Te Pūnaha Matatini

Data ▪ Knowledge ▪ Insight

Annual Report 2020–21

A Centre of Research Excellence hosted by the University of Auckland

Cover: Aerial shot of New Zealand forest. Credit: Sean Yeh.

Contents

This report covers the 18-month period from 1 January 2020 to 30 June 2021.

About us

Our story

We live in a data-rich but knowledge-poor world

Te Pūnaha Matatini – 'the meeting place of many faces' – is a New Zealand Centre of Research Excellence developing methods and approaches for transforming complex data about the environment, economy, and society into knowledge, tools, and insights for making better decisions.

As 'a meeting place for many faces', we are committed to equity, diversity, and inclusion, focussed on transdisciplinary research, and connected to colleagues across research, government, industry, and communities.

We're working together to enable New Zealanders to grow up and thrive in an increasingly complex and interconnected world

Te Pūnaha Matatini brings together the expertise of New Zealand's leading researchers in social sciences, economics, biology, mathematics, computer science, operations management, statistics, engineering science, and physics.

Our transdisciplinary approach advances knowledge of complex systems and networks, and their applications, for the social, economic, and environmental benefit of New Zealand.

Our partners

We're bringing together leading researchers from across New Zealand's research institutions

2012 — Shaun Hendy and Dion O'Neale discuss how a complex systems research team with a broad set of collaborators could make an impact

Early 2013 — Shaun Hendy encouraged to submit a proposal for a Centre of Research Excellence (CoRE)

Mid 2013 — Kate Hannah comes on board as bid manager

October 2013 — Investigators from around the country come together for the first time

Early 2014 — Bid team interviewed by Royal Society of New Zealand selection panel

February 2015 — Official launch of Te Pūnaha Matatini with 24 Principal Investigators

November 2015 — First Te Pūnaha Matatini Summer internship programme commences

2016 — Te Pūnaha Matatini spearheads equity, access and inclusion initiatives, code of conduct policy

August 2017 — Te Pūnaha Matatini achieves gender balance, 48% of investigators female

September 2018 — First Te Pūnaha Matatini-funded PhD student graduates

May 2019 — Establishment of Deputy Director for Equity & Diversity role

March 2020 — Te Pūnaha Matatini focuses efforts on Covid-19 response

October 2020 — Te Pūnaha Matatini successful with rebid application, funded until end of 2028

April 2021 — Te Pūnaha Matatini receives the Prime Minister's Science Prize

June 2021 — Shaun Hendy steps down as Director

- 25 Principal Investigators
- 50 Associate Investigators
- Executive Management Team of 15
- Over 150 students aligned with Te Pūnaha Matatini Whānau
- 68 students directly funded by or working on Te Pūnaha Matatini projects

Board Chair's report

Much has been said about the 'team of five million' over the period of this annual report but I would like to focus on the 'team at Te Pūnaha Matatini'.

The success and reputation that Te Pūnaha Matatini has achieved is a result of a united team effort led by our director Shaun Hendy. While some members of Te Pūnaha Matatini have been endlessly interviewed by the media, including a large number of TV and radio interviews, often at short notice, it requires the balance of Te Pūnaha Matatini's team to respond to the workload pressures that are caused as a result of Covid-19. In the words of Shaun at our June Advisory Board meeting, "I feel that workloads are manageable again for the first time since March 2020!" The Advisory Board is well aware of all the extra effort done this year, so on behalf of the Board a big thank you to the team for responding to the challenges that this extraordinary year has brought and for creating a step change in Te Pūnaha Matatini's reputation.

Since 2015 Te Pūnaha Matatini has been steadily building on its culture and its success. For example, our annual KPI for end user funding was $250k, which equates to $1.5m over the period 2015-2020. However, over this period Te Pūnaha Matatini brought in just under $6m, which represents circa 30% of the total revenue. A second KPI was that over 2015-2020 our research would lead to at least $100m worth of savings, enhanced productivity, environmental or social benefit or new business in total to New Zealand. In November 2020 the combination of Te Pūnaha Matatini Covid-19 modelling and the whole genome sequencing programme of ESR helped avoid a three-day lockdown in response to the Defence Force cluster saving the country circa $150m.

This story of success has been reflected in the award of the 2020 Prime Minister's Science prize to Te Pūnaha Matatini. An excerpt from the citation reads:

"Te Pūnaha Matatini has been uniquely positioned and have the relevant expertise to have aided the Covid-19 pandemic in a significant way for Aotearoa. Throughout the pandemic, they developed a series of new mathematical models and ran a multitude of different scenarios to inform the unique situation that New Zealand found itself in, analysing the data generated to directly inform the New Zealand Government's response to Covid-19. The results of this work were translated for Government policymakers and front-line operators, and helped inform the Government's response to the Covid-19 pandemic. Te Pūnaha Matatini's modelling was key in helping government make good decisions about lockdowns, particularly in April and May when the need to relax Alert Levels arrived, and in August, when a tailored lockdown was used in Auckland to eliminate a large outbreak."

It is very pleasing to note that there have been many individual awards made to Te Pūnaha Matatini members and unfortunately space does not permit everyone to be mentioned. However, I would like to mention three achievements in particular. Firstly, the successful rebid effort led by co-Directors Cilla Wehi and Murray Cox with support from Kate Hannah, Kathryn Morgan and many others. A successful rebid was a major objective for this year for obviously without success Te Pūnaha Matatini's journey would be over. Since then, unfortunately, Murray Cox advised he would be resigning from the co-directorship and, with regret, we wished him well in his future endeavours. In March 2021 the Advisory Board recommended to the University of Auckland that Cilla be appointed the Director of Te Pūnaha Matatini effective 1 July 2021, with Mike O'Sullivan appointed Deputy Director for an initial period of 18 months. This recommendation was accepted and formalised by the University of Auckland as the host university of Te Pūnaha Matatini.

Secondly it is appropriate that I acknowledge Siouxsie Wiles' incredible achievement in being named as the 2021 New Zealander of the year. I have included a small part of her citation: "…and in 2019 she was appointed a member of the New Zealand Order of Merit for services to microbiology and science communication. During Covid-19, Siouxsie joined forces with Spinoff cartoonist Toby Morris to make the science of the pandemic clear and understandable. The pair released their work under a Creative Commons licence, meaning their graphics have been seen by millions and even used by governments and organisations as part of their official pandemic communications."

Congratulations Siouxsie, from us all. Finally, Shaun Hendy himself. Shaun was the founder of Te Pūnaha Matatini, and has spent the last six and a half years leading it. He stepped down as Director on 30 June 2021. As Director he championed and built the culture of Te Pūnaha Matatini, its commitment to equity, diversity, partnership, engagement and all the things that make up Te Pūnaha Matatini's culture today. Thank you, Shaun. It would be remiss of me not to acknowledge your appointment as a Member of the New Zealand Order of Merit in the 2021 New Year's Honours List. A fitting acknowledgement of your achievements.

In closing I would like to thank all the Advisory Board members for their commitment and advice over this year and look forward to working with you on chapter two of Te Pūnaha Matatini's journey.

Richard Aitken
Chair, Te Pūnaha Matatini Advisory Board

Director's report

This is my last annual report for Te Pūnaha Matatini as Director. While I am looking forward to other challenges, the six and a half years that I've had the privilege of leading this centre will be the highlight of my career.

Over the course of 2013, a core team that included Kate Hannah, Adam Jaffe, Dion O'Neale, Alex James, and many others helped shape the original Te Pūnaha Matatini proposal, as did a close working relationship with Daniel Patrick and Dan Hikuroa at Ngā Pae o te Māramatanga. I was very grateful that the University of Auckland was willing to support this vision early on, although the way that Te Pūnaha Matatini operates has not always been an easy fit with the University's approach to CoREs.

We were elated to learn that we had been shortlisted in early 2014, and then, later that May, to find out that we had been selected for funding. Nonetheless, we were dismayed by the initial outcome for Ngā Pae, even though it was successful in a repêchage in 2015, as well as the significant cut to our funding (~40%). Both setbacks prompted big changes in strategy for us, including increasing our focus on recruiting Māori investigators (as opposed to partnering with Ngā Pae). I note that Te Pūnaha Matatini's new leadership team faces a similar situation in 2021, with the lack of a Pacific-focused CoRE and a reduced budget. We were also forced to cut research programmes, which we did by defunding those that we thought could be supported in other ways. Ironically, one of the research projects we decided to cut was 'Epidemic Spread', that aimed to "construct a multi-scale model of infectious disease propagation at the level of the entire country, including international interactions."

This was the project that we found ourselves having to execute in a matter of weeks in March 2020. Yet the reasoning we used in 2014 still stacks up; the project was eventually funded by an external party, as we anticipated, although it took the arrival of an actual pandemic to make it happen. It remains frustrating to know that New Zealand's funding system had failed to lay the foundations for the science response to a pandemic in March 2020. Despite this, I believe strongly that the Covid-19 response has been a vindication of Te Pūnaha Matatini's approach to research. Our emphasis on diversity and inclusion, the partnerships we built with iwi and iwi organisations, our transdisciplinary engagement with government agencies, our proactive development of policy and science communication skills in our investigators, and our values-driven approach to community building were all crucial to our Covid-19 response.

It remains for me to thank the many people who have been on the journey with me for all or part of the last eight years. When I became Director of Te Pūnaha Matatini many people warned me how lonely it was going to be, but I have never, ever felt alone in this role. I can thank our investigators for this, but few will realise how important the management team of Kate Hannah, Kathryn Morgan, and previously Sarah Hikuroa, have been in making Te Pūnaha Matatini what it is today. From 2015-2020 Kate, Kathryn, and Sarah were the only people who had worked full-time at Te Pūnaha Matatini, and so much has depended on their commitment. I look forward to watching Te Pūnaha Matatini grow and develop in its second phase, under the leadership of Cilla Wehi and Mike O'Sullivan.

Professor Shaun Hendy MNZM, FRSNZ
Director, Te Pūnaha Matatini

Our vision and values

Our vision

- We work with our stakeholders from industry, government, and the public to help reshape New Zealand's economy, society, and environment
- We train a new type of scientist for the benefit of New Zealand
- We help build the kind of New Zealand of which we can all be proud
- We enhance mātauranga Māori

Our vision is to undertake research and education to advance knowledge of complex systems and networks, and their applications for the social, economic, and environmental benefit of New Zealand.

Our values

- Visibility and international excellence
- Outreach and engagement – ensuring demonstrated relevance or impact
- Collaboration for discovery-orientated research
- Diversity through development and participation

Our values are drawn from the words of our foundational whakataukī, given to us in 2013 by Associate Professor Mānuka Henare (Ngāpuhi, Te Aupouri, Te Rarawa, Ngāti Kuri), Director of the Mira Szászy Research Centre for Māori and Pacific Economic Development:

E tipu, e rea, Mo ngā ra o tau ao –

Grow up and thrive for the days destined to you.

– Sir Apirana Ngāta, 1874–1950

2020–21 highlights

Realising our vision

A biosecurity risk framework for forestry in Aotearoa New Zealand

In her role with Scion, Dr Rebecca Turner is working with stakeholders in Aotearoa New Zealand and internationally using data to predict biosecurity risk.

Dr Rebecca Turner joined Scion as a postgraduate fellow in 2018, co-funded by the Biological Heritage National Science Challenge and Te Pūnaha Matatini. In 2020 she was promoted to a full-time biosecurity scientist. Scion is a Crown research institute that specialises in research, science and technology development for the forestry, wood product, wood-derived materials, and other biomaterial sectors.

"My postdoc led directly into this role," says Rebecca. "It created the opportunity for me to get to know Scion systems, plus New Zealand researchers and international collaborators through Te Pūnaha Matatini. Crown research institutes focus on applied science for the sectors they serve, so publishing reports for industry use is important. Having the postdoc and Te Pūnaha Matatini funding helped me build academic credibility by publishing papers."

Rebecca's background is in ecology, molecular biology and mathematical modelling. She is interested in research using mathematical techniques to understand biology and other applications. Rebecca was involved with Te Pūnaha Matatini Whānau during her postdoctoral fellowship, and appreciated building her network at our Annual Hui each year. She also contributed to our Mycoplasma bovis response, working with data from the National Animal Identification and Tracing (NAIT) system that tracks cattle movement around New Zealand.

At Scion, Rebecca's initial project explored the potential of using border interception data to predict arrivals and establishments of invasive pests in New Zealand. She says that the team hopes to be able to use border interception data to warn people what invasive species to look out for in orchards and forests. The project quickly became complicated and grew to include international interception data, and Rebecca is now working with the United States Forest Service on an extension of this project looking at data about beetles, which include large groups of potential forestry pests.

"Although we're really good at biosecurity in New Zealand and we've got a really good rate of interceptions and getting them down to species level relative to our population size, we're still a small country, and we can only collect a certain amount of data. So we then started working with international stakeholders to get interception data from other countries as well."

Three years in, they are now in a place where they have all the data, have started analysing it, and are starting to see where some of that data is useful for predicting establishments.

"In New Zealand forestry the major plant species that we have is Pinus radiata, so we're looking for insects that are associated with Pinus radiata, and trying to predict which are going to establish in New Zealand, using things like interception data and climate matching.

"We're creating a biosecurity risk framework specifically for the forestry industry. I'm also collaborating with AgResearch and Plant & Food Research through Better Border Biosecurity (B3) to create frameworks for the agricultural industry and the pasture industry."

Modelling for transport policy interventions

Julie Mugford is applying the skills that she learned through her doctoral project with Te Pūnaha Matatini to a career across the public service.

As she entered the final year of her PhD in 2020, Julie Mugford spotted an advertisement for a role with the Ministry of Transport. Julie had just completed an internship with the Ministry of Social Development, to see whether she enjoyed working in the public sector. She had found it a good fit, and when she saw a job available with 'agent-based modelling' in the description, she jumped at the chance. From May 2020 to September 2021, Julie worked as a data analyst on the team that is creating an agent-based model of the Aotearoa New Zealand transport system.

"It has the whole New Zealand transport network," explains Julie. "All the roads and public transport options, cycleways and footpaths. Then it has a population of typical New Zealanders with their activities that they want to do during the day, such as going to school or to work."

"They decide what time of the day they're going to go and what mode they're going to use. The aim of the model is to be able to change policy settings – for example, road pricing – and see what affect it has on transport behaviour and assessing the social and environmental impacts of such changes."

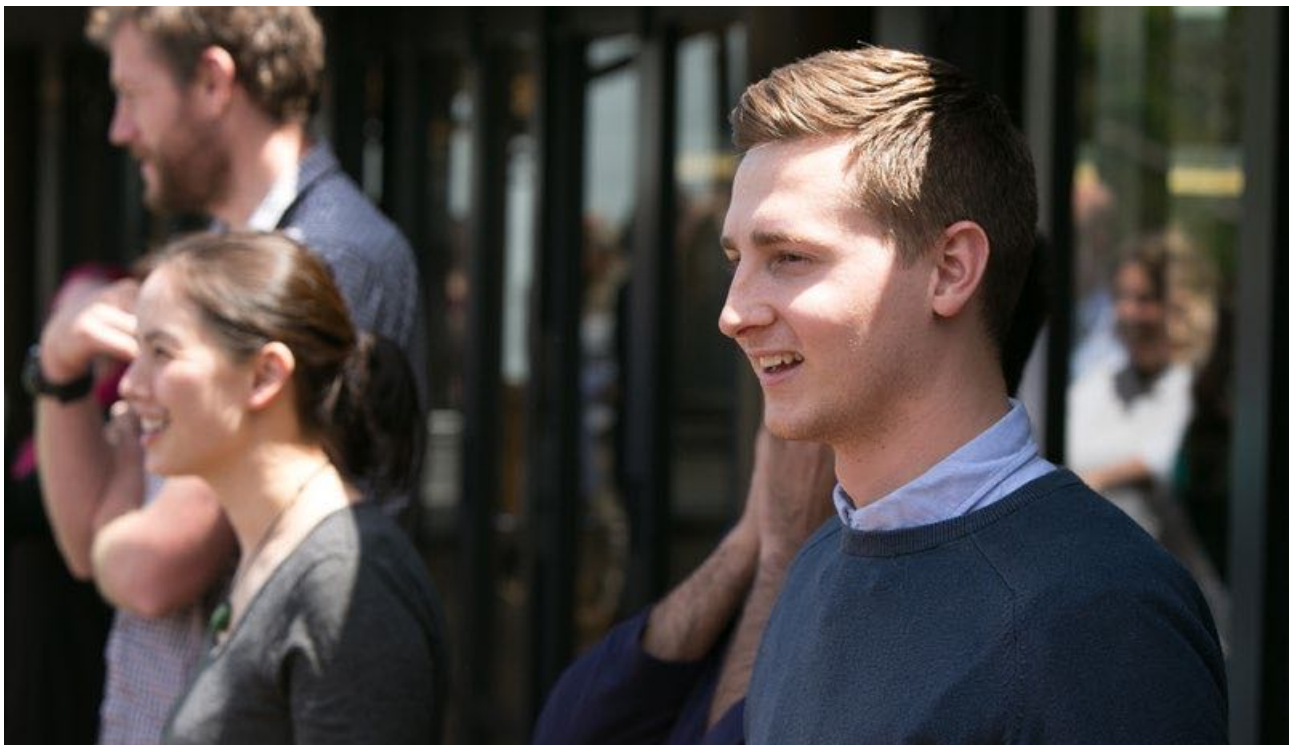
This is new territory for transport policy in Aotearoa New Zealand. Small detailed modelling tasks and larger scale aggregated modelling are already in use, but Julie is not aware of any agent-based modelling being used here. She notes that this approach has already been successfully applied in London, Melbourne, and some European countries.

Julie's PhD project in applied mathematics looked at citizen science, where members of the public help scientists gather and analyse various forms of information. The central question of her project was whether scientists could get useful insight out of noisy, biased citizen science data. She worked with her Te Pūnaha Matatini supervisors to develop methods to improve the reliability of data collected or analysed by members of the public through platforms like iNaturalist.

Being involved in Te Pūnaha Matatini and Te Pūnaha Matatini Whānau was the highlight of Julie's PhD experience.

"Te Pūnaha Matatini is full of so many amazing people,"she says. "It was a welcoming environment, and the interdisciplinary focus of Te Pūnaha Matatini added more depth to my PhD than I could have ever imagined when I signed up to a PhD at the University of Canterbury School of Mathematics and Statistics." She says that there was always a lot of variation in the speakers and activities that the Whānau organised, and serving as the chair was a great opportunity to develop leadership experience while studying.

Julie is enjoying working in the public sector and plans to explore working at different ministries over time. She recently continued this journey by accepting a role as a Senior Analyst at the Ministry of Health. "I like working in the public sector. It's really great how there are these big problems that I can work on and they actually require all the experience that I've gathered from my education."



Te Pūnaha Matatini enables transdisciplinary research into equitable science participation

Te Pūnaha Matatini was a natural home for Steven Turnbull to complete his doctoral project. In his PhD thesis, Steven sought to understand tertiary science participation in Aotearoa New Zealand.

Equity in science participation is central to Te Pūnaha Matatini's ethos, and so is Steven's distinctly transdisciplinary approach. He combined quantitative analysis of large-scale administrative student records with sociological theory and qualitative analysis of interviews to explore why students chose to engage or disengage from science education.

Using these methods, Steven explored disparities in science education and created a theoretical model showing how we can make the field of science education more equitable. He was supervised by Te Pūnaha Matatini Principal Investigators Dr Dion O'Neale and Dr Kirsten Locke.

Steven completed a Bachelor of Arts in education and psychology, before pursuing postgraduate research in education, culminating in this PhD project. He has been working with Dion since he did a summer scholarship in physics during his undergraduate study. Throughout his PhD, Steven was involved with Te Pūnaha Matatini Whānau, and is a regular participant in Te Pūnaha Matatini's Annual Hui.

"Steven's PhD is a perfect example of the sort of transdisciplinary research that Te Pūnaha Matatini has enabled," says Dion. "While Steven's thesis was a substantive academic piece of work, throughout his research there was a continuing focus on applications and outcomes that could bring about positive change in STEM education at both a systemic level and for individual students."

In his thesis Steven analysed data obtained from Aotearoa New Zealand's Integrated Data Infrastructure (IDI) about students studying STEM subjects in Aotearoa New Zealand. He used this data to identify trends in science participation through a novel method of network analysis.

This data was complemented by a survey of science students, followed by in-depth interviews to gain more insight into the human dimension to education engagement. Steven then interrogated his findings through a theoretical framework based on the sociological work of Pierre Bourdieu.

"Steven is the very first person to ever collect and analyse a decade's worth of NCEA science data through the IDI at Stats NZ," notes Kirsten.

Steven is now using the quantitative and qualitative skillsets developed in his thesis to address inequities present in existing sources of individual-level data as a postdoctoral research fellow on Te Pūnaha Matatini's Covid-19 modelling team. He says that "being in a place were you can contribute to mitigating Covid-19 risk in New Zealand is quite a powerful thing".

For Steven and the modelling team, this is values-driven work. "Te Pūnaha Matatini is constantly taking an equity-based approach, putting marginalised groups at the centre of everything we do."

Read Steven's thesis:
A Path Drawn Out: Understanding Tertiary Science Participation in Aotearoa New Zealand

Building bridges between theory and practice in science communication

In February 2020, 14 researchers converged on the Waihōanga River Lodge and Retreat for the inaugural Engagement Incubator. They ranged from PhD students to professors and were working on projects spanning freshwater science, mathematics, indigenous ecological restoration and chronic disease prevention. At this idyllic location they gathered around … a pop-up laundromat.

During the Engagement Incubator, participants worked collaboratively around cardboard washing machines designed by Jo Bailey. In this exercise for thinking about engagement, activities are framed around the cycle of washing clothes, and thoughts are collected at each step.

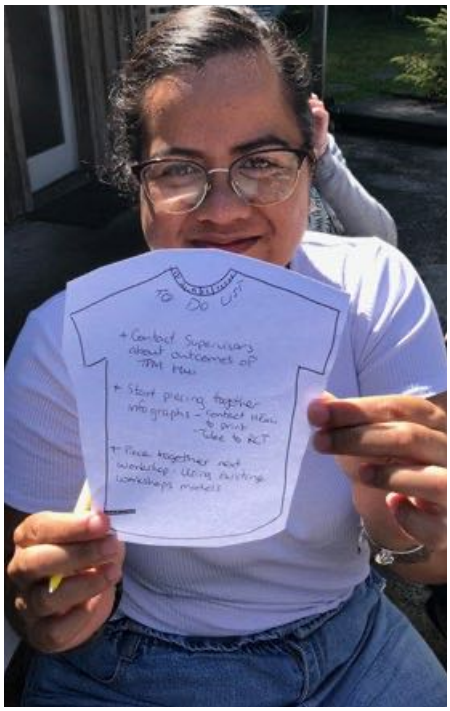
The Engagement Incubator was developed as a way for Te Pūnaha Matatini to think more deeply and strategically about our engagement activities. It is a structured opportunity to spend time together to think about our shared values and consider what it means to walk the talk in our commitment to public engagement. Engagement has always been central to the ethos of Te Pūnaha Matatini, and the Engagement Incubator is designed to embed engagement right at the start of projects.

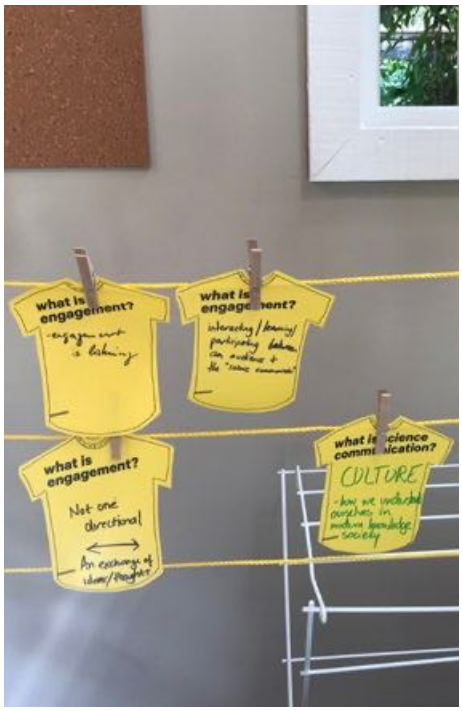
The Incubator emerged as part of the ongoing collaboration between Te Pūnaha Matatini Principal Investigator Rhian Salmon and PhD student Jo Bailey, and is a central part of the structure of the new phase of Te Pūnaha Matatini.

The first Engagement Incubator was centred around workshops, work with the Engagement Committee and Maths Craft, and a series of engagement laundromats. Rhian explains that they have learned a lot about "the power of metaphor and keeping things light and playful" as they have developed the concept of the engagement laundromat. Jo adds that "the laundromat is a private thing in a public place, which fits with the collective reflexivity that we want to generate."

After putting aside two dedicated days, participants in the inaugural Engagement Incubator were able to come away with specific engagement plans for their projects. Te Pūnaha Matatini Principal Investigator Troy Baisden appreciated the Incubator process because "I'm here not just to do complexity science, but to do complexity science that makes a difference. I really believe that we do that through getting engagement right."

"It was particularly valuable for me because at the end of the day I came out with a great list of things that were really important for designing my future activities. I knew what my priorities were and had a better understanding of what I could and couldn't accomplish, and having some confidence in those was a result of this process."





Engagement laundromat online!

Te Pūnaha Matatini Associate Investigator Dr Emma Sharp couldn't make it to the first Engagement Incubator, so Rhian and Jo brought it to her. Jo repackaged the tactile engagement laundromat experience into a pizza box, including a laundry line and a zine with the staged experiences."If you could see this in the flesh you'd see how captivating it is as a set of exercises," says Emma.

Emma used the laundromat to lay the foundation for her SoilSafe Aotearoa project. She found out a lot about what her team actually wanted to get from the project as part of this process. "We've achieved every major objective that we outlined at the beginning," says Emma. "So the process is really, really useful. I still have the chart on my wall, and the laundry line now has some new additions, including our SoilSafe t-shirts."

He took foundational physics and is now teaching the course

Dr Kannan Ridings teaches Tertiary Foundation Certificate and Tuākana students that the best work that they can do will come from collaborative efforts.

Dr Kannan Ridings (Rongowhakaata) struggled at high school – until he discovered science. "In one of the first tests that we had for science at high school I ended up getting one of the top marks in the class. It just seemed to come naturally to me, and that sparked quite a bit of interest."

"As I went through high school I became more interested in physics. I remember in one of my classes the teacher said that nothing can go faster than the speed of light, and I thought 'wow that's interesting, why is that?'"

"After high school I enrolled in the Tertiary Foundation Certificate and managed to do well enough to get accepted into a Bachelor of Science. I struggled quite a bit at first with studying, but in second and third year physics I hit my stride, and started getting quite good grades." When Kannan was taking his third year courses in physics, an inspirational lecturer started at the University of Auckland: Professor Shaun Hendy.

"Shaun was teaching a particularly interesting course about condensed matter physics, and he was one of the best lecturers I've had. I was continuously asking questions and being annoying. Shaun went on to become my PhD supervisor in computational material science. When I first met Shaun was also when Te Pūnaha Matatini was first funded. I remember having some conversations with him about using innovation as a way to improve New Zealand's economy and move away from reliance on agriculture. Those were some interesting ideas to be exposed to." As Kannan was in the final stages of his PhD, Shaun invited him to work on our Covid-19 programme. "One of the things which was great about joining that programme was that it was a team of great scientists, mathematicians and modellers," says Kannan. "Being in a team-based environment was quite different for me."

"Working on the Covid-19 programme taught me that a lot of the best science happens when you have not just an individual working on something, but when you get teams of people. The best projects and the best results come from collaboratively working together."

Kannan is now teaching the same foundational physics course that he took at the University of Auckland all those years ago. He is also a Tuākana mentor, offering academic support to Māori and Pacific students throughout their undergraduate experience. "Teaching foundational physics has been a rewarding experience. I think that some of the students find it inspiring that somebody who's done the Tertiary Foundation Certificate before is now teaching them."

Working in an interdisciplinary environment has exposed Kannan to a range of different methods, techniques, and styles of science that he is excited to apply as his career progresses. He teaches his students that acquiring a wide breadth of skills will make them very employable, and shares his insights into what can be achieved through collaboration.

"Throughout my study and time with Te Pūnaha Matatini I've seen that you learn the most when you're working as a team. An individual is not going to solve something like climate change; it's going to involve more of a collaborative effort. Being exposed to these ideas and approaches at Te Pūnaha Matatini has been one of the biggest influences in what I try to talk to my students about today."

Designing an Antarctic future by looking into our past

Dr Billy van Uitregt has been working to engage hapū and iwi in a kōrero about their history of connection to Antarctica and the Southern Ocean and their aspirations for its future.

In a series of online seminars and wānanga throughout 2020, Te Pūnaha Matatini postdoctoral researcher Dr Billy van Uitregt (Ngā Rauru, Te Ātihaunui-a-Pāpārangi, Tūhoe) engaged with Māori from all across the motu in a broad ranging conversation about Antarctic futures.

This is the first time that Māori connections to Antarctica have been approached in such a comprehensive way and on an international stage. Billy was mentored in this work by Te Pūnaha Matatini Associate Investigators Associate Professor Cilla Wehi and Associate Professor Krushil Watene. He says that it was "a bit of a baptism of fire. Cilla and Krushil are really hardcore thinkers and they really set a new standard for me in terms of the level of engagement."

The seminars covered diverse kōrero designed to prompt Māori to consider how they connect to Antarctica and how to strengthen that in the future. "Māori are really interested to engage in this mahi. There are many Māori who are experts in Antarctic kaupapa and lots of Māori students coming through ready to contribute," says Billy. The breadth of the conversation is mapped in an online report showing how Māori might want to get involved and take the conversation in their own directions.

"The starting point was to understand how Māori connect to Antarctica," says Billy. "From those narratives of connection, we can then start to understand our kaitiakitanga responsibilities." This led to conversations about how mātauranga Māori can strengthen Antarctic research programmes, how to establish effective Māori and Indigenous influence in Antarctic management, and how to build relationships with other Indigenous peoples. All of these threads culminated in considering the risks of climate change and the opportunities for Māori to contribute to mitigating them.

Aotearoa New Zealand and Antarctica were originally part of the supercontinent Gondwana. For Te Pūnaha Matatini Principal Investigator Dr Dan Hikuroa, this means that the flora, fauna and landscapes in Aotearoa New Zealand and Antarctica are related.

Several hapū and iwi have links to the Southern Ocean through narratives of voyaging by their tīpuna. Others have connections through migratory tohorā whales. The kōrero also explored connection through participation in the heroic age, research, fishing and the New Zealand Defence Force.

Explicitly Māori representations such as pouwhenua, tukutuku panels and whakairo carvings at Scott Base already encode Māori connection to Antarctica. "Reframing what Antarctic research looks like means that mātauranga Māori is now inherently included, which makes it more attractive to Māori to contribute to the kaupapa," says Billy.

Billy says that it has been a great learning experience to operate a discussion on an international level, but he is now keen to "hunker down" in his own whakapapa and "understand Ngā Rauru, Whanganui and Tūhoe ideas about connection to ground myself a bit more before jumping back into these big political conversations".

"And from there the conversation is all about the future. Antarctica is the canary in the coal mine. What can we learn from it to know how we need to adapt for the future? The beauty of that is that it really aligns with our 'ka mua, ka muri' concept, walking backwards into the future."

Read the full report:
Māori and Antarctica: Ka mua, ka muri Research Report

Collective impact: Shining the light on community

Dr Anna Matheson and Associate Professor Krushil Watene engage with the groundswell of innovative community action that is underway in Aotearoa New Zealand.

Most of our health and wellbeing is created within the places we are born, live, work, play and age. Unequal access to resources and power is the leading cause of health inequity globally. Across Aotearoa New Zealand, this is no different. Te Pūnaha Matatini Associate Investigators Dr Anna Matheson and Associate Professor Krushil Watene (Ngāti Manu, Te Hikutu, Ngāti Whātua o Orākei, Tonga) have been engaging with the communities that have been raising their voices in Aotearoa New Zealand to make positive change where they live.

Anna has a background in public health and equity and is interested in effective ways to achieve better community health and wellbeing, and Krushil specialises in moral and political philosophies of wellbeing, development and justice, with a particular focus on Indigenous philosophies. Decades of research has shown how inequality plays out in some communities. Adequately paid and safe employment is scarce; schools are under-resourced; homes are not fit to maintain health; green spaces are limited; playgrounds are neglected; plentiful retail and fast food outlets advertise and sell harmful products; and healthcare is difficult to access. Because of this, health outcomes remain unequal.

In some places, the Covid-19 pandemic revealed what more sustainable community ecosystems could look like: less traffic, more greenery, consuming locally, better urban design, taking greater care of the natural environment. Covid-19 has also shown that, for some communities, barriers to local action are more fundamental and closely tied to the broader determinants of health, including income.

In Aotearoa, well before the pandemic, a groundswell of innovative community action was underway. Local organisations are tackling public health concerns such as harms caused by alcohol and tobacco, prevention of chronic diseases, strengthening local food systems, and improving local service, physical and natural environments. Alongside renewed understandings of communities as complex systems of relationships, communities themselves are embracing methods of collective impact. Across Aotearoa, local perspectives on local systems are being valued and acted on – something Indigenous peoples have long practised.

The disruption of Covid-19 has caused communities in Aotearoa to be more vocal about what they need – and what they need is a change in their relationships. The type of relationships which exist between organisations that act locally – service providers, iwi, charities, non-governmental organisations and government – matter. Collective, collaborative, insight-gathering approaches to improving community wellbeing hold promise; but in practice, their implementation has been piecemeal and inequitable.

The challenges of evolving populations are frequently unknowable without deep roots in communities. If we can reorient our systems to be more locally adaptive and intimately focused, we can enhance wellbeing by reducing the burden of preventable diseases on our health system, improving equity, and reconnecting to the natural world which sustains us.

Read the full version of this article on the Spinoff:
Collective impact: Shining the light on community post Covid-19

What's in our soil, and what it means for us

Te Pūnaha Matatini supports the work of Soilsafe Aotearoa to explore community soil values and map lead and other metals in home garden soils.

Dr Emma Sharp has been interested in home garden soils since she came across a newspaper article about blood lead levels in domestic chickens in Sydney.

Emma is a geographer and an Associate Investigator at Te Pūnaha Matatini. When her environmental chemist colleague Dr Melanie Kah approached her about starting up a local version of an Australian project testing domestic soil for metal contaminants, Emma raced to her office to grab the newspaper clipping that had been pinned there for several years.

"I ran and got the newspaper article and waved it in front of Melanie and said 'I've been interested in this for a really long time!'" says Emma. "It turned out that it was the same research unit, and I said 'I've got all kinds of ideas for this. If I'm involved, we can make this true to Aotearoa – let's look at it from all angles.'"

"And so Soilsafe Aotearoa was born. It's a project of diverse soil values. We're thinking about community values, public education, Indigenous perspectives, artistic interpretations, and things that are beyond economics – which is how soil is usually considered in Aotearoa and around the world."

A mainstay of Soilsafe is an ongoing testing programme, in which members of the public send in samples of soil from key places in their gardens to be tested for a suite of eight heavy metals. The results are returned with guidance about how people can modify the ways they interact with soil to reduce exposure to any contaminants that might have been detected. Soilsafe's lab at GNS Dunedin was inundated with soil samples after the project was mentioned on TVNZ's Sunday show, and they have now processed over 2,000 samples.

Emma and Melanie are interested in patterns of soil contamination in locations close to main roads, due to the legacies of leaded petrol. They are also exploring a sociodemographic correlation to less well-maintained houses that have peeling lead paint.

Other data sources include questionnaires and interviews about people's values regarding gardens and gardening in Aotearoa over the Covid-19 lockdown period in early 2020. "We get the sense that people got into their gardens a lot more during lockdown," says Emma. "Gardens were safe spaces, but they were also spaces where people could turn their attention to something else and nurture and care for something in a world that was feeling challenging."

Te Pūnaha Matatini has funded two Soilsafe events in Takapuna and Rānui to engage children with the values of soil. Emma made sure that engagement was central to Soilsafe from the very start using Te Pūnaha Matatini's engagement laundromat. "Te Pūnaha Matatini has been a really fantastic support for the Soilsafe programme," she says.

At the engagement events, participants learned about soil from Emma and Melanie, enjoyed hands-on experience with soil science through microscopes and worm farms, and engaged in soil values through the work of artists Nicole Johnson and Ekarasa Doblanovic and photographer Shona Dey.

"Soilsafe is flourishing," says Emma. "It's great."

"We've had some amazing media pickup and interest from community organisations. For me, the most important thing is genuinely connecting with community organisations to make sure our work is community led, and useful for them."

Realising our values

…and then we'll tackle Covid-19

Te Pūnaha Matatini was founded to apply complexity science to the critical issues of our time, with a focus on communication and connection to government and the private sector.

"You could have added 'and then we'll tackle Covid-19' to the end of the first paragraph of our proposal," jokes Te Pūnaha Matatini Director Professor Shaun Hendy.

Te Pūnaha Matatini's involvement with Covid-19 began early in 2020. "Associate Professor Siouxsie Wiles is one of our superstars, and she'd been talking about Covid-19 in the media since January," explains Shaun. Siouxsie and Professor Michael Baker of the University of Otago had been fronting the New Zealand Government's communication about the pandemic, and Shaun was worried about the quality of information that they were receiving to do this. He put Siouxsie in touch with the Prime Minister's Chief Science Advisor, and by connecting the two of them was sucked right into the middle of the whole thing.

Siouxsie had asked Shaun whether an investigator hui that Te Pūnaha Matatini had planned was going ahead. "I put some data from Italy into the most basic epidemic model you can," says Shaun, "and I went 'okay, we're not going to be holding our hui'."

"At that point I started to realise that this was actually going to be something really serious. What I'd calculated – if it was anywhere near right – was an important thing to start communicating, to support Siouxsie in her communication efforts."

A red-letter day for Te Pūnaha Matatini was the board meeting on Tuesday 17 March 2020. Shaun presented his modelling, how it had informed the decision to not hold the investigator hui, and the decision to focus their efforts on doing work on Covid-19 to present to the government.

Deputy Director Equity and Diversity Kate Hannah says that after the presentation "the Dean of Science and the Deputy Vice-Chancellor Research looked at each other with this fear in their eyes when Shaun was presenting. That was when I realised that that was the first time they were hearing what was going to be happening. That the University of Auckland was going to have to shut down."

This prediction had big implications for the healthcare system, and Shaun's contacts in the healthcare industry had important questions: when should they start preparing beds? Shaun knew that Dr Mike O'Sullivan, Associate Professor Cam Walker and Associate Professor Ilze Ziedens had done previous work around patient flows, so he got them involved to model what the effect on hospitals would be as the virus spread through New Zealand.

"We looked at how many people you would have in intensive care; what the loads would be on intensive care units and in wards," says Ilze. "One of the things that really came through was this figure of around 500 as the maximum ICU capacity in New Zealand – and really you don't want to go anywhere near that capacity. You want to stay well away from that, for lots of reasons."

Although she was pleased to be involved, Ilze is thankful that we haven't reached the point where her work has needed to be used. "In New Zealand it's not ventilators that would be the constraining factor," Ilze explains. "We have beds, we have oxygen, but it's actually the staff looking after the patients that limits what we can do. It means that it's a really good idea not to have too many people in hospital. It's not just staff in intensive care units, it's staff in the wards as well."

"The overall question was what was the capacity of the system. What load could we actually cope with? And what would happen if we didn't have any controls in place. Those were the two main things driving what we did in our work modelling hospital capacity."

What began as a quick calculation with the most basic epidemic model available grew into a team that builds and runs

mathematical models calibrated to the latest data to estimate the effect that different interventions will have on the outcomes of Covid-19 in Aotearoa. Shaun was joined in this work by Principal Investigators Associate Professor Alex James, Professor Michael Plank and Dr Rachelle Binny, and Associate Investigator Dr Audrey Lustig.

Complex models

In order to respond to more nuanced questions, a team led by Dr Dion O'Neale used network-based models to simulate contagion spread. Along with his colleagues Dr Emily Harvey and Dr Oliver Maclaren, they kept the computing power of New Zealand eScience Infrastructure (NeSI) running hot as they ran contagion processes on their five-million-node network.

Along with his doctoral student David Wu, Oliver had been drawn into the world of connecting models with real world data through working with colleagues in Population Health to model the Samoan measles crisis last year. "We got kind of thrown in the deep end a bit there," says Oliver. "A few months into his PhD, David was all of a sudden getting media coverage for his modelling. I think he was a little bit freaked out at first, but tragically they turned out to be pretty accurate projections."

Dion had similarly been working with a PhD student on knowledge flows on employment networks. They were using data from the Integrated Data Infrastructure (IDI) research database created by Stats NZ to build a complete network of everyone's working relationship in New Zealand. They were almost at the point of running contagion processes on this model when Covid-19 hit.

Steven Turnbull, a PhD candidate in education, had been independently been working with the IDI looking at schools. They began work to combine these data sets and work towards a national-level model. "Network-based models help you answer the kinds of question that you can't address with simple models," says Oliver. "The simple models treat New Zealand as one big compartment where everyone interacts with everyone, and that's obviously not true."

"Individuals are actually different," elaborates Emily. "They have quite different ways that they're getting exposed to things, and the people they'd interact with."

"My initial plan was to get involved to look at the economic impacts around shutting down specific industries," Emily says. There was a lot of talk about sectors that have predominantly young people working in them, who are low-risk for this disease. But the question isn't who's going to catch it first, but where is that then going to spread? Who are they living with? Who are their other social and community connections? That seemed to be missing in a lot of the conversations about opening up high-value industries with low-risk workforces."

Countering disinformation

The spread of disinformation shot directly to the fore during the second wave of infections in August 2020, with malicious rumours reaching the mainstream. Kate Hannah is part of the group of investigators that had been tracking the spread of disinformation on New Zealand social media all year: monitoring the prevalence of certain phrases, measuring the level of bot interactions, and watching for posts from known unreliable sources being shared. Their monitoring showed that the volume of disinformation had not increased on social media in the early days of the second wave, but the key difference was that it had been picked up by politicians and the media.

"We saw an increase in the volume levels of this stuff that seemed to correlate with the beginning of the election campaign, with mainstream politicians laundering these ideas in public discourse, where they wouldn't usually seep into," says Kate. She explains that during the first outbreak in March and April New Zealand had a really strong uptake of information from trustworthy sources like the daily briefings, but this has become much more fragmented in the intervening months, and it is more difficult for people to locate trusted and reliable sources.

The investigators are sharing their findings and recommendations with the government. "The language that's often used is the language of inoculation, so rather than debunking, we're trying to get in before people hear these ideas and equip them with the tools to analyse them critically."

"We all need to be really prepared to stamp it out," she recommends. "Don't share it, don't transmit it – be the place where it stops."

Communication, phylodynamics and students

Principal Investigator Associate Professor Rebecca Priestley leads a team that has been investigating how Covid-19 has been communicated in Aotearoa, and Siouxsie has been co-leading a team with Tina Ngata to develop tools and methods to ensure Māori communities' continuous access to a robust and tested tikanga Māori media infoscape.

Associate Investigator Dr David Welch leads the phylodynamics team, which has been developing computational tools to analyse genomic data.

Students and early career researchers have been central to all the strands of work across this broad and transdisciplinary project.

The relationship between government and science

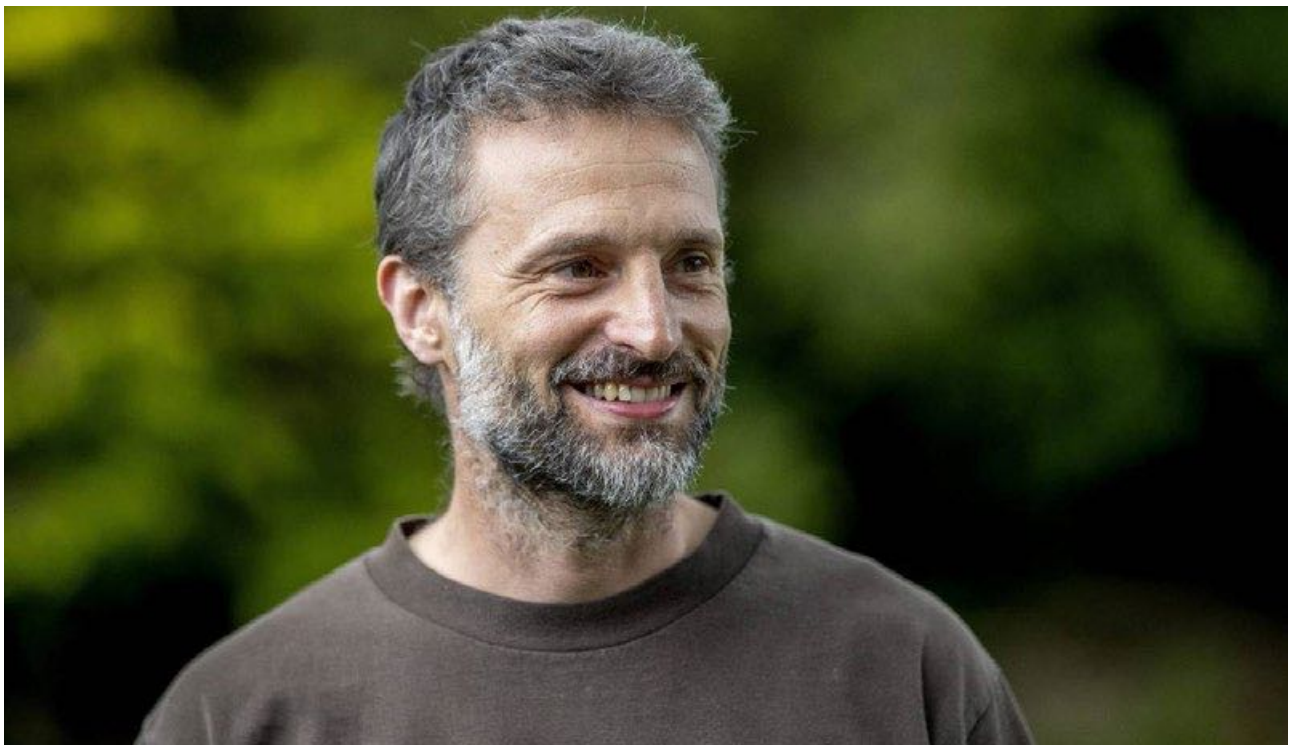
As a New Zealand-wide centre with strong links to government and industry, Te Pūnaha Matatini was perfectly equipped to handle this complex and fast-moving national challenge.

"On the one hand you can tell the sort of Forrest Gump-like story of how we just had the right conversations at the right time and then found ourselves in this position," reflects Shaun. "On the other hand, we've been building a community at Te Pūnaha Matatini to do exactly this. We've put emphasis on communicating our work, and we've put emphasis on working with policy makers to make a difference."

The Covid-19 response has demonstrated the value of having a rapid-response team of scientists with strong relationships ready to answer questions from the government at short notice.

The other key thing that distinguishes Te Pūnaha Matatini is our open, collaborative and values-driven approach. Scrawled across the top of a prominent whiteboard in our offices is "Everyone here is smart, distinguish yourself by being kind." This kindness has saved countless lives in New Zealand.

You can read all our Covid-19 reports on the Te Pūnaha Matatini website:
www.tepunahamatatini.ac.nz/Covid-19/



Making a global impact in predicting and preventing pandemics

Professor David Hayman made a global impact in 2020 with his contributions to the report on biodiversity and pandemics by the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES).

David Hayman is an epidemiologist and Associate Investigator at Te Pūnaha Matatini who uses multidisciplinary approaches to address how infectious diseases are maintained within their hosts and how the process of emergence occurs.

Dave has spent a long time working on emerging infectious diseases and bats, making him a natural candidate for Aotearoa New Zealand to put forward when the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES) put out a call for nominations for an expert panel to produce a report on the interactions between biodiversity and human drivers of disease emergence.

The report on escaping the 'era of pandemics' was produced at pace during a week-long virtual workshop to review the scientific evidence on the origin, emergence and impact of Covid-19 and other pandemics, as well as on options for controlling and preventing pandemics.

Dave now sits on the One Health High Level Expert Panel (OHHLEP), a high-level expert panel that gives advice across four international agencies: the World Health Organization, the World Organization for Animal Health, the Food and Agriculture Organisation and the United Nations Environmental Programme. He says that the IPBES report has been influential across these agencies, and is often referred to. "We are a high-level expert panel that provides expertise and advice to these major global organisations about how they can work better together," he says. "And I think the IPBES report has actually influenced that." The IPBES report has been an important step in these four agencies coming to terms with the complexity and interrelatedness of disease and the environment, and they are recognising the need to address these issues in a transdisciplinary way.

"There's a lot of things from Te Pūnaha Matatini and working in Aotearoa New Zealand that influenced my contributions to the report. There's lots I've learned from Te Pūnaha Matatini about style of working and things like respect for Māori and Indigenous knowledge."

Dave describes himself as both a pessimist and an optimist as we face a future of increasing pandemics and the effects of climate change. "It can seem all bad," he says. "But on the plus side a lot of the drivers for climate change, biodiversity crises and extinction crises are the same as the things that are driving disease emergence. So we can potentially have win, win solutions."

"We can look at things like reducing industrial-scale trafficking of wildlife or agricultural encroachment into rainforest, both of which are bad for the environment and may also be bad for human health. You can potentially reduce one risk and improve things in another way."

Dave concludes that tackling these issues will require quite big societal changes, but "what Covid-19 did show is that you can do large-scale stuff. You can shut down whole countries. I'm not saying that's a good thing, but it showed us the scale and pace at which societies can change and adapt."

You can read the full IPBES report on escaping the era of pandemics: https://ipbes.net/pandemics

The Spinoff

Communicating the science of Covid-19 to the world

Te Pūnaha Matatini has made a global impact in 2020 and 2021 with international excellence in communicating the science of the Covid-19 pandemic.

Amongst a litany of intractable global crises, the Covid-19 pandemic has been the definitive issue of 2020 and into 2021. Aotearoa New Zealand was a guiding light during this period, demonstrating how decisive leadership based on values, evidence and best practice could stamp out the virus that has such a stranglehold on our lives.

We also demonstrated the importance of science communication in a crisis.

> The work of Te Pūnaha Matatini's Covid-19 response has had significant health and social impacts for Aotearoa New Zealand and internationally.
> – Diane Abad Vergara, World Health Organization

Te Pūnaha Matatini's work and related research from around the globe was actively communicated to the public throughout 2020 and into 2021, and several of Te Pūnaha Matatini's researchers continue to be the most prominent science communicators of the pandemic.

The team's work was regularly cited in the daily 1pm briefings and received widespread media attention. This clear and consistent communication from prominent scientists improved trust in science throughout the pandemic.

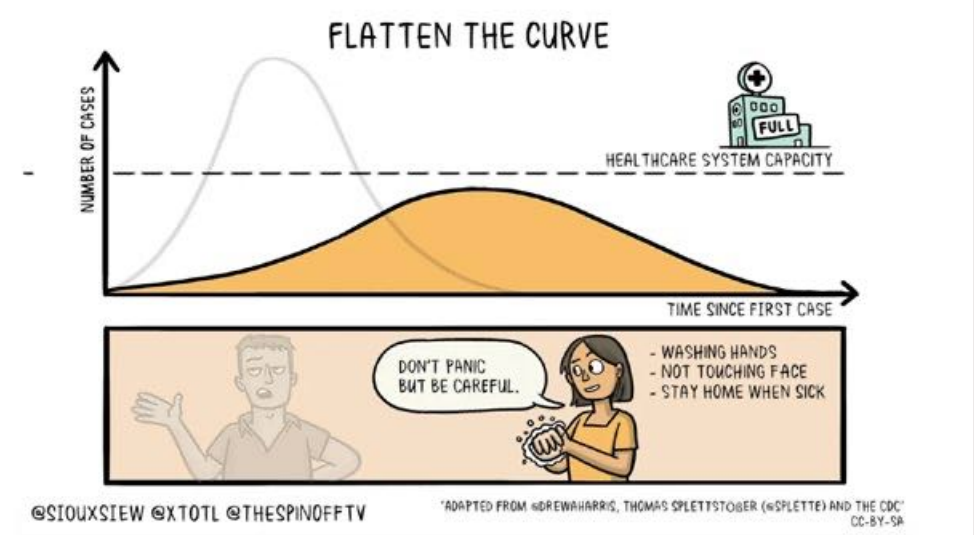
We publish all of our Covid-19 research on our website as soon as possible after rapid peer review, to ensure access for communities and decision-makers more broadly, and to enable media engagement.

Similarly, in line with Te Pūnaha Matatini's focus on transparency and openness, the Orion Health team set up a national algorithm hub to host our code and make it freely and publicly available. This made the code widely available to third parties and allowed international groups to use Te Pūnaha Matatini's models. This collaborative approach has meant that the benefits of the research and its outcomes are shared widely.

> Te Pūnaha Matatini has made a clear impact in New Zealand's response to Covid-19, both through directly advising the Ministry of Health with its modelling expertise, and communicating science to the public, via platforms such as the New Zealand Herald. That modelling has informed the Government's real-time response to the first wave of Covid-19 and the August Auckland cluster – as well as in its decision-making around moving between alert levels. Te Pūnaha Matatini's director, Professor Shaun Hendy, but also other investigators such as Professor Michael Plank, Dr Rachelle Binny, Associate Professor Alex James, Dr Dion O'Neale and Kate Hannah have all contributed much to an evidence-based public discourse on Covid-19.
> *– New Zealand Herald*

Siouxsie Wiles began fielding media enquiries on Covid-19 from as early as January 2020. Siouxsie became one of the leading international science communicators during the crisis. She partnered with The Spinoff cartoonist Toby Morris to produce visualisations that went viral around the world. The articles that Siouxsie wrote for The Spinoff and were illustrated by Morris have attracted more than three million page views.

The duo's first collaboration, Flatten the Curve, was an instant



viral success. The Prime Minister used it in a national press conference, the Washington Post, Buzzfeed and Wired shared it and NBC News called it "the defining chart of the coronavirus".

On 22 March 2020, they went internationally viral again, with a simple gif called Reduce the Spread. This time The Guardian, Reddit, NPR, Vox, India Today and the national broadcaster of Ireland shared it, and the gif was translated into many languages and spread around the world. The concept of the Reduce the Spread gif was soon adapted and used by the official government public health campaigns in Australia, Argentina, Germany, Scotland and Canada.

> These gifs are the poetry of the pandemic.
> – Lisa Jensen, Office of the Chief Public Health Officer of Canada

A simple chart comparing the symptoms of Covid-19, influenza, and the common cold was widely used across Aotearoa New Zealand by businesses, schools and public organisations to communicate with staff, students and members. The United Nations High Commission for Refugees had it translated into seven languages to distribute in Greek refugee camps, and a Somali version was created for use in migrant communities.

Siouxsie's collaborations with Toby Morris were released under a Creative Commons licence which has seen their graphics translated into multiple languages and adapted by various governments and organisations as part of their official pandemic communications. Several of the graphics were also translated into te reo Māori in collaboration with Te Puna Ora o Mataatua and into various Pasifika languages in collaboration with Moana Research.

Siouxsie and Toby's work continues. Toby and The Spinoff have been contracted by the World Health Organisation to help with their communication efforts, with Siouxsie acting in an advisory capacity when needed. Many of their original graphics have now been repurposed for the WHO, reaching audiences of millions. Their direct and compelling communications have led to changes in public understanding of the reasoning behind public health measures, and have increased trust in the reliability of science and expertise.

You can read Siouxsie's work at *The Spinoff*:
https://thespinoff.co.nz/author/siouxsie-wiles/

Maths Craft returns to Ōtautahi

On Sunday 23 May 2021, Maths Craft made a triumphant return to Ōtautahi's historic Arts Centre Te Matatiki Toi Ora for the third Christchurch Maths Craft Day.

Maths Craft is one of the signature public engagement events that Te Pūnaha Matatini supports, and over 1,500 visitors explored maths through crafts at this free day-long event. Participants enjoyed craft creation stations, along with public lectures given by mathematicians and crafters.

The hands-on craft stations were staffed by a trained team of volunteers drawn from University of Canterbury students and staff, from local school teachers, and from a growing pool of experienced volunteers from other Maths Craft New Zealand events.

These volunteers guided visitors through maths and craft: Möbius strips, mathematical colouring and drawing, knitted knots, fractal sculptures, origami, flexagons, crocheted hyperbolic planes, meanders, and string art.

"This was our first major public event since Covid-19 disrupted our plans in 2020 and our first in Christchurch since 2018," says Maths Craft Director and Te Pūnaha Matatini Principal Investigator Dr Jeanette McLeod. "We were thrilled to welcome back the public, and to see that enthusiasm for our events has only grown in our absence."

All of the craft tables were busy all day long, with friendly and keen volunteers circulating with advice, encouragement, and materials. People stayed for hours, exploring the crafts at the stations, and enjoying the many maths craft objects on display at the stations and in display cabinets."

The Arts Centre was busy all day," says Maths Craft Deputy Director and Te Pūnaha Matatini Associate Investigator Dr Phil Wilson. "And indeed the main feedback on our exit survey – apart from enjoyment of the day itself – was a request for us to move to a larger space next time. We agree that we have probably outgrown this beautiful space, and we will with regret look for a larger venue for our next Christchurch Maths Craft Day."

Find out more about Maths Craft:
http://www.mathscraftnz.org

Public engagement highlights

- Adrian McDonald and the The Gateway Antarctica Research Centre took over the International Antarctic Centre (an educational attraction based in Christchurch) for two days during Antarctic Season Opening Period in November 2020.
- Alex James, with assistance from Rachelle Binny, and Audrey Lustig, ran an outreach activity on mathematical modelling of epidemics with students at Beckenham School, Christchurch.
- Andrea Byrom contributed a *A Treaty-based approach to creating impact* during the University of Auckland, Impact Through Culture Change webinar series.
- Christina Painting gave two talks on Rēkohu Chatham Islands; the first was Behavioural Ecology of NZ Invertebrates, and the second was during a visit to Te One school where she talked with the students about the importance of insects. Christina also ran the *Science Learning Hub: All about insects webinar*, presenting to teachers around New Zealand on how to incorporate insects into their classrooms, and in collaboration with SouthSci, Auckland Libraries, Te Pūnaha Matatini investigator Leilani Walker, Morgane Merien, and Tom Saunders created online resources for teachers to help them incorporate these activities into their classrooms. She also visited Hukanui School to give a talk followed by an interactive session with various live insects.
- Daniel Hikuroa, in his role as *UNESCO Cultural Commissioner*, joined the UNESCO Matariki kōrero, with Youth Leaders Ashlee Peacock and Blair Kapa and talked about Matariki and Puanga – a single star that is another marker of the Māori New Year, depending on what region you're in. Track Zero, in partnership with PANNZ and Auckland Live, hosted a series of kōrero with leading thinkers in the sciences, arts and creative and cultural communities, bringing their perspectives on the powerful role arts can play in shaping a fair, carbon neutral future. The series is supported by Royal Society Te Apārangi and The Big Idea. Dan Hikuroa contributed to episode 3, *Arts + Climate Innovation, Mātauranga Māori and our Future*. Dan also gave a public lecture, *What is Matariki anyway?* for Whanganui Science Collective, and gave a lecture and ran a session for Northcross Intermediate, who had an engaging discussion about Waikato-Tupuna awa.
- David Hayman was invited to speak about investigating and understanding emerging infectious disease outbreaks for the Royal Society Te Apārangi, and gave public talks in Palmerston North entitled *What's happening with the virus?*, followed by *What's happening with the vaccine?*
- Dion O'Neale contributed to a Statistics NZ staff professional development presentation, and he also gave a presentation to the Statistics NZ Data Users Forum.
- Fraser Morgan had a busy time talking about Antarctica with children, including school groups and Scout troops. Junior classes focused on the biology within Antarctica, while older classes covered climate change and the potential effects Antarctica will face.
- Inga Smith was joined by Anna Tarr (University of Otago) to give a public talk Hosted by *Catalyst Trust Queenstown, International tourism and CO2: Implications for Queenstown*.
- Izi Castro gave a presentation at the Global Biodiversity Festival.
- Kate Hannah contributed to Kia Kotahi Ra, a marae-based Hapū-led hui on Covid-19 vaccination and disinformation.
- Leilani Walker partnered with three other entomologists and three South Auckland libraries for *Buzz in the garden*, developing monitoring protocols for insect communities in library gardens. Leilani also ran a Bioblitz for Summerland School.
- Lynn Riggs ran a short course, *Introductory Labour Economics for Public Policy* for the Government Economics Network. She also ran webinars for the Climate Change Commission.
- Matthew Parry ran a number of events for schools in Otago, which include school visits, and opportunities for children to visit the University of Otago to learn about Statistical techniques and Modelling Covid-19.
- Maui Hudson ran workshops with Te Mana Raraunga, The Māori Data Sovereignty Network.
- Michael Plank gave a public lecture on *Maths in the fight against Covid-19*, as part of the University of Canterbury Connect Lecture series 2021.
- Pierre Roudier gave a public talk, *The McMurdo Dry Valleys of Antarctica: at the limits of life* for Café Scientifique at the Globe Theatre in Palmerston North. He also demonstrated some Antarctic field gear at his local kindergarten!
- Tammy Steeves was an invited speaker and panel member for Maurice Wilkins Centre's Mentoring and Equity in Science Workshop, Tammy also contributed to Genomic Aotearoa Virtual Seminar Series.
- Tava Olsen gave a Webinar for the Centre for Supply Chain Management.
- Troy Baisden, organised a New Zealand Association of Scientists Town Hall/webinar *How did early career scientists contribute to NZ's Covid-19 response?*, hosted by Shaun Hendy. This is the first of a series focusing on Early Career Researchers, with a panel of ECRs who played a valuable role in Te Pūnaha Matatini's modelling response that informed the Government. Troy was also a speaker at the Lakes Water Quality Society Annual General Meeting.

Collaborating to get information to where it is needed in the health system

Te Pūnaha Matatini's Covid-19 modelling team works with Orion Health to create and share tools with the healthcare sector.

The multi-disciplinary Te Pūnaha Matatini Covid-19 modelling team comprises researchers and experts from across academia, Crown Research Institutes and industry, and includes Orion Health data scientists Pieta Brown, Dr Ning Hua and Dr Kevin Ross. The team make sure their models serve the health system by working with Orion Health data scientists to ensure information gets to where it is needed.

Orion Health data scientists deploy and manage machine learning models for a range of clients in the healthcare industry, and were able to provide similar support to Te Pūnaha Matatini to get the Covid-19 models up and running quickly, and to run regional scenarios as required.

Orion Health Product Director – Intelligence and Te Pūnaha Matatini Advisory Board member Pieta Brown is immensely proud of the work achieved by the Covid-19 modelling team. "It is a real privilege to work with such an amazing team of Te Pūnaha Matatini researchers to support Aotearoa New Zealand's pandemic response," says Pieta.

Ning recalls a period of intense activity in March, April and May 2020, with daily virtual meetings with the multi-disciplinary research team. "We adapted and deployed the researchers' models in our technology environment and ran and analysed large numbers of scenario simulations," she explains. "We also produced standardised reporting and refreshed these daily or weekly, as required."

Director of Te Pūnaha Matatini Professor Shaun Hendy said the Orion Health data science team is instrumental in the technical delivery effort supporting the Covid-19 modelling team's work. "Aotearoa's pandemic response shows how powerful science and research can be, especially when scientists can collaborate without barriers and research is put into practice nimbly," says Shaun. "The team from Orion Health are a great complement to our academic researchers, putting our modelling into an operational environment, and maintaining master models and reports while we continue to adapt and improve.

Pieta says the experience has been unique because the team are working with the realities of modelling a very complex and rapidly evolving situation, and learning in real time. "We saw the potential of a blended research team in action," says Pieta. "It was thrilling to see how quickly we were able to deliver results when we could communicate and collaborate freely, and conduct research in real time."

The team intends to make their models and tools available so they can be maintained in perpetuity. Two Covid-19 spread and effect models are available to the public and analysts through Orion Health's New Zealand Algorithm Hub. One of the exciting by-products of this time has been increased collaboration and sharing through tools like the New Zealand Algorithm Hub," says Kevin. "We now have a way for validated models to be deployed by data scientists, and used by clinicians and policy analysts."

"The teamwork through Covid-19 shows us that evidence-based decision making is both possible and transformative."

International collaborations

Cate Macinnis-Ng, (Cross-country collaboration), SapFluxNet global sap flow database

David Hall, Energy Policy Tracker, (Geneva, Switzerland), Climate-related COVID economic stimulus

David Hall, Energy Policy Tracker, (Geneva, Switzerland / International), Tracking post-Covid-19 economic stimulus and its alignment with climate adaptation/mitigation

David Hayman, Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), (Bonn, Germany), IPBES Workshop on Biodiversity and Pandemics

Isabelle Sin, Ran Abramitzky, (Stanford University); Travis Baseler, (University of Rochester), United States of America, How are refugees different from economic migrants?

Kate Hannah, Global Partnership for AI (GPAI), (Paris and Montreal, France and Canada), Responsible AI for Social Media

Kirsten Locke, Aarhus University, (Copenhagen, Denmark), Women and management in universities

Kirsten Locke, University of Oslo (Norway), Research collaboration on gender and universities

Krushil Watene, Independent Research Group - Global health justice, (London, United Kingdom), Global Health Justice

Marcus Frean, Max Planck Institute for Evolutionary Biology, (Plön, Germany), Collective narratives catalyse cooperation - ongoing collaboration with Chaitanya Gokhale

Maui Hudson, New York University, (New York, United States of America), Traditional knowledge and biocultural labels

Melinda Allen, Marie Skodowska-Curie Research and Innovation Staff Exchange grant, (multi-institutional research collaboration), Probing the genetic diversity and demographic history of ancient seafarers in ISEA and Oceania, from archaic hominins to the dispersal of the Malayo-Polynesian language family

Melinda Allen, Max-Planck Institute for the Science of Human History, ArchaeGLOBE: Islands extinction project.

Michael O'Sullivan, TU Graz & TU Darmstadt, (Graz & Darmstadt, Austria & Germany), Machine learning for emergency department prioritisation

Michael O'Sullivan, Illawarra Shoalhaven Local Health District, Working with IS LHD to provide surgery scheduling and pathway modelling

Rebecca Turner, The National Socio-Environmental Synthesis Center, (Annapolis, United States of America), Global insect invasions

Shaun Hendy, Adam Jaffe, (Boston, United States of America), Econometric study of the Marsden fund.

Other partnerships and collaborations

Anna Matheson, Common Unity (Community organisation), An MOU with Common Unity in Epuni to exchange experience and knowledge

Isabel Castro, 3B2 Ahu Whenua Trust (Rāwhiti Partnership), Three-year monitoring of the biodiversity outcomes of their 1080 aerial application that took place in 2018

Isabel Castro, Motu Kōkako Ahu Whenua Trust (Partnership), Training whānau to carry out monitoring of Motu Kōkako, or hole in the rock at Ipipiri

Michael O'Sullivan, Precision Driven Health (Public/private research partnership), Surgery scheduling for DHBs throughout New Zealand, particularly Nelson Marlborough DHB

Michael Plank, All-of-government COVID-19 response group (Ministry of Health, Department of Prime Minister and Cabinet, Treasury, MBIE), Policy advice for all-of-government group working on the response to COVID-19

Shaun Hendy, All-of-government COVID-19 response group (Ministry of Health, Department of Prime Minister and Cabinet, Treasury, MBIE), Policy advice for all-of-government group working on the response to COVID-19

Anna Matheson, Local Government Thinktank, Sharing knowledge of the role or local governance and public health including collaborating on a chapter for a book on wicked problems, relationalism and the social determinants of health

Emma Sharp, GNS (Crown research institute), Soilsafe Aotearoa

Isabel Castro, Ngati Kuta and Te Patukeha Hapu and 3B2 Ahu Whenua Trust, Research team leader for the kiwi whakapapa project in Northland for Te Patukeha Hapu.

Michael Plank, Orion Health, Providing COVID-19 modelling and algorithms for operational reports and situation updates to District Health Boards and all-of-government

Rachelle Binny, Sanctuaries of New Zealand Inc. (SONZ), Incorporated Society of ecosanctuaries comprising NGOs, DOC and regional councils, Data sharing collaboration among ecosanctuaries belonging to SONZ allowing national analyses of aggregated data

Tammy Steeves, Genomics Aotearoa, Research Platform (MBIE Strategic Science Investment Fund)

Tammy Steeves, Biomolecular Interaction Centre

Troy Baisden, Land and Water Science (Private sector collaboration)

An equity lens in Covid-19 programme right from the start

It is telling that one of the first pieces of research done by Te Pūnaha Matatini in response to Covid-19 was about inequities in infection fatality rates in Aotearoa New Zealand.

On 14 April 2020 we provided a paper to the New Zealand government showing that the risk of dying from Covid-19 is at least 50% higher for Māori and Pasifika than New Zealanders from European backgrounds.

Prioritising this area of research shows the value of Te Pūnaha Matatini's inclusive research team that brings together diverse approaches and strong community connections. "There was enormous pressure on us to get this work out," says Deputy Director, Equity and Diversity Kate Hannah. "Because of some of the misinformation that was out there. Māori communities really wanted that."

This paper was also important politically. "We understand our paper on infection fatality rates for Māori and Pacific peoples was particularly influential in obtaining New Zealand First's support for the pandemic response," says Professor Shaun Hendy.

This was followed up by work showing that Māori and Pasifika people in New Zealand have a higher risk of hospitalisation for Covid-19, and the establishment of the kia kotahi ra workstream to develop tools and methods for Māori to produce and manage their own high-quality resources about Covid-19. Both papers have now been published in the New Zealand Medical Journal.

The instigation for Te Pūnaha Matatini's equity work was the memory of northern iwi Te Aupōuri's experience in the 1918 influenza pandemic, shared by board member Peter Lucas-Jones. "Peter-Lucas told the story of Te Aupōuri's experience in the 1918 influenza pandemic, and the mass graves, and the memories of all the people who are still alive of being children at that time and visiting the grave sites," says Kate. "It was really profound to be reminded of it."

After this reminder of the horrifically disproportionate impact of the 1918 epidemic on Māori communities, Kate quickly worked to add an equity lens to our modelling work. Work on infection rates by ethnicity began soon after, and the results were provided to the government within a month. This initial work predicted alarmingly higher infection fatality rates for Māori and Pasifika. Dr Kannan Ridings (Rongowhakaata) was one of the authors of this paper.

"Māori and Pasifika people are more susceptible to hospitalisation and death from Covid-19 than other groups of people," he says. "A lot of this is because of unmet healthcare needs, systemic racism existing in our healthcare system, and these types of things." This was an influential piece of work in Aotearoa New Zealand's understanding and messaging around Covid-19. "It's my most highly cited paper," says Kannan, "by quite a big margin."

"Early on in the pandemic, you heard things like 'Covid-19 doesn't discriminate against who you are,' but it does discriminate against who you are, because if you come from a community which has poorer healthcare outcomes than other communities, you're going to be more vulnerable."

Misinformation and disinformation is also a particular challenge for Māori communities. A central part of the Covid-19

programme is the kia kotahi ra team, who develop tools and methods to ensure Māori communities' continuous access to a robust and tested tikanga Māori media infoscape.

The kia kotahi ra team provides resourcing – including direct access to expertise – to enable communities to produce and manage their own high-quality, relevant public health and wellbeing resources. Working from the often-quoted principle that "what's good for Māori is good for everyone," the research design centres Ngāti Porou expertise in mapping the current landscape of misinformation, establishing dynamic principles of whare kōrero for discernment and decision-making, and navigating around existing false information and narrative frameworks towards scientifically robust and culturally trustworthy narratives of health and wellbeing in the time of Covid-19.

Te Pūnaha Matatini's modelling has consistently shown that if Covid-19 is allowed to become widespread in New Zealand, it will have a devastating impact on Māori and Pasifika communities. This will be a double whammy for these communities: a higher rate of infection and a higher risk of severe illness or death following infection.

Unfortunately, these findings have played out in infection and hospitalisation rates in 2021.

Read the paper on Covid-19 infection fatality rates by ethnicity:
Estimated inequities in Covid-19 infection fatality rates by ethnicity for Aotearoa New Zealand

Te Pūnaha Matatini Whānau measure the impact of Covid-19 on research students in Aotearoa New Zealand

In the latter stages of 2020, as we emerged, blinking, into a precarious state of post-lockdown vigilance, Te Pūnaha Matatini Whānau released its report on the Covid-19 pandemic and its impact on research students in Aotearoa New Zealand.

This was a collaborative report, prepared by Ellen Hume and myself with many contributions from the Whānau committee and members of the Whānau. While it cannot claim to represent the experience of all research students and early career researchers in Aotearoa, the Whānau has members representing a diverse array of institutions, disciplines, and life experiences, so we were well placed to make an initial foray into documenting the challenges facing this particularly vulnerable segment of the research ecosystem.

Drawing on the personal experiences of the Whānau and a range of interdisciplinary scholarship, we documented the ways the pandemic was affecting research students and exacerbating the existing inequities in research and academia.

Support from tertiary institutions was inconsistent and largely inadequate. There was little recognition that suspending or extending study to manage the impacts of the pandemic could create significant financial hardship, and students applying for financial aid were often required to make invasive disclosures of private information.

While some research was halted completely during lockdown, other researchers were expected to meet business-as-usual expectations despite exceptional circumstances, including reduced supervision, increased family responsibilities, or working from bed to stay warm in a cold flat.

International students faced these challenges while studying away from family and support networks, and dealing with complicated and uncertain funding and visa arrangements. There was a sense of anxiety as students looked ahead from these immediate challenges to a job market with severely limited domestic postdoctoral and research opportunities. Simultaneously universities implemented hiring freezes and made cuts to their already precarious workforces.

These hardships disproportionately harm those individuals that universities and research institutions have systematically failed to support in Aotearoa New Zealand and who are already underrepresented—for example women, Māori, Pasifika, cultural minorities, LGBTIQA+ people and Takatāpui, those who are disabled or chronically ill, caregivers, and first-in-family in higher education.

The report was met with some enthusiasm, circulated around government, and tabled at the Royal Society Te Apārangi. The issues, however, remain. Those undertaking postgraduate research are under immense financial strain, have little voice in decision-making at their institutions, are facing severely limited job opportunities, and are still expected to thrive within the toxic culture and expectations of success in academia.

Despite producing much of the research output of our universities, it is clear that postgraduates are viewed as students instead of researchers in the early stages of their career.

By Max Soar, Te Pūnaha Matatini Whānau Secretary

Read the report:
Impact of Covid-19 pandemic on New Zealand research students

Awards, media and whānau

Awards

Prime Minister recognises transformative science

The 2020 Prime Minister's Science Prize was awarded to Te Pūnaha Matatini for our contribution to Aotearoa New Zealand's Covid-19 response.

The Prime Minister's Science Prize is awarded for transformative science which has had a significant economic, health, social or environmental impact. Te Pūnaha Matatini was recognised for our work that developed a series of mathematical models, analysed data and communicated the results to inform Aotearoa New Zealand's world-leading response to the global pandemic.

"Even I underestimated the centrality of [science] advice for me, in this time in office, and just how important it would become to us as a government," said Jacinda Ardern, Prime Minister of New Zealand, as she announced the award. "I want to thank the many, many, many people in this room who were a part in your own ways in either helping us generate the information we needed to make those decisions, or who helped us communicate those decisions when it mattered most," she continued.

Our values, expertise and focus on communication made Te Pūnaha Matatini uniquely positioned to grapple with the Covid-19 pandemic in Aotearoa New Zealand. Te Pūnaha Matatini's modelling was key in helping the government make good decisions about lockdowns, particularly in April and May 2020 when the need to relax Alert Levels arrived, and in August 2020, when a tailored lockdown was used in Auckland to eliminate a large outbreak.

These public health interventions have had an immense impact on New Zealanders' lives, not the least of which was preventing a considerable number of deaths due to Covid-19 if the virus had been allowed to spread unimpeded. Te Pūnaha Matatini's work and related research from around the globe was actively communicated to the public throughout 2020, and several of Te Pūnaha Matatini's researchers were the most prominent science communicators during the crisis.

The transdisciplinary team working on Covid-19 that received this award brought together researchers from the University of Auckland, University of Canterbury, Victoria University of Wellington – Te Herenga Waka, Manaaki Whenua Landcare Research, Market Economics, and Orion Health.

Investiture recognises breadth of services to science

Te Pūnaha Matatini Director Professor Shaun Hendy was invested as a Member of the New Zealand Order of Merit for services to science in the New Year Honours 2021.

This was a fitting culmination to Shaun's founding directorship of Te Pūnaha Matatini, during which he oversaw years of translation of complex systems and networks into understandable knowledge for eliciting change, and built an award-winning research community. Shaun's impressive scientific career has spanned lecturing, research, leadership, service and science communication. He has previously lectured at Victoria University of Wellington's School of Chemical and Physical Sciences and currently lectures in the University of Auckland's Faculty of Science.

Shaun was Deputy Director of the MacDiarmid Institute for Advanced Materials and Nanotechnology from 2008 to 2012, President of the New Zealand Association of Scientists from 2011 to 2013, and Director of Te Pūnaha Matatini from 2015 to 2021. He has published numerous articles and texts across a range of fields including condensed matter physics, nanotechnology, computational materials science, the physics of complex systems, and innovation and economics.

Shaun is a public spokesperson on scientific issues, appearing regularly on television and radio, and writing and commenting prolifically online and in print. He received the Prime Minister's Science Media Communication Prize in 2012.

As an advocate for adapting to the challenges of climate change, Shaun abstained from flying internationally and domestically for the year of 2018 to reduce his emissions. Several of his colleagues joined this movement, which formed the basis of his book '#NoFly'.

During the Covid-19 pandemic, Shaun has become a household name in Aotearoa New Zealand with his tireless efforts to clearly communicate the projections of Te Pūnaha Matatini's modelling team. He is now dividing his time between continued modelling of Covid-19 and building a one-of-a-kind global marketplace that places climate and the environment front and centre as a co-founder of Toha.

Siouxsie Wiles stepped up as New Zealand locked down

Te Pūnaha Matatini Co-Deputy Director Public Engagement Associate Professor Siouxsie Wiles is New Zealander of the Year after explaining the science of the Covid-19 pandemic to Aotearoa New Zealand and the world.

Prime Minister Jacinda Ardern presented Siouxsie with the 2021 Kiwibank New Zealander of the Year Te Pou Whakarae o Aotearoa award at a gala dinner in Auckland on 31 March 2021.

Already a prominent science communicator before the pandemic, Siouxsie has courageously talked Aotearoa New Zealand through all aspects of the pandemic, from lockdowns to vaccines. Her iconic ongoing collaborations with cartoonist Toby Morris to communicate the science behind Covid-19 clearly and engagingly have gone viral internationally and been translated widely.

The citation for the award recognised Siouxsie's selflessness in undertaking this important public work: "In the face of considerable criticism – on her authority, on her appearance, on her gender – Siouxsie's continued to respond to one of the greatest challenges of our time with empathy, innovation and courage, and her work has been seen by millions and even used by governments and organisations as part of their official pandemic communications."

Miriama Kamo, Te Koruru – patron of the awards, said: "While New Zealand collectively locked down, she stepped up – helping millions globally see past the fear and complexities of the pandemic. Her work provided support, strength and clarity across New Zealand and beyond, representing our country on a world stage and helping to keep us safe." Siouxsie shows no signs of slowing down in her efforts to save lives through world-leading science communication.

Further prizes awarded in 2020–21

- Audrey Lustig, Award for Exceptional Contribution, Manaaki Whenua Landcare Research
- Daniel Hikuroa, Hochstetter Lecture, co-awarded with Darren King, Geoscience Society of NZ
- David Hayman, Manawatū Standard person of the year, Manawatū Standard
- Isabel Castro, Massey University Research Team Medal
- Jeanette McLeod, Fellow of the New Zealand Mathematical Society (NZMS)
- Jonathan Tonkin, University of Canterbury Early and Emerging Career Researcher Award
- Krushil Watene, Leadership Fellowship, Homeward Bound
- Marama Muru-Lanning, University of Auckland Research Excellence Medal, University of Auckland
- Michael Plank, London Mathematical Society visiting Fellowship
- Michael Plank, E.O. Tuck Medal, Australia and New Zealand Industrial and Applied Mathematics
- Murray Cox, Massey University Research Medal
- Rachelle Binny, Science New Zealand Early Career Researcher Award
- Siouxsie Wiles, Critic and Conscience Award, Universities New Zealand and the Gama Foundation
- Stephen Marsland, 2021 National Geographic Explorer, National Geographic Society
- Tara McAllister, School of Biological Sciences Early Career Researcher Award, University of Auckland
- Tara McAllister, Te Whitinga Fellowship, MBIE and Royal Society Te Apārangi

Media

A team of sought-after experts

The Covid-19 communications effort has been massive with Principal Investigators Shaun Hendy, Siouxsie Wiles, Kate Hannah, Mike Plank, Alex James, and Rachelle Binny all featuring significantly as science communicators during the pandemic. The communications team remain heavily present in all major media outlets in New Zealand, as well as the international media.

Shaun, Mike and Alex's articles for the Conversation have attracted over a million page views. The modelling work has been covered in the Guardian, the Times, the BBC, and the ABC. Reports conducted by the Science Media Centre indicate that Te Pūnaha Matatini science and researchers have had thousands of mentions in the media from January 2020 to June 2021 in relation to Covid-19. Siouxsie Wiles has been mentioned in 3,126 media articles, and Shaun Hendy 1,965 times.

Shaun, Mike, and Alex partnered with Chris Knox and Jamie Morton at the Herald to produce a series of articles, particularly during the March/April outbreak, which included a number of infographics and visualisations of the team's modelling. An early highlight of this collaboration focused on explaining the reproductive number (R0) of the virus, which featured a simple interactive disease model.

Siouxsie Wiles' articles about Covid-19 for the Spinoff include the topics of PCR and serology testing, contact tracing, vaccine development, and modes of viral transmission. These articles have been viewed over six million times. Siouxsie's collaborations with Toby Morris were released under a Creative Commons licence which has seen their graphics translated into multiple languages, and adapted by various governments and organisations as part of their official pandemic communications. Several of the graphics were also translated into te reo Māori in collaboration with Te Puna Ora o Mataatua and into various Pasifika languages in collaboration with Moana Research.

Throughout the pandemic, Mike Plank has been a regular contributor of valuable insights that aimed to explain the scientific basis under-pinning the Government's Covid-19 response and other Covid-19 issues of the moment – appearing multiple times in TV and radio interviews, and in online articles. He is also no stranger to producing accessible, timely and informative threads on Twitter – especially in response to unfortunately frequent attempts by some actors to distort Covid-19 facts and spread mis- or disinformation online.

Kate Hannah has also regularly appeared in the New Zealand media to talk about the findings of Covid-19 research showing how Māori and Pacific populations within the country would be disproportionately affected by Covid-19, as well as the extent and potential impact of online efforts to undermine the official evidence-based response to the outbreaks. Kate was interviewed on TV and radio and appeared in online media articles, especially after the release of her team's report on the 'Prevalence and nature of Covid-19 disinformation in Aotearoa New Zealand social media' in early September. Of note, when New Zealand churches came under intense media scrutiny and an outpouring of public outrage, following an outbreak linked to a West Auckland-based congregation, Kate gave a measured and unifying message to One News: "It's a real struggle that church leaders in New Zealand are dealing with: wanting to support their congregations and support belief systems that are really important to them, but also so say that this is a public health crisis." Churches and their leaders have since been credited enormously for their efforts to educate their congregations.

Covid-19 media highlights

Every year, we report on the media activities of our investigators, and usually have a few hundred media articles to report. This year, because of the sheer volume of articles, we enlisted the help of the Science Media Centre, who produced collated lists of articles by or about our highest-profile investigators in the New Zealand media.

Alex James (111 articles)

Dan Hikuroa (92 articles)

David Welch (116 articles)

Kate Hannah (125 articles)

Michael Plank (825 articles)

Michelle Dickinson (517 articles)

Rachelle Binny (49 articles)

Shaun Hendy (1965 articles)

Siouxsie Wiles (3126 articles)

Te Pūnaha Matatini (1189 articles)

The Guardian – Trust is paramount during a pandemic – scientists and politicians must protect it

The BBC – How New Zealand relied on science and empathy

ABC Radio National – How to reopen borders safely: when and how will domestic and international travel resume?

TVNZ – Shaun Hendy says there could be 100 undetected Covid cases in the community in worst case

RNZ – The man modelling NZ's Covid-19 spread from his kitchen table

Stuff – Coronavirus: collective failure to prevent pandemic

Stuff – We lost this round of pandemic dice

The Conversation (Australia) – An endless game of Covid-19 whack-a-mole': a New Zealand expert on why Melbourne's stage 4 lockdown should cover all of Victoria

Stuff – Covid-19: How the coronavirus makes us lose our sense of smell

Stuff – NZ should take it slow and steady before reopening borders

Stuff – Shining a light on a Covid conspiracy

Stuff – Coronavirus: Misinformation found in a quarter of Covid-19 videos

The Conversation – NZ's decision to close its borders will hurt tourism but it's the right thing to do

Loading Docs (Documentary) – Siouxsie and the Virus

NZ Herald – Coronavirus Covid-19: The three scenarios facing Auckland

NZ Herald – Covid-19 coronavirus: Māori, Pasifika inequities 'major' factor in Auckland cluster's doubled hospital rates

NZ Herald – The maths of Covid-19 and how you can change it

Newshub – Māori 50 percent more likely to die from Covid-19 than non-Māori – study

RNZ – Modelling's role in improving Covid19 contact tracing

The Spinoff – Why mathematical modelling matters so much in fighting Covid-19

NZ Herald – Covid-19 coronavirus: What is genome sequencing and why is it so important?

RNZ – Melbourne – six week lockdown imposed after COVID outbreak

RNZ – Covid misinformation spreads in New Zealand

RNZ – Churches with links to the US being blamed for spreading Covid-19 misinformation

Newsroom – Have Covid-19 conspiracy theories evolved?

RNZ – Misinformation/disinformation: how it relates to public health

The Guardian – New Zealand election TV debate: fears inclusion of fringe party may 'legitimise conspiracy theories'

The Spinoff – Counting and Countering the infodemic: a deep dive into Covid-19 disinformation

The Project – How to keep being kind when our patience is wearing thin

Our investigators in the media

Te Pūnaha Matatini investigators were regularly sought for their expert opinion and comment by a range of local and international media in 2020–21.

Adrian McDonald

- Stuff: Clouds over the Southern Ocean hold the key to better climate change predictions, study says
- Phys.org: Cloud data a silver lining for climate change predictions

Alex James, Shaun Hendy

- The Conversation: New Zealand relaxes Covid-19 restrictions, except for Auckland. How much longer will the city have to wait?

Alex James, Michael Plank, Shaun Hendy

- The Conversation: Auckland's rapid lockdown has given New Zealand a better chance of eliminating coronavirus – again
- The Conversation: New Zealand is on alert as Covid-19 returns. This is what we need to stamp it out again

Alex James, Michael Plank

- The Conversation: How to keep Covid-19 at bay during the summer holidays – and help make travel bubbles a reality in 2021

Alex James, Audrey Lustig, Michael Plank, Rachelle Binny, Shaun Hendy

- The Conversation: A new community case of Covid-19 in New Zealand is a matter of when, not if. Is the country prepared for it?
- The Conversation: How New Zealand could keep eliminating coronavirus at its border for months to come, even as the global pandemic worsens
- The Conversation: 2 new Covid-19 cases in New Zealand, but elimination of community transmission still stands
- The Conversation: New Zealand hits a 95% chance of eliminating coronavirus – but we predict new cases will emerge

Andrea Byrom

- Science Media Centre: Budget 2020 – Expert Reaction
- Sciblogs: The climate crisis is also a biodiversity crisis
- RNZ: Ecologist says idea to introduce koala after Australia bushfire is short-sighted
- RNZ: Experts say vision needed for Budget's 11,000 nature-based jobs
- University of Auckland: A Treaty-based approach to creating impact: aligning the expectations of individual researchers and their organisations to achieve collective impact
- Newshub: Wildlife experts warn against introducing koalas to New Zealand
- Evening Standard (UK): Thousands back petition to introduce koalas to New Zealand to stop them from going extinct
- Te Tira Whakamataki: Thank you and farewell Dr Andrea Byrom

Andrea Byrom, Rachelle Binny

- Predator Free NZ: Ecosanctuaries in the spotlight

Ann Brower

- Otago Daily Times: Canterbury University study shows women in research earn $400k less than men
- RNZ: Female academic? Here's your lifetime pay gap
- NZ Herald: Pay gap: Female academics earn $400,000 less than men over life-time
- Times Higher Education: Age and performance 'fail to explain' gender pay gap

Anna Matheson

- Youtube: Reorienting health systems towards communities: How to achieve it? Dr Anna Matheson
- Newsroom: Covid-19: we need to get serious about privilege
- Newsroom: Covid-19 lays inequality in NZ bare
- Stuff: What does $9.5m health review mean for patients? Not a lot, say critics

Anna Matheson, Emma Sharp

- The Spinoff: Doughnuts and dandelions: Reimagining our food system post Covid-19

Anna Matheson, Krushil Watene

- The Spinoff: Collective impact: Shining the light on community post Covid-19

Audrey Lustig

- New Zealand eScience: Predictive models to combat invasive species
- Geospatial Research Institute Toi Hangarau: Modelling Large-Scale Predator Control Measures: Cape to City Project

Barry Milne

- A Better Start: National Science Challenges, Big Data explained

Cate Macinnis-Ng

- RNZ: The environmental research disconnect
- RNZ: Environmental research funding 'fragmented', government watchdog warns
- Tree Advocates: Save our kauri – expert evidence
- The Big Q: Sustainability Bites: How do trees look after us, and how can we look after them?
- Newsroom: The burning irony of our climate policy fix
- Scoop: Record Dry Spells And Effects On Forests
- The Guardian: Auckland set to break record for longest-ever spell without rain

Cate Macinnis-Ng, Isabelle Sin, Kate Hannah, Leilani Walker, Tara McAllister

- NZ Herald: Women still vastly under-represented in top uni roles – research

Cate Macinnis-Ng, Isabelle Sin, Kate Hannah, Leilani Walker

- Stuff: Study: Women still under-represented in universities across New Zealand

Christina Painting

- RNZ: Call for action on decline of insects: 'Without them we'd be in big trouble'
- Invertebrate Behavioural Ecology Lab: Shiny new lab!

Claire Postlethwaite

- Women In STEM: Mathematics – Women in STEM

David Hall

- The Conversation: By declaring a climate emergency Jacinda Ardern needs to inspire hope, not fear
- The Conversation: With a mandate to govern New Zealand alone, Labour must now decide what it really stands for
- The Conversation: Ardern's government and climate policy: despite a zero-carbon law, is New Zealand merely a follower rather than a leader?
- The Conversation: The Covid-19 crisis tests oppositions as well as governments. Ahead of New Zealand's election: National risks failing that test
- The Conversation: New Zealand's Covid-19 budget delivers on one crisis, but largely leaves climate change for another day
- Podcasts NZ: Inside The Science of Denial: Dr David Hall
- The Spinoff: The wellbeing approach is more important than ever in a crisis like Covid-19
- Otago Daily Times: Pressing reset
- RNZ: Govt promises carbon neutral public sector
- Otago Daily Times: 'Emergency' will have impact

David Welch

- The Conversation: Genome sequencing tells us the Auckland outbreak is a single cluster – except for one case
- The Conversation: Why New Zealand needs to focus on genome sequencing to trace the source of its new Covid-19 outbreak

Dion O'Neale

- NZ Herald: Covid-19 coronavirus: Clever New Zealand-developed model can predict virus' spread – by suburb

Inga Smith

- Otago Daily Times: Two paths to a shared fate
- University of Otago News: Connecting the boundary-less Climate Change Challenge

Isabel Castro, Stephen Marsland

- RNZ: What bird is that?

Isabelle Sin

- Royal Society New Zealand: Dr Isabelle Sin
- YouTube: Meet Dr Isabelle Sin
- Stuff: Unprecedented study finds NZ universities paying woman academics $400,000 less than men
- Science Media Centre: Ivory towers and glass ceilings: The gender pay gap in NZ research – Expert Reaction
- Newshub: Gender pay gap exists even at New Zealand universities – study
- Stuff: The Monday Effect: Why more workplace injuries happen on this day

James Sneyd

- University of Auckland News: Faculty of Science funding success a boon in tough year

Jeanette McLeod

- Education Gazette: Maths Craft brings maths to the masses

Jonathan Tonkin

- University of Canterbury News: Top freshwater scientist named as UC's 2020 emerging career researcher

Kate Hannah

- World Health Organization: Promoting integration of info-demic management response
- The Guardian: New Zealand election TV debate: fears inclusion of fringe party may 'legitimise conspiracy theories'

Kate Hannah, Michael Plank

- The Conversation: Research shows Māori are more likely to die from Covid-19 than other New Zealanders

Krushil Watene

- Massey University News: Māori philosophy – thinking about Antarctica
- Massey University News: Indigenous voices on sustainability take global platform
- The Conversation: Caring for community to beat corona-virus echoes Indigenous ideas of a good life
- The Spinoff: Prioritising Māori perspectives could make Aotearoa thrive

Leilani Walker, Tara McAllister

- RNZ: Māori, Pasifika scientists under-represented in NZ universities

Les Oxley

- Newshub: Coronavirus: Companies named 'corona' suffer massive hits to share prices
- Scoop: Major Funding Boost For Circular Economy Research Programme

Lynn Riggs

- Stuff: Coronavirus: How to live lightly while in home lock-down

Marama Muru-Lanning

- University of Auckland News: Study to assess the impact of Covid-19 on tikanga
- University of Auckland News: Kaumātua central to major Māori health project
- The Spinoff: Millions of dollars announced for NZ studies into Covid-19 and its effects

Markus Luczak-Roesch

- Newsroom: Connecting the dots in contact tracing

Matthew Parry

- Otago Daily Times: Whole Lotto loot lures statistician
- NZ Doctor: When can Covid-19 be declared eliminated from NZ? New modelling study
- Otago Daily Times: University research focused on pandemic
- Newsroom: Herd immunity: a misunderstanding
- Stuff: Coronavirus: NZ could be declared free of Covid-19 in 21 days
- NZ Herald: Lotto's $50m must-be-won jackpot: What are the odds of winning more money?

Maui Hudson

- University of Waikato News: Indigenous genomics under the microscope at SING conference
- RNZ: Tuariki Delamere files for urgent hearing into Treaty negotiations
- Waatea News: Maori data use in $6m probe
- Scoop: Waitangi Tribunal woes frustrating for Te Whakatōhea

Melinda Allen

- University of Auckland News: Settling of East Polynesia earlier and likely connected to prolonged drought
- RNZ: New study shows East Polynesia settled earlier than previously thought

Michael O'Sullivan

- Stanford Engineering Magazine: Michael O'Sullivan: Data leads New Zealand's Covid-19 response

Michael Plank, Murray Cox

- Scoop: Mathematical models are being used by governments around the world to predict and respond to the spread of Covid-19

Murray Cox

- Microsoft Partner Network: Data and the cloud: By unlocking our DNA we've found two new prehistoric ancestors
- Massey University News: Pandemic, Pasifika health and asthma research among Massey's Marsden successes
- Stuff: Asymptomatic Covid-19 cases ring alarm bells overseas but is it a problem in New Zealand?
- Scoop: Modelling Covid-19 In New Zealand – Expert Reaction
- Voxy: Massey recognises top alumni, teachers and researchers in 2020 awards
- Massey University News: Massey University Research Medal Winners

Nirmal Nair

- Scoop: Tiwai Point Closure – Expert Reaction
- NZ Herald: Auckland, The City of Fails: Broken bridge, rail tracks and water supply
- Sista: Sustainability-focused MFAT scholar Leonie Bule wins Best Paper award
- Scoop: Auckland Ambassador Programme Reaches 50-member Milestone Within Five Years

Priscilla Wehi

- Science Learning Hub: Mātauranga and the integration of Māori and western knowledge
- Stuff: Māori nailed it: Kaiwētā is a tree on which wētā feast
- Predator Free NZ: Kaitiakitanga and urban restoration
- 46 Questions: Priscilla Wehi

Rachael Ka'ai-Mahuta

- RNZ: Lessons from 'Korean Wave' could boost te reo – expert
- The Conversation: Making te reo Māori cool: what language revitalisation could learn from the Korean Wave
- The Conversation: Kia pārekareka te reo Māori: ko ngā akoranga o te Ngaru Kōrea mō te whakarauoratanga o te reo

Rachelle Binny

- Science Times: Seven Years of Pest Control Allowed Native Birds to Thrive
- The Telegraph: The importance of the coronavirus R rate in other countries across the globe

Rebecca Priestley

- NZ Herald: Work on Antarctic sea level rise wins Prime Minister's Science Prize
- Asia Pacific Report: French nuclear tests: 'I bury people nearly every day, what was our sin?'
- New Statesman: How the UK failed on Covid-19: the international view
- Stuff: What Kiwi authors to read this summer
- The Daily Blog: 75 plus 35 years – the Hiroshima and Rainbow Warrior nuclear rewinds
- RNZ: Rebecca Priestley discusses her book Fifteen Million Years in Antarctica with the Prime Minister's Chief Science Advisor Juliet Gerrard
- Granta: Prepare to Be Kind
- NZ Herald: What exactly united the 'team of 5 million' to quash Covid-19?
- Science Media Centre: Science Journalism Fund Covid-19 winners awarded

Rhian Salmon

- Science in Society: Communicating science: a global perspective
- Scoop: Hydroxychloroquine Research Retracted – Expert Reaction

Shaun Hendy

- New Zealand Geographic: Burning the midnight oil

Simone Linz

- YouTube: Dr Simone Linz: Algorithms in computational biology research at the University of Auckland
- YouTube: Reconstructing phylogenetic networks from trees by Simone Linz

Siouxsie Wiles

- The Conversation: Contrasting styles, some substance: 5 experts on the first TV leaders' debate of NZ's election

- The Conversation: 'An endless game of Covid-19 whack-a-mole': a New Zealand expert on why Melbourne's stage 4 lockdown should cover all of Victoria
- The Conversation: NZ's decision to close its borders will hurt tourism but it's the right thing to do

Stephen Marsland

- Predator Free NZ: AviaNZ open-source software helps analyse bird calls

Tahu Kukutai

- Te Ao Maori: Government must cooperate with Māori about data – Dr Tahu Kukutai
- The Spinoff: Whose data is it anyway?
- University of Waikato News: New research seeks to transform data ecosystems to benefit indigenous peoples
- Te Hiku: Dr Tahu Kukutai & Keoni Mahelona: Data Sovereignty
- Newshub: Block or engage? How to deal with whānau caught up in conspiracies
- Biz Edge: Researchers to examine Māori perspectives on ethical data management
- Listen notes: Prime Minister Jacinda Ardern talks with Tracey McIntosh and Tahu Kukutai
- Facebook: Dr Tahu Kukutai talks to us about the state of the economy after Covid-19, Māori Business & Recovery
- Waatea News: Equity critical to get Covid-19 response right
- Waatea News: UN 2030 Agenda fears based on nonsense
- NZ Herald: The Conversation: Māori and Pasifika must be part of planning New Zealand's Covid-19 recovery
- Stuff: Coronavirus: There were two, quite different Covid-19 lockdowns in New Zealand
- The Conversation: Recession hits Māori and Pasifika harder. They must be part of planning New Zealand's Covid-19 recovery
- RNZ: Pasifika on Census 2023: 'Should we even bother?'
- Newsroom: Sovereignty in a digital world – Part 2

Tammy Steeves

- RNZ: Genetic matchmaker … for birds!
- UC Science Radio: It's like Tinder…for birds!

Tava Olsen

- Newsroom: Vital supplies: produce locally and stock up
- Stuff: Coronavirus: Stretching the supply chain: Supermarkets maintain they're up for the lockdown challenge
- The Spinoff: Covid-19 has changed New Zealand forever. The experts explain how
- Stuff: Covid-19 has sparked a 'Buy NZ Made' resurgence – will it last?
- Stuff: A perfect storm at the ports: inside our freight and port delays

Troy Baisden

- The Conversation: Polluted, drained, and drying out: new warnings on New Zealand's rivers and lakes
- NewstalkZB: Government accused of investing in the wrong environmental research
- Scoop: NZ Association Of Scientists Reacts To Concerns At Massey Albany
- Stuff: Hot cows, less delicious wine: The problems food growers face with climate change
- Stuff: Report shows New Zealand's 'fragmented' environmental research funding doesn't match most urgent needs
- RNZ: Are Crown Research Institutes fit for purpose?
- The Conversation: Report shows New Zealand's 'fragmented' environmental research funding doesn't match most urgent needs
- The Big Q: How bad is the state of New Zealand's rivers?
- The Spinoff: Covid-19 has changed New Zealand forever. The experts explain how: part two
- Carbon News: Research spending doesn't match priorities – report
- RNZ: Scientists alarmed over Worksafe's GNS Science Whakaari charges
- TVNZ: Experts fear charging GNS Science could have silencing effect on its ability to give advice
- NewstalkNZ: Proposals could see massive cuts at Massey University
- RNZ: Govt unveils $130m boost to research and innovation
- RNZ: Panel wants more research funding for tertiary institutions and to end research league table
- NZ Herald: Budget 2020: Scientists welcome modest bump for sector
- The National Interest: New Report Warns of Water Pollution Crisis In New Zealand
- NZ Herald: Coronavirus Covid-19: Ventilators, rapid tests targeted in new Govt $25m fund
- NZ Herald: New Govt water reforms miss mark on nitrogen pollution, advocates say

Tze Ming Mok

- E Notes: Analyze how Tze Ming Mok, the author of "Race You There," questions hegemonic narratives and assumptions
- Ruth De Souza: Conversations on Tangata Whenua and Asian solidarity

Te Pūnaha Matatini

- The Conversation: Recession hits Māori and Pasifika harder. They must be part of planning New Zealand's Covid-19 recovery
- The Conversation: Delight, relief and caution: six experts on New Zealand's move to ease its coronavirus lockdown
- The Conversation: New Zealand hits zero active coronavirus cases. Here are 5 measures to keep it that way

Te Pūnaha Matatini Whānau

Report by Ellen Hume, Te Pūnaha Matatini Whānau Chair

Te Pūnaha Matatini Whānau is a national network of early career researchers including post-graduate students, post-doctoral and other early career positions. Members are united by two common interests: those who are working with complex systems, and are also willing to connect and work in inter- and transdisciplinary ways. While many of our members have supervisors or colleagues associated with Te Pūnaha Matatini, it is an inclusive network for anyone who feels their research and way of working fits with the group and wants to be involved. In this way, the Whānau provides a valuable place of belonging and connection for those outside of normal disciplinary boundaries.

The Whānau is run by a committee consisting of elected members. We organise a range of funded events and engagement opportunities for members to connect, with a focus on networking, upskilling in technical as well as leadership and entrepreneurial skills, collaboration, and outreach. 2020, the sixth year of the Whānau, saw us grow our membership base to 150, with more than 270 receiving our monthly newsletters.

Virtual events

With Covid-19 and lockdowns disrupting the normal in-person Whānau events, we organised and hosted eight webinars over the year for the Whānau and our associated networks of fellow early career researchers. The webinar event format, facilitated by committee members, proved to be very popular and provided connection and support for a much wider cohort of our national network in what was a very tough, disruptive year. Of particular note, was our well-being series with clinical psychologist Dr Desiree Dickerson (based in Spain), opening up the conversation on mental health and providing much needed practical strategies to survive the pressure of being post-graduate students.

Guests and topics included:

- Things I would like to have known as a postgrad – a panel discussion with Te Pūnaha Matatini investigators Dr Rachelle Binny, Dr Emma Sharp, Dr Izi Sin and Dr Jono Tonkin
- Matariki – Assoc Prof Hēmi Whaanga
- Increase your research visibility with Wikipedia – Dr Mike Dickison
- Writing skills – Associate Professor Greg Holwell
- Four webinar series on mental health and well-being – Dr Desiree Dickerson
- Strategies for managing our well-being during COVID times
- Motivation and procrastination
- Perfectionism and imposter syndrome
- Productivity amongst chaos

Other online engagement included holding drop-in Zoom afternoon teas during lockdown, virtual Shut Up and Write sessions to support members to carve out a space for writing, and group engagement and advertising via Slack, email newsletters, Twitter, and Facebook.

In-person events

After a couple of postponements, in October we seized a COVID-free window of opportunity to travel to the Nelson region for the Whānau's first ever writing retreat.

Many of the current cohort of Te Pūnaha Matatini-funded students are reaching the end of their studies, so three days of writing at The Pear Orchard, near Hope, was a perfect setting to get those thesis chapters and papers written. The 13 of us also felt incredibly grateful to meet face-to-face for the first time since 2019, make new friends, enjoy delicious nutritious food, play board games, and enjoy walking and biking round the countryside.

Less than three weeks later, a strong cohort of Whānau members participated in Te Pūnaha Matatini's Annual Hui at hubs throughout the country. Immediately after, 11 of us went to the Leigh Marine Reserve to stay at the University of Auckland Leigh Marine Laboratory for our four-day Whānau annual retreat. This retreat provides members with a chance to network, upskill and be challenged in our thinking.

Our virtual and in-person guest speakers included Dr Lucy Stewart (Toha) on early career pathways, Caleb Moses (Dragonfly) on Māori data science, and Rebekah White (NZ Geographic) on science journalism. Whānau members also led many workshops, with highlights including upskilling in poster design, networks, data visualisation, and sharing general tips and tricks for doing research.

In our downtime we enjoyed cliff and beach walks (and chilly swims for the brave!), board games, movie night and an epic version of our annual quiz night. While the weather was too wild for a boat tour of the marine reserve, we wrapped up the retreat with a fascinating morning in the Marine Discovery Centre learning about the incredible research that is done at the reserve and getting to play with amazing sea creatures.

Advocacy

Covid-19 caused a big hit to the education sector, with post-graduate and other early career researchers heavily impacted. We saw the opportunity to use our platform to speak up about the experience of research students during the pandemic. Te Pūnaha Matatini Whānau published the report "Impact of the Covid-19 pandemic on research students in Aotearoa New Zealand", detailing the impact of the disruptive year on our research, well-being, and future career opportunities. We also suggested a range of measures to support this generation of emerging researchers. This report was shared with key leaders in the NZ education and research, science and innovation sectors, and generated very constructive conversations around the system-level change that is required to ensure we can have successful futures in research.

Te Pūnaha Matatini Whānau Committee 2020

Ellen Hume, University of Auckland – Chair

Giorgia Vittiato, University of Canterbury – Vice-chair

Julie Mugford, University of Canterbury – Immediate past-chair

Max Soar, Victoria University of Wellington – Te Herenga Waka – Secretary

Neil Birrell, University of Auckland – Communications officer

Stephen Merry, University of Canterbury – Treasurer

Attaullah Sahito, University of Waikato – Committee member

Our research

Complexity, risk, and uncertainty

Today, both society and the economy generate a complex torrent of data. If this unprecedented flow of information is to be made useful, we require new tools and methods for its analysis.

Our work

The measurement, interpretation, and communication of complexity and risk is a key part of modern science. Te Pūnaha Matatini researchers working within the complexity, risk, and uncertainty theme are developing tools for understanding and dealing with complex systems by developing the underlying theory. This includes work on optimising stochastic systems from supply chains to healthcare, inferring numbers of New Zealand birds from their calls (AviaNZ), and building a library of New Zealand soils from their spectral signatures.

Public engagement with science is also a key part of Te Pūnaha Matatini's work, and the researchers in this theme are working on ways to better understand what makes for excellent public engagement, and improve scientists' engagement with diverse publics.

Our impact

Our work is both fundamental and applied. The theory that we develop is used, by ourselves and others, to support applications for the benefit of New Zealand, and international research. This theme is outward-looking, and combines with the other two themes to form integrated projects within Te Pūnaha Matatini, as well as externally.

Research highlight: Risk, reputation, and the strangeness of money

Professor Stephen Marsland and Associate Professor Marcus Frean have been exploring the foundations of money using evolutionary game theory.

One of the things that we've all learned from movies is that a drug deal is a risky thing to do. Exchanging one thing for another with a stranger requires a high level of trust, and when neither party has this trust, the necessary dance to make the exchange requires a cinematic level of intricacy.

We don't often think about how risky it is when we hand over money to a stranger for a good or service, who could easily abscond and leave us empty handed. In a pair of forthcoming articles, Te Pūnaha Matatini Principal Investigators Professor Stephen Marsland and Associate Professor Marcus Frean argue that money originated as a way of measuring and maintaining reputation, and examine the choreography that we use to enable monetary exchange between strangers.

"The apparent simplicity of money stands against its strangeness," they say. "Something of real value is willingly exchanged for an intrinsically worthless token, and attempts to define what is special about it are often circular: money has value because it can be exchanged, and can be exchanged because it has value."

Stephen and Marcus used evolutionary game theory to explore the basis and choreography of money.

"Once money exists, it works really well." says Stephen. "But we were interested in exploring how money could arise in the first place, and whether there is any alternative that could take its place. As a mathematician and physicist who does computer science, we've got the tools of both mathematical proof and simulation to test out ideas and see what works and what doesn't."

Reputations can be seen as a universal currency for human social interactions, functioning as a score by which others might condition their cooperation. "We argue that money is just a method of keeping score," says Stephen. "It says that if you have money then you are worth trading with, and if you don't then you're not. Physically passing a token is a literal way to keep this score."

In their work, Stephen and Marcus found only two possible systems from the broad range of theoretical possibilities to maintain reputational scores that were evolutionarily stable. One of these systems was also physically realisable and grounded the concept of value by incrementing one score at the cost of the other, which precisely matches the token exchange that forms the basis of money.

"Part of the physical aspect of money is conservation," they say. "Because it's a physical thing, you have to actually move it around. The physical system of money has the benefit that nobody has to keep score explicitly." The most common value in the resulting wealth distribution under this system is zero.

"The result that everyone gets excited about is the fact that under our system the most common score is zero, which is kind of astounding," says Stephen. "This arises because the distribution of money is exponential. Once you've got something that is of that form you get a very small number of rich people and therefore, because the money supply is completely fixed, you end up with a small number of very rich people and everyone else gets to zero."

After examining the origins of money as a physical exchange to maintain reputation, Stephen and Marcus went on to simulate the choreography for safe exchange between strangers. "If money is such a great way of swapping, how do we actually make the swap happen?"

Stephen and Marcus used stochastic game theory to show that an 'implicit' hold, whereby a participant believes that they could establish a hold on the items being exchanged or other trader if the other agent looked to be defecting, is enough to enable the simple swaps that are the hallmark of human interactions.

This implicit hold is often achieved through the layout of shops, where someone has to enter the premises of the other in order to perform the exchange. Online shopping has its own ways of building implicit trust, such as high-quality websites, or explicit ways of tracking and displaying the reputation of users.

For Stephen and Marcus, these explorations of money through evolutionary game theory have raised all sorts of interesting questions that can be approached from different perspectives, and he hopes that colleagues across other fields will be able to build upon this work.

"We are interested in the very fundamental aspects," they say. "We hope that our work is a stepping board for all sorts of other people to keep exploring the strangeness of money."

Complex economic and social systems

Te Pūnaha Matatini is using methods from complex systems analysis and organisational-level data sets to understand the role of innovation in productivity growth, and to assess the importance of knowledge, network, and supply-chain spillovers on firm behaviour.

Our work

The last decade has seen dramatic advances in our understanding of complex economic networks. Researchers at Te Pūnaha Matatini are applying new methods from complexity science to better understand New Zealand's economic and innovation performance. New Zealand's failure to close the gap in GDP with other advanced economies has been attributed to our small scale and distance from major markets, but the manner in which these factors influence the New Zealand economy's ability to capture and benefit from knowledge spillovers is largely unexplored. Understanding the potentiality of spillovers from diversity will inform government policy and decision-making, and will assist in the evaluation of the effectiveness and impact of government policies.

Our impact

Our research informs government policy and decision-making, and will assist in the evaluation of the effectiveness and impact of government policies. We work closely with the Ministry of Social Development, the Ministry for Business, Innovation, and Employment, and the Ministry for the Environment, which are sponsors of much of our work.

Research highlight: Gender pay gap in the medical workforce laid bare

Ongoing work by Dr Isabelle Sin into the gender pay gap in Aotearoa New Zealand shows that sexism plays a role, once again, in the medical profession.

Research by Te Pūnaha Matatini Principal Investigator Dr Isabelle Sin and Whānau member Bronwyn Bruce-Brand, published in the British Medical Journal in April 2021, laid bare the gender wage gap in Aotearoa New Zealand's publicly-employed medical workforce.

This research builds upon Izi's ongoing work exploring the drivers of the gender pay gap in Aotearoa. Her previous studies have tested whether men and women are paid different wages for adding the same amount of value to their employer, explored sexism in pay and career progression in academia, and tracked wage decreases after having a baby.

"One of my major research interests at present is gender equality and how we can ensure no one's opportunities are constrained by their gender," says Izi. "So this research fits very well with my goal of identifying and addressing situations where being a certain gender is a disadvantage."

This latest study used census data and tax records from 3510 medical specialists employed by a district health board (DHB) to construct and compare hourly earnings. The results showed that women who work as medical specialists for a DHB earned on average 12.5% lower hourly wages than men of the same age, in the same specialty, who work the same number of hours. Adding controls for a wide range of personal and work characteristics decreased the estimated gap only slightly to 11.2%.

Izi was approached to do this work by the Association of Salaried Medical Specialists (ASMS) – the union for senior doctors – who wanted to know if the women that belong to their union were being paid fairly. Dr Charlotte Chambers from the ASMS joined her as an author on this article.

"Te Pūnaha Matatini has helped to support my research," says Izi, "allowing me to establish myself in this area so organisations who have questions like this approach me. It has also deepened my understanding and appreciation of equity issues that remain problematic in today's society, and has strengthened my resolve to help address these issues through my research."

This work conclusively showed that men earn a large and statistically significant premium over women in the specialised medical workforce that is not explained by age, specialty, or hours of work. "In the context of gender inequality literature, the medical profession is an interesting case study because doctors have a high level of education and high earnings," says Izi. "And we know the gender wage gap tends to be greater at the top end of the income distribution."

"But at the same time nearly all DHB doctors are on a collective employment agreement that specifies minimum pay for each level of experience, which should theoretically limit the potential for a gender wage gap to arise. So studying doctors is informative about the extent to which collective agreements can mitigate gender pay gaps."

Their findings suggest that employment agreements that specify minimum wages for each level of experience, and progression through these levels, are insufficient to eliminate wage gaps between similar men and women with the same experience.

The authors recommend a comprehensive series of gender pay audits within Aotearoa's DHBs to ensure that existing and future remuneration arrangements are fair and unbiased. The ASMS now has a pilot study underway auditing remuneration at three DHBs.

Complexity and the biosphere

Te Pūnaha Matatini is applying network analysis, complexity theory, and dynamical systems methodologies to understand the biosphere; developing models that couple the interactions between biodiversity, the economy, and human decision-making.

Our work

The diversity of life on Earth is the planet's most striking feature; recent estimates are that fewer than a million of approximately eight million animal species have been described.

Biodiversity exists at a large range of physical scales: multicellular eukaryotes have linear dimensions that range in size from tens of microns to tens of metres, and metazoans encompass 17 orders of magnitude by volume.

The ability of next generation sequencing technologies to efficiently and simultaneously analyse massive numbers of DNA molecules has allowed the diversity and ecology of microbial communities to be examined in previously unfeasible depth and detail.

This vast new resource for understanding the hidden majority of species that contribute to New Zealand's terrestrial ecosystems and ecosystem services will require new tools for its analysis and visualisation. The research in this theme informs government policy and decision-making, and assists the New Zealand public in better understanding their relationship with our unique flora and fauna.

Our impact

Our research in complexity and the biosphere provides quantitative tools that help inform national and local government policy and decision-making, for example in biosecurity, conservation management, and pest eradication programmes. Our research aims to provide data to help New Zealanders better understand the relationship between us and our diverse flora and fauna by analysing the iNaturalist citizen science platform.

Research highlight:
Hīkoi, kōrero and community-led restoration of ngahere in Ōtaki

Two masters projects funded by Te Pūnaha Matatini are currently flowing together like a braided river towards creating communications to support community-led environmental restoration in Ōtaki.

Design student Katerina French Armstrong (Tūhoe) and science in society student Vicky Gane have been exploring how to communicate the value of reforestation in very different ways. Katerina's project connects kaupapa Māori and spatial narratives to navigate community-led environmental restoration, while Vicky's project measures the environmental effects of tree planting along the Ōtaki River.

Friends of the Ōtaki River have been carrying out replanting and restoration along a section of this river for over two decades. Associate Professor Rhian Salmon often visits this beautiful, reforested area with her students, and was recently struck by how little she knows about the effect that planting trees has on the environment. Existing signage tells visitors about the organisations that paid for trees to be planted, and people who helped with the planting, but very little about the trees themselves.

Rhian had a vision for creating a designed, living, growing science communication project that could tell visitors about how much carbon particular trees were absorbing, and how that relates to their climate impact. She joined forces with designer Jo Bailey and they decided to approach the project from a transdisciplinary angle, bringing together a design student and a science in society student. They also realised they needed the help of Associate Professor Cate Macinnis-Ng, to contribute her immense knowledge about trees.

For Te Pūnaha Matatini investigators Rhian, Jo and Cate, this is an exciting exploration into deliberately working transdisciplinarily, bringing together science communication, design, ecology and mātauranga Māori. The overall project also tests institutional boundaries, with Rhian based at Victoria University of Wellington – Te Herenga Waka, Jo at Massey University, Cate at the University of Auckland, and funding from Te Pūnaha Matatini.

"The thing that I love is that Kat has taken a big picture approach and looked into what the land used to look like in Ōtaki and how colonisation, politics and human presence have affected it," says Rhian. "And then Vicky's looking at the actual trees."

Katerina currently plans to produce an augmented reality app that shows how key landscapes around Ōtaki looked in the past, and how they could potentially look in the future. Alongside Jo, she has supervision and guidance from artist Associate Professor Huhana Smith (Ngāti Tukorehe, Ngāti Raukawa ki Te Tonga) at Massey University.

"Aotearoa's colonial history, rapid deforestation and land alteration has significantly changed the face of our whenua, and the relationship between tangata and the ngahere," says Katerina. "I grew up beside the Tararua Range and saw deforestation happen right outside my window. That's the point that I could relate to, so I went with that."

Vicky is using allometric equations to calculate the biomass of specific trees, five-minute bird counts and pitfall traps to understand the biodiversity of the area, and analysis of soil to understand its carbon content. She is co-supervised by ecologist Associate Professor Stephen Hartley at Victoria University of Wellington – Te Herenga Waka.

"I haven't done that kind of sampling before," says Vicky. "I come from a conservation biology background, but my main focus before now has been on fauna rather than flora -and definitely not on soil, so I'm learning a lot of new stuff."

The outcomes of both projects will be co-designed with the local community, and are intertwined in a way that Katerina and Vicky compare to a braided river. A central methodology for the two projects is meeting each week in Haruātai Park for a walk and kōrero with Watene Kaihau from local iwi Ngati Raukawa |ki te Tonga.

"It's a co-design process with all the people that we've been meeting along the way," explains Katerina. "This is a new way of working for me, because as a spatial designer I'm used to being handed a brief with set parameters. This project has been really rewarding because it feels a lot more meaningful to the specific site."

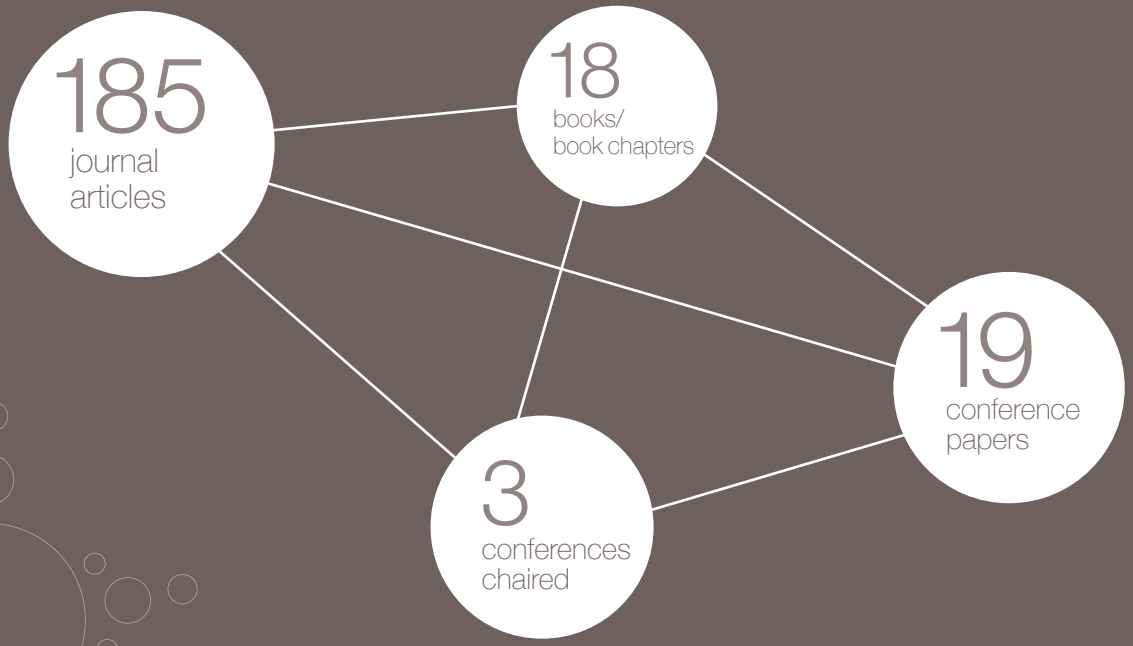
"Our projects connect in interesting ways," says Vicky. "Because I have been coming along to a lot of meetings with Katerina to talk to the locals about the area, I'm being informed by what the area was like originally, people's connections to the land, and the history of the area."

"I'm keeping all that in mind when I'm thinking about the measurements I'm doing. When I come to the next stage of communicating my findings it won't just be the scientific benefits of the site, it will be how it sits in the wider historical landscape and the community."

The results of the overall project are likely to ask questions as much as proffer answers, and Jo hopes that they will stimulate conversation.

"The great thing about this project is that it's taken on a life of its own," concludes Jo. "We've let it fly and it's flown off and transformed in this really beautiful way."

Research outputs



Publications

Journal articles

Highlights publications of note.

Abdelmegid, M. A., González, V.A., **O'Sullivan, M.J., Walker, C.G.,** Poshdar, M. and L.F. Alarcòn. Exploring the links between simulation modelling and construction production planning and control: a case study on the last planner system. *Production Planning & Control,* (2021): 1-18.

Abdelmegid, M., González, V., Poshdar, M., **O'Sullivan, M.J., Walker, C.** and F. Ying. Barriers to adopting simulation modelling in construction industry. *Automation in Construction,* no. 111 (2020): 103046.

Alimi, O., **Maré, D.C.** and J. Poot. Who partners up? Homogamy and income inequality in New Zealand cities. *Journal of Regional Science*. (2021).

Allen, M.S., McAlister, A., Petchey, F., Huebert, J.M., Maeva, M. and B.D. Jones. Marquesan ceramics, palaeotsunami, and megalithic architecture: Ho'oumi Beach site (Nho-3) in regional perspective. *Archaeology in Oceania,* no. 56(2) (2021): 73-99.

Aref S., Mason, A.J. and **M.C. Wilson**. A modelling and computational study of the frustration index in signed networks. *Networks,* no. 75(1) (2020): 95-110.

Arrouays, D., McBratney, A., Bouma, J., Libohova, Z., Richer-de-Forges, A.C., Morgan, C.L.S., **Roudier, P.**, Poggio, L. and V.L. Mulder. Impressions of digital soil maps: The good, the not so good, and making them ever better. *Geoderma Regional,* no. 20 (2020): e00255.

Barrett-Walker, T., **Plank, M.J., Ka'ai-Mahuta, R., Hikuroa, D. and A. James**. Kia kaua te reo e rite ki te moa, ka ngaro: Do not let the language suffer the same fate as the Moa. *Journal of the Royal Society Interface,* no. 17 (2020): 20190526.

Barrett, M., **Watene, K.** and P. McNicholas. Legal personality in Aotearoa New Zealand: an example of integrated thinking on sustainable development. *Accounting, Auditing and Accountability Journal,* no. 33(7) (2020): 1705-1730.

Behzadi, G., **O'Sullivan, M.J. and T.L. Olsen**. On metrics for supply chain resilience. *European Journal of Operational Research,* no. 287(1) (2020): 145-158.

Binny, R.N., Baker, M.G., **Hendy, S.C., James, A., Lustig, A., Plank, M.J., Ridings, K.M. and N. Steyn**. Early intervention is the key to success in Covid-19 control*. Royal Society Open Science*. (2021).

Binny, R.N., Hendy, S.C., James, A., Lustig, A., Plank, M.J. and N. Steyn. Effect of alert level 4 on effective reproduction number: review of international Covid-19 cases. *medRxiv*, (2020).

Binny, R.N., Hendy, S.C., James, A., Lustig, A., Plank, M.J. and N. Steyn. Probability of elimination for Covid-19 in Aotearoa New Zealand. *medRxiv,* (2020).

Binny, R.N., Innes, J., Fitzgerald, N., Pech, R., **James, A.**, Price, R., Gillies, C. and **A.E. Byrom**. Long-term biodiversity trajectories for pest-managed ecological restorations: eradication versus suppression. *Ecological Monographs,* (2020): e01439.

Binny, R.N., Innes, J., Fitzgerald, N., Pech, R., **James**, **A.,** Price, R., Gillies, C. and **A.E. Byrom**. Long-term biodiversity trajectories for pest-managed ecological restorations: eradication vs. suppression. *Ecological Monographs,* No. 91(2) (2021): e01439.

Binny, R.N., Law, R. and **M.J. Plank**. Living in groups: Spatial-moment dynamics with neighbour-biased movements. *Ecological Modelling,* no. 415 (2020): 108825.

Binny, R.N., Lustig, A., Brower, A., Hendy, S.C., James, A., Parry, M., Plank, M.J. and N. Steyn. Effective reproduction number for Covid-19 in Aotearoa New Zealand. *medRxiv*. (2020).

Bloch, F., Fabrizi, S. and **S. Lippert**. Experimentation and entry with common values. (2020).

Brower, A.L. and A. James. Research performance and age explain less than half of the gender pay gap in New Zealand universities. *PLoS ONE,* no. 15 (2020): e0226392.

Brower, A.L., Harding M.A.C., Head N.J. and S. Walker. South Island high country: Let's get it right this time. *New Zealand Journal of Ecology,* no. 44 (2020): 3405.

Burgess, M.G. and **M.J. Plank**. What unmanaged fishing patterns reveal about optimal management: Applied to the balanced harvesting debate. *ICES Journal of Marine Science*, no. 77(3) (2020): 901-910.

Cadelis, M.M., Copp, B.R. and **S. Wiles**. A review of fungal protoilludane sesquiterpenoid natural products. *Antibiotics,* no. 9 (2020): 1.

Cadelis, M.M., Geese, S., Gris, L., Weir, B.S., Copp, B.R. and **S. Wiles**. A revised structure and assigned absolute configuration of theissenolactone A. *Molecules,* no. 25 (2020).

Came, H., **Matheson, A.** and J. Kidd. Smashing the patriarchy to address gender health inequities: Past, present and future perspectives from Aotearoa (New Zealand). *Global Public Health*, (2021): 1-11.

Carroll, S. R., Garba, I., Figueroa-Rodríguez, O. L., Holbrook, J., Lovett, R., Materechera, S., Parsons, M., Raseroka, K., Rodriguez-Lonebear, D. and **M. Hudson**. The CARE principles for Indigenous data governance. *Data Science Journal*. no. 19(1) (2020): 43.

Casana, J., Laugier, E.J., Hill, A.C., Reese, K.M., Ferwerda, C., McCoy, M. and **T. Ladefoged**. Exploring archaeological landscapes using drone-acquired lidar: Case Studies from Hawai'i, Colorado, and New Hampshire, USA*. Journal of Archaeological Science: Reports,* no. 39 (2021): 103133.

Ceni, A., Ashwin, P., Livi, L. and **C. Postlethwaite**. The echo index and multistability in input-driven recurrent neural networks. *Physica D: Nonlinear Phenomena,* no. 412 (2020): 132609.

Chan, V., Reihana, P., Pope, R-N-A., Owen, R., **Frean, M.** and S. Shep. Indigenous frameworks for data-intensive humanities: recalibrating the past through knowledge engineering and generative modelling*. Journal of Data Mining & Digital Humanities,* (2021).

Corbet, S., Hou, G., Hu, Y. and **L. Oxley.** We Reddit in a forum: The influence of messaging boards on firm stability. (2021).

Corbet, S., Hou, G., Hu, Y., **Oxley, L.** and D. Xu. Pandemic -related financial market volatility spillovers: Evidence from the Chinese Covid-19 epicentre. *International Review of Economics & Finance,* no. 71 (2020): 55-81.

Corbet, S., Hou, Y., Hu, Y. and **L. Oxley**. The influence of the Covid-19 pandemic on asset-price discovery: Testing the case of Chinese informational asymmetry. *International Review of Financial Analysis*, no. 72 (2020): 101560.

Corbet, S., Hou, Y., Hu, Y., Lucey, B. and **L. Oxley.** Aye Corona! The contagion effects of being named Corona during the Covid-19 pandemic. *Finance Research Letters,* no. 38 (2021): 101591.

Corbet, S., Hou, Y.G., Hu, Y., Larkin, C. and **L. Oxley**. Any port in a storm: Cryptocurrency safe-havens during the Covid-19 pandemic. *Economics Letters,* no. 194 (2020): 109377.

Corbet, S., Hou, Y.G., Hu, Y., Larkin, C., Lucey, B. and **L. Oxley.** Cryptocurrency liquidity and volatility interrelationships during the Covid-19 pandemic. *Finance Research Letters,* (2021): 102137.

Corbet, S., Hou, Y.G., Hu, Y., **Oxley, L.** and D. Xu. Pandemic-related financial market volatility spillovers: Evidence from the Chinese Covid-19 epicentre. *International Review of Economics & Finance,* no. 71 (2021): 55-81.

Dauros-Singorenko, P., **Wiles, S.** and S. Swift. Staphylococcus aureus biofilms and their response to a relevant in vivo iron source. *Frontiers in Microbiology,* no. 11 (2020).

Davies, B. and D.C. Maré. Relatedness, complexity and local growth. *Regional Studies,* No. 55 (2020): 479-494.

Dawes, T., **Muru-Lanning, M.**, Lapsley, H., Hopa, N., Dixon, N., Moore, C., Tukiri, C., Jones, N., Muru-Lanning, C. and M. Oh. Hongi, harirū and hau: Kaumātua in the time of Covid-19. *Journal of the Royal Society of New Zealand,* no. 51(sup 1) (2021): S23-S36.

Dombroski, K., Diprose, G., **Sharp, E.L.** et al. Food for people in place: Reimagining food systems for economic recovery. *Sustainability,* no. 12 (2020): 9369.

Douglas, J., Geoghegan, J.L., Hadfield, J., Bouckaert, R., Storey, M., Ren, X., de Ligt, J., French, N. and **D. Welch**. Real-time genomics to track Covid-19 post-elimination border incursions in Aotearoa New Zealand. *medRxiv,* (2021).

Douglas, J., Mendes, F. K., Bouckaert, R., Xie, D., Jimenez-Silva, C. L., Swanepoel, C., de Ligt, J., Ren, X., Storey, M. and **D. Welch**. Phylodynamics reveals the role of human travel and contact tracing in controlling Covid-19 in four island nations. *medRxiv,* (2020).

Douglas, J., Mendes, F.K., Bouckaert, R., Xie, D., Jiménez-Silva, C.L., Swanepoel, C., de Ligt, J., Ren, X., Storey, M., Hadfield, J., Simpson, C.R., Geoghegan, J.L., Drummond, A.J. and **D. Welch**. Phylodynamics reveals the role of human travel and contact tracing in controlling the first wave of Covid-19 in four island nations. *Virus Evolution,* (2021): veab052.

Egbert, M.D., Jeong, V. and **C.M. Postlethwaite**. Where computation and dynamics meet: Heteroclinic network-based controllers in evolutionary robotics. *IEEE Transactions on Neural Networks and Learning Systems,* no. 31 (2020): 1084-1097.

El-Naggar, A. G., Hedley, C. B.**, Roudier, P.**, Horne, D. and B. E. Clothier. Imaging the electrical conductivity of the soil profile and its relationships to soil water patterns and drainage characteristics. *Precision Agriculture,* no. 22 (2021): 1045-1066.

El-Naggar, A.G., Hedley, C.B., Horne, D., **Roudier, P.** and B.E. Clothier. Soil sensing technology improves application of irrigation water. *Agricultural Water Management,* no. 228 (2020): 105901.

Farooq, U., Rack, W., **McDonald, A.** and S. Howell. Long-term analysis of sea ice drift in the western Ross sea, Antarctica, at high and low spatial resolution. *Remote Sensing,* no. 12 (2020): 1402.

Firestone, R., Faeamani, G., Okiakama, E., Funaki, T., Henry, A., Prapaveissis, D., Filikitonga, J., **Matheson, A.** et al. Pasifika prediabetes youth empowerment programme: Evaluating a co-designed community-based intervention from a participants' perspective. *Kōtuitui: New Zealand Journal of Social Sciences Online,* no. 16(1) (2021): 210-224.

Firestone, R., Faeamani, G., Okiakama, E., Funaki, T., Henry, A., Prapavessis, D., Masaga, J., **Matheson, A.** et al. Pasifika prediabetes youth empowerment programme: Learnings from a youth-led community-based intervention study. *The New Zealand Medical Journal,* no. 134 (2021): 57-68.

Firestone, R., **Matheson, A.**, Firestone, J., Schleser, M., Yee, E., Tuisano, H., Kaholokula, K. and L. Ellison-Loschmann. Developing principles of social change as a result of a Pasifika youth empowerment program: A qualitative study. *Health Promotion Journal of Australia,* (2020).

Fisher, D.N., Le Grice, R.J. and **C.J. Painting**. Social selection is density dependent but makes little contribution to total selection in New Zealand giraffe weevils. *Proceedings of the Royal Society B: Biological Sciences,* no. 288 (2021): 20210695.

Fitzgerald, N., **Binny, R.N.,** Innes, J., Pech, R., **James, A.**, Price, R., Gillies, C. and **A.E. Byrom.** Long-term biodiversity benefits from invasive mammalian pest control in ecological restorations. *Bulletin of the Ecological Society of America,* no.102(2) (2021): 1-3.

Frank, S.A. and **W. Godsoe**. The generalized price equation: Forces that change population statistics. *Frontiers in Ecology and Evolution,* no. 8 (2020): 240.

Fukuzawa, Y., Webb, W.H., Pawley, M.D.M., Roper, M.M., **Marsland, S.**, Brunton, D.H. and A. Gilman. Koe: Web-based software to classify acoustic units and analyse sequence structure in animal vocalizations. *Methods in Ecology and Evolution,* No. 11(3) (2020): 431-441.

Furian, N., **O'Sullivan, M.J., Walker, C**. and E. Çela. A machine learning-based branch and price algorithm for a sampled vehicle routing problem. *OR Spectrum,* no. 43 (2021): 693-732.

Gahegan, M. Fourth paradigm GIScience? Prospects for automated discovery and explanation from data. *International Journal of Geographical Information Science,* no. 34 (2020): 1.

Gawith, D., Hodge, I., **Morgan, F.** and A. Daigneault. Climate change costs more than we think because people adapt less than we assume. *Ecological Economics,* no. 173 (2020): 106636.

Geoghegan, J. L., Ren, X., Storey, M., Hadfield, J., Jelley, L., Jefferies, S., Sherwood, J., Paine, S., Huang, S. and **D. Welch**. Genomic epidemiology reveals transmission patterns and dynamics of SARS-CoV-2 in Aotearoa New Zealand. *Nature communications,* no. 11 (2020): 6351.

Geoghegan, J.L., Douglas, J., Ren, X., Storey, M., Hadfield, J., Silander, O.K., **Welch, D.** et al. Use of Genomics to Track Coronavirus Disease Outbreaks, New Zealand. *Emerging infectious diseases,* no. 27(5) (2021): 1317-1322.

Ghasemkhani, H., Goes, P. and **A. Tripathi.** Effect of market information on bidder attrition in online auction markets. *MIS Quarterly*, (2021).

Glover, H.J., **Ladefoged, T.N**. and E.E. Cochrane. Costly signalling and the distribution of monumental mounds in Savai'i and 'Upolu, Sāmoa. *Archaeology in Oceania,* no. 55 (2020): 141.

Gokhale, C.S., Bulbulia, J. and **M. Frean**. Collective narratives catalyse cooperation. *SocAriXiv*. (2020).

Governale, M., Bhandari, B., Taddei, F., Imura, K.-I. and **U. Zülicke**. Finite-size effects in cylindrical topological insulators. *New Journal of Physics,* no. 22 (2020).

Gray, L., Macdonald, C., Tassell-Matamua, N., Stanley, J., Kvalsvig, A., Zhang, J., Murton, S., **Wiles, S.**, Puloka, V., Becker, J., Johnston, D. and M.G. Baker. Wearing one for the team: Views and attitudes to face covering in New Zealand/Aotearoa during Covid-19 Alert Level 4 lockdown. *Journal of Primary Health Care,* no. 12 (2020): 199.

Gupta, P. and **M. Gahegan**. Categories are in flux, but their computational representations are fixed: That's a problem. *Transactions in GIS,* no. 24 (2020): 291.

Hackney, M., James, A. and M. J. Plank. Cooperative and non-cooperative behaviour in the exploitation of a common renewable resource with environmental stochasticity. *Applied Mathematical Modelling,* no. 89 (2020): 1041-1054.

Hall, M. M., **Wehi, P. M.**, Whaanga, H., **Walker, E.** T., Koia, J. H. and K. J. Wallace. Promoting social and environmental justice to support Indigenous partnerships in urban ecosystem restoration. *Restoration Ecology,* no. 29 (2020): e13305.

Harvey, J.A., Heinen, R., Armbrecht, I., Basset, Y., Baxter-Gilbert, J.H., Bezemer T. M., Böhm, M., **Painting, C.J.** et al. International scientists formulate a roadmap for insect conservation and recovery. *Nature Ecology & Evolution,* no. 4 (2) (2020): 174-176.

Helton, J. W., Kelly, F. P., Williams, R. J. and **I. Ziedins**. A Fluid Model of a Traffic Network with Information Feedback and Onramp Controls. *Applied Mathematics & Optimization*. (2021): 09766-8.

Hendy, S.C., Steyn, N., James, A., Plank, M.J., Hannah, K., Binny, R.N. and **A. Lustig.** Mathematical modelling to inform New Zealand's Covid-19 response. *Journal of The Royal Society Interface,* no. 51 (sup1) (2021): S86-S106.

Hu, Y., Hou, Y.G. and **L. Oxley**. What role do futures markets play in Bitcoin pricing? Causality, cointegration and price discovery from a time-varying perspective?. *International Review of Financial Analysis,* no. 72 (2020): 101560.

Hu, Y., Hou, Y.G., **Oxley, L.** and S. Corbet. Does blockchain patent-development influence Bitcoin risk?. *Journal of International Financial Markets, Institutions and Money,* no. 70 (2021): 101263.

Hudson, M., Nanibaa'A, G., Sterling, R., Caron, N. R., Fox, K., Yracheta, J., Anderson, J., Wilcox, P., Arbour, L. and Brown, A. Rights, interests and expectations: Indigenous perspectives on unrestricted access to genomic data. *Nature Reviews Genetics,* no. 21 (2020): 377-384.

Huebert, J.M. and **M.S. Allen**. Anthropogenic forests, arboriculture, and niche construction in the Marquesas Islands (Polynesia). *Journal of Anthropological Archaeology,* no. 57 (2020): 101122.

James-Scotter, M.S., Jiang, L. and **C. Walker**. A daily measure of job satisfaction in the operating room: Investigating its value and viability. *Journal of Perioperative Nursing,* no. 33 (2020): article 3.

James, A., Hendy, S.C., Plank, M.J. and N. Steyn. Suppression and mitigation strategies for control of Covid-19 in New Zealand. *medRxiv*. (2020).

James, A., Plank, M.J., Binny, R.N., Lustig, A., Hannah, K., Hendy, S.C. and N. Steyn. A structured model for Covid-19 spread: modelling age and healthcare inequities. *Mathematical Medicine and Biology: A Journal of the IMA*. no. 38(3) (2021): 299-313.

James, A., Plank, M.J., Hendy, S.C., Binny, R., Lustig, A., Steyn, N., Nesdale, A. and A. Verrall. Successful contact tracing systems for Covid-19 rely on effective quarantine and isolation. *PLOS One,* no. 16 (6) (2021): e0252499.

James, A., Plank, M.J., Hendy, S.C., Binny, R.N., Lustig, A. and N. Steyn. Model-free estimation of Covid-19 transmission dynamics from a complete outbreak. *PLOS One,* no. 16(3) (2021): e0238800.

Jones, D.J., **Hikuroa, D.**, Gregory, E., Ihaka-McLeod, H. and T. Moko-Mead. Weaving mātauranga into environmental decision-making. *New Zealand Science Review – Mātauranga and Science Special Issue,* no. 76 (2020): 49-53.

Juodakis, J., Castro, I. and S. Marsland. Precision as a metric for acoustic survey design using occupancy or spatial capture-recapture. *Environmental and Ecological Statistics,* no. 28 (2021): 587-608.

Kempa-Liehr A.W., Lin C.Y.-C., Britten R., Armstrong D., Wallace J., Mordaunt D. and **M.J. O'Sullivan**. Healthcare pathway discovery and probabilistic machine learning. *International Journal of Medical Informatics,* no. 137 (2020): 104087.

Kingsley M.R., Lavers J.L., **Steeves T.E.** and C.P. Burridge. Genetic distinctiveness of Masked Booby (Sula dactylatra) on Bedout Island, Western Australia. *Emu,* no. 120 (2020): 150.

Köhnke M.C., **Binny R.N.**, Holland E.P. and **A. James**. The necessity of tailored control of irrupting pest populations driven by pulsed resources. *Theoretical Ecology,* no. 13 (2020): 261-275.

Kukutai, T., McIntosh, T., Barnes, H. M. and T. McCreanor. New Normal – Same inequities or engaged Te Tiriti partnership? *A New Zealand Journal of Indigenous Scholarship,* no. 9(4) (2020).

Kuma, P., **McDonald, A. J.**, Morgenstern, O., Querel, R., Silber, I. and C. J. Flynn. Ground-based lidar processing and simulator framework for comparing models and observations (ALCF 1.0). *Geoscientific Model Development,* no. 14(1) (2021): 43-72.

L'Hermitte, C. and **N.K.C. Nair**. A blockchain-enabled framework for sharing logistics resources in emergency operations. *Disasters*. (2020).

Ladefoged, T.N., McCoy, M.D. and M.W. Graves. The dynamics of collective action and political agency in the leeward Kohala hinterlands, Hawai'i Island*. Journal of Pacific Archaeology,* no. 11 (2020): 44105.

Lazo, V. G., **Locke, K**., Rupcich, N., O'Connor, G., Yoon, C. and A. Longley. Pedagogy and social critique in the era of fragmentation: A collective writing experiment as cadavres exquis: Visual knowledge creation and critique*. Video Journal of Education and Pedagogy,* (2021): 1-22.

Le Heron, E., Allen, W., Le Heron, R., Logie, M., Glavovic, B., Greenaway, A.**, Hikuroa, D.**, Davies, K. and P. Blackett. What does success look like? An indicative rubric to assess and guide the performance of marine participatory processes. *Ecology and Society,* no. 26(1) (2021): 29.

Lee, J. E., Brook, E. J., Bertler, N. A., Buizert, C., **Baisden, T.**, Blunier, T., Ciobanu, V. G., Conway, H., Dahl-Jensen, D. and T. J. Fudge. An 83 000-year-old ice core from Roosevelt Island, Ross Sea, Antarctica. *Climate of the Past,* no. 16(5) (2020): 1691-1713.

Leihy R.I., Coetzee B.W.T., **Morgan F.**, Raymond B., Shaw J.D., Terauds A., Bastmeijer K. and S.L. Chown. Antarctica's wilderness fails to capture continent's biodiversity. *Nature,* no. 583 (2020): 567-571.

Leonard, G.H., Turner, K. E., **Richter, M. E.**, Whittaker, M. S. and I. J. Smith. Brief communication: The anomalous winter 2019 sea ice conditions in McMurdo Sound, Antarctica. *The Cryosphere,* no. 352 (2020).

Locke, K., Johnson, C. and A. Jones. Little paroxysms of rage: A conversation about academia and feminism with Professor Alison Jones. *Women's Studies Journal,* no. 34 (2020): 137-148.

Locke, K., Lund, R.W.B. and S. Wright. Rethinking gender equity in the contaminated university: A methodology for listening for music in the ruins. *Gender, Work & Organization,* no. 28(3) (2021): 1079-1097.

Locke, K., Rahman, A. and C. Johnson. Decolonising white feminism in Aotearoa/New Zealand: An interview with Anjum Rahman. *Women's Studies Journal,* no. 34 (2020): 149-160.

Loiseau, T., Richer-de-Forges, A. C., **Roudier, P.**, Ducommun, C., Chen, S., Lagacherie, P. and D. Arrouays. Essais de représentation cartographique de l'incertitude pour les utilisateurs de cartographies des sols par modélisation statistique*. Etude et Gestion des Sols, Association Française pour l'Etude des Sols,* no. 27 (2020): 257-275.

Luczak-Roesch, M. Networks of information token recurrences derived from genomic sequences may reveal hidden patterns in epidemic outbreaks: A case study of the 2019-nCoV coronavirus*. Medrxiv*. (2021).

Macinnis-Ng, C., Mcintosh, A.R., Monks, J.M., Waipara, N., White, R.S.A., Boudjelas, S., C.D. Clark et al. Climate-change impacts exacerbate conservation threats in island systems: New Zealand as a case study. *Frontiers in Ecology and the Environment,* no. 19(4) (2021): 216-224.

Manson, S., An, L., Clarke, K.C., Heppenstall, A., Koch, J., Krzyzanowsk,i B., **Morgan, F.,** O'Sullivan, D., Runck, B.C., Shook, E. and L. Tesfatsion. Methodological issues of spatial agent-based models. *JASSS,* no. 23(1) (2020): 3.

Mashhadi Moghaddam, S., **O'Sullivan, M.J., Walker, C.**, Fotuhi Piraghaj, S. and C.P. Unsworth. Embedding individualized machine learning prediction models for energy efficient VM consolidation within cloud data centers. *Future Generation Computer Systems,* no. 106 (2020): 221-233.

Matheson, A. Health inequality as a large-scale outcome of complex social systems: Lessons for action on the sustainable development goals. *International Journal of Environmental Research and Public Health,* no. 17 (2020): 2684.

Matheson, A., Kidd, J. and H. Came. Women, patriarchy and health inequalities: The urgent need to reorient our systems. *International Journal of Environmental Research and Public Health,* no. 18(9) (2021): 4472.

Matsuoka, K., Skoglund, A., Roth, G., de Pomereu, J., Griffiths, H., Headland, R., Herried, R., **Morgan F**. et al. Quantarctica, an integrated mapping environment for Antarctica, the Southern Ocean, and sub-Antarctic islands. *Environmental Modelling & Software,* no. 140 (2021): 105015.

McAllister, T.G., Naepi, S., Wilson, E., **Hikuroa, D.** and **L.A. Walker**. Under-represented and overlooked: Māori and Pasifika scientists in Aotearoa New Zealand's universities and crown-research institutes. *Journal of the Royal Society of New Zealand,* (2020): 42370.

McCarthy, J. K., Leathwick, J.R., **Roudier, P.**, Barringer, J.R.F., Etherington, T.R., **Morgan, F.J.**, Odgers, N.P., Price, R.H., Wiser, S.K. and S. J. Richardson. New Zealand Environmental Data Stack (NZEnvDS): A standardised collection of spatial layers for environmental modelling and site characterisation. *New Zealand Journal of Ecology,* no. 45(2) (2021): 3440.

McCoy, M., Casana, J., Hill, A., Laugier, E., Mulrooney, M. and **T. Ladefoged.** Unpiloted aerial vehicle acquired lidar for mapping monumental architecture: A case study from the Hawaiian Islands. *Advance in Archaeological Practice*. no. 9(2) (2021): 160-174.

McDonald, A.J. and L.H. Cairns. A new method to evaluate reanalyses using synoptic patterns: An example application in the Ross Sea/Ross Ice Shelf region. *Earth and Space Science,* no. 7 (2020): e2019EA000794.

McErlich, C., **McDonald, A.**, Schuddeboom, A. and I. Silber. Comparing satellite- and ground-based observations of cloud occurrence over high southern latitudes. *Journal of Geophysical Research: Atmospheres,* no. 126 (6) (2021): e2020JD033607.

McGeorge, E.K., Sellier, M., Moyers-Gonzalez,.M. and P.L. Wilson. Bedrock reconstruction from free surface data for unidirectional glacier flow with basal slip. *Acta Mech,* no. 232 (2020): 305-322.

Moghaddam, S. M., **O'Sullivan, M.J.,** Unsworth, C.P., Piraghaj, S.F. and **C. Walker.** Metrics for improving the management of cloud environments: Load balancing using measures of quality of service, service level agreement violations and energy consumption. *Future Generation Computer Systems,* no. 123 (2021): 142-155.

Moore, A. and **M. Gahegan**. GeoComputation 2019 special feature. *Journal of Spatial Information Science,* no. 21 (2020): 175.

Mugford, J., Moltchanova, E., **Plank, M.J.**, Sullivan, J., **Byrom, A., and A. James**. Citizen science decisions: A Bayesian approach optimises effort. *Ecological Informatics,* no. 63 (2021): 101313.

Mulgan, T., Enright, S., Grix, M., Jayasuriya, U., Ka 'ili, T.O., Lear, A.M, Māhina,'A.N.M., **Watene, K.** et al. Charting just futures for Aotearoa New Zealand: philosophy for and beyond the Covid-19 pandemic. *Journal of the Royal Society of New Zealand,* no. 51(sup 1) (2021): S167-S178.

Murdoch, D., Addidle, M., Andersson, H.-S., Arnold, B., Balm, M., Benschop, J., Betty, B., Birch, M., Bloomfield, M., Brunton, C., Burns, A., Chambers, S., Cook, L., Dalton, S., Duncan, H., Elvy, J., Everts, R., Freeman, J., French, N., Grimwade, K., Hammer, D., **Hayman, D.**, Holland, D., Hudson, B., Huggan, P., Ikram, R., Jack, S., Kelly, M., Lamont, I., Maze, M., McAuliffe, G., McBride, S., Metcalf, S., Morpeth, S., Morris, A., Murton, S., Pink, R., Pithie, A., Pitout, M., Priest, P., Raymond, N., Read, K., Ritchie, S., Rogers, M., Schroeder, P., Taylor, S., Taylor, J., Thomas, M., Upton, A., Ussher, J., Werno, A. and **S. Wiles**. Politicians: please work together to minimise the spread of Covid-19. *The New Zealand Medical Journal,* no. 133 (2020): 7.

Muru-Lanning, M., Lapsley, H. and T. Dawes. Ko ngā kaumātua ngā poupou o tō rātou ao: kaumātua and kuia, the pillars of our understanding. *AlterNative: An International Journal of Indigenous Peoples,* (2021): 246-253.

Naepi, S., **McAllister**, T.G., Thomsen, Leenen-Young, P.M., **Walker, L.A**. McAllister, A.L. Theodore, R., Kidman, J. and T. Suaaliia. The pakaru 'pipeline': Māori and Pasifika pathways within the academy. *The New Zealand Annual Review of Education,* no. 24 (2020): 142.

Naepi, S., Wilson, E., Lagos, S., Manuela, S., **McAllister, T.G.**, Kidman, J., Theodore, R. and J. Kokaua. Where are we now? Patterns of Māori and Pasifika enrolment in the natural and physical science and society and culture fields in Aotearoa New Zealand. *Higher Education Research & Development,* no. 40 (2021): 90-103.

Nims, R., Filimoehala, D., **Allen, M.S.** and V.L. Butler. When less is more: Element selection as sampling strategy in zooarchaeology. *Journal of Archaeological Science,* no. 121 (2020): 105205.

Noy, S. and **I. Sin**. The effects of neighbourhood and workplace income comparisons on subjective wellbeing. *Journal of Economic Behavior and Organization,* (2020).

O'Sullivan, D., **Gahegan, M.**, Exeter D.J. and B. Adams. Spatially explicit models for exploring Covid-19 lockdown strategies. *Transactions in GIS,* no. 24 (2020): 967.

Odiathevar, M., Seah, W.K.G., **Frean, M.** and A. Valera. An online offline framework for anomaly scoring and detecting new traffic in network streams. *IEEE Transactions on Knowledge and Data Engineering,* (2021).

Oz, B., Shneer, S. and **I. Ziedins**. Static vs accumulating priorities in healthcare queues under heavy loads. *arXiv*. (2020).

Parli, A., Besson, A., **Wehi, P.** and S. Johnson. Sub-lethal exposure to a mammalian pesticide bait alters behaviour in an orthopteran. *Journal of Insect Conservation,* no. 24 (2020): 535.

Plank, M.J., James, A. and N. Steyn. Comment: weekly Covid-19 testing with household quarantine and contact tracing is feasible and would probably end the epidemic. *Royal Society Open Science,* no. 8(6) (2021): 201546.

Plank, M.J., Binny, R.N., Hendy, S.C., Lustig, A., James, A. and N. Steyn. A stochastic model for Covid-19 spread and the effects of Alert Level 4 in Aotearoa New Zealand. *medRxiv*. (2020).

Plank, M.J., James, A., Lustig, A., Steyn, N., Binny, R.N. and S.C. Hendy. Potential reduction in transmission of Covid-19 by digital contact tracing systems. *medRxiv,* (2020).

Plank, M.J., Simpson, M.J. and **R.N. Binny**. Small-scale spatial structure influences large-scale invasion rates. *Theoretical Ecology,* no. 13 (2020): 277-288.

Prebble, M., Anderson, A.J., Augustinus, P., Emmitt, J., Fallon, S.J., Furey, L.L., Holdaway, S.J., Jorgensen, A., **Ladefoged, T.N.** and P.J. Matthews. Reply to Barber: Marginal evidence for taro production in northern New Zealand between 1200 and 1500 CE. *Proceedings of the National Academy of Sciences,* no. 117(3) (2020): 1259-1260.

Priyadarshani, N., Marsland, S., Juodakis, J., Castro, I. and V. Listanti. Wavelet filters for automated recognition of birdsong in long-time field recordings. *Methods in Ecology and Evolution,* no. 11(3) (2020): 403-417.

Qasim, M. and A. Grimes. Sustainability and wellbeing: the dynamic relationship between subjective wellbeing and sustainability indicators. *Environment and Development Economics,* (2021): 1-19.

Qasim, M., Oxley L. and E. McLaughlin. Genuine savings as a test of New Zealand weak sustainability. *Environment, Development and Sustainability,* No. 22 (2020): 89-127.

Qian X., and **T.L. Olsen**. Financial and risk management in agricultural cooperatives with application to the milk industry in New Zealand. *International Journal of Production Research,* (2020).

Qian X., and **T.L. Olsen**. Operational and financial decisions within proportional investment cooperatives. *Manufacturing and Service Operations Management,* no. 22(3) (2020): 429-643.

Rayner S., Clough T.J., **Baisden T.** and J. Moir. Can ruminant urine-N rate and plants affect nitrate leaching and its isotopic composition?. *New Zealand Journal of Agricultural Research,* no. 63(1) (2020): 87-105.

Rayner, M.J., Van Loenen, A.L., Shepherd, L.D., Cubrinovska, I.L.I.N.A., Scofield, R.P., Tennyson, A.J.D., Bunce, M. and **T.E. Steeves**. Comprehensive evidence for subspecies designations in Cook's Petrel Pterodroma cookii with implications for conservation management. *Bird Conservation International,* (2020).

Rho, Y., Fabrizi, S. and **S. Lippert**. Employee characteristics, absorptive capacity and innovation. *Munich Personal RePEc Archive,* (2021): 106407.

Ricardo, H., Wilson, D.J. and **P.M. Wehi**. Kiore (Rattus exulans) distribution and relative abundance on a small highly modified island. *New Zealand Journal of Zoology,* (2020): 1.

Richer-de-Forges, A.C., Lowe, D.J., Minasny, B., Adamo, P., Amato, M., Ceddia, M. B., dos Anjos, L.H., Chang, S. X., Chen, S. and **P. Roudier**. A review of the world's soil museums and exhibitions. *Advances in Agronomy,* no. 166 (2020): 277-304.

Roudier, P., Burge, O.R., Richardson, S.J., McCarthy, J.K., Grealish, G.J. and A.-G. Ausseil. National scale 3d mapping of soil ph using a data augmentation approach. *Remote Sensing,* No. 12(28) (2020): 2872.

Rulli, M.C., D'Odorico, P., Galli, N., **Hayman, D.T.H.** et al. Land-use change and the livestock revolution increase the risk of zoonotic coronavirus transmission from rhinolophid bats. *Nature Food,* no. 2 (2021): 409-416.

Sabetizade, M., Gorji, M., **Roudier, P.**, Zolfaghari, A.A. and A. Keshavarzi. Combination of MIR spectroscopy and environmental covariates to predict soil organic carbon in a semi-arid region. *Catena,* no. 196 (2021): 104844.

Safaei, S., Hendy, S.C. and G.R. Willmott. Stability of amphiphilic Janus dimers in shear flow: A molecular dynamics study. *Soft Matter,* no. 16(30) (2020).

Sakhaee, N. and M.C. Wilson. Information extraction framework to build legislation network. *Artificial Intelligence and Law,* no. 29 (2020): 35-58.

Salmon, R.A. and R.K. Priestley. Celebrating IPY education, outreach and engagement – 10 years on*. Polar Record*. no. 56 (2020): e2.

Salmon, R.A., Rammell, S., Emeny, M.T. and S. Hartley. Citizens, scientists, and enablers: A tripartite model for citizen science projects. *Diversity,* no. 13(7) (2021): 309.

Salvador, R. B., Tomotani, B. M., O'Donnell, K. L., Cavallari, D. C, Tomotani, J. V., **Salmon, R. A.**, and J. Kasper. Invertebrates in science communication: Confronting scientists' practices and the public's expectations. *Frontiers in Environmental Science,* (2021): 606416.

Sanjari M.J., Gooi H.B. and **N.K.C. Nair**. Power generation forecast of hybrid PV-Wind system. *IEEE Transactions on Sustainable Energy,* no. 11(2) (2020): 703-712.

Saranchimeg, S. and **N. K. Nair**. A novel framework for integration analysis of large-scale photovoltaic plants into weak grids. *Applied Energy,* no. 282 (2020): 116141.

Schori, J.C., **Steeves T.E.** and T.J. Murray. Informing the design of a long-term population density monitoring protocol for a Nationally Endangered grasshopper: removal sampling as a basis for estimating individual detection probabilities. *Journal of Insect Conservation,* no. 24 (2020): 841.

Sear, D.A., **Allen, M.S.**, Hassall, J.D., Maloney, A.E., Langdon, P.G., Morrison, A.E., Henderson, A.C.G., Mackay, H., Croudace, I.W., Clarke, C., Sachs, J.P., Macdonald, G., Chiverrell, R.C., Leng, M.J., Cisneros-Doza, I L.M. and T. Fonville. Human settlement of East Polynesia earlier, incremental, and coincident with prolonged South Pacific drought. *Proceedings of the National Academy of Sciences of the United States of America,* no. 117(16) (2020): 8813-8819.

Sharma, S.R., **Matheson, A.**, Lambrick, D., Faulkner, J., Lounsbury, D.W., Vaidya, A. and R. Page. Individual and community experience of rising burden of non-communicable diseases in two case districts of Nepal: a qualitative exploration. *Global Health Promotion,* (2021).

Sharma, S.R., **Matheson, A.**, Lambrick, D., Faulkner, J., Lounsbury, D.W., Vaidya, A. and R. Page. The role of tobacco and alcohol use in the interaction of social determinants of non-communicable diseases in Nepal: A systems perspective. *BMC Public Health,* no. 20 (2020): 1368.

Sharp, E.L. Care-fully enacting diverse foodworlds in Auckland, Aotearoa New Zealand. *Gender, Place and Culture,* no. 27(8) (2020): 1214-1218.

Shaw, V.M., Yu, A., Parsons, M., **Olsen, T.** and **C. Walker.** Acute assessment services for patient flow assistance in hospital emergency departments. *Cochrane Database of Systematic Reviews,* (2021).

Shep, S., **Frean, M.**, Owen, R., Reihana, P. and V. Chan. Indigenous frameworks for data-intensive humanities: recalibrating the past through knowledge engineering and generative modelling. *Journal of Data Mining and Digital Humanities*. (2020).

Sin, I. and N. Chappell. The effect of trial periods in employment on firm hiring behavior. *IZA Journal of Labor Policy,* no. 10(1) (2020).

Sin, I., Stillman, S. and R. Fabling. What drives the gender wage gap? Examining the roles of sorting, productivity differences, bargaining and discrimination. *Review of Economics and Statistics,* (2020): 16072.

Singh, C.K., **Vasques Filho, D.**, Jolad, S. and **D.R.J. O'Neale**. Evolution of interdependent co-authorship and citation networks*. Scientometrics,* no. 125 (2020): 385-404.

Soh K.W., **Walker C., O'Sullivan M.J.**, Wallace J. and D. Grayson. Case study of the prediction of elective surgery durations in a New Zealand teaching hospital. *International Journal of Health Planning and Management,* no. 35 (2020): 1593-1605.

Soh, K.W., **Walker, C. and M.J. O'Sullivan**. Comparison of jackknife and hybrid-boost model averaging to predict surgery durations: A case study. *SN Computer Science,* no. 1 (2020): 316.

Soh, K.W., **Walker, C. and M.J. O'Sullivan**. An evaluation of the hybrid model for predicting surgery duration. *Journal of Medical Systems,* no. 44 (2020): 42.

Stevenson, C. M., Naranjo-Cigala, A., **Ladefoged**, **T.N.** and F. J. Díaz. Colonial rainfed farming strategies in an extremely arid insular environment: Niche construction on Lanzarote, Canary Islands, Spain*. The Journal of Island and Coastal Archaeology,* (2021): 47119.

Stevenson, C.M., Rogers, A.K., Novak, S.W., Ambrose, W. and **T.N. Ladefoged.** A molecular model for obsidian hydration dating. *Journal of Archaeological Science: Reports,* no. 36 (2021): 102824.

Steyn, N., Binny, R.N., Hannah, K., Hendy, S.C., James A., Kukutai, T., Lustig, A., McLeod, M.**, Plank, M.J., Ridings, K.** and A. Sporle. Estimated inequities in Covid-19 infection fatality rates by ethnicity for Aotearoa New Zealand. *New Zealand Medical Journal,* no. 133 (2020): 28-39.

Steyn, N., Binny, R.N., Hannah, K., Hendy, S.C., James, A., Lustig, A., Ridings, K., Plank, M.J., and A. Sporle. Māori and Pacific people in New Zealand have higher risk of hospitalisation for Covid-19. *New Zealand Medical Journal,* no. 134 (2021): 28-43.

Steyn, N., Plank, M.J., James, A., Binny, R.N., Hendy, S.C. and A. Lustig. Managing the risk of a Covid-19 outbreak from border arrivals. *Journal of the Royal Society Interface,* no. 18 (177) (2021).

Swadi, T., Geoghegan, J.L., Devine, T., McElnay, C., Sherwood, J., Shoemack, P., Ren, X., **Welch D.** et al. Genomic evidence of in-flight transmission of SARS-CoV-2 despite predeparture testing. *Emerging Infectious Diseases*, no. 27(3) (2021): 687-693.

Teixeira, J.C., Jacobs, G.S., Stringer, C., Tuke, J., Hudjashov, G., Purnomo, G.A., Sudoyo, H., **Cox, M.** et al. Widespread Denisovan ancestry in Island Southeast Asia but no evidence of substantial super-archaic hominin admixture. *Nature Ecology & Evolution,* no. 5 (2021): 616-624.

Turnbull S.M., Meissel K., **Locke K. and D.R.J. O'Neale**. The impact of science capital on self-concept in science: A study of university students in New Zealand. *Frontiers in Education,* no. 5 (2020): 27.

Turnbull, S.M., and D.R.J. O'Neale. Entropy of co-enrolment networks reveal disparities in high school STEM participation. *Frontiers in Big Data,* (2021): 56.

Turner, R., Brockerhoff, E.G., Bertelsmeier, C., Blake, R., Caton, B., **James, A.**, MacLeod, A., Nahrun, H.F., Pawson, S., **Plank, M.J.**, Pureswaran, D.S., Seebens, H., Yamanaka, T., and A.M. Liebhold. Worldwide border interceptions provide a window into human-mediated global insect movement. *Ecological Applications,* (2021): e02412.

Turner, R.M., Plank, M.J., Brockerhoff, E.G., Pawson, S., Liebhold, A. and **A. James**. Considering unseen arrivals in predictions of establishment risk based on border biosecurity interceptions. *Ecological Applications,* no. 30 (2020): e02194.

Vasques Filho, D.V., O'Neale, D.R.J. and S.C. Hendy. Structure of the region-technology network as a driver for technological innovation. *Frontiers in Big Data,* (2021): 50.

Vasques Filho, D.V. and D.R.J. O'Neale. Structure dynamics of evolving scientific networks. *arXiv*. (2020).

Vasques Filho, D.V. and D.R.J. O'Neale. The role of bipartite structure in R&D collaboration networks. *Journal of Complex Networks,* no. 8 (2020): cnaa016.

Vasques Filho, D.V. and D.R.J. O'Neale. Transitivity and degree assortativity explained: The bipartite structure of social networks. *Physical Review E,* no. 101 (2020): 52305.

Vattiato, G., Plank, M.J., James, A. and R.N. Binny. Individual heterogeneity affects the outcome of small mammal pest eradication. *Theoretical Ecology,* no. 14(2) (2021): 219-231.

Vattiato, G., Plank, M.J., James, A. and R.N. Binny. Individual heterogeneity affects the outcome of small mammal pest eradication. *Theoretical Ecology,* (2020).

Walker, L.A., Sin, I., Macinnis-Ng, C., Hannah, K. and T.G. McAllister. Where to from here? Women remain absent from senior academic positions at Aotearoa New Zealand's universities. *Education Sciences,* no. 10(6) (2020): 152.

Wehi, P.M., Brownstein, G. and M. Morgan-Richards. Indigenous plant naming and experimentation reveal a plant–insect relationship in New Zealand forests. *Conservation Science and Practice,* no. 2(10) (2020): e282.

Wehi, P.M., Scott, N.J., Beckwith, J., Rodgers, R.P., Gillies, T., **Van Uitregt, V.** and **K. Watene.** A short scan of Māori journeys to Antarctica. *Journal of the Royal Society of New Zealand,* (2021): 1-12.

Wehi, P.M., Whaanga, H., **Watene, K. and T.E. Steeves**. Mātauranga as knowledge, process and practice in Aotearoa New Zealand. *SocAriXiv Papers,* (2020).

Wehi, P.M., **van Uitregt, V.**, Scott, N.J., **Watene, K.** et al. Transforming Antarctic management and policy with an Indigenous Māori lens. *Nature Ecology & Evolution,* no. 5 (2021): 1055-1059.

Wilkinson, C., **Hikuroa, D.C.**, Macfarlane, AH. and M.W. Hughes. Mātauranga Māori in geomorphology: existing frameworks, case studies, and recommendations for incorporating Indigenous knowledge in Earth science. *Earth Surface Dynamics,* no. 8(3) (2020): 595-618.

Wood, S.A., Kelly, L.T., Bouma-Gregson, K., Humbert, J.F., Laughinghouse IV, H.D., Lazorchak, J., **McAllister, T.G.**, McQueen, A., Pokrzywinski, K. and J. Puddick. Toxic benthic freshwater cyanobacterial proliferations: Challenges and solutions for enhancing knowledge and improving monitoring and mitigation. *Freshwater Biology,* no. 65(10) (2020): 1824-1842.

Zhou, S., Garcia, S., Kolding, J., and **M.J. Plank.** Fishing with smaller trace: assessing balanced harvest using EcoTroph – a sound modelling study with unsupported conclusions. *Frontiers in Marine Science*, (2021).

Books and book chapters

Bayati, S. and **A. Tripathi.** Antecedents of different social network structures on open source projects popularity. *Smart Business: Technology and Data Enabled Innovative Business Models and Practices*. Springer (2020).

Fleming, J.S., Longnecker, N., **Salmon, R.A. and D. C. Hikuroa.** Aotearoa New Zealand: Participatory science and bicultural knowledge communication. *Communicating Science: A Global Perspective*. Australian National University Press (2020).

Grimes, A., **Preston, K., Maré, D. C.**, **Badenhorst, S.** and S. Donovan. The contrasting importance of quality of life and quality of business for domestic and international migrants. *Labor markets, migration, and mobility: Essays in honor of Jacques Poot*. Springer Nature (2021).

Hall, D. *Consent in a changing climate. The Palgrave Handbook of Climate Resilient Societies*. Palgrave Macmillan (2021).

Hannah, K. Betty Batham: A comic biography*. Connected: a NZ School Journal*. (2021).

Hendy, S.C. Climate, meet COVID. *Living with the Climate Crisis*. Bridget Williams Books (2020).

Hu, T., **Tripathi, A**. and H. Berkman. The value of free content on social media: Evidence from equity research platforms. *Smart Business: Technology and Data Enabled Innovative Business Models and Practices*. Springer (2020).

Jandrić, P., Devine, N., Jackson, L., Peters, M.A., Lăzăroiu, G., Mihăilă, R., **Locke, K.** et al. Collective writing: An inquiry into praxis*. The Methodology and Philosophy of Collective Writing*. Routledge (2021).

Littleton, J., McFarlane, G., and **M.S. Allen.** Human-animal entanglements and environmental change: Multi-species approaches in Remote Oceania. *The Routledge Handbook of the Bioarchaeology of Climate and Environmental Change*. Routledge (2020).

Maré, D.C., Sanderson, L., and R. Fabling. Earnings and employment in foreign-owned firms. *Labor markets, migration, and mobility: Essays in honor of Jacques Poot*. Springer Nature (2021).

Nguyen, T.T.T. and **A. Tripathi.** A taxonomy of user-generated content (UGC) applications. *Smart Business: Technology and Data Enabled Innovative Business Models and Practices*. Springer (2020).

Oxley, L. and M. Qasim. On sustainable development. *Public Policy and Governance Frontiers in New Zealand*. Emerald Publishing Limited (2020).

Peters, M.A., Jandrić, P., Irwin, R., **Locke, K.**, Devine, K., Heraud, R., Gibbons, A. et al. Towards a philosophy of academic publishing. *The Methodology and Philosophy of Collective Writing*. Routledge (2021).

Sharp E.L. Free Fish Heads: A case study of knowing and practicing seafood differently. *Sustaining the Seas*. Rowman and Littlefield (2020).

Walter, M., **Kukutai, T.**, Russo Carroll, S., Rodriguez-Lonebear, D. (eds). *Indigenous Data Sovereignty and Policy*. Routledge (2020).

Watene, K. and E. Palmer. *Reconciliation, Transitional and Indigenous Justice*. Routledge (2020).

Wehi, P., Whaanga, H., **Watene, K. and T.E. Steeves.** Mātauranga as knowledge, process and practice in Aotearoa New Zealand. *The Routledge Handbook of Indigenous Environmental Knowledge*. Routledge (2020).

West, K., **Hudson, M. and T. Kukutai.** Data ethics and data governance from a Māori world view. *Indigenous Research Ethics: Claiming Research Sovereignty Beyond Deficit and the Colonial Legacy* (Vol 6). Emerald Publishing Limited (2020).

Published conference papers

Chopra A.R. and **N.K.C. Nair.** A review of methodical decentralisation of energy and energy transactions utilising distributed ledger via transition architecture based framework. *2020 IEEE Power and Energy Conference at Illinois*. (2020).

Fisher, D.N., LeGrice, R.J. and **C.J. Painting**. Social selection is density dependent but makes little contribution to total selection in New Zealand giraffe weevils*. Proceedings of the Royal Society B*. (2021).

Frochte, J. and **S. Marsland.** Regression learning on patches. *Proceedings of the IEEE Symposium Series on Computational Intelligence (2020)*. (2020).

Hannah, K. When worlds collide: addressing harm, hateful and violent extremism, and disinformation in Aotearoa New Zealand. *He Whenua Taurikura: New Zealand's Hui on Countering Terrorism and Violent Extremism*. (2021).

Harvey E.P. and D.R.J O'Neale. Using network science to quantify economic disruptions in regional input-output networks*. Proceedings in Complexity*. (2020).

Harvey, E.P. and D.R.J. O'Neale. Using network science to quantify economic disruptions in regional input-output networks*. Proceedings of NetSci-X 2020: Sixth International Winter School and Conference on Network Science*. (2020).

Heine, Z. and R.K. Priestley. Media reporting on sea level rise in Aotearoa New Zealand (1988 – 2018). *SCAR Open Science Conference 2020*. (2020).

Liu X., **Nair N.-K.C.** Review on D-PMU based applications for active electricity distribution system. *2020 IEEE International Conference on Power Systems Technology*. (2020).

Mittal, M., Asghar, M.R. and **A. Tripathi**. Do my emotions influence what I share? Analyzing the effects of emotions on privacy leakage in Twitter. *The 19th IEEE International Conference on Trust, Security and Privacy in Computing and Communications (TrustCom), 2020*. (2020).

Odiathevar, M., Cameron, D., Seah, W., **Frean, M.** and A. Valera. Humans learning from machines: Data science meets network management. *2021 International Conference on Communication Systems & Networks (COMSNETS)*. (2021).

Priestley, R.K., Leane, E., Roop, H., **Salmon**, R. and J. Xavier. Action group on public engagement with Antarctic science. *SCAR Open Science Conference 2020.* (2020).

Rea, W., **Oxley, L.** and M. Reale. A new procedure for discriminating between long memory and shifting means alternatives. *18th World IMACS Congress and MODSIM 2009 – International Congress on Modelling and Simulation: Interfacing Modelling and Simulation with Mathematical and Computational Sciences*, *Proceedings*. (2020).

Salmon, R. and J. Bailey. Exploring reflexivity: Building bridges between theory and practice in science communication*. Public Communication of Science and Technology Conference*. (2021).

Steyn N., Binny R.N., Hendy S.C., James A., Lustig A. and M.J. Plank. The effect of border controls on the risk of Covid-19 re-incursion in New Zealand. *Society of Mathematical Biology Conference 2020* (online). (2020).

Tran, N., Dinneen, M. and **S. Linz**. Close weighted shortest paths on 3D terrain surfaces. *Proceedings of the 28th International Conference on Advances in Geographic Information Systems (ACM SIGSPATIAL 2020).* (2020).

Vanberkel, P.T., Wedge, B., Carter, A.J.E. and **I. Ziedins.** Using a slotted queuing model to compare the efficacy of emergency departments operating with and without a physician in rural communities. *Proceedings in Mathematics and Statistics*. (2020).

Vasques Filho, D. and D.R.J. O'Neale. Latent space generative model for bipartite networks. *Proceedings of NetSci-X 2020: Sixth International Winter School and Conference on Network Science*. (2020).

Walker, C., Furian, N. and M. Reuter-Oppermann. Introduction to the minitrack on pptimization, simulation and IT for healthcare processes and services*. Proceedings of the 54th Hawaii International Conference on System Sciences*. (2021).

Zhao, X., **Oxley, L.**, Scarrott, C. and M. Reale. Extreme value GARCH modelling with Bayesian inference. *18th World IMACS Congress and MODSIM 2009 – International Congress on Modelling and Simulation: Interfacing Modelling and Simulation with Mathematical and Computational Sciences, Proceedings*. (2020).

Other publications

Ashwin, P. and **C.M. Postlethwaite**. Excitable Networks for Finite State Computation with Continuous Time Recurrent Neural Networks. (2020). Preprint.

Beattie, A. and **R. Priestley**. Fighting Covid-19 with the team of 5 million: Aotearoa New Zealand government communication during the 2020 'lockdown'. (2021). Working Paper.

Beaudette, D., **Roudier**, P. and A. Brown. *Package 'aqp'*. (2020). R Package.

Beaudette, D., **Roudier**, P. and A. Brown. *Package 'aqp'*. (2021). R Package.

Binny, R.N., Baker, M.G., **Hendy, S.C., James, A., Lustig, A., Plank, M.J., Ridings, K.M. and N. Steyn.** Early intervention is the key to success in Covid-19 control. *medRxiv (2021): 2020-10.* (2021). Preprint.

Brown, P., Ross, K.,Hua, N., **Hendy, S.C., James, A., Plank, M.J., Steyn, N., Binny, R.N. and A. Lustig**. Te Pūnaha Matatini modelling team with support from Orion Health. Covid-19 modelling update. Daily situation report to all-of-Government and District Health Boards, 26 March to 10 June 2020. (2020). Report.

Chew, K., Jansen, M., Rackauckas, C., Short, K., Taylor, P.G., Vuorinen, A. and **I. Ziedins.** A campus simulation model supporting the safe blues experiment. (2021). Preprint.

Cisternas, J.T., **Wehi, P.M.** and P. Bishop. Review of two translocations used as a conservation tool for an endemic New Zealand terrestrial frog Leiopelma archeyi. In: Soorae PS (ed) Global Reintroduction Perspectives: Case studies from the Reintroduction Specialist Group, Gland, Switzerland and Environment Agency, Abu Dhabi, UAE. (2020). Other.

Davies, B. and D.C. Maré. Delineating functional labour market areas with estimable classification stabilities. (2020). Motu Working Paper.

Davies, B., Gush, J., **Hendy, S.C. and A.B. Jaffe.** Research funding and collaboration. (2020). Working Paper.

Donovan, S., Grimes, A. and **D.C. Maré**. Modeling urban development in New Zealand. (2020). Motu Working Paper.

Fabling, R. and **D. C. Maré**. Measuring commute patterns over time: Using administrative data to identify where employees live and work. (2020). Motu Working Paper.

Geoghegan, J. L., Douglas, J., Ren, X., Storey, M., Hadfield, J., Silander, O. K., Freed, N. E., Jelley, L., Jefferies, S. and **D. Welch**. The power and limitations of genomics to track Covid-19 outbreaks: a case study from New Zealand. (2020). Preprint.

Gokhale, C.S., Bulbulia, J. and **M. Frean**. Collective narratives catalyse cooperation. (2020). Preprint.

Grelet, G., Lang, S., Merfield, C., Calhoun, N., Robson-Williams, M., Horrocks, A., Dewes, A., **Baisden, T.** et al. Regenerative agriculture in Aotearoa New Zealand–research pathways to build science-based evidence and national narratives. (2021). Report.

Grimes, A., Badenhorst, S., **Maré, D.C.** and J. Poot. Immigration and Innovation. (2020). Motu Working Paper.

Grimes, A., Badenhorst, S., **Maré, D.C.**, Poot, J. and **I. Sin**. Hometown & whānau, or big city & millennials? The economic geography of graduate destination choices in New Zealand. (2020). Motu Working Paper.

Hall, D. and S. Lindsay. Scaling climate finance: Biodiversity instruments. (2021). Concept Paper.

Harvey, E., Hobbs, M., Looker, J., **O'Neale, D.R.J.**, Scarrold, W. and **S. Turnbull.** Exploring Covid-19 transmission risk and vulnerability through the Aotearoa Co-incidence Network (ACN). (2021). Preprint.

Harvey, E., Hobbs, M., **O'Neale, D.R.J.**, Scarrold, W. and **S. Turnbull.** *COVID- 19* Transmission risk and vulnerability through the Aotearoa Co-incidence Network (ACN). Technical report, Te Pūnaha Matatini report to Ministry of Health and Department of Prime Minister and Cabinet, 2021. (2021). Technical Report.

Harvey, E., Maclaren, O., **O'Neale, D.R.J. and D. Wu.** Asymptomatic cases of Covid-19 in NZ: A study of data from the Auckland August re-emergence case data. (2020). Technical Report.

Harvey, E., Maclaren, O., **O'Neale, D.R.J., Ortiz-Cervantes, A., Patten-Elliott, F., Turnbull, S.M., Vasques Filho, D. and D. Wu.** Network-based simulations of re-emergence and spread of Covid-19 in Aotearoa New Zealand. Tech. Rep., Te Pūnaha Matatini, 2020. (2021). Technical Report.

Harvey, E., Maclaren, O., **O'Neale, D.R.J., Ortiz-Cervantes, A., Patten-Elliott, F.**, **Turnbull, S.M.W., Filho, D. V. and D. Wu**. Economic comparison of the use of Alert Levels 3 and 4 in eliminating the Auckland August outbreak: a cost-effectiveness analysis. (2020). preprint.

Harvey, E., Maclaren, O., **O'Neale, D.R.J., Ortiz-Cervantes, A., Patten-Elliott, F.**, **Turnbull, S.M.W., Filho, D. V. and D. Wu.** Network-based simulations of re-emergence and spread of Covid-19 in Aotearoa New Zealand. (2020). preprint.

Harvey, E., Maclaren, O., **O'Neale, D.R.J., Patten-Elliot, F., Turnbull, S.M. and D. Wu.** Alert Level 2.5 is insufficient for suppression or elimination of a Covid-19 community outbreak. Technical report, Te Pūnaha Matatini report to Ministry of Health and Department of Prime Minister and Cabinet, 2021. (2021). Technical Report.

Harvey, E., Maclaren, O., **O'Neale, D.R.J., Patten-Elliot, F., Turnbull, S.M. and D. Wu.** Effect of COVID- 19 variants with increased transmission rates on the effectiveness of Alert Level 3 for eliminating a community outbreak. Technical report, Te Pūnaha Matatini report to Ministry of Health and Department of Prime Minister and Cabinet, 2021. (2021). Technical Report.

Harvey, E., Maclaren, O., **O'Neale, D.R.J., Patten-Elliot, F., Turnbull, S.M. and D. Wu.** Effect of COVID- 19 variants with increased transmission rates on the effectiveness of Alert Level 4 for eliminating a community outbreak. Technical report, Te Pūnaha Matatini report to Ministry of Health and Department of Prime Minister and Cabinet, 2021. (2021). Technical Report.

Harvey, E., Maclaren, O., **O'Neale, D.R.J., Patten-Elliot, F., Turnbull, S.M., and D. Wu.** Estimating underlying prevalence of COVID in the community upon detection of a case with no known link to the border. (2020). Technical Report.

Harvey, E., Maclaren, O., **O'Neale, D.R.J., Patten-Elliot, F., Turnbull, S.M., and D. Wu.** Network modelling of effectiveness of various non-pharmaceutical interventions for Covid-19 elimination in Aotearoa New Zealand. (2020). Technical Report.

Harvey, E., Maclaren, O., **O'Neale, D.R.J., Patten-Elliot, F., Turnbull, S.M., and D. Wu.** Network modelling of elimination strategy pillars: Prepare for it, stamp it out. (2020). Technical Report.

Harvey, E., Maclaren, O., **O'Neale, D.R.J., Patten-Elliott, F., Turnbull, S.M. and D. Wu.** Alert Level 2.5 is insufficient for suppression or elimination of Covid-19 community outbreak. (2021). Preprint.

Harvey, E., Maclaren, O., **O'Neale, D.R.J., Patten-Elliott, F., Turnbull, S.M. and D. Wu.** Contagion network modelling of effectiveness for a range of non-pharmaceutical interventions for Covid-19 elimination in Aotearoa New Zealand. (2021). Preprint.

Harvey, E., O'Neale, D.R.J., and S. Turnbull. Far North, Whangārei, and Kaipara trip movements – Northland analysis of movement patterns derived from electronic transaction records. (2021). Technical Report.

Harvey, E., O'Neale, D.R.J., and S. Turnbull. Opōtiki and Gisborne trip movements – Te Whānau-ā-Apanui analysis of movement patterns derived from electronic transaction records. (2021). Technical Report.

Hauser, S., Galla, S.J., **Steeves, T.E.** and E.K. Latch. Comparing genomic-based estimates of relatedness for use in pedigree-based conservation management. *BioRxiv Preprints.* (2021). Preprint.

Hengl, T., **Roudier**, **P.,** Beaudette, D., Pebesma, E. and M. Blaschek. Package 'plotKML'. (2021). R Package.

Hikuroa, D. Ministry for the Environment and StatsNZ 'Our atmosphere and climate 2020 report' as part of the Science and Mātauranga Advisory Group. (2020).

Hikuroa, D. Te Mana Rauhi Taiao-Environmental Protection Authority 'Mātauranga Framework'. (2020).

Hughes, E., **Binny, R.N., Hendy, S.C. and A. James.** Predicting elimination of evolving virus variants. *medRxiv* (2021). (2021). Preprint.

James, A., Plank, M.J., Hendy, S.C., Binny, R.N., Lustig, A. and N. Steyn. Model-free estimation of Covid-19 transmission dynamics from a complete outbreak. (2020). Preprint.

James, A., Plank, M.J., Steyn, N., Lustig, A., Binny, R.N. and S.C. Hendy. Contribution to: Review of COVID-19 Alert Level 3 (CAB-20-SUB-0220*)*. (2020). Cabinet Paper.

Johnston, E. et al. (Including **K. Hannah**). The Impact of Covid-19 on Women in the STEM workforce. (2021). Rapid Research Information Forum brief prepared for the Australian Government.

Joint Report by **D. Hayman** et al. World Health Organization. "WHO-convened global study of origins of SARS-CoV-2.' (2021*). Geneva*. (2021). Report'

Juodakis, J., Castro, I. and S. Marsland. *Precision as a metric for acoustic survey design using occupancy or spatial capture-recapture*. (2020). Preprint.

Lai, A.G., Chang, W.H., Parisinos, C.A., Katsoulis, M., Blackburn, R.M., Shah, A.D., Nguyen, V., **Cox, M.P.** et al. An Informatics Consult approach for generating clinical evidence for treatment decisions. *medRxiv.* (2021). Preprint.

Luczak-Roesch, M. Networks of information token recurrences derived from genomic sequences may reveal hidden patterns in epidemic outbreaks: A case study of the 2019-nCoV coronavirus. (2020). Preprint.

Maré, D.C. and D. Hyslop. Covid-19 wage subsidy support and effects. (2020). Motu Working Paper.

Maré, D.C. Delineating functional labour market areas with estimable classification stabilities. (2020). Motu Working Paper.

Matheson, A., Gray, R., Wehipeihana, N., Walton, M., Lingberg, K. and M. Shanthankar. Interim evaluation report: Healthy Families NZ. (2020). Report.

Paaso, A., Bahramirad, S., **Nair, N.** et al. Sharing knowledge on electrical energy industry's first response to Covid-19. (2020). White Paper.

Pastor-Paz, J., Noy, I., **Sin, I.**, Fleming, D. and A. Sood. Projecting the effect of climate change-induced increases in extreme rainfall on residential property damages: A case study from New Zealand. (2020). Motu Working Paper.

Plank, M.J., James, A., Binny, R., Hendy, S.C., Lustig, A. and K. Ridings. Vaccination and testing of the border workforce for Covid-19 and risk of community outbreaks: a modelling study. (2021). Report.

Plank, M.J., James, A., Binny, R.N., Hendy, S.C., Lustig, A., and K. Ridings. Vaccination and testing of the border workforce for Covid-19 and risk of community outbreaks: A modelling study. (2021). Te Pūnaha Matatini Report.

Plank, M.J., James, A., Binny, R.N., Steyn, N., Lustig, A. and S.C. Hendy. Contribution to: Review of Covid-19 Alert Level 4 (CAB-20-SUB-0176). (2020). Cabinet Paper.

Plank, M.J., James, A., Steyn, N., Lustig, A., Binny, R.N. and S.C. Hendy. Contribution to: Review of Covid-19 Alert Level 2 (CAB-20-SUB-0270). (2020). Cabinet Paper.

Poehler, M., Gibson, L., **Lustig, A**., Moreland, N.J., McGregor, R. and **A. James**. Estimating decay curves of neutralising antibodies to SARS-CoV-2 infection*. medRxiv.* (2021). Preprint.

Poland, M., **Sin, I**. and S. Stillman. Why are there more accidents on Mondays? Economic incentives, ergonomics or externalities. (2020). Motu Working Paper.

Priestley, R.K. 'Prepare to Be Kind', in *Granta 153: Second Nature*, guest-edited by Isabella Tree, (November 2020 – Autumn), pp. 192-210. (2020). Essay.

Qasim, M. Sustainability and wellbeing: A text analysis of New Zealand parliamentary debates, official yearbooks and ministerial documents. (2020). Working Paper.

Rissmann, C.W.F., Pearson, L.K., Martin, A.P., Leybourne, M.I., **Baisden, W.T.,** Clough, T.J., McDowell, R.W. and J.G.W. Brown. A hydrochemically guided landscape-based classification for water quality: a case study application of process-attribute mapping (PoAM) at a national scale. (2021). Preprint.

Roudier, P. and M.P. Roudier. Package 'clhs'. (2020). R Package.

Roudier, P., and M.P. Roudier. Package 'clhs'. (2021). R Package.

Safaei, S., Todd, C., Yarndley, J., **Hendy, S.C.** and G.R. Willmott. Asymmetric Assembly of Lennard-Jones Janus Dimers. (2021). Preprint.

Schuddeboom, A.J. and **A.J. McDonald**. *The Southern Ocean radiative bias, cloud compensating errors and equilibrium climate sensitivity*. (2020).

Sharma, S.R., **Matheson, A.,** Lambrick, D., Faulkner, J., Lounsbury, D.W, Vaidya, A. and R. Page. Dietary practices, physical activity and social determinants of non-communicable diseases in Nepal: a systemic analysis. *medRxiv.* (2021). Preprint.

Soar, M., Smith, V.L., Dentith, M.R.X., Barnett, D., **Hannah, K.**, Dalla Riva, G.V. and A. Sporle. Evaluating the infodemic: assessing the prevalence and nature of Covid-19 unreliable and untrustworthy information in Aotearoa New Zealand's social media, January-August 2020. (2021). Working Paper.

Steyn, N., Binny, R.N., Hendy, S.C., James, A., Lustig, A. and M.J. Plank. The effect of border controls on the risk of Covid-19 reincursion from international arrivals. (2020). Preprint.

Steyn, N., Plank, M.J., Binny, R.N., Hendy, S.C., Lustig, A. and K. Ridings. A Covid-19 vaccination model for Aotearoa New Zealand. (2021). Preprint.

Steyn, N., Plank, M.J., Binny, R.N., Hendy, S.C., Lustig, A., and K. Ridings. A Covid-19 vaccination model for Aotearoa New Zealand. (2021). Report.

Swadi, T., Geoghegan, L., Devine, J., McElnay, T., Shoemack, C., Ren, P., Xiaoyun, **Welch, D.** et al. A case study of extended in-flight transmission of SARS-CoV-2 en route to Aotearoa New Zealand. (2020). ESR Working Paper.

Vromen, A., Andrejevic, M., Biddle, N., Dennis, S., Garrett, P., Goggin, G., **Hannah, K.**, Hjorth, L., Jetten, J., Lupton, D., Taylor, M., Walter, M. and K. Weatherall. Changes in public sentiment in relation to data privacy during Covid-19. (2021). Rapid Research Information Forum brief prepared for the Australian Government.

Wehi, P.M. and H. Whaanga. Te Tapa Ingoa. *Kaitiakitanga.* Lift Publications, Wellington. (2020).

Conference chair engagements

Cate Macinnis-Ng, *The 1st International Electronic Conference on Forests (IECF)*, Online

Ilze Ziedins, *ANZIAM 2020*, Hunter Valley, Australia

Cameron Walker, *Hawaii International Conference on System Sciences*, Hawaii (online)

Conference session chair engagements

Cameron Walker, Optimization, Simulation and IT for Healthcare Processes and Services, *HICSS*, Online

Daniel Hikuroa, Indigenous innovation, *International Indigenous Research Conference, "Gathering of Indigenous minds"*, Ngā Pae o te Māramatanga, University of Auckland

Isabelle Sin, 2.2 Household economics, *New Zealand Association of Economists*

Jonathan Tonkin, Community ecology and biological interactions, *NZ Rivers,* Invercargill

Kate Hannah, "Under his eye": Human rights, surveillance, and power, *Net Hui NZ*, Online

Krushil Watene, COVID modelling, *HDCA*, Online

Matthew Parry, Stochastic processes, *Australian and New Zealand Statistical Conference*, Online

Nirmal Nair, CIGRE panel session, *Electricity Engineers Association conference 2021*

Nirmal Nair, Electric vehicle grid integration: Opportunities, challenges and remedial measures – Oceania experience, *IEEE PES Global Workshop*

Nirmal Nair, Protection, automation and control of the evolving grid tutorial, *CIGRE Centennial Session 2021*

Rachelle Binny, Adventures in epidemiology, *NZ Mathematical Society Colloquium 2020*, Auckland and online

Rebecca Priestley, Public engagement with Antarctica in a changing climate, *Scientific Committee for Antarctic Research*, Hobart, Australia/virtual

Rhian Salmon, Public engagement with Antarctica in a changing climate, *Scientific Committee for Antarctic Research*, Hobart, Australia/virtual

Shaun Hendy, COVID modelling, *New Zealand Maths Colloquium*, New Zealand/Virtual

Tava Olsen, Leadtime quotation, *INFORMS Annual Meeting* (Virtual), Virtual

Troy Baisden, Citizen science, *NZ Rivers,* Invercargill

Invited speaker engagements

Emma Sharp, Precarity and ECRs, *NZ Geographical Society & Institute of Australian Geographers Conference*, University of Sydney

Maui Hudson, Operationalizing the CARE principles for Indigenous data governance in open-data and open-science environments, *AGU Fall Meeting 2020*

Michael Plank, Modelling the risk of re-introduction of Covid-19 from border arrivals, *Society for Mathematical Biology*, Online

Nirmal Nair, Review on D-PMU based applications for active electricity distribution system, *2020 IEEE International Conference on Power Systems Technology (POWERCON)*

Rebecca Turner, Forestry pests in international border interceptions, *IFQRG-17 Virtual Symposium*, Online

Rhian Salmon, Act Now: Is the time for science communication about climate change over, or just beginning?, *Public Communication of Science and Technology*, Aberdeen, Scotland (virtual)

Rhian Salmon, Science communication for social change: What does STS have to offer*?, Public Communication of Science and Technology*, Aberdeen, Scotland (virtual)

Shaun Hendy, Mathematical models for Covid-19 in Aotearoa New Zealand, *6th One Health Aotearoa Symposium*, New Zealand/Online

Simone Linz, Reconstructing phylogenetic networks from trees, *CMSA (Combinatorial Mathematics Society of Australasia)*, Online Seminar Series, Online

Contributed talk engagements

Cameron Walker, Exploring the integration of Last Planner® system, bim, and construction simulation*, Annual Conference of the International Group for Lean Construction* (2020)

Daniel Hikuroa, Mātauranga as evidence, Te Mana Rauhi Taiao Mātauranga framework*, International Indigenous Research Conference, "Gathering of Indigenous minds",* Ngā Pae o te Māramatanga, University of Auckland

Daniel Hikuroa, Navigating around the pakaru pipeline*, International Indigenous Research Conference, "Gathering of Indigenous minds"*, Ngā Pae o te Māramatanga, University of Auckland

Dion O'Neale, Latent space generative model for bipartite networks*, International Conference on Network Science*

Dion O'Neale, *The impact of science capital on self-concept in science: A study of university students in New Zealand, Frontiers in Education*

Emily Harvey, An integrated spatial planning tool to support the co-management of estuaries in Aotearoa New Zealand*, iEMSs 2020*, Online

Emma Sharp, Diverse soil values*, Australasian AgriFood Research Network (AFRN) Conference*, Online

Emma Sharp, Hopeful approaches to teaching and learning environmental wicked problems*, New Zealand Geographical Science Conference*, Wellington

Emma Sharp, Soilsafe Aotearoa: A citizen science project screening for metal contamination in domestic soils in New Zealand*, Australasian Land and Groundwater Association (ALGA) New Zealand Annual Conference*, Online

Emma Sharp, Soilsafe Aotearoa: Metal contamination in domestic soils in New Zealand*, New Zealand Society of Environmental Toxicology and Chemistry Quarterly*, Online

Kate Hannah, The empire collects back: Revising historical botanical networks in Aotearoa*, Museum Networks and Museum History Annual Conference*, London

Kate Hannah, Uncovering historic 'whisper' networks: Women's friendships in mid twentieth century New Zealand Science*, History of Science Society and History of Technology Society Annual Joint Conference*, New Orleans

Kirsten Locke, The impact of science capital on self-concept in science: A study of university students in New Zealand*, Frontiers in Education*

Michael Plank, Mathematical modelling to support New Zealand's Covid-19 elimination strategy*, ANZIAM Annual Conference*, Online

Nirmal Nair, A review of methodical decentralisation of energy and energy transactions utilising distributed ledger via transition architecture based framework*, 2020 IEEE Power and Energy Conference at Illinois* (PECI)

Pierre Roudier, Digital mapping of soil information at a broad-scale: A review on GlobalSoilMap*., EGU General Assembly Conference*

Pierre Roudier, Digital soil mapping for sustainable management*, LE STUDIUM Thursday Interdisciplinary monthly seminar*

Pierre Roudier, Regionalisation of New Zealand into hierarchical soilscapes*, Joint SSA-NZSSS-ASPAC Conference*, Cairns, Australia

Simone Linz, New data reduction rules for computing the TBR distance between two phylogenetic trees*, Waiheke 2020: The Annual New Zealand Phylogenomics Meeting*, Waiheke Island, New Zealand

Steffen Lippert, Hiding and herding in market entry*, World Congress of the Game Theory Society*, Budapest

Steffen Lippert, Pledge-and-review in the laboratory*, World Congress of the Game Theory Society*, Budapest

Thegn Ladefoged, An assessment of use-wear on obsidian from New Zealand archaeological sites*, New Zealand Archaeological Association Conference*, Taupo

Thegn Ladefoged, An intra-island social network analysis of obsidian on Ahuahu Great Mercury Island*, New Zealand Archaeological Association Conference*, Taupo

Thegn Ladefoged, Field systems, urbanism, and state formation in the Hawaiian Islands*, 86th Annual Society for American Archaeology Meetings*, Virtual

Troy Baisden, Tracing the sources of nitrate using isotopes: 10 years of progress for New Zealand*, NZ Rivers*, Invercargill

Key note speaker engagements

Kate Hannah, Harried, harangued and hating: Modulating the volume of violence on social media*, New Ec(h)o systems: Democracy in the Age of Social Media*, Dunedin

Plenary speaker engagements

Audrey Lustig, Role of ECRs in NZs COVID response*, NZ Association of Scientists for Early Career Researchers*, Online

Christina Painting, Sexual selection in wild New Zealand arthropods*, Australasian Society for the Study of Animal Behaviour*, Virtual

Ilze Ziedins, Improving health care delivery: Accumulating priority queues*, ANZIAM 2020*, Hunter Valley, NSW, Australia

Ilze Ziedins, Modelling patient pathways to improve health care delivery*, AustMS 2020*, University of New England, Armidale, NSW, Australia,

Kate Hannah, Counting and countering the infodemic in Aotearoa New Zealand*, New Zealand Defence Industry Association IDEAS 2020 Conference*, Online

Rachelle Binny, Dynamics of spatial structured populations in ecology and cell biology*, Australia and NZ Industrial and Applied Mathematics 2021 Conference*, Virtual conference, hosted by Monash University and University of Melbourne

Governance and management

Financial report 2020–21

Funding summary for the 18-month period ending 30 June 2021

	2020–21 Actuals $000
Funding received	
Tertiary Education Commission grant	3,290
Surplus carried forward	245
Total funding received	**3,535**
Expenditure	
Salaries	
Director and Principal Investigators	1,038
Associate Investigators	0
Research/Technical assistants	190
Others	331
Total salaries & salary-related costs	**1,559**
Other costs	
Overheads	1,161
Project costs	281
Travel	61
Postgraduate students	469
Total other costs	**1,972**
Total expenditure	**3,531**
Net surplus/(deficit)	**4**

Notes

This report covers the period from 1 January 2020 to 30 June 2021 and details funding received and funds distributed to collaborative partners of the CoRE.

All amounts are shown exclusive of Goods and Service tax (GST).

2020–21 summary

Broad category	Detailed category	2020	2021*
Value of CoRE funding from TEC ($M)		2,193,500	1,096,750
FTEs by category	Principal investigators	3.90	1.40
	Associate investigators	0	0
	Postdoctoral fellows	1.35	1.03
	Research technicians	1.40	0.7
	Administrative/support	3.30	1.10
	Total	**9.95**	**4.23**
Headcounts by category	Principal investigators	25	25
	Associate investigators	51	50
	Postdoctoral fellows	7	7
	Research technicians	2	2
	Administrative/support	5	5
	Total	**90**	**89**
Peer-reviewed research	Books/book chapters	12	6
	Journal articles	114	71
	Conference papers	14	5
	Other	42	36
	Total	**182**	**118**
Value of non-Vote S&I external research contracts awarded by source	Government (non-Vote S&I)	1,220,987	950,704
	Domestic – private-sector funding	142,895	205,498
	Domestic – other non-Government	0	190,157
	Overseas	1,430,831	3,918,174
	Total	**2,794,713**	**5,264,533**
Students studying at CoRE by level	Doctoral degree	32	40
	Other	35	28
	Total	**67**	**68**
Number of funded students completing	Doctoral degree	4	4
	Other	11	7
	Total	**15**	**11**
Immediate post-study graduate destinations (since 2015)	Employed overseas	28%	23%
	Employed in NZ	72%	77%

**Six months from 1 January 2021 to 30 June 2021*

Meeting our strategic outcomes

Research excellence

A strong collaborative network of investigators, students, and practitioners will be established in New Zealand, with a culture of research excellence that attracts and retains the very best national and international talent, and with expertise in the research, education, industry, and policy sectors that is required by stakeholders, end-users, and thought leaders.

After six years, Te Pūnaha Matatini has tangible evidence that our collaborative networks are delivering on our mission. Citation impact data reveals Te Pūnaha Matatini, with a focus on trans-disciplinary research publications, is generating impact at a level between that of the Santa Fe Institute and the Max Planck Institute for Complex Systems, the two international research centres to which Te Pūnaha Matatini is most readily compared. Of the seven CoREs funded in 2015, Te Pūnaha Matatini's publications have had the highest field-weighted citation impact over the period 2015–2020.

As detailed throughout this report, Te Pūnaha Matatini investigators are competing in the New Zealand science and innovation system at the highest levels of excellence, winning numerous awards, fellowships and prestigious grants. Our researchers are also known for their leadership, with several winning significant national honours. Te Pūnaha Matatini's Covid-19 team won the 2020 Prime Minister's Science Prize, Deputy Director Siouxsie Wiles was named New Zealander of the Year, and Director Shaun Hendy was invested as a Member of the New Zealand Order of Merit.

Te Pūnaha Matatini's expertise is in demand from stakeholders, end-users, and communities, as shown by high levels of funding, co-funding, and funding in-kind by end-user organisations. Investigators are regularly invited to give talks, presentations, and workshops for stakeholder and end-user organisations, and several investigators sit on or have sat on key stakeholder advisory boards. For instance, Shaun Hendy is a Special Advisor to the Covid-19 Strategic Public Health Advisory Group that reports to Cabinet.

Sought-after graduates

Our graduates will be sought after for their knowledge of complex systems methods and their ability to apply this knowledge to significant problems of relevance to our end-users.

More than 70 Te Pūnaha Matatini students (both graduate and undergraduate) have now been placed for 10 weeks at stakeholder and end-user organisations with joint internal and external supervisors. The internships were funded or co-funded by the external organisations (SIA, MBIE, Te Hiku Media, Ministry of Justice, MSD, Oranga Tamariki, Ministry for the Environment, Westpac, BRANZ, Ngāti Whātua Ōrākei). In some instances, students worked individually, but at several organisations we have used a team-based approach, where a PhD student leads a team of two undergraduate students. This team-based approach has worked very well, with both the students and hosting organisations being very pleased with the outcome.

We have had several interns work with Te Hiku Media, a charitable joint-iwi venture between the Far North iwi of Ngāti Kuri, Te Aupōuri, Ngāi Takoto, Te Rarawa and Ngāti Kahu, over the last three years, on natural language processing tools for te reo Māori. Students employed in 2017-2018 returned to continue work on projects in 2018-2019. A similar continuity of student involvement is seen in the programme of work with Ngāti Whātua Ōrākei, with the 2018-2019 project an expansion of census data analysis and cleaning undertaken in 2017. Student interns in government departments in 2018-2019 have been offered jobs following graduation. These projects are developing ongoing relationships and skills for students and organisations, and are providing immense benefit to New Zealand.

As we complete our sixth year, we can see that nearly 80% of our graduates have stayed in New Zealand at the end of their degrees, with 30% going on to academic roles and 70% finding work in government or in the private sector. Two of our graduates, Dr Rachelle Binny and Dr Audrey Lustig, have gone on to full-time research positions in Manaaki Whenua Landcare Research, while several continue to be employed by our spin-out company Nebula.

Student internships are leading to spinout companies: Nebula, headed by former Te Pūnaha Matatini intern Georgia Nixon, analyses the media using a range of network science techniques. This company now employs three graduates.

Research uptake

Our research will be used by stakeholders and end-users in New Zealand to provide direct savings, enhanced productivity, growth and diversification of the economy, environmental and social benefit, and develop new businesses.

There are now many examples of ways in which Te Pūnaha Matatini research has been used in New Zealand. For instance, work with the New Zealand Rugby Union and the data science company Qrious helped them develop new products and services. For the New Zealand Rugby Union, a visualisation |method was developed that allowed team coaches to visualise complex performance data sourced from games. Te Pūnaha Matatini researchers have worked with Qrious as they develop their mobile phone location-based human movement product Voyager. A Te Pūnaha Matatini PhD student worked with the Social Investment Agency to develop one of their main software tools.

Work being done by Te Pūnaha Matatini researchers Ilze Ziedins, Mike O'Sullivan, Cameron Walker and Tava Olsen provides practical solutions to real world problems within New Zealand's healthcare system. Their patient pathways project work involves the analysis of a complex series of steps between the time a patient presents for healthcare and the time of discharge, amidst a background of limited resourcing (e.g., staffing, surgical teams, and equipment). Prioritising one patient's access to a resource may have adverse effects for other pathways that also need that resource. To determine effective prioritisation strategies for patients therefore requires modelling of the complexity of patient pathways, their use of resources, and the effect of different prioritisation strategies. This is undertaken in partnership with District Health Boards so findings can be swiftly implemented to deliver benefit. This has led to the spinout company ORUA Health.

Te Pūnaha Matatini work on evaluating the impact of the Marsden Fund and the effectiveness of decision-making by its evaluation panels has been acknowledged as extremely valuable by the Marsden Fund Council: "This work was invaluable in allowing us to obtain an objective measure of proposal quality. We had asserted for many years that our near miss proposals were of equivalent quality to those that were funded, but this work allowed us to confirm this in an independent and quantitative manner." (Juliet Gerrard, Chair of the Marsden Fund Council). The study was also very important for getting Statistics New Zealand's Science and Innovation Domain Plan agreed upon by the sector, as it was a clear demonstration of what was possible with good data collection practices. Further analyses of the Marsden Fund are underway, with a new study commissioned by the Council in 2019.

Te Pūnaha Matatini is regularly commissioned to investigate and measure research impact. In the last three years we have carried out impact evaluation for the Concrete and Cement Association of New Zealand, the NZ Food Safety Science and Research Centre, the Bioheritage and Science for Technological Innovation National Science Challenges, the Science Media Centre, and the University of Auckland's Centre for Innovation and Entrepreneurship. In MBIE's discussion paper on measuring research impact, the two New Zealand studies cited were both undertaken by Te Pūnaha Matatini researchers. A project with the Science Media Centre has led to the spinout company Nebula.

Te Pūnaha Matatini has worked with the Ministry of Social Development (MSD) to provide network analysis tools for identifying at-risk children. Researchers characterised the networks that exist in their relational client database and provided workshops to MSD staff in using network tools. MSD funded a post-doctoral fellow, who has worked along MSD analytics staff to facilitate diffusion of network analysis methods into the Ministry. MSD and Oranga Tamariki are supporting further work in this project, which led to a high-profile publication in PLoS One in 2019.

Te Pūnaha Matatini has worked with the Ministry of Primary Industries to assist with the M. bovis eradication programme, a billion-dollar crisis for our primary sector. Our Director sits on the M. bovis Strategic Science Advisory Group and has given advice on science communication. Rebecca Turner, our post-doc at Scion, has undertaken a project to help understand animal movement data, which has been crucial in the response.

On 12 November 2020, an Auckland student who worked part-time at a clothing store in the CBD tested positive for Covid-19. This was the first community case since the August cluster that could not be linked to the border. However, the combination of whole genome sequencing and Te Pūnaha Matatini's stochastic model meant that the government was able to avoid another lockdown. The sequencing linked the case to a Defence Force worker who had been infected at a Managed Isolation and Quarantine facility the previous week. In this case, Te Pūnaha Matatini's stochastic model predicted that there were likely to be far fewer cases than had been seen in the August cluster and these did not require a lockdown for their control. The World Health Organisation said that "whole genome sequencing has been an effective approach in assisting with contact tracing in several countries. New Zealand's use of this may not be unique but combining it with their recently developed modelling data system is, and it appears at this stage to be part of an effective approach to helping reduce and control community transmission." The combination of the modelling advice and the sequencing likely avoided a three-day lockdown in Auckland, which would have cost the economy $132m based on New Zealand Treasury estimates.

Partnership models

In building close engagement with Māori communities and developing opportunities for Māori capability-building, the distinctive contribution of Māori to complex systems and networks will enhance social, economic, and environmental outcomes for New Zealand.

We have a significant partnership with iwi digital media venture Te Hiku Media. We have funded or co-funded interns working with Te Hiku since 2015, and are partners on the Kōrero Māori project (now Papa Reo, funded by as a MBIE data science platform) with Te Hiku and Dragonfly Data Science to develop natural language processing tools for te reo Māori.

Te Pūnaha Matatini is partnering with Ngāti Whātua Ōrākei on a Te Pūnaha Hihiko: Vision Mātauranga Capability Fund project which extends our existing collaboration, supported via repeated internship placements of Māori students working within Kaupapa Māori paradigms. 'He waka eke noa' combines qualitative and quantitative methods to develop tools for evaluation of tribal data and aspirations within a Ngāti Whātua Ōrākei framework.

There are now several Te Pūnaha Matatini research projects that enable the distinctive contribution of Māori, focusing on the interaction of mātauranga with complex systems and networks methods and approaches. Our flagship project Mai i ngā maunga ki te tai started in 2018. A key outcome will be developing processes of best practice for engagement by environmental scientists with tangata whenua. Furthermore, this project is being scoped and designed in partnership with Māori, with direction of the locus of research being entirely a response to community need and priority.

Te Pūnaha Matatini has partnered with Te Mana Raraunga, the Māori Data Sovereignty Network, to encourage the uptake of indigenous data sovereignty principles by New Zealand organisations and researchers.

Te Pūnaha Matatini has appointed a kaumātua, Dr Tom Roa from the University of Waikato. The role of kaumātua in Te Pūnaha Matatini is to be a repository of knowledge about New Zealand society, including aspects of history and social systems, especially pertaining to Māori; be knowledgeable in appropriate processes/tikanga, especially within Māori and bicultural contexts; interpret and protect Māori cultural practices and protocols, including helping to create and hold space for people who are culturally different in some way (in the broadest sense), and providing advice on implementing research; provide guidance to help find ways to solve thorny problems, and resolve disputes if necessary; and to have ceremonial roles e.g. during a pōwhiri.

One of the first papers produced by Te Pūnaha Matatini in response to Covid-19 focused on the predicted impact on Māori and Pacific peoples. There was clear need for nuanced understanding of the differential experiences of exposure and infection, as well as projected infection fatality rates, with requests for this modelling coming from iwi and hapū, as well as policy-makers. Historical knowledge of the 1918 influenza epidemic, contemporary knowledge of inequities in the New Zealand health system, and strong relationships with Māori communities meant that this paper was completed under urgency. Our work showed that the estimated infection fatality rate for Māori was at least 50% higher than for non-Māori and that Pacific peoples are also likely to be at higher risk of fatality. This research was important for iwi and Pacific communities in formulating their community-led responses, including providing an evidence base for decision-making for collective wellbeing. It enabled a critical context for the national response and community decision-making within the Auckland August re-emergence and its ongoing social and economic effects, which are particularly situated within the heart of Māori and Pacific communities in South Auckland.

Improved decision-making

Through knowledge sharing and best practice, our research will inform and improve decision-making in policy and public debate in New Zealand on issues related to complex systems and networks and their role in society, the economy, and the environment.

Te Pūnaha Matatini has led the national discourse on the public responsibilities of scientists to communicate their work and participate in public debate. Four Te Pūnaha Matatini investigators have won the Prime Minister's Science Communication Prize (Priestley (2016), Dickinson (2014), Wiles (2013), Hendy (2012)), three have won the Callaghan Medal for science and/or technology communication (Dickinson (2015), Wiles (2013), Hendy (2012)), and Siouxsie Wiles has been awarded a Blake Leadership medal. Books such as Silencing Science (Hendy 2016), Fukushima Effect: A New Geopolitical Terrain (Priestley 2016), and Antibiotic Resistance: the end of modern medicine? (Wiles 2018) have also contributed to international discourse on science communication.

Our researchers are consistent contributors to public debate as commentators themselves, but also by making their research accessible and promoting its use in public discourse. For instance, in 2018, Director Professor Shaun Hendy, with his #NoFly2018 campaign to reduce his carbon footprint, contributed to regular media discussions regarding climate change and climate justice. Te Pūnaha Matatini investigators are regularly in the media (as shown by the media mapping done by student spinout company, Nebula), and comment on diverse topics – from Kauri dieback to sexism in science and academia.

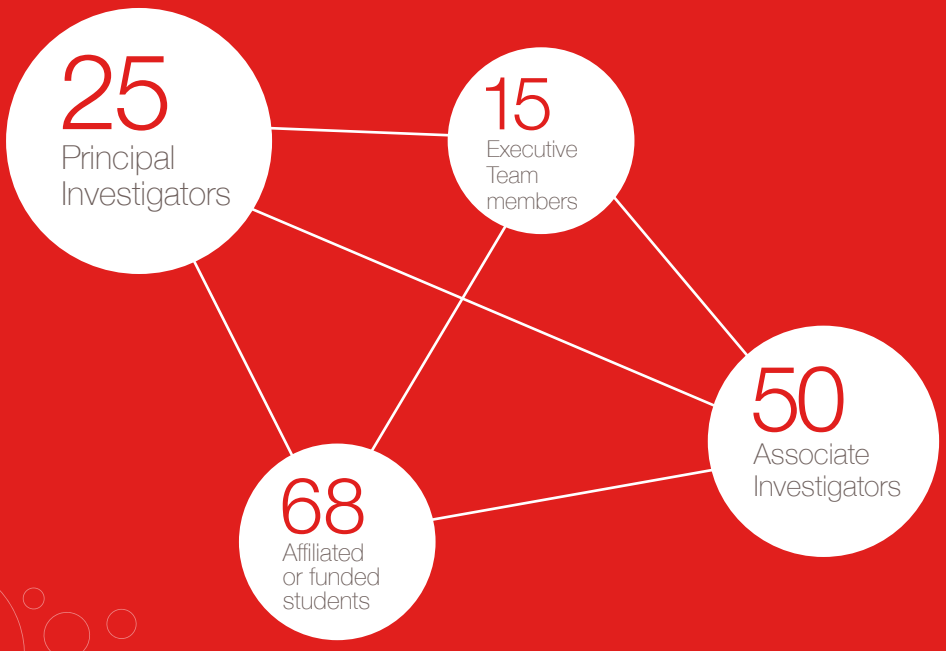
Te Pūnaha Matatini has run three national media campaigns "Reframing Innovation" (August 2016), "InfectedNZ" (November 2016), and "WaiNZ" (September 2017) to promote the using of data and evidence in public discourse. The third campaign, WaiNZ, sought to highlight the issue of polluted waterways in New Zealand. Held over the week of 11–15 September 2017, it was based around blog articles shared by leading environmental, social and health researchers. Overall, it generated more than 1,900 website views and 32,600 Twitter impressions. In 2018, Director Shaun Hendy ran a #nofly2018 campaign, which has led to more than a dozen media articles, and the establishment of a Facebook group dedicated to reducing flying.

Te Pūnaha Matatini has become well-known for leadership in collaborative management, advising other CoREs and research centres on structure and operational matters, governance, and policies for growing diversity. In particular, Te Pūnaha Matatini has taken a leadership role in promoting diversity within the New Zealand science system, beginning with evaluating the publicly available data for each Centre of Research Excellence. The Association of CoREs agreed in 2015 to adopt Te Pūnaha Matatini's Sponsorship Policy as its own. Critical to these initiatives was the decision to formalise Te Pūnaha Matatini's diversity, equity, access and inclusion statement as a policy, and to develop a sponsorship policy for public dissemination via the website. Alongside the sponsorship policy, a code of conduct was developed for Te Pūnaha Matatini investigators and students, and for Te Pūnaha Matatini events or events that we sponsor.

Te Pūnaha Matatini research has played an instrumental role in establishing the National Research Information System (NRIS). Our research was presented to the then Minister of Finance, Bill English, in 2015, and this proved crucial in the adoption of Statistics New Zealand's Science and Innovation Domain Plan, and the creation of NRIS (now NZRIS), which will allow the value of New Zealand's investments in science and innovation to be rigorously quantified.

Associate Professor Siouxsie Wiles began fielding media enquiries on Covid-19 from as early as January 2020. Wiles, a prior winner of the Prime Minister's Science Communication Prize, became one of the leading science communicators during the crisis, not only in New Zealand but also internationally. Wiles partnered with The Spinoff cartoonist Toby Morris to produce visualisations that became 'viral' around the world. The articles that Wiles wrote for The Spinoff and were illustrated by Morris attracted more than three million page views. Kate Hannah, Mike Plank, Alex James, Rachelle Binny, and prior Prime Ministers Science Communication Prize winner Shaun Hendy also featured significantly as science communicators during the pandemic. The communications team were present heavily in all major media outlets in New Zealand, as well as the international media. Hendy, Plank and James' articles for the Conversation attracted a million page views, and their modelling work was covered in the Guardian, the Times, the BBC, and the ABC. Reports conducted by the Science Media Centre indicates that that Te Pūnaha Matatini science and researchers have had thousands of mentions in the media since January 2020, in relation to Covid-19. As of August 2020, Siouxsie Wiles had been mentioned in 1,554 media articles, and Shaun Hendy 967 times.

Our people


25
Principal Investigators
15
Executive Team members
50
Associate Investigators
68
Affiliated or funded students

Dr Andrea Byrom honoured to accept new role as kairangi

Ecologist and science leader Dr Andrea Byrom has accepted a role as kairangi in Te Pūnaha Matatini.

Kairangi is a Māori word meaning 'the finest pounamu', which can be used to describe a person held in high esteem. This role acknowledges the important contributions of our senior colleagues.

Dr Andrea Byrom has been involved with Te Pūnaha Matatini as an associate investigator since the early days, and has contributed at many hui and supervised several early career researchers. She is currently co-supervising Te Pūnaha Matatini Whānau member Julie Mugford in the final stages of her thesis, alongside Associate Professor Alex James and Professor Michael Plank.

The project that Andrea is most proud of being involved with at Te Pūnaha Matatini was exploring the biodiversity benefits of large-scale pest control regimes with Dr Rachelle Binny. Their work quantified significant benefits for biodiversity from pest control over two decades. Andrea says that "I'm proud to have contributed to that research because it really demonstrated how important science is to the environment, and why we do large-scale conservation efforts like pest control or ecological restoration."

She also particularly enjoyed collaborating with Professor Shaun Hendy and a group of summer interns on network analyses of the many types of people and organisations involved in environmental protection in Aotearoa. "That was a real introduction to network analyses and some of the things Te Pūnaha Matatini had to offer that I had not previously thought of applying to te taiao the environment."

Andrea recently resigned from her role as director of Ngā Koiora Tuku Iho New Zealand's Biological Heritage National Science Challenge. She has been working in the New Zealand science system since joining Manaaki Whenua Landcare Research as a postdoctoral researcher in 1997.

Over two decades working at Manaaki Whenua Andrea moved away from directly doing her own research and into leadership roles, after becoming interested in how science leadership could empower scientists to do their work, rather than add more bureaucracy to their lives.

She says that she "really loved that leadership style".

"What I liked most about being a director of a National Science Challenge was having a view across all of the amazing talent that we have in the New Zealand science system."

Her directorial responsibilities meant that Andrea did not have as much time as she would like to devote to Te Pūnaha Matatini in recent years. "I've been on a separate journey from Te Pūnaha Matatini for the last wee while, so to come back in as a kairangi now is quite an honour."

"In the last few years, my interests have broadened to thinking about how we take our Te Tiriti o Waitangi partnership role seriously as scientists, and how we bring mātauranga Māori and kaupapa Māori research methods to the fore. I worked hard to facilitate a lot of that via the National Science Challenge

and ended up in a co-director role in that area with Melanie Mark-Shadbolt."

"I feel like the tide's turning and that people are starting to listen. But it's really important to put different perspectives and stories out there."

After a demanding period as a director, Andrea is focusing on spending more time with her partner, as well as doing environment consultancy work and board roles. "I'm particularly interested in how important governance is to science and the environment. That's my new passion, and as a kairangi I would like to contribute where I can – particularly around complex environmental research."

"I love being a sounding board for students and I love coming to hui where there are great minds contributing things that I hadn't thought of and ideas that I'm interested in."

Since stepping back as a director, Andrea and her partner have been making the most of their time together by killing off a large amount of lawn on their half-hectare property in mid-Canterbury and replanting it with over 5,000 native plants.

How to kill your lawn with Andrea Byrom

1. Acquire large quantities of cardboard boxes and flatten them
2. Lay cardboard over lawn on non-windy day
3. Cover cardboard with a whole lot of mulch
4. Water it all down
5. Leave for two months
6. Replant with native plants

Executive team

Professor Shaun Hendy
University of Auckland
Director, Te Pūnaha Matatini

Shaun Hendy is Director of Te Pūnaha Matatini and Professor of Physics at the University of Auckland. His interest in the science of complexity stems from a conversation at a lunchtime journal club at Industrial Research Ltd about Geoffrey West's work on the increase in the number of patents per capita with city size in the US. Hendy then downloaded an international patent database and found that the difference in patents per capita between Australia and New Zealand could be explained by the difference in population distributions.

Shaun served as Deputy Director of the MacDiarmid Institute for Advanced Materials and Nanotechnology from 2008–2012 and as President of the New Zealand Association of Scientists from 2011–2013. He has won a number of awards, including the Prime Minister's Science Media Communication Prize and ANZIAM's E. O. Tuck Medal. In 2012 Shaun was elected a Fellow of the Royal Society of New Zealand. In 2018 Shaun appointed as a Director on the Callaghan Innovation board.

Dr Priscilla Wehi
Manaaki Whenua/Landcare Research
Incoming Co-Director (2020) / Incoming Director (2021)

Priscilla (Cilla) is a conservation biologist and Rutherford Discovery Fellow at Manaaki Whenua Landcare Research in Dunedin. Since completing a PhD in ecology and Māori at the University of Waikato, her research has focused on the links between culture and biodiversity, and ecological restoration. Cilla is passionate about inclusivity and diversity in science and is part of the 2018 Homeward Bound programme – the largest ever all-female Antarctic expedition that aims to raise awareness of the low representation of women working in Stem. Cilla is also a member of the Predator-Free 2050 Bioethics Panel and the Kindness in Science Committee sponsored by Te Pūnaha Matatini.

Professor Murray Cox
Massey University
Incoming Co-Director (2020)

Murray Cox is Professor of Computational Biology at Massey University. Murray's research group integrates new genetic technologies with sophisticated computational analysis to address biological questions at the interface of genomics, computer science and statistics. Currently an Alexander von Humboldt Fellow at the Max Planck Society in Germany, Murray was awarded the 2017 Te Rangi Hīroa medal by the Royal Society of New Zealand for his work advancing "historical approaches to societal transformation and change."

Mike O'Sullivan
University of Auckland
Incoming Deputy Director (2021)

Mike is a Senior Lecturer in Engineering Science at the University of Auckland who specialises in Operations Research (OR). After completing a degree in Mathematics and Computer Science and a masters in OR at the University of Auckland, Michael spent time at Stanford University in the US where he obtained an MS in Engineering-Economic Systems and OR, and a PhD in Management Science and Engineering. Michael created the research group Operations Research Union Analytics (ORUA) which combines OR and analytics to develop intelligent systems.

Associate Professor Alex James
University of Canterbury
Deputy Director, Industry and Stakeholder Engagement

With a PhD in combustion engineering, Associate Professor Alex James made the transition from catalytic converters to the rest of the world, where she uses mathematical modelling to solve problems. At heart she's a mathematical modeller and works on problems from social science to climate change, but her main hobby is ecology. Although Alex says she is no ecologist – "friends had to teach me the difference between beetles and bugs" – she is excited by the contribution mathematics can make to the analysis and study of interactions among organisms and their environment.

Dr Dan Hikuroa
University of Auckland
Co-Deputy Director, Public Engagement

Daniel (Dan) Hikuroa is an earth systems scientist at the University of Auckland who integrates mātauranga Māori (Māori knowledge) and science to enhance the value of his research to the communities he works with. For his PhD, Dan led a British Antarctic Survey deep field geology mapping expedition, and completed a postdoctoral fellowship looking into how naturally occurring climate change affected the world's oceans and biosphere in the distant past. Among his many projects in recent years, Dan was a co-author on the *2014 State of the Hauraki Gulf Environment Report*.

Associate Professor Siouxsie Wiles
University of Auckland
Co-Deputy Director, Public Engagement

Siouxsie is an award-winning scientist who has made a career of manipulating microbes. She and her team make bacteria glow in the dark to understand how infectious microbes make us sick and to find new medicines. Siouxsie is also an enthusiastic tweeter, blogger, artist, curator and media science commentator and has won numerous prizes for her efforts, including the Prime Minister's Science Media Communication Prize. In 2017, she published her first book, *Antibiotic resistance: the end of modern medicine?* as part of the BWB Texts series.

Kate Hannah
Deputy Director, Equity and Diversity
Executive Manager, Te Pūnaha Matatini (2020)

Kate Hannah has a Master of Arts (2004) from Waikato University in 19th Century American Literary Culture. Her principal research area is the historiography of the history of science, with a focus on the cultures and subcultures of science, gender in science history, and narrative and complexity. She holds dual roles at Te Pūnaha Matatini, Executive Manager and Associate Investigator; she is a research fellow in the Department of Physics at the University of Auckland, course convener of Science Scholars 101, and a Te Pūnaha Matatini-funded PhD candidate in the Science and Society Group at Victoria University Wellington, investigating novel hybrid methodologies for the historiography of science. Basically, she's a historian in a Physics department.

Professor Stephen Marsland
Victoria University of Wellington
Theme Leader, Complexity, Risk, and Uncertainty

Stephen is Professor of Mathematics at Victoria University of Wellington. He was previously Professor of Scientific Computing at Massey University and has PhD from Manchester University and a degree from Oxford University. His research interests are in the applications of mathematics, especially differential geometry, to a wide variety of problems such as birdsong recognition, shape and medical image analysis, machine learning, and smart homes for the elderly. He also works in complexity science, including complex networks and agent-based models.

Professor Uli Zuelicke
Victoria University of Wellington
Theme Co-leader, Complex Economic and Social Systems

Uli is a Professor of Physics at Victoria University of Wellington and a Fellow of the New Zealand Institute of Physics. With a background in theoretical condensed-matter physics, Uli's research interests include mesoscopic and low-dimensional systems, spins in semiconductors, and complex materials such as graphene. He enjoys solving theoretical problems and collaborating with colleagues on experiments of mutual interest.

Professor Michele Governale
Victoria University of Wellington
Theme Co-Leader, Complex Economic and Social Systems (2020)

Michele Governale is an Associate Professor of Physics at Victoria University of Wellington. Prior to his arrival at Vic in 2009, Michele is a condensed matter theorist, with a particular interest in the theory of quantum transport in nanostructures. Studying the basic electronic properties of nanostructured systems has potential applications in the design of electronic devices of exceptionally minute dimensions (in the nanometres!).

Dr Cate Mcinnis-Ng
University of Auckland
Theme Co-Leader, Complexity and the Biosphere

Cate is a Senior Lecturer in Ecology at the University of Auckland's School of Biological Sciences and the President of the New Zealand Ecological Society. As an enthusiastic 'tree ecophysiologist', Cate's current research focuses on plant responses to climatic conditions – in particular, the impact of drought on New Zealand's native forests. Before moving to Auckland in 2010, Cate was based in Sydney, Australia, where she completed her undergraduate degree and PhD, and undertook postdoctoral research. Since then, she has received a host of awards – a Marsden Fast-Start grant in 2012 and a Rutherford Discovery Fellowship in 2015.

Associate Professor Michael Plank
University of Canterbury
Theme Co-Leader, Complexity and the Biosphere

Mike's research is in mathematical modelling, particularly in ecology and physiology. The motivation for this research comes from real-world problems and the emphasis is on qualitative mathematical models that capture the essential behaviour of a particular phenomenon. Mike has research interests in a variety of applications – ecology and exploitation of fish communities, collective cell behaviour, complex ecological networks, invasive species, epidemiology, animal movement, and neurovascular coupling.

Kathryn Morgan
Research Operations Coordinator, Te Pūnaha Matatini (2020)
Research Operations Manager, Te Pūnaha Matatini (2021)

Kathryn coordinates Te Pūnaha Matatini's day-to-day research operations and communications requirements, and provides critical support to the executive management team. After graduating with a Master of Science in Physical Geography from the University of Auckland, Kathryn worked initially as a researcher at several organisations, and also spent 12 years in a variety of roles at the Auckland Museum. Later, she trained in secondary education and for a number of years was a high school teacher.

Greg Town
Communications and Marketing Advisor, Te Pūnaha Matatini (2020)

Greg is supporting Te Pūnaha Matatini's communications requirements as part of his role with the University of Auckland's Faculty of Science marketing team. Since graduating with a Bachelor of Science in Physiology from the University of Auckland, Greg has worked as a magazine and news editor, medical writer, health journalist, and technology blogger for a variety of publishing firms and marketing agencies based in New Zealand, Singapore and the UK.

Jonathan Burgess
Communications and Marketing Senior Adviser, Te Pūnaha Matatini (2021)

Jonathan specialises in communicating complex academic work to a public audience. He has a background in communications, social media and web content management in higher education. Jonathan is a recognised leader in publishing web content at the University of Auckland and has created and managed content for the Faculty of Arts, Te Tumu Herenga Libraries and Learning Services, and Te Pūnaha Matatini.

Anna Vasilyeva
Research Operations Administrator, Te Pūnaha Matatini (2020)

Anna was a PhD candidate in the Faculty of Education and Social Work at the University of Auckland, and her thesis is exploring the power of images in the media and the way these images affect our self-perceptions. Anna has a BA in Linguistics and MCA in Communication Arts in Global Communication. She is the creator and owner of The Breakfast Workshop, a photography and videography company, and is particularly interested in motion design, AR, photography, video games and 3D modelling.

Ashwineer Mudaliar
Research Operations Administrator, Te Pūnaha Matatini (2020)

Ash, who joined us in 2020, was a first year student at Massey University studying Bachelor of Arts in Creative Writing. She previously studied at AUT but took a few years to choose her passion. Ash loves to read all types of literature, and her end goal is to become a novelist.

Pauline Donougher
Research Operations Coordinator Te Pūnaha Matatini (2021)

Pauline coordinates the daily operational requirements for Te Pūnaha Matatini. She has worked in tertiary education administration at Otago Polytechnic, University of Technology Sydney and Auckland University of Technology. Pauline started her career at the Department of Scientific and Industrial Research, and has worked across several industries including the adventure tourism sector. While living in Australia for 13 years, she graduated with a Diploma in Business Administration from the University of Technology Sydney. This varied and convoluted path has made her life interesting, and created a wealth of experience to draw upon.

Kaumātua

Tom Roa
Kaumātua

Dr Tom Roa (Ngāti Maniapoto, Waikato) is a Tainui leader and Manukura / Associate Professor in the University of Waikato's Faculty of Māori and Indigenous Studies, and is a familiar figure on marae throughout Tainui and the country. Tom's PhD examined questions about the theory and practices of Māori to English language translation and interpretation. Over the years, Tom has been a leading figure helping to bring the Māori language into the mainstream, and he is one of the founders of Te Wiki o Te Reo Māori movement in the 1970s.

Advisory Board

Richard Aitken
Advisory Board Chair
Director, Transpower Limited

Richard graduated from the University of Auckland in civil/structural engineering. After the 'obligatory overseas experience' he embarked on a 50-year career journey with Beca, which included being Chief Executive 2000–2009 and Executive Chairman 2009-2017. Richard is now a consultant to Beca and no longer involved in its operational activities.

Richard has held a number of external directorships: Trustpower Limited 2010–2019, Panuku Development Auckland Limited, director from 2015 and chair 2016-2018, Director of the Waterview Project Alliance board from 2011 and Chair from 2015 to completion, member of the Trust Board of the Power Engineering Excellence Trust, University of Canterbury 2002 to 2014 and Chair of the Construction Strategy Group from 2010 to 2015. Currently he is a director of Transpower Limited.

James Mansell
Business owner at Noos Ltd – Business consultant service

James, an independent consultant who provides mentoring courses and presentations on leadership, big data and government, champions the safe use of data science to deliver civic and environmental value. This includes developing an outcomes focused operating model to reform the state sector. Since 2014, James has been leading the development of a new model for data sharing known as the "Data Commons". In 2011, he was awarded the public sector's Leadership Development Centre (LDC) fellowship prize. This was used to study leadership at Harvard the Wharton School and Centre for Creative Leadership. James holds a first class honours degree in Philosophy from Victoria University of Wellington.

Peter-Lucas Jones
General Manager – Te Hiku Media

Peter-Lucas is an experienced broadcaster and digital content leader with tribal affiliations to Ngāti Kahu, Te Rārawa, Ngāi Takoto and Te Aupōuri. He is the General Manager of Te Hiku Media which is the tribal media hub of Te Hiku o Te Ika and the five iwi of Te Hiku, he is also Deputy Chair of Māori TV, and the Deputy Chair of Te Whakaruruhau o Ngā Reo Irirangi Māori o Aotearoa, the national Māori radio network. Peter-Lucas has led Te Hiku Media in creating Māori language content, documenting, curating and archiving Māori language oral histories of Te Hiku o Te Ika, and piloting digital access, and most recently played a leading role in the Māori language corpus gathering for the voice recognition project 'Kōrero Māori'. A former member of the Arts Council of New Zealand Toi Aotearoa and a treaty negotiator for Te Aupōuri, he has post-settlement governance experience.

Pieta Brown

Product Director – Intelligence, Orion Health

Pieta works with healthcare customers to deliver data science and machine learning solutions into real-world clinical and operational workflows. Pieta is passionate about the potential of cross functional teams to deliver these solutions and enjoys working at the intersection of rigorous science, new technology, good design and innovative approaches to governance. She has led large-scale data science projects and capability development for public and private sector organisations in New Zealand focusing on healthcare, financial services, retail and the social sector. Her previous roles have included Insights Manager, Chief Analytics Officer, Head of Data, and Associate Director at PwC. Pieta holds degrees in Science and Law, including a Master of Data Science from the University of Auckland, and is on the committee for the New Zealand Data Science and Analytics Forum.

Professor Wendy Lawson

Pro Vice-Chancellor Science, University of Canterbury

Professor Wendy Lawson, Pro-Vice-Chancellor for Science at the University of Canterbury, is a glaciologist with a passion for fieldwork. She has more than 30 years of experience of remote fieldwork in polar and alpine environments, including in Greenland, Svalbard, Alaska and Arctic Norway – as well as Antarctica. Wendy's previous roles include Dean of Science and Head of Department of Geography at the University of Canterbury, and as an academic at the University of Auckland. She has a range of academic and Crown sector strategic sector governance experience, including Ministerial appointments as a Board Director of NIWA and of Antarctica New Zealand. Wendy's PhD is from the University of Cambridge and her most recent qualification awarded in 2008 is a Postgraduate Certificate in Public Administration from the University of Warwick Business School. One of her career highlights of which she is most proud is the naming of a stream in Antarctica – Lawson Creek – in her honour in 1995.

Professor John Hosking

Dean of Science – University of Auckland

John is Dean of Science at the University of Auckland assuming the role in June 2014.
Immediately prior to that he was Dean of Engineering and Computer Science at the Australian National University and before that was Professor of Applied Computer Science in the Department of Computer Science at the University of Auckland including a six-year term as Head of Department between 1999 and 2005.
John's research career has been in software engineering, with over 200 publications to his name, and a long history of university-industry research engagement. He has been awarded both an FRSNZ in recognition of his research activities and a National Tertiary Teaching Excellence award reflecting his passion for teaching.

Professor Jim Metson

Deputy Vice-Chancellor (Research), University of Auckland

Professor Jim Metson is the Deputy Vice-Chancellor (Research) at the University of Auckland. For the past two years he has been Chief Science Adviser for the Ministry of Business, Innovation and Employment. With experience in academic research, working with industry and also with government, his past positions include: Deputy Dean of the University of Auckland's Faculty of Science, Associate Director of Light Metals Research Centre (LMRC), a Councillor for the Australian Institute of Nuclear Science and Engineering, the Chair of the Australian Synchrotron Science Advisory Committee, the former Head of the School of Chemical Sciences, chair of the Research Infrastructure Advisory Group (RIAG) for MBIEs predecessor MoRST and a Principal Investigator of the MacDiarmid Institute.

International Advisory Board

Professor Alan Hastings
University of California, Davis

Professor Alan Hastings is interested in a range of topics in theoretical ecology and population biology, and more generally in mathematical biology.

He is a Professor in the Department of Environmental Science and Policy and also a member of the Centre for Population Biology. Alan completed his PhD in Applied Mathematics at Cornell University in 1977 under the supervision of Simon A. Levin and have been at UC Davis (located in beautiful Davis, California) since 1979. He is the founding Editor in Chief of the journal *Theoretical Ecology*, published by Springer.

Professor Bronwyn H. Hall
University of California, Berkeley

Bronwyn H. Hall is Emerita Professor at the University of California at Berkeley, a Research Associate of the National Bureau of Economic Research and the Institute for Fiscal Studies, London, and a Visiting Fellow at NIESR, London. She currently serves as an associate editor of the Economics of Innovation and New Technology, and of Industrial and Corporate Change. She is also a member of several advisory boards (Solvay Brussels School of Economics and Management, European Patent Office, DIW – German Institute for Economic Research). She received a BA in physics from Wellesley College in 1966 and a PhD in economics from Stanford University in 1988.

Professor Frank Kelly
Fellow of Royal Society (UK)
Professor of the Mathematics of Systems
University of Cambridge

Frank Kelly is Professor of the Mathematics of Systems in the University of Cambridge. He was elected a Fellow of the Royal Society in 1989, and a Foreign Member of the National Academy of Engineering in 2012. In 2013 he was awarded a CBE for services to mathematical sciences. His main research interests are in random processes, networks and optimization. He is especially interested in applications to the design and control of networks and to the understanding of self-regulation in large-scale systems. From 2003 to 2006 he served as Chief Scientific Adviser to the United Kingdom's Department for Transport. He was chair of the Council for the Mathematical Sciences, and a member of the RAND Europe Council of Advisors.

Professor Ian Foster
Director, Computation Institute
University of Chicago

Ian Foster, Senior Fellow, is Director of the Computation Institute, a joint institute of the University of Chicago and Argonne National Laboratory. He is also an Argonne Senior Scientist and Distinguished Fellow and the Arthur Holly Compton Distinguished Service Professor of Computer Science. Ian received a BSc (Hons I) degree from the University of Canterbury, New Zealand, and a PhD from Imperial College, United Kingdom, both in computer science. His research deals with distributed, parallel, and data-intensive computing technologies, and innovative applications of those technologies to scientific problems in such domains as climate change and biomedicine. Methods and software developed under his leadership underpin many large national and international cyberinfrastructures. Dr Foster is a fellow of the American Association for the Advancement of Science, the Association for Computing Machinery, and the British Computer Society.

Professor Julia Lane
Wagner School of Public Policy at New York

Julia Lane is a Professor in the Wagner School of Public Policy at New York University. She is also a Provostial Fellow in Innovation Analytics and a Professor in the Centre for Urban Science and Policy. Julia has published over 70 articles in leading economics journals, and authored or edited ten books. She has been the recipient of over $50 million in grants and has organized over 40 national and international conferences, received several national awards, given keynote speeches all over the world, and serves on a number of national and international advisory boards.

Professor Manuel Trajtenberg
Tel Aviv

Manuel Tajtenberg is an economist and chair of the Planning and Budgeting Committee of the Council for Higher Education in Israel. Manuel graduated from the Hebrew University of Jerusalem with a major in economics in 1973 and completed a master's degree in economics and sociology in 1976, also at the Hebrew University. In 1984 he received his PhD from Harvard University for work entitled 'Economic Analysis of Product Innovation: The Case of CT Scanners.' Upon completing his PhD, he returned to Israel, and has since been serving as a professor in the Tel-Aviv University School of Economics. Trajtenberg has served in several public roles. He was a consultant to the Ministry of Industry, Trade and Labour and to the Prime Minister's Office. In 2006 he was appointed the first chair of the Israeli National Economic Council.

Professor Philip McCann
Groningen

Philip McCann trained as an economic geographer. He studied at and gained his PhD (1993) from the University of Cambridge (UK) and then worked at the University of Pennsylvania in the US (1993–1995), the University of Reading (UK) (1995-2005) and the University of Waikato in New Zealand. At Reading he was a professor of Urban and Regional Economics, in Waikato a professor of Economics. He has also been a guest professor in the US, Japan, Thailand and Italy. He has long had an intensive relationship with the Faculty of Spatial Sciences in Groningen, which he regularly visits for guest lectures, seminars and PhD ceremonies. Philip McCann's research covers a wide range of topics. Much of his research has been financed by extra-university clients such as the British Ministry of Trade and Industry, the EU and the OECD.

Research Committee

Professor Shaun Hendy (Chair)
University of Auckland
Director

Dr Priscilla Wehi
Manaaki Whenua/
Landcare Research
Incoming Co-Director (2020)
Incoming Director (2021)

Murray Cox
Massey University
Incoming Co-Director (2020)

Mike O'Sullivan
University of Auckland
Incoming Deputy-Director (2021)

Assoc Prof Alex James
University of Canterbury
Deputy Director, Industry and Stakeholder Engagement

Assoc Prof Cate Macinnis-Ng
University of Auckland
Theme Co-Leader – Complexity and the Biosphere

Dr Dan Hikuroa
University of Auckland
Co-Deputy Director, Public Engagement

Dr Dion O'Neale
University of Auckland

Dr Isabelle Sin
Motu Research

Kate Hannah
University of Auckland
Deputy Director, Equity and Diversity; Executive Manager

Professor Michele Governale
Victoria University of Wellington
Theme Co-Leader – Complex Economic and Social Systems

Assoc Prof Mike Plank
University of Canterbury
Theme Co-Leader – Complexity and the Biosphere

Ellen Hume
University of Auckland
Te Pūnaha Matatini Whānau Chair

Assoc Prof Siouxsie Wiles
University of Auckland
Co-Deputy Director, Public Engagement

Dr Rhian Salmon
Victoria University of Wellington

Professor Stephen Marsland
Massey University
Theme Leader – Complexity, Risk, and Uncertainty

Research Committee (continued)

Professor Uli Zuelicke
Victoria University of Wellington
Theme Co-Leader – Complex Economic and Social Systems

Public Engagement Committee

Dr Dan Hikuroa
University of Auckland
Co-Deputy Director, Public Engagement

Assoc Prof Siouxsie Wiles
University of Auckland
Co-Deputy Director, Public Engagement

Dr Rhian Salmon
Victoria University of Wellington

Dr Jeanette McLeod
University of Canterbury

Dr Jo Bailey
Massey University, Wellington

Kate Hannah
University of Auckland
Deputy Director, Equity and Diversity; Executive Manager, Te Pūnaha Matatini

Kathryn Morgan
Research Operations Coordinator, Te Pūnaha Matatini (2020)
Research Operations Manager, Te Pūnaha Matatini (2021)

Greg Town
Communications and Marketing Adviser, Te Pūnaha Matatini (2020)

Kairangi

Kairangi is a Māori term meaning 'the finest pounamu' (greenstone or jade) which can be used to describe a person held in high esteem. This category of investigator reflects our development as an organisation and acknowledges the important contributions of our senior colleagues.

Professor Adam Jaffe (Motu Research)

Dr Andrea Byrom (Retired)

Professor Andy Philpott (University of Auckland)

Professor Richard Easther (University of Auckland)

Professor Suzi Kerr (Motu Research)

Te Pūnaha Matatini Whānau

Te Pūnaha Matatini Whānau Committee 2020

Ellen Hume
University of Auckland – Chair

Giorgia Vittiato
University of Canterbury – Vice-chair

Julie Mugford
University of Canterbury – Immediate past-chair

Max Soar
Victoria University of Wellington – Te Herenga Waka – Secretary

Neil Birrell
University of Auckland – Communications officer

Stephen Merry
University of Canterbury – Treasurer

Attaullah Sahito
University of Waikato – Committee member

Te Pūnaha Matatini Whānau Committee 2021

Giorgia Vattiato
University of Canterbury – Chair

Neil Birrell
University of Auckland – Vice-chair

Ellen Hume
University of Auckland – Immediate past-chair

Rae Rho
University of Auckland – Secretary

John Cleveland Acuna
University of Auckland – Treasurer

Patricia Pillay
University of Auckland – Communications officer

Muhammad Yahhya Maqbool
Committee member

Principal Investigators

Associate Professor Alex James
University of Canterbury

Dr Cate Macinnis-Ng
University of Auckland

Dr Daniel Hikuroa
University of Auckland

Dr Dave Maré
Motu

Dr Dion O'Neale
University of Auckland

Dr Emily Harvey
Market Economics

Associate Professor Ilze Ziedins
University of Auckland

Dr Isabelle Sin
Motu

Dr Jeanette McLeod
University of Canterbury

Associate Professor Marcus Frean
Victoria University of Wellington

Associate Professor Michael Plank
University of Canterbury

Professor Michele Governale
Victoria University of Wellington

Professor Murray Cox
Massey University

Dr Pierre Roudier
Manaaki Whenua Landcare Research

Dr Rachelle Binny
Manaaki Whenua Landcare Research

Associate Professor Rebecca Priestley
Victoria University of Wellington

Dr Rhian Salmon
Victoria University of Wellington

Professor Sally Davenport
Victoria University of Wellington

Professor Shaun Hendy
University of Auckland

Associate Professor Siouxsie Wiles
University of Auckland

Professor Stephen Marsland
Victoria University of Wellington

Professor Tava Olsen
University of Auckland

Professor Thegn Ladefoged
University of Auckland

Professor Troy Baisden
University of Waikato

Professor Uli Zülicke
Victoria University of Wellington

Associate Investigators

Professor Adrian McDonald
University of Canterbury

Dr Andrea Byrom
Manaaki Whenua Landcare Research

Associate Professor Ann Brower
University of Canterbury

Dr Anna Matheson
Victoria University of Wellington – Te Herenga Waka

Associate Professor Arvind Tripathi
University of Auckland

Dr Audrey Lustig
Manaaki Whenua Landcare Research

Associate Professor Barry Milne
University of Auckland

Associate Professor Cameron Walker
University of Auckland

Dr Christina Painting
University of Waikato

Associate Professor Claire Postlethwaite
University of Auckland

Dr David Hall
Auckland University of Technology

Professor David Hayman
Massey University

Dr David Welch
University of Auckland

Dr Elodie Blanc
Motu Research

Dr Emma Sharp
University of Auckland

Dr Fraser Morgan
Manaaki Whenua Landcare Research

Dr Hamza Ajmal
Livestock Improvement Corporation

Dr Inga Smith
University of Otago

Associate Professor Isabel Castro
Massey University

Professor James Sneyd
University of Auckland

Dr Jonathan Tonkin
University of Canterbury

Kate Hannah
University of Auckland

Dr Kirsten Locke
University of Auckland

Associate Professor Krushil Watene
Massey University

Dr Leilani Walker
Auckland Museum

Professor Les Oxley
University of Waikato

Dr Lynn Riggs
Motu Research

Associate Professor Marama Muru-Lanning
University of Auckland

Professor Mark Gahegan
University of Auckland

Dr Mark Wilson (2020)
University of Auckland

Associate Professor Markus Luczak-Roesch
Victoria University of Wellington – Te Herenga Waka

Dr Matthew Parry
University of Otago

Associate Professor Maui Hudson
University of Waikato

Professor Melinda Allen
University of Auckland

Dr Michael O'Sullivan
University of Auckland

Dr Michelle Dickinson
Nanogirl Labs Ltd

Dr Mubashir Qasim
Livestock Improvement Corporation

Associate Professor Nirmal Nair
University of Auckland

Professor Niven Winchester
Motu Research

Dr Phillip Wilson
University of Canterbury

Dr Priscilla Wehi
Manaaki Whenua Landcare Research

Dr Rachael Ka'ai-Mahuta
Auckland University of Technology

Professor Richard Arnold
Victoria University of Wellington – Te Herenga Waka

Dr Sandra Velarde
Scion

Dr Simone Linz
University of Auckland

Dr Steffen Lippert
University of Auckland

Professor Tahu Kukutai
University of Waikato

Associate Professor Tammy Steeves
University of Canterbury

Dr Tara McAllister
University of Auckland

Dr Tze Ming Mok
Auckland Council

Dr WIlliam Godsoe
Lincoln University

Postdoctoral fellows

Dr Alex Beattie
Victoria University of Wellington – Te Herenga Waka

Dr Kannan Ridings
University of Auckland

Dr Nirosha Priyadarshani
Victoria University of Wellington – Te Herenga Waka

Dr Rebecca Turner
Scion

Dr Steven Turnbull
University of Auckland

Dr Tara McAllister
University of Auckland

Dr Vincent van Uitregt
Massey University

Dr Niffe Hermansson (2020)
University of Auckland

PhD students

Student	*Supervisor*	*Institution*
Adrian Ortiz-Cervantes	Dion O'Neale, Isabelle Sin, Claire Postlethwaite, David Maré	University of Auckland
Aida Shams	Tava Olsen	University of Auckland
Aisling Rayne	Tammy Steeves	University of Canterbury
Alberto De Rosa	Stephen Marsland, Isabel Castro	Massey University
An Yu	Cameron Walker	University of Auckland
Angela Natali	Isabelle Sin, Sally Davenport	Victoria University of Wellington – Te Herenga Waka
Atefeh Rahimi	Michael O'Sullivan	University of Auckland
Attaullah Sahito		University of Waikato
Benjamin Cranston	Cate Macinnis-Ng	University of Auckland
Chanelle L Duley	Steffen Lippert	University of Auckland
Clever Gama Alves	Michael O'Sullivan	University of Auckland
David Wu	Dion O'Neale, Emily Harvey	University of Auckland
Ellen Hume	Cate Macinnis-Ng, Troy Baisden	University of Auckland
Erana Walker	Priscilla Wehi	University of Waikato
Gautam Shrestha	Pierre Roudier	Massey University
Georgia McLellan	Emma Sharp	University of Auckland
Giorgia Vattiato	Rachelle Binny, Michael Plank, Isabel Castro	University of Canterbury
Gray Manicom	Claire Postlethwaite	University of Auckland
Hitaua Arahanga-Doyle		University of Otago
Jane Li		Victoria University of Wellington – Te Herenga Waka
Jessica Rohde	Rhian Salmon	Victoria University of Wellington – Te Herenga Waka
Jo Bailey	Rebecca Priestley, Rhian Salmon	Victoria University of Wellington – Te Herenga Waka
John Thomas Cleveland	Tava Olsen	University of Auckland
Julie Mugford	Alex James, Michael Plank, Andrea Byrom	University of Canterbury
Julius Juodakis	Stephen Marsland, Isabel Castro	Victoria University of Wellington – Te Herenga Waka
June Lau	Michael O'Sullivan, Ilze Ziedens	University of Auckland
Kannan Ridings	Shaun Hendy	University of Auckland
Kian Wee Soh	Cameron Walker, Mike O'Sullivan	University of Auckland
Liz McGeorge		University of Canterbury
Luke Liddell		University of Auckland
Maren Elisabeth Richter		University of Otago
Matthew Keith Skiffington		University of Waikato
Max Soar		Victoria University of Wellington – Te Herenga Waka
Mazyar Zarepour	Mike O'Sullivan	University of Auckland
Michael Ryan	Les Oxley	University of Waikato
Michal Salter-Duke	Stephen Marsland	Victoria University of Wellington – Te Herenga Waka
Muhammad Yahhya Maqbool		University of Waikato
Neda Pourreza	Mike O'Sullivan	University of Auckland
Neda Sakhaee	Mark Wilson	University of Auckland
Neil Birrell	Leilani Walker	University of Auckland

Nicholas Bowden	Barry Milne	University of Otago
Rae Rho	Steffen Lippert	University of Auckland
Reno Nims	Melinda Allen, Thegn Ladefoged	University of Auckland
Sarah Mark		University of Canterbury
Steven Martin Turnbull	Dion O'Neale, Kirsten Locke	University of Auckland
Thanos Kyritsis		University of Auckland
Warren Ladbrook	Michael O'Sullivan	University of Auckland
Wilbur Townsend		Harvard University
Zoë Heine	Rebecca Priestley, Rhian Salmon	Victoria University of Wellington – Te Herenga Waka

Masters students 2020

Student	*Supervisor*	*Institution*
Caitlan Butler	Thegn Ladefoged	University of Auckland
Elizabeth Ampong		University of Waikato
Frankie Patten-Elliott	Dion O'Neale	University of Auckland
Linda Jane Keegan	Cate Macinnis-Ng	University of Auckland
Max Soar	Rebecca Priestley	Victoria University of Wellington – Te Herenga Waka
Mckayla Holloway	Rhian Salmon	Victoria University of Wellington – Te Herenga Waka
Michaela Lambert		University of Waikato
Patricia Pillay	Melinda Allen	University of Auckland
Samuel Rammell	Rhian Salmon	Victoria University of Wellington – Te Herenga Waka
Stephen Merry	Alex James, Michael Plank, Jeanette McLeod	University of Canterbury
Summer Staninski		Auckland University of Technology
Valerie Chan		Victoria University of Wellington – Te Herenga Waka

Masters students 2021

Student	*Supervisor*	*Institution*
Anika Terry	Barry Milne	University of Auckland
Frankie Patten-Elliott	Dion O'Neale	University of Auckland
Hannah Kotula		University of Canterbury
Katerina French Armstrong	Rhian Salmon, Jo Bailey	Victoria University of Wellington – Te Herenga Waka
Mckayla Holloway	Rhian Salmon	Victoria University of Wellington – Te Herenga Waka
Michaela Lambert	Christina Painting	University of Waikato
Nicola Wilson	Troy Baisden	University of Waikato
Patricia Pillay	Melinda Allen	University of Auckland
Sam Rammell		Victoria University of Wellington – Te Herenga Waka
Stephen Merry	Michael Plank, Jeanette McLeod, Alex James	University of Canterbury
Summer Staninski		Auckland University of Technology
Te Kahuratai Painting	Daniel Hikuroa	University of Auckland
Tony Nemaia	Michael O'Sullivan	University of Auckland
Valerie Chan		Victoria University of Wellington – Te Herenga Waka
Vicky Gane	Rhian Salmon	Victoria University of Wellington – Te Herenga Waka

Honours students 2020

Student	*Supervisor*	*Institution*
Amy Arnesen		University of Auckland
Ethan Renner	Barry Milne	University of Auckland
Hamish Jellyman	Dion O'Neale	University of Auckland
Liam Gibson		University of Canterbury
Nicholas Steyn		University of Auckland
Sophie Richardson	Emma Sharp	University of Auckland
Tim West-Newman	Ilze Ziedins	University of Auckland

Honours students 2021

Student	*Supervisor*	*Institution*
Elliot Poehler		University of Canterbury
Liam Gibson		University of Canterbury
Maggie McGrath	Thegn Ladefoged	University of Auckland
Tim West-Newman	Ilze Ziedins	University of Auckland

Undergraduate students 2020

Student	*Institution*
Andrew Cox	University of Canterbury
Ebba Olsen	University of Auckland
Elliott Hughes	University of Canterbury
Gabrielle Baker-Clemas	University of Canterbury
Gabrielle Po Ching	Victoria University of Wellington – Te Herenga Waka
Hileni Nendongo	University of Auckland
Juniper Carmen Sprengers-Sanson	Victoria University of Wellington – Te Herenga Waka
Kahutia Foster-Hesp	University of Auckland
Kate Curtis	University of Waikato
Keana Virmani	Victoria University of Wellington – Te Herenga Waka
Megan Poehler	University of Canterbury
Regan Toogood	University of Canterbury
Rowan Stanley	Massey University
Sabrina Schmitz	University of Auckland
Ummat Somjee	University of Waikato
Zihao Zhang	University of Auckland

Undergraduate students 2021

Student	*Institution*
Anastasiya Kiddle	University of Auckland
Elliott Hughes	University of Canterbury
Frank Mackenzie	University of Auckland
Gabrielle Baker-Clemas	University of Canterbury
Nicholas George Watson	Auckland University of Technology
Nicholas Jones	University of Auckland
Regan Toogood	University of Canterbury
Zihao Zhang	University of Auckland

Research assistants 2020

Student	*Supervisor*	*Institution*
Atefeh Rahimi	Michael O'Sullivan	University of Auckland
Caitlan Butler	Thegn Ladefoged	University of Auckland
David Wu	Dion O'Neale, Emily Harvey	University of Auckland
Ebba Olsen	Claire Postlethwaite	University of Auckland
Elliott Hughes	Alex James	University of Canterbury
Ethan Renner	Barry Milne	University of Auckland
Frankie Patten-Elliott	Dion O'Neale, Emily Harvey	University of Auckland
Gabrielle Baker-Clemas	Alex James	University of Canterbury
Georgia McLellan	Emma Sharp	University of Auckland
Juniper Carmen Sprengers-Sanson		Victoria University of Wellington – Te Herenga Waka
Linda Jane Keegan	Cate Macinnis-Ng	University of Auckland
Max Soar	Rebecca Priestley	Victoria University of Wellington – Te Herenga Waka
Megan Poehler	Alex James	University of Canterbury
Michaela Lambert	Christina Painting	University of Waikato
Nicholas Steyn	Alex James, Mike Plank, Shaun Hendy	University of Auckland
Patricia Pillay	Melinda Allen	University of Auckland
Rae Rho		University of Auckland
Rowan Stanley	Krushil Watene	Massey University
Samuel Rammell	Rhian Salmon	Victoria University of Wellington – Te Herenga Waka

Research assistants 2021

Student	*Supervisor*	*Institution*
Alison Dijs	Thegn Ladefoged	University of Auckland
Anastasiya Kiddle	Kannan Ridings, Kate Hanna	University of Auckland
Andrew Cox	Michael Plank	University of Canterbury
Caitlan Butler	Thegn Ladefoged	University of Auckland
Caitlin Smith	Melinda Allen	University of Auckland
Catherine Bodnar	Barry Milne	University of Auckland
Cole Thompson	Priscilla Wehi	University of Otago
Colin Watanabe	Michael O'Sullivan	University of Auckland
David Wu	Dion O'Neale, Emily Harvey	University of Auckland
Elliot Poehler	Alex James	University of Canterbury
Erin Steed	Christina Painting	University of Waikato
Ethan Renner	Barry Milne	University of Auckland
Fin Johnson	Priscilla Wehi	University of Otago
Frank Mackenzie	Dion O'Neale, Emily Harvey	University of Auckland
Frankie Patten-Elliott	Dion O'Neale, Emily Harvey	University of Auckland
Ha Nguyen	Isabelle Sin	Motu Research
Hannah Kotula	David Mare, Isabelle Sin	Motu Research
Juniper Sanson	Priscilla Wehi	University of Otago
Katie Robertson	Thegn Ladefoged	University of Auckland
Kim Peita	Krushil Watene	Massey University
Lauren Baal	Emma Sharp	University of Auckland
Liam Gibson	Alex James	University of Canterbury
Livvy Mitchell	Isabelle Sin	Motu Research

Maggie McGrath	Thegn Ladefoged	University of Auckland
Max Soar	Kate Hannah	University of Auckland
Molly Magid	Tammy Steeves	University of Canterbury
Nic Steyn	Shaun Hendy, Michael Plank	University of Auckland
Nicholas Jones	Marama Muru-Lanning	University of Auckland
Nicholas Watson	Isabelle Sin	Motu Research
Patricia Pillay	Thegn Ladefoged, Melinda Allen	University of Auckland
Sabrina Schmitz	Ilze Ziedins	University of Auckland
Sarah Sowerby	Thegn Ladefoged	University of Auckland
Shannon Minehan	Isabelle Sin	Motu Research
Suz Te Tai	Krushil Watene	Massey University
Tai Wright	Thegn Ladefoged	University of Auckland
Will Scarrold	Dion O'Neale	University of Auckland
Xueping Yang	Arvind Tripathi	University of Auckland

2020–21 summer interns

Intern	*Project title*	*Industry/sector partner*
Mckayla Holloway	Science Communication – TPM's early career scientists' contribution to NZ's Covid-19 response	Victoria University of Wellington – Te Herenga Waka
Amy Arnesen	Care in food: meat, dairy and waste	University of Auckland
Elizabeth Ampong	Citation Network for Lake Taupo Nitrogen Management	Waikato University
Elliott Hughes	Estimating the size of a Covid-19 outbreak using supermarket sales data	University of Canterbury
Gabrielle Baker-Clemas	How Covid-19 is racist: exploring why the Pasifika population in New Zealand faced the highest health burdens from the 2020 outbreaks	University of Canterbury
Hileni Nendongo	Te Pūnaha Matatini Analytics	University of Auckland
Zihao Zhang	Te Pūnaha Matatini Analytics	University of Auckland
Summer Staninski	Are more gender equal countries more open to ideas generated by women?	Motu Research

Contact us:
Te Pūnaha Matatini
University of Auckland
Private Bag 92019
Auckland 1011
New Zealand

+64 9 373 7999
tepunahamatatini@auckland.ac.nz
tepunahamatatini.ac.nz
@punahamatatini

Te Pūnaha Matatini
Data ▪ Knowledge ▪ Insight