

Te Pūnaha Matatini
Complexity is at our heart

Annual Report 2022



Īhahā!

Ko te reo o Te Pūnaha Matatini e tūpapahū nei
Ki Te Ōwī, ki Te Ōwā –
Ka haruru; ka ngatoro;
He oro tī! He oro tā!
He oro kōkō e pāoro nei
Ki runga ki ngā iwi
O te motu whānui, o te ao nui tonu.

He kōingo ki te pono, he minaka ki te tika,
He karanga ki te rangahau; he raranga i te hauhū.
Te ngākau o Te Iti kia ngiha;
Te mahara o Te Rahi me mura –
“Ko te mauri o te raraunga ko ngā kōrero i tuku iho!”

Tihei Mauri Ora!

The voice of 'Te Pūnaha Matatini' resounds
Across the peaks of Te Owi and Te Owa
Reverberating, broadcasting, echoing near and far
A sweet voice indeed, playing amongst the people
Of this land, across the globe.

Desirous of the truth, of justice
Calling for research, weaving the findings
That will light up the hearts of the humble
That will bring a fire to the minds of the proud –
“Stories are data with soul!”

Tihei Mauri Ora!

A Centre of Research Excellence hosted by the University of Auckland



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About us



Complexity is at our heart

**We build community across disciplines
to solve complex problems.**

Te Pūnaha Matatini – the meeting place of many faces – is the Aotearoa New Zealand Centre of Research Excellence for complex systems. We are funded by the Tertiary Education Commission and hosted by the University of Auckland. We bring together researchers from tertiary institutions, government institutes, private sector organisations and marae communities from throughout Aotearoa New Zealand.

We apply inter- and transdisciplinary approaches to address the most complex and critical issues of our time.

Our strategy is to transform the research system in Aotearoa New Zealand by embedding a strong foundation of values that permeates the work that we do on complex systems. We train ethical, collaborative researchers that work with complex data across diverse sectors.

Te Pūnaha Matatini provides a safe place for researchers to grow and develop.

Ko te matatini-tanga hei iho

Ko tā mātou he whakatupu hapori i ngā pekanga mātauranga hei rongoa i ngā raru matatini.

Ko Te Pūnaha Matatini, arā, ko te kāpunipunitanga o ngā tini mata – ko te whare o te rangahau kounga o Aotearoa mō ngā pūnaha matatini. He mea tautoko mātou, ā-pūtea nei, e Te Amorangi Mātauranga Matua, he mea whakaruruhau anō hoki e Waipapa Taumata Rau. Ko tā mātou he whakakotahi mai i ngā kairangahau nō ngā whare wānanga, nō ngā tari kāwanatanga, nō ngā whaka-haere nō te rāngai tūmataiti, nō ngā hapori nō ngā marae puta noa i Aotearoa anō hoki.

Ka whāia e mātou ngā ara mahi ngātahi, whakawhitiwhiti anō hoki i waenga i ngā pekanga mātauranga, kia aro atu ai ki ngā take matatini katoa, ki ngā take whai tikanga katoa hoki o te wā.

Ko tā mātou rautaki ko te panoni i te pūnaha rangahau i Aotearoa mā te whakaū i ētahi uaratanga pakari hei tūāpapa mō ā mātou mahi e hāngai ana ki ngā pūnaha matatini. Ka whakangungua e mātou he kairangahau matatika, e waia ana ki te mahi tahi, ka mahi hoki ki ngā momo raraunga matatini puta noa i ngā rāngai kanorau.

Ko tā Te Pūnaha Matatini he whakarite kāinga haumaruru e whanake ai a ngāi kairangahau.

Our values

Manaakitanga

Reciprocal care for others and recognition and return of mana in relationships

Tika

Doing the right and proper thing

Tapu

Ethical behaviour that acknowledges the intrinsic and sacred value of each and every person and thing

Pono

Truth, genuineness and ethical behaviours

Te kawau mārō

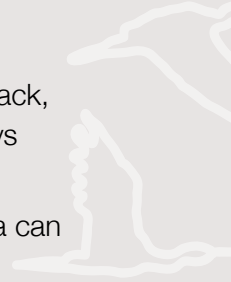


Complexity science enables new ways of seeing and understanding the world.

When birds flock for flight, they move from an individual state to a highly ordered structure that enables them to move together, aiding their collective journey. The kawau, or shag, extends its neck as it prepares to dive. Maniapoto's military strategy — te kawau mārō — is based on coordinated collective action that punches through existing barriers to create beneficial new outcomes.

In reducing the world to its constituent parts, the traditional frameworks of our universities and national research institutes fail to describe how people, the economy, and the environment can, do and must relate to each other. The key features of complexity science — connections, feedback, attractors, intervention points, critical transitions, and emergence — all offer new, innovative ways of tackling societal problems.

The flight of the kawau reveals how seeing and understanding the structures behind phenomena can bring unexpected insights.



Kia mau ki tēnā

Kia mau ki te kawau mārō

Whanake ake! Whanake ake!

Stick to that, the straight-flying cormorant!

– Maniapoto

Mā te rangahau matatini e hua ai he tirohanga hou, he māramatanga hou anō ki te ao.

Ka apū haere ana te rere a te manu, ka huri te āhua o te whakarite - nāwai i takitahi te āhua, ka kuhu kē ki tētahi rāngai kua āta whakaraupapatia, e tapatahi ai te rere, e ngāwari ake anō ai te haere ngātahi. Ka whātaimai te kawau, nōna e whakarite ana ki te ruku. Hei tūāpapa mō te rautaki pakanga a Maniapoto ko te koke ngātahi kia turakina ai ngā tauārai, e puta ai ko ētahi painga hou e whaihua ana.

I te āhua o te āta wāwāhitia o te ao hei wāhi motuhake, kāore e oti i ngā anga whakahaere auraki o ō tātou whare wānanga me ngā whare rangahau ā-motu te āta whakaahua i te āhua e honohono nei te tangata, te ōhanga me te taiao ki a rātou anō, me te tika o te pērā. Ko ngā āhuatanga matua o te pūtaiao matatini - arā, ko ngā hononga, ngā whakahokinga, ngā wāhi whārite, ngā wāhi panoni, ngā whakawhitinga whai tikanga nui, me te mahi ngātahi – hei huarahi hou, hei huarahi auaha anō hei rongoā i ngā raru ā-pāpori.

Ko tā te rere a te kawau e whakatauiria mai ana, mā te aro, mā te whai māramatanga anō ki te hanga o tētahi momo āhuatanga, e kitea ai pea he māramatanga kāore i whakapaetia.



Director's report

Kia mau ki tēnā, kia mau ki te kawau mārō

Hold fast to that, hold fast to the swoop of the shag

In 2022, Te Pūnaha Matatini set our sights firmly on charting a new collective direction, and strengthening the relationships between our investigators, whānau and communities. With an overarching goal of building complex systems and interdisciplinary expertise, we have grown opportunities for students and investigators alike.

We have launched research projects that speak to issues such as climate change, the health of biodiversity, and social equity, as well as examining the tools of complex systems. The three Communities of Inquiry (COIs) that are woven into the heart of Te Pūnaha Matatini have hosted workshops and seminars for our research community, and highlighted the benefits of reflective practice.

Many of our investigators have also contributed to the development of critical thinking, with exciting initiatives such as the launch of Maths Craft in a Box for teachers and secondary students, the first edition of which was fully subscribed within 36 hours.

Our values of tika, pono, tapu and manaakitanga have helped us to steer our course. We provided Covid-19 guidance on our website to assist all those holding in-person meetings to do so safely. We cared for our students through actions like the provision of free vaccinations. Our flagship internship programme returned, but in a format that encourages pastoral care and the teaching of interns where they are at, rather than where we desire them to be.

There are increasing conversations on topics where Te Pūnaha Matatini leaders have made long term contributions, from data sovereignty to the building of an equitable research system. In 2022, we extended this work by providing quantitative data to inform the Ministry of Business, Innovation and Employment's white paper Te Ara Paerangi, and the transformation of the research system through an evidence-based lens.

In all of our endeavours, our goal is to lead with care for people, keeping complexity at our heart and acknowledging the many in achieving our goals. In so doing, we as the kawau take flight and are best able to find our way.

Ngā manaakitanga,

Associate Professor Priscilla Wehi
Director, Te Pūnaha Matatini



Board Chair's report

The new iteration of Te Pūnaha Matatini is making good progress after a challenging first six months in the second half of 2021. This progress is, in no small part, due to the sustained efforts and hard work of Director Associate Professor Priscilla Wehi, Deputy Director Associate Professor Michael O'Sullivan, and the senior leadership they have appointed to help them. The advisory board joins me in thanking you all for your efforts.

This report illustrates the breadth and diversity of Te Pūnaha Matatini's research and its complexity – especially with increasingly large datasets. You will note Te Pūnaha Matatini's stance on ethical behaviour, and their approach that combines people, their knowledge, their research, and the transdisciplinary approach. The diversity of research is illustrated by the activities of the Observatory, whose topics of investigation are described as “explosive”. Knowing what they are doing I must agree.

I would like to highlight Maths Craft, led by Principal Investigators Dr Jeanette McLeod and Dr Phillip Wilson. Jeanette and Phil have made an excellent contribution to Te Pūnaha Matatini with Maths Craft over many years and this year I was particularly interested in the impact they are making on students throughout Aotearoa New Zealand with Maths Craft in a Box.

My thanks on behalf of the advisory board to the outgoing chair of TPM Whānau, Neil Birrell, for his efforts over 2022. TPM Whānau now has 233 members. Well done!

2022 was Professor Jim Metson's last year on the advisory board, and I would like to thank him for his advice and guidance over a number of years. I would also like to recognise the contribution of Peter-Lucas Jones, who stepped down in the second half of 2022. Peter brought many thoughtful contributions to our discussions, which pushed us to think more deeply. We also welcome Professor Frank Bloomfield, the new Deputy Vice Chancellor (Research) for the University of Auckland, who has replaced Jim Metson on the advisory board.

Finally I would like to acknowledge and thank our headquarters team, led by Kathryn Morgan. They are an essential behind-the-scenes component in the progress Te Pūnaha Matatini has made in 2022 – quick to respond to requests, efficient, and respected. Our thanks to you Kathryn and your team.

Richard Aitken
Consulting engineer (retired)
Advisory Board Chair, Te Pūnaha Matatini

TPM Whānau report

Written by outgoing TPM Whānau Chair Neil Birrell.

2022 was an exciting and eventful year for TPM Whānau, the early career researcher network in Te Pūnaha Matatini. We added a further 31 members in 2022, bringing our network to 233. The highlight of the year was resuming in-person events following the disruptions of the pandemic. This included our annual retreat, the annual hui, and our writing retreat.

Our first event in 2022 was our annual retreat, where 19 of us stayed at Motu Moana Camp in Blockhouse Bay. This retreat created space to share knowledge and skills, listen to invited speakers, bond over kai, and socialise.

We shared kai with Te Pūnaha Matatini Deputy Director Dr Michael O'Sullivan, had a workshop by Greg Holwell on academic writing skills, a panel on career paths chaired by Dr Kyle Higham, a research skills market, a talk on community engagement with Ben Jones and Patricia Pillay, a workshop on mentoring chaired by Bethany Cox and Ngaio Balfour, a network analysis of TPM Whānau members attending the retreat by Giorgia Vattiato and Ellen Hume, a talk on social media branding by Victoria Agyepong, a talk by Dr Emily Kendall and Professor Richard Easter on their Covid-19 work, and a talk by Professor Pejman Rohani on early warning systems for infectious diseases.

Following our retreat, a large cohort of TPM Whānau members also attended the annual hui, where we had the chance to learn about each other's research, talk with principal investigators, and hear more about the future direction of Te Pūnaha Matatini. A highlight of the annual hui was having five current and past chairs of TPM Whānau in attendance.

In November, we held our writing retreat at the University of Auckland's Leigh Marine Laboratory. This was a weekend to spend writing without distraction in a relaxing location, with colleagues in similar stages of writing up articles or thesis chapters.

Covid-19 once again played a large part in our lives in 2022. We started off the year with the uncertainty and anxiety of the Omicron variant arriving, the change in alert settings and the realisation that Omicron was here to stay. During this time we supplied P2 masks and flu vaccination vouchers to TPM Whānau members who needed them, and helped members who needed assistance getting groceries when isolating.

We also created a detailed plan outlining exactly how our events would be run to minimise the risk of Covid-19 and what would happen if someone tested positive for Covid-19. This was based on the guidance shared by Te Pūnaha Matatini, and helped attendees to feel safe and informed when attending our events.

Finally, we had a record number of applications to join the committee for 2023, with nine applicants. This has allowed us to expand the size of the committee, establishing an extra committee member position and an event coordinator role. I am very excited to see what we achieve next year, with the leadership of an incredibly talented and compassionate team led by Aisling Rayne.



Te Pūnaha Matatini Whānau 2022



Te Pūnaha Matatini Whānau Committee 2022

Chair: Neil Birrell

Vice Chair: Rae Rho

Immediate Past Chair: Giorgia Vattiato

Secretary: Aisling Rayne

Treasurer: Henry Morse

Communications Officer: Patricia Pillay

Committee Member: Reju Sam John

Communities of Inquiry

Communities of Inquiry (COI) are the central threads that weave through all the work we do at Te Pūnaha Matatini.

Our three COIs provide leadership and community around key practices that are fundamental for research at Te Pūnaha Matatini. They weave people and knowledges together, lead by example, and create space for bold and transformative ideas to grow.



Complexity COI

The Complexity COI provides leadership in the development and application of complex systems methods. It aims to empower investigators and students to work collaboratively and ethically on big data, including national databases, and the modelling and analysis of complex systems in a diverse range of applications and contexts.

Leadership:

- Associate Professor Ilze Ziedins
- Professor Michael Plank
- Dr Matthew Parry

Culture of Research Excellence COI

The Culture of Research Excellence COI grows a culture of research excellence by supporting inclusive, interdisciplinary research teams, that acknowledge tangata whenua, the aspirations and needs of communities, and that demonstrate theoretical rigour to nurture and innovate ideas from inception to publication.

Leadership:

- Associate Professor Krushil Watene
- Associate Professor Tammy Steeves
- Victoria Agyepong

Engagement COI

The Engagement COI is an opportunity for anyone involved in Te Pūnaha Matatini to connect with others who are interested in communication and engagement – be that sharing experiences, learning new skills, getting involved in hands-on activities, developing new ideas or simply meeting like-minded people. Supported by a vibrant core of Te Pūnaha Matatini energy, we also hope to enable those who want to become champions, knowledge-holders and agents for engagement activities within their own Te Pūnaha Matatini projects, research groups and home institutions.

Leadership:

- Associate Professor Rhian Salmon
- Dr Daniel Hikuroa
- Mckayla Holloway

Engagement Incubator

The Engagement Incubator is a key part of the structure of Te Pūnaha Matatini that supports researchers to embed engagement from the start of their projects.

The Engagement Incubator:

- Develops pathways that enable Te Pūnaha Matatini researchers and research projects to be engaged with the ethical, socio-political, cultural, economic, and environmental contexts of the proposed research, and appropriate tools for respectful engagement with Te Tiriti o Waitangi partners, communities, and stakeholders.
- Creates opportunities for stimulating ideas and providing training in research engagement and impact, including engagement to inform policy-making and engagement with communities.
- Provides a safe space to interrogate and catalyse critical conversations about the practice of research, including topics such as data ethics, open science, engagement with Māori and Pacific communities, and being self-critical about equity, diversity, inclusion and access in our workplaces.

People:

- Associate Professor Rhian Salmon
- Jo Bailey



The Observatory

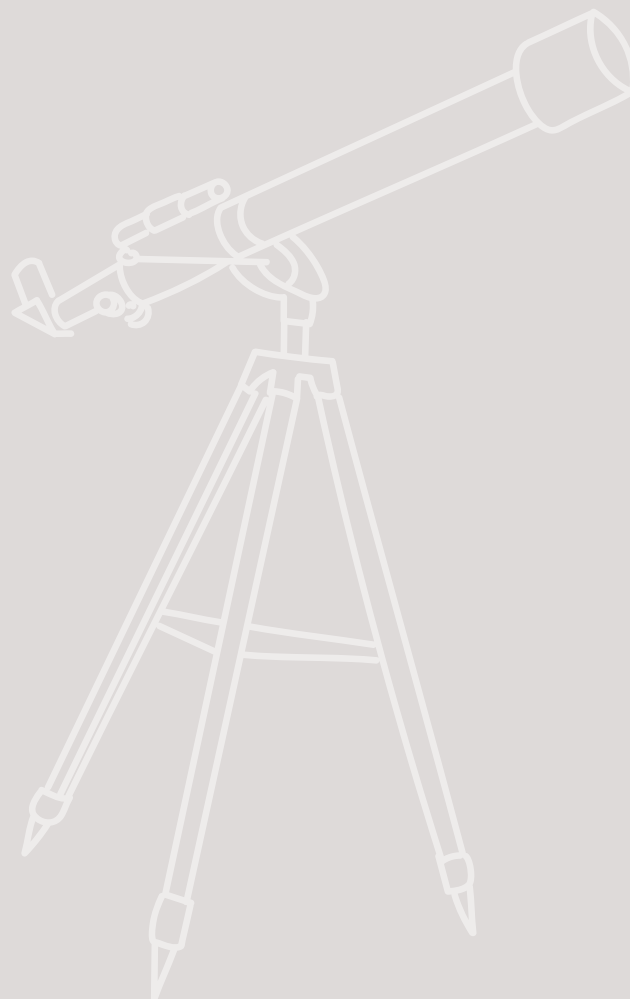
The Observatory is a small yet pivotal feature of the structure of Te Pūnaha Matatini that finds ‘explosive’ issues growing toward tipping points where Te Pūnaha Matatini can shape positive transformation.

Aotearoa New Zealand, and the world, face critical challenges which are interconnected and complex. Best practice decision-making relies on responsive, reflexive, contextualised and relevant evidence-based research which is accessible to all decision-makers.

The Observatory scans the horizon and gathers information about new and upcoming likely intervention points with a focus on emerging issues for Aotearoa New Zealand where complex systems research can create meaningful impact.

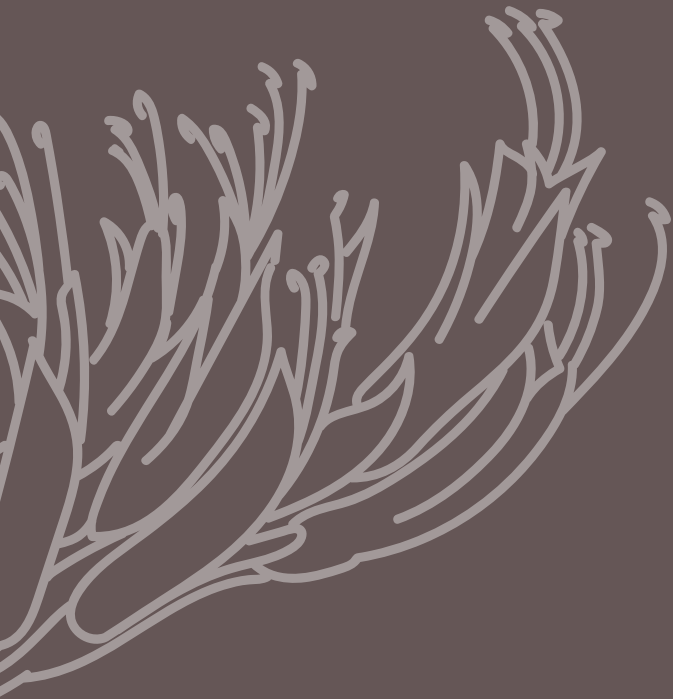
People:

– Professor Troy Baisden





Our research



Impact areas

Our core research projects for 2021–24 are organised into four interrelated impact areas, which relate to the United Nations Sustainable Development Goals.

Our changing climate

Projects which explore the links between climate change impacts, mitigations, and civil society, from anthropogenic impacts in Antarctica, to rivers as testcase ecosystems for mitigation approaches, and Aotearoa New Zealand's unique braided rivers in social and environmental decision-making. These connected projects tease out the complex relationships between governmental and inter-governmental policy, environmental flourishing, and human approaches to environments, using complex systems models and methods to examine these data.



Achieving sustainable and resilient river ecosystems in Aotearoa under climate change

Leveraging data and models to identify solutions to increase the resilience of river ecosystems to uncertain futures both nationally and globally.

Dr Jonathan Tonkin (Project Lead) | Associate Professor Michael Plank | Dr Audrey Lustig | Dr Andrea Tabi



Braided rivers: The land the law forgot

Integrating legal, economic, social, and cultural factors into the well-established models of the topology of braided rivers, along with models of climatic uncertainty to better understand these unique landscape features.

Professor Ann Brower (Project Lead) | Dr Audrey Lustig | Renate Vosloo | Connor Fraher | Aimee Calkin



Human activity in the McMurdo Dry Valleys. Rescue, knowledge and understanding our role as a vector of change

Accessing, rescuing, and analysing the vast range of (mostly hidden) historical information about human activities in this geographically and scientifically distinctive region.

Dr Fraser Morgan (Project Lead) | Associate Professor Rebecca Priestley | Dr Pierre Roudier | Associate Professor Claire Postlethwaite | Professor Thegn Ladefoged | Associate Professor Priscilla Wehi | Kristin Wilson

Building a just and equitable society

Projects ranging from evaluating the effectiveness of researchers' impact on policy, to culturally safe primary healthcare delivery, the revitalisation of te reo Māori, and the impact of the distrust of science. These interlinked projects provide the underpinning to utilising complex systems approaches in order to build a more just civil society.



Ebbs and flows of knowledge and influence across the science-policy interface

Studying the influence of scientific research on science policy, and the influence of science policy on scientific research, in Aotearoa New Zealand.

Dr Kyle Higham (Project Lead) | Dr Mubashir Qasim | Professor Troy Baisden



Te ara o te reo Māori The trajectory of the Maori language

Collating, analysing and transforming data on te reo Māori into an assessment of the current and future trajectory of the language.

Dr Rachael Ka'ai-Mahuta (Project Co-lead) | Professor Michael Plank (Project Co-lead) | Professor Alex James | Professor Murray Cox



Ngā ara hou ki te ora New pathways to wellbeing

Modelling healthcare delivery and optimising for wellbeing, justice, equity and efficiency.

Associate Professor Ilze Ziedins (Project Lead) | Associate Professor Krushil Watene | Associate Professor Cameron Walker | Dr Marama Muru-Lanning | Dr Michael O'Sullivan | Professor Tava Olsen



Science, statistics and the media

Investigating how particular communities in Aotearoa New Zealand use the language, markers and tools of science and technology to promote non-credible scientific and social scientific claims.

Associate Professor Rebecca Priestley (Co-lead) | Professor Richard Arnold (Co-lead)

Better models and methods

Projects which focus on developing better, more transparent and equitable algorithms, exploring the mathematical roots of emergence and investigating network structure in multilayer networks, with real world applications. These projects collectively develop and test new complex systems methods and models.



Evolutionary game theory of Bellman agents

Investigating the origin of cooperation using evolutionary game theory.

Associate Professor Marcus Fread (Project Lead) | Dr Chrissie Painting | Professor Stephen Marsland



Spreading processes on (multilayer and multiplex) networks

Understanding how the outcomes of spreading processes on real-world networks are affected by the multilayer and multiplex network structures and by different network topologies.

Associate Professor Claire Postlethwaite (Project Co-lead) | Dr Dion O'Neale (Project Co-lead) | Dr Emily Harvey



Kindness in Science

Developing a culture of inclusion which sustains the robust discourse essential for science but does not come at the expense of the dignity of those who participate.

Associate Professor Tammy Steeves (Project Lead) | Dr Emma Sharp | Dr Leilani Walker | Dr Kirsten Locke | Dr Shaun Hendy | Associate Professor Priscilla Wehi | Associate Professor Anna Matheson | Dr Aisling Rayne | Bethany Cox



Maths Craft in a Box

Making maths accessible in new ways to support the vital work of maths teachers across the country.

Dr Jeanette McLeod (Project Lead) | Dr Phillip Wilson | Jo Bailey | Dr David Pomeroy



The Co-production Project

Developing knowledge of co-production in order to improve use of this method in an Aotearoa New Zealand setting.

Professor Anna Brown (Project Lead) | Associate Professor Faith Kane | Associate Professor Siouxsie Wiles | Associate Professor Rhian Salmon | Jo Bailey | Linda Baxter | Anjuli Muller

Human and environmental health and wellbeing

A collection of projects which focuses on balancing the demands and rights of human society and the environment. Examining economic benefits of the nature of knowledge flows, through to systems mapping to understand the relationships between human and environmental health, this impact area reviews archaeological data about land management and use through a mātauranga (Indigenous knowledge) lens and develops artificial intelligence methods to improve Aotearoa New Zealand's bioprotection.



Ki te toi o te ora: System change to reverse health inequality and environmental degradation

Creating a system-wide map to identify effective levers for systems change in the interrelated complex systems reproducing health inequalities and environmental degradation.

Dr Anna Matheson (Project Co-lead) | Professor Troy Baisden (Project Co-lead) | Dr Daniel Hikuroa | Dr Dion O'Neale | Professor David Hayman | Associate Professor Krushil Watene | Dr Lynn Riggs | Dr Rachael Ka'ai-Mahuta



Kaitiakitanga and the ecodynamics of early Māori horticulture

Investigating how Māori drew on the knowledge of the founding Polynesian ancestors and developed unique perspectives and practices in response to the Ahuahu Great Mercury Island landscape.

Professor Thegn Ladefoged (Project Lead) | Dr Pierre Roudier | Dr Daniel Hikuroa | Professor Melinda Allen | Dr Rebecca Phillipps | Dr Matiu Prebble | Associate Professor Priscilla Wehi | Associate Professor Tom Roa | Dr Emily Harvey | Alex Queenin



Networks of knowledge sharing

Understanding the driving forces of knowledge propagation through communities and to investigate whether aspects of this process can shine light on quality and/or value associated with certain items of knowledge.

Professor Uli Zuelicke (Project Lead) | Professor Jens Dietrich | Dr Kyle Higham | Dr Adam Jaffe | Professor Les Oxley | Dr Hēmi Whaanga | Dr Shaun Hendy | Dr Mubashir Qasim | Professor Michele Governale | Robert O'Brien | Dr Izi Sin | Tipene Merritt



Towards a better understanding of artificial intelligence and its interaction with its environment

Developing new tools to both understand the consequences of interactions between artificial intelligence (AI) and the systems they purport to study.

Dr William Godsoe (Project Co-lead) | Associate Professor Claire Postlethwaite (Project Co-lead) | Dr Emma Sharp | Victoria Agyepong

Clusters

Clusters bring researchers at Te Pūnaha Matatini together over shared interests and ideas

Climate Change

A group of Te Pūnaha Matatini investigators and TPM Whānau is working on climate change impacts, mitigation and adaptation across social and ecological spaces.

Climate change is one of the biggest challenges facing the planet. This cluster will bring together researchers from across Te Pūnaha Matatini to work across fields of expertise to make a real and measurable difference to understanding climate change impacts and find solutions. We will support research development processes and facilitate knowledge transfer. We aim to be inclusive and welcome input from all members of Te Pūnaha Matatini.

Coordinators: Associate Professor Cate Macinnis-Ng, Professor Adrian McDonald

Aotearoa Food Futures

Bringing together people with broad interests in food systems, including food production, distribution, consumption and their complex relationships.

Our transdisciplinary research cluster examines complex relationships with and within food systems – inclusive of food production, distribution, and consumption. Recognising diverse understandings of the role and value of food, our food systems community draws on local and global knowledge to chart just and resilient food futures for Aotearoa New Zealand. Incorporating socio-cultural, environmental, economic, as well as political and scientific imperatives, we bring together people with interests in food security and food sovereignty to address a range of complex food-related challenges related to social and environmental justice including poverty, climate change, and resource use.

Coordinators: Dr Aisling Rayne, Dr Emma Sharp

Healthcare

Using complex systems modelling to understand and improve healthcare systems.

Health and wellbeing are fundamental to both individuals and society. The systems that provide support and deliver care for both health and wellbeing are complex and overburdened. This cluster will provide complexity science approaches that are qualitative, quantitative and a hybrid of both to better understand, model and improve healthcare systems.

Coordinators: Associate Professor Ilze Ziedins, Dr Tom Adams

Storytelling

Building capacity within Te Pūnaha Matatini to tell interesting, expansive, creative and articulate stories using different modes of communication.

Storytelling is an important way to connect our research with multiple audiences! Early opportunities to practise storytelling have been crucial in the careers of science communicators like Associate Professor Siouxsie Wiles and Dr Shaun Hendy, and the storytelling cluster aims to provide a safe space for Te Pūnaha Matatini investigators and TPM Whānau to develop this skill.

Coordinators: Professor Anna Brown, Jonathan Burgess

Seed funding

Te Pūnaha Matatini provides seed funding to start new research projects, to run research-related hui or workshops, or for support of publication and dissemination of research. Individuals or small groups from Te Pūnaha Matatini, including TPM Whānau, can apply. Applications for seed funding are reviewed quarterly at the Strategic Leadership Group meetings.

In 2022, Te Pūnaha Matatini awarded seed funding of \$325,404 to ten initiatives.

Collective Actions | \$30,000

David Kelley, Krushil Watene, Michael O'Sullivan

Funding to support David Kelley in postdoctoral research on the kinds of collectives formed by individuals, in order to better understand the role of individuals and groups in the crises we collectively face.

Trees + Climate + People | \$48,260

Cate Macinnis-Ng, Vicky Gane, Katerina French Armstrong, Rhian Salmon, Jo Bailey, Watene Kaihau

Funding to disseminate the information generated by the Trees+Climate+People project through publications, communications and engagement with the wider community. This project explores the ecological and cultural benefits of tree planting, as well as the practical realities, challenges, benefits and complexities of cross-disciplinary and cross-institutional collaboration, genuine community engagement, and integration of kaupapa Māori throughout both the science and design components.

Presentation of two working papers | \$10,000

Mubashir Qasim, Kyle Higham

Funding for Mubashir Qasim and Kyle Higham to present working papers on the links between sustainability and wellbeing at an international conference, and cover manuscript submission and publication fees.

The land the law forgot | \$38,800

Ann Brower, Alex James, Fraser Morgan, Audrey Lustig, Rhian Salmon, John Page, John Reid, Tom Wilson, Dave Frame

Funding to support Connor Fraher to upgrade from a masters project to a PhD on the 'Braided rivers: The land the law forgot' project.

Tales of Diversity | \$124,276

Michael O'Sullivan, Kirsten Locke

Funding for Tony Nemaia to continue from his masters project on 'Tales of Diversity' into a Doctor of Education project.

Deconstructing the role of disturbance and species traits in determining trophic cascade strength | \$7,200

Jonathan Tonkin, Anne McLeod, Jack Anderson

Funding to support a summer student to tease out temporal drivers of trophic cascade strengths in a disturbance prone ecosystem with the particular goal of determining how the tradeoffs between morphological defences and disturbance vulnerability interact and contribute to food web resilience.

Eyes in the sky: towards smarter detection of archaeological features using LiDAR | \$23,248

Thegn Ladefoged, Pierre Roudier, Ben Jolly

Funding for the use of LiDAR to complement the 'Kaitiakitanga and the ecodynamics of early Māori horticulture' project. This will begin to create an island-wide documentation of early Māori occupation and gardening on Ahuahu and Whakau. This will provide a greater understanding of Māori land-use, knowledge that will hopefully be of significance to mana whenua and others. The research will also create high precision and ground truthed base-line geographical data for interweaving with both heritage protection and cultural ecosystem restoration.

Masters student on the Coproduction Project | \$11,000

Anna Brown, Faith Kane, Siouxsie Wiles, Rhian Salmon, Jo Bailey, Anjuli Muller, Linda Baxter

Funding to support Eleanor McGeachie (Ngāti Tumutumu) to do her Master of Design on the Coproduction Project, focusing on Indigenous design approaches to explore the experiences of wāhine Māori in the areas of women's health and reproductive health.

Large-scale and long-term restoration for mid to late successional forest species | \$6,420

Henry Morse

Funding for travel and a research assistant for Henry Morse's PhD fieldwork, looking at how landscape content, configuration, and connectivity impacts the regeneration of complex plant communities at planted forest restoration sites.

Supporting resilience to climate extremes | \$26,200

Adrian McDonald, Cate Macinnis-Ng, Jonathan Tonkin, William Godsoe

Funding for a masters student to develop open source extreme precipitation datasets over Aotearoa New Zealand and connecting them to ecological datasets to quantify ecosystem vulnerability.

Sponsorship

Te Pūnaha Matatini sponsored two events in 2022:

- Government Economics Network Annual Conference, \$2,500
- Two screenings of 'Juliet Gerrard: Science in Dark Times' by the Association for Women in the Sciences, \$2,500





Our stories

Impact statement

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





Healthy Families NZ is working well, but it's a drop in the bucket

Te Pūnaha Matatini Principal Investigator Associate Professor Anna Matheson leads the team that has released a new report evaluating the Healthy Families NZ initiative.

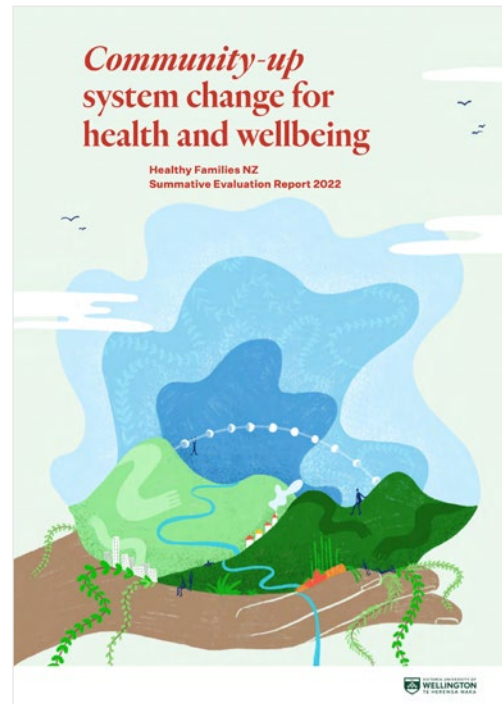
Healthy Families NZ is a large-scale initiative that aims to create a healthier Aotearoa by addressing the systems and environments that impact our health and wellbeing. It was launched in 2014 as a new approach to preventing chronic disease that recognises the importance of a systems change approach.

This initiative is happening in 10 different place-based communities around New Zealand, and involves innovative health promotion teams working to improve the way that organisations collaborate together and building on existing health and wellbeing initiatives to make change on the social determinants of health and wellbeing.

Anna, in partnership with Nan Wehipeihana, leads the team that has evaluated Healthy Families NZ throughout its existence. They have just released their fourth report, which focuses on the last four years, from 2017–2021.

The recent phase of the evaluation concluded that Healthy Families NZ is continuing to make successful progress and has remained grounded in integrity to the purposes of the initiative. For the evaluation team, Healthy Families NZ is clearly demonstrating that comprehensive and effective action guided by local voices and local needs to address the determinants of health and wellbeing can be achieved.

Complex systems and thinking about how to change systems is a strong focus of Anna's academic work. She co-leads the core Te Pūnaha Matatini research project 'Ki te toi o te ora: System change to reverse health inequality and environmental degradation'. This academic background makes her perfectly placed to undertake this evaluation work. "Healthy Families NZ frames itself as a systems change initiative," she says. "It's trying to shift the systems that operate locally, and influence the wider systems that impact local stuff."



Above left: Associate Professor Anna Matheson. Above right: The beautifully designed report evaluating Healthy Families NZ.

The team took a complex systems approach to evaluating the initiative, which considered the different communities involved and their different contexts, and asked what was working for who, where, when and how. Healthy Families NZ is a complicated initiative to understand, so Anna engaged another Te Pūnaha Matatini Principal Investigator, Professor Anna Brown, and the Toi Āria team to design the report.

The published report uses each community as a case study, drawing upon data such as interviews, surveys and demographic data, but also asking the communities themselves to explain their successes in their own words. The team then used these quantitative and qualitative sources to explore the six key evaluation questions that Te Whatu Ora – Health New Zealand wanted answered for the report.

Overall, Healthy Families is “working well, but it’s a drop in the bucket!” says Anna. “Very little of the budget for health in New Zealand gets spent on trying to prevent disease and address the social determinants that we know are the main causes of inequities and poorer health outcomes.”

“Healthy Families NZ is a comparatively small investment, but the potential for it to make a huge difference down the track is significant, including saving the healthcare system money in terms of treatment for things like chronic diseases.”

She hopes that the report clearly articulates what Healthy Families NZ does, so that good policy decisions can be made from it.

<https://www.tewhatauora.govt.nz/publications/community-up-system-change-for-health-and-wellbeing/>



Environmental engineering in early taro and kūmara cultivation

Field work is archaeologist Alex Queenin's happy place. At the moment, she's finding that happy place on Ahuahu Great Mercury Island, an island off the west coast of Coromandel.

An archaeological investigation has been running on Ahuahu since 2011, exploring some of the earliest sites of human habitation in Aotearoa New Zealand. A group of Te Pūnaha Matatini investigators are working with data from these sites to explore how Māori learned to live in Aotearoa after their arrival from Polynesia.

The current environmental crisis demands a better understanding of human relationships with the environment. While the overuse of resources by humans is a common pattern throughout history and today, there is limited understanding of Indigenous land use management practises outside Indigenous communities.

Te Pūnaha Matatini investigators are working to better understand the long-term dynamics of complex human-environment interactions through the lens of Aotearoa's first people. This research has special significance for Ngāti Hei, the tangata whenua of Ahuahu, and Te Arawa, Tainui, Horouta and Paikea waka who have traditional links to the island.

This research into the origins and development of Māori kaitiakitanga and tikanga elucidates how Aotearoa kaitiakitanga might further develop in the changing world in which we now find ourselves, where anthropogenic activities are leading to critical environmental degradation.

For her PhD project, Alex is working to reconstruct human-environment interactions on Ahuahu. She is looking at how paleoenvironmental evidence can inform archaeological interpretations of both settlement and horticulture by studying sediment from the island.

On Ahuahu, she is collecting and analysing sediment cores from catchments adjacent to archaeological sites. Alex uses geochemical techniques like x-ray fluorescence and physical techniques like magnetic susceptibility to understand more about human activity on the island.



“You don’t always get all the information from the archaeological sites,” explains Alex. “For example, when people first got to Aotearoa from Polynesia, you get a bit of initial occupation at archaeological sites and then generally a burn off of the forest to start agriculture. This created charcoal that was mixed into soils to grow taro and kūmara.”

“Not a lot of that evidence survives in archaeological sites, but you get big sediment deposits in adjacent catchments after the burn off.” This is proxy evidence of human behaviour. “Because the forest cover has been removed, you’ll then get detrital indicators showing that soils started to erode a lot quicker after the burn off.”

Evidence like this allows archaeologists to understand more about interactions between humans and the environment. “People had to do some very specific environmental engineering to make horticulture work on these islands,” says Alex.

“Especially on Ahuahu, where the main bedrock is rhyolite, which is not great for gardening. Early Māori had to make suitable soils for gardening by incorporating things like charcoal and shells.” This is known as niche construction, where the intentional and unintentional actions of people result in positive or negative environmental outcomes.

Alex’s work is part of Te Pūnaha Matatini’s core project on kaitiakitanga and the ecodynamics of Māori horticulture, led by Principal Investigator Professor Thegn Ladefoged. This project draws on the strength of Te Pūnaha Matatini’s interdisciplinary approach, with archaeologists collaborating with soil scientists, mātauranga Māori experts, and mathematical modellers to better understand the long-term dynamics of complex human-environment interactions through the lens of Aotearoa’s first people.

For Alex, working with experts from different disciplines creates a much more detailed understanding of archaeological sites. Archaeology is an interpretive discipline, and using modelling and different lines of multi-proxy evidence creates different ways of looking at the landscape, strengthening confidence in its interpretations.

Before starting her PhD, Alex was working as a contract archaeologist in cultural resource management. She says that working as a contract archaeologist around the North Island was hard work, but a fulfilling job. “You get to meet a lot of great people, and learn a lot of cool stuff – especially from kaitiaki.”

Even though the field is her happy place, Alex still loves lab work. In the future, she hopes to start her own lab for doing multiproxy analysis in conjunction with people doing archaeological work. But for now she has to focus on getting the balance right for her PhD. “I have to make sure to not stay in the lab all the time,” she says. “I need to do some writing, too.”



Drawing rangatahi into using technology to understand complexity in the environment

It's pretty muddy out at Orangihina. Luckily the volunteers who look after the native plants and animals on this reserve on the Te Ātatu Peninsula had plenty of gumboots for the interns from Rutherford College who they took out to show how they control pests.

Throughout 2022, Te Pūnaha Matatini has supported these Māori and Pacific high school students to explore how they could use technology like drones to improve pest control outcomes in the second largest natural wetland remaining in west Auckland.

Through field trips like this, they were inspired to use technology to better understand the way that elements interact with each other in the complex system of a wetland. Complex systems approaches are essential to understanding the environment, and solving ecological problems.

Orangihina comprises freshwater swamp, estuarine saltmarsh and mangroves. The reserve is home to a significant range of native plant and animal species like copper skink, common copper butterfly, pūkeko, New Zealand dotterel, North Island fernbird, nursery web spider and banded rail.

Dayton, Kea, Joshua and Lincoln were entranced as they squelched through the mud to open up the traps and see if there were any rats inside. On this particular day the traps were empty, so they just needed to fill them back up with a special blend of peanut butter.

The management of these rat traps is a challenge for the Forest and Bird and Community Waitakere volunteers that maintain them. The interns were there to get some hands-on experience in how the traps and tracking tunnels worked, before heading back to school to use engineering, science, mātauranga Māori and problem solving to explore solutions to help.



Left: Interns from Rutherford College learn about how rat traps work in Orangihina.

These were the first interns funded by the Tika Māori and Pacific scholarships, made possible through seed funding from Te Pūnaha Matatini. These scholarships are designed to open up the world of complex systems approaches to rangatahi Māori and Pasifika.

As part of their internship, Dayton, Kea, Joshua and Lincoln ventured through bushy areas, learned computer programming and engineering concepts, and shared pizza lunches.

“Learning about the purpose of the traps in Orangihina and the advancements that were made to better them over the years allowed us to gain an understanding of the capabilities that engineers have in our society,” the interns say. “With our Māori and Pacific population being the minority within engineering and science, it was welcoming to see that our input was wanted to improve the society and environment around us.”

On a later trip to Orangihina, the interns explored the conditions that affected the success of the traps, and mapped their locations using the R programming language. From the results they gathered, they were able to give feedback on the performance of the traps, and make recommendations for improvements. The scratches on their legs from cutty grass and thorns also taught them a valuable lesson in attire that they can use for future field work.

Through the internship experience, the interns say they were able to see the environment as well as engineering in a different light. Exploring a range of theory and practical activities increased their motivation and dedication to their school work, and they appreciated how their Te Pūnaha Matatini mentors guided them in the right direction, and made them feel like a family learning from one another.

“Their positive attitudes along with excessive respect and care for us students allowed us to realise the enjoyment that you are able to get out of work that you enjoy and feel comfortable doing,” say Dayton, Kea, Joshua and Lincoln.

“It was a great experience and we are very grateful to have had the opportunity to use complexity science to improve our native wildlife protection. We can’t wait to see what next year’s interns will achieve!”



An environment where everyone feels like they can do the things they dream about

The first thing that Te Pūnaha Matatini Principal Investigator Associate Professor Markus Luczak-Roesch tells his doctoral students is that they will work together as colleagues. “Often I learn much more from them than they learn from me,” he says.

The thing he enjoys most about his job is “having the chance to allow people to achieve stuff that they couldn’t imagine achieving.”

Markus trained as a computer scientist, and brings his technical skills to a broad range of projects. He has published in information systems, computer science, human-computer interaction, communications, public policy, psychology, sociology, and humanities.

Markus brings unique computational approaches to highly collaborative and co-authored teams to generate new insights into complexity. “I’ve shifted from purely publishing on computer science to publishing on answering bigger questions,” he says.

Markus is supervising eight doctoral students at the moment, across a dizzying array of topics.

One big stream of their work is understanding psychological constructs through language use, based on the theory that values and personality are reflected in how we speak. Markus is collaborating with a team of cross-cultural psychologists who have specific interest in understanding whether the construct of personality is actually stable across cultures, languages and time.

This interest in the construct of personality led Markus back thousands of years, to apply natural language processing to the epic of Gilgamesh. “How do you study the change of human personality if you can’t talk to the people anymore and the historical accounts may be very sparse?” asks Markus. “Ron-

ald Fischer and I used textual artifacts to look at reflections of personality in historical texts like Gilgamesh and the works of Jane Austen and Charles Dickens, as well as contemporary narratives.”

They have also recently turned their attention to exploring ideological bias and possible discrimination in large language models like ChatGPT.

Markus is also supervising a doctoral student working on computational propaganda, exploring how groups with deceptive intents leverage algorithms on platforms to disseminate falsehoods, misinformation or misleading content. Another student is looking at how we contest artificial intelligence.

“How do you disagree with a robot?” asks Markus. “We are facing these issues already, from self-driving cars through to loan decisions made by computers. These are very wide and interdisciplinary topics with links to the human computer interaction and sociotechnical systems worlds.”

Another student is working on Transcendental Information Cascades. Markus describes this as his “life topic”. He created the first version of this method, which aims to capture universal patterns of recurrence within everything. “I don’t want to stretch the metaphor too far, but to me this is my personal big Stephen Hawking-style theory of everything,” he explains. “If we understand all physical and non-physical things in the world as information, such as matter and time, does that information form meaningful patterns as these various physical and non-physical things co-evolve over time?”

His student and TPM Whānau member Béatrice Désy is working on Transcendental Information Cascades as a theoretical physicist, and Markus is learning something new from her every day. “It’s really humbling if someone works on something you invented and then takes that further, and this is the first time that’s ever happened to me on a topic so close to my heart.”

Other students are applying tools like natural language processing to understanding the science-policy interface, and how language influences survey questions.

As a doctoral supervisor, Markus says that he is there “to make the process of them becoming the expert as efficient as it can be for them. I also like breaking stereotypes about who can have a successful research career.”

Completing a PhD was an exhausting experience for Markus. He was the first in his family to achieve a high school education that allowed him to go to university, and felt alienated at university because he had no peers with the same background. “I was surrounded by people who didn’t speak the same language as me, didn’t behave like me, didn’t have the same interests, and didn’t have the same struggles. It was hard work to go through that completely by myself.”

Markus wants to make sure that his students are better supported than he was in facing these challenges. “I want to prepare my students for the systemic things that they will face, so that they don’t have to give in. And at the same time, never have the feeling that they are in the wrong place because of who they are.”

“Putting the science aside, if I can help to create an environment where everyone feels like they can do the things they dream about but don’t quite know how to do it yet, and they can be themselves, that’s what I enjoy the most.”

“We try to live that in our research lab, and we’re rewarded by the people who find us, because it just keeps growing. We meet once a month and we entertain crazy ideas, or we talk about the latest paper we are writing, or just share what is going on in our lives.”

This approach changes lives, as Markus knows from his own experience. “I relate to the transformative potential that knowledge, learning and the right mentorship can have on your life.”



Sharing guidance around keeping people safe from Covid-19 at events

The work of Te Pūnaha Matatini and the wider research community thrives on meeting *kanohi ki te kanohi*, face to face. In 2022, after a long period of event restrictions to reduce the spread of Covid-19, *hui*, symposia, conferences and workshops kicked back into action.

The annual *hui* is the key event in Te Pūnaha Matatini's calendar. In advance of our annual *hui* in July 2022, we put a lot of thought into how to keep our investigators and TPM Whānau safe from Covid-19 at this event.

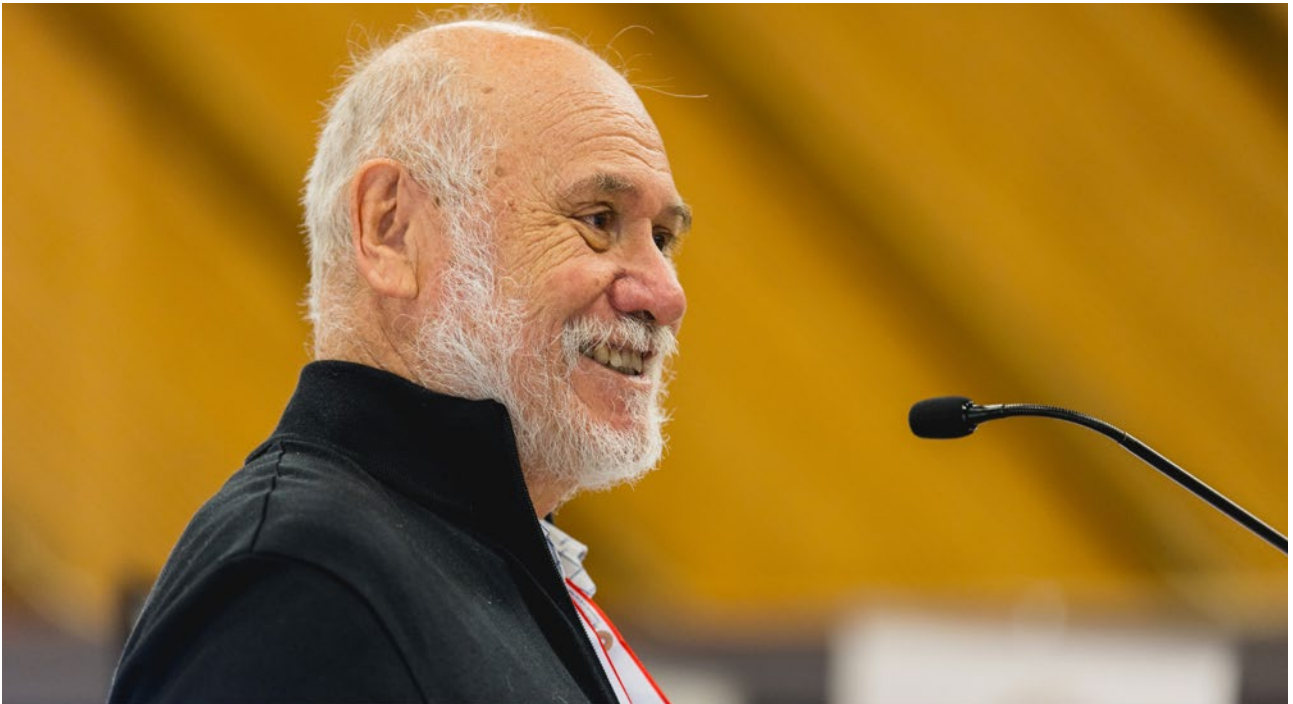
To help our colleagues across the research sector organising conferences and events, we worked with Principal Investigators Dr Emily Harvey, Associate Professor Siouxsie Wiles and Dr Dion O'Neale to put together and share guidance based on what we had learned and used ourselves. We then published guidance to our website to help other people run safer events.

At our annual *hui* we used several evidence-based interventions, like having each participant take a rapid antigen test (RAT) each morning before attending, wearing masks unless speaking or eating, and ensuring good ventilation in the venue that we used.

These protective measures were rolled out across all Te Pūnaha Matatini events in 2022, and there was no spread of Covid-19 at our events. Asymptomatic positive cases were identified by RATs before every event that we held in 2022. Because they were identified in advance, these people were able to isolate and not attend events, and this prevented spread of Covid-19.

The guidance on our website was viewed over 3,000 times during 2022, and was particularly popular around Christmas functions. It was put to use by conferences and institutions like Kiwi PyCon, Nuclear Connections Across Aotearoa, He Pito Mata and the Malaghan Institute of Medical Research.

<https://www.tepunahamatatini.ac.nz/our-values/safe-covid-19-events/>



Laying down the seeds to grow understanding of tikanga in Te Pūnaha Matatini

Te Pūnaha Matatini Kāumatua Associate Professor Tom Roa led a series of four puna kōrero on tikanga in 2022. These were reflective discussion sessions where investigators and early career researchers were able to ask questions and share experiences to grow our collective understanding around tikanga. Tikanga is a Māori concept incorporating practices and values from mātauranga Māori – Māori knowledge. For the first session Tom was joined by Raukura Roa, who offered perspectives as a Tainui woman in te ao Māori. They kicked off with an exploration of the fundamentals of tikanga, and shaped an inclusive and nuanced discussion around the constant negotiation of tikanga.

Te Pūnaha Matatini Principal Investigator Associate Professor Claire Postlethwaite took part in the puna kōrero. Claire is a mathematician, and is interested in how mātauranga Māori fits into the highly theoretical research that she does. “I felt nervous about approaching this topic,” says Claire, “and really appreciated the supportive environment that Tom and Raukura created for us to ask questions about Māori concepts.”

Subsequent sessions headed off into explorations of changes to tikanga in the online world, applying tikanga approaches to the misinformation that was swirling in 2022, and delving deep into the tikanga and complexities of mana whenua and tangata whenua.

Up to 25 Te Pūnaha Matatini investigators and TPM Whānau participated in each of these puna kōrero, bringing their questions, experiences and observations to the discussion.

“I was so humbled to have Tom and Raukura host these puna kōrero for us,” says Te Pūnaha Matatini Director Associate Professor Priscilla Wehi. “I just cannot say how much I value their guidance and having them as part of our whānau.”



Scanning the horizon for climate risks and opportunities

Te Pūnaha Matatini has brought together a cluster of researchers from across Aotearoa to make a real and measurable difference to understanding climate change impacts, and to find solutions.

Climate change is the ultimate complex problem, and developing transdisciplinary approaches that can understand and respond to this complexity is crucial.

“There is an aspect of climate change in the research of many investigators at Te Pūnaha Matatini,” says Principal Investigator Associate Professor Cate Macinnis-Ng, who co-leads the Climate Change Cluster. “We want to connect all that expertise and focus on solutions and outcomes.”

The cluster includes expertise in ecology, business, mathematics, philosophy, human geography, history, science communication, statistics and physics, with members from Aotearoa universities and research facilities.

“Work in climate change is changing very quickly, and a group that has expertise in complexity can make a lot of useful contributions,” says Principal Investigator Professor Troy Baisden.

One of the first actions of the cluster was to undertake an horizon scan to identify and prioritise threats and opportunities from climate change. This process uncovered key, under-discussed topics relevant to climate change in Aotearoa.

Horizon scanning is an established method used by ecologists to identify potential emerging threats. It is a systematic approach to identifying medium- to long-term threats or opportunities that have not yet been identified in a particular field.

“One of the best parts of the process was working together on a different way to collaborate,” says Cate. “Truly transdisciplinary research is rare but it is highly rewarding. Often when we collaborate some individuals or disciplines may be more dominant but the horizon scan approach created a more level playing field.”



Summer interns Anya Christiansen and Rachel Liu on Ahuahu Great Mercury Island.

Te Pūnaha Matatini supports summer interns

It's lucky that Jed Thompson-Fawcett's summer internship supervisor didn't tell him how much the equipment he was working with was worth before she let him do an experiment with it.

Jed (Ngāti Whātua) was one of 13 interns supported by Te Pūnaha Matatini over the 2022-23 summer, on projects ranging from natural language processing of te reo Māori and philopatry of seabirds through to defense behaviour of wētā and obsidian hydration dating.

Jed was working with Te Pūnaha Matatini Principal Investigator Inga Smith to compare measurements between two conductivity, temperature and depth (CTD) instruments in supercooled water. These measurements are important for our understanding of sea ice, which influences the global climate.

The majority of Jed's work was analysing data collected on the instruments by Inga and a small team in McMurdo sound, but she also let him have a go on one of the CTDs.

The SBE 19plus V2 SeaCAT has a glass conductivity cell with electrodes throughout it. It's delicate and expensive. "I'm very glad that Inga didn't tell me how much it cost," says Jed. "I wouldn't have done the experiment if I knew!"

Rachel Liu and Anya Christiansen used more robust equipment for their archaeological field work on Ahuahu Great Mercury Island, working with Te Pūnaha Matatini PhD student Alex Queenin. They got a lot of hands-on experience with vibracoring and surveying. Although they had to haul the surveying equipment up and down a steep hill about 50 times, they both enjoyed the experience.

Alana Rodrigues-Birch also spent the summer on an archaeological internship, but "instead of being out in the field and having lots of nice times dragging stuff around up and down hills, I was in a lab."

Alana used obsidian hydration dating to investigate when obsidian artifacts found on Tūhua Mayor Island were made. This was to help to create schematics showing trade networks between different groups of Māori.

“I realised I actually really like being locked in a lab all summer,” says Alana. “Archaeology is often represented as being a very field-heavy discipline, but this experience showed me how the lab work is important as well.”

Te Pūnaha Matatini has a longstanding relationship with Te Hiku Media, and Alice Qin was under their wing as an intern this summer. She spent her time identifying misalignments in te reo Māori in Te Hiku’s natural language processing model Papa Reo. Alice is completing postgraduate study in statistics, specialising in machine learning, so this internship was a perfect fit for her.

As part of their internship, Luke Thompson and Hamish Doogan had the exciting opportunity to contribute to a research article on defensive behaviours in wētā that they plan to submit for a special issue of the New Zealand Journal of Zoology.

Toni Gordon produced a two-minute mixed-media video to help rangatahi understand eDNA, which will be hosted on the Science Learning Hub website, and Brittany Bennenbroek will be publishing a visual timeline of policy events in Aotearoa New Zealand relevant to the Kindness in Science approach.

Te Pūnaha Matatini Deputy Director Dr Michael O’Sullivan took charge of the internships this summer, and looked after the interns. They started with an induction, followed by two catch-ups and a concluding hui for everyone to share their mahi.

Ela Hunt worked on philopatry in seabirds, and said that she appreciated the chance to hear about the other projects and how everyone was doing. “Sometimes you can feel a little alone, or not know if your project is going the way it should be going,” she says.

Te Pūnaha Matatini Director Associate Professor Priscilla Wehi loved the diversity of topics among our summer interns. “It reminds me of what we do at Te Pūnaha Matatini,” she says. “A bunch of mathematicians and physicists and computer scientists sitting in a room with historians and ecologists and science communicators.”

“This strange interdisciplinary space is where the best ideas come out, and it turns out it’s really important when we’re trying to solve these big problems like biodiversity loss, climate change, or thinking about health and how we can work to improve the lives of people in our society.”

Te Pūnaha Matatini summer interns 2022–23

Brittany Bennenbroek | Past policy changes and kindness in science | Office of the Prime Minister’s Chief Science Advisor / Kindness in Science

Toni Gordon | Communicating eDNA | Cawthron Institute

Alice Qin | Misalignments identification for te reo Māori | Te Hiku Media

Sophie Doyle | Community attitudes and awareness toward pekapeka | Department of Conservation / University of Waikato

Hamish Doogan | Defensive behaviours of wētā | University of Otago

Luke Thompson | Defensive behaviours of wētā | University of Otago

Anya Christiansen | Vibracoring, surveying and core analysis | University of Auckland

Rachel Liu | Vibracoring, surveying and core analysis horticulture | University of Auckland

Anne Matena | Modelling healthcare delivery | University of Auckland

Alana Rodrigues-Birch | Obsidian hydration dating | University of Auckland

Jed Thompson-Fawcett | Comparing measurements taken in supercooled water | University of Otago

Ela Hunt | Philopatry and seabirds | University of Otago

Daniel Reid | Better AI | University of Auckland

Jack Anderson | Deconstructing the role of disturbance and species traits in determining trophic cascade strength | University of Canterbury



Tom Adams (left) is working to improve surgical scheduling using algorithms.

Efficient and fair surgical schedules with algorithms

Written by Dr Tom Adams, TPM Whānau member.

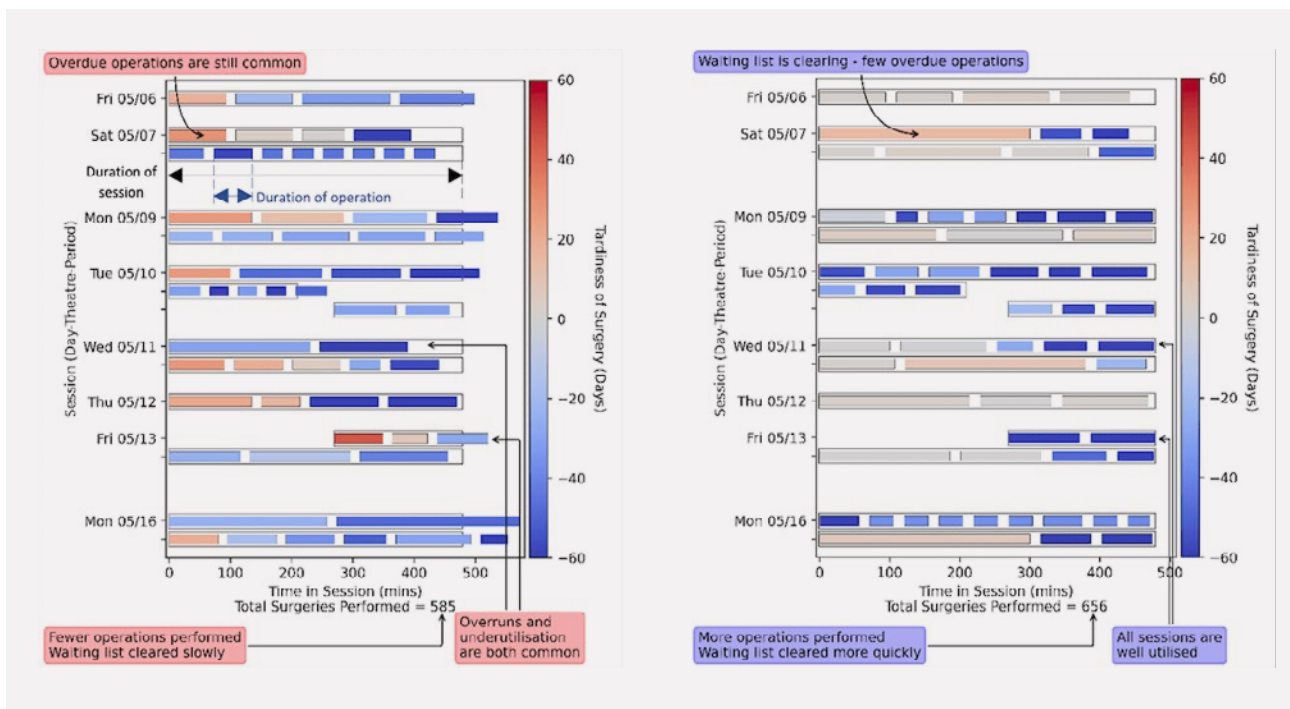
Dr Tom Adams is working to improve surgical scheduling using algorithms and individualised surgical duration predictions.

Increased throughput, increased utilisation, decreased overtime, fewer overdue operations, and less staff time required for planning: all of these can be achieved with improved surgery scheduling. By using accurate predictions of operation durations, giving priority to patients that are urgent or have been waiting a long time, and balancing the trade-off between increasing utilisation and surgical sessions running overtime, computer algorithms can be used to inform surgical schedules that are efficient and fair.

I have been awarded a postdoctoral fellowship from Precision Driven Health and the Health Research Council to develop improved surgical scheduling algorithms using individualised surgical duration predictions. I am currently working on this project alongside Te Pūnaha Matatini Principal Investigators Associate Professor Cameron Walker and Dr Michael O'Sullivan.

We have combined a novel algorithm for predicting how long operations take with an advanced scheduling algorithm. The novel prediction algorithm uses the Systemized Nomenclature of Medicine (SNOMED) medical terminology database to find links between types of procedures, which enables us to make better predictions for less frequent procedures, as similarities can be found to more common procedures.

These improved predictions are fed into our scheduling algorithm alongside the operations that need to be performed and the sessions that they can be performed in. The scheduling algorithm finds the best way of allocating the operations to the sessions so that as many operations are performed as possible, while making sure that no patients have to wait too long for their operation and no sessions are scheduled that are too likely to run over time.



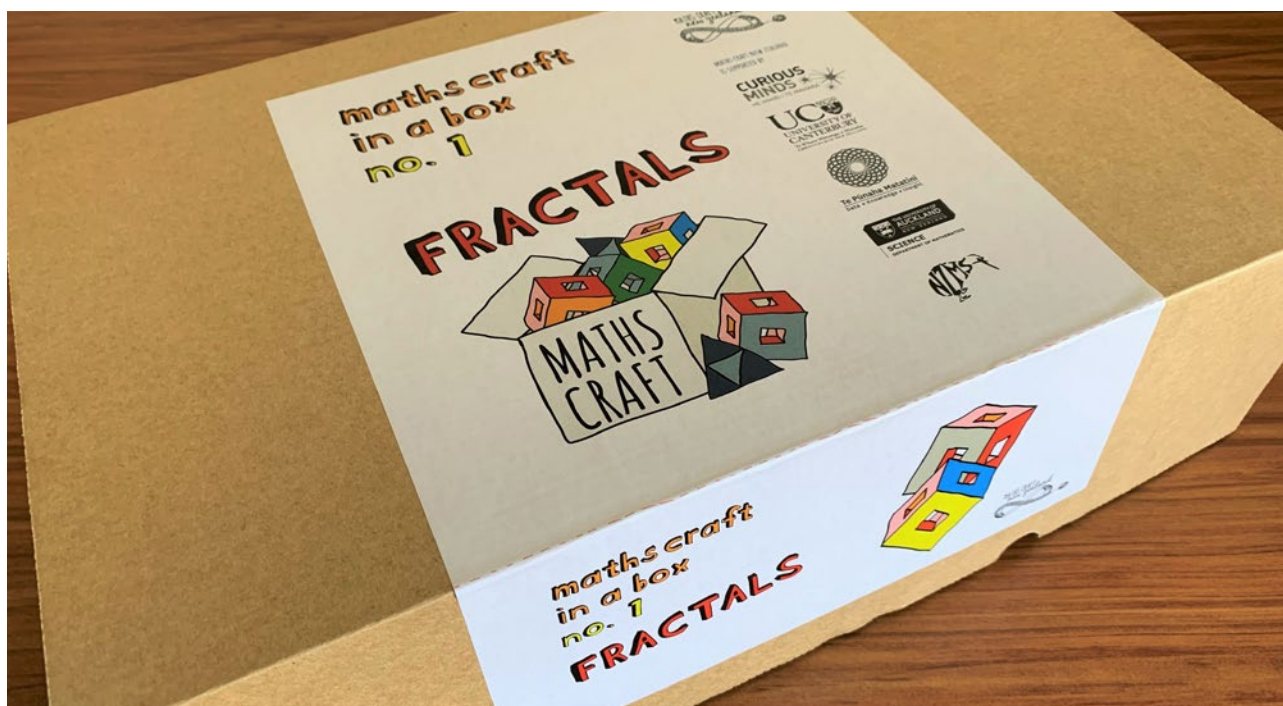
Above: A comparison between a normal surgical schedule (left) and an algorithm-supported schedule, showing more surgeries being performed, and better utilisation of session time.

Initial testing of our algorithm-supported approach shows improvement in all key metrics: a 7% increase in throughput, a 5% increase in utilisation, a 14% reduction in overtime and a 21% reduction in operations being overdue. The optimised schedule fitted in more operations, allowing more of the waiting list to be cleared, and resulting in fewer overdue operations remaining. The surgical sessions were also better utilised, with no overruns or underutilised sessions.

The next step in our research is to better understand how operating rooms are managed and surgeries are currently scheduled in Aotearoa New Zealand, so that we can refine our algorithms to be as relevant and easy to use as possible. In particular we are interested in how operating room time is allocated to specialties or surgeons, how far in advance operations are scheduled, who decides which operations are performed on each day, and how emergency operations are accommodated.

We are also working alongside scOPe solutions to organise a pilot of the scheduling software, and have collaborated with Orion Health to make a simplified version of the scheduling algorithm available online via the New Zealand Algorithm Hub.

<https://algorithmhub.co.nz/algorithms/surgical-scheduling>



First edition of Maths Craft in a Box ships nationwide

Maths Craft in a Box started shipping to schools around Aotearoa New Zealand on Wednesday 17 August 2022, and all 200 boxes of the first edition were snapped up within 36 hours.

Maths Craft in a Box is a core Te Pūnaha Matatini project. Te Pūnaha Matatini Principal Investigators Dr Jeanette McLeod, Dr Phillip Wilson and Jo Bailey developed the Box alongside education researcher Dr David Pomeroy from the University of Canterbury. This transdisciplinary team brings together the mathematics expertise of Jeanette and Phil, Jo's design talents, and David's expertise in education.

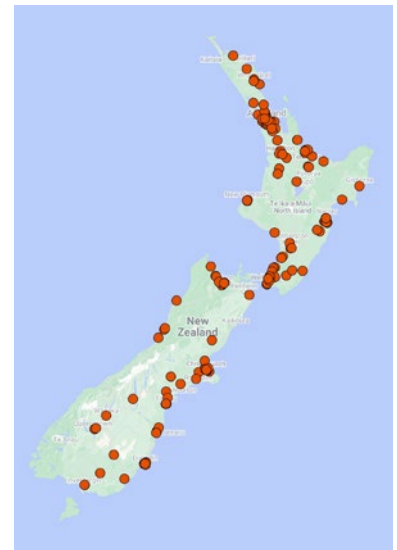
The first edition of Maths Craft in a Box is a free, entirely self-contained box dedicated to exploring the fascinating world of fractals in the classroom. It includes enough craft materials to build a large fractal sculpture, packs of student zines providing a beautifully illustrated introduction to the mathematics of fractals, and custom-made online instructional videos.

The Box includes enough content to easily fill several lessons, is ideal for years 7–13, and can be entirely student-led. It also includes a zine for teachers, to help them to feel empowered and confident in delivering the resource in the classroom.

Through Maths Craft in a Box, the project team hope to engage children in mathematics, and show them that it is much more than numbers on a whiteboard.

For Jeanette, Aotearoa has its own special problem with mathematics. “Not only do we suffer from a sort of phobia of maths, but we don't know that it's useful. In Aotearoa, people think that maths is only good for becoming a teacher, or becoming an engineer. And so they don't see maths as useful for their lives and future careers.”

“Teachers bear the brunt of this problem, so that's why we wanted to support them with Maths Craft in a Box.”



Maths Craft in a Box (left) has gone to schools all over Aotearoa (above).

“We want to engage with the people who dislike mathematics and show them that there are different ways of looking at mathematics and different kinds of mathematics. And it’s not all fractions and percentages, which our feedback has shown are the things that people are most afraid of.”

By the end of September 2022 they had sent out the last of the 200 Boxes, and estimate that they could reach 10,000 students. The Box has gone to schools all over Aotearoa, from tiny rural primary schools like Stirling School in South Otago (with a roll of 33 students) to giant urban high schools like Westlake Boys and Westlake Girls in Tāmaki Makaurau Auckland (each with a roll of over 2,200 students).

“Maths Craft in a Box helps kids with maths and normalises maths being an accessible part of life,” says Jo. “So there is a strong possibility of it rippling out positive maths vibes up the generations in Aotearoa.”

<https://www.mathscraftnz.org/box>

Research outputs

1 Book

8 Book chapters

87 Journal articles

8 Conference presentations

20 Pre-prints

9 Reports

1 Presentation

1 Software package

1 Stamp competition

Research highlights

Our investigators and TPM Whānau published 136 pieces of peer-reviewed research in 2022. Here are some of the highlights:

Bailey, Jo, Rhian Salmon, and Maja Horst. "The 'Engagement Incubator': Using design to stimulate reflexivity about public engagement with science." *Journal of Science Communication* 21, no. 04 (June 10, 2022): A01. <https://doi.org/10.22323/2.21040201>

Binny, Rachelle N, Patricia Priest, Nigel P French, **Matthew Parry, Audrey Lustig, Shaun C Hendy,** Oliver J Maclaren, et al. "Sensitivity of Reverse Transcription Polymerase Chain Reaction Tests for Severe Acute Respiratory Syndrome Coronavirus 2 Through Time." *The Journal of Infectious Diseases* 227, no. 1 (December 28, 2022): 9–17. <https://doi.org/10.1093/infdis/jiac317>

Brown, Anna. "Participatory design for a digital world = Te hoahoa whakauruuru mō te ao matihiko." In *More zeros and ones: Digital technology, maintenance and equity in Aotearoa New Zealand*, edited by Anna Pendergast and Kelly Pendergast. BWB Texts. Wellington: Bridget Williams Books, 2022.

De Rosa, Alberto, Isabel Castro, and **Stephen Marsland.** "The acoustic playback technique in avian field-work contexts: A systematic review and recommendations for best practice." *Ibis* 164, no. 2 (2022): 371–87. <https://doi.org/10.1111/ibi.13033>

Frean, Marcus, and **Stephen Marsland.** "Holds enable one-shot reciprocal exchange." *Proceedings of the Royal Society B: Biological Sciences* 289, no. 1980 (August 10, 2022): 20220723. <https://doi.org/10.1098/rspb.2022.0723>

James, Alex, and **Ann Brower.** "Levers of change: Using mathematical models to compare gender equity interventions in universities." *Royal Society Open Science* 9, (September 7, 2022): 220785.
<https://doi.org/10.1098/rsos.220785>

Keegan, Linda, Richard White, and **Cate Macinnis-Ng.** "Current knowledge and potential impacts of climate change on New Zealand's biological heritage." *New Zealand Journal of Ecology*, January 31, 2022.
<https://doi.org/10.20417/nzjecol.46.10>

Lansing, J. Stephen, Guy S. Jacobs, Sean S. Downey, Peter K. Norquest, **Murray P. Cox,** Steven L. Kuhn, John H. Miller, Safarina G. Malik, Herawati Sudoyo, and Pradiptajati Kusuma. "Deep ancestry of collapsing networks of nomadic hunter-gatherers in Borneo." *Evolutionary Human Sciences* 4 (ed 2022): e9.
<https://doi.org/10.1017/ehs.2022.3>

McAllister, Tara G., Sereana Naepi, Elizabeth Wilson, **Daniel Hikuroa,** and **Leilani A. Walker.** "Under-represented and overlooked: Māori and Pasifika scientists in Aotearoa New Zealand's universities and Crown Research Institutes." *Journal of the Royal Society of New Zealand* 52, no. 1 (January 1, 2022): 38–53.
<https://doi.org/10.1080/03036758.2020.1796103>

Sharp, Emma L., and Miriam J. Williams. "Feminist ethics of care in urban food governance." In *Routledge Handbook of Urban Food Governance*. Routledge, 2022.

You can see all of our published research at <https://www.zotero.org/tepunahamatatini/library>





Awards, grants and public engagement

Genomic history helps to understand the complexity of modern lives

Te Pūnaha Matatini Principal Investigator Professor Murray Cox was awarded the 2022 Hector Medal by the Royal Society Te Apārangi.

He was nominated for major advances in population genetic theory and the development of associated methods that have delivered insights into genome evolution.

Murray is a computational biologist. This field sits at the intersection of genetics, computer science and statistics. He has had amazing opportunities to work on a range of very different questions.

Murray has always been fascinated by the genetics and prehistory of the Pacific region. “The thing about the Pacific is that people tend not to understand just how big it is,” says Murray. “If you take a globe of the world and you spin it in just the right way, the Pacific fills an entire hemisphere.”

“Island Southeast Asia was ultimately the springboard for the settlement of the broader Pacific region,” explains Murray. He has focused his research attention on this area, in particular on Indonesia – the fourth largest country in the world based on population, which is underrepresented in both modern and ancient genome data.

“Over 20 years ago I had the good fortune to partner with an amazing team of Indonesian researchers,” says Murray. “Much of our early work together involved characterising the sheer diversity of people living across Island Southeast Asia, and particularly Indonesia.”

Murray’s major breakthroughs with this team include discovering a previously unknown species of archaic human and showing that it lived in the Pacific region, identifying the limits to which functional information from European genetic datasets can be transferred to Pacific communities, building the first quantitative model to elucidate how social behaviour jointly shapes language and genetics, and identifying new mechanisms for how the 3D structure of DNA in a cell’s nucleus coordinates gene expression.

“Perhaps the most fascinating discovery is just how important a role genetic variation from archaic hominins plays,” says Murray. “Europeans carry genetic variants from Neanderthals. So too do people in Southeast Asia and the Pacific, but they also have a genetic legacy from another archaic hominin: Denisovans, a sister group to Neanderthals.”

Research that Murray was involved in showed that Papuans carry genes from two Denisovan groups, with one unique to Oceania. These two deeply divergent Denisovan lineages separated over 350 thousand years ago, and one of these lineages is so different from the other that the study suggested they should be considered as an entirely new archaic hominin species.

Their work suggested that this group lived in New Guinea, or its adjacent islands, showing that the centre of archaic diversity was not in Europe or the frozen north, but instead in tropical Asia.

For Murray, the importance of this historical analysis of genomes is in understanding modern life. “While it may appear that my work has largely involved studying the past, it has always felt to me that it is much more about understanding the complexity of how people live their lives today.”

“One of our most important findings is that many of the genetic variants inherited from Denisovans strongly affect the health of people living today. New clinical treatments have now been developed to address some of these healthcare issues.”



Murray has achieved insights into long-standing questions through novel quantitative and computational problems, and constantly working across disciplines to solve problems that matter to communities. As well as the Hector Medal, earlier in 2022 he was also elected as a Fellow to the Academy of the Royal Society Te Apāra.

In 2023, the field of Island Southeast Asian and Pacific genetics will be celebrating its centenary. “We’ve come a long way, especially in the the last few years,” says Murray. “And it’s been a genuine honour to be part of that amazing journey.”

“I can’t help but hope though, that the best work is yet to come.”

You would fit in well with this crowd because you use data in creative ways

In November 2022, the Royal Society Te Apārangi awarded Te Pūnaha Matatini Principal Investigator Professor Ann Brower the Charles Fleming Award for Environmental Achievement for protecting the environment through her work on high country tenure review.

When the Crown Pastoral Land Reform Bill passed its third reading in May 2022, Te Pūnaha Matatini Principal Investigator Professor Ann Brower was delivering a shared inaugural lecture with Principal Investigator Professor Alex James.

Their lecture was on changing the world, one data point at a time. Ann had been working for 15 years to achieve the change enshrined by the bill that passed that day, and would have loved to have been in parliament to see it happen. But delivering her first lecture as a professor on changing the world with data was an appropriate reason to miss it.

The Crown Pastoral Land Reform Bill ended tenure review, a process introduced in 1991 in which leased Crown land could be bought by the government for conservation or bought in full by the farmer who holds the lease. Tenure review affected 10 per cent of Aotearoa New Zealand's landmass – 2.4 million hectares along the eastern slope of Te Waipounamu the South Island's Main Divide.

For Ann, the high country in Te Waipounamu is “possibly the most treasured 10 per cent of the country, with the possible exception of the coast. It's iconic and mythical and culturally significant in a lot of ways.”

It was a long road to get to this point of awards and inaugural lectures. Ann first arrived in Aotearoa on a Fulbright scholarship and, through her research into the politics of land reform as an early career researcher, exposed what she calls the “biggest and quietest rot in the Southern Hemisphere”. She discovered that the Crown had been paying the runholders of South Island high-country stations to freehold parts of their pastoral lease farms, and letting them purchase the rest, often to subdivide for massive profits.

Land that went into private ownership in these deals included significant parts of the shorelines of Lakes Tekapo, Wānaka, Hāwea and Wakatipu, as well as some of the finest vineyard country in Central Otago.

Ann's initial research in the mid-2000s showed that the Crown was making a net loss on these sales and purchases. The release of her first report detailing these findings caused considerable controversy, earning her some choice epithets, like the ‘chirpy anti-Christ’ and a ‘socialist infection’. Later analysis showed that newly freeholded land sold for an average of around 1,000 times what the Crown sold it for, resulting in an estimated \$275 million capital gain.

As the project expanded to include law academics, economists and ecologists, the full scope of the shortcomings of tenure review was brought into stark relief. “The financial outcomes of the land reform were nonsensically bad,” says Ann. “But the environmental and ecological outcomes were borderline criminal. The land with the most ecological value was privatised and the land with the least conservation value was conserved.”

Ann worked closely with a succession of ministers about this issue through several changes of government. “Because I knew something about high country tenure review that the public had essentially paid me to find out, I felt like it was my job to share that as appropriate.”



“Speaking the truth, as we see it, is our job as academics.”

It was Alex James – who Ann was sharing her inaugural lecture with the night the bill passed ending tenure review – who suggested that she get involved with Te Pūnaha Matatini. “Alex told me ‘You would fit in well with this crowd because you use data in creative ways,’” says Ann. “She said ‘I think you could learn some new methods and grow your use of data in creative ways.’ And that Te Pūnaha Matatini folks could learn from the ways that I use data to make the world a better place.”

“In sum she was right,” says Ann. “The creative use of data was the connection.”

Ann is now putting data to creative use in leading one of the current core Te Pūnaha Matatini projects to better understand braided rivers, another iconic feature of Te Waipounamu. This project integrates legal, economic, social, and cultural factors into the well-established models of the topology of braided rivers, along with models of climatic uncertainty to better understand these unique landscape features.

The successful ending of tenure review and Ann’s recognition for the environmental impact of her work is bittersweet. “It’s nice to have an impact,” reflects Ann. “But that impact really came too late. If they had made this change 17 years ago, when I first showed them the evidence, it would have been a much different situation.”

She still loves the high country, though. “It’s such an amazing, rich story,” Ann concludes. “I never get tired of it.”

Awards

Professor Anna Brown

Best in Class, Australian Good Design Awards

Social Impact Award, Australian Good Design Awards

Gerard Reid Award for Best Book, Publishers Association of New Zealand

Penguin Random House New Zealand Award for Best Illustrated Book, Publishers Association of New Zealand

Booksellers Aotearoa New Zealand People's Choice Award, Publishers Association of New Zealand

Silver, Best Design Awards, Designers Institute of New Zealand

Jonathan Burgess

Vice Chancellor's Excellence Award, University of Auckland

Professor Isabel Castro

Fellow of the International Ornithological Union

Professor Murray Cox

Hector Medal, Royal Society Te Apārangi

Dr Daniel Hikuroa

Blake Award, Blake Trust

Dr Tara McAllister

Te Kōpūnui Māori Research Award, Royal Society Te Apārangi

Zonta Science Award, Zonta

Dr Jeanette McLeod

Gillian Thornley Award, New Zealand Mathematical Society

Kathryn Morgan

Vice Chancellor's Excellence Award, University of Auckland

Associate Professor Nirmal Nair

Best Paper, IEEE Power and Energy Society

Best Paper, Electricity Engineers' Association

Protection and Automation Outstanding Service Award,
International Council on Large Electric Systems (CIGRE)

Professor Tava Olsen

Best Paper Award, Omega Journal

Associate Professor Claire Postlethwaite

Kalman Prize for Best Paper, New Zealand Mathematical Society

Dr Emma Sharp

Early Career Research Excellence Award, University of Auckland

Associate Professor Tammy Steeves

Highly Commended, Regional Distinguished Service Award,
Society for Conservation Biology Oceania Section

Associate Professor Krushil Watene

Jeanette K Watson Distinguished Visiting Professorship in the
Humanities, Syracuse University

Associate Professor Siouxsie Wiles

Runner up, Best Artist/Graphic Design, Voyager Media Awards

Dr Phillip Wilson

Gillian Thornley Award, New Zealand Mathematical Society

Grants

Te Pūnaha Matatini investigators are involved with projects which were awarded \$47 million in funding in 2022.

Professor Troy Baisden

Just Transitions Guide, MBIE, \$320,000

Just Transitions Dialogues, Aotearoa Foundation, \$150,000

Professor Isabel Castro

Assessment of kiwi vulnerability to drought, Manaaki Whenua Landcare Research, \$25,500

Dr Giulio Valentino Dalla Riva

Data Fluencies, Mellon Foundation, \$8 million

Professor David Hayman

Pilot study to generate evidence on emerging disease risks through GIS tools, Food and Agriculture Organisation of the United Nations, \$46,846

Aquatic protozoa analysis and advice services, Ministry of Health, \$350,000

Enlisting kākahi: developing a model system to protect Māui dolphins from toxoplasmosis, Endeavour Fund, Ministry of Business, Innovation and Employment, \$999,999

Analysis of water samples for the detection of cryptosporidium and giardia, Institute of Environmental Science and Research, \$460,000

Dr Kyle Higham

Mechanisms for firm growth through product and process innovations, KAKENHI, \$157,740

Dr Daniel Hikuroa

Pou rahui, pou tikanga, pou orange: reigniting the mauri of Tikapa Moana and Te Moananui-a-toi, Endeavour Fund, MBIE, \$14 million

Professor Thegn Ladefoged

Paleotsunami and archaeology: An Ahuahu case study, Australia's Nuclear Science and Technology Organisation (ANSTO), Capabilities and Facilities, \$50,000

Māori-ecosystem interactions and adaptations on the offshore islands of Aotearoa/New Zealand: Agricultural niche construction during the initial settlement of southern Polynesia, Marsden Fund, \$869,000

Dr Steffen Lippert

Climate Teams, University of Auckland Research Development Fund, \$5,000

Associate Professor Cate Macinnis-Ng

Fair and just climate futures for Tāmaki Makaurau Auckland, University of Auckland, \$60,000

Ontogenetic constraints to climate change resilience: Investigating consequences of heteroblasty under increasing aridity in New Zealand forests, National Science Foundation USA, \$600,000

Professor Stephen Marsland

Soundscapes of kauri dieback, New Zealand's Biological Heritage National Science Challenge, \$25,000

Associate Professor Anna Matheson

Evaluation of Healthy Families NZ, Te Whatu Ora, \$1.5 million

Dr Tara McAllister

Transforming science with mātauranga Māori, Te Whitinga Fellowship, \$320,000

Associate Professor Barry Milne

Simulation Modelling for A Better Start, MBIE, \$214,084

Associate Professor Nirmal Nair

Energy Technology Prototyping, Counties Energy, \$70,000

Dr Michael O'Sullivan

Towards preventing family violence in New Zealand: integrating qualitative and quantitative methods to provide evidence-based, modelling-informed policy, \$100,000

Dr Chrissie Painting

A complex systems approach to understanding the evolution of mating systems, Marsden Fund, \$360,000

Professor Michael Plank, Dr Dion O'Neale, Dr Emily Harvey

Covid-19 Modelling Aotearoa, Department of the Prime Minister and Cabinet, \$2 million

Professor Michael Plank

Understanding key epidemiological features of the Covid-19 pandemic in NZ to improve the response, Ministry of Health, \$483,167

Associate Professor Rebecca Priestley

Te Ao Hiruhuri: Te Ao Ho – Our Changing Coast, Endeavour Fund, Ministry of Business, Innovation and Employment (MBIE), \$13 million

Dr Emma Sharp

Soilsafe Aotearoa and Dustsafe Aotearoa, New Staff Faculty Research Development Fund, Faculty of Science, University of Auckland, \$30,000

The rule of the beancounters: Global management consultancies and the governance of social futures in New Zealand, Marsden Fund, \$815,000

Soilsafe Kids, Unlocking Curious Minds, MBIE, \$149,382

Soilsafe Kinds (expansion), Unlocking Curious Minds, MBIE, \$150,000

Māori Kuku Economies, High Value Nutrition National Science Challenge, \$174,877

Associate Professor Inga Smith

Climate impacts from Antarctic ice-mass loss in a multi-model experiment, Deep South National Science Challenge, \$180,000

Associate Professor Jonathan Tonkin

Innovating climate risk assessment: A system-wide, geospatial approach, MBIE Smart Ideas, \$999,999

Associate Professor Krushil Watene, Associate Professor Priscilla Wehi

Kaitiakitanga and Antarctic Narratives, Marsden Fund, \$660,000

Associate Professor Ilze Ziedins

Tired of waiting? Data-informed dynamic models for congestion control, MBIE Catalyst Seeding Grant, \$74,000



Public engagement

Public engagement is central to the kaupapa of Te Pūnaha Matatini. Alongside a considerable volume of peer-reviewed publications, our investigators work hard to communicate their research to diverse audiences.

A highlight of 2022 was the considerable engagement efforts of the Tales of Diversity team, who work to connect the power of stories in science, technology, engineering and maths education from intermediate school through to the science and engineering professions.

As part of the Tales of Diversity project, Dr Michael O'Sullivan and Te Pūnaha Matatini PhD student Tony Nemaia have been working with a virtual reality company to produce a virtual walkthrough of the Faculty of Engineering at the University of Auckland, to demystify university for students who haven't had the chance to visit one.

In November 2022, the virtual reality experience they developed travelled to the Cook Islands Science Expo, where long lines of kids took a turn and were delighted to be able to visit New Zealand and experience the University of Auckland without catching a plane.

Our investigators were not only using cutting-edge technology for engagement. Jo Bailey, Kate Hannah and Associate Professor Rebecca Priestley created a set of Women in Science stamps with NZ Post. In celebration of all the women scientists in Aotearoa New Zealand, this stamp issue highlights the remarkable work of four trailblazing women: Mākereti Papakura, Lucy Moore, Joan Wiffen and Beatrice Hill Tinsley, who achieved in the scientific fields of ethnography, botany, palaeontology and cosmology in the 20th century.

Te Pūnaha Matatini masters student Katerina French Armstrong held a month-long exhibition at Māori lands in Ōtaki, where she exhibited the work that she developed for her TPM-funded masters project looking at trees, people and climate. This installation was created to guide people through an immersive visual karakia expressing whakapapa and mauri. Earlier in the year, over 50 people from a wide range of communities and ages gathered for a tree planting event to engage with this research project.

Alongside these creative engagement efforts, Te Pūnaha Matatini investigators continue to be sought-after, respected experts speaking to wide audiences about their research.

Media highlights

‘Biblical’ floods in NZ, and a heatwave in Antarctica: Are they related?,

featuring Professor Adrian McDonald

<https://www.stuff.co.nz/national/explained/300548222/biblical-floods-in-nz-and-a-heatwave-in-antarctica-are-they-related>

NZ summers are getting hotter – and humans aren’t the only ones feeling the effects,

featuring Associate Professor Cate Macinnis-Ng

<https://thespinoff.co.nz/science/11-01-2022/nz-summers-are-getting-hotter-and-humans-arent-the-only-ones-feeling-the-effects>

Can ancient Māori knowledge aid science? Ask these freshwater crayfish,

featuring Dr Daniel Hikuroa

<https://www.nytimes.com/2022/06/01/world/australia/matauranga-maori-new-zealand.html>

How cutting-edge virtual reality is making marae more accessible,

featuring Professor Hēmi Whaanga

<https://thespinoff.co.nz/atea/28-09-2022/how-cutting-edge-virtual-reality-is-making-marae-more-accessible>

Elon Musk’s Twitter takeover has disrupted the Christchurch Call – NZ needs to rethink its digital strategy, featuring Associate Professor Markus Luczak-Roesch

<https://theconversation.com/elon-musks-twitter-takeover-has-disrupted-the-christchurch-call-nz-needs-to-rethink-its-digital-strategy-195213>

South Island kōkako: Recording raises hopes of spotting elusive bird,

featuring Professor Stephen Marsland

<https://www.rnz.co.nz/news/national/459506/south-island-kokako-recording-raises-hopes-of-spotting-elusive-bird>

It lives with you, boy: Tom Roa on his journey to keep te reo Māori alive,

featuring Associate Professor Tom Roa

<https://www.stuff.co.nz/pou-tiaki/129808708/it-lives-with-you-boy-tom-roa-on-his-journey-to-keep-te-reo-mori-alive>

In New Zealand, conservation is buoyed by Indigenous knowledge,

featuring Associate Professor Tammy Steeves

<https://undark.org/2022/08/24/in-new-zealand-indigenous-knowledge-helps-crayfish-conservation/>

Governance and management

Advisory Board

Richard Aitken (Chair)

Consulting engineer (retired)

Peter-Lucas Jones

Te Hiku Media

Pieta Brown

Orion Health

Professor Wendy Lawson

AUT

Atawhai Tibble

Social Investment Agency

Professor John Hosking

University of Auckland

Professor Jim Metson

University of Auckland

Strategic Leadership Group

Associate Professor Tom Roa

Kaumātua
University of Waikato

Associate Professor Priscilla Wehi

Director
University of Otago

Dr Michael O’Sullivan

Deputy Director
University of Auckland

Associate Professor Ilze Ziedins

Complexity Community of Inquiry Lead
University of Auckland

Associate Professor Krushil Watene

Culture of Research Excellence Community of Inquiry Lead
Massey University

Associate Professor Rhian Salmon

Engagement Community of Inquiry Lead
Victoria University of Wellington – Te Herenga Waka

Associate Professor Anna Matheson

Project Leader Representative
Victoria University of Wellington – Te Herenga Waka

Professor David Hayman

Investigator Representative
Massey University

Kathryn Morgan

Research Operations Manager
University of Auckland

Neil Birrell

Chair, TPM Whānau
University of Auckland

Financial report 2022

Funding summary for the period ending 31 December 2022

	Actuals
	\$000
Funding received	
Tertiary Education Commission grant	4,000
Surplus carried forward	1,758
Total funding received	5,758
<hr/>	
Expenditure	
Salaries funded by CoRE	1,163
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Other costs	
Overheads	1,119
Project costs	179
Travel	85
Postgraduate students	196
Extra-ordinary expenditure	0
Total other costs	1,579
<hr/>	
Total expenditure	2,742
<hr/>	
Net surplus/(deficit)	3,016

Notes

This report covers the period from 1 January to 31 December 2022 and details funding received and funds distributed to collaborative partners of Te Pūnaha Matatini.

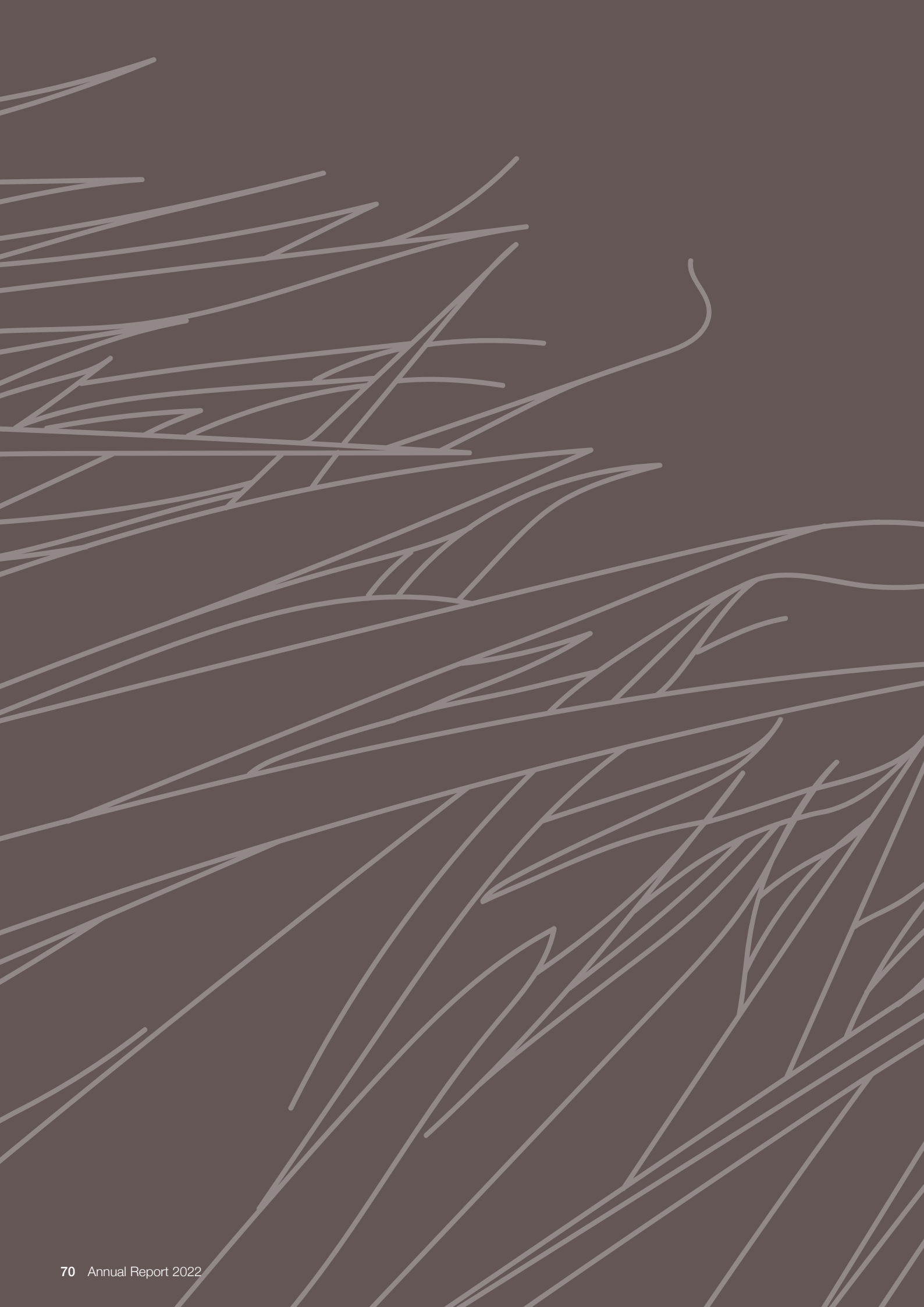
All amounts are shown exclusive of Goods and Service Tax (GST).

The net surplus will be carried forward into 2023 to fund future expenditure of the CoRE and also those projects and postgraduate students that have had delays to their start dates.

Table of statistics

Broad category	Detailed category	Yr1	Yr2
Value of CoRE funding from TEC (\$M)		2	4
FTEs	Principal investigators	1.8	4.677
by category	Postdoctoral fellows	0	0.633
	Administrative/support	1.62	2.78
	Total	3.42	8.12
Headcounts	Principal investigators	78	77
by category	Postdoctoral fellows	8	20
	Research technicians	1	0
	Administrative/support	4	5
	Research students	63	102
	Total	159	204
Peer-reviewed research outputs by type	Books	0	1
	Book chapters	7	8
	Journal articles	85	87
	Conference papers	7	8
	Prizes and distinctions*		
	Other (PBRF category)	43	32
	Total	141	136
Commercial activities	Spinouts (cumulative)	4	4
	Total	4	4
Students studying at CoRE by level	Doctoral degree	40	56
	Masters degree	10	21
	Other	13	25
	Total	63	102

* Reported on page 60



Our people

77 Principal Investigators

233 TPM Whānau

4 HQ Team

1 Kaumātua



Founding investigator becomes kairangi

In September 2013, Professor Tava Olsen received an email. Dr Shaun Hendy was moving to the University of Auckland, and was bringing with him an application to form a Centre of Research Excellence for complex systems. Did she want to start a conversation about being involved?

Tava accepted the invitation, and became one of the founding investigators of Te Pūnaha Matatini. She is an award-winning expert in operations and supply chain management, and brought this valuable expertise to her role as an investigator.

In November 2022 Tava took up a role as Deputy Dean, Academic at Melbourne Business School, and drew to a close nine years of involvement with Te Pūnaha Matatini – including 18 months as Deputy Director Industry and Stakeholder Engagement.

She will be putting her leadership and research experience to work in Australia to strengthen the way the Melbourne Business School teaches, conducts research and engages with industry.

During her time at Te Pūnaha Matatini, Tava led a project that explored cooperative models within the New Zealand red meat industry, and contributed to work developing solutions to help hospitals optimise the scheduling and flow of patients through their facilities and services. Her expertise was in high demand in the media as supply chains were challenged during the early years of the Covid-19 pandemic.

Tava's contribution to Te Pūnaha Matatini has been recognised with an honorary position as kairangi. Kairangi is a Māori term meaning 'the finest pounamu' (greenstone or jade) which can be used to describe a person held in high esteem. This category of investigator reflects our development as an organisation and acknowledges the important contributions of our senior colleagues.

"Being involved with Te Pūnaha Matatini for the past nine years has been an honour and a privilege," says Tava. "Being part of the leadership team was also a wonderful experience."

"Best wishes to everyone in Te Pūnaha Matatini," says Tava. "I have made many friends and hope we can stay in touch. And best of luck for the continuation of a highly successful Centre of Research Excellence."

Kaumātua

Associate Professor Tom Roa

Kaumātua
University of Waikato

Executive team

Associate Professor Priscilla Wehi

Director
University of Otago

Dr Michael O’Sullivan

Deputy Director
University of Auckland

Kathryn Morgan

Research Operations Manager
University of Auckland

Jonathan Burgess

Communications and Marketing Senior Adviser
University of Auckland

Pauline Donougher

Research Operations Coordinator
University of Auckland

Jillian Menezes

Research Operations Coordinator
University of Auckland

Principal investigators

Dr Hamza Ajmal

Livestock Improvement Corporation

Professor Melinda Allen

University of Auckland

Professor Richard Arnold

Victoria University of Wellington – Te Herenga Waka

Professor Quentin Atkinson

University of Auckland

Jo Bailey

Massey University

Professor Troy Baisden

Motu

Dr Rachelle Binny

Manaaki Whenua Landcare Research

Dr Élodie Blanc

Motu

Professor Ann Brower

University of Canterbury

Professor Anna Brown

Massey University

Professor Isabel Castro

Massey University

Emeritus Professor Murray Cox

Massey University

Dr Giulio Valentino Dalla Riva

University of Canterbury

Associate Professor Marcus Frean

Victoria University of Wellington – Te Herenga Waka

Professor Mark Gahegan

University of Auckland

Dr William Godsoe

Lincoln University

Professor Michele Governale

Victoria University of Wellington – Te Herenga Waka

Dr David Hall

AUT

Kate Hannah

Victoria University of Wellington – Te Herenga Waka

Dr Pauline Harris

Victoria University of Wellington – Te Herenga Waka

Dr Emily Harvey

Market Economics

Professor David Hayman

Massey University

Dr Shaun Hendy

Toha

Dr Daniel Hikuroa

University of Auckland

Associate Professor Māui Hudson

University of Waikato

Professor Alex James

University of Canterbury

Dr Rachel Ka’ai Mahuta

AUT

Professor Thegn Ladefoged

University of Auckland

Dr Simone Linz

University of Auckland

Dr Steffen Lippert

University of Auckland

Dr Kirsten Locke

University of Auckland

Associate Professor Markus Luczak-Roesch
Victoria University of Wellington – Te Herenga Waka

Dr Audrey Lustig
Manaaki Whenua Landcare Research

Associate Professor Cate Macinnis-Ng
University of Auckland

Professor David Maré
Motu

Professor Stephen Marsland
Victoria University of Wellington – Te Herenga Waka

Associate Professor Anna Matheson
Victoria University of Wellington – Te Herenga Waka

Dr Tara McAllister
Victoria University of Wellington – Te Herenga Waka

Professor Adrian McDonald
University of Canterbury

Dr Jeanette McLeod
University of Canterbury

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Kairangi

Kairangi is a Māori term meaning ‘the finest pounamu’ (greenstone or jade) which can be used to describe a person held in high esteem. This category of investigator reflects our development as an organisation and acknowledges the important contributions of our senior colleagues.

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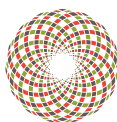
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Front cover: The poutama pattern represents the pathway on which Tane-te-wānanga-ā-rangi ascended in his quest for knowledge. The steps symbolise the various levels of growth, learning and achievement. This is overlaid with an illustration of a braided river.

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Te Pūnaha Matatini
Complexity is at our heart