National Science Challenges

NEW ZEALAND'S BIOLOGICAL HERITAGE

Ngā Koiora Tuku Iho

NGĀ RĀKAU TAKETAKE

Saving Our Iconic Trees

from Kauri Dieback & Myrtle Rust

2022 Highlights

New Zealand's Biological Heritage National Science Challenge, Ngā Koiora Tuku Iho, aims to protect and manage

Aotearoa New Zealand's biodiversity, improve our biosecurity, and enhance our resilience to harmful organisms

New Zealand's Biological Heritage National Science Challenge.

Highlights Report 2022.

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OUR VALUES

Mahi whaipainga

Ngākaunui / Uekaha / Ngakau Whakapuke

Whanaungatanga

Manaakitanga

Mana Motuhake / Tino Rangatiratanga

Whakapapa

Kaitiakitanga

Mātauranga

Tohungatanga / Ngā tiketiketanga o te pai

Mahi rangapū

Nā ngā Kaiwhakahaere
From the Directors

Nau mai, haere mai, welcome to the latest Highlights Report from Ngā Koiora Tuku Iho – New Zealand's Biological Heritage National Science Challenge.

Daniel Patrick

Shaun Ogilvie

The three years since the last report have been some of the most tumultuous in modern history – resulting in professional and personal upheaval for many. We have been absolutely stunned by our researchers' and communities' resilience over this time and we're excited to share with you a few highlights from their work.

But first a thanks. Thank you to everyone who is inspired by a future in which our biological heritage is thriving. It is because of you we can collaborate far and wide across Aotearoa, assembling the right teams to deliver excellent science and meaningful impact.

It is because of you that in 2019 we were able to create seven new research teams under the banner of Ngā Rākau Taketake – Saving Our Iconic Trees. These teams have not only contributed to knowledge in the areas of kauri and myrtle forest health, but they are also paving a new road to authentic and effective engagement with mana whenua.

Our National Science Challenge research programmes have made huge progress in their respective areas. They are holding real and sometimes difficult conversations while collaborating with a variety of partners. Because of this they are producing excellent science results and having an impact where it is needed the most.

We'd like to thank our Mana Rangatira Governance Group and International Science Advisory Panel for their continued strategic oversight and guidance. Your support and advice has enabled us to step into the very large shoes Andrea Byrom and Melanie Mark-Shadbolt left for us as co-directors.

For the next two years we will be working closely with our 250+ researchers to whakamana (empower), tiaki (protect) and whakahou (restore) the biodiversity and biosecurity system in Aotearoa. We will continue to restore respectful, balanced relationships and uplift Te Ao Māori: leading as an example of how a true commitment to Te Tiriti o Waitangi results in immense benefits for both te tangata me te taiao (the people and the land).

We will continue to be ambitious with our goals, adventurous with our methodologies and be flexible to pivot (if Plan A doesn't quite work out). The transition to implementation will be a focus over the coming years, to ensure the results of our research reach the hands that helped co-design it in the first place.

We hope you enjoy this brief glimpse into our teams' mahi.

Noho ora mai,

Daniel Patrick and Shaun Ogilvie
CO-DIRECTORS

Ngā Mahi Tahi
Collaborations

The BioHeritage National Science Challenge is one of 11 created by the Ministry of Business, Innovation and Employment in 2014.

Our role is to convene, prioritise, and connect a range of partners and existing investments to accelerate progress. We work with 18 Challenge Parties, which includes all of the universities and Crown Research Institutes in Aotearoa.

We also take pride in partnering with mana whenua, iwi and Māori groups, government and non-government organisations, regional councils, businesses, and private citizens.

As you can imagine, with 16 main research programmes spanning the breadth of biodiversity and biosecurity issues in Aotearoa, there is overlap between some of them. That's why we hold regular wānanga for our National Science Challenge and Ngā Rākau Taketake teams to come together and help each other out. This way we can increase collaboration, expand networks and eliminate duplication of effort.

By partnering far and wide we can break down the silos of the traditional science system and build better teams, which leads to better results for the entire country.

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
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Manaaki Whenua Landcare Research

Te Mahi Tahi ā-Pātui ki te Iwi Māori
Partnering with Māori

A commitment to Te Tiriti o Waitangi and our values (page 2) are cornerstones of how the BioHeritage National Science Challenge operates. Throughout our existence we have strived to continually restore respectful relationships between tangata whenua (people of the land) and tangata Tiriti (people of the Treaty) – uplifting Te Ao Māori to its rightful place within Aotearoa.

Genuine partnership starts at the top, which we demonstrated when our Kahui Māori and Governance Groups merged in 2019. This ensured the guidance of both groups was valued and weighted equally. Our Kaihautū Ngātahi (Co-Director Māori) Shaun and Co-Director Daniel work together to drive the everyday activities of BioHeritage. Shaun does this role as part of his position as Professor of Ecology and the Environment at the Ngāi Tahu Centre, University of Canterbury. This forms part of their commitment to being a treaty-led university, along with the establishment of a treaty partnership office.

Shaun works with our Pou Pūtaiao (Chief Scientist Māori) Erina Watene-Rawiri to lead the recently refreshed Rautaki Māori (Māori Strategy). This was collectively written by Te Aho Mātauranga, our group of senior Māori researchers, to guide our objectives, priorities and actions. It will ensure we adhere to our values and was the driving force behind our recently published Te Tiriti o Waitangi Statement of Commitment.

Almost all of our research programmes have two co-leads: one with whakapapa Māori (Māori heritage) and one without. They are stronger teams because of this and can safely operate within a range of environments. Some research programmes are dedicated to the empowerment of Te Ao Māori. For example, the Oranga team describe their research as "unashamedly indigenous", while both co-leaders of the Adaptive Governance & Policy team have been nationally recognised for their expertise in the field of co-governance.

We have recently established a programme called "He Mātai i te Taiao" (the perpetual examination of the environment). This team will be investigating what the science system in Aotearoa would look like today if Te Tiriti o Waitangi had been honoured for the past 180 years, and what we need to do now to get to that point.

Within the Ngā Rākau Taketake work stream our researchers are trialing a new way for scientists in institutions to engage with mana whenua within their rohe. Called 'Te Whakahononga', this initiative has the potential to improve relationships within the Aotearoa science sector. See over the page for more details.

We are immensely proud to be leading by example, something we can only accomplish because of the wealth of expertise of our Māori team members. So much effort has been put in by those before us to get to where we currently stand, and we are honoured to be able to build on this mahi.

Te Whakahononga
Creating a connection

Co-leads
Dave Milner Ngāti Wai, Ngāti Whatua, Ngāpuhi, Ngāti Porou; Perception Planning Ltd. **Juliane Chetham** Patuharakeke, Ngātiwai, Ngāpuhi; Chetham Consulting Ltd. **Waitangi Wood** Ngatirua, Ngāti Awa, Ngāti Kahu, Ngāpuhi Nui Tonu; Independent Contactor. **Alby Marsh** Ngāti Ranginui, Ngai Te Rangi, Ngā Puhi, Ngāti Hine, Te Rarawa; Plant and Food Research.

Ngā Rākau Taketake Pou (supporting architecture)

More and more of Aotearoa New Zealand's ngahere is imperiled by kauri dieback (KDB) and myrtle rust (MR). These diseases threaten not only the rākau themselves but also the intricate ecosystems and the cultural relationships and identity associated with these taonga. Vulnerable species include kauri, as well as rātā, pōhutukawa, maire, kānuka, mānuka, ramarama, rōhutu, and adopted taonga such as commercial feijoa crops.

Te Whakahononga is coordinating a multi-disciplinary response, connecting people who have mātauranga Māori skills and unique localised knowledge with other NRT scientists across 15 geographic areas impacted by KDB and/or MR. With 15 different mana whenua groups coming on board, this is an unprecedented level of community/hapū participation for BioHeritage.

Mana whenua have a rich history and tradition of innovating and utilising customary tools and knowledge such as rāhui, kaitiakitanga and other environmental protocols to address species decline. The challenges have been diverse, from first discovering and investigating the globally-unique ecosystems of Aotearoa, through the dramatic challenges brought about by the European colonial event, to today. Through mātauranga and generational knowledge coalescing with conventional science methodologies, Te Whakahononga will showcase a truly Te Tiriti-led approach to conservation.

Leading Māori social scientist, Karen Fisher, of Waikato-Tainui (Ngāti Mahuta) and Ngāti Maniapoto (Ngāti Paretekawa) descent, is based at the University of Auckland and is part of the team to assist in recording, synthesising and sharing knowledge from this ground-breaking approach.

The team also includes Mana Epiha, who is of Ngāpuhi nui tonu (Ngāti Rehia, Ngāti Kura, Te Uriroroi, Patuharakeke) descent and is an award-winning producer, director and film maker. He is recording the development and progress of Te Whakahononga.

The Te Whakahononga approach recognises that mana whenua kaitiaki and tohunga are best placed to co-design and co-develop our next steps towards controlling the threat presented by KDB and MR, and returning our ngahere and crops to vitality.

Ngā Pī Ka Rere
The fledgling birds shall fly

Co-leads
Aisling Rayne Cawthron Institute. **Symon Palmer** Ngai Te Rangi; Te Herenga Waka Victoria University of Wellington
Helen Warburton University of Canterbury.

National Science Challenge and Ngā Rākau Taketake Pou (supporting architecture)

The future of our science system, and our country, depends on those who come after us. That's why BioHeritage is investing in the next generation.

The Ngā Pī Ka Rere early careers network was established in 2019 to ensure our early career professionals have all the support they need to flourish in their chosen careers. The group intentionally don't use the common term 'early career researchers' because there are so many more career pathways within the science system. They want to enable those starting, or restarting, their careers to not feel restricted to academia.

Other goals of the group include setting up a mentorship programme, building leadership capability within our 'fledglings', and offering networking opportunities that might not otherwise be available.

Co-leads Helen, Symon and Aisling are embracing the values of whanaungatanga, manaakitanga and whakapapa: connecting early careers, advocating for them and recognising the interconnected and intergenerational nature of our country's science system.

Aisling says "There's growing recognition that the challenges we're facing — in terms of biodiversity, biosecurity, climate change and so forth — are very large and complex, and bring in multiple threads: environmental, social, and cultural.

"We need approaches that recognise different ways of thinking, of knowing and of being, and that include diverse disciplines and communities."

Whakamana – Empower

Helping New Zealanders protect our precious environment.

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

Eco-index

Co-leads
John Reid Ngāti Pikiao, Tainui; JD Reid Ltd. **Kiri Joy Wallace** University of Waikato.

Those working to reverse biodiversity decline across Aotearoa will soon have new information, targets and tools to inform their efforts, through the work of the Eco-index team. With a 100-year National Biodiversity Vision to underpin their mahi, the Eco-index programme is focused on guiding and boosting biodiversity investment towards effective outcomes.
This includes ecological restoration targets, new remote sensing tools and cutting-edge analysis of investment and outcomes.

Case Study

Eco-index sets groundwork for biodiversity transformation

What will Aotearoa's landscapes look like 100 years from now? Or more importantly – what do we want our whenua to be like? That's one question researchers have been exploring in the first half of the Eco-index project, culminating in a 100-year vision backed by science and grounded in *te ao Māori*. 'Protected, Restored, Connected 2121' envisages a minimum 15% of native ecosystem restored, connected and protected across Aotearoa, ki uta ki tai.

We know that our biodiversity is in bad shape, and our efforts to reverse species decline aren't really working. Setting a shared vision is the first step towards evidence-based action to combat biodiversity loss. "It's all gauged towards real impact on the ground," says Eco-index co-lead John Reid.

The vision was developed through in-depth kōrero with iwi, industry, scientists, and local government, alongside a robust analysis of existing biodiversity strategies. The specifics are informed by current scientific understanding of what essentials biodiversity needs to thrive. "We've done a lot of homework to set a strong foundation so that the vision will gain traction," says John.

This mahi is distilled into a vision centred around three themes.

- **Protect | Tiaki:** Protect native ecosystems from threats. Kia haumaru te mauri o te taiao.
- **Restore | Whakahou:** Restore native ecosystems in every catchment to a minimum of 15% of original extent. Kia whakahoki te mauri o te Taiao ki te taumata e hiahia ana e tātau.
- **Connect | Tūhono:** Connect native ecosystems from mountains to the sea. Ko te mauri o te Taiao te taukaea honohono mai i uta, tae atu ki tai.

"We have set this vision as a realistic goal to achieve together," says Eco-index co-lead Penny Payne.

Now, the next big question is how we are going to achieve this collective long-term goal. What's the gap between our current situation and ideal future, and what targets do we need to get there? "We are undertaking measurements, assessment and modelling to understand what the data is telling us, in order to inform recommendations," explains Penny. Such a rigorous approach will ensure targeted impact on the ground, across the motu. Targets for industry, iwi, regional councils and catchments will be announced in the coming months.

Key to success will be the Eco-index tool, designed to quantify the impact of all sorts of actions to help biodiversity, such as predator control and tree planting. An online dashboard will summarise the current status of biodiversity at a national scale, and outline the investment required to realise the vision via incremental steps. By connecting investment with real-world outcomes, Eco-index will help land managers decide which initiatives will give them the most bang for the buck on the road to 2121.

With the vision as inspiration and guide, the Eco-index team are embarking on proof-of-concept projects in collaboration with local iwi and industry, pulling together data from diverse sources, and investigating novel artificial intelligence technologies to help monitor biodiversity indices at large scale.

"When we pull this off, it will make a huge difference to informing biodiversity-related decisions," says Penny. "It's taken us more than 100 years to do this much damage, so it's going to take a long time to fix it."

NEW ZEALAND'S BIOLOGICAL HERITAGE **NATIONAL SCIENCE CHALLENGE | 2022 HIGHLIGHTS**

Empowering Kaitiakitanga & Environmental Stewardship

Co-leads
Pike Stahlmann-Brown Manaaki Whenua - Landcare Research. **Jane Kitson** Ngāi Tahu, Ngāti Mamoe, Waitaha; Kitson Consulting Ltd.

The Empowering Kaitiakitanga & Environmental Stewardship team is aiming to understand the underlying values and drivers that lead some people to actively protect our biological heritage. They also want to understand feedbacks between people and the ecosystems in which they live.

Case Study

Creating kaitiaki and champions for urban freshwater

Aotearoa has come together as a team of five million when it comes to Covid-19, but how do we create a team of five million for the environment? This research theme, led by Pike Stahlmann-Brown and Jane Kitson, is figuring out the best ways to empower urban citizens to demand and enact environmental stewardship and kaitiakitanga when it comes to freshwater biodiversity.

First, the team took a deep dive into the literature on environmental stewardship and kaitiakitanga, to gather up everything researchers know about what it means to be an environmental protector.

“Environmental stewardship tends to be written about in certain domains, but not others. There wasn’t very much in freshwater, and particularly in urban spaces, so that’s where we thought we would focus,” says Pike. “I think there’s been so much focus on freshwater in rural areas that we sometimes forget that 87% of the population is urban.”

“It really highlights the importance of urban freshwater systems,” adds Jane, listing off a multitude of factors impacting our city waterways: channelisation, lack of habitat, chemical inputs into the system – both industrial and household, sewage treatment, ageing infrastructure… the list of challenges is long.

But when it comes to fostering pro-environmental, pro-freshwater behaviours in people to tackle these challenges, evidence is thin on the ground for what actually results in impact – for both people and rivers.

So, the team interviewed a range of freshwater experts to collate ideas for high-impact actions people could take to help their local waterways, developing a list of 15-20 possibilities.

The next step: asking the general public about these actions and behaviours (and the drivers/barriers behind them) through two nationally representative surveys, which are underway now.

These surveys will identify “those activities in urban freshwaters that people are not currently doing, that they’re willing to do and that are going to have a big impact,” says Pike.

The next step will be to co-develop behaviour change interventions with communities, and implement these interventions through field experiments in 2023.

These experiments will be designed to leverage drivers and reduce barriers to pro-freshwater behaviours, as well as drawing on the rigorous design principles usually seen in clinical trials.

This rigour is needed to evaluate whether interventions are changing behaviour and whether they are ultimately having positive environmental outcomes.

“We want to see whether we can have a real impact in the community. We want to see if we can help drive positive change within waterways,” says Pike. “It’ll be very exciting on the ground research soon in this project, we just had to do the groundwork first.”

Participants of an Empowering Kaitiakitanga & Environmental Stewardship hui visiting a gully restoration project.
Image thanks to Tash Tassell-Matamua.

Relationships with urban freshwater vary widely across the country.
Image thanks to Andrea Airey.

NEW ZEALAND’S BIOLOGICAL HERITAGE **NATIONAL SCIENCE CHALLENGE | 2022 HIGHLIGHTS**

Oranga

Co-leads
Melanie Mark-Shadbolt Ngāti Kahungunu, Ngāti Porou, Te Arawa, Te Āti Awa, Ngāti Raukawa, Ngāti Tūwharetoa, Te Tira Whakamātaki; Ministry for the Environment. **Valance Smith** Ngāpuhi, Waikato, Ngāti Haina, Ngāti Pākehā; Auckland University of Technology.

The Oranga research theme is a suite of kaupapa Māori projects that aim to restore the collective health of trees, forests and people. The team is doing this by connecting to, and resourcing, Māori communities and their environmental knowledge holders to explore solutions embedded in mātauranga Māori (Māori knowledge).

Case Study

Te Whakaora a ngā Kauri: Putting mātauranga into practice to save kauri

In the forests of northern Aotearoa, kauri are suffering. These giant rākau of the ngahere are afflicted by a plant pathogen called *Phytophthora agathidicida*. When translated to English this literally means *'plant destroyer-kauri killer'*. But the kauri have a strong kaitiaki in Matua Tohe Ashby (Ngāti Hine), a rongoā Māori tohunga (expert) based in Northland.

Matua Tohe has developed a rongoā treatment for kauri affected by this disease that draws on the shared whakapapa of a unique relationship between the kauri and paraoa (sperm whales). According to the cultural narrative of the north, the pair are brothers – sharing the same skin, full of resin or oil and large stature – who became separated when paraoa chose the moana (ocean) over the ngahere (forest).

"When the kauri began to get sick, I said I would take the whale back to the kauri," says Tohe. "One of my elders, Kevin Prime, said to me that if you can save one tree, that's a big thing, you could consider it a gift back."

Recently, Tohe has been called upon by other Māori groups across kaurilands to help save their kauri, including a recent example on the land of Ngāti Whātua. "One of the students came to see me and asked how they could save the kauri trees in the bush near them," Tohe explains. "I gave them some whale bone and oil, and told them to harvest some kahikātoa, mix it all up, and then apply it to the trees and land.

"They marked the trees and applied the medicine. There were seven trees that this medicine was given to. These seven trees – they've all been healed. They have all come back to life."

Jamie Ataria (Rongomaiwahine, Ngāti Kahungunu, Ngāti Paki) sees the benefits of the Oranga kaupapa extending beyond saving trees: "The notion of oranga (wellbeing) is not just about the kauri, it's about us as people.

Matua Tohe Ashby at the base of a kauri tree affected by kauri dieback disease. Image thanks to Jamie Ataria

Our oranga would be much improved if both were afforded the same consideration and stood side by side, as equals," he says.

The research programme is also an opportunity to raise the profile of mātauranga Māori, according to Jamie, "We need to get behind our mātauranga... it needs to be more broadly accepted as a legitimate form of knowledge, particularly when dealing with issues or kaupapa here in Aotearoa New Zealand."

"The research, science and innovation process here in Aotearoa New Zealand has effectively been closed to Māori for many years. This project is supporting Matua Tohe's aspirations and his kaitiaki obligations to heal the kauri using uniquely Māori approaches, and so what we're doing here is quite different and I'd like to say that it's more 'us'. I hope that really encourages people who hear about this work to say that, 'well actually, maybe there's a role or a place for me and my kaumatua's and kuia's knowledge to help on this issue'. I hope that communities feel empowered by this research process."

Matua Hori Parata (Ngāti Wai) performing karakia (incantation) in front of a kauri tree. Image thanks to Jamie Ataria

NEW ZEALAND'S BIOLOGICAL HERITAGE **NATIONAL SCIENCE CHALLENGE | 2022 HIGHLIGHTS**

Mobilising for Action

Co-leads
Marie McEntee University of Auckland. **Mark Harvey** Mātāwaka no Ngāti Toa; University of Auckland.

This research theme focusses on the human dimension of forest health in Aotearoa New Zealand. Specifically, the people and communities affected by, or at risk of being affected by kauri dieback and myrtle rust.

Konini Primary School's Matariki Celebrations 2022.
Images thanks to Ariane Craig-Smith

Case Study

Toitū te Ngahere: Using art to connect tamariki with the ngahere

In the leafy suburb of Titirangi, more than half the grounds of Konini Primary School are cloaked with lush native bush. It's the perfect setting for Toitū te Naghere, a project drawing together art, mātauranga Māori and science to engage tamariki and teachers with the ngahere.

"We want the kids that we're working with to look at that big picture of forest health, and the role that they can play in being part of supporting health in our native environments," says project coordinator Ariane Craig-Smith. "So, learning about those species and also sharing the learning that they are doing with their wider community. Plus, we want art to be a really critical part of that."

Konini Primary School is one of two schools participating in the programme this year – the other being Kauri Park Primary School on the North Shore. Next year, the programme will shift to three schools on Aotea Great Barrier Island.

"What we're asking those schools to do is come on a collaborative journey with us. They each have a unique relationship to the landscape – so exploring that. What is the current landscape, what are the histories of those sites, what knowledge is there within the community, within their families? Those things will all feed into how the project unfolds," says Ariane.

A team of mentors, drawn from postgraduate studies in arts and science, will work with schools to deliver the project.

"The integration of art into the classroom is a really healing tool and a really powerful tool for learning," says Justice Hetaraka (Ngātiwai, Kāi Tahu), advisor for Toitū te Ngāhere.

"The process and the way we're going about learning is actually a Māori way of doing things. Art gives tamariki the ability to use their creativity and imagine a future that doesn't exist yet."

> "The integration of art into the classroom is a really healing tool and a really powerful tool for learning."

Konini Primary School principal Andrew Ducat is enthusiastic about the benefits of combining art, science and mātauranga in the context of their own patch of ngahere. "That emotional connection to the learning task gives far more enriched learning opportunities that will last," he says.

"We get so many messages about the damage we are doing to the environment as a species," says Ariane. "I hope that we can be contributing to changing that narrative and giving those tamariki an awareness that they can be a healthy part of that ecosystem."

Tiaki – Protect

Contributing to a world-class biosecurity system

Ka whakawhānake tō tātau pūnaha tiaki koiora ki te Ao















He Tangata, He Ōhanga, He Taiao:
a values-based biosecurity framework for Aotearoa

Co-leads
John Kean AgResearch, Better Border Biosecurity (B3). **Christine Reed** Independent Contractor.

With our increasing global interconnectedness and growing complexity of trade, the spread of pests and diseases is accelerating. How can we lower the risk of pests entering Aotearoa?

Case Study

He Tangata, He Taiao, He Ōhanga research team is developing a biosecurity risk assessment framework, to ensure people in the biosecurity system are able to be actively engaged in the identification and prioritisation of biosecurity risks.

What makes a good biosecurity decision?

"We know there are lots of biosecurity decisions being made all the time, but we all have different impressions of how good those decisions are," says John Kean, co-lead of the He Tangata, He Taiao, He Ōhanga. "We are trying to really understand what makes a good biosecurity decision, so that we can develop a framework that delivers good biosecurity decisions."

The risk assessment framework will draw on a holistic set of values, aiming to spark wider participation in biosecurity decision making, especially among mana whenua.

"There's a perception that biosecurity decisions are economically based decisions," says co-lead Christine Reed. "So, what we're striving to do is bring more of those other values into biosecurity decision making."

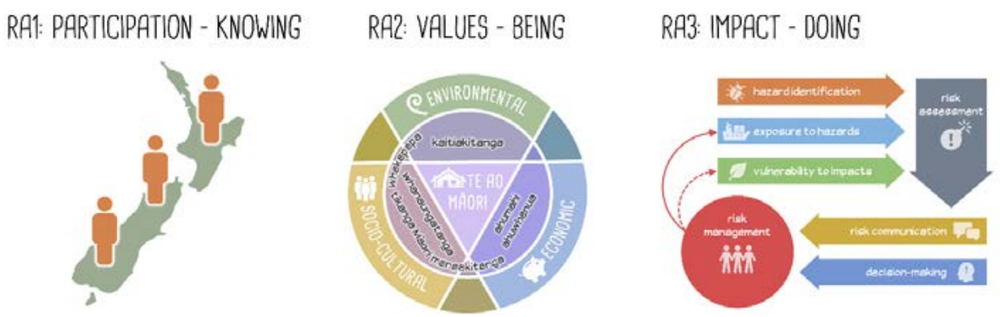
In the project's first year, the team has undertaken a literature review of what we currently know about Aotearoa New Zealand's different economic, environmental and socio-cultural values when it comes to biosecurity. As might be expected, the review found that values vary widely between people – but place-based values were important to many New Zealanders, and particularly Māori.

Many of the values identified echo four principles from Te Ao Māori, identified by PhD candidate Tracey Godfery as important for biosecurity: whakapapa (genealogy), tauutuutu (reciprocity), tuakana-teina (relationship based learning), and mōhio (inherent wisdom). "It's really interesting that concepts like reciprocity and relationship-based learning have that commonality across cultures," says John.

Environmental values were often represented as ecosystem services – "but these aren't always compatible with Te Ao Māori," says Christine, "So we're looking for other metrics that are more compatible."

This values review has been accompanied by a deep dive into existing risk assessment frameworks by researcher Melanie Newfield, who interviewed 26 decision makers across the biosecurity field. It turns out there are a few frameworks out there, but some are sitting disused and others are only applied sporadically. Plus, trust is key for a useful risk assessment framework.

"There's no point coming up with yet another risk assessment framework," says Christine. "We really need to understand what those challenges and blocks and barriers are for decision makers, before we can develop a new one."



NEW ZEALAND'S BIOLOGICAL HERITAGE **NATIONAL SCIENCE CHALLENGE | 2022 HIGHLIGHTS**

State-Of-The-Art Surveillance

Programme Lead
Steve Pawson University of Canterbury.

Surveillance is an essential part of protecting New Zealand's economic assets and natural taonga from damaging exotic organisms.

Our government currently spends over $125 million a year on monitoring for biological threats. It's an expensive process because it requires thousands of hours of highly skilled human labour.

The State-Of-The-Art Surveillance team is developing prototype technologies that will automate and improve surveillance results, while saving costs.

Case Study

Supercharging biosecurity surveillance with new tech – and insect soup

When you're an island nation like Aotearoa, safeguarding biological heritage and industries is paramount. We've already got a strong biosecurity system to keep out unwanted organisms, but with strange new insects and pathogens turning up all the time, there's room to supercharge our surveillance strategies and make them more efficient.

"We have a good surveillance system, but we can't be everywhere," says Steve Pawson, one of the lead investigators for the State-Of-The-Art surveillance research programme. "So we're trying to develop new technology that can help us find things earlier, so that we can eradicate them."

In the decade to 2017, a whopping 71,000 organisms were intercepted at the border, and our current systems could only identify around half of them. Of those organisms that were identified, around half were only ever seen once.

"Most of the new things arriving are not on anyone's lists – there are just so many potential threats that aren't on our radar. We get things turning up here that are new to science, and they establish here. So to have the strongest possible biosecurity surveillance system, you want to make it as broad as possible to catch as much as you can," says Steve.

That's where insect soup comes in. The idea goes like this: set up a UV light trap at places like ports. Insects are attracted to the light, and fall into a container of antifreeze. The insect-antifreeze mix is blitzed up into a soup, and then the DNA in that mixture is analysed to see which species are present.

By detecting species earlier, eradication would prove a simpler – and less costly – task.

Product design and electrical engineering students at the University of Canterbury are developing a custom UV light trap, which is solar powered and has 'Internet of Things' capability, so it can be controlled remotely. An earlier prototype has been deployed at the Port of Tauranga to collect samples, which are now being analysed.

> "You've either got to have strong trust in your DNA reference library, or you need to develop methods to extract the DNA whilst keeping insects whole. We're working with both of these approaches right now."

The goal is to build up a database of reference DNA 'barcodes' for all the different common species. Publicly available sequences of known pest species will be added to the reference database too.

But Steve says this is trickier than it sounds.

"You've either got to have strong trust in your DNA reference library, or you need to develop methods to extract the DNA whilst keeping insects whole. We're working with both of these approaches right now."

The team aims to test the prototype surveillance system next summer, with a possible national roll-out after that.

Entomologist Carl Wardhaugh with an insect light trap used at the Port of Tauranga. Image thanks to Scion.

Novel Tools & Strategies - Invertebrates

Co-leads
Ocean Mercier Ngāti Porou; Te Herenga Waka - Victoria University of Wellington. **Phil Lester** Te Herenga Waka - Victoria University of Wellington. **Symon Palmer** Ngāti Te Rangi; Te Herenga Waka - Victoria University of Wellington.

Lots of our current pest control strategies have unintended and detrimental effects on the surrounding environment. We need new tools to effectively control pests while avoiding these unwanted side-effects.

The Novel Tools & Strategies – Invertebrates team aims to develop a new, landscape scale, invertebrate pest management tool by 2024.

While working towards this goal, they are engaging with, Māori to understand how new pest control tools can enhance kaitiakitanga and promote tino rangatiratanga.

Case Study

Social science and molecular innovation combine to tackle honeybee threat

The *Varroa* mite is tiny – only a few millimetres across. But if you're a honeybee, these invaders are deadly – and that's causing huge issues for beekeepers across Aotearoa. Right now, treating *Varroa*-infected hives means applying a toxic miticide. This can affect other invertebrates (including bees) and even humans, and eventually stops working once the mites become resistant.

So, what if there was a better way? A biodegradable, safe, *Varroa*-specific solution that doesn't generate resistance? That's exactly the research focus of one team under the 'Novel Tools & Strategies' umbrella.

Their solution doesn't actually kill the *Varroa* mites, but stamps out their ability to reproduce. It's a type of double-stranded RNA (dsRNA) "which specifically targets mite proteins, so it's harmless to honeybees, humans and other non-target species," says researcher Rose McGruddy. "It's also non-toxic – it degrades in water and soil."

Rose presented results of this work at the Apiculture New Zealand Conference in June, where she won the best student speaker award. She says "Beekeepers are very excited about this technology. It is a highly targeted pest control approach with a lot of potential for the industry."

The next step is to take the technology out of the lab and into field trials.

But how do people feel about this new, cutting-edge approach to pest control? Another research strand within this theme aims to feel the pulse on invertebrate control issues among Māori – including businesses, an 'informed' audience, and people with religious or spiritual affiliations.

"Unsurprisingly there was a range of views," says researcher Symon Palmer, "There were some views that permitted the use of these technologies, they were all on board. But then there was also opposition."

> "Do nothing is not an option," says Symon. "People recognised that there are these biosecurity risks and invasive species."

Some people were concerned about off-target effects, and the use of genetic tools in particular. But all recognised the need for action, and wanted more information from a neutral standpoint.

"Do nothing is not an option," says Symon. "People recognised that there are these biosecurity risks and invasive species."

A 'do nothing' approach would result in the mites killing all the bees, and therefore the hive.

"We need to control the mite parasite somehow, which is typically achieved using chemical pesticides. Alternatives to help the bees are desperately needed.

"What surfaced from our research is the importance of a tikanga standpoint on this very complex conversation – signalling a shift from 'social licence to operate' to rangatiratanga," says Symon.

The team is currently undertaking a survey of Māori beekeepers to understand their views on new tools, like dsRNA, to control *Varroa* mites.

A honey bee with parasitic *Varroa* mites. This bee is also suffering the effects of the "Deformed wing virus" which is spread by varroa. This heavily infected bee will never be able to fly. Image thanks to Phil Lester

Novel Tools & Strategies - Supporting Predator Free 2050

Co-leads
Chris Jones Manaaki Whenua - Landcare Research. **Nikki Harcourt** Waikato-Tainui; Manaaki Whenua - Landcare Research.

There are so many different pest control options available, and under development, it can be hard to choose the best approach for any given project.

That's why the Novel Tools and Strategies – Supporting Predator Free 2050 research team is creating an online tool that will allow project managers to estimate what is achievable with the resources they have, or what it will likely cost to achieve their eradication goals.

By combining existing predator management models, cost data, and social and cultural preference data the team will support projects to develop relative cost-effectiveness rankings for different eradication options.

Case Study

A new tool to deliver better on-the-ground results for Predator Free 2050

In the quest to make Aotearoa free of possums, rats and mustelids by 2050, there is a huge range of traps, bait stations and other tools available at an equally huge range of price points. So how can community groups and trappers get the best bang for their buck?

"It sounds very exciting, doesn't it? 'Cost-effectiveness of predator eradication'," deadpans Chris Jones, programme co-lead. "But in dealing with a lot of predator-free projects, it's come up as an issue, and hopefully we can support projects to do things a little bit better going forward."

Since the Predator Free 2050 aspiration was announced in 2016, it has attracted around $300 million in funding.

"There's been an understandable element of 'invest first, then see what happens'," says Chris, "But there are probably very few other areas of industry that would invest $300 million without assessing what the likely return on investment would be.

"How can we better support projects to do that, so they have some confidence that the money they invest, or their funders invest, will achieve what they're hoping to achieve?"

Chris, Nikki Harcourt (co-lead) and the team are developing software that will allow users to estimate the cost and likely outcomes of their efforts on the ground, enabling them to plan for their goals and budget.

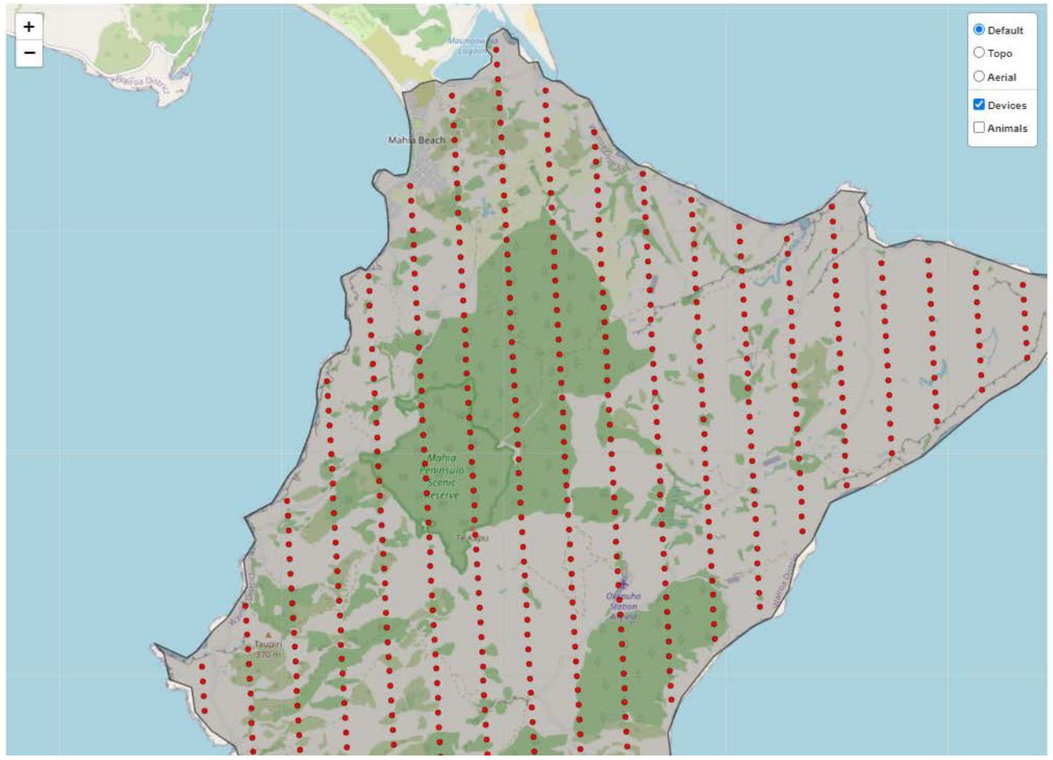
Existing software already allows estimation of the impact resulting from a particular trapping regime – based on spacing and type of traps, duration of project, and how often the traps are checked, among other parameters.

"But now we can also ask: how much will that cost?" says Chris. The software will empower users to figure out what they can achieve with their available funding, or how much cash they need to realise their pest-free dreams.

The team have successfully built the cost add-on for the software, and are now turning their attention to socio-cultural considerations – for example, some pest control options, like toxins, may not be socially or culturally acceptable in some areas. "It's really important to acknowledge that people make decisions based on more than just economics," says Chris.

The final bit of the project will be to take the software and turn it into a user-friendly and accessible web app that any community group or trapping operation could use. "We're going to work with communities to keep it real," says Chris.

Trapping network on Mahia Peninsula.
Image thanks to Chris Jones



Risk Assessment & Ecosystem Impacts

Co-leads
Luitgard Schwendenmann University of Auckland. **Simon Wegner** Scion. **Māori Advisor: Nick Waipara** Rongowhakaata, Ngāti Ruapani; Plant and Food Research.

We need to understand kauri dieback and myrtle rust better if we want to protect our ngahere.

That's why the goal of the Risk Assessment & Ecosystem Impacts team is to identify the effects of these diseases and management, as well as which species and ecosystems are most at risk. More detailed information will allow us to better prioritise conservation efforts and management decisions.

If we get really good data now, we will be better informed in 10, 50 and 100 years' time about the changes in the forest ecosystems.

Case Study

Tracing food webs fed by kauri

When ecosystem ecologist Andrew Barnes visits an ancient kauri forest, he feels incredible. "It's one of the nicest places in the world to be," he says.

Beneath his feet, there is an entire world of microbes and tiny animals like nematodes, spiders and centipedes inhabiting the soil. This interconnected community is ultimately fuelled by the kauri giants above ground, whose fallen leaves decompose and enrich the soil with nutrients.

Andrew is one of a team of scientists based at the University of Waikato, working alongside Te Kawerau ā Maki in Te Wao Nui a Tiriwa (the Waitākere Ranges). They are untangling this food web and figuring out how it might be affected if the kauri above is suffering from dieback.

"We're interested in knowing if the community of animals that lives in the soil beneath kauri trees is different from non-kauri trees," explains Marijke Struijk, another researcher on the team. "And then we're also interested in finding out how that might be affected by kauri dieback."

"What happens if we lose kauri from that system? Well, we know that kauri are connected to all of these different species," says Andrew. "They have a really strong role to play in structuring the way that the soil looks, the soil chemistry, the structure of the soil, and so of course they're very strongly interconnected with all of the organisms that live in this very specific and unique kauri soil."

"When a tree is slowly dying, the amount of litter and the quality of litter falling from a tree might change and so that might have a whole cascade of effects on the food web," says Marijke.

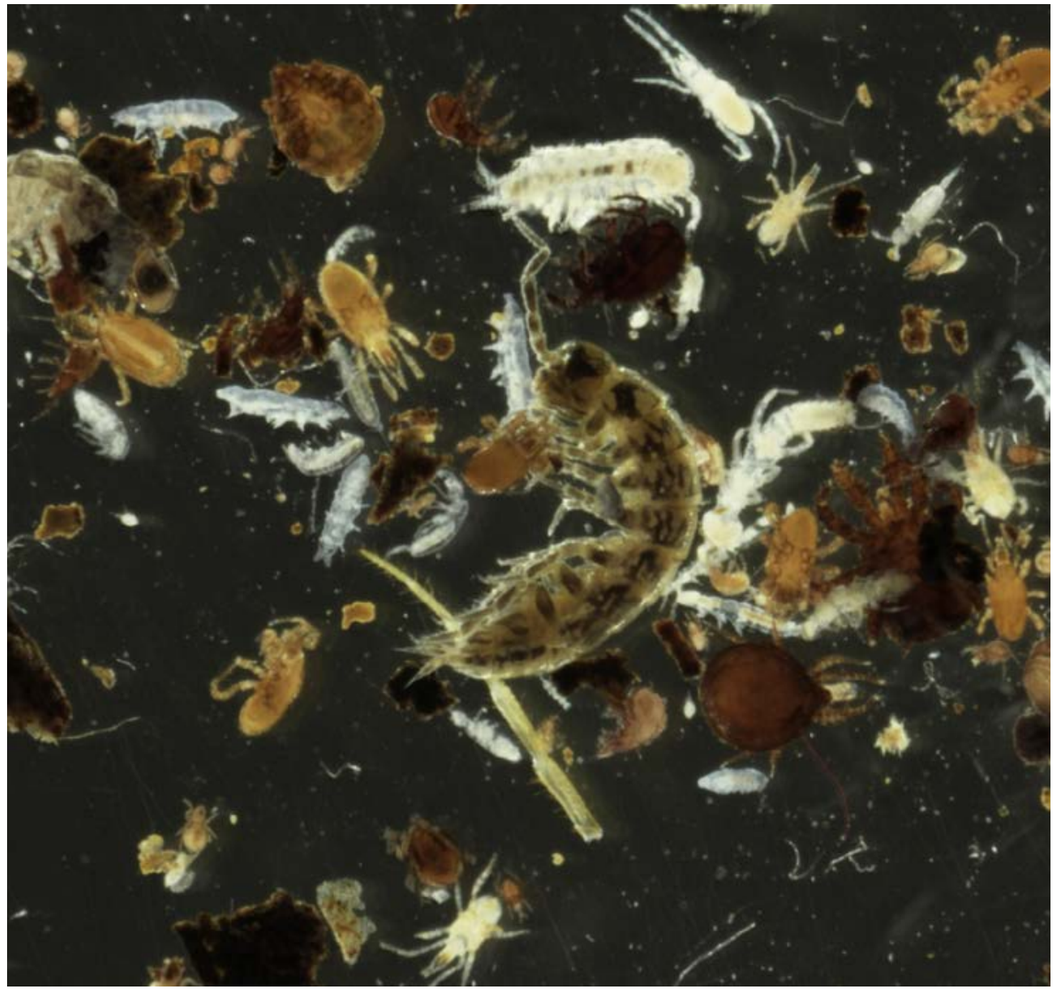
To identify who is living beneath kauri, the team collects soil cores and uses a heat extractor to coax out the organisms. The sample is slowly heated from the top, while the bottom is cool, encouraging the moisture-loving soil organisms to move downwards to avoid the drying soil. Eventually, the organisms fall out the bottom of the soil sample and are collected in vials. They can then be identified – often with the aid of a microscope, because they are so tiny.

Most of the samples so far have been collected from the Te Wao Nui a Tiriwa, and the team are developing a basic understanding of the soil food web there. But tracing changes will be a longer-term process.

"It's hard to know how much information we really need to develop a baseline picture. I feel like this is really just the beginning. To get good baseline data it does need to be more of a long-term monitoring process," says Andrew.

Ultimately, understanding the wider effects of kauri dieback on the entire ngahere ecosystem will help us make decisions to safeguard its future.

The inhabitants of kauri soil.
Image thanks to Poppy Romera and Marijke Struijk.



NEW ZEALAND'S BIOLOGICAL HERITAGE **NATIONAL SCIENCE CHALLENGE | 2022 HIGHLIGHTS**

Integrated Surveillance

Co-leads
Cecilia Arienti-Latham Manaaki Whenua - Landcare Research. **Waitangi Wood** Ngatirua, Ngāti Awa, Ngāti Kahu, Ngāpuhi Nui Tonu; Independent.

The Integrated Surveillance team is striving to improve biosecurity surveillance systems and approaches in Aotearoa. Guided by Te Tiriti o Waitangi, the team is working with biosecurity stakeholders to consider cultural licence, intelligence and data sovereignty. By doing this they can collaboratively develop tools and approaches to improve our surveillance systems.

Their environment-centric surveillance framework focusses on ensuring that the state and health of taonga and ngahere are integrated into any surveillance response. The team are using *Phytophthora agathidicida* (that causes kauri dieback) and *Austropuccinia psidii* (that causes myrtle rust) as case studies to test the framework and model 'proof of disease freedom'.

This research provides the foundation for culturally appropriate approaches for collection and storage of up-to-date and accurate data regarding the extent of the two pathogens, and the state of biological heritage affected.

Case Study

Data sovereignty key to empowering mana whenua in fight against myrtle rust and kauri dieback

As some of Aotearoa New Zealand's most iconic and beloved plant species have fallen victim to infections, mana whenua are seeking information to help them protect their taonga.

A. psidii threatens trees in the myrtle family – such as ramarama and mānuka – while *P. agathidicida* kills kauri trees. Surveillance is a really important tool to track and anticipate the impacts of these pathogens across the motu, but reams of surveillance data generated by crown agencies and researchers are often inaccessible to mana whenua, who urgently need to know if these diseases are present in their Biodiversity Management Areas (previously described boundaries revived by this research programme).

"Mana whenua and kaitiaki always felt disconnected from the decisions that were made about their land," says data analyst Audrey Lustig, "and they didn't have access to the data or the information that they needed to do surveillance on the ground and manage their land.

"The idea here was really to create a platform that enables better sharing of data and information for everyone – for crown research institutes, for agencies, for mana whenua."

Enter the Mātauranga Māori Surveillance Framework.

"The Mātauranga Māori Framework looks at how we could equitably elevate mātauranga Māori into the science system and mana whenua into the research and science space," says project co-lead Waitangi Wood.

"We're focussing on data sovereignty and cultural sovereignty, and understanding how we can ensure that mana whenua are able to access their own information and data, or information and data about their taonga, or research that's occurring within their respective areas," Waitangi says.

"Data sovereignty is important for our communities because it allows us to participate, to engage, to influence," she adds.

A key part of recognising and giving effect to data sovereignty involves tracing the data's whakapapa back to the whenua or part of te taiao from which it originated, which then connects it to the mana whenua of that particular area.

To achieve this, the team is developing an integrated intelligence platform. This is a digital tool that safeguards information's whakapapa and makes the distinction between the person, organisation or entity that collects, uses, stores or repurposes data, and the sovereign authority of that data.

"It's a new way of doing research and a new way of working together," says Audrey, "and it's rewarding to be part of that."

"The idea here was really to create a platform that enables better sharing of data and information for everyone – for crown research institutes, for agencies, for mana whenua."

Control, Protect, Cure

Co-leads
Dave Milner Ngāti Wai, Ngāti Whatua, Ngāpuhi, Ngāti Porou; Perception Planning Limited. **Marion Wood** Plant and Food Research.

The myrtle rust and kauri dieback spaces desperately need a suite of fully integrated management techniques and tools to save our ngahere.

The Control, Protect, Cure team have been using an extensive outreach process to develop and socialise new technologies, assess important values and concerns, and ensure research, operations and case studies are integrated effectively.

Their diverse team has been brought together to develop and explore strategies and tools that can be used in the fight against these devastating organisms.

Case Study

Connecting high-tech detection tools with on-the-ground aspirations

It's easy to see when a kauri is sick: bleeding gum, yellowing leaves, dead branches and a thinning canopy. But detecting the dieback pathogen – which lives in the soil – *before* it reaches the tree is tricky and time consuming.

David Williams, a chemistry professor at the University of Auckland, is part of a team aiming to make detection of the dieback soil "beasties" easier, by designing high-tech sensors.

David sums up his research as "providing new ways of seeing things you can't see with your eyes". To do this, he has designed a device called a 'microfluidic cytometer'. Essentially, the microscopic pathogens travel down a channel narrower than a human hair, and are detected when they pass by two electrodes, disrupting the electric current.

These devices could be deployed into the soil directly, allowing detection of the kauri dieback pathogen before it infects the tree and makes it sick.

The team have successfully shown that the device can detect teeny polystyrene balls, and have also figured out that they can 'attract' the dieback pathogen in the soil with carrot juice. Now, the challenge is to get the device operational in the field, automatically sensing the presence of the kauri dieback pathogen.

Meanwhile, Kiri Reihana (Ngāpuhi, Te Rarawa, Tūhoe, Whakatōhea) is helping iwi and hapū put mātauranga Māori into practice with 'mātauranga monitoring' – also known as cultural monitoring – a tangata-centric project complementary to the development of a high-tech sensor.

She "extracts the values, worldviews and dialects" of an iwi or hapū, using them to develop metrics that can measure both tangible and intangible concepts – things like whanaungatanga, mauri and manaakitanga. The metrics are then tested in the field with kaimahi, and revised in an iterative process.

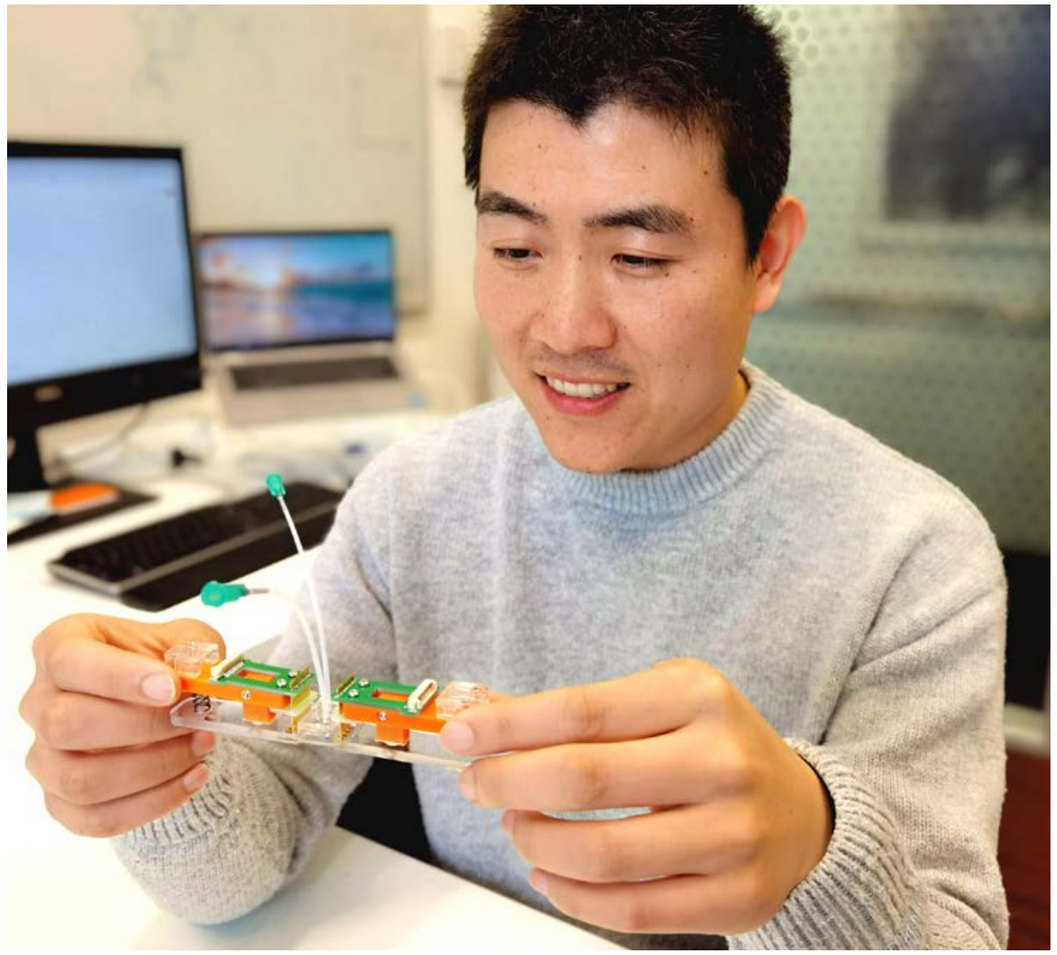
"What I've observed from doing this kind of monitoring, is that iwi want their own data so they can present it in their own way and to contribute to decision making around their own resources," says Kiri. "It's framing and understanding the environment from their own perspective, and capturing information from their own perspective, and then being able to communicate that back out."

"Mātauranga is not supposed to be kept and held," she says. "It's supposed to be shared, so it has that ebb and flow like a river, so it moves through the generations and it picks up the nutrients along the way and deposits it at another place.

"That connection to whenua I think is just so important for so many reasons: mentally, physically, spiritually. We are much happier beings when we're connected to the whenua."

"Mātauranga is not supposed to be kept and held," she says. "It's supposed to be shared, so it has that ebb and flow like a river, so it moves through the generations and it picks up the nutrients along the way and deposits it at another place."

Research Fellow Peikai Zhang (University of Auckland) holding the microfluidic cytometer.



NEW ZEALAND'S BIOLOGICAL HERITAGE **NATIONAL SCIENCE CHALLENGE | 2022 HIGHLIGHTS**

Whakahou – Restore

Creating a resilient, thriving environment

He whenua haumako,
aumānga hoki a Aotearoa

Pathways to Ecosystem Regeneration

Co-leads
Joanne Clapcott Ngāti Porou; Cawthron Institute. **Danielle Shanahan** Zealandia, Te Herenga Waka - Victoria University of Wellington.

The Pathways to Ecosystem Regeneration team aims to build social and ecological resilience by understanding and restoring connections between people and nature. They are working with communities to develop tools and approaches that reflect their unique needs and contexts, and ultimately support their efforts to scale-up for impact.

Caleb Royal, the Farming with Native Biodiversity mātauranga Māori advisor and ecologist talking with a farmer during a farm visit to do an ecological assessment of the farm and interview for the project. Image thanks to NZ Landcare Trust.

Case Study

Empowering farmers for biodiversity ‘win-wins’

Sheep, beef and dairy farms aren’t just paddocks – these landscapes contain around one-quarter of Aotearoa New Zealand’s native vegetation. This makes pastoral farms and farmers key players in a future with flourishing native ecosystems.

But getting advice on farm environment planning – from planting to pest control – can be costly, confusing and time consuming. An innovative pilot project, ‘Farming with Native Biodiversity’, is aiming to change this by improving access to expert advice and empowering farmers, ecologists and advisors to deliver wins for both biodiversity and business.

The programme will run for 20 months and facilitate a small team of ecologists to talk to farmers about their goals, what biodiversity means, and barriers they face when it comes to taking action. The team will initially consult on 40 farms – at least 15% of which must be Māori owned.

“There’s no point us writing a plan that may be scientifically sound, if it’s not practical to follow through with,” says ecologist Josh Foster. “We’re getting a dialogue going, figuring out what is most practical.”

As well as action to identify important areas and protect them – like fencing off areas with high biodiversity value – Josh says the team is keen to find ways for farmers to monitor change on their farms over time, without incurring huge costs.

“We help draw up detailed, best practice plans to tackle the projects that farmers are most enthusiastic about, and that are most likely to provide benefits to their farming system, as well as the local native ecosystems.

“Farmers already spend a lot of time thinking about ecology on their land but may not realise it. If we can help them join a couple of dots together on the finer points of biodiversity management, we expect that they will start to recognise the value of their own institutional knowledge and feel confident putting it to work with some scientific rigour around planning and monitoring in future,” says Josh.

The team plans to develop a range of resources and media to provide practical expert advice in an accessible way to thousands of farmers. But the project is about more than just handy checklists and guidelines – it’s focussed on building a community with the skills, motivation and confidence to engage in on-farm biodiversity protection, restoration and monitoring.

“So far, we’ve seen that among the people who are sometimes hesitant to take action on native restoration or biodiversity work, our plans give them confidence to go forward,” says Josh.

The project is led by the NZ Landcare Trust, with support from Silver Fern Farms, the Living Water Partnership (Fonterra and the Department of Conservation) and the Biological Heritage National Science Challenge.

Such a diverse range of partners is essential for a project such as this.

Silver Fern Farms Sustainability Manager, Matt Harcombe says it’s about much more than just funding.

“The project partners can connect directly to thousands of farmers through an existing trusted relationship,” he says.

“Building the capability and capacity in specialist advice to provide the right kind of support, scaling it, and creating real value for farmers are essential if the project is going to be successful beyond the initial funding.”

https://www.landcare.org.nz/current-project-item/farming-with-native-biodiversity

Josh Foster and Becky Clements, Farming with Native Biodiversity ecologists Image thanks to NZ Landcare Trust.

Becky Clements and Josh Foster (FwNB project ecologists) presenting at a recent Wetland Restoration workshop hosted by Tony Watson of New Zealand Landcare Trust. Image thanks to NZ Landcare Trust.

Adaptive Governance & Policy

Co-leads

Maria Bargh Te Arawa (Ngāti Kea/Ngāti Tuara), Ngāti Awa; Te Herenga Waka - Victoria University of Wellington. **Carwyn Jones** Ngāti Kahungunu; Te Wānanga o Raukawa.

The Adaptive Governance & Policy team aims to break the mould and build new systems, policies and capability that will provide much greater protection to our bioheritage. This includes embracing Treaty relationships with Māori and investigating the many opportunities for the environment that can arise when government engages in co-design of policy and co-governance of natural resources.

The team is studying what does and doesn't work in Aotearoa when it comes to redistributing authority, decision-making and responsibility.

Tuna guest star in the video Champagne Shoes.

Case Study

Film competition inspires rangatahi to imagine future visions for te taiao

Who gets to decide what happens to our biological heritage? It can be difficult for some groups, especially iwi and mana whenua, to have their knowledge and values recognised when it comes to caring for nature.

The Adaptive Governance & Policy team are aiming to disrupt this norm, by figuring out new ways to build relationships based on Te Tiriti and identifying opportunities for co-governance. As part of this, they ran a short film competition in October 2021, called 'Future Visions for Te Taiao'.

The dual aims of the competition were to engage with communities and raise awareness about the idea of Te Tiriti-based governance. Through visual and multimedia storytelling, the team encouraged communities to contribute their ideas and aspirations by envisioning a future of te taiao, and in particular its management and protection.

The competition received ten entries across four categories: rangatahi (up to 11 years old); taiohi (12-18 years), pakeke (open age category); and a category for Ngāti Kea and Ngāti Tuara hapū members.

Each entry brought something unique and different to the competition – dance, drama, comedy, te reo, music, community aspirations and animation. Prizes included best entry in each category, best example of mātauranga Māori, best te reo entry, most creative film, and most novel representation of governance.

"Future Visions for Te Taiao allowed me to think deeply and creatively about the future I hope to see in Aotearoa," says participant Ruby Hansen, who was in the team 'Champagne Shoes' and won 'Most creative film' for the film 'Whakarongo ki te Tuna'.

"It was the ideal project to work on during lockdown in Tāmaki Makaurau, because even though were stuck indoors, spring offered a peaceful time to consider the importance of te taiao, the whenua we stand on, and the mauri within each tree, person, rock.

"By creating a short film, my pou was put to test; the principles I have around taking care of te taiao and decolonisation was manifested into a piece of art – thought became action. It was a powerful and inspiring prompt to create! For this I am so grateful," says Ruby.

The Adaptive Governance & Policy team are now analysing the films to learn what they can teach us about environmental relationships and management.

"It was joyful and heartbreaking to hear from the rangatahi especially, who generously shared their own worldviews, hopes, laughter, and vulnerability for our kaupapa," says facilitator Kahu Kutia.

The films are available to watch on the BioHeritage YouTube channel.

Ruby Hansen in the video Champagne Shoes.

Tuna guest star in the video Champagne Shoes.

Host, Pathogen & Environment

Co-leads
Juliane Chetham Patuharakeke, Ngātiwai, Ngāpuhi; Chetham Consulting Ltd, **Nari Williams** Plant and Food Research

The Host, Pathogen & Environment team is focussing on the 'disease triangle': host susceptibility, the pathogen and the right environment for disease expression.

The team is investigating the role environmental factors play on kauri dieback and myrtle rust disease expression and severity, as well as researching the pathogen genomes. The knowledge they gain will contribute to improving surveillance, control, management and conservation efforts, and they hope to discover new ways to mediate these diseases.

Case Study

Kauri epidemiology research connects hapū to ngahere

Speaking from a hapū perspective, Juliane Chetham sees kauri as a central part of the Patuharakeke identity.

"One of the things I've been saying since being involved in the kauri kaupapa with this disease, is that really it's a threat to our identity," she explains. "When we say our pepeha, when we talk about these significant places... how can you have Pukekauri when it doesn't have kauri on it? It's a real risk to our narrative, our kōrero... all those things that we pass on to our tamariki and mokopuna."

The Pukekauri forest is one of the long-term monitoring sites where researchers and mana whenua are collaborating to track the spread of kauri dieback through the soil and across the landscape. This monitoring will help figure out how the pathogen is transported through the forest, and how long it takes for a tree to become infected and display symptoms – just like we tracked and traced the spread of Covid-19.

"The land is regenerating kauri forest, there's thousands and thousands of kauri up there, it's pretty healthy bush," says Juliane. But a detection of the kauri dieback pathogen in 2019 – which has not been replicated since – puts the dieback-free status of this ngahere in question.

"We really, really want to know one way or another because that will affect how we manage and make decisions going forward up there with all of our kaitiaki practices," says Juliane.

Researchers are training Patuharakeke kaitiaki so they can sample trees across the forest, to build up a landscape-scale picture of the ngahere health. They're also mapping out other environmental variables – such as the locations of track and traplines, topography and moisture – to see what conditions are more likely to promote kauri dieback infection.

"It's a whole-of-ngahere approach that coalesces really well with our Te Ao Māori thinking (and sits alongside our own mātauranga)," says Juliane. "We don't just want to look at what the pathogen is doing or unhealthy trees, we want to look at what makes the ngahere healthy or unhealthy, and how is the pathogen moving through our ngahere – or not."

The field sampling is empowering mana whenua to be at the forefront of research in their own rohe.

"This kauri epidemiology research really feeds into this whole interconnected kaupapa, and how do we reconnect with this place? We're trying to collect all that traditional kōrero as part of this. It all ties into the expression of kaitiakitanga, what we're trying to revitalise and achieve up there," says Juliane.

The Patuharakeke Taiao Unit surveying the ngahere.
Image thanks to Host, Pathogen & Environment.

NEW ZEALAND'S BIOLOGICAL HERITAGE **NATIONAL SCIENCE CHALLENGE | 2022 HIGHLIGHTS**

Conservation & Restoration

Co-leads
Peter Bellingham Manaaki Whenua – Landcare Research. **Alby Marsh** Ngāti Ranginui, Ngai Te Rangi, Ngā Puhi, Ngāti Hine, Te Rarawa; Plant and Food Research.

It's a huge challenge to conserve and restore kauri and native plants vulnerable to myrtle rust for future generations. It requires Te Ao Māori world view and appropriate governance arrangements over the whenua – not just where adult plants grow but also where they can potentially regenerate.

Working from a pathogen host and ecosystem point of view, this research team incorporates conservation biology principles to make sure susceptible plant species survive myrtle rust and kauri dieback in Aotearoa.

Case Study

DNA fingerprinting to pinpoint unique kauri populations

The Kaimai kauri forest in the Bay of Plenty is the southernmost kauri ngahere – and perhaps the healthiest kauri forest in the country, being relatively untouched by kauri dieback.

Behind the thick trunks and towering canopies, this population of kauri may be genetically distinct, too.

"We have very limited knowledge of the natural genetic diversity of kauri across the landscape – so from the far north to the south, how does it vary naturally?" says Peter Heenan, a researcher at Manaaki Whenua. "We need to understand the genetic diversity of kauri so we can manage it in response to kauri dieback."

Peter is identifying unique DNA fingerprints that can identify distinct populations of kauri – similar to how forensic scientists on CSI identify people using unique DNA markers.

"We want to know if there are populations that have unique DNA fingerprinting that occurs nowhere else, because they would be quite important to conserve," he explains.

In general, populations of organisms with more genetic diversity are less prone to being wiped out by disease. So if there are any kauri out there displaying less susceptibility to dieback, understanding whether there is a genetic basis for that will be really important.

"I guess that's the spark – there's always more stuff to learn about what these plants are, what their whakapapa is... and understanding how they fit into the environment, and these days that's also the cultural environment, the human impact."

Riki Nelson (Ngāti Te Wai) sees the two-way human-kauri impact daily, through his mahi with rangatahi. "Our youth need to have hope and we believe in taking people back to our roots... We know for a fact that when we take our people into the bush, there's a certain wairua in there that heals them," he says.

Riki is the operations manager for Kaimai Kauri, a hapū-led kauri advocacy company based in Katikati, caring for the Kaimai kauri forests that may be genetically unique.

Riki would like to see more ideas shared between iwi and hapū from different regions in order to save kauri. "The thing with government agencies is that they need to be supporting this kaupapa, they need to be helping to enable us so that we all are working together, kotahitanga, across all kaurilands," he says.

Kaimai Kauri's mahi on the ground. Images thanks to Kaimai Kauri.

Riki, Trinity, Danielle and Marino

NEW ZEALAND'S BIOLOGICAL HERITAGE **NATIONAL SCIENCE CHALLENGE | 2022 HIGHLIGHTS**

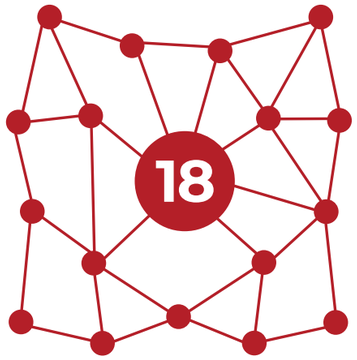
Impact

The big picture

Total funding:
72.4m

(BioHeritage NSC $37.9M + Ngā Rākau Taketake $34.5M)

Number of Challenge Parties:



Percentage of (total) researchers who identify as Māori:

26%

Number of organisations and independent researchers contracted:

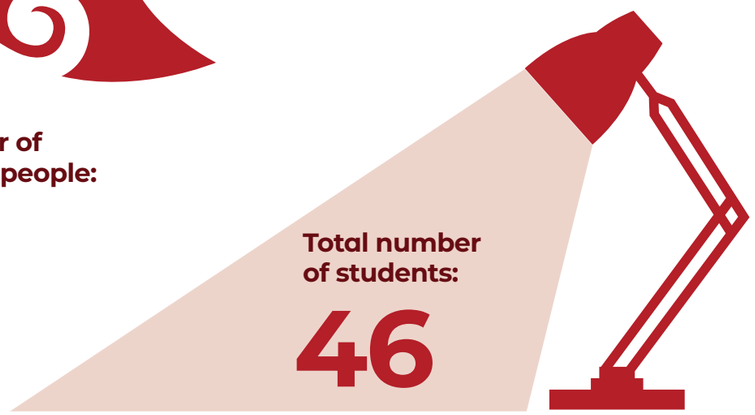
>75

Total number of Early Career people:

62

Total number of students:

46



Reaching out

2021 – 2022

Publications and reports:

103

Social media followers:

6,219

Website visitors:

>28,000

Connections with Māori communities and community groups:

102

Conference presentations:

>75

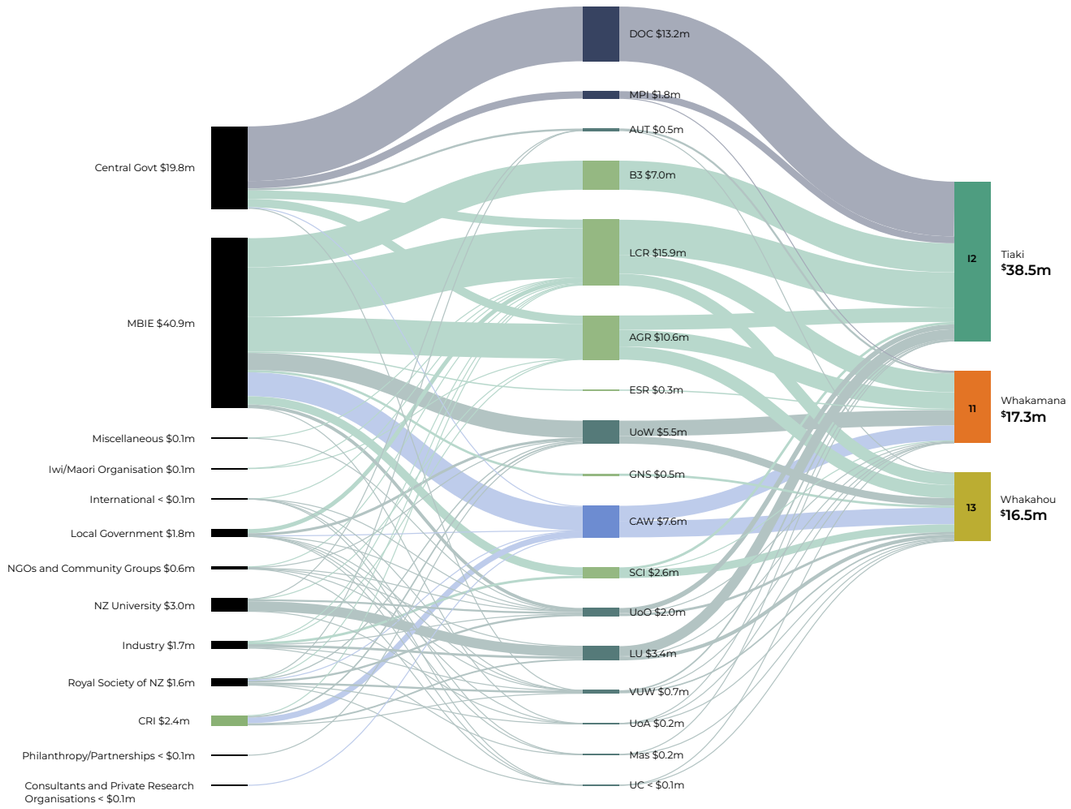
Social media posts reached

~379,000

people

Aligned research funding July 2021 – June 2022

Each year millions of dollars of funding goes into research aligned with BioHeritage impacts – Whakamana, Tiaki, Whakahou. Below you can see the source of funding on the left, the research provider in the middle and the impact to which it aligns on the right.



MBIE: Ministry for Business, Innovation and Employment
CRI: Crown Research Institute
B3: Better Border Biosecurity
PFR: Plant & Food Research
LCR: Manaaki Whenua – Landcare Research
AGR: AgResearch

GNS: GNS Science
SCI: Scion
DOC: Department of Conservation
MPI: Ministry for Primary Industries
CAW: Cawthron Institute
UoO: University of Otago
UoW: University of Waikato

AUT: Auckland University of Technology
VUW: Te Herenga Waka – Victoria University of Wellington
Mas: Massey University
UoA: University of Auckland
LU: Lincoln University
UC: University of Canterbury

Manaaki Whenua
Landcare Research

About our host

Our Challenge host, Manaaki Whenua – Landcare Research, is the Crown Research Institute for Aotearoa New Zealand's land environment.

Its 450 staff conduct and support research focused on four areas of research impact: restoring biodiversity and beating invasive species; enhancing soils, water and land; action on climate change; and building social, cultural and economic research capability to understand people's decision making in matters of the natural environment.

To achieve positive impact, Manaaki Whenua works alongside Māori iwi as the Tiriti partner, central and local government, business and industries, the primary sector, community groups, and the global research sector.

Manaaki Whenua plays a number of important roles for the BioHeritage Challenge, including providing legal, accounting, human resources, IT, editing, communications and graphics support.

All $9.2 million of Manaaki Whenua's Platform 1 Strategic Science Investment Fund (SSIF) land-based ecosystem research is aligned with the BioHeritage Challenge. Manaaki Whenua also aligns research from other funding sources with the BioHeritage Challenge, and undertakes research commissioned by the BioHeritage Challenge.

c/- Manaaki Whenua - Landcare Research New Zealand Limited

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