Te Pūnaha Matatini
Data ■ Knowledge ■ Insight

Annual Report 2018

A Centre of Research Excellence hosted by the University of Auckland

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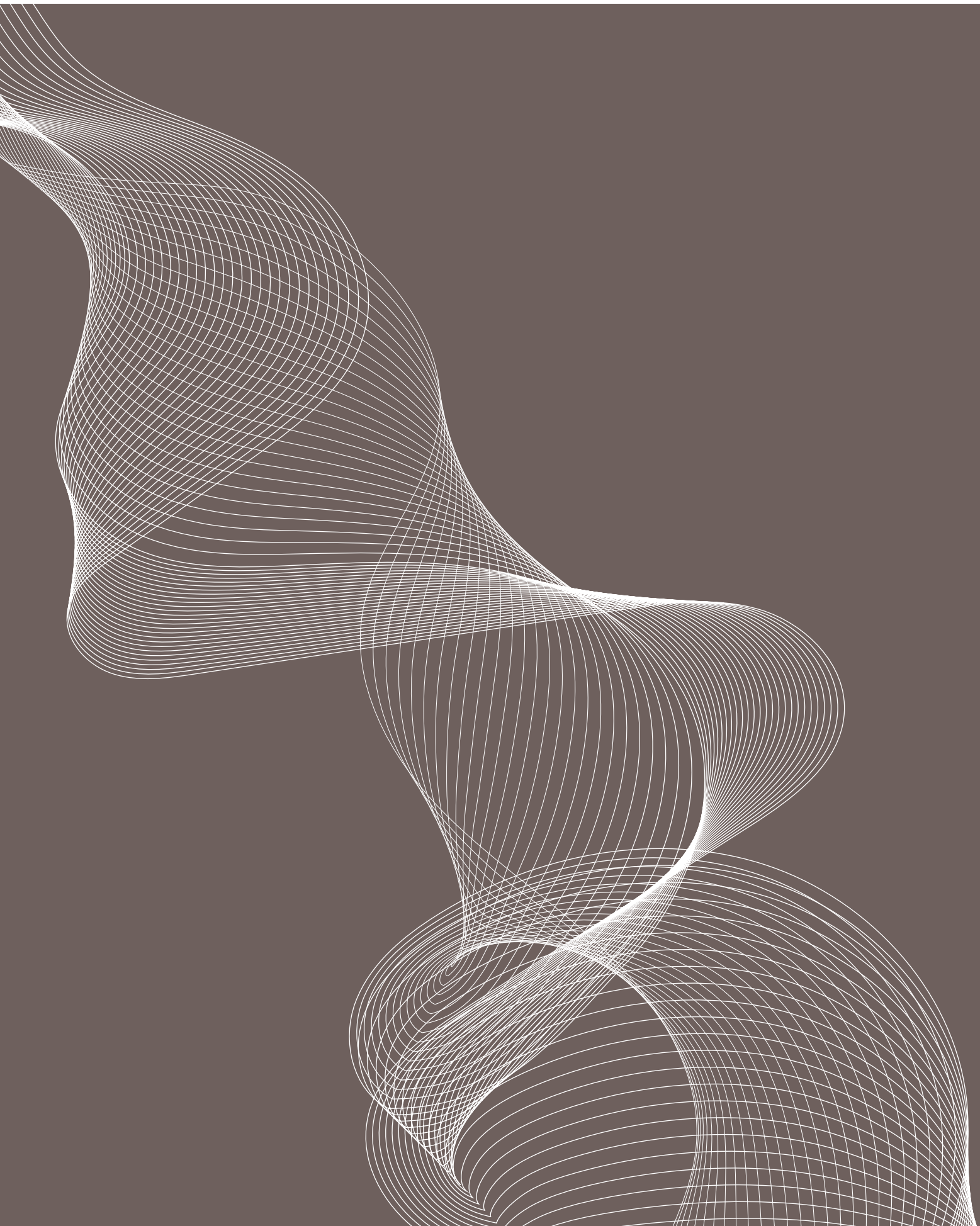
About Us

Our Partners

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

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Motu

Manaaki Whenua
Landcare Research

m.e research

2012	Early 2013	Mid 2013	October 2013	Early 2014	February 2015
Shaun Hendy and Dion O'Neale discuss how a complex systems research team with a broad set of collaborators could make an impact.	Shaun Hendy encouraged to submit a proposal for a Centre of Research Excellence (CoRE).	Kate Hannah comes on board as bid manager.	Investigators from around the country come together for the first time.	Bid team interviewed by Royal Society of New Zealand selection panel.	Official launch of Te Pūnaha Matatini with 24 Principal Investigators.

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.

Director Shaun Hendy discusses Te Pūnaha Matatini's work on RadioLIVE.

http://bit.ly/1ohHOmk

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.

December 2018
- 26 Principal Investigators
- 26 Associate Investigators
- Executive Management Team of 13
- Over 100 students aligned with Te Pūnaha Matatini Whānau
- 47 students directly funded by or working on Te Pūnaha Matatini projects.

Board Chair's Report

Another year passes and one which I am pleased to report has been a successful year for Te Pūnaha Matatini.

We have continued to grow and have increased our reputation. It has also been a year that has seen a number of changes successfully made to Te Pūnaha Matatini's structure as we enter our rebid year. I discuss this later in my report, but first some brief comments on selected highlights which are described in detail in the body of the annual report.

Dr Siouxsie Wiles (our Co-Deputy Director– Public Engagement and Outreach) was made a Member of the New Zealand Order of Merit for services to microbiology and science communication in the 2019 New Year's Honour's List. An award and public recognition that was well deserved given Siouxsie's reputation and mana in the science community.

Each year our Board notes the continued and increasing success of Maths Craft which aims to connect the general public with mathematics. The idea was developed by Dr Jeanette McLeod and Dr Phil Wilson of the University of Canterbury. Maths Craft has now reached more than 10,000 people since it started in September 2016. In the words of Jeanette, "You took a chance on us when we were just a crazy idea." But we would say, not so – you had the vision and ability to make it succeed so thank you both for doing a great job.

I noted the success of the intern programme in 2018 which, under the control of Alex James (our Deputy Director Industry and Stakeholders) and Kathryn Morgan (our Research Operations Coordinator), placed 29 undergraduate and postgraduate internships with ten different organisations. It is worthwhile to reflect upon the progress made by this programme – in the four years of Te Pūnaha Matatini's journey, it has increased from 1 to 14 to 21 to 29 internships this year. This programme is no easy task to successfully organise and administer the scheme, which is so valuable an experience for the successful applicants. I note Alex and Kathryn had to process a total of 162 applications for internships to arrive at the 29 interns which gives an indication of the amount of effort required.

A brief commentary on selected highlights needs to include our director Professor Shaun Hendy's #nofly2018 commitment. Shaun had the leadership and tenacity to keep it going for the complete year, reducing his carbon footprint by 95% compared to his 2017 carbon footprint. Although he is flying this year, he is targeting a 35% reduction in his footprint on a more permanent basis. His actions do remind us all of the need to monitor our own carbon footprints and to see what we can do about reducing them – all of which will be a help to minimise individual "climate anxiety," a concept which I understood when I saw it mentioned in the body of the report. Well done Shaun on your achievement!

I alluded to some changes in the structure of Te Pūnaha Matatini in my opening remarks. These are as follows. Our advisory board has had three members step down from the Board in 2018 – Arthur Grimes (Motu), Lillian Grace (Figure NZ), and Kevin Ross (Orion Health). I want to take this opportunity to thank them for their excellent advice and assistance with the governance at Te Pūnaha Matatini. Wendy Lawson (PVC Science Canterbury) did step down briefly as a board member but was successfully persuaded to return for a second term. Many thanks Wendy for your past contributions to Te Pūnaha Matatini and it is great to have you back. I would also like to officially welcome our new advisory board members – Pieta Brown (PwC) and Peter-Lucas Jones (Te Hiku Media) to the Board, and to thank our continuing second term board members, John Hosking (Dean of Science, University of Auckland), Jim Metson (Deputy Vice Chancellor Research, University of Auckland) and James Mansell (Noos Ltd), for their ongoing contributions.

It is appropriate that I make a comment on our rebid year. A recruitment panel of advisory board members plus two Te Pūnaha Matatini investigators was tasked with assessing two applications for incoming director. It was no easy task considering the quality of the applications and the presentations but finally the panel reached a recommendation that the application from Professor Murray Cox (Massey) and Dr Priscilla Wehi (Manaaki Whenua) be accepted, which has now been confirmed. Murray and Priscilla will be incoming co-directors for 2019/2020 and are responsible for leading the bid for CoRE funding for 2021 and beyond. At the time of writing this annual report, it should be noted that Te Pūnaha Matatini is still awaiting advice as to the programme which will apply to the rebid but we are, in the interim, assuming a programme that requires our full rebid proposal to be completed late this year – December 2019. Needless to say, a successful rebid is an essential outcome for our CoRE which to achieve will require hard work, a team effort from all involved, notwithstanding the ever present time pressure. I have confidence that the Te Pūnaha Matatini team under Shaun Hendy's overall guidance, can rise to this challenge. Any support the Board can give will be readily available.

In conclusion, on behalf of the Board, I thank Shaun and his executive team for all their hard work in 2018 which has resulted in Te Punaha Matatini's continuing successful journey.

Richard Aitken

Richard Aitken
Board Chair

Director's Report

Te Pūnaha Matatini's focus in 2018 was the implementation of its 2018–2020 three-year plan, but it was also a year where we were able to reflect on the successes that came from our 2015–2017 plan.

At the point of our mid-term review, which took place in early 2017, less than two-and-a-half years into the life of Te Pūnaha Matatini, we were still very much based on our promise rather than our delivery.

Our International Advisory Board told us that: "Looking across the academic disciplines of the researchers participating in TPM gives one an idea of the breadth of expertise available in the network: from traditional fields such as physics, mathematics, anthropology, and economics, through network science, operations research, and computational social science, to science communication and mātauranga Māori. It is hard to imagine a similar research network anywhere in the world. This fact creates an opportunity for unique research output from a small country."

In 2018, we were finally in a position to see whether Te Pūnaha Matatini's research network had lived up to these expectations.

CoREs must demonstrate excellent research. In as much as citations can be used as a proxy for excellence, our body of research measures up extremely well. Te Pūnaha Matatini's set of publications from its first two years generated citation impact that places the Centre between the Santa Fe Institute and the Max Planck Institute for Complex Systems, arguably the two leading international research centres that Te Pūnaha Matatini could be compared with. In terms of the field-weighted citation impact of its papers, Te Pūnaha Matatini compares very favourably with the other CoREs selected in the 2013–14 funding round, with only one of these other six CoREs fractionally ahead on this measure and most considerably behind. It is especially pleasing that this citation impact is being generated from our most trans-disciplinary research publications, which stem from collaborations that would not exist without Te Pūnaha Matatini.

Citation impact is not a measure we set out to maximise. Te Pūnaha Matatini's mission has been to experiment with new ways of organising and delivering research in New Zealand. We wanted to create a diverse, accessible, and inclusive research community that would focus on research questions that matter to Aotearoa New Zealand. Nothing illustrates this more than Te Pūnaha Matatini's student internship programme, which has seen more than sixty students placed in paid summer internships working with external organisations since the programme began in 2015. Our interns form a diverse group (54% have been women, 5% Pasifika, and 19% Māori), particularly when one considers that the computational and mathematical sciences are dominated by Pākeha men in New Zealand. Our interns have gained experience and built networks across a large range of organisations, from Te Hiku Media, an iwi-owned broadcasting organisation that is working to develop natural language processing tools for Te Reo Māori, to the Social Investment Agency, a government organisation that aims to use data to improve the delivery of social services, to Westpac, a bank that wanted to explore the use of banking data for public good. We have seen interns go into full-time employment with their host organisations after graduation and one even started a company in 2018 based on her summer project.

We can see our relevance to Aotearoa in other ways. We have been called on to assist in the M. bovis eradication programme, a billion-dollar crisis for our primary sector, both to help understand animal movement data and to advise on science communication. Our investigators sit on numerous national advisory boards, including the Royal Society Te Apārangi's panel on "A fair go in life: equality, equity and fairness in Aotearoa New Zealand", the Environmental Protection Agency's Ngā Kaihautū statutory Māori Advisory committee, the government's Fair Pay Agreement Working Group, and Callaghan Innovation's Board of Directors. Our external research income from end-user organisations continues to grow in magnitude and diversity, up from $490k in 2017 to $780k in 2018.

Our way of doing things has started to be noticed by other research organisations. In 2018, Nature, the world's pre-eminent scientific journal, highlighted the work of our early career researcher network, the Te Pūnaha Matatini Whānau, not long after the Whānau's first research output, which was based on a topic model of New Zealand's Parliamentary transcripts, appeared in the journal PLoS One. Earlier in the year, Nature ran a feature on the 'Kindness in Science' event that we co-organised in late 2017. Indeed, our equity, diversity, access, and inclusion policies are starting to be adopted both by organisations within New Zealand, such as the Royal Society Te Apārangi, as well as internationally, by organisations like the Australian Mathematical Society.

As we move into 2019, I find myself immensely proud of the value that Te Pūnaha Matatini's research network has created at this stage in its life-cycle. We started with the hypothesis that a diverse, inclusive, and accessible research community would enable very special things to happen and so it has proved. It remains for me to thank the people that I have shared this journey with over the last few years, particularly the team at Te Pūnaha Matatini HQ, Kate Hannah, Kathryn Morgan, and Greg Town, but also our Whānau, our investigators, our Advisory Board, and our many enthusiastic supporters outside the research community.

E tipu, e rea, mo ngā ra o tau ao.

Ngā mihi.

Professor Shaun Hendy
Director

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 discover-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;
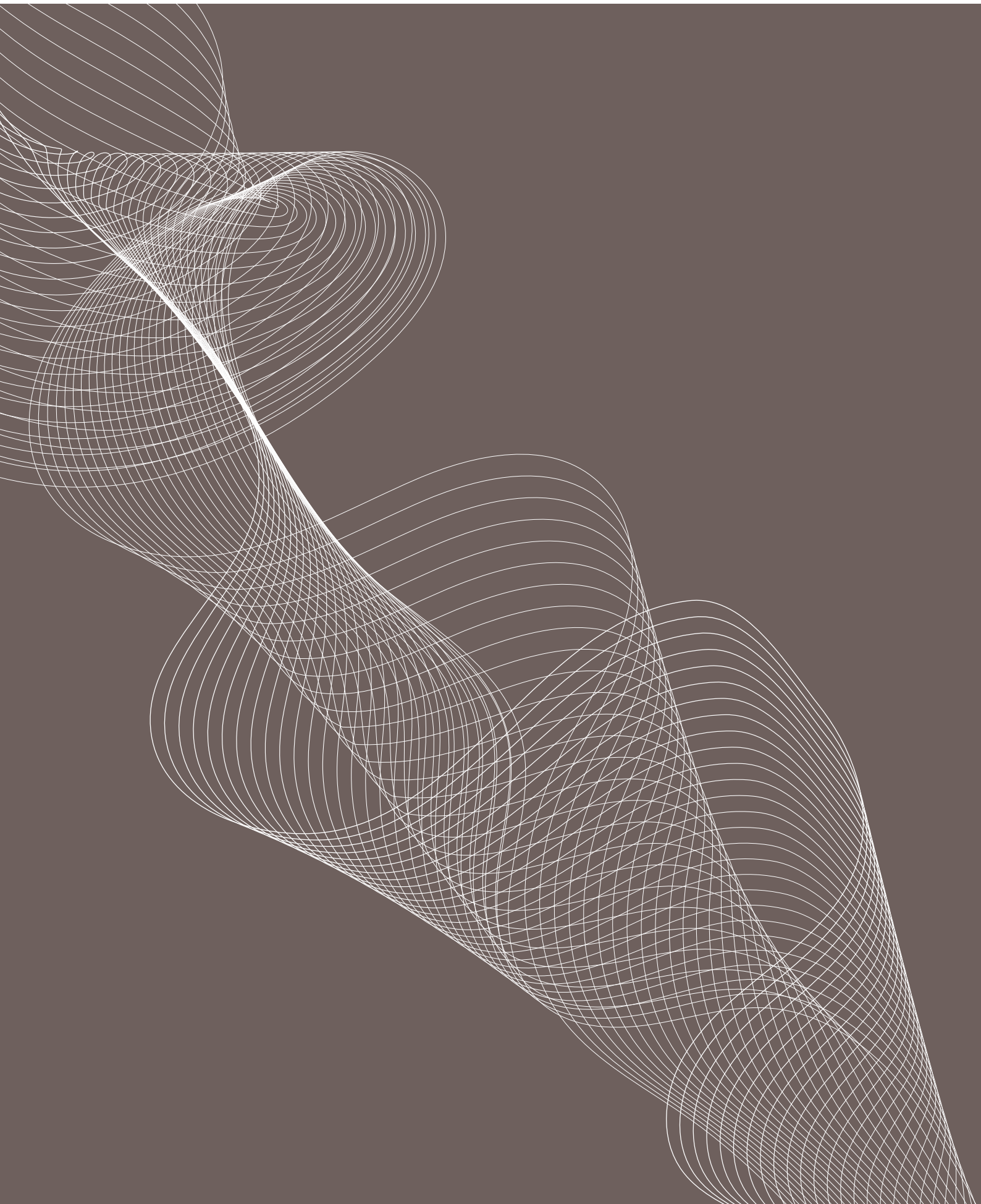
E tipu, e rea, Mo ngā ra o tau ao –
Grow up and thrive for the days destined to you.
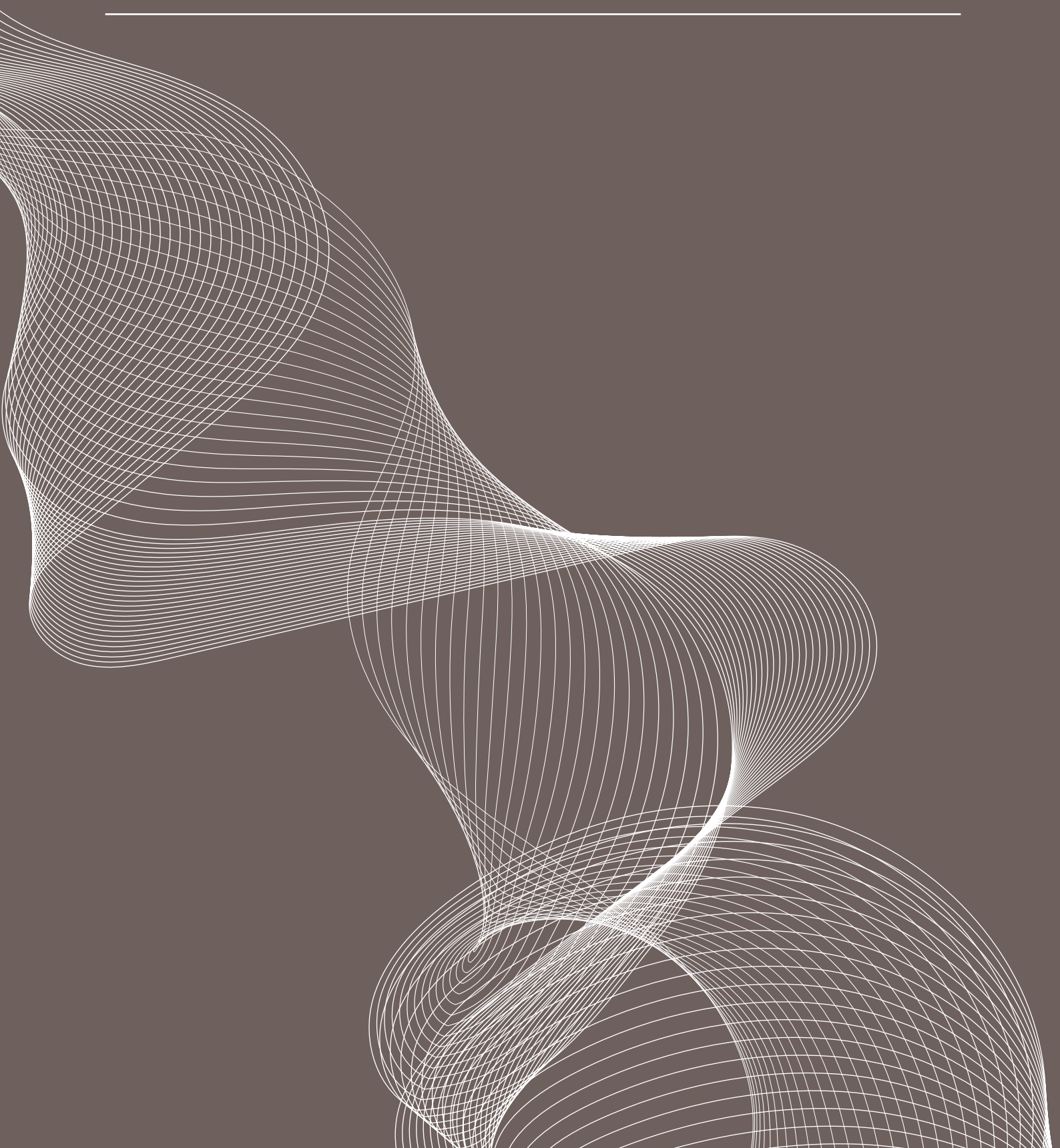– Sir Apirana Ngāta, 1874-1950

2018 Highlights

Realising Our Vision

Kate Hannah, Deputy Director of Equity and Diversity at Te Pūnaha Matatini, during the University of Auckland's Kathleen Curtis Atrium naming ceremony in November 2018. Photo by Dr Virginia Braun, Associate Dean (Equity), Faculty of Science, University of Auckland.

Te Pūnaha Matatini's impact on academic culture in New Zealand and beyond

Since its inception in 2015, Te Pūnaha Matatini has placed great emphasis on the importance of certain values – in particular around the area of equity, diversity, access and inclusion. This has led to the Centre developing practises and policies which have been adopted by other organisations around the country and overseas. Award-winning New Zealand journalist **Naomi Arnold** looked into Te Pūnaha Matatini's legacy as a leader driving cultural and systemic change in the New Zealand research system.

When you're a scientist, a woman, and researching gender inequality in employment, not much of what you turn up is a surprise.

"Depressing, maybe, but not surprising," says Dr Isabelle Sin, a Te Pūnaha Matatini principal investigator whose research includes the gender pay gap.

"And that's a fairly common response among the women I've talked about this to," she says. "They look at what happens when you've had kids and say 'Wow, that's depressing'."

Dr Leilani Walker wasn't particularly surprised at the results of one of her recent papers either. A Te Pūnaha Matatini associate investigator, one of her areas of study is women's participation in universities. She has found they're still not well represented in the top strata of academia despite attempts to turn that around.

"It's not surprising; it's visually apparent when you look at the faculty," she says. "And being a female academic in a STEM subject, you are constantly told that these things are going to

be challenging, that it's an additional burden on young female academics."

What's it like being a woman in academia conducting research that reveals people of your own gender, in your own profession, are systemically paid less and promoted less often than men? How do you go to work each day, knowing more than most that statistically, you're starting a third of the way down the ladder?

"You just get on with it," Walker says. "There isn't really another option."

Except to keep working towards change.

Women, of course, have always developed their own ways of edging around these barriers. "We're starting to realise now that in some respects the only way we can keep going is because women develop these networks – whisper networks," Walker says. However, it does help to boost morale if you are a part of an organisation dedicated to data, knowledge, and insight, which not only values the results of Walker's and Sin's

Photo by Juan Ramos, Unsplash.

research and that of others, but does something about it.

Te Pūnaha Matatini is unusual in New Zealand academia in that since its inception, it has put conscious, specific structures in place to identify and overcome lack of diversity and fairness. Women make up 48 percent of investigators as of the end of 2018, so the organisation has already met its goal of being fully representative by 2020. The centre also has family-friendly policies so primary carers aren't disadvantaged. It means all staff are able to begin unravelling those unconscious biases we all harbour in their work, research, and personal lives. The organisation's intention is that this focus on equality will percolate into its surrounding corporate and academic communities.

Kate Hannah, Te Pūnaha Matatini's executive manager and deputy director of equity and diversity, says that as a centre of research excellence funded by graduates and the Tertiary Education Commission, being a leader in cultural and systemic change is a really important part of Te Pūnaha Matatini's mission.

Equity, diversity, access, and inclusion are the four pillars of the organisation that measure its success, and they have been embedded into its fabric from the beginning, at the most seemingly insignificant level; at the annual hui, dinner is served on sharing platters family-style, rather than individual plates.

"We do a seating plan so everyone feels welcome and included and the food gets handed around; it feels so much nicer," Hannah says. "It's one of those little things that I care about and I feel it makes a difference to how people interact."

At the Te Pūnaha Matatini office, school holidays are also quite different to most organisations, which sometimes seem to pretend that parents don't exist.

"It's nice to be fully human at your workplace," Hannah says.

Te Pūnaha Matatini's research remit also reflects these concerns. Hannah herself studies the invisibility of women in science. Te Pūnaha Matatini research fellow Dr Tara McAllister (Te Aitanga ā Māhaki, Ngāti Porou), recently published 'Why isn't my professor Māori? A snapshot of the academic workforce in New Zealand Universities' in MAI Journal. It examines the dearth of ethnic diversity in higher levels of academia and paints a damning picture of New Zealand universities' inability to meet their own diversity and equity values and questions their commitment to te Tiriti o Waitangi. Investigators Ann Brower and Alex James have collaborated on gender effects in the Performance-Based Research Fund, a globally unique study that compared promotion trajectories for men and women with similar research performance.

Their work shows that women are less likely than men to be a professor even when they have the same standard of research outputs. In fact, of the individuals with the highest research ranking, men had double the odds of being a professor when compared to women. Over the decade of the study, women at lower ranks improved their research quality more than men – but still had lower promotion rates. That leads to such dismal seniority participation figures such as those from 2012, which reveal just 19 per cent of professors and 31 per cent of associate professors were women.

Meanwhile, Kirsten Locke and Dion O'Neale are co-supervising Steven Turnbull, a Te Pūnaha Matatini PhD student in the University of Auckland's Faculty of Education and Social Work. He has examined how women and men move through physics education at the University of Auckland in a paper recently published in PLoS One. The findings debunk any kind

of idea that there's a lack of high-achieving female physics students out there.

"We found that the majority of high-achieving female physics students were actually studying physics for life sciences, which is needed for medicine and bioscience, and not actually for core physics," Turnbull says. "More importantly, of those students who do pursue further study in physics, we see higher attrition rates for female students after controlling for achievement level, with the exception of higher achievers."

Dr Dion O'Neale (left) and Stephen Turnbull (right).

Te Pūnaha Matatini is unusual in New Zealand academia in that since its inception, it has put conscious, specific structures in place to identify and overcome lack of diversity and fairness.

Dr Isabelle Sin.

Dr Leilani Walker.

The implications of this are potentially career-limiting for women, as they apparently opt for physics engagement strongly associated with specific career pathways, in ways that differ from their male counterparts.

Kate Hannah says girls who have a high-level achievement in NCEA or equivalent international qualifications are still much more likely to choose, or be encouraged to choose, the papers that are considered 'easier'. The effect repeats itself as they age.

"Those boys who were lower achievers are much more likely to continue through and persevere than the girls are," Hannah says. "There are cultural messages being sent. We are trying to figure out whether it's around the idea that from birth girls are more likely to be told how smart they are while boys are told how hard they work."

Hannah says that when the founding team started thinking about what their values were for the centre, they didn't necessarily think those would be reflected in the type of research it would eventually do.

"We thought we'd be a fairly standard research centre. But we wanted to share those values, with our students and community and make it a safe and inclusive space. When you do that work internally it changes the nature and the types of the questions you start asking."

Isabelle Sin, who has a PhD in Economics from Stanford University and is a Fellow at Motu Economic and Public Policy

Research where she specialises in labour economics and economic history, says Te Pūnaha Matatini is "really cognisant of these issues".

"I think it's been doing some great things on this front; I'm impressed with the attitude of the people there," she says. "Everyone seems to buy in to the fact that this is a problem – and say hey, we don't rule the world, but there are things we can do about this. There is an attitude of 'We can make situation better for other people' and I think that's a really great thing."

One of the papers that she and Leilani Walker are working on with Dr Tara McAllister draws on a study from 2012, when the Human Rights Commission reviewed women's participation in the workforce and discovered there was about one woman for every three men in more senior academic positions.

While there were variations between institutions and fields, even in areas that could be considered to be dominated by women a majority of senior academics were male.

Walker, who has a PhD in evolutionary biology and is a postdoctoral researcher in the Faculty of Health and Environmental Science at the Auckland University of Technology, says their research found the pattern hasn't changed in seven years, in spite of mentoring schemes and programmes such as the New Zealand Universities Women in Leadership.

Board member Peter Lucas-Jones takes the microphone during a panel session at Te Pūnaha Matatini's 2018 Annual Hui in Christchurch.
Photo by Troy Baisden.

"Our results are reflecting what we are seeing internationally in that there is no connection in the presence of these inter–ventions and any major step towards equity, particularly at those higher levels," she says. In fact, the researchers made a predictive model that says if rates of women in senior leader-ship positions stay on the current path, it will take until 2050 to reach equality.

Walker says it's difficult to tackle issues such as these because there isn't a consensus as to the most effective way to do it.

"There are lot of mentoring schemes and things like that, but while that creates a larger number of senior women slowly, we found in our data that women still aren't being promoted at the same rate as you might expect equally qualified male colleagues, and we haven't got an explanation for that as to why that is."

It doesn't seem to be based on productivity or career interrup-tion; there is something else going on.

"And we have ideas about what that may be, but it's not quite as simple as we might have thought it was."

Walker has a biology background, a subject which she says is comparatively equitable. But their research found different nuances between universities themselves. The agriculture-focused Lincoln University, for example, had some years where there were no senior women academics at all. But they have found that younger, newer universities have had a slightly better track record because they start hiring from zero for each position.

Internationally, there has been plenty of research to show that there are a range of structural barriers for women in the work-place, as well as certain personal qualities women are more likely to have that can be a disadvantage in a white male-dominated workforce.

"Women are more risk-averse when it comes to applying for promotions; they're less likely to apply for them unless they are absolutely certain they fulfil all requirements," Walker says. "Whereas male colleagues are a bit bolder in that respect."

However, research shows that doubt in their abilities comes from all around them. Letters of recommendation for women tend to undersell them compared to men, consciously or not. In STEM fields in particular, women often have to present themselves as higher-achieving in order to be considered equal to their peers.

"Women in academia tend to be involved in a large number of pastoral care, teaching and other activities that don't generate prestige within their field, which is a requisite for promotion to professor," Walker says. (Typically, women are the ones asked to take care of a visitor, arrange work social occasions, buy colleague gifts and farewell cards, organise food and drink at meetings, and take meeting notes). Although the total number of women in academia is reaching 50/50, it's skewed far more towards women in early career roles and they taper off towards the top.

Those prestige markers are goalposts that have historically been set by men. It's frustrating, Walker says, because as much as mentoring programmes assist individual women, they don't address the fact that all of our measures for success within academia, as with a lot of other workplaces, are gen-erated and calibrated on a male workforce, and in particular a white male workforce that often overlooks cultural values.

"So in that way the success measures are not built in a way to accommodate the hugely different trajectories that female careers take for a range of different reasons."

She acknowledges that the data she and her co-researchers are working with has complicating factors, including ethnicity

Dr Tara McAllister.

Associate Professor Alex James.

Dr Ann Brower.

Dr Kirsten Locke.

and sexuality. Data often doesn't allow for further investigation into different gender identities or ethnicities.

"But in some respects whatever is done, trying to look after the littlest guy or girl generally helps everyone."

Using Statistics New Zealand data, Isabelle Sin has researched a number of issues around gender inequality. One landmark paper proved mathematically that men and women are equally productive, but women simply get paid less – particularly women who are mothers.

Typically, women who are highly educated and doing well in their careers advance quickly until they have children and their progress flattens. They are overlooked for the good projects, and overlooked for promotion. People assume they won't be as committed to work, and they don't seem to have the same opportunities.

"And even before they have children a lot of people have the expectation that 'Oh she's a woman of childbearing age she's likely to get distracted and have kids soon so let's not put too much effort into her'," Sin says.

To investigate this, she and the research team compared similar firms that have a different mix of genders among their employees, and found that firms employing a high proportion of women are no less productive than firms that are employing a high level of men – but their wage bills are lower.

"So the women on average are getting paid less but the firms are doing just as well," she says. "Our conclusion was that productivity is not part of the explanation as to why women earn less than men on average. The patterns we saw across industries of when and where women tend to earn less than men was suggesting that sexism and gender discrimination is likely to be an important driving factor of those differences."

Common layperson excuses as to why women earn less on average than men include women taking time out of their careers to have children, not being as committed to their careers as men, and more interested in family. The evidence does not support any of them.

"We do look at what happens to women's earnings, the hours worked and the earnings when they have children, and they do go down considerably, whereas they don't for men," Sin says. "It's not showing that women are earning less because they're

being distracted looking after kids or anything like that. They're being paid less for doing work of the same value."

For the parenthood paper, they followed individuals before and after having children, then examined what happened. "That allows us to do a lot of detailed analysis in terms of who's earning how much from whom and how that changes over time when they have children and so on," she says.

"Do they take time off, do they reduce their hours, how do their earnings change? We look at how that varies for men and for women across the period when they have children and saw some very striking changes and differences between the genders."

One of findings was that women suffer a major "motherhood penalty" in both total and hourly earnings that men simply don't. The pay penalty is more severe for women who stay away from the office for longer than six months.

Sin says mothers tend to earn less than you would expect the same people to do if they hadn't had children – and that's not the case for fathers.

"What we want to look at in this piece of research is whether it's actually about being a mother or whether it's about having taken time out of work to raise a child," she says. "There are some men who take time away from work instead of their partners to raise children and we are comparing how their outcomes change after this relative to those of women. So is it a gender thing or is it a child raising thing?"

Both Walker and Sin mention the other difficulty with re-searching sexism and then trying to fix it: Men dismissing the problem. About a third of male academics in the American Economics Association, for example, believe opportunities in academia actually favour women.

"Based purely on personal experience I would say we don't do super great with that attitude in New Zealand either," Walker says. "Things are improving and some of it will just improve by sheer attrition, but if we want to get there before 2050 some-thing specific has to be done."

Sin has observed the same when she presents her findings. Women believe her; men don't.

"There's still a reasonable amount of denial that a) there's a problem and b) that we should do anything about it even if we knew what we had to do," she says.

"I talk to a lot of people, a lot of government agencies and also some private organisations. Among the audiences generally there's a lot of belief on the part of women, that yes, what you are saying does line up with my experience.

"You get a bit of backlash from some men. As soon as you start saying 'This group is treated unfairly' then some people start feeling defensive. And I think that's another reason why it's important to have research and data backing this up, not just women saying 'We're being treated unfairly'. It's saying 'We're being treated unfairly and here is the evidence' rather than just going out and raising people's hackles about the whole argument."

Men regularly misinterpret her findings as anti-male. "Whereas actually the literature shows that women are equally capable of discriminating against women as men are," she says. "So it's not just that women are the innocent victims and men are doing these horrible things in society. It's that in society as a whole, most people have these norms that favour men in certain ways, often subconsciously."

"Our #MeToo moment in academia has not happened yet, though it's starting to happen internationally," Hannah says. "In New Zealand, there hasn't been that kind of coherent collective revisiting of why things might need to change."

Sin says cultural norms around who looks after families plays a big role in the issue, but that's one thing that's very slow to change.

"There isn't one thing that you can do to change it everywhere; I think it's a matter of multiple things in multiple places and chipping away at the issue rather than one solution to fix everything."

It's frustrating, she says, but part of the solution is building a safe culture, which Te Pūnaha Matatini is doing. "It's about encouraging some people to be the first to get in there and make it a safe place for women."

Walker says she can see plenty of gaps, but it's tough to know what to focus on.

"One of the things we recommend currently in the paper, although we are still reviewing it, is that there is some kind of culpability for third-party funding granters," she says. "In some respects you are trying to make universities demonstrate to people to people that they are culpable too, and they are doing the necessary work."

She also mentions associations like New Zealand's Kindness in Science initiative, which aims for better science outcomes by fostering Te Pūnaha Matatini's values of diversity, respect, wellbeing and openness.

"There are pre-existing initiatives which are beginning to form enough of a basis to start addressing how we measure success in science, how diversity and a happy diverse workforce creates greater outcomes even if our original metrics don't measure that," she says.

Perhaps equality can be reached before the next 30 years is up. Hannah says Te Pūnaha Matatini's influence is spreading; some key organisations in New Zealand have adopted its code of conduct or its policies and processes around diversity, including New Zealand's Biological Heritage National Science Challenge.

"We want it to be reusable and shareable so people can take on these things and make the change themselves."

Siouxsie Wiles MNZM.

Siouxsie Wiles recognised in New Year's Honours List

Associate Professor Siouxsie Wiles, Te Pūnaha Matatini Co-Deputy Director – Public Engagement and Outreach, ended the year as a Member of the New Zealand Order of Merit (MNZM) for services to microbiology and science communication in the 2019 New Year's Honours List.

Siouxsie received her MNZM medal from Her Excellency The Rt Hon Dame Patsy Reddy, New Zealand's Governor-General, at a special investiture ceremony held at Government House in Wellington.

Being appointed as a Member of the New Zealand Order of Merit was "an award and public recognition that was well deserved given Siouxsie's reputation and mana in the science community," said Richard Aitkin, Te Pūnaha Matatini Board Director.

It also topped off a stellar year in which Siouxsie was incredibly active in her efforts to raise awareness of various issues in science, in particular the increasingly concerning global threat of antimicrobial resistance, and promoting equity, diversity and inclusion in the science field.

Siouxsie began 2018 as a high-profile finalist in the 2018 Kiwibank New Zealander of the Year awards, alongside fellow nominees Kristine Bartlett, rest-home carer and pay equity campaigner in the healthcare sector (who took out the top honour) and Mike King, well-known comedian turned mental health and suicide prevention campaigner.

Siouxsie's research and campaigning to reduce the high rates of infectious diseases in New Zealand kids was strongly brought into the public spotlight as a result of these awards.

Professor Shaun Hendy, Director of Te Pūnaha Matatini, says it was an incredible achievement for Siouxsie to be named as one of the three finalists for Kiwibank New Zealander of the Year.

"She is an inspiring role model for everyone at Te Pūnaha Matatini and we are all incredibly proud to work with her," said Shaun.

"Siouxsie is driven by her curiosity about the world and a desire to make a difference in people's lives. She thinks very deeply about the ethics and impact of her work, and this is evident in the problems she chooses to study and the approach she takes to this study. She is also a passionate believer in making science transparent to the public, and strives to make it accessible to everyone. Siouxsie works hard to make it so that science is something for everyone, not just a privileged few."

Congratulations Siouxsie for your magnificent mahi and for being a great Kiwi. Aroha nui!

Te Pūnaha Matatini researchers are looking at tools that may help to improve New Zealand's conservation efforts.

Modelling large-scale predator control measures

Te Pūnaha Matatini researchers Audrey Lustig, Alex James and Mike Plank, all with the University of Canterbury, are collaborating on research that involves the development of models that can predict the effectiveness of interventions designed to control predators in large geographical areas within New Zealand.

Pests are everywhere in New Zealand – from urban gardens to national parks. However, agreeing on how to control them is not always straightforward.

About one-third of the country's land area is classed as protected, but there remains large tracts of land owned by private individuals where conservation efforts have been a relatively low priority.

When it comes to land management decisions such as pest control actions, careful negotiations are required with a wide range of stakeholders with differing views and expectations – from 'cat lovers' to 'rabbit haters' – which can influence their engagement and participation in pest management practices. Yet, these individual behavioural aspects are seldom modelled in environmental management – despite the fact they may drive its success or otherwise.

The aim of this project led by Audrey, Mike and Alex is to develop a social-ecological model that takes into account links between human and ecological systems, and scenarios tested to help predict their influence over each other and help improve pest management practices. Such modelling can help predict the abundance and the likely persistence of New Zealand top mammalian predators in the light of potential changes in management effort across human-dominated landscape and can be used to formulate a management regime that is most likely to achieve eradication.

In 2018, the team's research continued to focus on developing the ecological aspects of the model. A key contribution of this work has been the integration of a more sophisticated representation of species-habitat interactions into a generic model of spread to create dynamic maps showing future population trajectories. The model describes the behaviour of individual mammals located explicitly in a map of their habitat. Key events in an individual's lifetime comprise birth, death and dispersal, and these are simulated as stochastic, i.e. there is uncertainty in the timing of each event.

Such modelling provides detailed forecasts of mammal abundance at regular time intervals into the future. Data are colour-coded so that areas of high and low mammal density are easily distinguished. The approach developed is based on combining generic mathematical modelling frameworks with spatial information on habitat distribution, population dynamics and actual levels of control. Therefore, the approach could be applied to a variety of medium size mammalian pests. In addition, the model allows exploration of how the distribution and abundance of mammals can be affected by control interventions by landholders. Important roles for this type of model are to help predict hotspots of mammalian pest activities, to suggest the most effective control strategy, and to identify important parameters and data for improving predictions.

Model prediction

☐ Treatment area
▨ Fenced sanctuary reserve
■ High
■ Low

Pest detection

☐ Treatment area
▨ Fenced sanctuary reserve
■ High
■ Low

Difference map

☐ Treatment area
▨ Fenced sanctuary reserve
■ Overpredicted
■ Underpredicted
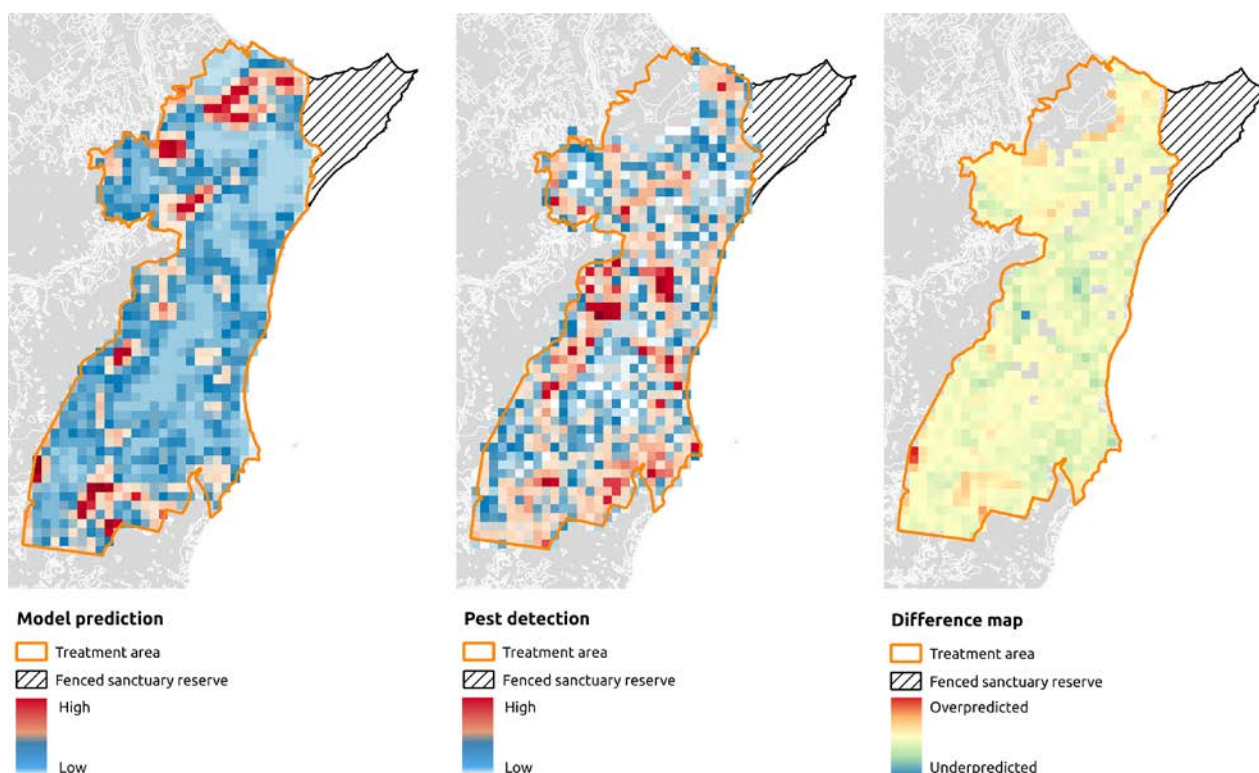
Figure 1. Model predictions (left panel) provides realistic forecasts of pest detection locations from chew-track-cards (middle panel) (Brown et al, 2016). The difference map (right panel) shows the difference between the relative density predicted by the model and by the detection location data. Model results were averaged over 100 simulations and predictions varied very little in response to changes in life-history, dispersal parameters and estimates of carrying capacity.

As a case study, the project has looked at the common brush-tail possum (*Trichosurus vulpecula*) population across a large geographical area in Te Matau a Māui/Hawke's Bay. The Cape-to-City programme, a multi-agency initiative that coordinates predator management efforts in this region, involves controlling possums, as well as other mammalian pests, across 26,000 ha of predominantly private land in Hawke's Bay. It is the start of a much more ambitious project to eliminate mammalian pests from the entire country. As part of the campaign to suppress possums in the Cape-to-City treatment area, intensive monitoring efforts have focused on better understanding the spatio-temporal patterns of abundance and spread of the species.

Ultimately, the model's aim is to improve strategic planning for mammal control at regional scales. In particular, the model has will serve as a basis to support the roll out of the programme Predator Free NZ.

Of note, the model was presented at two national seminars and one international conference in 2018. A scientific paper describing the modelling approach is under review in the Journal of Applied Ecology. The modelling framework was developed as a freely available, open-sourced application (https://github.com/AudreyL/PestManagement) using the Python programming language.

Te Pūnaha Matatini director Shaun Hendy trials out an electronic vehicle in the South Island.

Shaun Hendy's #nofly2018

Te Pūnaha Matatini's Director, Professor Shaun Hendy, reflects on his year free of flying.

In 2018 I took a year off flying. I didn't travel overseas and took trains, buses, and ferries in my journeys around the country. I wanted to walk the talk on climate change and to find out whether people would take the issue more seriously if senior scientists like myself were prepared to cut up our frequent flyer cards. At the end of #nofly2018 I found I had cut my 2017 carbon footprint from travelling by an impressive 95%.

This sounds significant, but in fact the planes still flew. My year off flying just meant that someone else emitted that carbon on my behalf. This was not unexpected – I knew that acting alone I could have only a negligible effect on the climate. To make an impact I needed to encourage other people to take action, either by changing their lifestyles or by voting for politicians prepared to take action. Although I was able to generate a lot of positive media coverage, it is hard to know for sure how much influence I had in the end. Nonetheless, #nofly2019 has become a thing, both in New Zealand and overseas.

Not flying had an unexpected side effect. By taking action myself, I started to feel better about the world. Near the end of my year on the ground, I took a train to a workshop organised by Te Pūnaha Matatini investigator Dr Rhian Salmon in Wellington. The workshop, which brought together people who communicate about the climate, opened with a session that was about 'speaking from the heart'. The first speaker was another investigator from Te Pūnaha Matatini, Associate Professor Rebecca Priestley. She talked about her 'climate anxiety'. I knew exactly what she meant. The morning after the 2016 US Presidential elections, I woke up with what I would describe as a climate change hangover. With Trump in the

White House, I knew we had just lost another four years in the fight against climate change. My year off flying was, in fact, a way of dealing with this climate anxiety.

The second speaker at Dr Salmon's workshop was Lisa Maclaren from Generation Zero, an activist organisation led by young people. Maclaren, who is a PhD student at Victoria University of Wellington, talked about how Generation Zero had worked to keep climate change on the political agenda. Indeed, with Jacinda Ardern's new government aiming for a 'zero carbon' economy by 2050, New Zealand is poised to take international leadership in the fight against climate change.

As a small, lightly populated country, our emissions account for less than 0.5% of those globally. But, as we did in the 1980s when we took a stand against nuclear weapons, we can set an example for the world to follow. Our principled stand against nuclear war now forms a core part of our identity as New Zealanders. It makes us feel better about our place in the world. Think how much better we will feel if we can led the way on climate change.

Dr Isabelle Sin.

Research reveals cost of motherhood

A 2018 report co-authored by Dr Isabelle (Izi) Sin, Te Pūnaha Matatini Principal Investigator from Motu Economic and Public Policy Research, has revealed that being a mother in New Zealand means decreased hours and wages.

Motu Research's 'Parenthood and Labour Market Outcomes Study', co-authored by Izi Sin, Kabir Dasgupta and Gail Pacheco, showed that women in New Zealand experience a 4.4% decrease in hourly wages after having a baby.

The researchers analysed Statistics NZ data on worked and hourly wages of mothers and fathers in the workforce, going as far back as 2005. Their report estimated an average wage gap between men and women without children at 5.7%. However, when comparing men and women who become parents, the pay gap increases to 12.5%. Their research also found that the extent of the wage reduction experienced by mothers varies markedly depending on the amount of time spent out of employment. Mothers in the study who returned to work within 6 months, for example, experienced a 2.3 reduction in hourly wages, whereas those who were out for over 12 months had an 8.3% drop.

In contrast, there was no change in hours or wages after a child's birth for fathers. "When we look at monthly income, you see very large decreases in monthly income for women who are high earners and who are on rapidly increasing earning trajectories before they had children, said Izi, in an interview with Radio NZ. "In contrast, we looked to see if men's out-comes change when they become parents and we really found nothing. We didn't find any change in the number of hours that they worked, in their employment, in their monthly earnings, or in their hourly earnings."

Associate Professor Siouxsie Wiles, Te Pūnaha Matatini Principal Investigator, commented on the report in a New Zealand Herald article and talked about her own experience as a mother seeking employment. In particular, Siouxsie explained that during her initial interview for a permanent position at the University of Auckland, she was asked how the job might impact her family.

"That was the first time I had been slapped in the face with 'you are a woman and you are a mother'. It was a real eye-opener to how some of the people who I work for and with, how they view me. In that particular case, I got my job. But it points to a culture," said Siouxsie.

On the other hand, Siouxsie's husband, who also works at the University of Auckland, wasn't asked about his family at a job interview. "It certainly feels like fatherhood doesn't affect men as much as motherhood affects women," Siouxsie said. "It's very hard to pin down specific instances, but it's interesting that overall there is this gender gap [in pay]. That's partly because you are taken more seriously as a man than as a woman."

Reference

Sin I., Dasgupta K., Pacheco G. (2018). *Parenthood and labour market outcomes*. Motu Working Paper 18-08, Motu Economic and Public Policy Research. Wellington, New Zealand. (Also a Ministry for Women Report.)
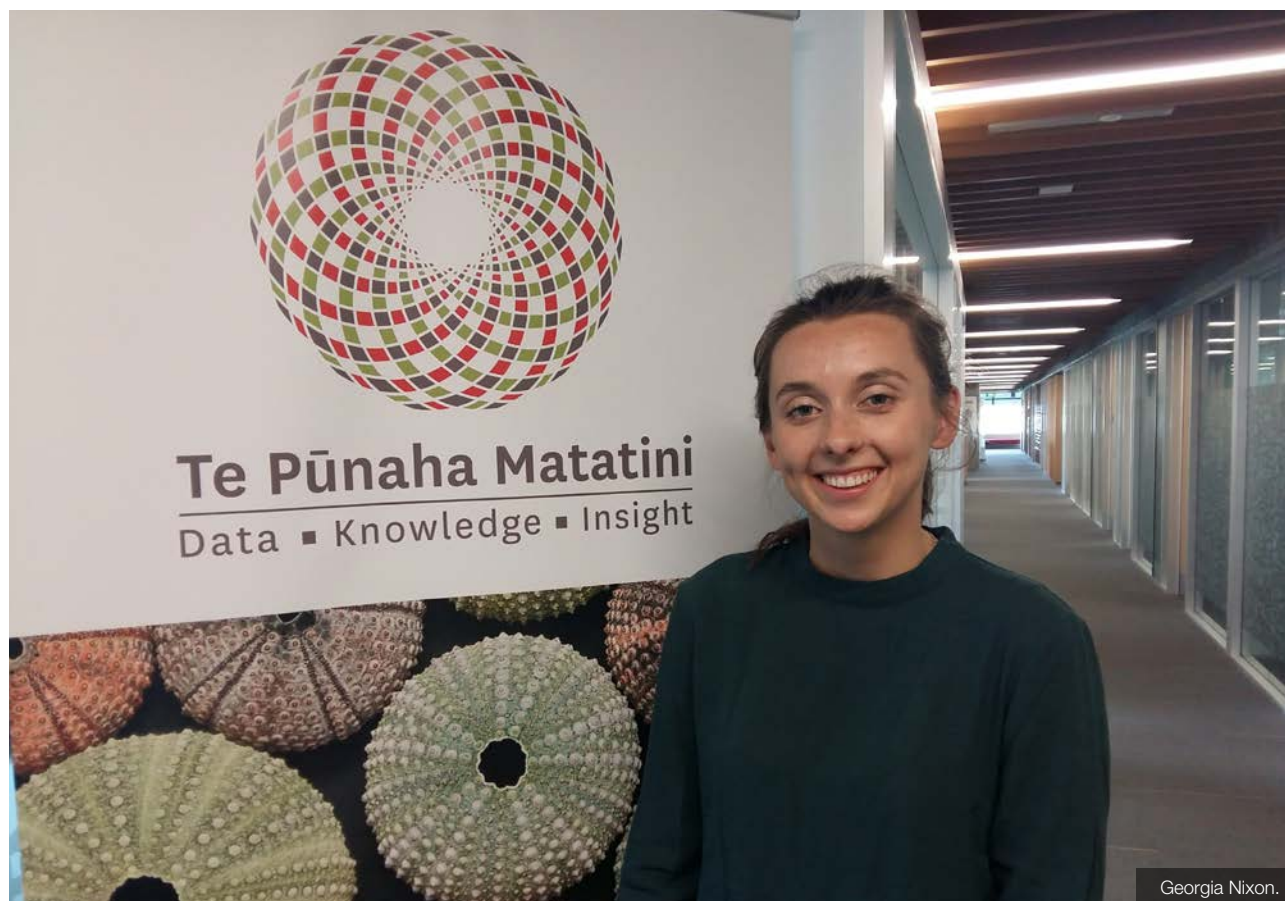
Georgia Nixon.

Cambridge PhD scholarship for Te Pūnaha Matatini intern

In October 2018, we celebrated the news that Georgia Nixon, an intern with Te Pūnaha Matatini at the University of Auckland, had been awarded a three-year Cambridge Rutherford Memorial PhD Scholarship by the Royal Society Te Apārangi.

Georgia plans to commence her PhD at the University of Cambridge in September 2019, working on a project involving quantum information and applications for quantum computing.

Leading up to her scholarship award, Georgia completed a Bachelor of Science (Honours) degree in Physics at the University of Auckland in 2017, on the topic of interferometric data fitting. In 2018, she was strongly involved with Te Pūnaha Matatini; initially as an intern and subsequently as co-founder of Nebula, which is a data-analysis start-up.

"I had just finished my honours degree and I was looking for interesting research to do over the summer," said Georgia. "I saw the ad [for Te Pūnaha Matatini's 2017/2018 Summer Student Internship programme] and that caught my eye.

While there were other options around to do summer research as part of the university, the TPM internship was very appealing given it would give me the opportunity to work with real clients on real problems."

After a successful summer internship for our partners at the Biological Heritage National Science Challenge, Georgia was invited to stay on with Te Pūnaha Matatini to conduct data analysis work for the Science Media Centre. This work subsequently led to Georgia setting up Nebula.

Nebula is a natural language processing and data visualisation start-up that is working on rigorous analysis of news media text.

"Many of the clients we've worked with so far have been looking for a way to do some extensive analysis of media," explained Georgia. "They don't necessarily want to count the number of times a word is mentioned etc. They want to go into the text, analyse the quality of the text, the sentiment, the connections, the topics coming up."

So far, Nebula has taken on a variety of projects. One example of a small project the team were involved in was related to the pesticide 1080.

"We analysed 1080 in the media – all the articles on 1080 for the past decade," Georgia revealed. "We looked at all the people, topics and organisations mentioned in those articles. It was interesting to see how that changed over time and also to see the impact of different events."

Georgia said working with Te Pūnaha Matatini had opened up a whole new world of science for her, in terms of being able to apply science in the real world.

"I studied physics and maths because I have always really enjoyed those topics, but at times I found it unfulfilling when the discussion didn't leave the textbook. Working with Te Pūnaha Matatini showed me how you can take science and use it for something that has an impact."

Samin Aref (left) with Shaun Hendy, a very proud director.

Te Pūnaha Matatini celebrates first ever PhD graduates

The Centre marked to major academic milestones in September 2018, when Samin Aref submitted his PhD thesis, becoming the first ever Te Pūnaha Matatini intern to do so, followed soon after by Kyle Higham

Samin Aref, a valued member of the Te Pūnaha Matatini Whānau, commenced his PhD under the supervision of Te Pūnaha Matatini Associate Investigator Mark Wilson.

With a background is in operations research and complex networks, Samin's PhD thesis was the intersection of network science and mathematical modelling. This involved research into developing efficient methods and graph optimisation algorithms for the structural analysis of large-scale networks.

Samin secured a post-doctorate position at the prestigious Max Plank Institute for Demographic Research in Rostock, Germany, for which he flew out to Europe very soon after handing in his thesis.

A couple of months later, Kyle Higham – our much admired and highly active TPM Whānau past-chair and member – successfully defended his PhD thesis.

Kyle undertook his PhD at the Victoria University of Wellington, researching knowledge diffusion and the dynamics of citation networks under the supervision of Te Pūnaha Matatini investigators Adam Jaffe, Michele Governale and Uli Zuelicke.

Kyle landed an exciting role at the prestigious Ecole polytechnique fédérale de Lausanne (EPFL) in Switzerland, a world leading research institute and university specialising in engineering and natural sciences.

Kyle Higham.

"As a physics student seeking to work on social and economic problems, Te Pūnaha Matatini offered an opportunity to use this background not only to study these problems but to bring a novel perspective and approach to them," said Kyle.

"Working in this highly interdisciplinary space has opened my mind to the exciting and unexplored possibilities that exist, while also providing a broad skill-set that gives me the chance to explore many different and traditionally unrelated fields. This education has given me the confidence that I will find work that I love, and meet critical societal needs at the same time."

Brianne Halbert (left) and Megan Leijh (right), who worked on a project for Ngāti Whatua Ōrakei.

Our 2018–19 summer interns showcase their talents

Te Pūnaha Matatini was able to offer New Zealand university students paid 10-week internship positions over the 2018–19 summer, which involved working on projects with various partner organisations.

Out of a total of 160 undergrad and postgrad students from across the country who applied for the programme, 29 were successful and placed at 11 partner organisations – including government ministries, iwi organisations and private companies.

Although the students had a wide range of backgrounds, they all had one thing in common – a passion to change the world through data and its applications and contexts.

"This programme provides students with invaluable data analytics experience and new perspectives while working for organisations in a real-world setting," said Dr Alex James, Te Pūnaha Matatini's Deputy Director of Industry and Stakeholder Engagement.

"Through its student internship programme, Te Pūnaha Matatini is able to engage with partners to complete small-scale projects with defined outcomes, develop relationship networks, and introduce talented students to potential employers."

Now in its fourth year of operation, the 2018-19 programme featured an excellent variety of projects, and the overall feedback from both students and industry stakeholders was very positive.

University of Canterbury Masters of Applied Data Science student Romalee Amolic spent the summer in Hamilton working with scientists at AgResearch, helping develop a tool to streamline survey data for social network analysis.

In addition to providing a much-needed tool for AgResearch, Romalee is now working out how to commercialise her software so more people can take advantage of it.

"From our perspective, we got exactly what we'd hoped for, which was a new viewpoint and different expertise from what we may have normally recruited," said Helen Percy of AgResearch, Romalee's supervisor.

The collaboration network is unique in that it embodies New Zealand business enterprises, government institutions, private not-for-profit organisations, as well as higher education institutions and all their research connections.

"After the internship, I made all research outputs related to this project publicly available online (https://doi.org/10.6084/m9.figshare.5705167)," said Samin.

"My supervisors Shaun Hendy and David Friggens and I also published the main outputs of the project as a conference paper which received a presentation award as well as a travel grant from the conference organisers."

Intern Romalee Amolic (centre) with her AgResearch supervisors Penny Payne (left) and Helen Percy (right).

Cherie Vasta.

Brianne Halbert and Megan Leijh, who are both at the University of Auckland, worked together on a project that is part of an ongoing research partnership between Ngāti Whātua Ōrākei and Te Pūnaha Matatini.

Led by their supervisor Kate Hannah, Te Pūnaha Matatini's Deputy Director, Equity and Diversity, and Dion O'Neale, a Te Pūnaha Matatini Principal Investigator, the 'He waka eke noa' project combines qualitative and quantitative methodologies to work with iwi and hapū data, centralising Māori data sovereignty.

An important goal of our internship programme is to have students with complementary skill sets working together. That was certainly the case for Bri and Megan. Bri is undertaking a double major in Computer and Data Science, while Megan is completing a conjoint Law (Hons) and Arts degree in political philosophy, law and politics.

"While these disciplines may appear vastly different, we were able to find a lot of overlap and even harmony in our exploration of inclusive education for Māori," wrote Bri and Megan in a subsequent co-authored blog.

"From the outset, a major goal was to utilise our respective disciplines for research while keeping the essence of te Ao Māori alive throughout. Thus, we incorporated kupu o te wiki, watched Te Kaea and participated in a lot of korero".

Bachelor of Engineering in Mechatronics at the University of Canterbury, Cherie Vasta (pictured above), worked with both Te Hiku Media and Dragonfly Data Science on a project to aid in the development of a Māori voice assistant.

The tool is designed to make Te Reo Māori more accessible and fun in the digital age. At the completion of Cherie's internship, the project was documented and all the code uploaded online to allow other developers at Te Hiku Media to progress it further and demonstrate the abilities of the Rāpere box.

"I got a great feeling of accomplishment from my work," said Cherie. "I'm grateful to Te Pūnaha Matatini for connecting me with Te Hiku Media and providing me with the opportunity to have this internship."

Environmental scientist Dr Tara McAllister.

New project a major boost for mātauranga in science

A Te Pūnaha Matatini research project that aims to improve the way in which scientists connect and work with Māori was awarded $100,000 in funding by New Zealand's Ministry of Business, Innovation & Employment (MBIE) in 2018.

The project, part of MBIE's Te Pūnaha Hihiko: Vision Mātauranga Capability Fund, will be led by Dr Tara McAllister (pictured), an environmental scientist with the University of Auckland, in collaboration with ecologist Dr Cate Macinnis-Ng and earth systems scientist Dr Daniel Hikuroa, Principal Investigators with Te Pūnaha Matatini at the University of Auckland.

Importantly, the project team will partner with Mahaanui Kurataiao Limited, an environmental and resource management advisory firm established by the six Rūnanga in the Canterbury region of the South Island. Its aims include the enhancing and improving the recognition and protection of mana whenua values in their takiwā.

While there are some excellent examples of scientists engaging well with Māori communities, there are also instances when connecting has been a struggle. "We want to look at how we make those interactions more successful, more productive, and more workable for everybody involved," Dr Macinnis-Ng said. "So we are going to co-develop a project with an Iwi group, where we'll look at what their science needs are, and work out who in our field can deliver those things. By co-developing the project, it's all about what the needs are of that group, rather than imposing what scientists want to do."

The project will be conducted in a reflective way so the project team can understand what works best for the different groups involved. It will also develop te reo science materials

appropriate for school curricula. "We'll be developing some teaching materials for kura kaupapa to make science more accessible to everyone," said Dr Macinnis-Ng.

Project leader Dr Tara McAllister has conducted extensive research into the presence of the toxic algae Phormidium in New Zealand rivers, while at the University of Canterbury. "I like solving problems and the toxic algae I study is a massive problem plaguing our rivers in Canterbury, New Zealand and worldwide," said Tara. "I love my research because I get to spend a lot of time outside in rivers, thinking about why things are the way they are. I feel like I am at home in the rivers I work in and I feel a deep connection to them."

Another of Tara's passions is learning te reo Māori. "I love learning te reo because it is a window which allows me to explore my Māoritanga. It is important for me as an emerging Māori scientist to be able to walk in both te ao Māori (the Māori world) and te ao Pākehā (the Pākehā world)."

Professor Shaun Hendy, Director of Te Pūnaha Matatini, said this newly funded project with Tara at the helm will be very important to the Centre's wider research programme. "Building close engagement with Māori communities and learning about the mātauranga of complex systems is a wonderful opportunity for us," he said. "Not only will this project be essential to us in meeting our research goals, it will also provide social, economic, and environmental benefits to Aotearoa New Zealand."

Dr Dan Hikuroa, Co-Deputy Director, Public Engagement for Te Pūnaha Matatini.

Te Pūnaha Matatini supports Māori data sovereignty

Government and other entities regularly collect information about Māori. In recent years, Te Pūnaha Matatini has worked to support Māori data sovereignty, which recognises that Māori data should be under Māori governance.

The concept of Māori data sovereignty stems from the Treaty of Waitangi as well as the United Nations Declaration on the Rights of Indigenous Peoples language, explained Professor Dan Hikuroa, Co-Deputy Director, Public Engagement for Te Pūnaha Matatini.

"The background is that there was all this data [pertaining to Māori being collected, and sometimes it was being used for good purposes and sometimes it wasn't," said Dan.

"And there was a group of people who got together and said, 'Well, we actually want to have sovereignty over the data about us'. So instead of being the 'researched', which is how some groups felt, they wanted to take ownership or sovereignty of the data and then have some sort of say in how it was used."

Dan and other Te Pūnaha Matatini researchers have been actively involved in discussions and hui concerning data sovereignty over the past few years. Initial discussions led to Te Mana Raraunga (the Māori Data Sovereignty Network) being established.

Led by new Associate Investigator, Professor Tahu Kukutai (Ngāti Tīpā, Ngāti Mahanga, Ngāti Kinohaku, Ngāti Ngawae-ro and Te Aupōuri), Te Mana Raraunga advocates for Māori rights and interests in data to be protected as the world's data environment becomes increasingly open.

The principles established by Te Mana Raraunga have been crucial in Te Pūnaha Matatini's collaborations with Te Hiku Media and with Ngāti Whātua Orākei.

Realising Our Values

Dr Anna Matheson, Associate Investigator at Te Pūnaha Matatini and public health researcher at Victoria University of Wellington.

New Zealand health research recognised globally

Dr Anna Matheson, Te Pūnaha Matatini investigator and senior lecturer at Victoria University of Wellington, specialises in applying complexity theory to aid our understanding of actions that reduce health inequalities, research that has been recognised globally.

Anna is particularly interested in the use of novel approaches to social intervention that take account of social complexity, and has been involved in numerous research projects related to the social determinants of health, barriers to and through health systems, and approaches to reducing health inequalities in Aotearoa New Zealand.

Anna's current work includes co-leading the evaluation of Healthy Families NZ, which is funded by the Ministry of Health, and as a co-investigator on two community action research projects funded by the Health Research Council.

"Together with a colleague, we designed and are carrying out an evaluation, grounded in complexity theory, of a multi-community intervention to prevent chronic diseases – Healthy Families NZ," said Anna.

"The approach we have taken is sensitive to context, and accounts for multi-level actions and perspectives which has been shown to be a big challenge in large-scale public health evaluations. Complexity theory has helped me to theorise and articulate the way that health inequalities arise in relation to excluded communities such as Māori and Pasifika."

When brought together with the evidence, the theory shows that causes of health inequalities are systemic. These systemic causes compound in individuals and communities. For example, Māori and Pacific people experience multiple barriers to, and through, the health system, as well as being impacted by multiple levels of discrimination and other determinants of health such as income, education and housing.

"I have used this understanding of the social processes leading to health inequalities to inform the ideas in articles I have written about what this means for how to intervene to reduce health inequalities," said Anna.

Connections abroad are incredibly important, said Anna, with international conferences and meetings being great opportunities to share her research findings and contribute to knowledge globally. Of note, she was recently invited to be a Fellow of the Salzburg Global Seminar (SGS), a prestigious non-profit organisation set-up 70 years ago to promote peace and the exchange of ideas across people and nations.

Following her attendance at a SGS session on 'Building Healthier Communities: The Role of Hospitals', Anna led the writing of an article for the BMJ, one of the world's leading medical journals, with co-authors from Australia, Pakistan and Rwanda.

"It has been valuable to see how people in different countries are thinking about complexity and health, as well as the innovative approaches being taken to improve complex health outcomes, and the enormous challenges that some countries face," said Anna.

"These international connections have also provided me with a very positive perspective on my own work. The relationship with SGS is on-going, and they have an interest in the career development of those they invite to attend. I have also provided suggestions of others working in innovative community action areas within New Zealand to attend SGS sessions."

Dr Audrey Lustig, Associate Investigator at Te Pūnaha Matatini and postdoc researcher with the Geospatial Research Institute.

Presenting at one of the world's largest ecology meetings

Audrey Lustig, Te Pūnaha Matatini Associate Investigator and postdoctoral researcher with the Geospatial Research Institute (GRI) Toi Hangarau, University of Canterbury, presented a paper at the 2018 British Ecological Society (BES) conference, the second largest annual meeting for ecologists in the world.

Audrey said it was a privilege to attend the BES conference, held in Birmingham, UK, in December 2018.

"This really is an exciting place to be for those partial to thinking about the natural world…. It was an incredibly stimulating and well-organised three days, with a lovely balance between unstructured (social) time and scientific talks and posters."

Audrey's current research involves the use of socio-ecological models to assess the feasibility of scaling-up predator control outside traditional conservation areas and to inform decisions about resource allocation.

"It has always fascinated me that something as tiny as a non-native bug can cause dramatic and unexpected shifts in the dynamics of the ecosystems and regional economies when introduced to a new place, sometimes even causing food insecurity and serious public health problems," said Audrey.

"Many quantitative tools exist that can help with anticipating which species might pose a threat to a particular region and exploring best management practices of already introduced invasive species. However, despite widespread claims of the applicability of these tools… evidence of their practical utility remains surprisingly sparse. I am a strong advocate of quantitative tools and believe that engaging with science, technology, engineering and mathematics is key if we want to better anticipate and manage future biological invasions."

New Zealand is one of the few countries that enforces strict biosecurity controls and sets out visionary goals in the pest management space, Audrey added.

"New Zealand universities are probably among the rare examples worldwide recognising the increasing need to produce a new generation with skills to deal with risks presented by new pests and diseases crossing the border, as well as managing those that are already here.

"When it comes to land management decisions such as pest control actions, careful negotiations are required with a wide range of stakeholders with differing views – from cat-lovers to rabbit-haters – so that agreements can be reached. Yet, these individual behavioural aspects are seldom modeled in environmental management."

For a predator-free New Zealand to flourish, it will take the understanding and effort of the community at large to carry the vision into the future, Audrey explained.

"A key part of my current work involves better understanding perceived social and ecological costs and benefits regarding conflicts of interest in predator control and the development of a planning tool for predicting the abundance and the likely persistence of New Zealand pests in the light of potential changes in management effort across human-dominated landscape."

Audrey's work aligns very well within Te Pūnaha Matatini's 'Complexity and the Biosphere' research theme.

"My involvement in Te Pūnaha Matatini since 2014 has provided a tremendous stepping stone into early career research… Te Pūnaha Matatini helped me to build a purposeful professional network with researchers who cross disciplinary boundaries. But most importantly, TPM has provided a lot of opportunity for growth, always encouraged me to be innovative, think big, and create something new."
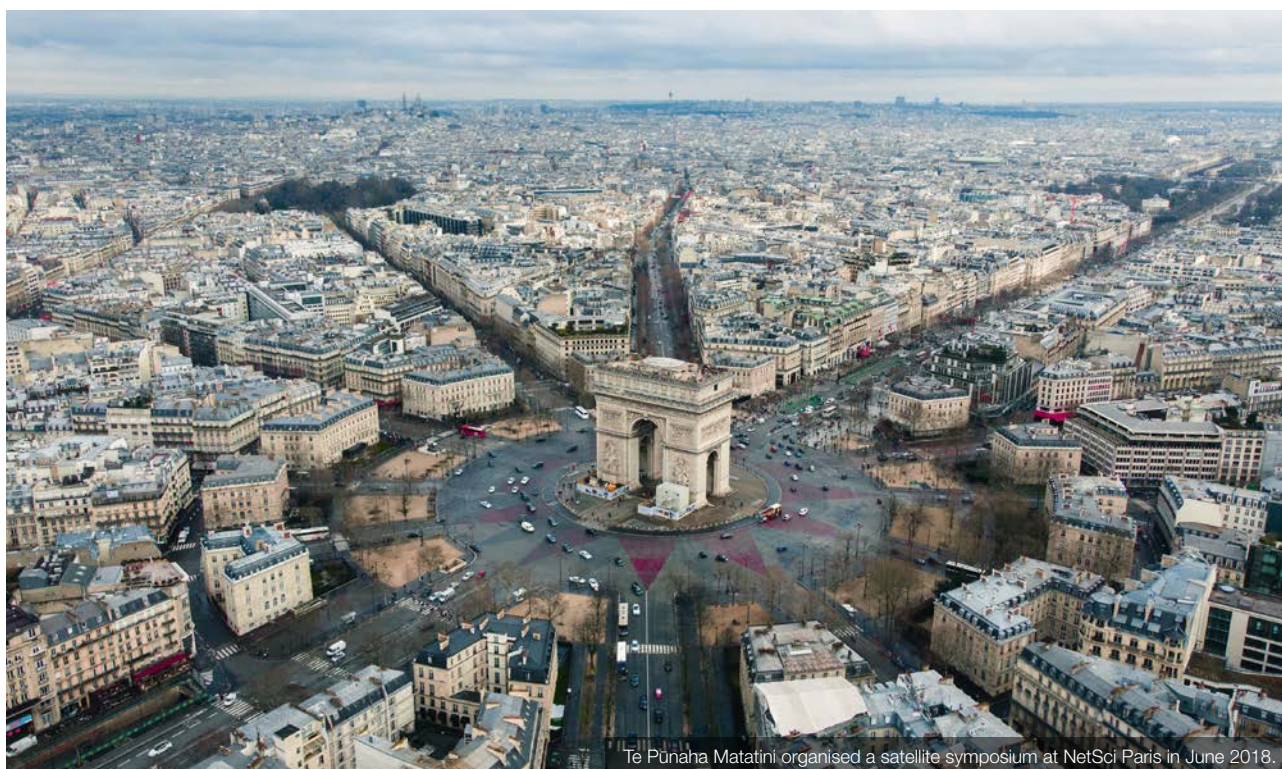
Te Pūnaha Matatini organised a satellite symposium at NetSci Paris in June 2018.

Te Pūnaha Matatini satellite session at NetSci Paris

The International School and Conference on Network Science (NetSci) is the annual conference of the Network Science Society, and was held in Paris, France, in June 2018. Te Pūnaha Matatini investigators Stephen Marsland, Murray Cox, Dion O'Neale and Kate Hannah co-organised a satellite session, People, Places, Things, held on June 12, prior to the start of the conference.

People, Places, Things explored the interplay between networks as research tools and their contexts. One of the great advantages of networks as research tools comes from their abstract nature. However, there are many cases where the context of the network – not just the nodes and the interactions inherent in edges – gives additional information that can inform analysis. Similarly, there are cases where a network representation of a dataset or datasets can provide context to the data itself, revealing structures and relationships.

This satellite session encouraged interdisciplinary researchers to investigate examples, particularly in the digital humanities and social sciences, where exploring and visualising the context of a network improves the analysis of that network. Keynote speaker, Dr Mark Stewart (University of Amsterdam) challenged the attendees with an exploration of affect, 'People, places, things … feels? The Affective Layer of Complex Social Networks,' while Te Pūnaha Matatini PhD students Demival Vasques Filho and Steven Turnbull presented aspects of their PhD research. The programme successfully exposed Te Pūnaha Matatini researchers to international interdisciplinary scholarship, and introduced some of the unique features of Te Pūnaha Matatini transdisiciplinary approaches to an international audience. Kate Hannah presented on Contextualising Historical Correspondence Networks, a collaboration with Dion O'Neale which utilises indigenous-centred research methods and practices with 'history from below.'

With a desire to develop shared spaces for digital humanities researchers to enagage more deeply with network science, and for network scientists to consider contexts and contextualisation, the day concluded with a wide-ranging and explorative panel, chaired by Kate Hannah, and with panelists Leto Peel (Université Catholique de Louvain, Belgium), Ruiqi Li (Beijing University of Chemical Technology), and Yerali Gandica (Université de Namur, Belgium.) The diverse and thoughtful questions from the audience were indicative of the deep engagement fostered in this successful satellite session.

Over 10,000 people attended MathsCraft events across the country in 2018.

Seeing the beauty in maths through the medium of craft

Te Pūnaha Matatini is a key sponsor for Maths Craft, a wonderfully conceived non-profit initiative that aims to bring maths to the masses by celebrating the links between mathematics and craft. The Maths Craft team was very busy in 2018, organising several successful events across New Zealand.

Created by Dr Jeanette McLeod and Dr Phil Wilson, mathematicians and Te Pūnaha Matatini investigators at the University of Canterbury, together with the rest of their team, Maths Craft aims to engage the public with mathematics through craft and show people how fun, creative, and beautiful it can be.

The largest events the team organised in 2018 were the Dunedin Maths Craft Day in February (1,000 visitors), the Christchurch Maths Craft Day in July (1,100 visitors), and the pilot Maths Craft in Class teacher training workshop in October (13 participants).

In addition, they participated in Space & Science Festival in May (950 visitors). There were also numerous other smaller happenings such as making giant pink string art on the lawn at the University of Canterbury for 'Pink Day', and giving lectures to trainee teachers.

"We have now reached more than 10,000 people since we started in September 2016," said Jeanette. "Our professional development workshop for teachers was a new venture for us this year, and it worked out wonderfully. Our teacher participants have already been using Maths Craft in class, and even training their colleagues. This has been a very effective way to both support maths teachers and to reach even more young people."

"Te Pūnaha Matatini is the reason that Maths Craft is what it is today," Jeanette added. "You took a chance on us when we were just a crazy idea and we are so grateful to you for that and for the continuing support and encouragement."

Associate Professor Cate Macinnis-Ng, Principal Investigator at Te Pūnaha Matatini.

Media seeks comment from our researchers on Kauri Dieback

Local Māori placed a rāhui on large areas of West Auckland's Waitākere ranges in late 2017, as a measure to counter the growing problem of Kauri dieback disease. Over the following months, media outlets gave ample coverage to the issue and in April 2018, the New Zealand Herald contacted our investigators for comment.

Kauri dieback is a disease that killing our Kauri trees at an alarming rate. Caused by a fungus-like pathogen called Phytophthora agathidicida, it's a deadly disease for which there is no known cure. For those involved in trying to stem the problem, one of the concerns that became apparent in 2017 was that, while Kauri dieback can be spread in many ways, it is us humans, walking through forests, that are accelerating it.

In line with their mātauranga, Te Kawerau a Maki, mana whenua of the Waitākere Ranges, were so alarmed at the rate of disease's spread and placed a rāhui (temporary comprehensive restriction) on the Waitakeres in early December 2017.

However, by March 2018, it was evident that many people were still walking through the ranges, either unware or wilfully ignoring the restrictions in place, and that agencies such as the Auckland City Council were not enforcing them.

Fortunately, the media continued to keep the issue at the forefront of public consciousness and highlighted concerns regarding the still high level of foot traffic in the Waitākeres. In April 2018, the New Zealand Herald sought out three of our best science communicators – Dan Hikuroa, Kate Hannah and Cate Macinnis-Ng – to contribute an editorial piece that would explain the science behind the rāhui to raise further awareness to avoid the restricted areas.

Here are a few pertinent paragraphs the Te Pūnaha Matatini trio wrote in the article:

"Rahui have been effective tools of conservation and management used successfully by Māori for centuries, and are one example of tikanga.

"One of the underlying rationales driving those who continued to walk in the Waitakere Ranges was that they were exercising their 'right' to walk in the bush that they love – despite all the evidence clearly showing that humans are accelerating the spread of kauri dieback; despite the rahui being supported by some community groups, and the rationale for it by many scientists.

"Perhaps it is the system of 'rights' that is also in part at fault, with environmental obligations developed through the lens of property rights. "Heoi ano, what we do know is that people expressing their love for the bush by exercising their 'right' to walk in it is killing our kauri.

"We simply ask for Aucklanders and other park visitors to see beyond yourselves, to see yourself as part of the ecosystem, to exercise your "right" to not go into the Waitakere Ranges, and to do your part to preserve an ancient, iconic member of our community – the kauri."

This was a great example of our investigators contributing their science communication talents and scientific knowledge towards a matter of national importance – speaking directly to the New Zealand public about an issue that is at its heart very scientific in nature, but in language that is clear and accessible. Well done Dan, Cate and Kate.

Reference

NZ Herald Comment: 'Right' to revel in outdoors by walking in Waitakeres means we're loving our kauri to death, 22 April 2018.
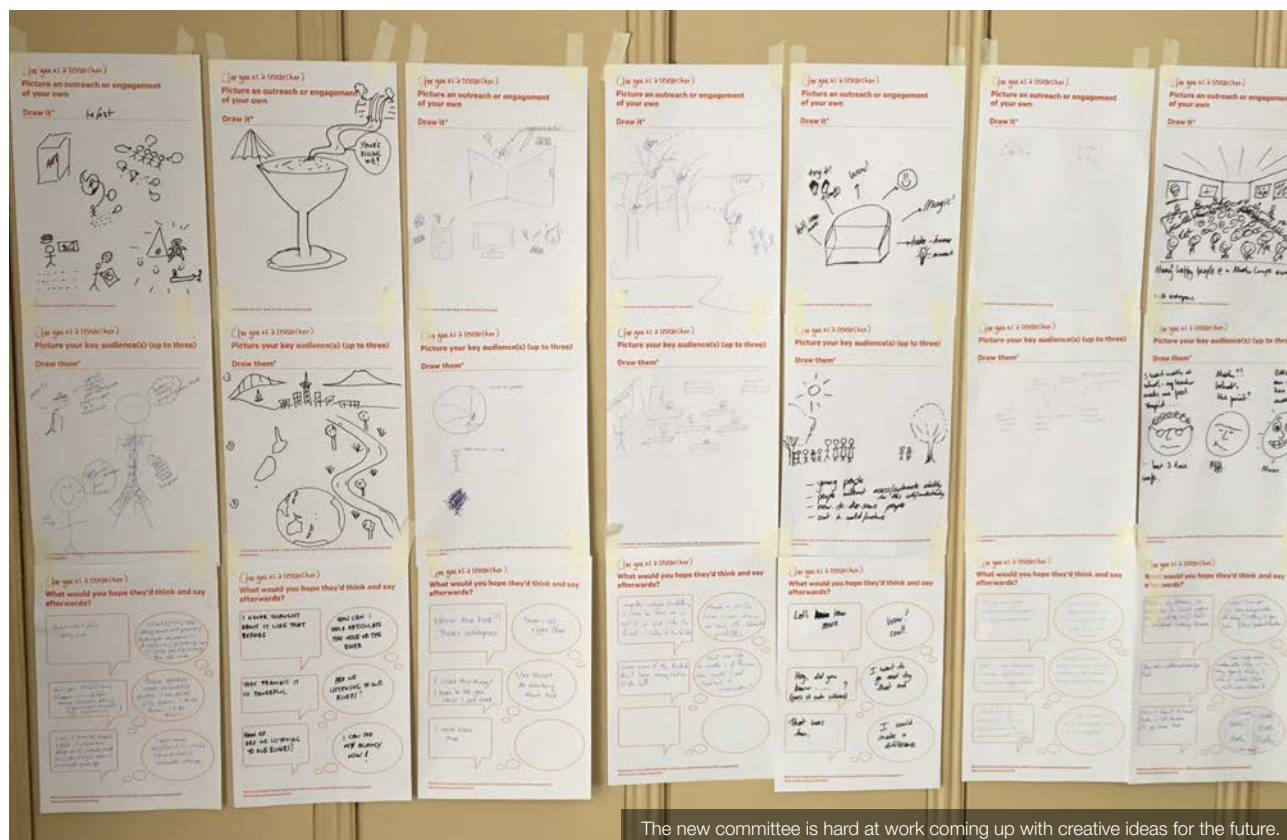
The new committee is hard at work coming up with creative ideas for the future.

Te Pūnaha Matatini establishes public engagement committee

In 2018, Alex James stepped down as Deputy Director responsible for our Public Engagement and Outreach portfolio and took up the Industry and Stakeholder Engagement portfolio instead. Alex passed the mantle for public engagement on to Dan Hikuroa and Siouxsie Wiles.

With their complementary skills and extensive experience engaging with diverse audiences to share the role, Dan and Siouxsie's first task was to reimagine what the Public Engagement portfolio means for Te Pūnaha Matatini going forward. Their vision is for all our researchers and students to contribute to building an Aotearoa New Zealand whose people can think critically and make informed decisions in this data-rich world where misinformation and fake information spreads like wildfire. Under their leadership, Te Pūnaha Matatini will redefine the value of public engagement within our academic and research institutions.

To help them realise their vision, Dan and Siouxsie have put together a Public Engagement committee. Their committee includes Te Pūnaha Matatini researchers from the Centre for Science in Society at Victoria University of Wellington, as well as from the wildly successful Maths Craft initiative, which is demystifying maths using crafts like knitting and crocheting. The committee is now hard at work developing a work plan that will build capability, enabling the sharing of best practices, and helping our researchers evaluate the success of their engagement activities.

Public Engagement Committee

Dan Hikuroa, University of Auckland

Siouxsie Wiles, University of Auckland

Rhian Salmon, Victoria University of Wellington

Jo Bailey, Victoria University of Wellington

Jeanette McLeod, University of Canterbury

Phil Wilson, University of Canterbury

Kate Hannah, University of Auckland

Kathryn Morgan, University of Auckland

Greg Town, University of Auckland

Sponsorship

Te Pūnaha Matatini is committed to increasing equity, diversity, access, and inclusion in science and research, and as such, our expectation when sponsoring events is that event organisers will have a documented plan to achieve balanced gender and cultural representation in keynote and invited speakers, and on panels, as well as processes to ensure representative diversity amongst general event attendees. We note that gender is not binary.

Furthermore, we expect organising committees to be diverse, and to have documented plans and processes for supporting broader diversity in conference attendees, speakers, and invited speakers.

We also expect event organisers to create a safe space for all participants in Te Pūnaha Matatini-sponsored events, and ask that organising committees implement a Code of Conduct which is available on our website as a reference.

Where possible, our preferred sponsorship mechanism is to support the provision of a dedicated and suitable parenting space at the conference, symposium or meeting, with a live stream provided of plenary sessions for those present in the parenting space, and the use of Sli.do or similar for audience questions and participation.

Sponsorship in 2018

Public Engagement:

- Maths Craft Festival http://www.mathscraftnz.org/ Te Pūnaha Matatini was delighted to support, for another year, the activities of the Maths Craft Festival, led by investigator and Maths Craft Founder Dr Jeanette McLeod. In 2018, the Maths Craft focus was on the development of curriculum-specific resources for teachers, using the Maths Craft methodologies and experiments.

- Aotearoa New Zealand Science Journalism Fund: Te Pūnaha Matatini partnered with the Aotearoa New Zealand Science Journalism Fund, founded by Te Pūnaha Matatini investigator Associate Professor Rebecca Priestley with her Prime Minister's Science Communication Prize funding. In 2018, we funded three longform articles/investigations on the topic: Controversial Technologies: should we even go there? as part of our commitment to research-informed publics and decision-making.

- Te Pūnaha Matatini is committed to supporting communities to engage with science and research; in 2018 we funded buses to enable school students from schools outside central Auckland to attend mathematics events.

- Auckland Writers' Festival: Sponsor of attendance of Professor Hope Jahren (Centre for Earth Evolution and Dynamics, University of Olso), author of the acclaimed 2016 memoir, Lab Girl. Te Pūnaha Matataini and the Auckland Writers' Festival entered into an ongoing partnership in 2018 to bring diverse science writers and thinkers to participate in the Festival and surrounding events, particularly the Schools Programme. Te Pūnaha Matatini investigator and Deputy Director, Public Engagement, Associate Professor Siouxsie Wiles, interviewed Professor Jahren for her Festival event.

Sector Engagement

- Royal Society Te Apārangi Research Honours dinner, 2018: Te Pūnaha Matatini was delighted that the 2018 Research Honours Dinner was the first Royal Society Te Apārangi event at which their new Code of Conduct for events was in place. This Code draws on Te Pūnaha Matatini's.

- Te Pūnaha Matatini's Sponsorship Policy and Code of Conduct had significant impacts in 2018: of the three conferences we sponsored, two were required to implement the Code of Conduct and were able to do so supported by advice from Te Pūnaha Matatini:

  o IIPC: International Internet Preservation Conference at National Library

  o Great Southern Unconference

  o ANZAMP (Australia/NZ Maths Physics) 2018 meeting.

- Women in Maths & Physics Retreat: This event alternates between a local event and a national event annually, and is a critical support and development network for women working in the male-dominated disciplines of physics and mathematics. Te Pūnaha Matatini has sponsored the national events since 2015.

Commitment to Te Tiriti o Waitangi

- Te Pūnaha Matatini was a principal sponsor for Ngā Pae O Te Māramatanga's International Indigenous Research Conference, held in November 2018. This sponsorship reflects our commitment to Mātauranga Māori and indigenous ways of knowing more broadly.

- A further commitment to Te Titiri o Waitangi and Te Reo Rangatira was demonstrated in our sponsorship of the NZ Journal of Ecology Special Issue on Mātauranga Māori, "Shaping Ecological Futures", in which our funding enabled the translation of scientific abstracts into Te Reo Rangatira.

Julie Mugford, PhD student at the University of Canterbury.

Improving citizen science data analysis tools

Julie Mugford, a PhD student at the University of Canterbury and Chair of Te Pūnaha Matatini Whānau, is researching and developing statistical tools to improve the accuracy of classification-based crowdsourcing, aka citizen science.

Citizen science is the involvement of volunteers in helping scientists collect and analyse information, and Julie's research aims to measure the accuracy of users and to develop efficient ways to improve the overall accuracy of such data.

Typically, classification-based citizen science projects ask multiple participants to identify each object and consensus methods are used to decide the classification of the object. Commonly, simple consensus methods – for example, majority vote – are used. However, majority vote weights the contributions from each participant equally but the participants may vary in accuracy with which they can label objects.

"Our approach is to use Bayesian statistics to estimate users' accuracies at identifying objects and include these accuracies in the classification process," explained Julie. "Although this approach complicates the classification process compared to a simple majority vote rule, it improves the accuracy of the classification decisions and provides more robust measures of classification certainty."

Citizen scientists can encompass a wide range of members within our society – from school children to trained scientists – who participate in a variety of research projects. These projects are often set up and managed by professional scientists, and specifically designed to give volunteers a role. For example, sharing and classifying bird and other observations of nature, classifying land types in satellite images of Earth, or classifying galaxies.

The popularity of citizen science projects has risen enormously in the last two decades, providing researchers with access to data from a large range of locations at unprecedented frequencies with minimal costs. This has become increasingly important as costly expert resources struggle to match the effort required to answer scientific questions. However, there is ongoing debate on the usefulness and accuracy of citizen science data as it may be prone to greater variability due to differences in volunteer's skills.

"Motivated by the vision of Biosecurity New Zealand to have a biosecurity team of 4.7 million [New Zealand's resident population], we have initially focused on improving the accuracy of classification-based citizen science projects that could be used as a tool to monitor invasive pests in New Zealand," said Julie.

Biosecurity New Zealand, a part of the Ministry for Primary Industries, has set out a vision for 2025, and one of its five strategic directions aims is to make all New Zealanders aware of the importance of biosecurity and to get them involved in pest and disease management. It hopes to encourage a collective effort across the country – in which 'every New Zealander becomes a biosecurity risk manager and every business manages their own biosecurity risk'.

Te Pūnaha Matatini incoming co-directors Priscilla Wehi and Murray Cox.

Researching impact of Moa extinctions on early Māori

Te Pūnaha Matatini incoming co-directors Priscilla (Cilla) Wehi, conservation biologist with Manaaki Whenua Landcare Research, and Murray Cox, Professor of Computational Biology at Massey University, have collaborated on an analysis of Māori ancestral sayings (whakataukī), and their recognition of extinctions and their impact.

Cilla and Murray co-authored a paper published in the journal Human Ecology, reporting the linguistic analysis of indigenous Māori whakataukī that focus on fauna and environment, particularly with regard to extinctions of important food sources such as Moa.

The findings provide evidence that such extinctions were important as they influenced both ecological and social thought in Māori society. The authors also suggest that oral traditions could have played a similar role in other early societies living through major faunal extinction events.

Examples of whakataukī referring to Moa extinction:

Kua ngaro i te ngaro o te moa

Lost as the moa was lost

Huna i te huna a te moa

Hidden as the moa hid

Ka ngaro ā-moa te iwi nei

The people will disappear like the moa

"Oral tradition, such as these whakataukī passed down by Māori, provide our only real glimpses into the ecological relationships and concerns of early settler populations, and provide early human context to an otherwise relatively dry scientific record of extinction events," the researchers wrote.

"The whakataukī emphasise that indigenous peoples are not simply passive actors against an environmental backdrop but rather interact with the environment in myriad ways that affect not only the species assemblages present but also the development of cultural values, ideas, and practices."

Cilla and Murray's work was picked up by The Conversation in an article entitled 'Dead as a moa: oral traditions show that early Māori recognised extinction', and in interviews on Radio NZ, Radio Waatea and TVNZ's Te Karere.

Reference

Wehi, P. M., Cox, M. P., Roa, T., Whaanga, H. (2018). *Human perceptions of megafaunal extinction events revealed by linguistic analysis of indigenous oral traditions, Human Ecology*, 46, 461–470.

Visualised data for AgResearch low methane sheep project

In late 2018, Te Pūnaha Matatini hosted AgResearch scientist Dr Melanie Hess. Melanie worked with Te Pūnaha Matatini MSc student, Nicholas Morton on a project to visualise genomic data from the microbes that live in sheep rumen and help digest food.

AgResearch has developed a method for high-throughput genetic sequencing of the microbes from sheep rumen – the end-goal being to sequence thousands of rumen samples to aid in the selection of animals with the lowest methane emissions. Methane gas from sheep and cattle accounts for almost a third of New Zealand's greenhouse gas emissions, making it our single largest contributor to global warming.

Melanie had a dataset that contained rumen microbial profiles for sheep that were extremely high or low methane producers. This dataset showed these profiles were heritable and repeatable across time, suggesting that it should be possible to select sheep with more favourable rumen microbiomes to produce low methane flocks.

However, Melanie needed to find a way to visualise the relationships between different microbes and between different sheep, particularly the low and high emitters. Nick worked with Melanie to visualise the datasets using network analysis, which uncovered a strong relationship between samples collected on the same day.

Once collection date had been accounted for, there was a clear separation between samples from high and low methane animals. This discovery was critical for future integration of microbial profiles with host genetic information for identification of ruminants that have low methane emissions.

Over the next few years, AgResearch plans to use this approach to study many thousands of sheep, cattle, deer and goat rumen microbiomes in its search for environmentally friendly ruminants.

Dr Melanie Hess' research is funded by AgResearch, the MBIE funded Genomics for Production and Security Programme, the Global Partnerships in Livestock Emissions Research, the Pastoral Greenhouse Gas Research Consortium, and the New Zealand Agricultural Greenhouse Gas Research Centre.

International collaborations

Audrey Lustig	INSTEPP, University of Minnesota, Saint Paul Minnesota, USA, *An HPC Architecture for high-resolution dispersal modelling of invasive species*
Daniel Hikuroa	Stockholm University, Stockholm, Sweden, *Environmental Humanities*. Invited to give a talk at aworkshop to launch the Environmental Humanities department, and to be member of Steering Committee for an International Research Consortium, *Imaginings of Water: Lost Waters*, Storied Waters
Dion O'Neale	Indian Institute of Technology, Gandhinagar, India, Citation-collaboration networks. (Supervision of IIT PhD student Chakresh Singh on a project in conjunction with Dr Shivakumar Jolad (IIT). Chakresh visited UoA for three months in 2018) Southern Methodist University and Virginia Commonwealth University, Dallas, Texas & Richmond Virginia, USA, Obsidian social networks Xi'an-Jiaotong Liverpool University, Suzhou, China, Economic Networks
Fraser Morgan	Australian Antarctic Division, Hobart, Australia, Environmental drivers and hotspots of biodiversity to inform conservation planning in terrestrial Antarctica
Ilze Ziedins	Heriot-Watt University, Edinburgh, Scotland, Application of accumulating priority queues in telecommunication networks Karlsruhe Institute of Technology, Karlsruhe, Germany, Emergency Department optimization
Isabel Castro	Natural History Museum, Paris, Paris, France, Apteryx anatomy. Anick Abourachid from the Museum came to NZ to conduct a study of kiwi lower limb anatomy to explain their odd (for a bird) gate
Marcus Frean	Max Planck Institute for Evolutionary Biology, Plön, Germany, Evolution of money, Yes, I was termed a "Visiting Professor" – this wasn't a fellowship as such, but the Institute did support me (office, help with some costs)., Yes, I stayed all of 2018, working closely with Dr Chaitanya Gokhale, and more loosely with Prof. Paul Rainey (one of the Directors).
Michael O'Sullivan	Karlsruhle Institute of Technology, Karlsruhle, Germany, *Logistics and analytics in Primary care and Emergency Services (ReAL PrimES)*. Melanie Reuter, Manager of the Health Care Lab, Karlsruhe Service Research Institute, Germany, visited NZ multiple times.
Michael Plank	Queensland University of Technology, Brisbane, Australia, *Mathematical models of cell migration in three-dimensional living tissues*
Pierre Roudier	INRA – Infosol, Orleans, France, Soil science. A short visit, but very productive visit. The team is now writing up a paper about mapping soil colour in France, using a combination of remote sensing and machine learning techniques
Simone Linz	University of East Anglia, Norwich, UK, *Joint ongoing research on combinatorial aspects of phylogenetic networks* University of Greifswald, Greifswald, Germany, *Parsimony of phylogenetic networks*
Steffen Lippert	Paris School of Economics, Paris, France, *Learning and Market Entry*
Suzi Kerr	Climate Teams: International Greenhouse Gas Mitigation, Wellington, Seoul, California, New Zealand, Colombia, Republic of Korea, *International Greenhouse Gas Mitigation*
Tava Olsen	Durham University, Durham, USA, *Leadtime pricing* Indiana University, Bloomington, USA, *Autonomous vehicles* University of Chicago, Chicago, USA, *Leaving the Emergency Room without Being Seen*

Te Pūnaha Matatini has demonstrated a strong commitment to diversity, access and inclusion. Photo by Helloquence, Unsplash.

Te Pūnaha Matatini's code of conduct policy widely adopted

Te Pūnaha Matatini, recognises and celebrates the distinct status of Māori as tāngata whenua, and is committed to the principles and spirit of Te Tiriti o Waitangi.

We are inclusive, respectful of difference, and acknowledge and support the worth of the diverse peoples of our communities. We support access and inclusion through policies and processes which recognise the barriers to flourishing within an academic or research workplace. We are committed to safety, promoting inclusion, and preventing bullying and harassment.

Our commitment to diversity, equity, access, and inclusion is supported by our Diversity, Equity, Access, and Inclusion Policy, Sponsorship Policy, and Code of Conduct, which we developed in 2016, and revise annually. We encourage Te Pūnaha Matatini investigators, students, and community members to use, share, and adapt our policies and Code of Conduct in their own disciplinary communities, societies, departments, and conferences – with significant spread of the impact of these nationally and now, in 2018, internationally.

The University of Otago was host in April 2018 for the major international conference, Public Communication of Science and Technology, at which a number of Te Pūnaha Matatini investigators and students presented their work. Reports of the behaviour of some well-known invitees made implementing a Code of Conduct prior to the conference a major safety initiative for Te Pūnaha Matatini, and after robust conversations with the local organising committee, the Code of Conduct was adopted. This was the first instance in which, while not a sponsor of the conference, Te Pūnaha Matatini was able to influence the decision-making of conference organisers and in the process, protect conference attendees.

By December 2018, the Te Pūnaha Matatini Code of Conduct had been adopted or adapted by: Royal Society Te Āparangi,

the Department of Internal Affairs, the National Library of New Zealand, the International Internet Preservation Consortium, Science Communicators' Association of New Zealand, Public Communication of Science and Technology, the Australian Mathematical Society, Australian and New Zealand Industrial and Applied Maths Society (ANZIAM), and the Great Southern Unconference. The New Zealand Biological Heritage National Science Challenge, and its annual conference 'Crazy and Ambitious' have adopted Te Pūnaha Matatini's policies and Code of Conduct, committing, as we have, to these informing all activities and events.

- Te Pūnaha Matatini is a New Zealand Centre of Research Excellence, recognising and celebrating the distinct status of Māori as tangata whenua, and committed to upholding the principles of Te Tiriti o Waitangi.
- We are inclusive, respectful of difference, valuing the diverse peoples of our varied communities.
- We support access and inclusion through practices and processes that encourage balance, flexible working, and wellbeing.
- We are committed to safety, supporting our people, promoting inclusion, and preventing bullying and discrimination.

As a New Zealand Centre of Research Excellence comprised of members from diverse backgrounds, organisations, and lived experiences, we are committed to the open exchange of ideas, freedom of thought and expression, and respectful debate. These require a community and an environment that recognises the inherent worth of every person and group, which fosters inclusion, dignity, understanding, and mutual respect, and embraces diversity.
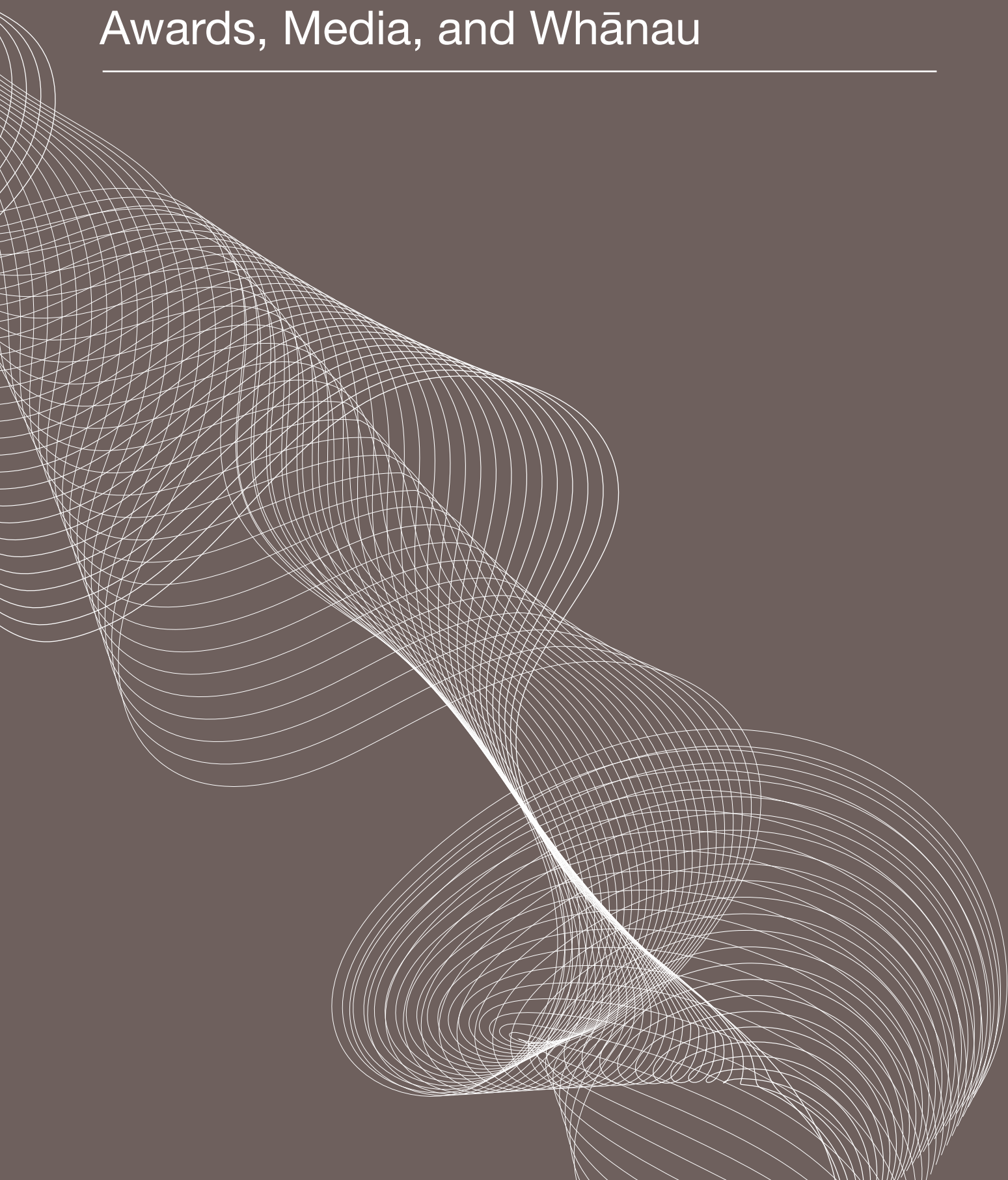
Awards, Media, and Whānau

Recognising excellence within our CoRE

Several Te Pūnaha Matatini researchers received awards recognising their research efforts, leadership skills, and science communication activities in 2018.

Professor Sally Davenport

Te Pūnaha Matatini Principal Investigator Professor Sally Davenport was made a Member of the New Zealand Order of Merit (MNZM) in the 2018 New Year's Honour's List for her distinguished services to science. She has more than 25 years' experience as a researcher, manager and educator in science, technology, management and innovation.

Sally took up the role of lecturer in the management of science and technology at Victoria University of Wellington in 1991. She was Head of the Victoria Management School from 2009 to 2011 and in 2011 was appointed an inaugural Commissioner of the Productivity Commission. She has been an Associate Investigator of the MacDiarmid Institute for Nanotechnology and Advanced Materials and Associate Dean of VUW's Faculty of Commerce and Administration.

She served as investigator and leader of three major Foundation for Research, Science and Technology grants focusing on the growth of high-tech firms. She has been a member of scholarship selection and grant-making panels and has held a range of advisory roles within academia and for professional groups, the Royal Society, and central government. Since 1998, Sally has served as the New Zealand Correspondent to the International Association for the Management of Technology, and has represented New Zealand at the United States-based Academy of Management's Technology and Innovation Management Division.

In 2017, Professor Davenport was appointed leader of the newly-established Science for Technological Innovation National Science Challenge.

Further prizes awarded in 2018

- **Associate Professor Rebecca Priestley** (Victoria University of Wellington) was made a Companion by the Royal Society Te Apārangi. Election as a Companion is an honour recognising outstanding leadership or sustained contributions to promoting and advancing science, technology or the humanities in New Zealand.

- **Dr Alex James** (University of Canterbury) was presented with the 2018 Research Award by the New Zealand Mathematical Society for "her contributions in mathematical modelling ranging from the theoretical, such as Lévy walks and complex ecological systems, to the very applied, such as masting and snail dynamics."

- **Professor Stephen Marsland** (Victoria University of Wellington) was made a Fellow of New Zealand Mathematical Society. Fellowships are awarded to members of the NZMS in recognition of their contributions to mathematics and their professional standing in the NZ Mathematics community.

- **Professor Murray Cox** (Massey University) was awarded the Miegunyah Distinguished Visiting Fellow by the University of Melbourne. The program enables overseas scholars of international distinction to make an extended visit to the University and contribute to the University's academic, intellectual and cultural life. In 2018, he was also awarded a College Research Award (College of Sciences – Individual) from Massey University.

- **Associate Professor Nirmal Nair** (University of Auckland) was made a Distinguished Member of CIGRÉ, the International Council on Large Electric Systems.

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 2018.

Adrian McDonald
- Super-cooled liquid clouds: Why researchers want to know more (Radio NZ)
- Scientists to investigate unexplored Antarctic sea floor (Newstalk ZB)

Alex James
- Science Made Simple: Alex James on complex systems (*NZ Herald*)

Andrea Byrom
- 'Facts' don't give scientists a monopoly on the truth (*Stuff*)
- Government announces special funding to fight kauri dieback (*Newshub*)
- 50 questions about the environment: Our nature (*NZ Herald*)
- Should we learn to live with introduced species rather than wipe them out completely? (*Stuff*)
- New funding to tackle kauri dieback and myrtle rust may not be enough (*Newshub*)
- Can New Zealand really kill every rat, possum and stoat? (Newstalk ZB)
- Myrtle rust spreads to South Island (*Otago Daily Times*)
- Myrtle rust found for first time on DOC land (*NZ Herald*)
- Researchers air criticisms of NZ's 2050 pest wipe-out mission (*NZ Herald*)

Arvind Tripathi
- How Kiwi teen went from sharing inspirational quotes to working with US millionaires (*Stuff*)

Barry Milne
- 2018 Census external data quality panel confirmed (*Scoop*)

Cate Macinnis-Ng
- Auckland scientist climbs Kauri to study impact of climate change on giants of the forest (TVNZ)
- Is the Quay St protest really about the trees? (*The Spinoff*)
- The worst climate change denial myths, debunked by experts (*Stuff*)
- From climate delusion to Taylor Swift to Rocket Lab: NZ scientists' 2018 revelation (*The Spinoff*)
- Climbing kauri for climate change (Aotearoa Science Agency Youtube)

Daniel Hikuroa
- Scoop: New members of Pāmu Environment Reference Group announced (*Scoop*)

David Hall
- How Jacinda Ardern embodies the spirit of republicanism (*Stuff*)
- Government's billion trees should include natives (*NZ Herald*)
- We all need to make a difference to the climate (*NZ Herald*)
- Step two: ignore step one and accept people do give a toss about climate change (*The Spinoff*)
- Comment: Why it's time to bank on a greener future (*NZ Herald*)
- GDP should be just one barometer of how a country's doing (*Stuff*)
- Paris riots show importance of getting climate policy right (*Stuff*)
- Editorial: A need for more resilient forests (*Stuff*)
- Clear-cut forestry might make a profit, but local communities pay the price (*Stuff*)
- Delving into the issues (*Otago Daily Times*)

Isabel Castro
- Big-brother listens in to native birds to help protect them (*Stuff*)
- Study to look at use of native birds to control orchard pests (*Newshub*)
- It's 'Save The Kiwi' month, yet they're declining at 2 per cent a year (*Stuff*)
- Starlings flocking back in defiance of scarers (*Stuff*)
- Native birds on pest control mission (*NZ Herald*)

Isabelle Sin
- Profile: Isabelle Sin (MBIE Curious Minds)
- Mothers take 4.4% wage cut to have a baby, research reveals (*NZ Herald*)
- How parenthood continues to cost women more than men (*Victoria University Blog*)
- Gender pay gap: The argument for discussing pay with colleagues (*Newshub*)
- The parent pay chasm: how the gender pay gap widens among those with kids (*The Spinoff*)
- Wage penalty of motherhood – revealed (Radio NZ)
- Out-dated gender roles: Gender pay gap larger among parents than non-parents (National Council of Women New Zealand)
- Strikes and lockouts to be banned during negotiations for new Fair Pay Agreements (TVNZ)
- Government's Fair Pay Agreement work to begin (Government Press Release)
- Jim Bolger to lead 'Fair Pay' working group (*Otago Daily Times*)

Kate Hannah
- Michelle Duff: Let Beatrice Tinsley's shining star guide the way (*Stuff*)

Marcus Frean
- Mathematics Shows How to Ensure Evolution (*Quanta Magazine*)

Michelle Dickinson
- Sometimes it really is rocket science (*Gisborne Herald*)
- Kiwi scientist calls out Elon Musk's 'bulls**t' (*Newshub*)
- Nanogirl Michelle Dickinson: Sun sets on grimy homes and harmful bacteria (*NZ Herald*)
- Nanogirl Michelle Dickinson: Is banning plastic bags bad for the environment? (*NZ Herald*)
- Nanogirl Michelle Dickinson: Modifying our fight against cancer (*NZ Herald*)
- Nanogirl Dr Michelle Dickinson: Early bird or night owl, you can get the grades (*NZ Herald*)
- Nanogirl Michelle Dickinson: Sponging up lithium to power smartphones (*NZ Herald*)
- Nanogirl Michelle Dickinson: Tattoos get under your skin (*NZ Herald*)
- Nanogirl Michelle Dickinson: How drinking water could keep you safe, dehydration has greater effect than thought (*NZ Herald*)
- Nanogirl Michelle Dickinson: Real dangers of drinking (*NZ Herald*)

Murray Cox
- How Indonesia's DNA secrets could help NZ (*NZ Herald*)
- Oral traditions show that early Māori recognised the extinction of the moa (*The Spinoff*)

Nirmal Nair
- Nirmal Nair on bitcoin and power usage, cybersecurity threats to electricity grid resilience, NZ's tree planting, the Census, RD&D, microchipping employees, Dilbert and more (*Interest.co.nz*)
- The Carrington Event (Radio Live)

Priscilla Wehi
- Oral traditions show that early Māori recognised the extinction of the moa (*The Spinoff*)
- Whangarei carver heading to Antarctica (*NZ Herald*)

Rachael Ka'ai-Mahuta
- The lasting legacy of a Pākehā teacher who believed in the power of te reo Māori (*The Spinoff*)
- Time to kōrero te reo! Give it a go (*NZ Doctor*)

Rachelle Binny
- Saving our native species comes with winners and losers (*NZ Herald*)

Rebecca Priestley
- Celebrating the amazing women of Antarctica (*The Spinoff*)
- Book Awards Judges announced for 2019 (*Scoop*)
- Michelle Duff: Let Beatrice Tinsley's shining star guide the way (*Stuff*)
- How Ross Island tells the story of climate change in Antarctica (*Noted*)
- Nelson teacher named Royal Society Companion (*Stuff*)
- Radioactive generators powered Antarctic science (*Stuff*)

Shaun Hendy
- What Next? The Next Chapter (TVNZ)
- More transparency wanted around Government's national science challenges (*Stuff*)
- Why scientist Shaun Hendy has grounded himself (Radio NZ)
- Scientist Shaun Hendy's year of no flying for climate change (*Stuff*)
- Top scientist's climate-friendly, flight-free 2018 (*NZ Herald*)
- Why is NZ's environmental regulator trying to muzzle scientist Mike Joy? (*The Spinoff*)
- Q&A: Remembering Kiwi visionary Sir Paul Callaghan (*NZ Herald*)
- Scientists a minority among GMO submissions in the north (*Newsroom*)
- Nelson company partner with Israeli biotech firm to produce valuable algae (TVNZ)
- Dancing with Atoms: the new documentary honouring the 'Sir Ed of science' (*The Spinoff*)
- Budget: Few surprises in Govt's science and tech spend (*NZ Herald*)

Shaun was a regular science correspondent for TVNZ Breakfast, The AM Show; Radio Live science correspondent for Graeme Hill, and RNZ Nights.

Siouxsie Wiles
- David Seymour's claims against reusable bags fact checked by leading scientists (*Stuff*)
- Three inspirational Kiwis picked for New Zealander of the Year awards (*NZ Herald*)
- Siouxsie Wiles: Funding research is disheartening (*Stuff*)
- Enough is enough. Academics must stand up against this bullshit (*The Spinoff*)
- Trailblazers: Siouxsie Wiles (*NZ Herald*)
- 'Kids are born scientists' – Siouxsie Wiles talks STEM and sexism (*NZ Herald*)
- Siouxsie Wiles: Politicians, don't interfere with science (*Stuff*)
- Mothers take 4.4% wage cut to have a baby, research reveals (*NZ Herald*)
- Siouxsie Wiles: Sex chromosomes more complicated than XY and XX (*Stuff*)
- 'Only a matter of time' before superbug with no treatment arrives in NZ (Newstalk ZB)

Siouxsie is a regular correspondant on RNZ's Nine to Noon.

Steffen Lippert
- 'From theory to Application': Transfers, self-enforcing agreements and climate cooperation (Coalition Theory Network series)

Stephen Marsland
- Big-brother listens in to native birds to help protect them (*Stuff*)

Suzi Kerr
- Climate change making storms 'more intense' says scientist (Radio NZ)
- Interim climate change committee gets underway (*Scoop*)
- New committee to immediately begin work on making farmers pay for climate pollution (*NZ Herald*)
- Climate change committee just needs a farmer (*Rural News*)
- What's the beef with methane? (*Newsroom*)
- Enviro watchdog: Farm tool Overseer needs oversight (*NZ Herald*)
- Planting push could cut emissions and boost jobs: report (*Newsroom*)
- How NZ could cut agriculture emissions by to 10 per cent (*NZ Herald*)
- Climate change committee members announced (Radio NZ)
- Outsourcing Government: The $55m cost of reviews (*Stuff*)
- How many children should we have for the country? (Radio NZ)

Tava Olsen
- Is Auckland headed for disaster? (*NZ Herald*)

Troy Baisden
- Troy Baisden: Six ways to improve lakes and rivers (*NZ Herald*)
- Can the lessons of Havelock North reverse the declining health of NZ waterways? (*The Spinoff*)
- Freshwater quality: Good news and bad news (*Newshub*)
- Biosecurity and Sustainable Farming Fund big winners in Budget (*Stuff*)
- Murky report highlights state of New Zealand waterways (Newstalk ZB)
- Enviro watchdog: Farm tool Overseer needs oversight (*NZ Herald*)
- Six ways to improve water quality in New Zealand's lakes and rivers (*NBR*)
- Te Waikoropupū Springs hearing adjourned over challenge to evidence (*Stuff*)
- Six ways to improve water quality in New Zealand's lakes and rivers (*The Conversation*)

Te Pūnaha Matatini Whānau members who gathered in Christchurch in October 2018. Photo by Troy Baisden.

Te Pūnaha Matatini's network of emerging scientists

Chair of Te Pūnaha Matatini Whanau, **Reno Nims**, writes about the group's aims and goals, as well as the valuable experiences and get-togethers over the course of 2018.

Te Pūnaha Matatini Whānau is a network for Te Pūnaha Matatini's emerging scientists. It is an active trans-disciplinary community with a shared interest in complex systems and networks, comprising postgraduate students, postdocs and early career researchers from all over New Zealand. While many of our members have supervisors or colleagues affiliated with Te Pūnaha Matatini, our Whānau is an inclusive group and we welcome anyone who feels their research aligns with one or more of Te Pūnaha Matatini's research themes and is keen to be involved.

Many of our members are undertaking trans-disciplinary research which can make it difficult to fit in to any one department at their institute. By belonging to our Whānau network our members can feel part of a collective and meet other researchers who share their interest in complex systems and networks.

Te Pūnaha Matatini Whānau provides a space for collaboration and skill-sharing, and we encourage our members to take an active role in shaping our goals and activities. We organise a range of seminars and workshops with the aim to encourage networking, to develop leadership and entrepreneurial skills, and for outreach. Activities are held all over NZ and we offer a limited amount of travel funding to support attendance at Whānau events.

The first Te Pūnaha Matatini Whānau event of 2018 was a Research Retreat at Snowdon Lodge, Windwhistle, Canterbury, in February. Our Research Retreat was modelled after the Santa Fe Institute's Week of Science, in which a team of researchers collaborate to produce a draft publication over the course of a single week. We had a strong turnout of 12 Whānau members who worked for five days to study the relationships between NZ census data and polling behaviour. There was a lot of data cleaning and wrangling to do, but at the end we were just able to start some analysis.

We explored whether people from similar demographic communities vote similarly, and from a quick network analysis produced by Demi it looks like this is true. Most importantly, everyone made new and stronger connections with other Whānau members and learned more about some of the various methods we use in our work. We also made sure to take plenty of time to keep up with the winter Olympics, play board games, and go for a walk along the Rakaia Gorge.

Our Annual Retreat, attended by 20 Whānau, was held at the Waihōanga Centre near Otaki – just north of Wellington, in September. We were fortunate to have guest talks from Mike Joy on science and government, Sarah Hodge on the

Whānau Retreat at the Waihōanga Centre near Otaki in September 2018.

rollercoaster of life in small business, and Mary O'Keefe on archaeology and science-iwi engagement. We had some great opportunities to learn skills from fellow Whānau members who shared talks on their current research or areas of interest.

TPM principal investigator Rhian Salmon also treated us to an afternoon discussion on life-work balance, and a visit to nearby neighbours Steve and Jenny for a look at their unique take on life-life balance. They showed us how to light a fire with friction, let us get into some wood whittling, and we all enjoyed a cup of kawakawa tea around the fire. To top it all off we walked up the nearby hiking tracks in Otaki Gorge.

The last event of the year for the Whānau coincided with Te Pūnaha Matatini's Annual Hui in Christchurch in October. The hui was a great opportunity to make connections, to catch up with each other and with TPM investigators. Overall, 23 Whānau attended and newcomers presented lightning talks on their research. We also attended an early career panel, organised by Vice-Committee Chair Julie Mugford, where five early career panelists from a variety of academic, government, and start-up organisations shared their views and experiences on the transition from postgraduate study to early career employment. The Whānau ended the hui with a group dinner to solidify our friendships and welcome the new Whānau members to Te Pūnaha Matatini.

Te Pūnaha Matatini is unusual in New Zealand academia in that since its inception, it has put conscious, specific structures in place to identify and overcome lack of diversity and fairness.
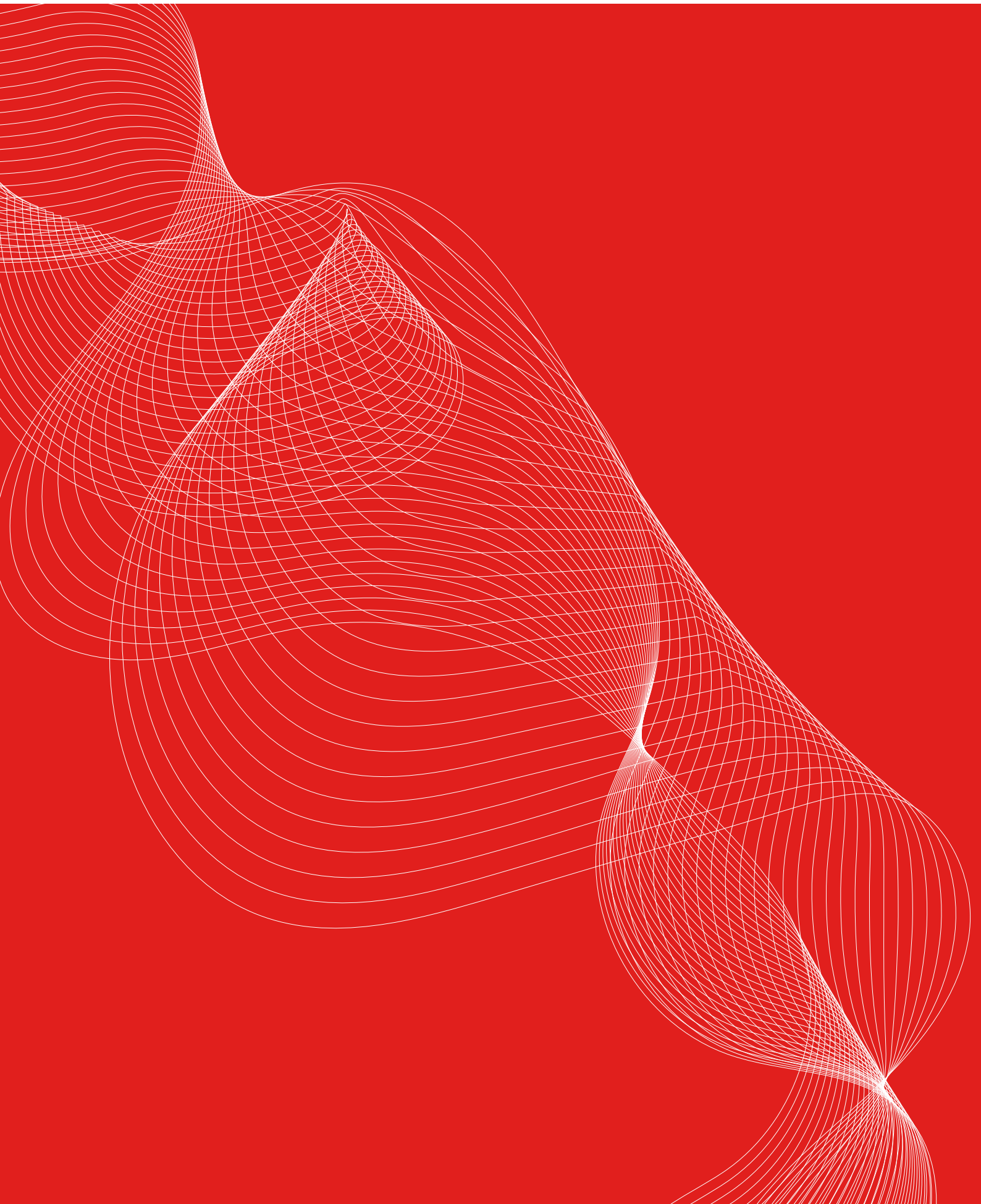
Our Research

✹ Complexity, Risk, and Uncertainty

Today, 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 (formerly called Complex Data Analytics) 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 health-care, 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 improve scientist-public interactions.

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.

Our team

University of Auckland

Principal Investigators:
Ilze Ziedins, Dion O'Neale, Siouxsie Wiles, Tava Olsen, Dan Hikuroa, Cameron Walker
Associate Investigators:
Claire Postlethwaite, Barry Milne, Michelle Dickinson, Kate Hannah, Mark Gahegan, Mark Wilson, Nirmal Nair, Arvind Tripathi, David Welch

Victoria University of Wellington

Principal Investigator:
Marcus Frean, Stephen Marsland, Rebecca Priestley, Rhian Salmon
Associate Investigators:
Anna Matheson
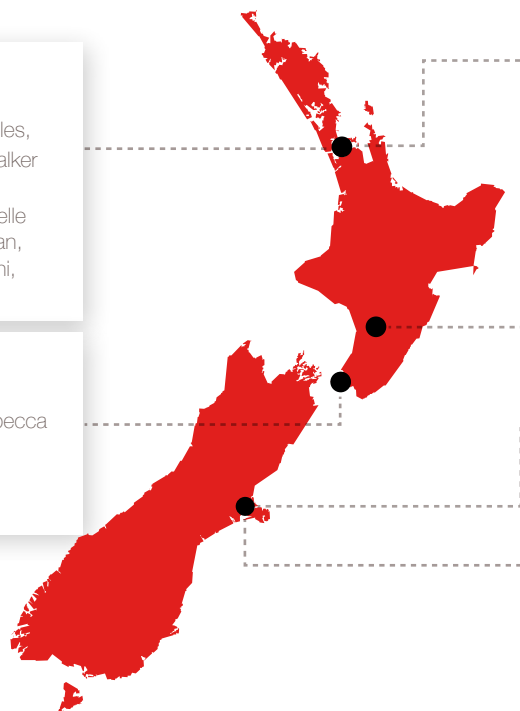
Market Economics

Principal Investigator:
Emily Harvey

Massey University

Principal Investigator:
Murray Cox

University of Canterbury

Principal Investigator:
Jeanette McLeod

Manaaki Whenua Landcare Research

Principal Investigator:
Pierre Roudier

Associate Investigator:
Priscilla Wehi

Our research

The Complexity, Risk and Uncertainty theme is particularly diverse. We have research interests covering all parts of the process of using data, from developing visualisations of data (particularly networks), through theoretical developments in game theory, dynamical systems, machine learning, to investigating public engagement with science.

Research highlight: Networks

The mathematical theory of networks combines graph theory, statistics, and data analytics. We are extending this theory in a variety of ways, such as by treating them as dynamical systems, and developing new ways to transform them, and to find useful structure within them. In addition, we are turning these new methods to transform data into real information in a variety of application areas, including post-marital residence patterns of human societies. Combining theory and practice gives us a unique perspective on many of the problems that we investigate.

- Vasques Filho, D., & O'Neale, D. R. "Degree distributions of bipartite networks and their projections", *Physical Review E*, 98(2), 022307 (2018).

- Ashwin P., & Postlethwaite, C. "Sensitive finite-state computations using a distributed network with a noisy network attractor", *IEEE Transactions on Neural Networks and Learning Systems*, 1–12 (2018).

- Moravec J.C., Atkinson Q., Bowern C., Greenhill S.J., Jordan F.M., Ross R.M., Gray R., Marsland S., Cox M.P. "Post-marital residence patterns show lineage-specific evolution", *Evolution and Human Behavior*, (39), 594–601 (2018).

- Whaanga H., Wehi P., Cox M.P., Roa T., Kusabs I. "Māori oral traditions record and convey indigenous knowledge of marine and freshwater resources", *New Zealand Journal of Marine and Freshwater Research*, (52), 487–496 (2018).

Research highlight: Data analysis

It is common to hear that modern societies are data rich, but information poor. In Te Pūnaha Matatini, we are seeking to redress this balance by developing new data analysis methods hand-in-hand with the problems where the data arise. Examples from 2018 come from geology, where a team from Landcare Research have analysed soil carbon stocks, and statistical ecology, where the AviaNZ project based at Victoria University and Massey has been complemented by research from Auckland, looking at ways to extend the statistical models of animal abundance that are currently used to take into account some of the human errors that are inherent in their application.

- Malone B., Hedley C., Roudier P., Minasny B., Jones E., McBratney A. "Auditing on-farm soil carbon stocks using downscaled national mapping products: Examples from Australia and New Zealand", *Geoderma Regional* (13), 01–014 (2018).

- Hamilton O.N.P., Kincaid S.E., Constantine R., Kozmian-Ledward L., Walker C., Fewster R.M. "Accounting for uncertainty in duplicate identification and group size judgments in mark-recapture distance sampling", *Methods in Ecology and Evolution*, (9), 354-362 (2018).

- Priyadarshani N., Castro I., Marsland S. "The Impact of Environmental Factors in Birdsong Acquisition using Automated Recorders", *Ecology and Evolution* (8), 5016-5033 (2018).

Research highlight: Simulation and medical data

Hospitals are rich sources of complex data. Within Te Pūnaha Matatini we focus in this sphere is on projects that are involve people, which generally require our expertise in complex systems analysis. Examples from 2018 of this are centred on modelling: simulating the emergency department, using simulating to evalutation proposed community health interventions, and looking for changes that could work to improve health equity.

- Furian N., Neubacher D., O'Sullivan M., Walker C. "GEDMod – Towards a generic toolkit for emergency department modelling", *Simulation Modelling Practice and Theory*, (87), 239–273 (2018).

- Matheson A., Bourke C., Verhoeven A., Khan M.I., Nkunda D., Dahar Z., Ellison-Loschmann L. "Lowering hospital walls to achieve health equity", *BMJ*, (362), k3597 (2018).

- Matheson A., Walton M., Gray R., Lindberg K., Shanthakumar M., Fyfe C., Wehipeihana N., Borman B. "Evaluating a community-based public health intervention using a complex systems approach", *Journal of Public Health*, (40), 606–613 (2018).

Research highlight: Supply chain optimisation

Supply chains are a key component of production, from obtaining materials from suppliers through to delivering completed products. Optimisation of this chain can substantially reduce the costs of doing business, by reducing storage needs, ensuring that nothing is wasted, and that time is not spent waiting. While this is important for any business, in agribusiness, where products can spoil if they are not harvested on time, or take too long in transit, these matters are even more critical. Te Pūnaha Matatini researchers are combining statistical and business expertise to study how to deal with the risks inherent in such business management practices.

- Behzadi G., O'Sullivan M.J., Olsen T.L., Zhang A. "Agribusiness supply chain risk management: A review of quantitative decision models", *Omega*, (79), 21–42 (2018).

- Behzadi G., O'Sullivan M.J., Olsen T.L., Zhang A. "Allocation flexibility for agribusiness supply chains under market demand disruption", *International Journal of Production Research*, (56), 3524–3546 (2018).

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.

Our team

University of Auckland
Principal Investigators:
Dion O'Neale, Shaun Hendy, Tava Olsen
Associate Investigators:
Barry Milne, Mark Wilson, Steffen Lippert

University of Waikato
Associate Investigator:
Les Oxley

Victoria University of Wellington
Principal Investigators:
Marcus Frean, Michele Governale, Stephen Marsland, Sally Davenport, Uli Zuelicke

Market Economics
Principal Investigator:
Emily Harvey

Motu Research
Principal Investigators:
David Maré, Izi Sin, Suzi Kerr

University of Canterbury
Principal Investigators:
Alex James, Jeanette McLeod
Mike Plank

Our research

Te Pūnaha Matatini researchers are applying new methods from complexity science to better understand New Zealand's economic performance, the impact of innovation, and issues in social development. This understanding will inform government policy and decision-making, and will assist in the evaluation of the effectiveness and impact of government policies.

Research highlight: Social development

The Network Science for the Social Sector project applied social network analysis to develop a new model that uses relationship information to assess risk to children. Evidence-based decision making tools are increasingly common in social services provision but few, if any, have used social network data. This programme was directly funded by the Ministry for Social Development (MSD). The results show that information about close family relationships integrated from national databases can substantially improve decision making as well as quantifying the importance of family relationships in children's lives and providing additional information about risk factors for social workers assessing a case. A working paper was discussed at a Roundtable on Social Investment with Minister Sepuloni in Wellington in July. Laura Black, Director of the Methodist Mission Southern, a prominent social services provider, said "The practical implications if the child network study are quite profound when considering a preventative lens."

- A. James, J. McLeod, M. Plank, S. C. Hendy, K. Marks, D. Rusu, and S. Nik, "Hidden in plain sight: the effect of close family relationships on outcomes for children", Te Pūnaha Matatini working paper (2018).

Research highlight: Knowledge networks

Samin Aref, one of our first PhD graduates, took up a post-doctoral fellowship at the Max Planck Institute for Complex Systems in 2018. He published nine papers during his PhD, with the last one appearing in the Proceedings of the Australasian Computer Science Week Multiconference in 2018. This paper was based on his internship at the Ministry of Business, Innovation, and Employment, where he curated a Scopus bibliometric dataset for identification of New Zealand research institutions. This was applied to study co-institutional research collaboration within New Zealand.

- Aref, S., Friggens, D., Hendy, S. "Analysing scientific collaborations of New Zealand institutions using scopus bibliometric data" *ACM International Conference Proceeding Series*, 3167920, (2018).

Research highlight: Knowledge networks

Demival Vasques and Dion O'Neale published their work on bipartite networks, i.e. networks that connect two types of entity, such as research articles and their authors. These types of networks are important in the analysis of social and economic systems as they explicitly show conceptual links between different types of entities. They show that bipartite degree distributions are not the only feature driving topology formation of projected networks (networks of papers or networks of co-authors), in contrast to what is commonly described in the literature.

- Vasques Filho, D., & O'Neale, D. R. "Degree distributions of bipartite networks and their projections" *Physical Review E*, 98(2), 022307 (2018).

Research highlight: Evidence and policy-making

Suzi Kerr and Steffen Lippert released a working paper that looks at how countries can cooperate to tackle climate change. International agreements addressing climate change must overcome the difficulties implied by the absence of an institution with the power to ensure compliance. They have to be self-enforcing: the threat of future punishment must give participants sufficient incentives to comply with the agreed reductions in emissions voluntarily. Every country has an incentive to increase their emissions unilaterally, to produce higher economic output, benefitting the individual country. The environmental costs or the increase in greenhouse gas emissions, however, are shared by the community of countries, leading to inefficiently high individual incentives to emit. In contrast, efficient global mitigation – low emissions by all countries – generates the greatest joint gains. In the context of climate change, this means that, for patient countries, the loss of future cooperation is so large that short-run opportunistic increases in emissions today do not pay. Unfortunately, as we have learned from 30 years of climate negotiations, this theoretical insight does not easily transfer into reality. Because we do not like where the rules of the game take us, we need to change them.

- Suzi Kerr, Steffen Lippert, and Edmund Lou "Transfers, self-enforcing agreements and climate cooperation" From Theory to Application 21.2018 Coalition Theory Network (2018).

Complexity and the Biosphere
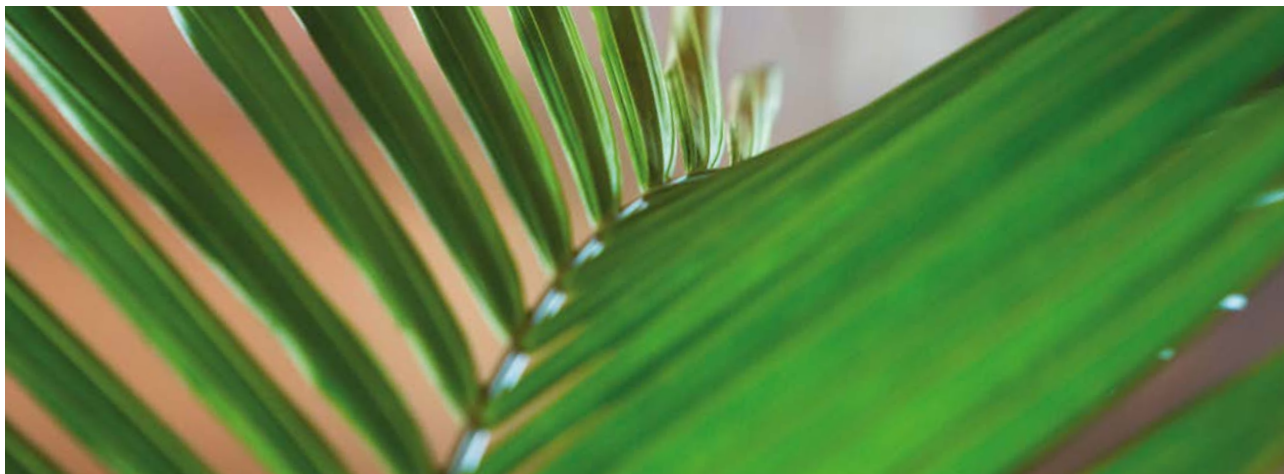
Te Pūnaha Matatini is applying network analysis, complexity theory, and dynamical systems methodologies to understand the biosphere.

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 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.

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 unique flora and fauna by analysing the iNaturalist citizen science platform.

Our team

University of Auckland
Principal Investigators:
Dan Hikuroa, Thegn Ladefoged, Cate Macinnis-Ng, Siouxsie Wiles
Associate Investigators:
Alexei Drummond, James Sneyd, Michelle Dickinson, Melinda Allen, Simone Linz

Auckland University of Technology
Associate Investigators:
David Hall, Rachael Ka'ai-Mahuta

University of Waikato
Associate Investigator:
Troy Baisden

Victoria University of Wellington
Principal Investigator:
Rebecca Priestley, Rhian Salmon, Stephen Marsland

Market Economics
Principal Investigator:
Emily Harvey

Massey University
Principal Investigator:
Murray Cox
Associate Investigator:
Isabel Castro

Motu Research
Principal Investigator:
Suzi Kerr

University of Canterbury
Principal Investigators:
Alex James, Jeanette McLeod, Mike Plank
Associate Investigators:
Audrey Lustig, Adrian McDonald

Manaaki Whenua Landcare Research
Principal Investigators:
Pierre Roudier, Rachelle Binny
Associate Investigators:
Priscilla Wehi, Andrea Byrom, Fraser Morgan
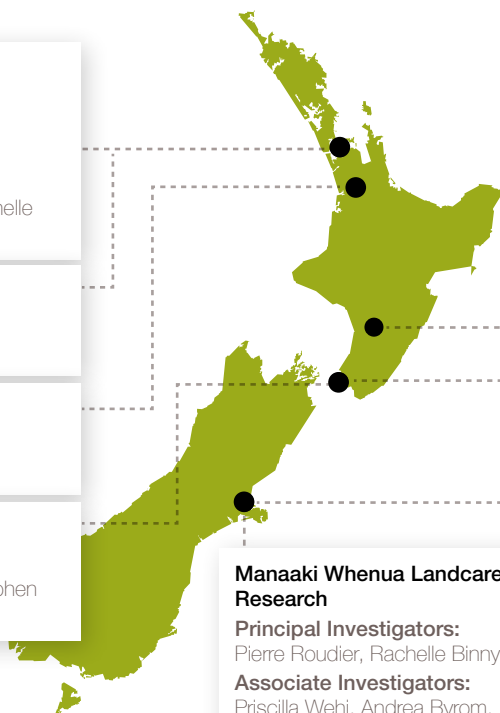
Our research

Making use of data concerning New Zealand's biodiversity will enable better understanding of our unique flora and fauna, by both informing policy and decision-making, and building community capacity. This research theme has a close partnership with New Zealand's Biological Heritage National Science Challenge, via investigator Dr Andrea Byrom, its Director, and with Scion through postdoctoral fellow Rebecca Turner, funded by Te Pūnaha Matatini and the Biological Heritage National Science Challenge. We also work with iwi and other stakeholders at the Ministry for Primary Industries, Department of Conservation, and Hawkes Bay Regional Council.

Research highlight: Modelling large-scale predator control measures

We have a close partnership with colleagues at Manaaki Whenua Landcare Research. Manaaki Whenua has provided co-funding and co-supervision for a PhD student developing methods for using citizen science data. Te Pūnaha Matatini-funded postdoctoral fellow Audrey Lustig has started a part-time position at Manaaki Whenua to develop predator control models to inform a pest eradication programme on the Mahia Peninsula. The data that is driving a Te Pūnaha Matatini PhD project on possum contact networks has also been provided by Manaaki Whenua.

Strong support from the University of Canterbury has resulted in the co-funding of three PhD students. One of these is also funded by Manaaki Whenua and two are co-funded by Te Pūnaha Matatini. The University of Canterbury has also provided substantial co-funding for the postdoctoral fellowship on pan-regional predator control, based in the Geospatial Research Institute.

Peer reviewed journal article

- Lustig A., James, A., Anderson D., Plank, M. "Pest control at a regional scale: identifying key criteria using a spatially explicit, individual-based model", Journal of Applied Ecology, In Review (2018).

National and international conferences

- Lustig A., James, A., Anderson D., Plank, M. "Pest control at a regional scale: identifying key criteria using a spatially explicit, individual-based model", Birtish Ecological Society Annual Meeting, Birmingham, United Kingdom, 16–18 December (2018).

- Lustig, A., James, A., Anderson, D., Plank, M. "Large-scale control of invasive predators", Bio-Protection Research Seminar Series, Christchurch, NZ, 30 August (2018).

- Lustig, A. "Modelling the abundance of mammalian species across the landscape, Stouffer-Tylianakis Seminar Series, Christchurch, NZ, 24 May (2018).

Research highlight: 'Mai i ngā maunga ki te tai – From the mountains to the sea – enhancing conservation using mātauranga'

Postdoctoral Fellow Tara McAllister is making good progress on the project 'Mai i ngā maunga ki te tai – From the mountains to the sea – enhancing conservation using mātauranga' Tara and Investigators Dan Hikuroa and Cate Macinnis-Ng were successful in securing an MBIE Vision Mātauranga Capability Fund grant to extend Tara's work. The project is entitled 'He waka hourua ki te ao kei mua – Mātauranga and Science engagement framework' and is developing better processes and practices for research co-developed with Māori.

Research Outputs

75 journal articles

1 patent filed

7 books/ book chapters

12 conference papers
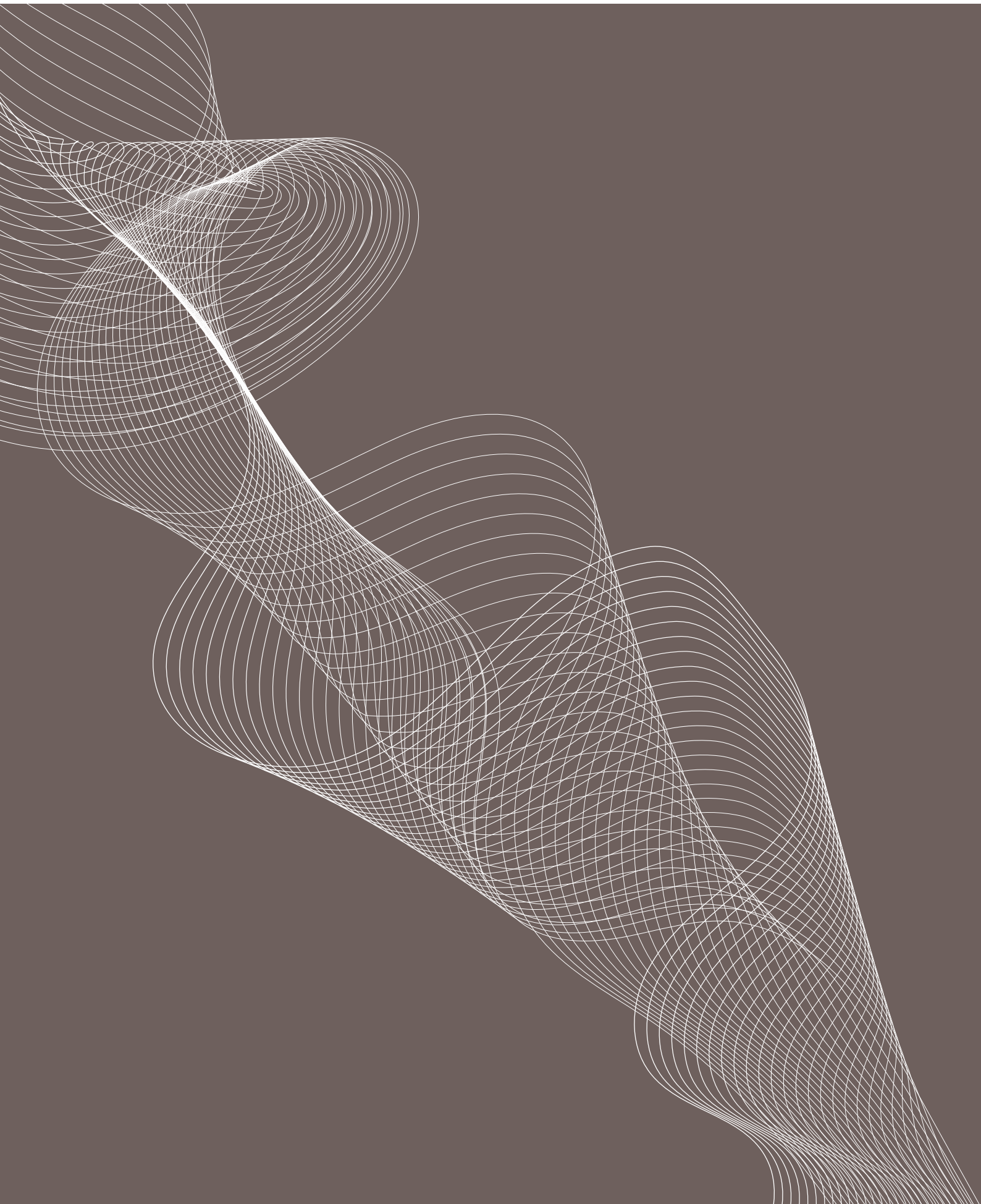
3 spinouts
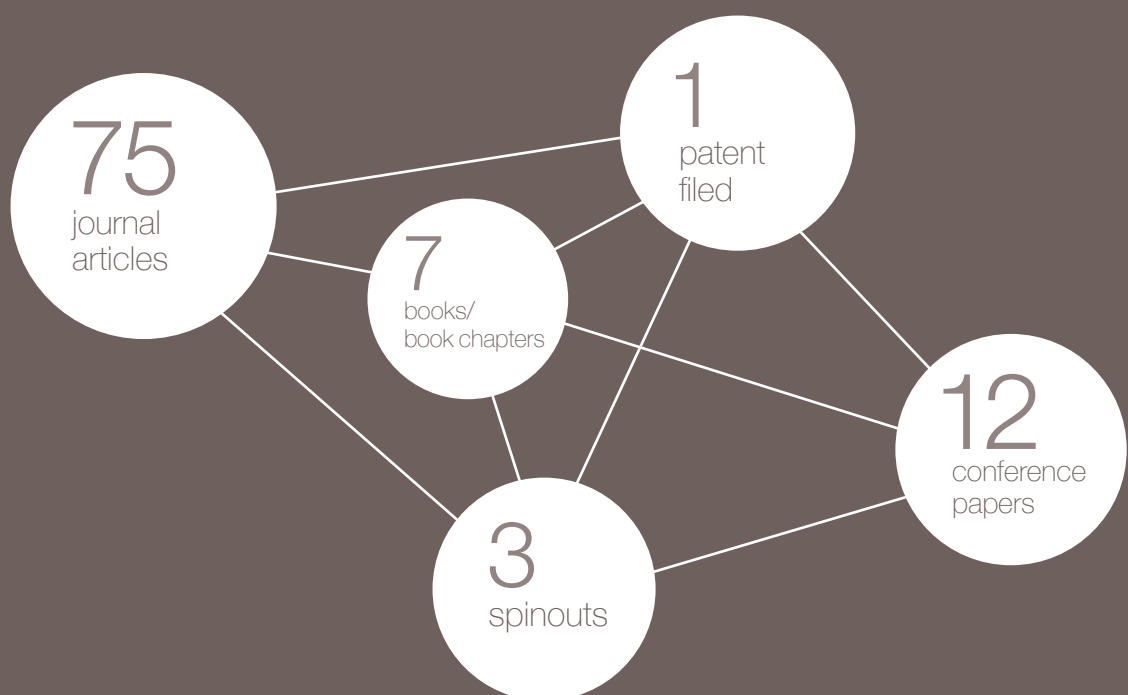
Publications and Presentations of Note

Aref S., **Wilson M.C**., Balance and frustration in signed networks, *Journal of Complex Networks*

Brierley G., Tadaki M., **Hikuroa D**., Blue B., Šunde C., Tunnicliffe J., Salmond A., A geomorphic perspective on the rights of the river in Aotearoa New Zealand, *River Research and Applications*

Curran B., **Higham K**., **Ortiz E**., **Vasques F.D**., Look who's talking: Two-mode networks as representations of a topic model of New Zealand parliamentary speeches, *PLoS ONE*

Furian N., **Walker C**., Voessner S., **O'Sullivan M**., Evaluating the impact of optimization algorithms for patient transits dispatching using discrete event simulation, *Operations Research for Healthcare*

Malone B., Hedley C., **Roudier P**., Minasny B., Jones E., McBratney A., Auditing on-farm soil carbon stocks using downscaled national mapping products: Examples from Australia and New Zealand, *Geoderma Regional*

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Spinouts

Nebula Networks, **Shaun Hendy** founded with Georgia Nixon, Nickolas Morton, and Toby Bi

ORUA Health, **Michael O'Sullivan**, has founded a spinout company in China which is looking to commercialise surgery scheduling and planning reserach (Healthcare Analytics)

Toha, **Shaun Hendy** founded with James Mansell, Mike Taitoko, Nathalie Whittaker, Robert O'Brien. Currently raising capital
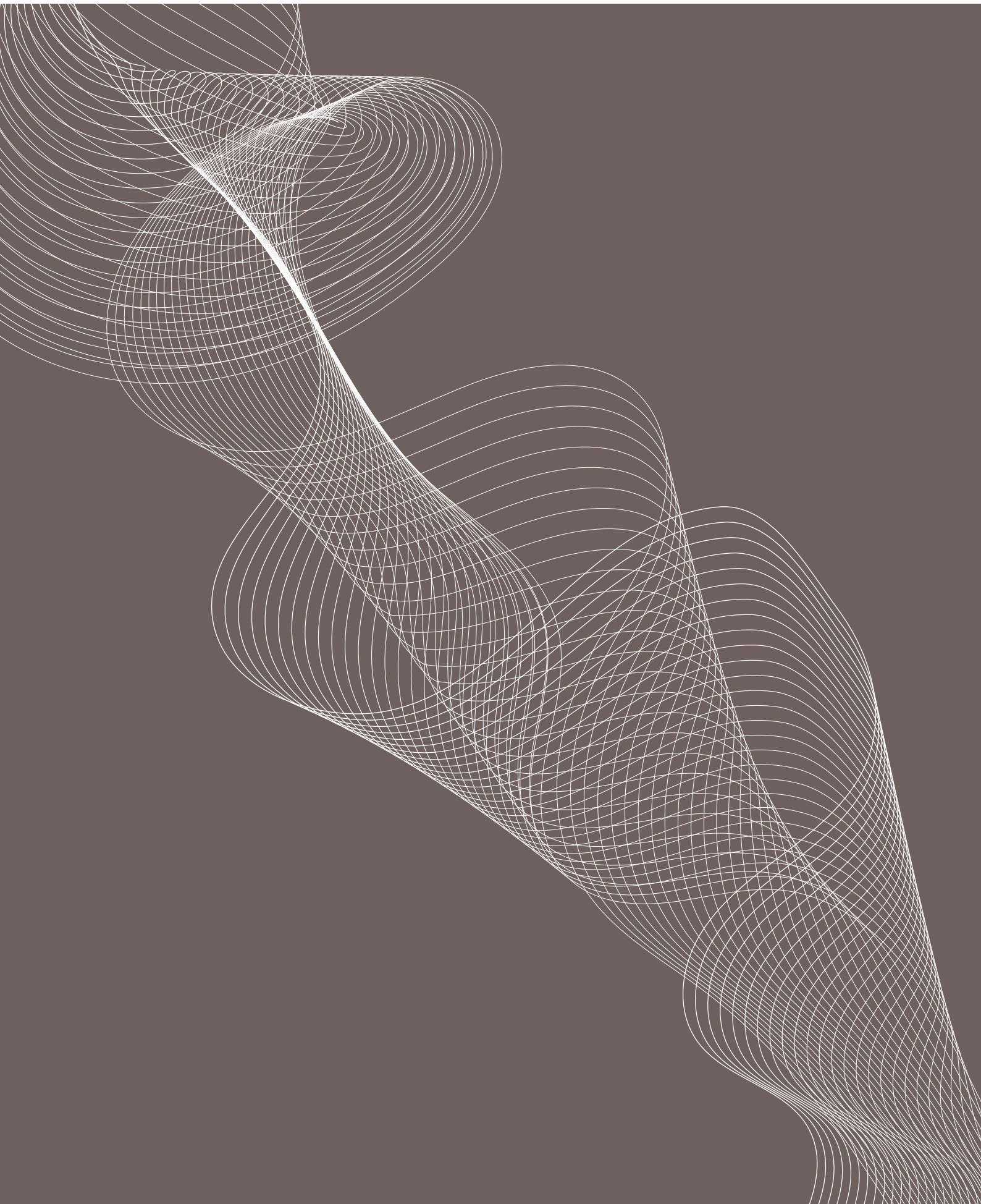
Governance and Management

Financial Report 2018

	2018 Actuals $000
Funding received	
Tertiary Education Commission grant	2,194
Surplus carried forward	773
Total Funding received	**2,967**
Expenditure	
Salaries	
Director and Principal Investigators	569
Associate Investigators	0
Research/Technical assistants	56
Others	206
Total Salaries & Salary-related costs	**831**
Other costs	
Overheads	793
Project Costs	288
Travel	125
Postgraduate students	345
Total Other Costs	**1,551**
Total Expenditure	**2,382**
Net Surplus/(Deficit)	**585**

Notes

This report covers the period from 1 January 2018 – 31 December 2018 and details funding received and funds distributed to collaborative partners of the CoRE.

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

The net surplus will be carried forward into 2019 to fund future expenditure of the CoRE.

2018 Summary

Broad category	Detailed category	Yr4
Value of CoRE funding from TEC ($M)		2,193,500
FTEs	Principal investigators	3.80
by category	Associate investigators	0
	Postdoctoral fellows	5
	Research technicians	1
	Administrative/support	2.5
	Total	**12.3**
Headcounts	Principal investigators	26
by category	Associate investigators	26
	Postdoctoral fellows	5
	Research technicians	1
	Administrative/support	3
	Total	**64**
Peer-reviewed research outputs by type	Books/book chapters	7
	Journal articles	75
	Conference papers	12
	Other	15
	Total	**109**
Value of non-Vote S&I external research contracts awarded by source	Government (non-Vote S&I)	1,584,880
	Domestic – private sector funding	192,717
	Overseas	13,800
	Total	**1,791,397**
Commercial activities	Patents granted	1
	Spinouts	3
	Total	**4**
Students studying at CoRE by level	Doctoral degree	47
	Other	38
	Total	**85**
Number of students completing qualifications by level	Doctoral degree	5
	Other	7
	Total	**12**
Immediate post-study graduate destinations (since 2015)	Employed overseas	22%
	Employed in NZ	78%
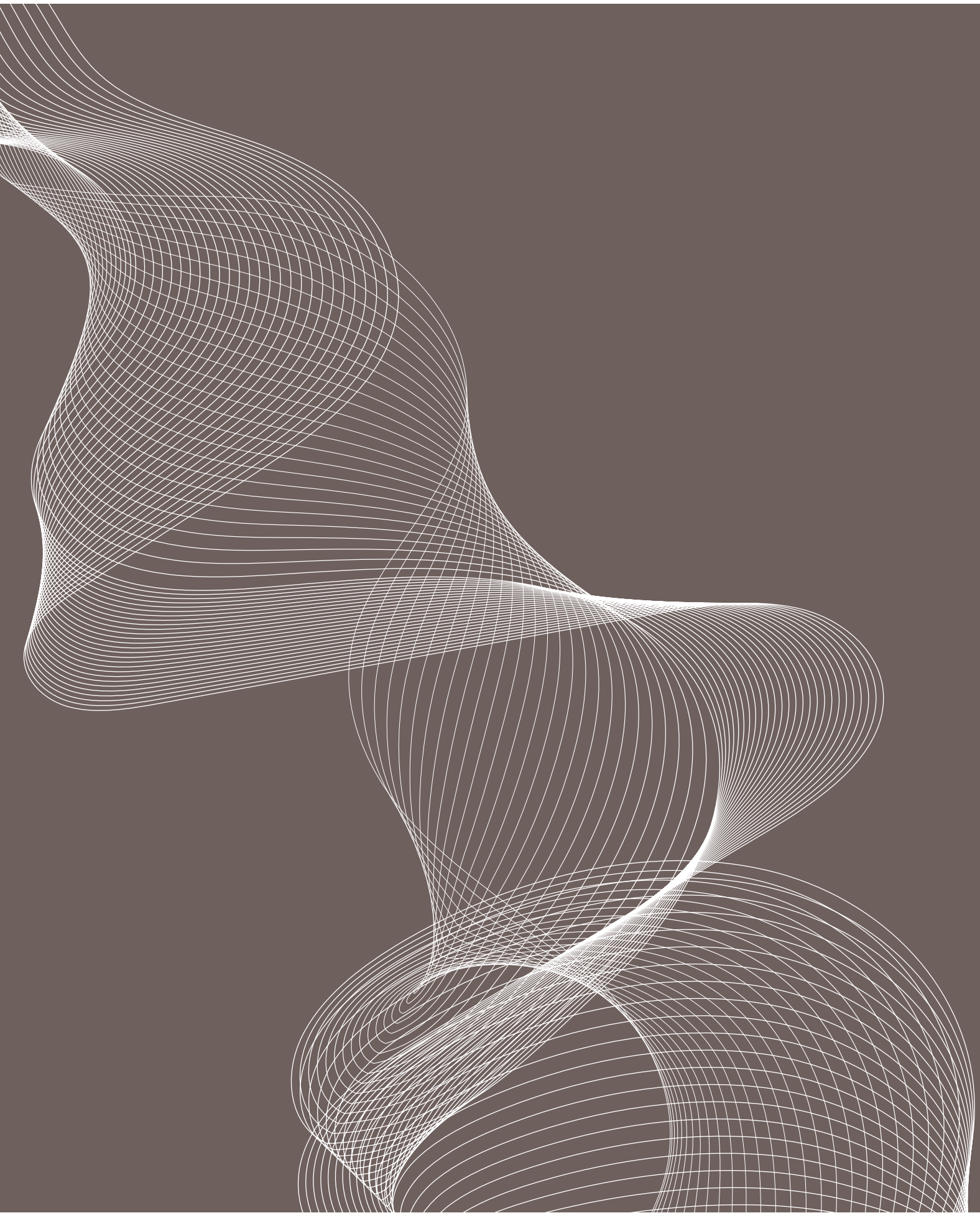
Meeting Our Strategic Outcomes

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 four 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.

- 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 leadership awards and national honours.

- 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.

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 60 Te Pūnaha Matatini students (graduate and under-graduate) were placed at stakeholder and end-user organisations with joint internal and external supervisors as part of our 10-week summer internship programme. The internships were funded or co-funded by the external organisations (AgResearch, Stats NZ, SIA, MBIE, Te Hiku Media, Ministry of Justice, MSD, Oranga Tamariki, Westpac, BRANZ, Ngāti Whātua Orākei). In some cases, students worked individually, but at several organisations we used a team-based approach, where a PhD student led a team of two undergrads. This team-based approach worked very well, with both the students and hosting organsations 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 Aupouri, Ngai Takoto, Te Rārawa 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 Orākei, 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 fourth year, a number of PhD students from our first funded cohort have graduated. PhD students Samin Aref, Kyle Higham and Demival Filho Vasques have all gone to prestigious postdoctoral positions overseas. We note that our first Whānau Chair, Dr Rachelle Binny, is now a research scientist at Manaaki Whenua, while Dr Audrey Lustig has a prestigious postdoctoral position at the University of Canterbury.

- 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.

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 Punaha 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 Zeidins, 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 for example 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 spirit out company ORUA Health.

- Te Pūnaha Matatini work on the 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.

- 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 spin-out 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.

- Te Pūnaha Matatini has worked with the Ministry of Primary Industries on 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.

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.

Capability-building

- 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 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 Orākei 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 in within a Ngāti Whātua Orākei framework.

- There are now several Te Pūnaha Matatini research projects that will enable the distinctive contribution of Māori, focusing on the interaction of mātauranga (Māori traditional knowledge) 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 will be 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.

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? (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.

Our People

26
Principal
Investigators

5
Postdoctoral
Fellows

26
Associate
Investigators

147
Affiliated
or funded
students

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.

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 and Outreach

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'.

Dr Siouxsie Wiles
University of Auckland
Deputy Director, Public Engagement and Outreach

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.

Professor Stephen Marsland
Victoria University of Wellington
Theme Co-Leader, Complexity, Risk, and Uncertainty

Stephen Marsland 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 Michele Governale
Victoria University of Wellington
Theme Co-Leader, Complex Economic and Social Systems

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!).

Professor Uli Zuelicke
Victoria University of Wellington
Theme Co-Leader, Complex Economic and Social Systems

Uli Zuelicke 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.

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.

Kate Hannah
Executive Manager, Te Pūnaha Matatini

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.

Kathryn Morgan
Research Operations Coordinator, Te Pūnaha Matatini

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 Masters of Sciences 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 – highly translatable experience for when dealing with academics!

Greg Town
Communications and Marketing Advisor, Te Pūnaha Matatini

Greg is supporting Te Pūnaha Matatini's communications requirements as part of his role with the University of Auckland's Science Faculty marketing team. Since graduating with a Science degree 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.

Reno Nims
Chair, Te Pūnaha Matatini Whānau

Reno is a PhD student in the University of Auckland Anthropology Department where he uses zooarchaeological methods to explore Māori interactions with the environment in the past. He began studying anthropology at the University of California and completed his M.S. in Anthropology at Portland State University in 2016. Reno's doctoral research will also contribute to a multidisciplinary collaboration between archaeologists and computational mathematicians at Te Pūnaha Matatini who seek to understand the long-term resilience of Aotearoa New Zealand fisheries.

Advisory Board

Richard Aitken

Advisory Board Chair

Executive Chairman, Beca (New Zealand)

Through his 45-year career at Beca, Richard has played an active part in growing this professional services consultancy to a team around 3000-strong throughout New Zealand, Australia and Asia.

He has served in several executive positions and held a range of directorships both internal and external. Before taking up the Chairmanship of the Beca Group in 2009 he held the lead role of Group Chief Executive for a decade.

Richard has in-depth experience in engineering project management and with partnering and alliance contracting. Current external directorships are with Trustpower Ltd and Panuku Development Auckland Ltd (Deputy Chair) and since February 2015 the Te Pūnaha Matatini Advisory Board (Chair). Richard has represented Beca on the Project Alliance Board for the Waterview Project (Auckland) for the last five years and was appointed to the Chair in late-2015. He remains a member of the Construction Strategy Group (a high-level industry body) having chaired it from inception for nearly five years.

Richard is a Distinguished Fellow of the Institution of Professional Engineers NZ (IPENZ) and a Fellow of the Institution of Structural Engineers UK (IStructE).

Peter-Lucas Jones

General Manager, Te Hiku Media

Peter-Lucas Kaaka Jones 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

Manager, Data & Analytics, PwC New Zealand

In Pieta's role as Data & Analytics Manager at PwC's Experience Centre, she brings a real passion for data and analytics, technical expertise, practical common sense and the ability to see the big picture to PwC's clients. Pieta believes broad thinking from multiple disciplines is critical to analytics success and her data science 'dream team' comprises technical expertise alongside psychology, anthropology and design. Her previous roles have been as a statistician, Insights Manager and Chief Analytics Officer.

James Mansell

Business owner at Noos Ltd

James is an independent consultant who also provides mentoring courses and presentations on leadership big data and government. James champions the safe use of data science to deliver public and economic value. This includes supporting organisations to use analytics and shared data to solve challenges in child protection, social development, education, tax, and health.

At a whole of government level James is supporting ministers and senior officials in New Zealand and Australia to adapt to and use data science to better orientate the state sector to be more outcomes focused and innovative. This includes building the right kind of national data ecosystem required for safe use of data science and data sharing.

In 2011 James 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. He holds a first-class honours degree in Philosophy from Victoria University of Wellington.

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 Ph.D. 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
University of Auckland

Assoc Prof Alex James
University of Canterbury

Assoc Prof Cate Macinnis-Ng
University of Auckland

Dr Dan Hikuroa
University of Auckland

Dr Dion O'Neale
University of Auckland

Dr Isabelle Sin
Motu Research

Kate Hannah
University of Auckland

Professor Michele Governale
Victoria University of Wellington

Assoc Prof Mike Plank
University of Canterbury

Reno Nims
University of Auckland

Professor Rhian Salmon
Victoria University of Wellington

Dr Siouxsie Wiles
University of Auckland

Professor Stephen Marsland
Massey University

Professor Uli Zuelicke
Victoria University of Wellington

Kairangi

Te Pūnaha Matatini has introduced a new category of investigator – Kairangi, a Māori term meaning 'the finest pounamu' (greenstone or jade) which can be used to describe a person held in high esteem. This new category reflects our development as an organisation and acknowledges the important contributions of our senior colleagues.

Professor Adam Jaffe, Motu Research
Professor Andy Philpott, University of Auckland
Professor Richard Easther, University of Auckland

Te Pūnaha Matatini Whānau

Reno Nims (Chair)
University of Auckland

Julie Mugford (Vice-Chair)
University of Auckland

Kyle Higham (Immediate Past-Chair)
Victoria University of Wellington

Hamza Ajmal (Treasurer)
University of Waikato

Mubashir Qasim (Communications Officer)
University of Waikato

Audrey Lustig
University of Canterbury

Attaullah Sahito
University of Waikato

Mohammad Sanjari
University of Auckland

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 Research

Dr Dion O'Neale
University of Auckland

Dr Emily Harvey
Market Economics

Associate Professor Ilze Ziedins
University of Auckland

Dr Isabelle Sin
Motu Research

Dr Jeanette McLeod
University of Canterbury

Associate Professor Marcus Frean
Victoria University of Wellington

Associate Professor Michael Plank
University of Canterbury

Associate Professor Michele Governale
Victoria University of Wellington

Professor Murray Cox
Massey University

Dr Pierre Roudier
Manaaki Whenua

Dr Rachelle Binny
Manaaki Whenua

Associate Professor Rebecca Priestley
Victoria University of Wellington

Professor 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

Dr Suzi Kerr
Motu Research

Professor Tava Olsen
University of Auckland

Professor Thegn Ladefoged
University of Auckland

Professor Troy Baisden
University of Waikato

Professor Uli Zuelicke
Victoria University of Wellington

Associate Investigators

Associate Professor Adrian McDonald
University of Canterbury

Professor Alexei Drummond
University of Auckland

Dr Andrea Byrom
Manaaki Whenua

Dr Anna Matheson
Massey University

Associate Professor Arvind Tripathi
University of Auckland

Dr Audrey Lustig
University of Canterbury

Dr Barry Milne
University of Auckland

Associate Professor Cameron Walker
University of Auckland

Associate Professor Claire Postlethwaite
University of Auckland

Dr David Hall
Auckland University of Technology

Dr David Welch
University of Auckland

Dr Fraser Morgan
Manaaki Whenua

Associate Professor Isabel Castro
Massey University

Professor James Sneyd
University of Auckland

Kate Hannah
University of Auckland

Professor Les Oxley
University of Waikato

Professor Mark Gahegan
University of Auckland

Dr Mark Wilson
University of Auckland

Professor Melinda Allen
University of Auckland

Dr Michael O'Sullivan
University of Auckland

Dr Michelle Dickinson
University of Auckland

Associate Professor Nirmal Nair
University of Auckland

Dr Priscilla Wehi
Manaaki Whenua

Dr Rachael Ka'ai-Mahuta
Auckland University of Technology

Dr Simone Linz
University of Auckland

Dr Steffen Lippert
University of Auckland

Postdoctoral Fellows

Postdoctoral fellow	Supervisor
Dr Addison Pan	Steffen Lippert
Dr Binyamin Oz	Ilze Ziedins
Dr Mohammad Sanjari	Nirmal Nair
Dr Rebecca Turner	Michael Plank/Alex James
Dr Tara McAllister	Cate Macinnis-Ng

PhD Students

Name	Supervisor	Institution
Abhinav Chopra	Nirmal Nair	University of Auckland
Adrian Ortiz-Cervantes	Dion O'Neale	University of Auckland
Alberto De Rosa	Stephen Marsland	Massey University Palmerston North
Alex Wang	Ilze Ziedins	University of Auckland
Angela Natali	Isabelle Sin	Victoria University of Wellington
Attaullah Sahito		University of Waikato
Cate Ryan	Cate Macinnis-Ng	University of Auckland
Daniel Marc dela Torre		University of Auckland
Daniel Thomas Braithwaite	Marcus Frean	Victoria University of Wellington
David Kelley		University of Auckland
Demival Vasques	Dion O'Neale	University of Auckland
Ellen Hume	Cate Macinnis-Ng	University of Auckland
Giorgia Vattiato	Rachelle Binny	University of Canterbury
Hamza Ajmal		University of Waikato
Hitaua Arahanga-Doyle		University of Otago
Jacob Pastor	Isabelle Sin	Victoria University of Wellington
Jiri Moravec	Stephen Marsland	Massey University
Jo Bailey	Rhian Salmon	University of Victoria Wellington
Julie Mugford	Andrea Byrom	University of Canterbury
Julius Juodakis	Stephen Marsland	Victoria University of Wellington
June Lau	Ilze Ziedins	University of Auckland
Kate Hannah	Rebecca Priestley	Victoria University of Wellington
Kian Wee Soh	Michael O'Sullivan	University of Auckland
Kyle William Higham	Uli Zuelicke	Victoria University of Wellington
Laura Kranz	Rhian Salmon	Victoria University of Wellington
Lingyan Han	Stephen Marsland	Victoria University of Wellington
Lorena Di Bono		Victoria University of Wellington
Malin Undin	Isabel Castro	Massey University
Michael Hackney	Alex James	University of Canterbury
Michal Salter-Duke	Stephen Marsland	Victoria University of Wellington
Mubashir Qasim		University of Waikato
Neda Sakhaee	Shaun Hendy	University of Auckland
Niffe Hermansson		University of Auckland
Nirosha Pyiyadarshani	Stephen Marsland	Victoria University of Wellington
Ploy Pongjetanapong	Cameron Walker	University of Auckland
Raneetha Abeywickrama	Ilze Ziedins	University of Auckland
Reno Nims	Thegn Ladefoged	University of Auckland
Samin Aref	Shaun Hendy, Mark Wilson	University of Auckland
Shahab Bayati	Arvind Tripathi	University of Auckland
Sina Safaei	Shaun Hendy	University of Auckland
Stephen Merry	Alex James	University of Canterbury
Steven Turnbull		University of Auckland
Thomas Adams	Michael O'Sullivan, Cameron Walker	University of Auckland
Toya Shaw	Cameron Walker	University of Auckland
Virginia Listanti	Stephen Marsland	Victoria University of Wellington

Honours Students

Name	Supervisor	Institution
Caleb Gemmell		University of Auckland
Davis Cooper	Stephen Marsland	Victoria University of Wellington
Georgia Nixon		University of Auckland
Karan Dasgupta		University of Auckland
Muru Odiathevar	Marcus Frean	Victoria University of Wellington
William Doonan	Uli Zuelicke/Michele Governale	Victoria University of Wellington

Masters Students

Name	Supervisor	Institution
Alex White	Stephen Marsland	Victoria University of Wellington
Carline Bentley	Steffen Lippert	University of Auckland
Hayley Glover	Thegn Ladefoged	University of Auckland
Mashall Aryan	Marcus Frean	Victoria University of Wellington
Matthew Soar		Victoria University of Wellington
Narayanan Arunachalam		University of Canterbury
Nickolas Adrianus Morton	Shaun Hendy	University of Auckland
Shakked Noy	Isabelle Sin	Victoria University of Wellington
Valerie Chan	Marcus Frean	Victoria University of Wellington

2018/2019 Summer Interns

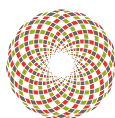| Intern	Project title	Industry/ sector partner	Industry supervisor	TPM supervisor	Location
Elspeth Mack	A critical review assessing the potential benefits of linking administrative and survey data for research and policy practice	Ministry of Social Development	Hugh Webb	Rhian Salmon	WGTN
Narayanan Arunachalam	Building on a prototype app for MSD's employment assistance programmes	Ministry of Social Development	Marc De Boer	Rhian Salmon	WGTN
Hiroyuki Nezu	Building a prototype app that would aggregate information about MSD's income support payments	Ministry of Social Development	Divinagracia Sto. Domingo-Macaulay	Rhian Salmon	WGTN
Edgar (Fernando) Cagua Bermudez	Data science in social services	Ministry of Social Development	Daniel Lensen	Rhian Salmon	WGTN
Sage Anastasi	Reforming New Zealand's Justice sector; using data insights to deliver operational improvement; using data insights to deliver better justice services	Ministry of Justice	Andrew Rae	Jo Bailey	WGTN
Alexander Simson	Reforming New Zealand's Justice sector; using data insights to deliver operational improvement; using data insights to deliver better justice services	Ministry of Justice	Andrew Rae	Jo Bailey	WGTN
Rebecca Tonacao	Reforming New Zealand's Justice sector; using data insights to deliver operational improvement; using data insights to deliver better justice services	Ministry of Justice	Andrew Rae	Jo Bailey	WGTN

Intern	Project title	Industry/ sector partner	Industry supervisor	TPM supervisor	Location
Henry Alferink	Teleconnections in Antarctic environmental data	Te Pūnaha Matatini/ Manaaki Whenua	Fraser Morgan	Dion O'Neale	AKL
Catherine (Kate) Stewart	Design and build a data management system for archaeological records	Te Pūnaha Matatini	Thegn Ladefoged	Dion O'Neale	AKL
Robert Bruce	Visualising Te Pūnaha Matatini	Te Pūnaha Matatini	Mike Plank Greg Town	Alex James	CHCH
William Asiata	Machine learning for te reo Māori	Te Hiku/Dragonfly	Caleb Moses	Shaun Hendy	AKL
Cherie Vasta	Machine learning for te reo Māori	Te Hiku/Dragonfly	Ed Abraham/ Keoni Mahelona	Ed Abraham	WGTN
Max Bunting	Machine learning for te reo Māori	Te Hiku/Dragonfly	Caleb Moses	Shaun Hendy	AKL
Megan Leijh	Auckland 2050 – He waka eke noa	Ngāti Whātua Orākei	Michael Steedman	Kate Hannah	AKL
Brianne Halbert	Auckland 2050 – He waka eke noa	Ngāti Whātua Orākei	Michael Steedman	Kate Hannah	AKL
Mia Biggs	Develop an environmental sustainability dashboard	Ministry of Business, Innovation & Employment	Antony Kennedy	Izi Sin	WGTN
Lingyu Li	International visitor survey analysis	Ministry of Business, Innovation & Employment	Antony Kennedy	Izi Sin	WGTN
Sujay Suresh	Self-service information portal	ACC	Erica Voss	Izi Sin	WGTN
Romalee Amolic	Social network analysis of the biosecurity tourism landscape in New Zealand	AgResearch	Helen Percy	Troy Baisden	HMTN
Meremaihi (Sharleen) Mahutoto	Data science and social network analysis – Whakapakari ake i te waka kia pae ki uta	Te Arawa Lakes Trust	Nicki Douglas	Troy Baisden	ROT
Badi James	Automation of sampling error production using R	Stats NZ	Penny Barber	Alex James	WGTN
Jung (John) Park	Creation of a Quality Assurance module	Stats NZ	Sharon Snelgrove	Alex James	WGTN
Rachel Youngson	Investigating administrative data for non-private dwellings	Stats NZ	Tracey Savage	Alex James	CHCH
Michael Hackney	Enhancing our understanding of lived experience with integrated data	Social Investment Agency	Simon Anastasiadis	Suzi Kerr	WGTN
Athira Nair	Enhancing our understanding of lived experience with integrated data	Social Investment Agency	Simon Anastasiadis	Suzi Kerr	WGTN
Ying (Jackie) Excell	Optimal contracting: optimising the spread of risk across building industry contracting	BRANZ	Karla Falloon	Tava Olsen/ Mike O'Sullivan/ Steffen Lippert	AKL
Jack Skerman	Optimal contracting: optimising the spread of risk across building industry contracting	BRANZ	Karla Falloon	Tava Olsen/ Mike O'Sullivan/ Steffen Lippert	AKL
Chen (Ella) Liang	Optimal contracting: optimising the spread of risk across building industry contracting	BRANZ	Karla Falloon	Tava Olsen/ Mike O'Sullivan/ Steffen Lippert	AKL
Jiachen (Rebecca) Cui	Optimal contracting: optimising the spread of risk across building industry contracting	BRANZ	Karla Falloon	Tava Olsen/ Mike O'Sullivan/ Steffen Lippert	AKL