NEW ZEALAND'S BIOLOGICAL HERITAGE

Ngā Koiora Tuku Iho

National SCIENCE Challenges

Partnering for Impact

2019 Highlights

NEW ZEALAND'S BIOLOGICAL HERITAGE

Ngā Koiora Tuku Iho

National SCIENCE Challenges

c/– Manaaki Whenua – Landcare Research
New Zealand Limited

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Contents

Our Values

How We Apply Our Values

Mahi whaipainga	We care about making a difference for Aotearoa
Ngākaunui / Uekaha / Ngakau Whakapuke	We are passionate and enthusiastic about our work
Whanaungatanga	We work as a family We have fun together
Manaakitanga	We build trust and create a place that others want to be a part of We build mana in others around us to enhance the mana of the whole
Mana Motuhake / Tino Rangatiratanga	We recognise and empower sovereignty and autonomy
Whakapapa	We recognise interconnections We have an intergenerational vision
Kaitiakitanga	We enable stewardship of our biological and cultural heritage
Mātauranga	We recognise the value of blending traditional and modern knowledge
Tohungatanga / Ngā tiketiketanga o te pai	We apply excellence to everything we do
Mahi rangapū	We work respectfully in partnership

From the Chair and Directors
Nā te Tumuaki me ngā Kaiwhakahaere

He hononga whaimana tō ngā tāngata katoa o Aotearoa ki te tuku ihotanga ā-koiora o Aotearoa, arā, te taiao māori, te tāone me ngā papa whakaputa hua. Mā ēnei papa whenua e ū ai tō tātou tuakiri ā-motu. He pānga hōhonu ā-ahurea, ā-wairua, ā-whānau hoki ō te nuinga o tātou ki ngā maunga, ngā ngahere, ngā pāmu, ngā roto me ngā awa. E honoa rawatia ana, e whakawhirinaki atu ana hoki tō tātou tōnuitanga ā-ōhanga, ā-taiao, ā-ahurea hoki ki tō tātou tuku ihotanga ā-koiora.

Kei te uho o te āhuatanga mahi o Wero te whakarite hononga me te poipoi i ngā mahinga tahitanga, mā te **mahi ngātahi anake e whakatau ai tātou i ngā raru nunui rawa ā-taiao o Aotearoa. Ko te mahi ngātahi ki te whakatau take** te kaupapa matua a te Tuku Ihotanga ā-Koiora i a mātou ka whai ki te whakatutuki i ngā painga mau roa mō ngā taiao o Aotearoa.

He nui ngā mahi kua oti i ngā tau e rima, ā, e hiamo ana mātou ki te whakatakoto i ētahi o aua mahi hei tirotiro māu i konei, i tā mātou pūrongo whakaharahara nō nā tata nei. E whakamārama ana tēnei pūrongo i ā mātou kokenga me ā mātou whakatutukitanga nō nā tata nei. E whakaaturia ana te whakaūnga o te pūtaiao kounga me ngā kokenga e whakatauhia ai ētahi take matatini. Ehara, e kaha ake ana te tirohia mai o mātou hei kāinga māori hei whakatau i ngā take matatini i runga i te āheinga o mātou ki te whakaemi i ētahi rōpū rawe, pūkenga rau anō hoki nō ngā whakahaere rerekē.

Nā te arotake motuhake i ngā kokenga i te tau 2018 i tohua ai te rawe, te wātea me te mahi ngātahi hoki o te ahurea kua whakaritea i roto i te Wero Tuku Ihotanga ā-Koiora. I whakatauhia hoki, kua whakaritea e mātou tētahi hononga tauira ki ngā iwi Māori, ko tōna tūāpapa ko ngā mātāpono o Te Tiriti o Waitangi.

Kua whakaatu mai ā mātou hōtaka pūtaiao i ngā kokenga nui i roto i te wā poto, ā, kua whakaritea te tūāpapa e koke tonu ai mātou ki te whakatutuki i tā mātou whāinga, arā, he whakaiti i te tauheketanga o te tuku ihotanga ā-koiora o Aotearoa. E harikoa ana, e whakamānawa ana hoki mātou i te tautoko mai a ō mātou Rōpū Wero 18.

I a mātou ka neke ki te Wāhanga 2 o Ngā Wero Pūtaiao ā-Motu e arotahi ana mātou me pēhea e kaikā ake ai ngā kokenga a te pūnaha rangahau, auaha hoki o Aotearoa ki te whakaū i ngā pānga nunui ki tō tātou taiao.

E mihi ana mātou ki tō mātou Rōpū Whakahaere me te Kāhui Māori nā rāua i ārahi ā-rautaki mai, tae atu hoki ki te katoa i whai wāhi mai ahakoa pēhea, kia ū ai ngā whakatutukitanga i whakatakotoria ai i tēnei pūrongo me te tūāpapa i whakaritea ai kia angitu tonu ai ā anamata.

Ahakoa tō mātou whakahīhī i ngā kokenga ā mohoa nei, he nui tonu ngā mahi kei mua i te aroaro. He kawenga whaitake tā mātou e ū ai mātou ki tētahi kaupapa kotahi, puta noa i ētahi whakahaere me ētahi rāngai rerekē kia pai ai tā mātou whakaū ngātahi i ngā painga mau roa mō ngā uri whakatupu.

All New Zealanders have a powerful connection to Aotearoa's biological heritage: our natural, urban, and production environments. These landscapes underpin our sense of national identity. Most of us have deep cultural, spiritual or family connections to mountains, forests, farms, lakes and rivers. Our economic, environmental and cultural prosperity are inextricably linked to, and strongly depend on, our biological heritage.

Forging partnerships and fostering collaboration are central to the Challenge way of working – we can only tackle Aotearoa's biggest environmental problems by working together. **Partnering for impact** is the dominant theme for the BioHeritage Challenge Ngā Koiora Tuku Iho as we strive to achieve enduring benefits for Aotearoa New Zealand's environments.

Much has been achieved during our first five years, and we are delighted to present some of that to you here, in our latest highlights report. This report sheds light on our recent progress and achievements. It shows not only delivery of excellent science but also tangible progress to solving complex issues. Indeed, we're increasingly seen as a natural home for addressing complex issues, based on our ability to assemble excellent, inter-disciplinary teams drawn from diverse organisations.

Independent assessment of progress in 2018 highlighted the excellent, open and collaborative culture that we have built in the BioHeritage Challenge. It also concluded that we have established an exemplary partnership with iwi/Māori, grounded in Te Tiriti o Waitangi principles. Our science programmes have demonstrated great progress in a relatively short time, establishing the foundations on which we will now strive to make tangible progress towards our mission – reversing the decline of New Zealand's biological heritage. We are delighted and grateful for the strong support shown by our 18 Challenge Parties.

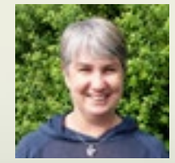
As we move into Tranche 2 of the National Science Challenges, we are sharpening our focus on how Aotearoa's research and innovation system can accelerate progress to deliver greater impact for our environment.

We'd like to thank our Governance Group and Kāhui Māori for their strategic oversight, and all those who have contributed in various ways to the achievements set out in this report and the foundations established for future success.

While we're proud of progress to date, we're conscious of the mahi in front of us. Our role is vital for building commitment to a common agenda across diverse organisations and sectors, so we can collectively deliver enduring national benefit for future generations.

Dr James Buwalda
Tumuaki, Governance Group Chair

Melanie Mark-Shadbolt
Kaiwhakahaere Māori, Director Māori



Dr Andrea Byrom
Kaiwhakahaere, Director

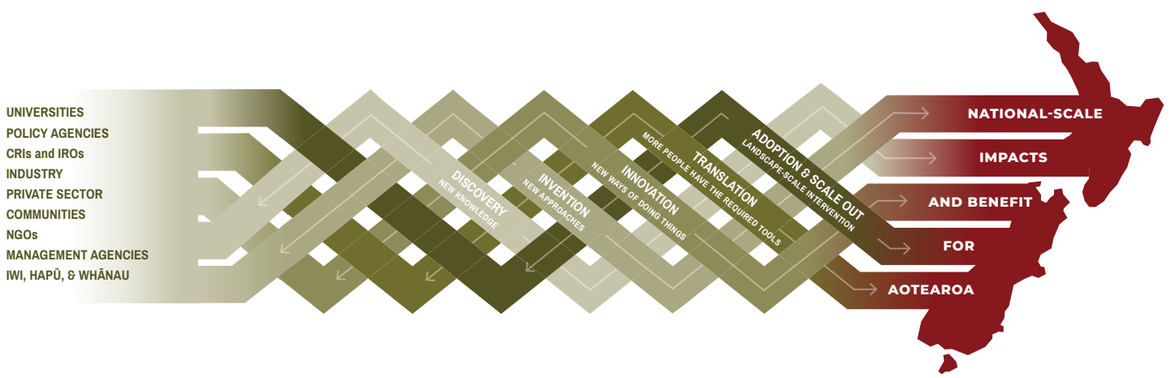
Partnering for impact

The BioHeritage Challenge, Ngā Koiora Tuku Iko, aims to protect and manage Aotearoa New Zealand's biodiversity, improve our biosecurity, and enhance our resilience to harmful organisms.

Our role is to convene, prioritise, and connect a range of partners and existing investments to accelerate progress. Within the Challenge, a wide range of partners are working together to tackle some of Aotearoa New Zealand's biggest environmental issues, taking a collaborative, inter-disciplinary approach to achieve national-scale impact.

New Zealand's innovation system

The concept of an innovation system takes a collective-impact approach to research investment. The approach interweaves all types of knowledge, including mātauranga Māori, from new discoveries and innovations to novel ways to use this knowledge – for greater impact and benefit for Aotearoa. The innovation system allows for a diversity of contributions from a wide range of individuals and institutions: a national partnership.



Our Challenge Parties

Our Challenge Parties include all eight of Aotearoa's universities and seven Crown Research Institutes. Mana whenua, iwi and Māori groups, government and non-government organisations, private citizens and regional councils are also working closely in partnership with the Challenge.

We are one of 11 National Science Challenges, with investment being administered by the Ministry of Business, Innovation and Employment.

BioHeritage is hosted by Manaaki Whenua – Landcare Research.

Manaaki Whenua
Landcare Research

AUT
Lincoln University
Department of Conservation Te Papa Atawhai
Ministry for Primary Industries Manatū Ahu Matua
agresearch āta mātai, mātai whetū
The University of Waikato Te Whare Wānanga o Waikato
University of Otago Te Whare Wānanga o Otāgo New Zealand
Plant & Food Research Rangahau Ahumāra Kai
E/S/R Science for Communities
Massey University Te Kunenga ki Pūrehuroa
GNS Science Te Pū Ao
The University of Auckland Te Whare Wānanga o Tāmaki Makaurau New Zealand
Te Whare Wānanga o te Ūpoko o te Ika a Māui Victoria University of Wellington
University of New Zealand
Cawthron The power of science®
NIWA Taihoro Nukurangi
Scion Forests Products Innovation
UC University of Canterbury Te Whare Wānanga o Waitaha Christchurch New Zealand

Throughout 2018, all 11 National Science Challenges were reviewed by independent assessment panels convened by the Ministry of Business, Innovation & Employment. Each Challenge re-focused its strategic direction for 'Tranche 2': 2019 to 2024.

Our strategy sharpens the focus on three impact areas: whakamana, tiaki, whakahou.

Whakamana Empower

Tiaki Protect

Whakahou Restore

Whakamana Empower

Ki te whakamana tātau o Aotearoa whānui, ki te manaaki tō tātau taiao

Helping New Zealanders protect our precious environment

The natural, urban and production environments in which we live, work and play are under threat from invasive organisms and from new pressures emerging in a rapidly changing global environment.

Stewardship of biological heritage is in the hands of all New Zealanders, but people need to be inspired to take action.

One of the greatest impacts we can make is to empower New Zealanders so they value our biological heritage, understand how it is changing, and feel inspired to take action to protect it.

Students out in the field as part of Tohu o te wā – Hangarau pūtaiao (Signs of our time – fusing technology and science). Image: Te Whare Kura o Maniapoto

Tiaki Protect

Ka whakawhānake tō tātau pūnaha tiaki koiora ki te ao

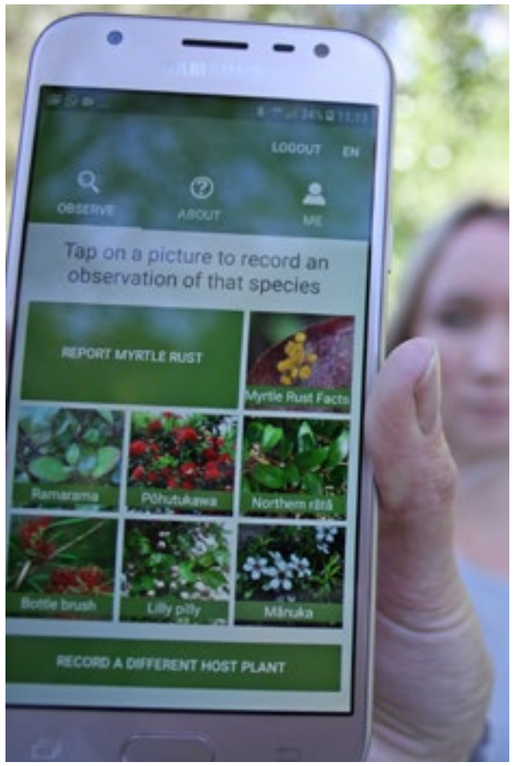
Contributing to a world-class biosecurity system

Our biosecurity system prevents or manages risks from harmful organisms, like pests, weeds and pathogens. As well as protecting our environment, the biosecurity system helps protect Aotearoa's economy, human health, and a range of social and cultural values. It does this by:

- stopping pests and diseases before they arrive
- dealing with pests if they do enter the country.

We need to remove or mitigate known priority threats – wasps, plant and animal pathogens, small mammal predators and invasive weeds – plus improve prediction of emerging global threats.

By combating such biotic threats, we can create better ways of protecting Aotearoa's natural, urban and production environments and help create a world-class biosecurity system.



The Myrtle Rust Reporter app makes it easy to report plant and animal pests. Image: Caroline Fenton

Whakahou Restore

He whenua haumako, aumānga hoki a Aotearoa

Creating a resilient, thriving environment

Our natural, urban and production environments underpin our sense of national identity, with most of us having deep cultural, spiritual or family connections to mountains, forests, farms, lakes and rivers.

The health of these environments depends on sustaining our natural assets – including geology, soil, air, water and all living things – in an ever-changing biotic, economic and social environment.

We need to create resilient and thriving ecosystems that New Zealanders are proud of – so they're inspired to make positive changes for future generations.

Strategic Outcomes

To achieve the transformational change required to deliver greater impact and benefit for Aotearoa, large, cohesive, interconnected portfolios of collective effort are structured into seven Strategic Outcomes sitting under the three impact areas.

Strategic Outcomes are jointly designed by Māori, communities, industry and end-user agencies to ensure an integrated and collective approach to achieving impact.

Leverage points are a key focus for Challenge investment. Our investments are also designed to build interconnections among individuals, organisations and knowledge holders, providing an integrated pathway to impact for each Strategic Outcome.

Whakamana • Empower

- Bioheritage scorecard
- Environmental stewardship

Tiaki • Protect

- Predicting current and future threats
- State-of-the-art surveillance
- Novel tools and strategies

Whakahou • Restore

- Ecosystem interdependencies
- Adaptive governance and policy

University of Canterbury PhD student Aisling Rayne catches a kēkēwai (freshwater crayfish), ready to take clippings from its limbs for genetic sampling. Image: John Hollows

How this report is structured

This report is in two main sections: 'Impacts' and 'Collaborations'.

In the Impact section (pp. 10-31), we showcase examples of how the Challenge has delivered impact and benefit for Aotearoa in our three impact areas (Whakamana, Tiaki, Whakahou); impact through kaupapa Māori; and examples of impact through leaving a legacy for Aotearoa's innovation system.

In the Collaborations section (pp. 32-49) we showcase examples of how mahi tahi (collaborations) can strengthen a focus on system-wide goals, such as Predator Free 2050, to deliver greater impact and benefit for Aotearoa.

IMPACT ONE HIGHLIGHT

Whakamana

Empowering people to take action to restore biological heritage

Last year, BioHeritage was proud to join the Tauranga Moana Biosecurity Capital (TMBC) partnership – an exemplar for regional collaboration and partnership. Image: TMBC

Background

Public acceptance of innovative technologies to control pest species in New Zealand varies widely, and both existing and new technologies sometimes meet with strong opposition. Understanding New Zealanders' beliefs and attitudes about new pest control technologies during their development presents a proactive opportunity for positive, early engagement with the nation.

Responsible science requires discourse with the public while tools are being developed, to ensure public opinion is part of the decision-making. Such an approach can anticipate public concern toward specific methods and ensure that novel research approaches are being developed responsibly.

We recognise that public support for science and research is an important underlying consideration in the selection and development of new technologies. Public support is essential for future uptake and implementation of solutions by industry and community partners.

Social research, linked to Challenge investment in projects developing tools for pest control, is vital if we are to create impact from technology development.

The research

Social science frameworks are required to experimentally test the degree of social acceptance of novel technologies for wide-scale pest control. A research team led by Dr Edy Macdonald (Department of Conservation) undertook this work.

The team surveyed more than 8,000 members of the public, including 1,000 Māori respondents, about their attitudes to future control methods for pest wasps and rats as complementary case studies. These novel control methods are being developed in the Challenge.

Key findings

Many people see pests as a significant conservation concern, deserving of attention and resources. Public views on pest control options are related to people's personal values and beliefs, with respondents tending to adopt one of four perspectives: humanitarian, individualistic, scientific, or pragmatic.

Creating impact

Public attitudes towards pest control are influenced by people's different underlying values. An outcome of this work is to **promote a more empathetic approach which seeks consensus** around pest control.

The team discovered that simply **providing more factual information** can in fact **polarise** community views. This research has laid a strong foundation for the agencies that conduct pest control to better communicate with the New Zealand public through direct dialogue, rather than seeking to alter people's opinions just by presenting facts.

The results emphasise a strong need to approach conversations about pest control from a range of vantage points (**social, environmental and political**) to address a diversity of priorities and concerns among New Zealand citizens.

Extra funding from the Ngā Pae o Te Māramatanga Centre of Research Excellence ensured a large sample size of Māori participants. Analyses focusing on **Māori beliefs and values** are still being explored in depth.

This research has demonstrated the value of social science research, as well as the insights and impact that well-designed and executed behavioural research can provide. As a result, environmental NGOs, regional councils, and central government agencies are **seeking to build capability** in their own organisations. They also want to collaborate across a network of social scientists on future pest control projects that will more **effectively engage the community**. Some have provided additional funding to complement Challenge investment.

More information

Video

Check out the discussions at the Conservation Biology Oceania meeting in 2018: http://bit.ly/2GoRmaP

Watch: http://bit.ly/2IBWh9N

Further reading

Kannemeyer R. 2017. A systematic literature review of attitudes to pest control methods in New Zealand. http://bit.ly/2UFx9pS

Strategic partners

Department of Conservation *Te Papa Atawhai*

Manaaki Whenua Landcare Research

University of Otago *Te Whare Wānanga o Otāgo* New Zealand

Te Herenga Waka Victoria University of Wellington

Lincoln University

Te Tira Whakamātaki Māori Biosecurity Network

Bio-Protection *Bioprotection science for New Zealand*

Contacts

Edy Macdonald, **Fabien Medvecky**

Image: Grant Maslowski, Photonewzealand

IMPACT TWO HIGHLIGHT

Tiaki

Protecting New Zealand's environment from public nuisance number one

Vespula germanica wasp

Background

When it comes to bringing Aotearoa's wasp problem under control, there are a number of avenues to explore with respect to future control technologies. When a research team convened by the BioHeritage Challenge started their work four years ago, options such as the use of pheromones, gene silencing, population modelling and future gene drives were all showing promise.

The multi-institutional team, led by Professor Phil Lester at Victoria University of Wellington, spanning disciplines as diverse as population modelling, ecology, entomology, social research, and mātauranga Māori, decided to investigate all these options in the early stages of the research programme.

At the same time, more fundamental lines of enquiry were established – such as understanding the ecological benefits of removing wasps, and building in Māori world views – so that any control options applied in future would be acceptable to the public and have the best chance of success.

The research

Researchers at the University of Otago and Genomics Aotearoa focused on sequencing the genome of the wasp – research that paves the way for the use of future gene editing technologies and enables a better understanding of genetic diversity among New Zealand wasp populations.

Another potentially game-changing technology is the use of gene silencing: a technique that can be used to disrupt natural metabolic processes in wasps and other pest invertebrates.

To understand Māori perspectives to novel wasp control techniques, a research assistant and two Masters students at Victoria University of Wellington used different interview techniques: one focusing on Māori students, one on Māori businesses and one on religious and spiritual perspectives.

A PhD student at the University of Auckland studied wasps on offshore island ecosystems, providing valuable insights into ecological impacts, and how wasps interact with mammal pests such as rats and possums.

Simultaneously, population models for wasps were developed, so as to understand how techniques such as gene editing and gene silencing will help control wasp populations in future.

Key findings

Future technologies

Several technologies and approaches were evaluated, 'Dragons Den' style, by a wide range of stakeholders in a 2018 workshop where the goal was to narrow the field to two or three new technologies for wasp control with appropriate tactical, strategic, and end-user considerations. Those with the greatest potential to deliver wide-scale solutions to the wasp problem are now being further investigated. Other lines of enquiry, such as the use of pheromones, still show some promise but will not be further researched.

Ecological impacts

Offshore islands that are closer to the mainland and inhabited by people were found to have higher populations of wasps. However, wasp numbers are not related to the number of mammalian pests, nor are wasp numbers determined by whether native or exotic trees dominate the landscape.

Māori perspectives on new wasp technologies

Considerable progress has been made seeking Māori perspectives on novel wasp control approaches. The work has generated global interest, including a presentation at the World Indigenous Research and Education Conference (WIREC) in Norway in 2018 and the 2018 4S Social Science Conference in Sydney.

Creating impact

Research on wasps has resonated with the public, receiving considerable media attention and public interaction though TV, radio, newspaper, and public talks. It is vital to have research into potentially game-changing technologies open to public scrutiny and discussion. This is an exciting era, with Aotearoa taking on a **leadership role in transparent public discussion** under the umbrella of the BioHeritage Challenge.

The programme has also been successful in **actively engaging Māori** in assessing the social acceptability of the novel technologies.

Ecological research on offshore islands has determined that **future restoration** of offshore island ecosystems needs to consider factors that can help reduce wasp populations, such as increasing forest canopy cover and reducing human impacts on the land.

The Wasp Tactical Group of stakeholders **actively participated in shaping the research**, successfully narrowing the focus of the project team towards technologies – complemented by social research and a deep understanding of ecological impacts – that will generate the greatest benefit for Aotearoa.

More information

Media

Wasp genomes revealed: http://bit.ly/2K6hWVs

The Vulgar Wasp: The Story of a Ruthless Invader and Ingenious Predator: http://bit.ly/2Gx3ZIG

Can NZ ever be free of the 'vulgar' wasp?
http://bit.ly/2KEQiUe

Further reading

Mercier OR, King Hunt AR, Lester PJ 2018. Novel biotechnologies for eradicating wasps: seeking Māori perspectives with Q Method. *Kōtuitui*: New Zealand Journal of Social Sciences 14:1, 136-156. http://bit.ly/2In4QpJ

Lester PJ & JR Beggs. Invasion success and management strategies for social *Vespula* wasps. *Annual Review of Entomology*. http://bit.ly/2UAwVAi

Strategic partners

Department of Conservation *Te Papa Atawbai*

Manaaki Whenua Landcare Research

Te Herenga Waka Victoria University of Wellington

LAB IN A BOX

Plant & Food Research Rangahau Ahumāra Kai

genomics aotearoa

Ministry for Primary Industries Manatū Ahu Matua

Contacts

Phil Lester, Ocean Mercier, Peter Dearden, Julia Schmack, Symon Palmer, Alan King Hunt

Julia Schmack is studying the impact of wasps on offshore island ecosystems for her PhD at Auckland University. Image: Julia Schmack

IMPACT THREE HIGHLIGHT

Whakahou

Keeping ecosystems resilient, healthy and functioning

Background

Researchers are developing a framework to help predict and prevent rapid, harmful and difficult-to-reverse changes in ecosystems, sometimes called ‘tipping points’.

Once an ecosystem reaches a tipping point, it can be costly or unfeasible to reverse – for example the loss of peat-forming species in wetlands, or the loss of soil structure and quality with intensive agriculture.

The research

Led by Professor Jason Tylianakis at the University of Canterbury, the team has been investigating which ecosystem characteristics make habitats vulnerable to tipping points, including how humans can both degrade or, conversely, protect the environment. This link between humans and the environment is sometimes called a ‘social-ecological’ system. Understanding the processes that lead to tipping points in social-ecological systems, and using that knowledge to develop generic, widely applicable tools, can help to proactively manage and sustain healthy ecosystems.

Mātauranga Māori is critical to the research, which is being co-designed with Kati Huirapa kaitiaki members who are using their indigenous knowledge of restoring populations and sustaining harvests of mahinga kai (food gathering) to shape the research priorities. The aim is to reverse degradation across a range of Aotearoa’s natural and primary production ecosystems, and nudge these systems towards a healthy, self-reinforcing state.

Rosemary Clucas and Koko the whitebait sniffer dog (in training) on the hunt for whitebait spawn. Image: Rosemary Clucas

Key findings

The research team developed a conceptual framework for understanding the mechanisms that drive social tipping points in indigenous communities, and how these influence ecosystem resilience and social adaptive capacity. The framework identifies 'adaptive engagement' with the environment as a means to protect existing mātauranga, and to allow mātauranga, tikanga and kawa to adapt to changing social, economic, and biophysical conditions.

In freshwater ecosystems, the team discovered that habitat-forming organisms (such as aquatic plants in lowland lakes) are key to preventing ecological tipping points. Habitat-forming organisms can affect how vulnerable an ecosystem is to stressors, particularly if they dominate and influence physical habitat conditions. Calm aquatic environments, such as spring-fed channels, shallow lakes and lake outlets, are thus particularly vulnerable.

Creating impact

The research has culminated in a **framework for promoting intergenerational resilience** of mahinga kai (specifically Inanga) under changing environmental conditions, with specific mitigation methods identified. These include the creation of resilient spawning sites through bank realignment; hapū wānanga to capture and pass on traditional knowledge and practices; working with the wider community to begin habitat plantings for future spawning environments; and dealing with the loss of mahinga kai by investigating alternative sites and/or alternative resources.

Aotearoa will always require expertise in understanding and modelling the complexity that arises in social-ecological systems, in order to build resilience to tipping points. The team successfully **developed and retained capability** (Dr Johanna Yletlinen) – recruited internationally – in social-ecological modelling of tipping points within New Zealand.

A **Policy Brief** emphasises that tipping points are underpinned by feedback mechanisms that mean, even if the stressors are removed, habitat can be extremely difficult to restore. With a better understanding of tipping points, agencies can take more effective action to **restore degraded ecosystems.**

More information

Further reading

Policy Brief: http://bit.ly/2UDK3F4

Book: Indigenous Pacific Approaches to Climate Change. The book includes a chapter on overcoming the impacts of social tipping points associated with resource access, in order to improve future resilience of mahinga kai resources. http://bit.ly/2J1tThq

Strategic partners

Contacts

Jason Tylianakis, Phil Lyver, Angus MacIntosh, Johanna Yletlinen, Nigel Scott, Lyn Carter, Rosemary Clucas, Richard White, George Perry, Sarah Richardson, Pike Brown, Janet Wilmshurst, Kevin Simon

Non-native aquatic plants (macrophytes) in the Selwyn River catchment
Image: Angus MacIntosh

Recognising mātauranga

To support protection of biological heritage in Aotearoa

Background

Kaumātua-led research that puts Māori methods and knowledge holders first is a key part of restoring Aotearoa's land and freshwater ecosystems. Fundamental elements of mātauranga can be characterised in such a way that it can be empowered to strengthen protection of biological heritage.

This programme is one of a very few examples where investment has been provided directly to Māori practitioners who are employing a mātauranga-based approach. The team co-designed a research approach between kaumātua, knowledge-holders and potential users that has at its heart a Māori philosophy. The aim is to restore and future-proof the pre-colonial transfer of mātauranga Māori.

The research

Central to the research is the formation of He Putunga Kōrero-He Puna Mātauranga – a rōpū of respected and knowledgeable kaumātua and knowledge-holders who are examining knowledge management issues and advising on the development of best practices and wellbeing indicators.

Operating within a kaupapa Māori framework demands a collaborative research process that prioritises ethics informed by tikanga. Ultimately, the aim is to establish a process that provides a safe environment to discuss and debate issues, where engagement occurs in a way that kaumātua and knowledge holders are comfortable.

Culturally safe practices and agreements need to protect a person's inherited authority and the common good, and intellectual property needs to be protected via knowledge agreements. When combined, these factors create trust and a culturally safe environment for researchers where appropriate Māori cultural practices, and the use of the Māori language, are normalised.

Students out in the field as part of Tohu o te wā – Hangarau pūtaiao (Signs of our time – fusing technology and science). Image: Te Whare Kura O Rakaumaunga

Key findings

The collaboration has been underway since 2017 and a number of themes are coming through from kaumātua. For example, there is an increasing physical disconnection and erosion when it comes to applying cultural environmental knowledge. Further, the western science system and practitioners do not prioritise Māori environmental knowledge.

Increasing misappropriation of Māori knowledge is also common, especially in Aotearoa's science policies. Further, there is a lack of understanding about what underpins 'healthy' knowledge and the wellbeing of kaumātua and kuia.

These findings mean that mātauranga Māori clearly has a role in reversing the decline of Aotearoa's biological heritage, but it does not always get the opportunity to participate or contribute.

Creating impact

The knowledge-holder/kaumātua-led research has generated significant impact in part because the research team has been given the freedom to **embed conversations in context-specific locations** such as the ngāhere, where the kaumātua feel comfortable. Embedding conversations within contexts that are conducive to discussing and debating the challenges, issues and needs facing Māori has been extremely important to them. The depth of discussion and openness from the kaumātua has signalled a growing comfort in their direction and ownership of the programme.

In turn, the mahi of the kaumātua has become visible publicly. For the first time, **specific mention of mātauranga-based solutions is being reported via Māori media**, creating significant momentum in research on the plant pathogen that causes kauri dieback, and opening a discussion around the application of mātauranga to address this disease.

The **word spread even further in Māoridom** after the team attended the Ngā Taonga Tuku Iho Conference in Nelson. The kaumātua and other team members participated at all levels. Well-known and highly respected national and international authorities and **practitioners of indigenous intellectual property protection and enhancement** attended, significantly extending the reach and impact of this work.

Building Māori capability and expertise is another important contribution to the overall impact of the project. After working with the team, summer scholarship recipient Adrian Peachey secured a position at the Northland Regional Council as a Biosecurity Officer for kauri dieback. Working with Māori knowledge-holders was a key factor in their decision to appoint him.

Real impact from this project has stemmed from the **empowerment of biodiversity knowledge- holders to lead and guide research**. Giving them space and place to kōrero about the issues they are facing in maintaining and transferring their mātauranga has been invaluable: the knowledge-holders have been extremely open because the process has been tika (right).

More information

Media

Watch: Tohe Ashby on the potential of a whakapapa Māori solution for kauri dieback outbreak: http://bit.ly/2InSD4a

Further reading

Ataria J, Mark-Shadbolt M, Mead ATP, Prime K, Doherty J, Waiwai J, Ashby T, Lambert S, Garner GO 2018. Whakamanahia Te Mātauranga o te Māori: empowering Māori knowledge to support Aotearoa's aquatic biological heritage. *New Zealand Journal of Marine and Freshwater Research* 52(4): 467-486. http://bit.ly/2Io1h2D

Strategic partners

Contacts

Project Leaders

Kevin Prime (Ngati Hine), Tohe Ashby, Jim Doherty (Tuhoe), Hemi Waiwai (Tuhoe, Ngati Ruapani)

Researchers

James Ataria (Rongomaiwahine, Ngāti Kahungunu, Ngāti Tūwharetoa), Melanie Mark-Shadbolt (BioHeritage and Te Tira Whakamātaki), Aroha Mead (Ngāti Awa, Ngāti Porou), Tame Malcolm (Te Tira Whakamātaki)

International Collaborators

Simon Lambert (Tūhoe, Ngāti Ruapani ki Waikaremoana), Mariella Marzano (Forest Research UK), Damien Lee (Ryerson University, Yellowhead Institute)

Additional team members, including knowledge-holders: brought in to meet specific needs such as topic-specific mātauranga, visual design and whanaungatanga.

Former BioHeritage student Adrian Peachey is working on Northland Regional Council's kauri dieback team. Image: Northland Regional Council

The role of the National Science Challenges

Creating impact for Aotearoa

Image: Joanna Spaak

New ways of working

Inter- and trans-disciplinary teams that include individuals from numerous organisations are becoming the norm as the National Science Challenges strive to strengthen and enhance collaborations among researchers, communities and stakeholders. In addition to our formally-signed-up Challenge Parties, the BioHeritage Challenge has embraced knowledge and expertise from many other organisations, including mātauranga held in indigenous communities.

In this section, we highlight some of the important **transformational shifts** that have taken place in the way we work across institutions, disciplines, and sectors.

A Treaty partnership

In November 2018, **Melanie Mark-Shadbolt** (Ngāti Kahungunu, Ngāti Porou, Te Āti Awa, Ngāti Raukawa) became the **Director Māori** for BioHeritage. Melanie is working with Challenge Director Dr Andrea Byrom on strategic priorities and on building strategic links with Māori. The co-Director approach signals a commitment on the part of BioHeritage to apply the partnership principle of **Te Tiriti o Waitangi**. Melanie also works part-time as Kaihautū Chief Māori advisor for the Ministry for the Environment, cementing a strong connection with a key stakeholder.

Dr Andrea Byrom, left, and Melanie Mark-Shadbolt

Imparting knowledge to the next generation

An important role for the National Science Challenges is to show our emerging kaitiaki and leaders how Aotearoa can do things differently. Through inter-disciplinary collaborations in the BioHeritage Challenge, researchers who had previously never met have been inspired to provide new perspectives and inter-disciplinary insights to an **emerging generation of students.**

For example, as a result of a collaboration between two Victoria University of Wellington researchers in the wasp programme, Dr Ocean Mercier now teaches Māori perspectives in biodiversity and conservation in Professor Phil Lester's classes in biology. Meanwhile, Phil has given lectures on wasp control technologies in Ocean's classes in Te Kawa a Māui.

Local, regional, global

Across Aotearoa, many researchers have existing relationships with international collaborators. In the BioHeritage Challenge we take a strategic approach to facilitating and enhancing the more critical relationships, in areas where New Zealand scientists or knowledge-holders can impart their knowledge internationally, and where they in turn can learn from international colleagues.

One such example is a focus on conserving seeds to fight plant extinction, with support from Te Tira Whakamātaki. Whānau of Te Awa Tupua, the Whanganui River, were the fifth recipients of a seed-banking drum kit: a special kit that enables community members to collect, dry and store seeds from local taonga (treasured) plants.

Whanganui wāhine Kim Ranginui and Marilyn Tamakehu are strongly connected to the marae alongside Te Awa Tupua, and Te Kura o te Wainui ā Rua – the awa school based at Rānana – and felt it was fitting for the seed-bank gifting to happen at the kura. They're passionate about seed-banking, ensuring iwi gain knowledge of preserving taonga species and that this is maintained for generations to come.

Kim then secured a place on a three-week, intensive Seed Conservation Techniques course hosted by Royal Botanic Gardens Kew's Conservation Science Department in the UK. This two-way exchange helped further discussions around Māori concerns that tikanga is not adequately acknowledged in national or international seed-banking practices.

Strategic partners

TE TIRA WHAKAMĀTAKI Māori Biosecurity Network

Royal Botanic Gardens Kew

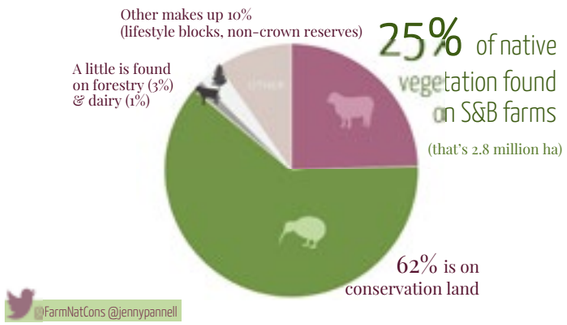
Whānau of Te Awa Tupua have been gifted a seed-bank, enabling them to collect and store seeds from local taonga (treasured) plants. Image: Te Awa Tupua

Collaborating with industry

Drivers of native biodiversity loss, retention and restoration on sheep and beef farms are an important consideration for the 40% of New Zealand under this land-use type.

As part of the *Farming and Nature Conservation* team, Dr Jennifer Pannell has highlighted the growing awareness of the link between biodiversity restoration and human health. The work is guided by Beef + Lamb NZ.

Where is Aotearoa's native vegetation?



Strategic partners

BEEF + LAMB NEW ZEALAND

agresearch āta mātai, mātai whetū

AUT

UC UNIVERSITY OF CANTERBURY Te Whare Wānanga o Waitaha CHRISTCHURCH NEW ZEALAND

THE UNIVERSITY OF AUCKLAND Te Whare Wānanga o Tāmaki Makaurau NEW ZEALAND

Ngā Rākau Taketake:
a 'systems' approach to combating kauri dieback and myrtle rust

To achieve transformational change, part of the Challenge's role is to drive a step-change in how we create and use all forms of knowledge in Aotearoa to generate impact for future generations.

Such step-change is urgent for many environmental issues but one that has resonated strongly with the public is the potential impact of kauri dieback and myrtle rust on New Zealand's taonga trees and ecosystems.

Bioheritage has been tasked with leading the development of a new programme that aims to accelerate the critical research needed to combat the spread of kauri dieback and myrtle rust. **Ngā Rākau Taketake – Saving our Iconic Trees** aims to coordinate and focus work already being done by government agencies, councils, research providers, Māori and interest groups, while also investing in critical priority research.

The name Ngā Rākau Taketake reflects the historical connections Māori and all New Zealanders have with our kauri and myrtaceae. Taketake refers to the permanence of that relationship. Ngā Rākau Taketake aims to protect and restore that relationship and connection.

Leading development and implementation of Ngā Rākau Taketake are Strategic Leadership Group members Dr Nick Waipara (Plant & Food Research) and Dr Maureen O'Callaghan (AgResearch). Their vision is to coordinate currently disparate efforts across the biosecurity system to achieve transformational change in the way that we tackle the impacts of plant pathogens in Aotearoa.

Read: http://bit.ly/2HLE0HJ

Ngā Rākau Taketake eNewsletter: http://bit.ly/2Yltf2H

NGĀ RĀKAU TAKETAKE
Saving Our Iconic Trees
from Kauri Dieback & Myrtle Rust

Mathematics and biology combine to protect Aotearoa's biosecurity system

A critical part of any biosecurity system is the ability to predict pests before they arrive, or to eradicate pests that have established. Keeping pests out of Aotearoa is a vital part of protecting our unique natural environment and primary industries.

Led by Scion Post-Doctoral Fellow Dr Rebecca Turner, researchers have developed a mathematical modelling framework that incorporates insect border interception data from New Zealand and internationally to predict which insects are likely to invade next. A mathematician and biologist, Rebecca was contracted to help the Ministry for Primary Industries eradicate *Mycoplasma bovis* – a cattle disease that recently arrived in New Zealand.

Rebecca's research is co-funded by Te Pūnaha Matatini, and includes a team from Scion, B3, and the University of Canterbury.

Te Pūnaha Matatini: http://bit.ly/2VJyDvD

Strategic partners

From summer student to valued employee

A former BioHeritage student has secured himself a job in a specialist kauri dieback team within the Northland Regional Council. Adrian Peachey is one of a three-strong team, with the job of identifying and managing the spread of kauri dieback disease in Te Tai Tokerau. Adrian was hired after finishing his Bachelor of Science, majoring in bioprotection and biosecurity at Lincoln University. The council needed a skill-set capable of working with private landowners on tailor-made kauri dieback management plans to lessen the risk of the disease spreading from private land and district council reserves.

Kauri dieback management programme: http://bit.ly/2fdePRd

University of Canterbury MSc student Levi Collier-Robinson sampling kōwaro with students from Te Kura o Tuahiwi. Image: Ashley Overbeek

Genomic tools for conservation

Genomics – the branch of molecular biology focused on the structure, function, evolution and mapping of genomes – is a vital tool for a wide range of conservation applications. In 2018, Genomics Aotearoa was established as a collaborative, cross-institutional research platform for genomics and bioinformatics in Aotearoa.

Through researchers in common, the BioHeritage Challenge has numerous informal connections with Genomics Aotearoa, and two formal partnerships. One of these partnerships has a focus on the population genomics of introduced rats in Aotearoa, in collaboration with Predator Free 2050 Limited.

The other partnership – through the University of Canterbury – focuses on 'long read' sequences of the kēkēwai (freshwater crayfish) genome, complementing work through the University of Otago which focuses on 'short read' sequences. Together, these collaborations provide a complete reference genome for kēkēwai.

Genomics Aotearoa: http://bit.ly/2DdZmJK

Predator Free 2050 Limited: http://bit.ly/2GoNXZw

Strategic partner

Members of the Tuawhenua community who took part in a Māori values study. Image: Puke Timoti

Enabling the inter-generational transfer of mātauranga

Enabling the inter-generational transfer of mātauranga within communities is a vital part of restoring the biological heritage of Aotearoa. An initiative entitled: *Te Weu o te Kaitiaki* (The roots of the kaitiaki – Inter-generational transfer of knowledge) was established in 2018. The first wānanga *Nau mai e manu e waha ki toku tua* (Return bird unto my shoulder) was conducted with Tuawhenua kaumātua and ākonga.

The kaupapa of the wānanga focused on the inter-generational transfer of knowledge relating to the kererū (NZ pigeon). The wānanga was based at Mataatua Marae, Ruatāhuna but involved a field trip day with kaumātua and rangatahi at old settlement and kererū harvesting sites within Te Urewera.

Two documentaries from the wānanga are being produced for Māori TV with Kia Mau Media Ltd. In addition, mātauranga and narrative from interviews and the wānanga are contributing to course work within Te Whare o Rehua which is a traditional academy recently established in Ruatāhuna.

The mōteatea called *Te Mauri o te Kererū* – created by Puke Timoti and the Ruatāhuna community – expresses the biocultural relationship that Tuawhenua have with kererū in Te Urewera. It was composed as an outcome from the *Te Weu o te Kaitiaki wānanga*. The mōteatea was adopted by the BioHeritage Challenge in development of our 2019–2024 strategy (with permission from the community), and can be found on page 61 of this report.

MAHI TAHI COLLABORATIONS

A scorecard for Aotearoa's biological heritage

Tracking our progress in reversing the decline

How will we know when we are successful in 'reversing the decline' of New Zealand's biological heritage? Tracking our progress towards a set of common indicators is an important part of measuring and monitoring success. It involves choosing the 'right' environmental, social and cultural indicators, and using the latest monitoring tools and technologies at our fingertips.

Imagine if a scorecard for Aotearoa's biological heritage was presented on TV every day along with the stock market, weather, and sport. In this section, we highlight the efforts of scientists and citizens to develop, measure, and value some indicators of success.

Image: Stacey Bryan

Whakamana

DNA sequencing technology reaches out to students

Cutting-edge technology is enabling scientists to identify what a wild rat had for dinner, which bacteria are living in soil, and allowing students to see DNA analysis in real time.

The MinION is a hand-held DNA sequencing device that plugs into any computer and lets DNA analysis happen at the same time as the experiment. Massey University's Dr Nikki Freed says it enables sequencing of longer DNA strands.

More than 150 Year 11 and 12 students have had a glimpse of what's possible using the MinION. Metagenomics Day was held across Aotearoa, and gave high school students interested in biology the chance to get some hands-on experience in the lab. The students isolated eDNA from the hundreds to thousands of microbes in a few grams of soil to determine soil health.

The MinION device sequenced the eDNA they isolated. Results appear in just a few minutes. With traditional methods, students would need to send the eDNA to a special facility, where results would have taken several days or weeks.

Tiaki

A virtual hub for environmental DNA (eDNA)

A first step in protecting the biological heritage of Aotearoa is to understand what is out there. Researchers across New Zealand are exploiting recent advances in DNA sequencing to extract and sequence DNA directly from environmental samples, such as soil and freshwater, as an alternative method to catalogue the diversity of life across our landscape.

However, until now, the resulting data were hard to access. A national online 'virtual data hub' has been constructed as a platform to share eDNA data and data interpretations to detect and monitor changes in New Zealand's biological heritage over space and time. This work is led by doctors Austen Ganley and Gavin Lear at the University of Auckland.

Several major national eDNA datasets have been integrated into the hub, and novel analytical solutions and data visualisations developed to (i) detect the presence of potential pests and pathogens from these, and future data, and (ii) to report biodiversity data via a variety of metrics and data visualisations. Data searches can be undertaken at various spatial scales, including national, or limited to regions or rohe.

The online hub provides an entirely new way for Aotearoa to protect our biological heritage and looks set to deliver a step-change in biodiversity and biosecurity assessment.

Whakahou

An open-access database of freshwater traits for Aotearoa

A new, integrated and open access freshwater traits database is being developed for Aotearoa New Zealand. Co-developed and informed by data-users and knowledge-holders, the database will facilitate integration of freshwater trait information across multiple taxa and trophic levels – algae, plants, invertebrates and fish.

The database is part of a larger global effort to standardise and integrate knowledge across scales and will be essential for future-proofing indigenous freshwater biological data and for restoring freshwater ecosystems.

Doctors Catherine Febria and Helen Warburton (University of Canterbury) will focus on completing the fish component of the database, funded from their BioHeritage programme that aims to understand how we can build resilience into freshwater ecosystems. A comprehensive, integrated database on the country's fish species is vital, as there is currently no database of traits information for freshwater fish.

Strategic partners

Contacts

Nikki Freed, Austen Ganley, Gavin Lear, Helen Warburton, Catherine Febria

More information

Metagenomics Day: http://bit.ly/2V89M85

More on eDNA: http://bit.ly/2v6v9HZ

Freshwater traits database: http://bit.ly/2Dh1d0p

Empowering communities

Inspired to take action

Stewardship of Aotearoa's biological heritage is everyone's responsibility, but we need to inspire New Zealanders to take action. To reverse the decline of biological heritage, we need to blend traditional knowledge and modern research methods, reconnect people with nature, re-create thriving ecosystems, and leave a legacy for future generations.

Imagine if 4.7 million citizens undertook one small action every day to protect our biological heritage. In this section, we highlight our work with citizens and communities around Aotearoa.

Dr Steve Pawson, right, trains up Stink Bug finders as part of the Creepy Crawlies Meets Primary Production programme. Image: Caroline Fenton

Whakamana

Training up Stink Bug finders

Brown Marmorated Stink Bugs (BMSB) are one of the biggest threats to New Zealand's primary industries. About 2,500 Stink Bugs were intercepted at the New Zealand border in 2017.

North Island students have been learning how to help stop the bugs from becoming established. During a field trip to Trevelyan's Pack and Cool in Te Puke in late 2018, about 90 students took part in activities designed to teach them about the science behind protecting New Zealand's primary industries such as kiwifruit production.

The field trip was part of an Unlocking Curious Minds project, Creepy Crawlies Meets Primary Production, led by Dr Steve Pawson (Scion). Creepy Crawlies has taught more than 500 primary school students about pest management and biosecurity since it was launched. The field trip included students from Kaitao Intermediate, Te Rangihakahaka, Rotorua Intermediate and Kaingaroa Forest School.

Students became 'certified Stink Bug finders' by searching for fake Stink Bugs in a kiwifruit orchard, learned the science behind spraying orchards to protect them from bugs, weeds and disease, plus toured a pack-house to see how avocados are inspected and graded. The aim was to inspire students to consider science as a career to support New Zealand's fruit-growing industry.

Tiaki

Find-A-Pest goes live

Supported by central and regional government, primary sector participants, iNaturalist NZ and Te Tira Whakamātaki, a team led by Dr Steve Pawson (Scion) are testing the first version of a new multilingual app called Find-A-Pest as part of a series of case studies with forestry, kiwifruit and weeds.

Testing Find-A-Pest was the culmination of a long gestation, including stakeholder engagement, software building and subsequent beta-testing with stakeholders. Software developer Cucumber was contracted to develop the first version of Find-A-Pest.

The technology integrates the priorities of all the participants, and the case studies will assess its potential to deliver a future step-change in general surveillance for invasive pests in New Zealand. It featured almost 250 pest species during the pilot trials.

Steve highlighted the app during the New Zealand Biosecurity Forum's disruptive technology workshop and has since received interest from groups beyond the case studies, for example people from the aquaculture industry.

Key features of the app have been translated into te reo Māori and the platform can incorporate other languages. This will be an advantage in large multi-cultural urban areas, such as Auckland, where language needs often span multiple cultures. The technology aims to engage citizens more deeply in the general surveillance process by including them as identifiers of submitted observations.

Case studies concluded in May 2019, with the team reporting to an interim stakeholder governance group that will decide on next steps for Find-A-Pest.

Whakahou

Connecting rangatahi with te taiao

North Island rangatahi are testing a new app that aims to connect them with biodiversity and the environment by teaching them about plants and animals.

Manaaki Whenua – Landcare Research's Kiri Reihana and Yvonne Taura held a series of wānanga in Te Kuiti and Huntly to gather information to provide a framework for the bilingual app. The project is co-funded by Unlocking Curious Minds, and is known as Tohu o te wā – Hangarau pūtaiao (Signs of our time – fusing technology and science).

The aim is to inspire rangatahi to get into the environment, and to be inspired to study science. Many rangatahi are not always aware of the names of native plants and trees, and many do not always recognise pest species in Aotearoa.

A prototype app will be tested with rangatahi from Te Whare Kura o Maniapoto (Te Kuiti) and Te Whare Kura O Rakaumaunga (Huntly).

Strategic partners

Manaaki Whenua Landcare Research

Ministry for Primary Industries Manatū Ahu Matua

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B3 Science Solutions for Better Border Biosecurity

Plant & Food RESEARCH RANGAHAU AHUMĀRA KAI

Contacts

Steve Pawson, Kiri Reihana, Yvonne Taura, Aleise Puketapu

More information

Ko Tātou This is Us: http://bit.ly/2ZdxChJ

Creepy crawlies meet primary production: http://bit.ly/2UkcC59

'Find-A-Pest': http://bit.ly/2J3ei0P

Google play | App Store | FIND A PEST

MAHI TAHI COLLABORATIONS

Enhancing biological heritage in cities

Biodiversity and biosecurity in our back yard

There is an increasing body of evidence worldwide which suggests that re-connecting people with the environment is good for both environmental health and human wellbeing.

Imagine if it was just as 'normal' for New Zealanders to check the rat trap in their compost heap, use natural remedies to protect the kauri in their back yard, or place a nectar feeder to attract tui, as it was to brush their teeth in the morning. In this section, we highlight how research is re-connecting citizens with nature in our towns and cities.

The People, Cities and Nature programme in action. Image: Catherine Kirby

Whakamana

Aligned research: the People, Cities and Nature programme

This programme is undertaking multi-disciplinary research on urban nature and the benefits of connecting urban New Zealanders to their biological heritage.

Working in close partnership with councils, community-based groups and businesses, it's creating safe and abundant habitats for indigenous plants and animals in our cities. This is supporting New Zealand's national and international biodiversity commitments and realising economic, social and health benefits for our people.

Interest and activity in urban ecological restoration is growing throughout New Zealand. However, best practice methods are not consistently available in this emerging field. Knowledge gaps relate to everything from planting densities and urban lizard presence, to how people from different cultures relate to nature and the factors that encourage them to help restore it.

This MBIE-funded programme, led by Professor Bruce Clarkson and Catherine Kirby (University of Waikato) was designed to address these knowledge gaps, with six teams of leading researchers undertaking a series of studies in nine different urban centres. They are investigating what works best in different locations and then making that information available.

Ultimately, they believe their research will help create flourishing natural environments in cities and towns. Our native plants and animals will have a better chance of thriving and urban restoration projects will be more cost effective, beneficial and engaging for all urban residents.

Tiaki

Collaborative action towards biosecurity excellence

To enhance community engagement and raise the profile of science, the Challenge supports three flagship sites – areas that showcase to the public research done by our Challenge Parties.

In 2018, we made two important connections in Tauranga – as part of a collective effort to create a world-class biosecurity system for Aotearoa. BioHeritage adopted the Port of Tauranga (PoT) Biosecurity Excellence partnership, and became part of the Tauranga Moana Biosecurity Capital programme (TMBC).

The PoT biosecurity partnership was formed in 2014 between the port, several primary industries, and central and local government agencies. PoT is the largest port in the country both in terms of total cargo volume, and container throughput. Partners work together to prevent and respond to biosecurity risks through the port.

TMBC aims to show how a team of 4.7 million New Zealanders can think about biosecurity, how biosecurity connects to our everyday lives, and how people can get involved. The Challenge's involvement supports research on surveillance and detection of pests at the border being done by the Better Border Biosecurity (B3) science consortium. It bolsters PoT's commitment to use science to support innovation and grow biosecurity excellence.

Innovation is crucial when dealing with the ever-increasing pressure on New Zealand's border and the many challenges our biosecurity system faces, including continued growth in goods and passengers arriving here, mounting biological risk from offshore, and changing climatic conditions. Our ability to safely trade and gain market advantage – including the standards and measures we put in place to keep new pests and diseases out – must be underpinned by robust science.

Whakahou

Tiaki mō kauri: a citizen science success story

Tiaki mō kauri (Kauri Rescue) is a community-led citizen science programme developed in response to the outbreak of kauri dieback – a disease that has killed possibly thousands of taonga (treasured) kauri trees. Community groups, mana whenua and private landowners in Northland and West Auckland drive the project, with support from the Northland Regional and Auckland councils. Practical tools supplied by the research team are used to inject phosphite into the trunks of trees to delay development of the disease. The team is also helping landowners to record information that is then used to continuously refine the treatment.

Meanwhile, social researchers are collecting data to inform a co-design framework for future citizen science projects that rely on large-scale management actions by communities.

Dr Ian Horner (Plant & Food Research) supplies the tools and assists with training, while Dr Marie McEntee (Aranovus) leads the social research. The use of culturally appropriate strategies has resulted in communities, organisations, kaitiaki, and academics working together in new ways.

The Kauri Rescue team was awarded a Judge's Commendation for the Rātā Award at the annual Love Your Place Awards hosted by Ecomatters and the Waitākere Ranges Local Board. One of the community ambassadors, Thomas Dawson, won the Youth Award.

Strategic partners

Contacts

Ian Horner, Marie McEntee, Nick Waipara, Catherine Kirby, Bruce Clarkson

More information

People, Cities & Nature programme: http://bit.ly/2GnDuxj

Tauranga Moana Biosecurity Capital: http://bit.ly/2UZGfwZ

Port of Tauranga receives biosecurity award: http://bit.ly/2ZakZnL

Kauri Rescue home page: http://bit.ly/2UncRwg

Kauri Rescue newsreel: http://bit.ly/2Iz0PxK

Better Border Biosecurity (B3): http://bit.ly/2KGN3fc

Future-proofing Aotearoa's biosecurity system

Biosecurity is everyone's business

Our economic, environmental and cultural prosperity are inextricably linked to, and strongly depend on, our biological heritage. However, biological heritage is under threat from invasive organisms and from new pressures emerging in a rapidly changing global environment. To future-proof Aotearoa's biosecurity system, we need to foresee emerging risks and to innovate towards the most sophisticated surveillance, control and eradication tools available.

Imagine if a wide range of industry partners, government agencies, communities, Māori, and international partners worked together to ensure Aotearoa's biosecurity system was globally leading. In this section, we highlight some of our efforts to help achieve this goal.

Whakamana

Seed-banks revitalise restoration traditions

Māori communities have identified seed-banking as central to enhancing efforts iwi and hapū are undertaking to revitalise traditional customary practices and to protect and restore taonga species. Easy to build and straightforward to use, seed-banking drum kits enable communities to conserve and dry seeds according to their own mātauranga and tikanga.

In late 2018, a hapū near Whangārei was the latest recipient of a seed-bank courtesy of BioHeritage and Te Tira Whakamātaki, enabling them to collect and store seeds from local taonga plants.

Via Te Tira Whakamātaki, seed banks were delivered to Patuharakeke whānau. The hapū was the sixth recipient of a seed-banking drum kit built as part of a BioHeritage programme focused on developing Māori solutions to fight myrtle rust.

Patuharakeke kaumātua blessed the seed-kit, calling it a gift that would be treasured. The Patuharakeke Taiao/Resource Management Team and kaitiaki are now working on a wider pest management strategy for the native bush blocks in Takahiwai.

Tiaki

Combating pathogen risk using genomics

To protect our native and production ecosystems from the invasion of new pathogens, rapid assessments of the potential impact of identified and unidentified pathogens are critical.

A research team led by Dr Bevan Weir (Manaaki Whenua – Landcare Research) is developing a predictive model using comparative genomics. The model aims to accurately measure and demonstrate the potential threat of unknown organisms to Aotearoa's biological heritage.

Genomic data collection has sequenced 11 *Phytophthora* cultures: a first step in identifying pathogenic risk elements in the environment. Cultures have also been screened for dsRNA viruses. In partnership with stakeholders, a pathogenicity gene annotation pipeline has been developed to enable development of the risk model based on pathogenicity genes. The team is also developing practical implementation methods for detecting and tracking *Phytophthora*.

Phytophthora genome sequence data generated has already been critical for the Ministry for Primary Industries (MPI) as it rapidly responds to the report of a new *Phytophthora* species in New Zealand. Because the team had sequenced the genomes of three relevant *Phytophthora* species, they were able to extract comparative multi-gene data from these genomes and conduct phylogenetic analysis. This analysis revealed that the species were in fact *P. pseudocryptogea*. This information allowed MPI to stand down the investigation.

Patuharakeke whānau are the latest recipients of a seed-bank courtesy of BioHerilage and Te Tira Whakamātaki. Image: Dr Andrea Byrom

Whakahou

Biosecurity networks shed light on pest movements

How can we make use of information about movements of unwanted organisms in order to restore and future-proof Aotearoa's biosecurity system? That is the focus of research to understand biosecurity 'networks' – pathways and movements of pests once they have entered the country – led by Lincoln University researcher Professor Phil Hulme.

The team has chosen four different networks as case studies: a livestock transport network, a horticulture network, a network of freshwater recreational users, and Tahuri Whenua (the Māori Vegetable Growers' Network).

So far, the team has delivered state-of-the-art network tools to assist the Ministry for Primary Industries (MPI) better manage the spread of zoonotic pathogens in poultry farms by understanding the internal pathways of spread through animal and feed movements using genomic markers.

Network data on the movement of horticulture plants has improved Aotearoa's understanding of the likely spread of plant pathogens in this sector. It has also helped inform biosecurity standards for New Zealand Plant Producers Incorporated and identify simple rules of thumb to guide interventions and surveillance.

For freshwater pests, the application of networks to data gathered through the MPI-led Check, Clean, Dry campaign has helped highlight high-risk user groups and the scale of individual movements of people and boats between different waterbodies in New Zealand.

Collaboration with Tahuri Whenua has highlighted risks arising from moving plant produce among different iwi and Māori grower groups, pointing to the value of increased traceability of such movements from a biosecurity perspective.

Strategic partners

Lincoln University · Manaaki Whenua Landcare Research · Te Tira Whakamātaki Māori Biosecurity Network · Bio-Protection Bioprotection science for New Zealand · nzppi

Contacts

Bevan Weir, Phil Hulme, Nick Waipara, David Milner, Nick Roskrudge, Paul Champion

More information

Te Tira Whakamātaki: http://bit.ly/2XenWBO

Māori biosecurity solutions: http://bit.ly/2Goz49t

Combating pathogen risk: http://bit.ly/2ImqkTG

MAHI TAHI COLLABORATIONS

Towards a predator-free Aotearoa

Out with the fur, in with the feathers

A decade ago, the idea of a 'predator-free New Zealand' seemed audacious and far-fetched – an impossible dream. Ten years on, and the story is completely different. Strong cross-government support and significant new investment in the predator-free New Zealand initiative, from both private and public sources, has galvanised communities and government agencies into action.

Imagine if you had to shoo the kiwi out of your vegetable patch to stop them stealing all the worms, check your shoes in case there was a wētā inside, or compete with kākā for the apples on your tree. This section highlights the efforts of scientists and communities to eliminate predators and make such nice-to-have problems a reality.

Whakamana

Citizens trial new stoat lure

The Predator Free 2050 campaign has given greater urgency to the search for new tools and techniques. The discovery that invasive stoats and weasels are attracted to the odour of dominant predators could provide one such tool.

To be used in the field, information is required on the effectiveness of the lure in control operations. Also, a synthetic version of the natural material is needed so that artificial scent can be created. Using artificial scent rather than the primary biological material extends the longevity and effectiveness of the lure, and enables sufficient quantities to be produced.

Led by Dr Patrick Garvey, researchers from Manaaki Whenua – Landcare Research and University of Auckland worked with community volunteer pest control groups to trial the promising lure. The multi-site citizen science project demonstrated an increase of between 66% and 300% in stoat and weasel trapping rates when the odour of a dominant predator was applied to their regular trapping approach.

Synthesis of the natural lure has identified a small subset of attractive compounds from hundreds of candidates using a combination of behaviour trials and chemical analyses. The team is now testing dilution media and assessing compound concentrations so that the volatile release rates of the synthetic compound will match those of the natural dominant predator odour.

Development of new super-lures could provide noticeable improvements for invasive species management throughout Aotearoa.

Tiaki

Te Ao Māori perspectives on predator control

Protecting the unique biodiversity of Aotearoa from the impacts of introduced predators is about more than just killing predators. Highlighting Te Ao Māori perspectives on the predator-free New Zealand initiative is often about helping communities prosper, creating jobs, educating the next generation and providing a platform for Māori and Pākehā to work shoulder-to-shoulder in new and exciting ways.

That wider perspective was the focus of a BioHeritage grant to the Science Journalism Fund for 'Māori and Predator Control', with recipient Jacqui Gibson working with *E-Tangata* magazine on a longform article about Ngāti Kuri's journey to develop a large-scale predator-proof fence in Northland.

The story centered on the experience and perspective of Sheridan Waitai, a board member of Ngāti Kuri in the Far North. The ultimate goal of the fence is to help fulfil the Board's vision of Ngāti Kuri to be self-sufficient, strong and thriving. It's also part of Sheridan's late grandmother's wishes set out in the WAI 262 Treaty claim.

Jacqui was inspired to write the story during a previous media interview with Sheridan because she wanted to help readers see the enormous value of supporting and believing in Māori leadership.

The feature article was published in *E-Tangata*, an online Sunday magazine run by the Mana Trust, and is available for others to use under a creative commons licence. The magazine's kaupapa is to build a stronger Māori and Pacifika presence in Aotearoa's media.

Whakahou

Auckland Island / Motu Maha a step closer to predator free

The most ambitious multi-species eradication ever attempted is a step closer to reality, thanks to underpinning research assisted by Dr James Russell, research leader at University of Auckland.

James spent a month conducting field trials on the remote subantarctic islands, helping the Department of Conservation (DOC) with the Maukahaka/Pest Free Auckland Island project, which aims to clear the 46,000-hectare island of its last mammalian pests.

The island group is listed as a World Heritage site because of its diverse endemic wildlife. However, pigs, cats and mice still have had a disastrous effect on endemic species.

James leads a BioHeritage project that aims to find high-tech solutions for the widespread suppression and eradication of small mammal pests, including possums, rodents and stoats. Because of his experience working on island ecosystems, he was well-placed to help DOC with the ambitious Maukahaka project. Field trials on the islands yielded promising results.

Strategic partners

Manaaki Whenua Landcare Research

The University of Auckland Te Whare Wānanga o Tāmaki Makaurau New Zealand

Department of Conservation Te Papa Atawhai

Contacts

James Russell, Patrick Garvey, Jacqui Gibson

More information

Science Journalism Fund: Ngāti Kuri wants predator-proof fence: http://bit.ly/2GqExNa

Blog: Why New Zealand needs alternatives to 1080: http://bit.ly/2Cr8MjW

Maukahuka / Pest free Auckland Island: http://bit.ly/2Umq0Wy

Read: Russell JC, Stanley MC 2018. An overview of introduced predator management in inhabited landscapes. *Pacific Conservation Biology*. http://bit.ly/2LAVIWg

MAHI TAHI COLLABORATIONS

Combating plant diseases

Small organisms, big impact

For such small organisms, plant pathogens can cause a lot of damage to our taonga trees and primary industries. Kauri dieback (a soil-borne *Phytophthora*) and myrtle rust (wind-borne rust) are just two examples of pathogens that can cause major disease symptoms or even death of some plants, with severe consequences for primary industries and natural ecosystems. Such systems are not always resilient to incursions of new pathogens, or to the emergence of latent pathogens. These emergent or new organisms may find favourable conditions as our climate and land uses change.

Imagine a future in which New Zealand ecosystems were resilient to new wind-borne and soil-borne pathogen invaders. This section highlights work being done to make that future a reality.

Myrtle rust is threatening many iconic native species as well as plants important to primary industries. Image: Roanne Sutherland

Whakamana

Te Kura o te Kauri gets the green light

Dr Monica Gerth, of Victoria University of Wellington, has been awarded an Unlocking Curious Minds grant to develop Te Kura o te Kauri – The School of the Kauri. Te Kura o te Kauri is a mobile classroom which will visit tamariki of Northland and Auckland at schools, marae and other community venues.

The Te Kura o Te Kauri team includes a trailblazing team of science, arts and local engagement leaders. Together, they aim to inspire ākonga to become the next generation of kaitiaki o ngāhere by using a multi-disciplinary approach that includes science, mātauranga Māori and the arts.

The novel learning environment will provide hands-on experience with both molecular and mātauranga Māori approaches to the science of a healthy forest, while engaging the participants' senses through art, sound, and virtual reality (VR) technology. VR will enable the ākonga to virtually zoom in from the canopy of mighty kauri to the tiny spores that are threatening to infect it.

The project officially launched in February 2019 with school visits starting in Whangarei in October 2019.

Tiaki

Collaboration is the key

Selected native plant extracts are able to attract, repel (and sometimes kill) zoospores of *Phytophthora agathidicida* – the pathogen causing kauri dieback.

Guided by mātauranga Māori knowledge holder Matua Kevin Prime, Victoria University of Wellington researcher Dr Monica Gerth has been leading a BioHeritage project that combines mātauranga Māori with biochemistry in order understand how chemical signals from kauri (and other native plants) affect zoospore navigation. The team includes Dr Amanda Black (Associate Investigator), Dr Scott Lawrence (Postdoctoral Research Fellow), Ms Waitangi Wood, Ms Ria Heke and a small army of keen students. Together, they are making significant progress towards finding new ways to potentially control the spread of kauri dieback, either through co-planting and/or development of rongoā treatments.

During this project, the team also unexpectedly discovered that certain plant extracts also killed the zoospores. This has led to an aligned research programme (currently funded by an MBIE Smart Ideas grant) that is expanding their search for new anti-microbials, while also exploring the molecular basis of these observations. This multi-disciplinary project includes Chris Pairama and Te Rangi Kaihoro as mana whenua engagement leaders, and scientists Associate Professor Wayne Patrick, Professor Nigel Perry and Dr Amanda Black. More research is needed but the hope is that native plants may provide long-term solutions to the kauri dieback epidemic.

Whakahou

Mana whenua prioritise taonga Myrtaceae for restoration

Myrtle rust is a pathogen that attacks trees in the Myrtaceae (myrtle) family, including taonga species pōhutukawa, mānuka and rātā. The disease can spread rapidly, and is a serious threat to Aotearoa's biodiversity.

A research team led by collaborators at Scion is using myrtle rust as a case study, which combines contemporary science with mātauranga to develop a Māori community response to fight the spread of myrtle rust. In 2018, host-range testing of taonga Myrtaceae began in a new collaboration between members of the research project team and the Forestry and Agricultural Biotechnology Institute (FABI) at the University of Pretoria in South Africa.

The research in South Africa is led by internationally renowned plant pathologist Professor Mike Wingfield. They will be screening culturally prioritised (by mana whenua) native taonga Myrtaceae for myrtle rust resistance and susceptibility. Results will be reported back to kaitiaki technicians in each rohe which could assist in the protection and management of taonga plants.

Plant pathology postdoc Julia Soewarto will be travelling to FABI to complete screening once the plants have reached experimental maturity.

Strategic partners

Contacts

Monica Gerth, Amanda Black, Waitangi Wood, Nick Waipara, Melanie Mark-Shadbolt, Julia Soewarto, Cate Macinnis-Ng, Wayne Patrick, Ariane Craig-Smith, Kelly Kahukiwa, Te Kaurinui Parata, Taoho Patuawa, Chris Pairama, Kevin Prime, Scott Lawrence, Ria Heke, Te Rangi Kaihoro, Nigel Perry, Mike Wingfield

More information

FABI: http://bit.ly/2XaGQJC

Blog: "Act now or it will be too late" for kauri dieback (Dr Monica Gerth): http://bit.ly/2X952fE

Opinion piece: Lose kauri and we lose a piece of ourselves (Doctors Monica Gerth and Amanda Black): http://bit.ly/2Iy0riZ

Read: Lambert S., Waipara N., Black A., Mark-Shadbolt M., Wood W. 2018. Indigenous Biosecurity: Māori Responses to Kauri Dieback and Myrtle Rust in Aotearoa New Zealand. In: Urquhart J., et al. (eds) *The Human Dimensions of Forest and Tree Health:* http://bit.ly/2PaSnpP

Read: Black, A., Waipara, N., & Gerth, M. 2018. Calling time on New Zealand's oldest tree species: http://bit.ly/2Jv42it

MAHI TAHI COLLABORATIONS

Towards healthy freshwater

Ki uta ki tai (from the mountains to the sea)

Public awareness about the state of Aotearoa's freshwater ecosystems – ground water, lakes, streams, rivers and wetlands – has increased considerably in recent years. Fresh water is needed for drinking, recreation, and for primary production, and Māori consider fresh water to have its own mauri, or life force. The health and mauri of our freshwater ecosystems face multiple threats, which impact on biodiversity and mahinga kai.

Imagine if we could develop a suite of tools for restoration of our freshwater – tools that can easily be adopted by communities and by industry – so that everyone can drink and gather kai from thriving, functional streams and rivers. In this section, we highlight examples of BioHeritage collaborations focused on freshwater restoration.

Challenge Project Leader Dr Ian Duggan, left, gets out into the field with the Te Arawa Wai Warriors near Rotorua. Image: Ian Duggan

Whakamana

Empowering Māori to restore freshwater kai

Protecting taonga species kākahi (freshwater mussels) and kōura (crayfish) from pest fish and invasive macrophytes is the aim of Dr Ian Duggan of the University of Waikato, in a programme co-designed by Te Arawa Lakes Trust and hapū around lakes in the Waikato, through a combination of contemporary science and mātauranga.

Both kōura and kākahi are culturally important kai for central North Island iwi, particularly around the Te Arawa lakes and Taupō, and are functionally important in the freshwater ecosystem. By determining whether introduced aquatic plants and animals contribute to the population decline of taonga species, they can investigate interventions that could sustain and protect kākāhi and kōura. Māori communities are thus empowered to implement Māori values, a Māori worldview and technical science knowledge to reverse the decline of their freshwater taonga.

The involvement of Te Arawa Lakes Trust is helping rebuild the relationship between young Te Arawa and kākāhi and kōura. Local school children participate in the project, building Māori capacity and capability in freshwater management.

The research underlines solutions and strategies for restoration and management of taonga species that may potentially be undertaken by Te Arawa. Implementing these strategies may aid in the sustainable use of kākahi and kōura in the future.

Tiaki

The unsung heroes of our groundwater ecosystems

Bacteria and tiny invertebrates that filter out contaminants could hold the key to helping protect Aotearoa's waterways, but much of the fundamental information about groundwater organisms – such as specific functions, habitats and inter-relationships – are poorly understood.

Led by doctors Graham Fenwick, Michelle Greenwood (NIWA) and Louise Weaver (ESR), researchers from NIWA, ESR and Waikato University are investigating how the microbes living in underground aquifers help to keep groundwater supplies healthy. In future, these organisms could be introduced to specific waterways to help clean them up. Groundwater plays a vital role in processing contaminants, such as nitrates, from a range of land uses.

In this ground-breaking research, the scientists are building a picture of the array of organisms present in groundwater. Preliminary genetic results indicate more than 20 distinct genetic units of groundwater amphipods across three regions, with additional samples yet to be analysed. This is twice the diversity detected by initial morphological analysis.

Understanding the processes and organisms involved in groundwater unlocks the potential to use them for bio-remediation. In future, 'seeding' ecosystems with these organisms could drive the removal of contaminants.

This research is part of wider, aligned research through ESR's Strategic Science Investment Fund (SSIF) which aims to develop an index of the health of the groundwater resource. New Zealand scientists are at a very early stage of developing that groundwater index, and refining systems for getting accurate samples of the vast array of macroinvertebrates and microbial organisms in groundwater.

Whakahou

Stirring the waters to clean them up

Disrupting waterways may hold the key to long-term stream restoration because it highlights the weaknesses of unwanted invertebrates living in the ecosystem. When a river is stressed, only the hardiest species like sedentary worms and snails can survive – taking up all available space. Destabilising the community can remove the biological advantage that these species have.

This is the theory being tested by University of Canterbury (UC) student Issie Barrett as part of a research team focusing on restoring degraded streams and rivers.

At UC's Cass Field Station in Arthur's Pass, a bespoke outdoor system artificially recreates freshwater stream ecosystems. Separate sections of the system are filled with invertebrate samples that have been taken from a range of streams – some healthy, some degraded and others that are prone to flooding.

The stream communities are then disrupted for 24 hours with elements including nutrients, sediment or a flood of water. This helps researchers understand how disruption alters the community of invertebrates living in each water sample.

The next stage of Issie's trial is to extend the length of time that the disruption is carried out. The cause of the stress will then be removed, to see if the stream sample can be restored. In its third year, the trial will be carried out in a real stream.

University of Canterbury (UC) student Issie Barrett with the bespoke system she built at UC's Cass Field Station. Image: Issie Barrett

Strategic partners

ESR Science for Communities

UC University of Canterbury Te Whare Wānanga o Waitaha Christchurch New Zealand

NIWA Taihoro Nukurangi

The University of Waikato Te Whare Wānanga o Waikato

Contacts

Helen Warburton, Catherine Febria, Ian Duggan, Louise Weaver, Graham Fenwick, Michelle Greenwood, Issie Barrett

More information

Blog: Stressing a community in a bid to improve it: http://bit.ly/2v3SuKs

Stream restoration: http://bit.ly/2VKR82U

Freshwater taonga: http://bit.ly/2WIauGI

MAHI TAHI COLLABORATIONS

Restoring biodiversity and threatened species

From genes to landscapes

The decline in biodiversity is not just a problem for Aotearoa: it is a global phenomenon. The diversity of life is important because it provides essential 'ecosystem services' and helps connect people to their special places. Having a rich array of species in an ecosystem in turn supports other species.

Imagine if we could understand and protect complexity of life – from genes to entire landscapes. In this section we highlight research on innovative tools and approaches to help protect biodiversity that are accessible to everyone, including our kaitiaki.

University of Canterbury MSc student Levi Collier-Robinson sampling kōwaro with students from Te Kura o Tuahiwi. Image: Ashley Overbeek

Whakamana

Building Māori capability and capacity in genomics

Collecting genomic data and reference genomes from threatened taonga and declining mahinga kai species is a vital part of protecting and restoring their populations and needs to be done in partnership with kaitiaki.

To maximise transparency around the collection of genomic data from threatened species, a research team led by Associate Professor Tammy Steeves at the University of Canterbury is working in partnership with Te Rūnanga o Ngāi Tahu to co-develop an iterative decision timeline that includes sample handling, sequencing technologies, sequencing facilities, data handling, data storage and data access for kōwaro and kēkēwai (mudfish and crayfish) to generate reference genomes.

Development of Māori capability and capacity in genomics is a key outcome. Postgraduate student Levi Collier-Robinson (Ngāti Apa ki te rā tō, Ngāi Tahu) is leading the genomics research for kōwaro. Draft reference genomes and population genomic data have been generated for both species, and traditional methods (maramataka – Māori lunar calendar and tau kōura – fern bundles) for kēkēwai inform sample collection.

Partnerships between scientists and primary industry around the use of genomic data to enhance commercial outcomes have also been developed and the team has designed a series of 'genetic rescue' translocation experiments which are being conducted in collaboration with Te Rūnanga o Ngāi Tahu, Genomics Aotearoa, and aquaculture company KEEWAI. The experiments will inform translocations to enhance customary and commercial harvests.

Tiaki

Eight ways to protect native vegetation on private land

Pastoral farming – primarily sheep and beef – comprises 40% of Aotearoa's land area. However, to substantially increase the scale of native restoration, several issues need to be built into restoration planning, implementation and monitoring.

The study, by University of Canterbury researcher Professor David Norton, focuses on pastoral farms because these are the areas that will get the most conservation benefit from substantially upscaling restoration activities. Upscaling means dramatically increasing the land area of restoration activities to tens or hundreds of thousands of hectares.

Potential gains include increasing the total area of native habitat for flora and fauna, enhancing linkages among remnants of the original forests, and removing carbon dioxide from the atmosphere. Restored areas also reduce soil erosion and purify water.

Professor Norton makes eight recommendations on how New Zealanders can help increase the benefits they reap from large-scale native restorations located on private land:

1. Retain remnants
2. Address factors that limit natural regeneration
3. Plant to increase linkages among native vegetation
4. Eco-source plant species and mycorrhizal fungi
5. Establish certification for seed and seedling supply
6. Invest in new technologies
7. Adopt best-practice planting
8. Integrate across public, private, old growth, regenerating and planted areas for an optimum result.

Whakahou

Ngā Kākano Whakahau – striving for easy-grow native forests

A research team led by Dr Janice Lord at the University of Otago is using above- and below-ground techniques to restore degraded ecosystems by developing cost-effective methods for establishing native trees from seeds inoculated with native fungi, delivered using innovative agricultural approaches.

The Ngā Kākano Whakahau project is developing a customised seed-mix that can be planted to grow large-scale forests of native vegetation as easily as farmers sow pasture. Joint investments from BioHeritage, QEII National Trust Molloy fund, and Soho Properties have aided development of a fungal inoculum collection and testing of methods for bulking up inoculum to deliver to seeds.

Agricultural techniques can be used to plant the seed-mix by the hectare – drastically reducing costs and increasing the success rate of native reforestation. As well as planting the seeds, the scientists are working on techniques to re-introduce the native mycorrhizal fungi upon which many native species depend. Most native trees and shrubs need their roots to be colonised by mycorrhizal fungi in order for them to obtain enough phosphorus and nitrogen in Aotearoa's naturally nutrient-limited soils.

The study could have major implications for the Government's Billion Trees initiative and for long-term ecological restoration projects that need to be done at landscape scales. It has sparked a surge of interest in native mycorrhizae among Otago and Southland community-based restoration groups.

Strategic partners

University of Otago Te Whare Wānanga o Otāgo New Zealand

UC University of Canterbury Te Whare Wānanga o Waitaha Christchurch New Zealand

QEII National Trust Ngā Kairauhi Papa Forever protected

Contacts

Janice Lord, Tammy Steeves, Levi Collier-Robinson, David Norton

More information

Eight ways to protect native vegetation on private land: http://bit.ly/2DgcbmS

Billion Trees programme: http://bit.ly/2GoVwiS

Building Ecosystem Resilience

Putting our ecosystems back together

‘Resilience’ is a term that is used a lot in many different contexts, but it is not always well defined or understood. Internationally, resilience is defined as the capacity of a system to rebound from a major disturbance. Disturbances to ecosystems can take many forms and can be natural or human-induced: major storms, vegetation clearance, droughts, or introduced predators reinvading a pest-free island are all forms of disturbance.

Imagine if we could combine a better understanding of an ecosystem’s ‘web of life’ – the interactions among living things and the water and soil in which they live – with a good understanding of the role of humans in the system and how our decisions, policies and legislation can affect ecosystem resilience. Here we highlight examples of research designed to address such complexities.

Image: Stacey Bryan

Whakamana

One DNA extraction method to rule them all

New tools are needed to paint a much clearer picture of the state of our environment and determine whether or not ecosystems are in decline: our ability to accurately detect the species present in an environment is crucial for monitoring biodiversity and aiding conservation efforts.

PhD student Syrie Hermans, mentored by a research team from the University of Auckland and AUT, has identified a single DNA extraction method that accurately detects species present in a wide range of environments. If the method is adopted by all researchers extracting environmental DNA (eDNA), it has the potential to hugely advance eDNA as an ecological research tool and provide a significant step forward for biodiversity monitoring.

The research has comprehensively assessed the biases associated with six DNA extraction methods and identified one that is optimal for multiple organisms and sample types: DNeasy PowerSoil.

The adoption of standardised approaches for eDNA extraction will ensure that results can be more reliably compared, and biases quantified, thereby advancing eDNA as an ecological research tool.

Common metrics to measure progress toward reversing the decline of Aotearoa’s land- and water-based ecosystems is an important part of building ecosystem resilience.

Tiaki

A bioethical approach to protecting ecosystems

Researchers are constantly thinking about ways to develop novel tools and technologies for landscape-scale control of small mammal predators such as stoats and rats. Moving any new tools from the lab to the landscape is as much a social challenge as it is a biological challenge, but it is a vital part of protecting and building resilient social-ecological systems.

‘System resilience’ involves people, so we need to find ways to include the public early and often in discussing predator control plans, and to allow people to have a say in which methods are deployed.

In response to this need, a Bioethics Panel was co-convened by Drs Emily Parke (Philosophy) and James Russell (Biology) from the University of Auckland as part of Challenge investment in novel predator control technologies.

The Panel brings together a wide range of academic, industry and community experts who horizon-scan the social, cultural and ethical issues around the implementation of high-tech solutions to invasive mammal pest control. Membership of the Panel is diverse in terms of gender and culture, and includes representatives with experience in philosophy, law, psychology, marketing, ecology, genetics, hunting, welfare and stewardship.

The Panel’s final report was made publicly available at the Challenge’s Crazy & Ambitious 2 symposium in May 2019.

Whakahou

Linking biodiversity research to farmers

Land uses are changing significantly in Aotearoa, and industry is stepping up to the restoration challenge. Many farmers want to protect biodiversity, but lack the species-specific knowledge of what’s special, why it should be valued and how best to manage it.

In their environment strategy, Beef & Lamb New Zealand (B+LNZ) is encouraging sheep and beef farmers to include biodiversity in Land Environment Plans by 2021. New tools will be needed to ensure thriving biodiversity, and to provide habitats that protect native species.

The Farming & Nature Conservation research team, led by Dr Hannah Buckley (AUT) and Professor David Norton (University of Canterbury) has aligned with B&LNZ’s goals. The team are working with B+LNZ, iwi, and farmers to develop a biodiversity framework to support New Zealand’s 12,500 sheep and beef farmers to boost native species on their land. The aim is to benefit both native species and the farm business.

B&LNZ senior capability and Māori agribusiness manager Doug Macredie argues that iconic species could be used as a starting point to look at ways of raising awareness of the less conspicuous species. Ngāti Mākino Iwi Authority general manager Dr Kēpa Morgan has introduced the concept of using mauri to measure different world views and track sustainability over time.

The next step is to evaluate current biodiversity resources available to farmers and how best to include biodiversity in Land Environment Plans.

Strategic partners

agresearch — āta mātai, mātai whetū

AUT

The University of Auckland — Te Whare Wānanga o Tāmaki Makaurau — New Zealand

UC University of Canterbury — Te Whare Wānanga o Waitaha — Christchurch New Zealand

Beef + Lamb New Zealand

QEII National Trust — Ngā Kairauhi Papa — Forever protected

Contacts

David Norton, Hannah Buckley, James Russell, Emily Parke, Gavin Lear, Austen Ganley, Syrie Hermans

More information

Report: from the Bioethics Panel: http://bit.ly/2WuI02X

Video: 2018 EDS conference conservation reform session: http://bit.ly/2V5GqmF

Video: Bioethics Panel at the 2018 Society for Conservation Biology Oceania Congress: http://bit.ly/2PT22BG

Read: about the Panel’s work in Science magazine: http://bit.ly/2VbQVEW

A ‘mauriometer’ to measure world views: http://bit.ly/2Xg4BA2

Farming and Nature Conservation: http://bit.ly/2KHKFF3

Read: optimal extraction methods: http://bit.ly/2Wz20RW

The Faces of the BioHeritage Challenge

Governance Group

Responsible for oversight of the strategic development, risk management and delivery of the BioHeritage Challenge.

Dr James Buwalda

Chair

James specialises in governing collaborative ventures, particularly for organisations with biosecurity and biodiversity objectives. He currently chairs the OSPRI Stakeholders' Council, the Better Border Biosecurity (B3) research collaboration, and is co-Chair for Biosecurity 2025. He is a board member for Hawke's Bay Biodiversity Foundation and has previously consulted on strategy and innovation matters for government, tertiary education and industry bodies.

Professor Emily Parker

Emily received her PhD in biological chemistry at the University of Cambridge in 1996 and joined the Ferrier Research Institute in June 2017 to lead the Chemical Biology Research Group. Her research focuses on the chemistry and biochemistry of enzyme-catalysed reactions, with the aim of aiding the development of new treatments for diseases and using natural biosynthetic machinery for the efficient generation of valuable products.

Mr Barry O'Neil

Barry is a biosecurity specialist consultant. His previous roles have included being CEO of Kiwifruit Vine Health, and leading MAF Biosecurity NZ. Barry's experience includes policy and international standard setting, trade negotiations, and operational biosecurity and food safety risk-management activities. He is on the boards of Horticulture NZ, Scion, and the Bio-Protection Research Centre.

Mr Devon McLean

Devon advises the philanthropic NEXT Foundation and directs a number of their landscape scale ecological restoration projects. He is a director of Zero Invasive Predators Ltd (ZIP) and of Predator Free 2050 Ltd.

Dr Daniel Walker

Dan is Chief Scientist at the Australian Centre for International Agricultural Research (ACIAR). His role is to oversee ACIAR's research portfolio including science quality and impact assessment. Prior to this, Daniel was Research Director for Agriculture and Global Change in CSIRO Agriculture. He was previously Chief of Division for CSIRO Ecosystem Science.

Mrs Glenice Paine

Glenice is of Te Atiawa o Te Waka a Maui, Te Rūnanga o Ngāi Tahu and Ngā Matapopore descent. She is a Deputy Commissioner of the Environment Court and accredited RMA Commissioner with experience dealing with legislation, especially the Resource Management Act. She is an executive member of Te Tira Whakamātaki, and on the Steering Group for the implementation of Biosecurity 2025.

Mr Rob Phillips

Rob is Chief Executive of Environment Southland. He joined the organisation in August 2012, having previously been Director of Operations with Taranaki Regional Council. Rob's focus is addressing significant and complex resource management challenges in a region very dependent on use and management of water and land. He is committed to working collaboratively, with a focus on developing long-term solutions.

Strategic Leadership Group

Responsible for strategic planning and delivery of research with high value, impact and relevance, and for building alignment of research activity towards the BioHeritage Challenge impacts.

Dr Andrea Byrom

Director

Andrea's research interests lie in the ecology of multiple invasive mammal species in New Zealand and how they interact with other drivers of global change. She is an Associate Investigator in the Te Pūnaha Matatini Centre of Research Excellence, collaborating on projects that look at the role of citizen science in invasive species management and the biodiversity outcomes of major pest control regimes in New Zealand.

Ms Melanie Mark-Shadbolt

Director Māori

Melanie is of Ngāti Kahungunu, Ngāti Porou, Te Arawa, Te Āti Awa, Ngāti Raukawa and Ngāti Tūwharetoa descent. She is an Indigenous environmental sociologist, the Chief Executive of Te Tira Whakamātaki and the Ministry for the Environment's Kaihautu Chief Māori Advisor.

Dr Nick Waipara

Nick is of Rongawhakaata, and Ngāti Ruapani descent. He has a PhD in microbiology and is a Senior Lecturer at Auckland University's School of Biological Sciences and Senior Scientist at Plant & Food Research. Nick is a Māori champion/kaiāwhina at the Bio-Protection Research Centre.

Dr Maureen O'Callaghan

Maureen is a Principle Scientist at AgResearch, with interests including ecology of beneficial soil, and insect and plant-associated micro-organisms. She leads multi-institute trans-disciplinary research to develop environmentally benign solutions for control of some of New Zealand's most significant and intractable pests and diseases. Maureen is also a member of the Science Leadership Team and a key researcher at the Bio-Protection Research Centre.

Dr Duane Peltzer

Duane is an ecosystem ecologist based at Manaaki Whenua – Landcare Research in Lincoln, with research interests in biological invasions, plant-soil interactions, disturbance ecology and linking research to management needs. Duane has a strong track record of international collaborations and is keen to help develop richer international links in the Challenge.

Dr Tara Strand

Tara is an atmospheric scientist who specialises in boundary layer turbulence in complex environments and modelling the dispersion of particles and gases in the atmosphere. Tara wears two hats: Rural Fire Research Leader and Project Leader for biosecurity-based projects. A recent career highlight was the Urban Toolkit research team, led by Tara, receiving the Biological Heritage Challenge Science Award at the 2018 Biosecurity Awards.

Ms Aroha Mead

Aroha is of Ngāti Awa, Ngāti Porou, Ngāti Tūwharetoa, Tuhourangi and Ngāi Tūhoe descent. She is a research director specialising in mātauranga Māori/indigenous knowledge, and indigenous cultural and intellectual property Issues. Aroha has worked across sectors, including public policy, academia, journalism, Iwi/Māori organisations, as well as national and international NGOs.

Mr Thomas (Tame) Malcolm

Tame is of Te Arawa whānui and Ngāti Ruanui descent. He has worked for Puna Consultants Ltd, Animal Health Board, the Department of Conservation, the Waikato and Bay of Plenty regional councils and Te Tira Whakamātaki. Tame came through the school system with total immersion in Te Reo Māori and has more than 10 years of experience in biosecurity and biodiversity management.

Dr Kathryn McRae

Based at Invermay with AgResearch's Animal Genomics group, Kathryn is leading BioHeritage's work on securing threatened species and resilient ecosystems by compiling a complete picture of Aotearoa's natural environment. She has a background in genetics and zoology, with current research interests focused around the genetic basis of animal health.

Mr Kevin Collins

Kevin provides advocacy, strategic analysis and project facilitation to public agencies, NGOs and the private sector. He has a proven ability to develop strategies that bring complicated projects to successful conclusions. Kevin has a strong interest in improving communication and understanding between different political, administrative, technical, scientific and community groups.

Dr Pike Brown

Pike is Principal Economist at Manaaki Whenua – Landcare Research. He is an expert in innovative survey design, enumeration, and inferential analysis using econometric methods. He has published extensively in leading economics journals and environmentally focused interdisciplinary journals. He directs surveys including the New Zealand Survey of Rural Decision Makers and the New Zealand (Bee) Colony Loss Survey.

Dr Helen Warburton

Helen is an early career freshwater ecologist based at the University of Canterbury. Her research focuses on understanding the structure and dynamics of freshwater communities, with the aim of testing and developing ecological theory that is fundamental for the effective management of ecosystems.

Dr Shaun Ogilvie

Shaun is of Te Arawa (Ngāti Whakahemo) and Ngāti Awa (Ngāti Pukeko) descent. He is the Director of Eco Research Associates Ltd and a principal investigator for Ngā Pae o te Māramatanga. In addition, Shaun is the Māori Business Development Consultant for the Cawthron Institute and a contractor to other organisations, including Tonkin & Taylor Ltd, MBIE, and Scion.

Kāhui Māori

Provides advice and support to the BioHeritage Challenge on Vision Mātauranga, the Treaty of Waitangi and WAI 262 principles, as well as wider cultural matters.

Ms Glenice Paine

Chair

Glenice is of Te Atiawa o Te Waka a Maui, Te Rūnanga o Ngāi Tahu and Ngā Matapopore descent. She is a Deputy Commissioner of the Environment Court and accredited RMA Commissioner with experience dealing with legislation, especially the Resource Management Act. She is an executive member of Te Tira Whakamātaki, and on the Steering Group for the implementation of Biosecurity 2025.

Mr Kevin Prime

Kevin is of Ngāti Hine, Ngāti Whātua, Tainui and Welsh descent. An Environment Court Commissioner, he was named Conservationist of the Decade in the 1990s. Kevin has long been a community role model in positions with various companies, trusts and community organisations relating to philanthropy, health, conservation, justice, Māori development, education, environment, forestry, farming and sport.

Mr Jan Hania

Jan is of Ngāti Tūwharetoa and Ngāti Raukawa-ki-te-Tonga descent. He is interested in large-scale restoration, collaborative processes and system change to achieve impact at scale, integrating western science and mātauranga approaches. As NEXT Foundation Environmental Director, Jan leads the water portfolio and assists with the leadership, development and evaluation of a number of their environmental endeavours.

Ms Erina Watene-Rawiri

Erina is of Waikato-Tainui, Ngāti Maniapoto and Ngāi Te Rangi descent. She is a freshwater scientist and works at the interface between iwi, policy and science. She is a strong advocate for undertaking research that is co-developed with Māori, based on their aspirations and values, which result in tangible outcomes that build the capacity of Māori. She has worked for several iwi and trusts and is a member of numerous freshwater and fisheries societies in New Zealand and Australia.

International Science Advisory Panel

Leading international experts who provide high-quality, independent scientific advice and support to the BioHeritage Challenge.

Professor Jan Bebbington, Chair
University of Birmingham, UK

A social scientist, Jan has extensive experience in research relating to social and environmental accounting and reporting. She has a track record of researching in inter-disciplinary teams and extensive public policy experience advising Scottish and United Kingdom governments on sustainable development.

Associate Professor Phil Cassey
University of Adelaide, Australia

As a trans-disciplinary scientist, Phil brings critical analytical techniques to the study of invasion ecology, wildlife trade, and biosecurity risk management. His research group focuses on analytical, conceptual and applied techniques for conducting high-impact research. His research has led to significant advances in the discipline of global change biology, and the prioritisation of evidence-based biosecurity decision-making.

Professor Richard Duncan
Institute for Applied Ecology, University of Canberra, Australia

Richard's specialties are in ecology, weed biology and conservation, with a focus on biological invasions and extinctions. His recent work examines the ways in which invasive species arrive, establish, spread and impact natural ecosystems. Richard was formerly a member of the Bio-Protection Research Centre at Lincoln University.

Professor Robert Ewers
Imperial College, London, UK

Robert works on spatial patterns of forest ecosystems, and the biodiversity contained within those forests. His research involves investigating and trying to predict patterns of forest cover from local through to global scales, sampling taxa within selected landscapes located in both temperate and tropical parts of the world, and manipulative experiments in both the field and lab. Most of his work uses invertebrates as a model system.

Professor Joshua Viers
University of California, Merced, USA

Joshua is a watershed engineer with expertise in resource management and environmental decision-making. He is UC Merced's Director of the Centre for Information Technology Research in the Interest of Society, which promotes collaborative research on California's environmental and societal problems. He is also the co-Director of the University of California Water Security and Sustainability Research Initiative and a member of the University of California's Agriculture and Natural Resources Governing Council.

Professor Andrew Young
CSIRO, Australia

Andrew is a plant ecological geneticist and Director of the CSIRO-hosted National Research Collections, Australia. The 15 million specimens held in these collections, and their associated genomes and contextual data, represent a vast amount of underpinning biological knowledge about Australia's unique biodiversity.

Knowledge Brokers

The Knowledge Brokers work with Challenge Project Leaders on stakeholder engagement and implementation of research findings in the real world.

Mr Bill Dyck

A science and technology broker, Bill's main role is to bring end-users and scientists together. This has the dual aim of ensuring science gets used, and that end-users communicate their needs in advance to scientists.

Mr Jack Craw

Jack is a consultant in the fields of research, planning, monitoring and programme implementation across a wide range of biosecurity and biodiversity areas. He has a focus on novel pest animal and plant management and eradication, and kauri dieback disease. His clients include people from the United Nations, UK government, MPI, councils and throughout the Pacific.

Dr Kerri-Anne Edge

Co-founder of Edge Effect, Kerri gathers user stories and perspectives about our environment and weaves this mātauranga with the science as a foundation for authentic engagement. She is a Fiordland Marine Guardian and in 2018 received a Leadership Scholarship from the Community Trust of Southland in 2018 for her work with and on behalf of the local community.

Support Team

The support team keeps the BioHeritage wheels turning behind the scenes, including day-to-day operations, contracts management, reporting and evaluation, data management, budgeting and communications.

Mr Aaron McGlinchy
Operations Manager

Aaron manages the day-to-day operation of the BioHeritage Challenge. He works closely with the Strategic Leadership Group, develops and manages the budget, and manages the support team.

Mrs Andrea Airey
Research Activities Manager

As Research Activities Manager, Andrea's main role is to promote and implement efficient and effective reporting, and evaluate all research activity.

Ms Stacey Bryan
Science Communicator

Stacey helps to translate the science being done throughout the BioHeritage Challenge into everyday language. Stacey also works as a research assistant for BioHeritage project Farming & Nature Conservation.

Mrs Carla Ashby
Personal Assistant

Carla's role includes managing the diary and supporting the Challenge Director, plus assisting the Strategic Leadership Group, Governance Group and Kāhui Māori. She joined the BioHeritage Challenge team in 2016 after several years working in the commercial real estate industry.

Ms Caroline Fenton
Communications Manager

Caroline drives the Challenge's communications strategy, aiming to enhance the connection with target audiences and strengthen the BioHeritage brand. With extensive marketing and communications experience, her career has included roles in the arts, Canterbury rebuild, local government and science sectors.

Dr Liz McCallum
Research Coordinator

Alongside the Operations Manager, Liz looks after all aspects of contracting plus provides general research and project management support.

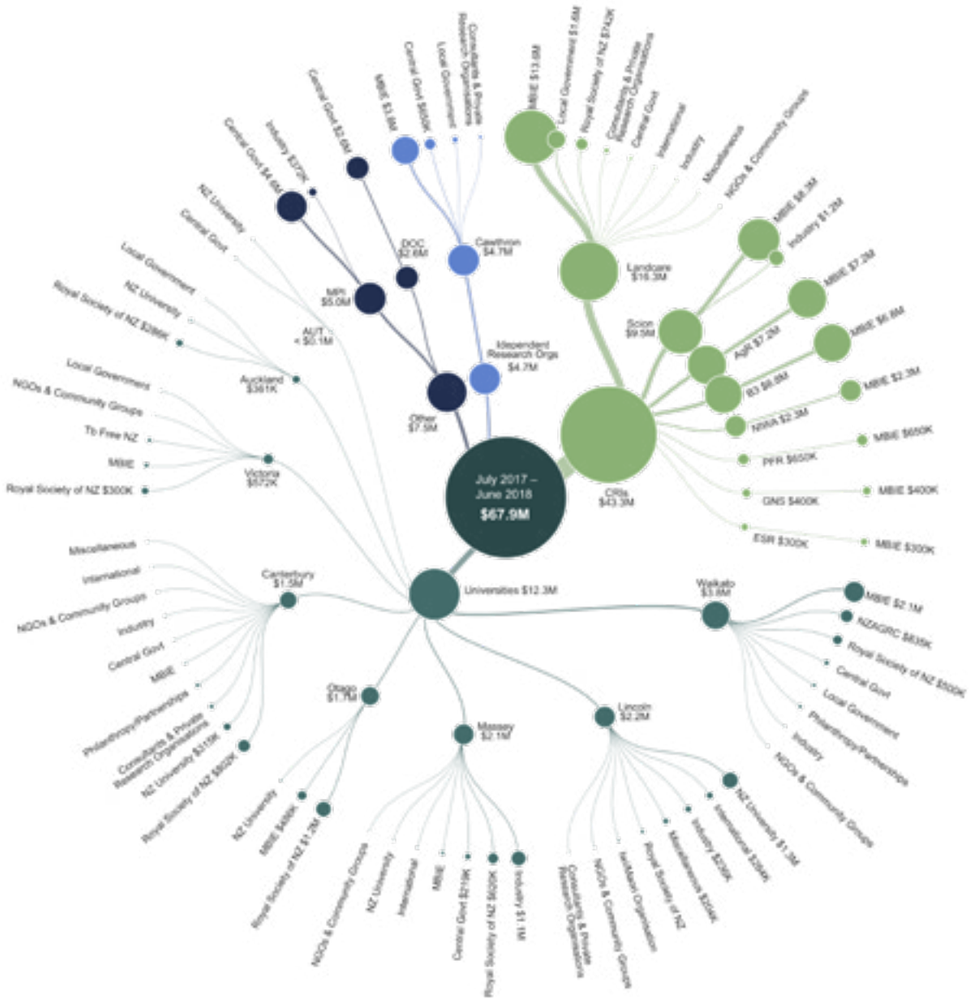
She has a research background in cardiovascular and respiratory physiology in addition to strong senior administrative experience.

Aligned research

Using Challenge investment, our aim is to connect, integrate and co-ordinate significant areas of aligned research being done by our 18 Challenge Parties. Aligned research is work funded through other investment mechanisms, but that aligns to the mission of the BioHeritage Challenge. In the three years to 2018 our Challenge Parties identified almost $180m of aligned research being carried out by their organisations.

Mapping the research landscape is a critical first step towards working together to focus and scale-up efforts for maximum impact, which will help achieve the mission of saving Aotearoa New Zealand's environment. This collaborative approach is a cornerstone of the BioHeritage strategy.

In 2018, we analysed one year's worth of aligned research in order to spark conversations about research priorities and gaps. This is enabling us to more clearly direct and reshape Challenge investment as we move forward – explicitly targeting those gaps and priorities.



Info bites

Challenge at a glance:

Research funding in Tranche 1

$25.8M

(2014–2019)

Number of Challenge Parties **18**

Funded projects **18**

Vision Mātauranga projects **4**

Cumulative value of aligned research over the past three years

$179M

Percentage of researchers who identify as Māori

23%

Investing in future biological heritage capability:

Undergraduate students and summer scholars working on BioHeritage projects **51**

(22% of whom identify as Māori)

Post Doc and Early Career Researchers **38**

New Zealand's Biological Heritage
National Science Challenge

www.bioheritage.nz

Reaching out 2018–19:

Publications and think pieces **46**

Conference presentations **63**

Media mentions **>80**

Māori communities we have connected with **32**

Social media followers

4,500

Social media shares, likes and follows

>30,000

What they say about us

Combating pathogen risk using genomics

"I've grown my understanding of fungi and how despite their hidden nature, they are incredibly valuable to maintaining our larger species that we depend on for hauora and protection of mauri ora. Working with kauri and other native species has grown my connection to papatūānuku and tane mahuta. Furthermore, I feel that I can take the knowledge that I've learned and pass it on to others. Through the studentship, I've learned the importance of connecting the knowledge of our tipuna and a Māori world view with the knowledge and practices of modern western science. When these two perspectives are integrated, it is my belief that the most benefit can come to our land and our people. For this to occur, however, there must be Māori involvement at the forefront. I am thankful for this opportunity because it has developed my passion for mycology and hopefully I will be able to share that with others to help spark their interest as well so that in the future there can be equal partnership and participation from Māori."

Māori summer student Sophia Stewart studying fungal endophytes in the roots of kauri, tōtara, and Araucaria.

Testing the stoat lure

"Thanks for that report – good results. Anything that catches more stoats for a given (volunteer) effort has to be good. I would like to talk about our participation in your project at our upcoming Ruahine Whio hui and record it in my annual Oroua/Pohangina – will this be OK? My reports all are available to anyone interested."

Ōroua Blue Duck Protection Trust, Manawatū-Wanganui

"The trial that you carried out in the Whangawehi catchment completely blew us away in terms of the results achieved. It was incredible to see such an increase in catches with your new lures. Keep us in the loop for further trial work as we are keen to continue working with you and potentially purchase some of your products."

Nic Caviale, Project Manager, Whangawehi Catchment Management Group, Māhia Peninsula

Inspiring the next generation

"... I (became) fascinated about the BioHeritage's determination to deal with kauri dieback by implementing a mix of scientific research and indigenous knowledge, and somehow I found a research topic around the unique NZ way to deal with biosecurity issues....

Of course, BioHeritage as an institution is going to be a crucial part of my doctoral research, ...(it's important) to keep the social media channels opened and active not just for promotional purposes but also as a means of education and awareness of the general public. It totally worked with me."

Cultural anthropology student

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Te Mauri o Te Kererū

Tikina ki hea?
Tikina ki te rangi?
Tikina ki a Matariki
Te whetu tapu o te tau
He tohu I te makuru o te tau kai hau kai
Tēra ko Ngāwhata ki te tuāpae
Nau mai te manga tawaī ā Rehua

Papā te whatitiri i te ana whakatangi
Hoki mai te manu ora ki te maunga koia!
E ko Te Puanui a Tāne
Hau ko te kahikatea, te pakiaka haere whenua
Kaua ki Te Houhi, ko Te Kōhai kawa poro kai whenua

Nau mai e manu ki toku tua
Ka hiko e
Ka kapo, kapo e, ka kapo, ka kapo
Ka hiko i te pae o te rangi e
Aue!

The Life Essence of the Kererū

Where shall it be retrieved?
Retrieve it from the heavens
Retrieve it from Pleiades
From the sacred star of the year
That foretells the abundance of this season
We look upon Ngāwhata (An arm of Orion's belt)
that rests on the horizon
And we welcome the resting perch of Rehua (Antares)

The lightning claps in the caves that echoed
Return o sacred bird to your mountain solace!
To declare the opening abundance of Tāne
In the presence of the great trees that walk this land
No time during the Houhi and the Kōhai that decays the flesh

Return o sacred bird unto my shoulder
Lightning flickers! People clutching!
They clutch, they clutch
It flickers in the horizon of the sky.
Sadness!

He mōteatea mo te kererū
(A lament about the kererū)

Composed by Tuawhenua kaumātua and rangatahi – Te Weu o te Kaitiaki wananga

Challenge Research: Customary approaches and practices for optimising cultural and ecological resilience *(Kia mau tonu ki ngā tapu taonga o ngā mātua tūpuna* – hold fast to the treasures of the ancestors)

Mr Puke Timoti, Tūhoe Tuawhenua Trust; Dr Phil Lyver, Manaaki Whenua

Manaaki Whenua
Landcare Research

Our Land, Our Future

Tō tātou whenua, mō āpōpō

About the Challenge Host

Manaaki Whenua – Landcare Research

Our Challenge host, Manaaki Whenua – Landcare Research plays a number of important roles, including providing legal, accounting, human resources, IT, editing, communications and graphics support.

Manaaki Whenua are the crown research institute for our land environment. They are tasked with helping New Zealanders understand and care for our land and the rich biology that shares this land with us. Their 380 scientists and experts study New Zealand's biodiversity, ways to protect our land from biosecurity threats, the sustainable use of our land resources, and our changing environment. They work with government, Māori, industry, communities, individuals and scientists from around the world to create lasting impacts for our land. Because our land is our future – tō tatou whenua, mō āpōpō.

Manaaki Whenua aligns more than $15 million a year of research activity with the Challenge via the Strategic Science Investment Fund (SSIF), government-funded contestable research programmes, and commercial (non-government) sources.

Manaaki Whenua's SSIF funding supports numerous Challenge investments.


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