miko Kirschbaum, Carolyn Hedley) a paper that will set the framework for being able to manage soil carbon in New Zealand. The paper reviewed changes in carbon stocks in New Zealand's pasture systems and identified gaps in understanding the magnitude of change and associated uncertainties. The authors proposed that gaps were best addressed by establishing a national measurement campaign to further understanding on soil carbon stocks along with resampling existing sample sites or sampling paired land uses.

With colleagues at the Cawthron Institute, Pike Brown published the first study to evaluate public perceptions of freshwater management in regions with collaborative processes. This paper reviews the results from 450 survey respondents in Hawke's Bay, Northland, and Waikato, some of whom live in catchments in which collaborative processes are under way and some of whom do not.

Susan Wisser co-authored a *Science* manuscript with scholars from 90 institutions around the world [she

contributed National Vegetation Survey data and analysis]. They discovered a globally consistent positive effect of tree species diversity on forest productivity. The team estimated the economic value of biodiversity in maintaining commercial forest productivity alone to be USD\$166–490 billion per year.

Andrew McMillan, Gwen Grelet, Bevan Weir and Thilak Palmada discovered that reactive nitrogen [N] could be chemically converted to unreactive di-nitrogen gas [N₂] without forming harmful (i.e. highly 'warming') N₂O. This was published in *Nature Scientific Reports*.

Rich Leschen co-authored a publication in *Nature Communications* where fossil mushroom and beetle specimens were examined from Burmese amber. Rove beetles from the Early Cretaceous were found to have highly specialised structures for feeding on mushrooms. This suggests the existence of diverse Agaricomycete mushroom fungi and a specialised trophic interaction and ecological community structure by this early date, 99 million years ago.

Janet Wilmschurst was a co-author of a paper published in a special issue of *Science*: 'Biodiversity losses and conservation responses in the Anthropocene'. The paper places the current extinction crisis in the context of long-term impacts of humanity. It assesses current trends in biodiversity loss and identifies successes as well as failures in our response to this crisis and draws lessons on what is needed to turn the tide of biodiversity loss.

Looking Ahead

We will continue to grow our reputation for nationally and internationally recognised science excellence.

This will be achieved by adding to a growing output of high-profile scientific papers, and continuing to develop collaborations with national and international experts. We will also continue to find new technologies and innovations as part of our strategic planning to invest in high-risk, high-reward science.

Through ongoing digitisation of our Nationally Significant Databases and Collections we will continue to ensure data from decades of the Crown's investment in science are available to guide and develop New Zealand's conservation, biosecurity and environmental management protocols for the future benefit of New Zealand.

We will continue to be active in global data collaborations to develop data synthesis initiatives. We will also invest in growing the digital literacy of our staff and make sure our internal data networks, data storage and modelling environments meet future demands.

Manaaki Whenua – Landcare Research supports the SDGs



SUSTAINABLE
DEVELOPMENT
GOALS



Our People

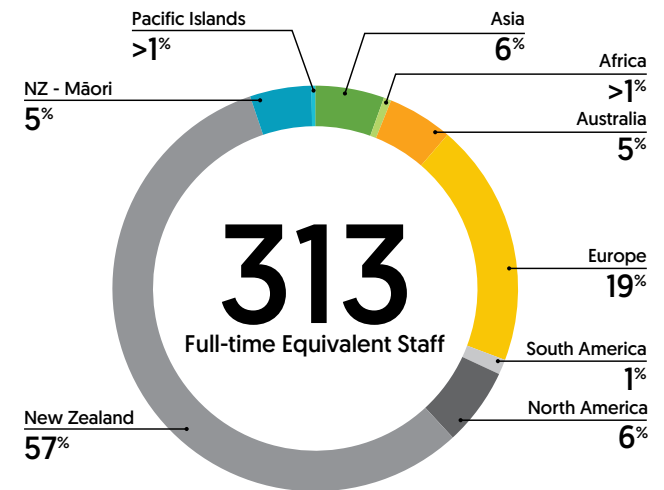


Manaaki Whenua is an organisation of over 330 researchers, specialists and support staff, and their diversity of skills, experiences and ideas contribute to the success of the organisation.

Our staff rate Manaaki Whenua as a great place to work because they feel valued and secure in the success of the organisation. Talented individuals (nationally and internationally) regularly seek to join our organisation.

We have been formally recognised for our diversity, and for policies and initiatives promoting inclusivity. We place a high value on ensuring Manaaki Whenua is a safe place to work. Health, Safety and Environment is an automatic consideration in all job planning, and audit results find no non-conformances. Succession for key roles is actively managed and we have capable and committed potential successors in the leadership pipeline. Our remuneration levels are competitive with relevant market benchmarks.

ETHNICITY OF STAFF



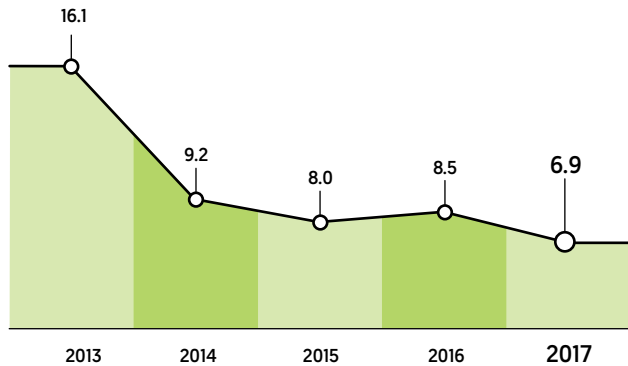
Empowering work culture

Our culture of empowerment comes from great leadership and communication, bringing together the best teams and effectively managing our talent. We have grown our research capability, investing in key areas to support National Science Challenges, Conservation and Environment Roadmaps, and Strategic Science Investment Fund (SSIF) objectives that include Vision Mātauranga.

Everyone is 100% committed to health, safety and well-being. We have invested in various health and safety initiatives, including Health and Safety Representative training, Safety Differently (an approach to developing a safety culture from the bottom up by focusing on work as done rather than work as imagined), well-being, and emergency management.

We updated our payroll management practices and outsourced this function to an external provider to improve risk management.

EMPLOYEE TURNOVER (%)



70% OVERALL LEVEL OF EMPLOYEE ENGAGEMENT

We value diversity, equality, agility and collaboration

These principles support our commitment to being a good employer and form the basis of our People Strategy – Kō tātou tēnei. Our achievements against the seven key elements of being a good employer are:

Leadership, accountability and culture

We achieved a 74% response rate to this year’s pulse check employee engagement survey. Our engagement index increased by 7% to 70%, and outscores the participating CRI benchmark of 65%. The largest gains were in the questions ‘our organisation is interested in the views and opinions of its people’, ‘there is strong evidence of effective leadership’, and ‘Manaaki Whenua has a clear vision of where it is going and how it is going to get there.’

The CEO, Senior leadership team and our established mid-level leaders completed an in-house leadership development programme that included workshops, seminars, and coaching opportunities. Tier 4 staff and our future leaders also attended a 2-day Management Essentials programme.

We have a developed Equal Employment Opportunities policy that links to our values and our bicultural awareness initiatives, which consist of Treaty of Waitangi and cultural competency workshops, including a noho marae 2-day event.

Recruitment, selection and induction

Our vigorous recruitment and selection policies and procedures are impartial and transparent, ensuring we minimise barriers and biases to further enhance our culturally diverse organisation. We focus on making strategic hiring decisions to guarantee we have appropriate staff capability for the future. Our induction process is thorough so employees are aware of their responsibilities and available organisational support.

Employee development, promotion and exit

As part of our performance appraisal and development programme, throughout the year all employees will have at least three opportunities to discuss their aims and aspirations with regards to career, personal development and training. All individuals have learning and development plans, actioned and monitored by our Training Coordinator. Exit questionnaires are collected and collated from departing employees for review.

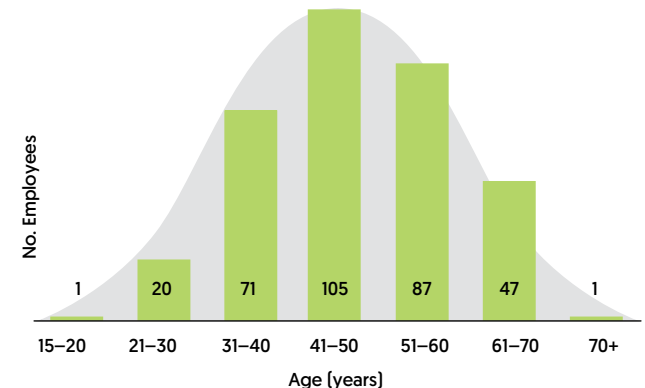
Flexibility and work design

Manaaki Whenua continues to support flexible working arrangements to support work-life balance and provides phones and laptops to improve staff mobility. We offer part-time, variable hours, and teleworking arrangements as appropriate.

Remuneration, recognition and conditions

The annual review of our remuneration policy verifies it continues to support our recruitment and retention strategies. Manaaki Whenua has an equitable, transparent and gender neutral remuneration system that ensures all individuals and groups have equal employment

2017 AGE PROFILE



opportunities and conditions. We benchmark our salary medians against the CRI, science and general market sectors and also provide annual performance bonuses to recognise exceptional individual contributions.

Harassment and bullying prevention

Manaaki Whenua is committed to maintaining a respectful and safe work environment with zero tolerance of harassment or bullying. Employees are made aware of our Workplace Harassment and Bullying policy as part of our induction process. Our company values highlight our expected behaviours.

13 AVERAGE YEARS TENURE
OF OUR EMPLOYEES

Scientists 14 • Technicians 17
General Support 9 • Research Support 13

Safe and healthy environment

The Health and Safety at Work Act 2015 prompted renewed focus on Health and Safety (H&S) during the 2016/17 financial year with the election of 24 Worker H&S Representatives across the organisation and the investment in an additional H&S specialist role. Pleasing results were received in the engagement survey when 92% of respondents agreed with the statement 'Risks to my health and safety at work are reduced as far as is reasonably practicable'. Following 17 years of certification within the ACC Workplace Safety Management Practices (WSMP) scheme, the organisation is now looking at alternative external certification systems, as well as investigating the Safety Differently model, which offers exciting potential for a people-centred, knowledge-based organisation such as Manaaki Whenua.

A strong focus is placed on all staff receiving appropriate health and safety training for their roles. Performance appraisals and position descriptions clarify individual responsibilities for health and safety. We also focus on reducing work-related stress and enhancing individual lifestyle choices, with a number of organisational initiatives available to employees, including access to the on-line website Tracksuit-Inc.



Leadership

In 2017 we invested in our people through our leadership programme with a focus on stakeholder engagement, leading change and leading leaders. We further developed this by introducing a Future Leaders programme to create a stronger leadership pipeline for Manaaki Whenua. We identified three young researchers with motivation and ambition to be future leaders of Manaaki Whenua and are working with them on individual career plans.

Vision Mātauranga

We have focused on building capability to support researchers with Vision Mātauranga objectives as part of their projects. This included Treaty of Waitangi and cultural competency programmes and the appointment of a replacement GM Māori Development.

Looking Ahead

Our key focus for 2018 is to be attractive to new staff in a competitive labour market by creating greater opportunities for mobility and flexibility, career growth and performance recognition. We will achieve this through developing new orientation and induction programmes, career paths, and succession planning, and revising our approach to performance review and development.

We will continue investing further in promoting and developing a health and safety culture that balances compliance with employee-led initiatives. We also intend to develop a bespoke well-being programme to better support our busy people. We will continue to invest in career development, bicultural and leadership capability.

We will reduce complexity and support new ways of working, including collaboration and integration, both internally and externally. This includes investment in new HR management and health and safety systems.

Our support of young students from lower decile schools through our participation in the First Foundation programme will also continue.

Manaaki Whenua – Landcare Research supports the SDGs



A photograph showing three individuals in an outdoor setting, likely a field or rural area. Two people in the foreground are wearing orange high-visibility safety vests and orange hard hats. They are focused on a drone on the ground, with one person adjusting it. A third person, wearing glasses and a dark shirt, stands behind them, observing. The background features a grassy field and a hillside under a bright, low sun, creating a warm, golden light.

Real-world Solutions Through Partnership

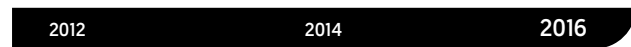
Manaaki Whenua forms partnerships across organisations and disciplines at national and international levels to find workable, science-based solutions to environmental challenges.

Science excellence in itself is not enough to address New Zealand's and the world's challenges. Solutions based on excellent science must be workable and relevant to the needs of people and agencies struggling with those challenges. Partnership and integration of science with other contributions are a hallmark of how we operate.

Strategic relationships

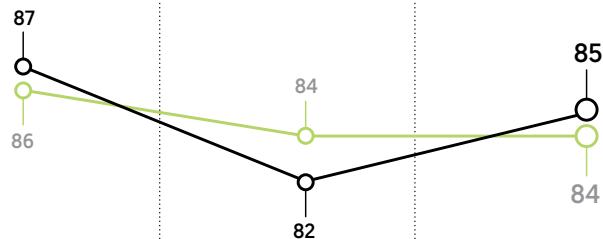
Manaaki Whenua works hard to understand what creates value for our clients and engages proactively to maximise that value. Our engagement is increasingly supported by tailored communications, tools, business models and relationship plans. We have a growing reputation for our co-innovation approaches with key clients, who work alongside us to set research priorities and co-design 'user-ready' solutions. Together with our key clients we will create new value by building on client-led initiatives and adapting new technologies. We appreciate that our clients are champions of Manaaki Whenua's work and help us to communicate the value of our science for New Zealand's future.

Manaaki Whenua is working to develop strategic partnerships that increase our national impact, while allowing us to focus on research and technology. Strategic partnerships enable product development (e.g. predator controls and land-use tools); supporting policy (e.g. land and water goals); high-risk, high-return science (e.g. genomics); regional and Māori land development; and science capability (e.g. access to training and specialist skills).

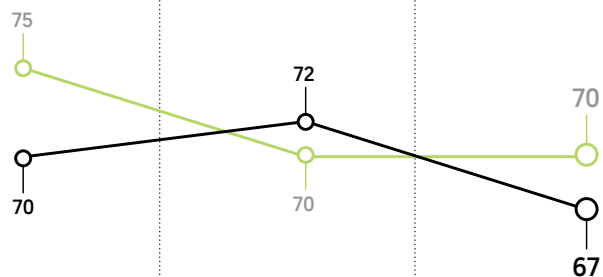


—○— Manaaki Whenua
—○— Av. CRI response

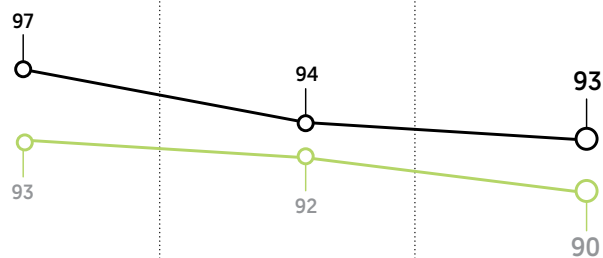
Overall stakeholder satisfaction [%]



Confidence CRI considers sector's priorities [%]



Stakeholder adopted knowledge or technology from CRI in past 3 years [%]



Trusted advice

We aim to be responsive to the needs of our clients and partners, and for the solutions and advice we provide to be trusted. Much of our environmental research is for the public good, and benefits New Zealand and New Zealanders. We work closely with central and local government stakeholders to develop and share high-priority science expertise to help develop key policy, legislation and regulation. We also collaborate with a variety of Māori, primary- and private-sector organisations to make sure our research widely benefits the development and management of New Zealand's land resources.

Recently we have been working even further afield. In collaboration with the Niue Department of Environment, a team led by Peter Newsome has been raising awareness of Niue's natural heritage, improving management of protected areas, and building capability in government and communities to use natural resources sustainably. Among other things, Niue now has: a network of permanent vegetation monitoring plots and nature trails following work by Larry Burrows and Susan Wiser; a biodiversity education course for schools written by Judy Grindell; a Land Cover Database at three points in time compiled by Peter Newsome and Anne Sutherland; researched advice on protected area financing from Florian Eppink; and bolstered sustainable land management capabilities in the agricultural and forestry sectors as a result of workshops and training by David Leslie, Russell Coker, John Widdowson and Daniel Tobin.

Integration

Environmental challenges such as climate change and the loss of biodiversity are complex. Solutions must reflect that complexity. This means multiple disciplines must be brought together to address the economic, social and

environmental aspects. Challenges must be addressed across a range of spatial scales – local, regional, national, and even global. Different world-views will be relevant and goals will be needed over different timescales from the next year to the next several generations. We call the bringing together of all these dimensions 'integration', and it is a hallmark of the Manaaki Whenua approach.

An example of the way we are seeking to achieve integration in our research is collaboration with Hawke's Bay Regional Council. We have been co-developing a framework to support the implementation of land and water and community outcomes. The framework will be used as people design and go through the process of implementation, and resources (information, models, tools) will be linked to the framework to support action. The framework was recently tested at a workshop run by Hawke's Bay Regional Council with five other regional councils, all of whom were keen to adopt the framework.

Supporting National Science Challenges

National Science Challenges take a collaborative approach to solving some of New Zealand's biggest issues. They are an opportunity to increase the stretch and impact of our research and to provide an economy of scale for working with collaborators. Manaaki Whenua is proud to host one of New Zealand's 11 National Science Challenges, New Zealand's Biological Heritage (NZBH). We also contribute to Our Land and Water, Deep South, Resilience to Nature's Challenges, Science for Technological Innovation and Unlocking Curious Minds.

50

42% SSIF FUNDS ALIGNED TO NATIONAL SCIENCE CHALLENGES

The Challenge's objective is to 'Protect and manage our native biodiversity, improve our biosecurity, and enhance ecosystem resilience to global threats and pressures' – an objective that is strongly aligned with Manaaki Whenua's 'Our Biodiversity', 'Our Biosecurity', and 'Our Environment' goals. There are 17 collaborating parties in the NZBH Challenge.

We have aligned more than \$8M of SSIF funding with the NZBH Challenge, enabling our best researchers to contribute to priority projects involving 'best national team' collaborations. Here are two examples.

Environmental DNA: a novel tool for biodiversity and biosecurity assessment

The ability to extract and sequence DNA directly from environmental samples ['environmental' DNA or eDNA] is transforming our understanding and measurement of biological diversity. 'Metabarcoding' of DNA provides a window into the world of microbial diversity that would otherwise be largely hidden from view, and has potential as a novel, universal tool for biodiversity and biosecurity assessments. These methods are applicable to all organisms (archaea, bacteria, protists, fungi, animals and plants). We have aligned SSIF funding to this important project, enhancing the ability of the project team to deliver a nationally standardised framework for sharing and interpreting the vast array of taxonomic information obtained from eDNA. Eventually, integration of nationally consistent eDNA methodologies and existing monitoring programmes will deliver a step-change in biodiversity assessment.

Planning for tipping points and enhancing resilience in production landscapes

We live in an era of unprecedented change. The cumulative impact of human activities is affecting our environment locally and globally, with far-reaching consequences. Yet society is becoming increasingly aware of our dependence on a healthy environment.





An NZBH team, led by Professor Jason Tylianakis at the University of Canterbury, is investigating ecosystem tipping points: critical thresholds where accelerating change caused by a positive feedback can drive a system to a new state. Tipping-point events are challenging to manage and plan for, as they usually occur unexpectedly when the system is no longer able to absorb pressure, with a loss of ecosystem services.

Policy makers can cultivate New Zealand's capacity to adapt to change by fostering social and ecological resilience. Policies can be designed to decrease the risk of undesired tipping points. As part of the Challenge team, we provided regional and central government with a policy brief outlining key concepts that can assist in dealing with tipping points in production systems.

NZBH Challenge parties

AgResearch, ESR, GNS Science, NIWA, Plant & Food Research, Scion, Department of Conservation, Ministry for Primary Industries, Auckland University of Technology, Lincoln University, Massey University, University of Auckland, University of Canterbury, University of Otago, University of Waikato, and Victoria University of Wellington.

National
Science
Challenges

NEW ZEALAND'S
BIOLOGICAL
HERITAGE

Ngā Kōiora
Tuku Iho

Looking Ahead

As part of our strategy development process we will continue to focus on understanding our clients and proactively sharing information within Manaaki Whenua so our staff can create greater value for them. This will include more integrated research, which brings together environmental, economic, social, and cultural interests and values.

We will also deliver research that integrates research domains through adapting new technologies (e.g. land and water research), invest in high-risk, high-reward, mission-led science, and develop 'real-world tools' that can be easily used by a wide range of New Zealanders. We will increase our strategic relationships and develop new partnerships to widen the relevance, impact and value of our work to sectors outside the Natural Resources Sector.

Manaaki Whenua – Landcare Research supports the SDGs





Growing Our Impact Sustainably

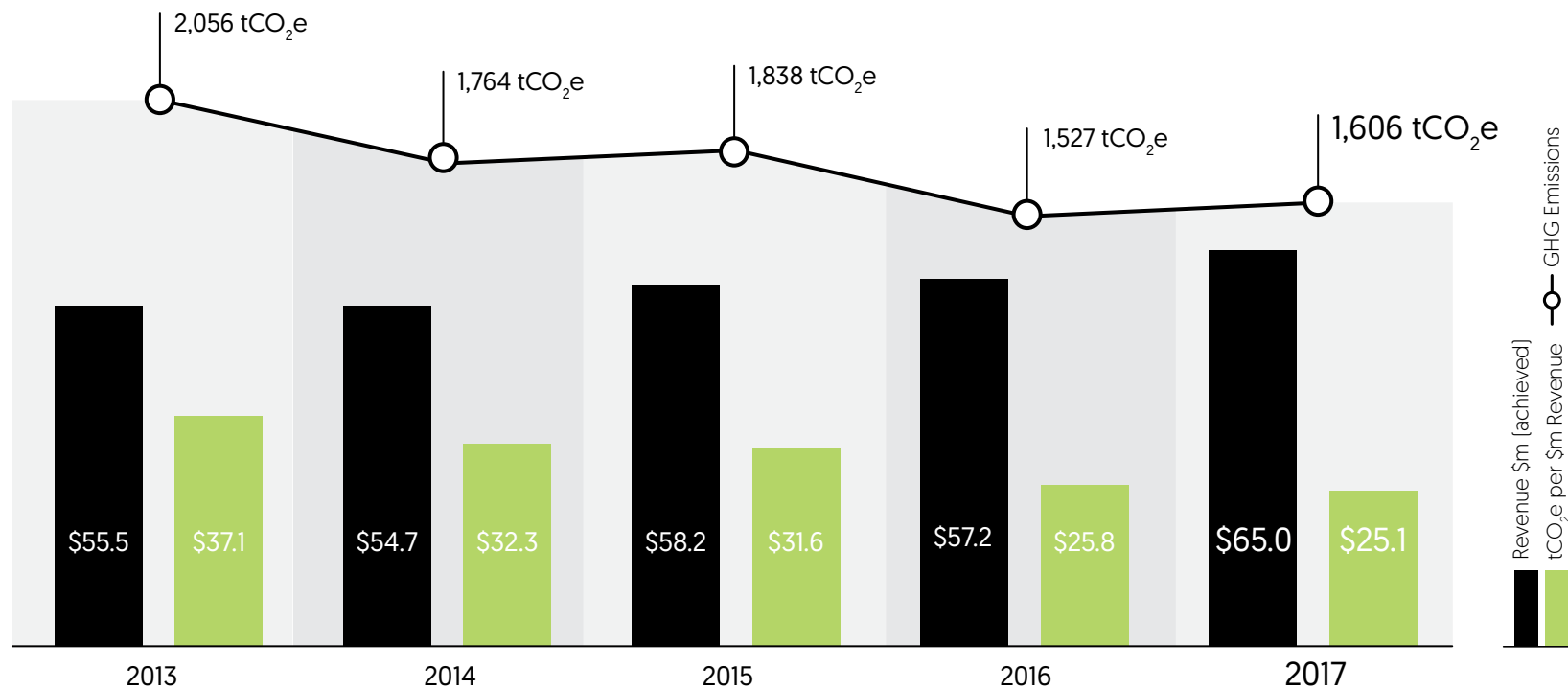
Our contribution to the future of New Zealand is underpinned by a sustainable business model that balances social, economic and environmental impacts.

While sustainable business is a core tenet of our culture and business, it is also critical to ensure our continued positive impact for New Zealand. Our long-term financial management is designed to optimise our funding performance overtime, ensuring we can both deliver on immediate research needs, but also make longer term investments in critical science and business infrastructure. While our research is focussed on helping New Zealand to live more sustainably with our land, we are also end-consumers of New Zealand's resources, and choose to lead the way in mitigating, and measuring our own impact on the environment. As outlined in the section Our People our ability to deliver our exceptional science, research and real-world solutions is entirely dependent on our ability to attract and retain the best scientists, researchers, technicians and support staff that New Zealand and the world has to offer.

Sustainable development goals

Sustainability is our business. We work with a wide range of organisations to understand sustainable development goals and implement pathways to achieve them. That is our principal contribution: the social, economic and environmental impact of our research, science and technology. Our own operations have their own impacts, and in recent years we have focussed on carbon footprint and a range of other goals to improve our own environmental performance. We have been ISO14001 certified since 1998 and we have been carbon neutral since 2011. In recent years our social focus has been on talent development, gender equity and staff welfare, including health and safety [see 'Our People' section].

REVENUE & GREENHOUSE GAS EMISSIONS



For the 6th year running Manaaki Whenua has maintained carbonZero certification through our subsidiary Enviro-Mark Solutions. As the CRI for our environment, our commitment to carbon neutrality goes back even further, and through our greenhouse gas emissions management and reduction plan we are pleased to have exceeded our 15% emissions intensity reduction target.

Achieving carbonZero certification requires that we both measure and manage our GHG emissions reduction, and then neutralise any remaining unavoidable emissions

through cancellation of an appropriate number of verified carbon credits. We have offset our unavoidable carbon emissions by purchasing all our carbon credits from the Hinewai Reserve near our headquarters.

Hinewai is a biodiversity taonga on Banks Peninsula, developed and managed by botanist (and Manaaki Whenua research associate) Hugh Wilson. The 1,230 ha of native bush and abundant bird life are a case study of the value of gorse as a nursery plant for naturally regenerating native forest. Hinewai was one of the first blocks to be

admitted to Manaaki Whenua's Emissions-Biodiversity Exchange (EBEX) programme. It was the site where many of the protocols were developed for how private landowners could participate in 'carbon farming'.



Financial Performance Summary

Summary table of group financial performance indicators

	2015	2016	2017	2018
	Achieved	Achieved	Achieved	Target
Revenue, \$m	58.2	56.9	64.6	78.9
EBIT before investment, \$m	3.0	3.4	5.3	3.6
EBIT, \$m	2.2	2.8	4.8	2.9
Investment, \$m	0.8	0.6	0.5	0.7
Total assets, \$m	47.7	53.6	62.6	68.3
Return on equity	5.5%	6.7%	10.4%	6.5%
Dividend \$m	-	-	-	-
Equity ratio	66%	64%	61%	56%
Gearing	0%	0%	0%	0%

Revenue excludes income from interest on investments and from finance leases, \$0.4m for 2017 (2016: \$0.3m)

Financial result

Total revenue for the year was \$2.9 million better than budget and \$7.8 million up on the previous year. This reflects a strong year, with demand for our science expertise increasing both through the MBIE Endeavour contestable research funding and non-MBIE funding from MPI, OSPRI, and National Science Challenges in particular. Science Revenue was \$57.0m, \$5m up on budget and \$6.1m up on the previous year. Net Profit after Tax at \$3.7 million was \$2.7 million better than budget and \$1.5 million better than the previous year.

As a CRI we do not seek to maximise profit beyond what is needed for financial resilience, which is agreed in advance with our government owners. Last year we invested significantly in new staff and we are continuing to do that this year as an investment in our future. The high profit result was due in part to the budget being conservative, to higher than expected revenue recognition late in the year, and to lower than budgeted depreciation charges on our physical assets.

Infrastructure investments

Our Balance Sheet and cash flows have the capacity to enable the significant planned investment phase that will contribute to making Manaaki Whenua a more sustainable and future-proofed organisation. Our long-term asset plans have been reviewed and the key Lincoln Redevelopment investment will begin in the 2017/18 financial year.

Enviro-Mark Solutions

How can businesses and other organisations make credible and reliable claims about their environmental performance?

This was the challenge we took on in the early 2000s when we established the Enviro-Mark, carbonZero and CEMARS [Certified Emissions And Reduction Scheme] programmes. Since then close to 1,000 organisations have adopted our certifications with over 30% maintaining certification for 5 years or more. These organisations have gained many benefits, including cost-savings, market advantage and recognition from stakeholders.

Enviro-Mark Solutions Ltd is a wholly owned subsidiary of Manaaki Whenua and in 2016/17 sold its programmes in five countries (principally New Zealand and the United Kingdom) to around 400 organisations. Over 3,000 carbon and environmental management system audits have been conducted, over 550,000 tCO₂e emissions have been offset and over 187 million tCO₂e footprint certified. Close to three times New Zealand's annual carbon footprint is under management globally through the CEMARS and carbonZero programmes. Emissions reduction by these organisations over a 6-year period has been more than 8 million tCO₂e or 20% on average, with some reductions over 50% of the base year. Eighty-five percent of Enviro-Mark programme participants have achieved Gold standard or above.

A doubling of new programme sales in 2016/17 compared with the previous year reflects increasing interest of businesses in taking action to improve environmental performance. During the year JAS-ANZ [Joint Accreditation System of Australia and New Zealand] reaccreditation as a certifier was achieved for a further 4 years, and Enviro-Mark Solutions Ltd became an accredited verification provider for the Carbon Disclosure Programme [CDP].



**ENVIRO-MARK
SOLUTIONS**

Looking Ahead

At Manaaki Whenua we have developed a 5-year strategy that seeks both to enhance the national and global impact of our science and to strengthen our own performance as an organisation with social, economic and environmental impacts. We welcome the United Nations Sustainable Development Goals as a framework for organisations to understand and identify their material impacts, set targets and monitor performance.

We have an ongoing programme to upgrade buildings and research infrastructure across our sites in the coming years. Our investments will be focussed on ensuring facilities and systems are fit-for-purpose, and able to support innovative research and outcomes for the future. Open, flexible workspaces will contribute to innovation, collaboration and partnership, and ensure we can attract and retain the best international talent.

We will also be investing in key technology systems. Working closely with other CRIs we will adapt the best ideas and ensure our IT systems are fit-for-purpose, affordable over the long term, secure, and able to benefit from the rapid innovation occurring in the sector.

Manaaki Whenua – Landcare Research supports the SDGs



**SUSTAINABLE
DEVELOPMENT
GOALS**





Science Working with Mātauranga Māori

Māori have been kaitiaki of Aotearoa for generations, and by incorporating a Māori world-view into our work we can better understand our land, environment and biodiversity.

Manaaki Whenua has developed enduring partnerships with selected iwi, groups of iwi, Māori trusts/incorporations and Māori organisations. These partnerships support our strategic objectives as an organisation. We engage regularly with these groups in the spirit of partnership, as expressed in the principles of the Treaty of Waitangi.

We seek to understand and respond proactively to the needs of our Māori partners, including novel approaches [e.g. through secondments, new commercial models, etc.]. We increasingly co-design our science and research programmes with our Māori partners. We build on and add value to the platforms, tools and technologies of our Māori partners to grow joint intellectual property beneficial to New Zealand. Our people have the skills and characteristics to engage well, deliver value and support our Māori partners.

Effective engagement with Māori

During 2016/17, Manaaki Whenua has continued its extensive programme of engagement with iwi and Māori stakeholders, including pre- and post-settlement tribal governance entities, Māori land trusts and Māori incorporations. We have produced a range of valuable science and research outcomes [e.g. through MBIE Vision Mātauranga projects] in collaboration with the following entities: Te Rūnanga o Ngāi Tahu, Te Uri o Hau (Northern Kaipara), the Integrated Kaipara Harbour Management Group [including Kaipara iwi], Waikato-Tainui, Ngati Porou Miere, Atihau-Whanganui Inc, Taitokerau Miere Coalition, Maniapoto Māori Trust Board, Te Rūnanga o Ngāti Kuri, Te Runanga o Te Rarawa, Ngati Rangī, Ngā Tāngata Tiaki

MARAE VISIT & TREATY WORKSHOP ATTENDANCE



2016 Noho Marae - 19



2017 Lincoln Treaty Workshop - 27



2017 Auckland Treaty Workshop - 20

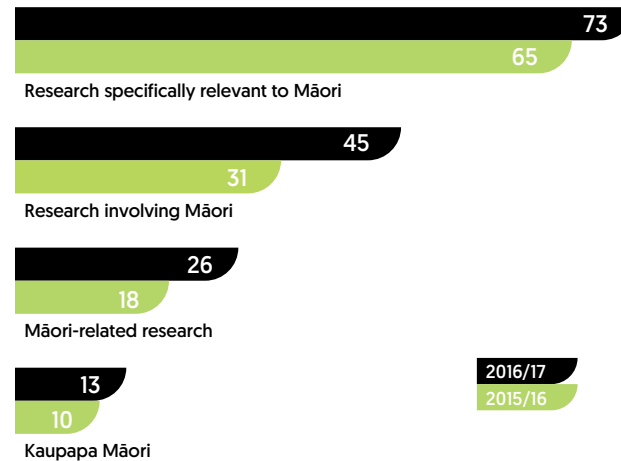
[Te Awa Tupua PSGE], Tuhoe-Tuawhenua Trust, Maungaharuru- Tangitū Trust, Arai-Matawai Incorporation [Turanganui], Te Kura Kaupapa Māori o Ōtepoti, and a number of other organisations.

We are also establishing new or renewing existing relationships with a range of groups, including Ngā Wairiki- Ngāti Apa, Te Kāhui o Rauru, Taranaki Iwi Chairs Forum, Te Runanga o Ngati Ruanui, the National Iwi Chairs Forum, and Wakatu Incorporation.

Building our brand in the Māori sector

Manaaki Whenua seeks to become the preferred science and research partner with iwi and Māori as kaitiaki for their whenua, awa, ngahere and other land-based taonga. This year we have begun to position ourselves in this regard. We have also started to explore a number of collaborations in the Māori land-use capability space, which, if successful, could see us have a much greater presence in this area. This has included engagement with iwi and landowners in the design phase of the Development and Advisory component of the Māori Land Service. We are currently undertaking a review of Whenuaviz, our online Māori Land Visualisation Tool, with

VISION MĀTAURANGA PROJECTS



a view to enhancing its usability as a landowner planning tool in preparation for the upcoming Te Ture Whenua Māori legislative reforms. Another channel through which we hope to build our brand and presence among iwi is the National Iwi Chairs Forum, in which we are able to participate through current Manaaki Whenua networks.

Building our capacity and capability

This year has seen Manaaki Whenua increase its capacity to meet the growing demand for Māori perspectives and partnerships in our science and research. We recently filled the vacant GM Māori Development position; established and filled a new role, Chief Researcher Māori; and recruited two new Māori research staff, based in Hamilton and Auckland. An understanding of the Treaty context is essential as we look to increase the engagement of our science staff with Māori. This year we have provided two 1-day Treaty workshops to staff at our Lincoln and Auckland sites, with another planned for Palmerston North.

Looking Ahead

Moving forward, Manaaki Whenua wants to strengthen its relationships, particularly with iwi – not just because they are significant landowners in their own right but because, as Treaty partners, they have co- governance and co-management interests across the full range of land-based resources. This includes the conservation estate, indigenous flora and fauna and rivers, lakes, wetlands and other waterways [see section 8 Resource Management Act and section 4 Conservation Act]. Manaaki Whenua has developed a number of models and frameworks to integrate Mātauranga Māori with Science (e.g. the Wai Ora Wai Māori Model & Te Ao Māori Reporting Framework for MfE) and we are keen to engage with iwi for the uptake of these tools.

We also see significant opportunities for Manaaki Whenua to provide advice to Māori landowners [based on best science and research] on sustainable land-use options for marginal land. Our track record in integrating Mātauranga Māori with science, along with our existing work with Māori landowners and in modelling environmental impacts against different land-use options, positions us well in this area.

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Engaged with All New Zealanders

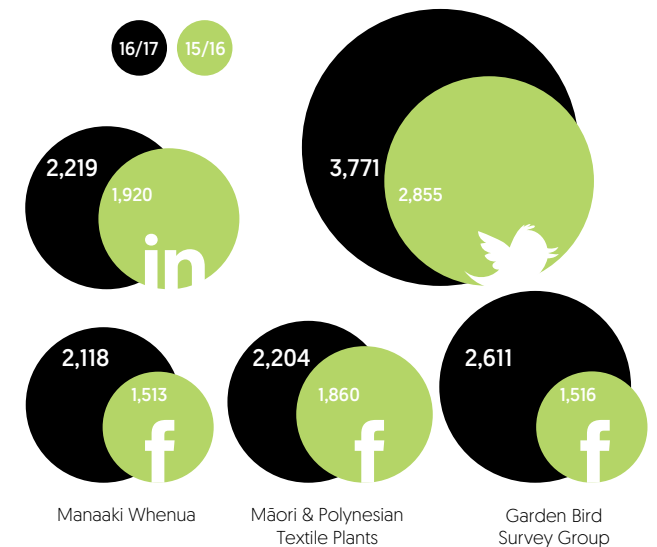


Manaaki Whenua exists to ensure our science and research can improve the way New Zealanders live with our land, Aotearoa.

Our science and research need to be communicated to people who can put it into practice – New Zealand industry, national and regional government, Māori, fellow scientists, and the wider New Zealand public.

Engaging New Zealanders in our science will create opportunities to work with new communities from across New Zealand. It will also elevate our relevance in the minds of New Zealanders, the voters who ultimately give us our mandate to operate. But beyond that, we see it as our responsibility to help New Zealanders answer some of the huge environmental questions they face every day. For example, how will climate change affect us and what can we do? how do we protect our treasured species? and can we continue to use our land for intensive farming while ensuring land resources are sustainable?

SOCIAL MEDIA ENGAGEMENT



Over the past year we have undertaken a strategic review of our brand, marketing and communications with the objective of creating a step-change in our engagement with New Zealanders. Our new strategy is focussed around three principles: [1] establishing a strong, clear and widely known identity; [2] being proactive in speaking on environmental matters; and [3] leading citizen science to get New Zealanders involved in our work.

Refreshing our identity

To better connect with New Zealand, we first needed to re-connect with our own story. In this annual report we share our new brand story. Our purpose, vision and ambitions are simply ways to articulate why we exist and what we do

for New Zealand. Our refreshed logo is modern, but also timeless with a strong link back to our past. Our new design system was purpose built to help showcase our work. Together our new identity is a platform from which we will tell our story to all of New Zealand.

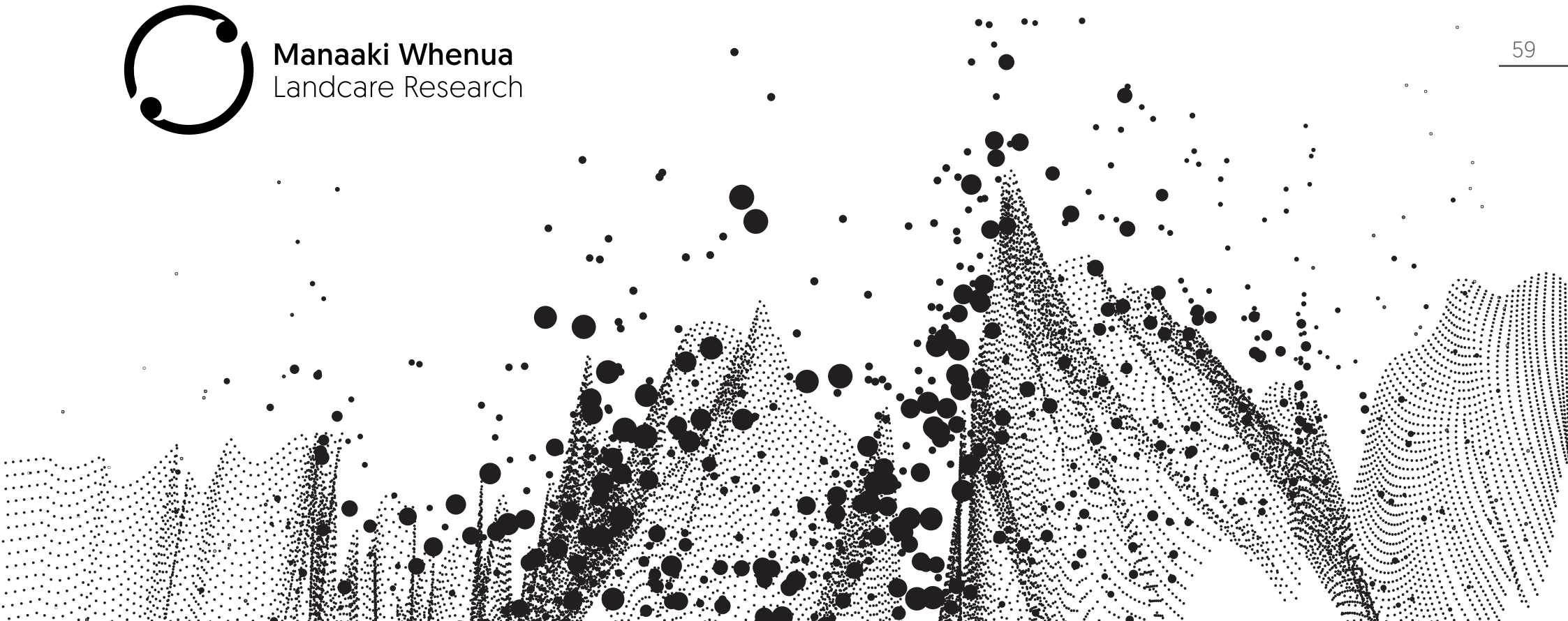
Sharing our knowledge

New Zealanders want answers to some of the biggest questions of our time. Unfortunately answers can come from sources without scientific validity, objectivity or rigour. While joining debates on topics such as biosecurity, biodiversity, land use and our environment can be difficult for scientists who prefer to remain objective and impartial, New Zealanders need our help to find these answers.

We have recently been offering our research and insights to some of these questions, with great early success. For example, after the Christchurch Port Hills fire this year, Fiona Carswell, our Chief Scientist, wrote a well-received article on the planting strategies to reduce future risk. Later, senior managers Justine Daw and Alison Collins wrote an interpretation from a science perspective of the OECD's 2017 environmental performance report on New Zealand. Both articles were published in all Fairfax papers in New Zealand.



Manaaki Whenua
Landcare Research



Citizen science

Engaging New Zealanders more directly in our science has many potential benefits. It can raise our profile by making our work more accessible; it educates New Zealanders, making our science more understandable and inspiring a next generation of scientists; and it expands our knowledge by engaging people across the country. In addition to the successful Ahi Pepe | MothNet project [see our innovation story on page 61], this year's NZ Garden Bird Survey was well received by the public. Ahead of the survey, our team released a report that detailed the changes in bird sightings seen through the survey. The shocking statistic of a 44% decline in sightings of silvereye captured the imagination of New Zealanders, and we saw a huge response on social media and traditional media to the story. This is a great example of citizen science not only engaging New Zealanders in the direct collection of scientific data, but also engaging hearts and minds. Another Curious Mind-funded project saw students from Rongomai Primary School, working with Manaaki Whenua mycologist Peter Buchanan, identify, name and publish papers on three new yeast species.



New Zealand
GARDEN BIRD SURVEY

How have bird counts changed?

National picture: 2007–2016



Looking Ahead

Our aspiration is for Manaaki Whenua to become much more of a household name. This will be a huge challenge, but we know that the work we do is of direct relevance to New Zealanders. Our focus will be to raise awareness of our work through bringing our amazing stories to life.

Investment in our digital experience [including our website and social media] to create engaging content will give us the best chance of reaching all New Zealanders. Video, stunning images and engaging writing will make sure our stories reach a wide audience, including school children and their families, our government, businesses and the international science community. We will also ensure our scientists and senior managers have the marketing tools to open doors and share our capability and experiences with new and existing partners and customers.

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SUSTAINABLE DEVELOPMENT GOALS



Our Future Scientists

Barbara Anderson is passionate about moths.

Over 2,000 species of moths and butterflies in New Zealand play an important role in the ecosystem, as pollinators and as food for our native birds, insects, spiders and reptiles. They are often underappreciated, but thanks to Barbara and her team many others now better understand their value. Through the project Ahi Pepe | MothNet, a citizen science endeavour, the team aims to raise public appreciation of moths and explore their potential to act as ecological indicators of the health of our natural world.

To make moth-lovers of the masses, the team has provided teachers, students and whānau with the skills, tools and connections to run a nationally significant scientific experiment, including internationally recognised moth-monitoring techniques, to evaluate the effectiveness of vegetation restoration in restoring ecosystem function.

And they do it by making moths fun.

Ahi Pepe | MothNet started in the Otago region and will be rolled out in the North Island in 2018. It has its own community radio show, an excellent series of guides, and 14 schools engaged in monitoring moths. Barbara's collaborators include Orokonui Ecosanctuary, Ngāi Tahu, the Geography Department, Te Tumu (University of Otago), Te Kura Kaupapa Māori o Ōtepoti, and the Otago Museum.

Barbara said, 'Making citizen scientists of New Zealanders is deeply satisfying but also really important science.'



Glossary & Guide to Acronyms

ACC	Accident Compensation Corporation	www.acc.co.nz
CRI	Crown Research Institute	
DOC	Department of Conservation	www.doc.govt.nz
EBITDAF	Earnings before income tax, depreciation, amortisation and fair value adjustments	
FOMA	Federation of Māori Authorities [Me Uru Kahikatea]	www.foma.org.nz
KPI	Key performance indicators	
LINZ	Land Information New Zealand	www.linz.govt.nz
MBIE	Ministry of Business, Innovation and Employment	www.mbie.govt.nz
MFE	Ministry for the Environment	www.mfe.govt.nz
MPI	Ministry for Primary Industries	www.mpi.govt.nz
Natural resources sector [NRS]	Comprises the core government agencies responsible for the management and stewardship of New Zealand's natural resources; regional councils are stakeholders	http://nrs.mfe.govt.nz
NPAT	Net profit after tax	
NSC	National Science Challenge	
NSSI	National Statement of Science Investment	www.mbie.govt.nz
NZBH	New Zealand Biological Heritage	www.biologicalheritage.nz
OLWNSC	Our Land and Water National Science Challenge	www.ourlandandwater.nz
OSPRI	Operational Solutions for Primary Industries [TBfree New Zealand Ltd and NAIT Ltd are wholly owned subsidiaries]	www.ospri.co.nz
RMA	Resource Management Act	www.mfe.govt.nz/rma
RSNZ	Royal Society of New Zealand	www.royalsociety.org.nz
SCI	Statement of Corporate Intent	
SCP	Statement of Core Purpose	www.landcareresearch.co.nz
SSIF	Strategic Science Investment Fund [MBIE]	www.mbie.govt.nz
TPK	Te Puni Kōkiri	www.tpk.govt.nz



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¹ From 1 July 2017

² Finished 30 June 2017

³ Finished 28 February 2017



Manaaki Whenua is proud to be a Crown Research Institute. Together we represent the insight and commitment of 3,500 people – using science for a more prosperous, sustainable and innovative New Zealand.



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