Te Pūnaha Matatini
Data ▪ Knowledge ▪ Insight

Annual Report 2016

Contents

About Us

Our Partners

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

Partners:

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

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

VICTORIA
UNIVERSITY OF WELLINGTON

MASSEY UNIVERSITY
TE KUNENGA KI PŪREHUROA
UNIVERSITY OF NEW ZEALAND

Motu

Collaborators:

University of Waikato
Te Whare Wānanga o Waikato

Landcare Research
Manaaki Whenua

GNS Science
Te Pū Ao

University of Otago
Te Whare Wānanga o Otāgo

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

Shaun Hendy encouraged to submit a proposal for a Centre of Research Excellence (CoRE).

Kate Hannah comes on board as bid manager.

Investigators from around the country come together for the first time.

| 2012 | Early 2013 | Mid 2013 | October 2013 |

Our Story

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

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

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

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

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

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

Director Shaun Hendy discusses Te Pūnaha Matatini's work on RadioLIVE.
http://bit.ly/1ohHOmk

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

January 2015
Te Pūnaha Matatini comes into official existence with 24 Principal Investigators.

February 2015
Official launch of Te Pūnaha Matatini.

January 2016
Te Pūnaha Matatini continues to grow.

December 2016
- 26 Principal Investigators
- 24 Associate Investigators
- Executive Management Team of 6
- Over 100 students aligned with Te Pūnaha Matatini Whānau
- 12 students directly funded by or working on Te Pūnaha Matatini projects.

Board Chair's Report

Welcome to the second Annual Report of Te Pūnaha Matatini. The Board has been very pleased with the progress that has been made and the growing reputation the Centre has achieved.

This year the Centre has built on the relationships, partnerships, and collaborative networks that were established in our first year of operation.

In 2016, our investigators were awarded more than $5m from outside the New Zealand science and innovation system to pursue projects related to Te Pūnaha Matatini's research plan. A good deal of this funding is coming from central government's need for analytics to support its social investment programme. This illustrates the revelance of Te Punaha Matatini's research programme and bodes well for the employability of its graduates.

This relevance is also evident in the strong partnerships the Centre is building with its stakeholders. It has a deepening relationship with Te Hiku Media, a charitable joint venture between the Far North Iwi. A Te Pūnaha Matatini intern worked with Te Hiku over the summer 2016-17 to build a dashboard and the two organisations have submitted joint a joint proposal to support the 'Kia ora Hiri' project that would develop machine learning tools for transcribing Te Reo Māori.

The fruits of Te Pūnaha Matatini's multi-disciplinary collaborative networks are starting to appear. Investigators Thegn Ladefoged, Dion O'Neale, and Marcus Frean, who had not met before joining Te Pūnaha Matatini, were awarded a prestigious Marsden Fund grant for a project that brings together archaeology, mathematics, and computer science. PhD student Kyle Higham, along with economist Adam Jaffe, and physicists Michele Governale and Uli Zülicke published work this year that shows how methods from physics can be used to model the obselescence of ideas in patents over time.

The Board is very aware that the progress that has been made this year is a direct result of the hard work and passion of our Director, Professor Shaun Hendy and his dedicated team. On behalf of the Board I want to thank them for a successful year and for all the progress that has been made.

Richard Aitken

Richard Aitken
Board Chair

Director's Report

Our second year in operation felt very different to me from our first. With many strategic decisions made and administrative systems in place, the collaboration that underlies Te Pūnaha Matatini began to deliver very tangibly on its promise.

Cross-disciplinary and cross-institutional research has become the norm at Te Pūnaha Matatini, with investigators who had not met prior to the establishment of Te Pūnaha Matatini now writing papers and winning grants together. We also saw Te Pūnaha Matatini research and scholarship being discussed in the public sphere by commentators who ranged from the New Zealand Prime Minister's Chief Science Advisor, Sir Peter Gluckman, to the Prime Minister himself, John Key. Major policy initiatives were launched based on or informed by the work of our investigators, including the government's move to support Predator Free New Zealand and the Ministry of Business, Innovation and Employment's launch of the Science and Innovation Domain Plan.

This cross-disciplinary approach has extended to our outreach events. Investigator Jeanette McLeod and her team organised the Maths Craft Festival at the Auckland War Memorial Museum over a weekend in September 2016. The event combined arts and craft work stations with a mathematics theme, interwoven with public talks on mathematics throughout the weekend. The event attracted more than 1800 attendees over the two days, making it one of the biggest events the Museum has hosted in the last year, and featured on TV One's six o'clock news bulletin. The festival has uncovered a huge unmet interest and it is planned to expand the festival to other centres in 2017. At our first cross-theme hui, investigators decided to support a PhD in the science of science communication, a project combining both quantitative and qualitative research methods to study the impact of our outreach and engagement initiatives.

Our expertise is also very much in demand from our stakeholder and end-user organisations, as shown by growing levels of co-funding for our research. We were able to place a dozen graduate and undergraduate students in external organisations for funded summer internships. The feedback from these internships has been very positive and on this basis we will expand this programme in 2017. We have also become well-known for our leadership in collaborative management, advising other CoREs and research centres on structure and operational matters, governance, and policies for growing diversity. A number of other organisations, including several CoREs, have adopted our diversity policies and the Royal Society Te Aparangi has continued to adapt a number of its practices in the course of responding to our sponsorship policies.

Our investigators continue to distinguish themselves by winning awards and being appointed to key leadership roles. Since Te Pūnaha Matatini was established, Sally Davenport and Andrea Byrom have both become Directors of National Science Challenges while Daniel Hikuroa was appointed as Ngā Kaihautū of the Environmental Protection Authority. Siouxsie Wiles won a Blake Leadership Award and Alex James was elected as a Fellow of the New Zealand Maths Society. Rebecca Priestley won the 2016 Prime Minister's Science Communication Prize, bringing the number of Te Pūnaha Matatini investigators who have won this prize to four.

Let me once again thank our Advisory Board (Chair Richard Aitken, and Board members Jim Metson, John Hosking, Lillian Grace, James Mansell, Kevin Ross, and Wendy Lawson), our executive manager and administrative team (Kate Hannah, Sarah Hikuroa, and Danene Jones), Deputy Directors (Tava Olsen, Alex James, and Siouxsie Wiles), theme leaders (Stephen Marsland, Andy Philpott, Adam Jaffe, and Michael Plank), and our 2016 Whānau Chair, Catriona Sissons. I must also also offer thanks to all our investigators, students, and supporters, especially those who have served on one of our committees, and the many volunteers from outside Te Pūnaha Matatini who have made a contribution to one of our outreach and engagement events. It is a huge privilege to be the spokesperson for such a diverse, dynamic, and ambitious group of people who are on a mission to change the world.

Professor Shaun Hendy
Director

Our Vision and Values

Our Vision

- We work with our stakeholders from industry, government, and the public to help reshape New Zealand's economy, society, and environment

- We train a new type of scientist for the benefit of New Zealand

- We help build the kind of New Zealand of which we can all be proud

- We enhance Mātauranga Māori

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

Our Values

- Visibility and international excellence

- Outreach and engagement – ensuring demonstrated relevance or impact

- Collaboration for discover-orientated research

- Diversity through development and participation

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

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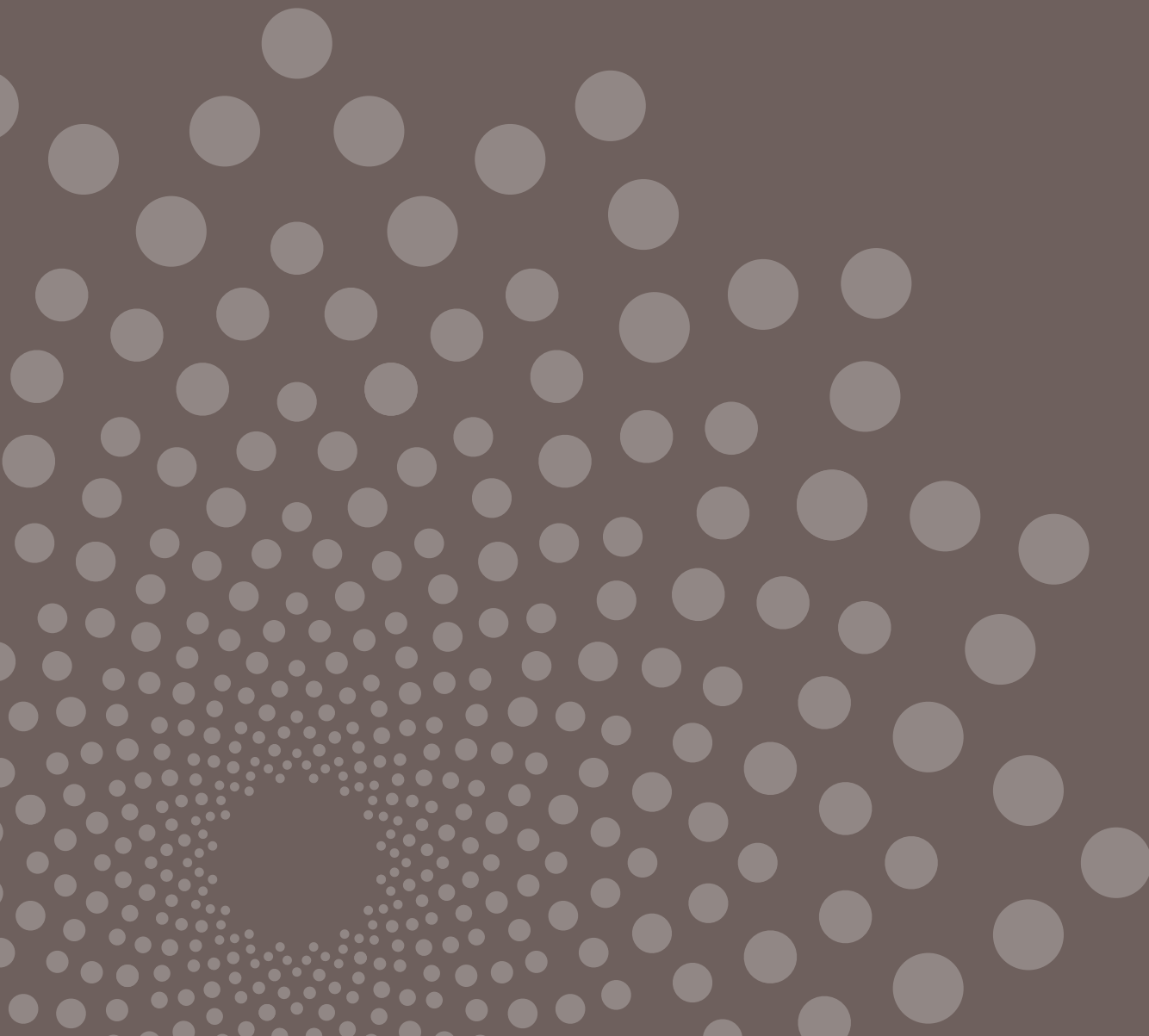*Grow up and thrive for the days destined to you.*
– Sir Apirana Ngāta, 1874-1950

2016 Highlights

Realising Our Vision

Te Pūnaha Matatini Director Shaun Hendy.

Applying a complex systems and network science approach to aid government decision-making

There is growing interest, in New Zealand and overseas, in the use or lack of use of scientific evidence for informing public policy.

More recently, government itself has become an important source of scientific knowledge. In New Zealand, the Integrated Data Infrastructure (IDI) has evolved into a powerful source of socio-economic administrative data that records many aspects of the lives of residents and citizens. The IDI is used by independent researchers, as well as by researchers within government organisations, to inform both operational practice and policy development, as well as to study the effectiveness of policies.

Te Pūnaha Matatini is at the forefront of these developments. Its researchers have used the IDI to develop models for operational decision-making in the social sector, to evaluate the effects of particular public policies on employment and the economy, as well as undertaking research that has informed policy development in science and innovation. Many of our students make direct use of the IDI or are working with related data sets, giving them skills that are in high demand by government and the data science industry.

Te Pūnaha Matatini is also considering the broader implications of this blurring in distinction between research and policy. Te Pūnaha Matatini Director Shaun Hendy has argued that researchers and policy-makers need to develop a more sophisticated understanding of the strengths and limitations of scientific knowledge and the means by which we arrive at that knowledge. Hendy has also made a case that new institutional arrangements will be needed if government is to utilise the norms and practises of the research community that make scientific knowledge so useful and powerful.

Relevant publications:

- Nathan Chappell and Isabelle Sin, 'The Effect of Trial Periods in Employment on Firm Hiring Behaviour' *New Zealand Treasury Working Paper* 16/03 (2016).

- Shaun C. Hendy, 'Science for Policy: The need for a Commission for Science', *Policy Quarterly* 12 46 (2016).

- Shaun C. Hendy, 'Data Matters' *What Works Global Summit*, London (2016).

- Jonathan Boston, *Safeguarding the Future: Governing in an Uncertain World,* Bridget Williams Books (2017).

Student interns from Te Pūnaha Matatini's 2016 intake.

Te Pūnaha Matatini students tackle real world data science

The Te Pūnaha Matatini Internship programme began in 2015 when we funded an intern position for Tulele Masoe within the Participatory Science Platform for South Auckland, known as South Sci.

Tulele, a Bachelor of Civil Engineering and Bachelor of Science student, assisted in communicating and marketing the project, and supported community groups to design, implement, and evaluate science research projects of local benefit and interest.

The relationships developed with South Auckland schools and community groups through this project are ongoing. Seeing the benefits of internships to students, host partners and Te Pūnaha Matatini, a decision was made to continue and expand the partnership, as an aspect of our broader student internship programme, which was piloted in 2016.

In 2016-2017, 12 students were recruited from both undergraduate and postgraduate applicants. The placements took place over ten weeks with partners including the Social Investment Unit within the Ministry of Social Development, the Ministry of Business, Innovation and Employment, Te Hiku Media, and Ripe Time.

To ensure all students could access these opportunities, the internships were either cofunded or fully funded by the external organisations – an indication of the value partners placed on hosting students. These stakeholders were also the end-users and defined the projects the students undertook to suit their business needs.

Many of the interns found the projects had a distinct 'real world' element which was missing from their studies. They described being challenged to learn new skills, and rated the experience as highly valuable. A student who was based at the Social Investment Unit in Wellington commented:

"The project directly related to what I was studying and the course I had studied at the beginning of the year. I was really passionate and loved going into work because I knew the work I was doing was contributing to making a difference for New Zealanders – creating a wellbeing index to evaluate life satisfaction of Kiwis."

Te Pūnaha Matatini Director Shaun Hendy works with students from Manurewa High School. *Image credit: Dr Sarah Morgan.*

Several interns commented that the experience had widened their perception of future careers. Samin Aref, who interned at MBIE commented, "Now I know the government can be as cutting edge as a research university, I'll be interested to work for the government".

The internship partners were highly satisfied with the results of the projects and many will offer places for the future cohorts. A team-based approach was trialed at the Social Investment Unit in Wellington where a Masters student led a team of two undergraduates. The structure worked well with strong outcomes and will be used again where possible.

Te Pūnaha Matatini has a growing partnership with Te Hiku Media, a charitable joint-Iwi venture between the Far North Iwi of Ngāti Kuri, Te Aupouri, Ngai Takoto, Te Rārawa and Ngāti Kahu. The intern who was placed with Te Hiku Media is now employed part-time to extend the audience analytics dashboard they developed during their project.

Through the internship programme, Te Pūnaha Matatini is able to engage with partners to complete small scale projects with defined outcomes, develop relationship networks and introduce talented students to potential employers. Students gain invaluable experience which broadens their horizons and allows them to bring new perspectives when they return to their studies.

Intern Tulele Masoe. *Image credit: Dr Sarah Morgan.*
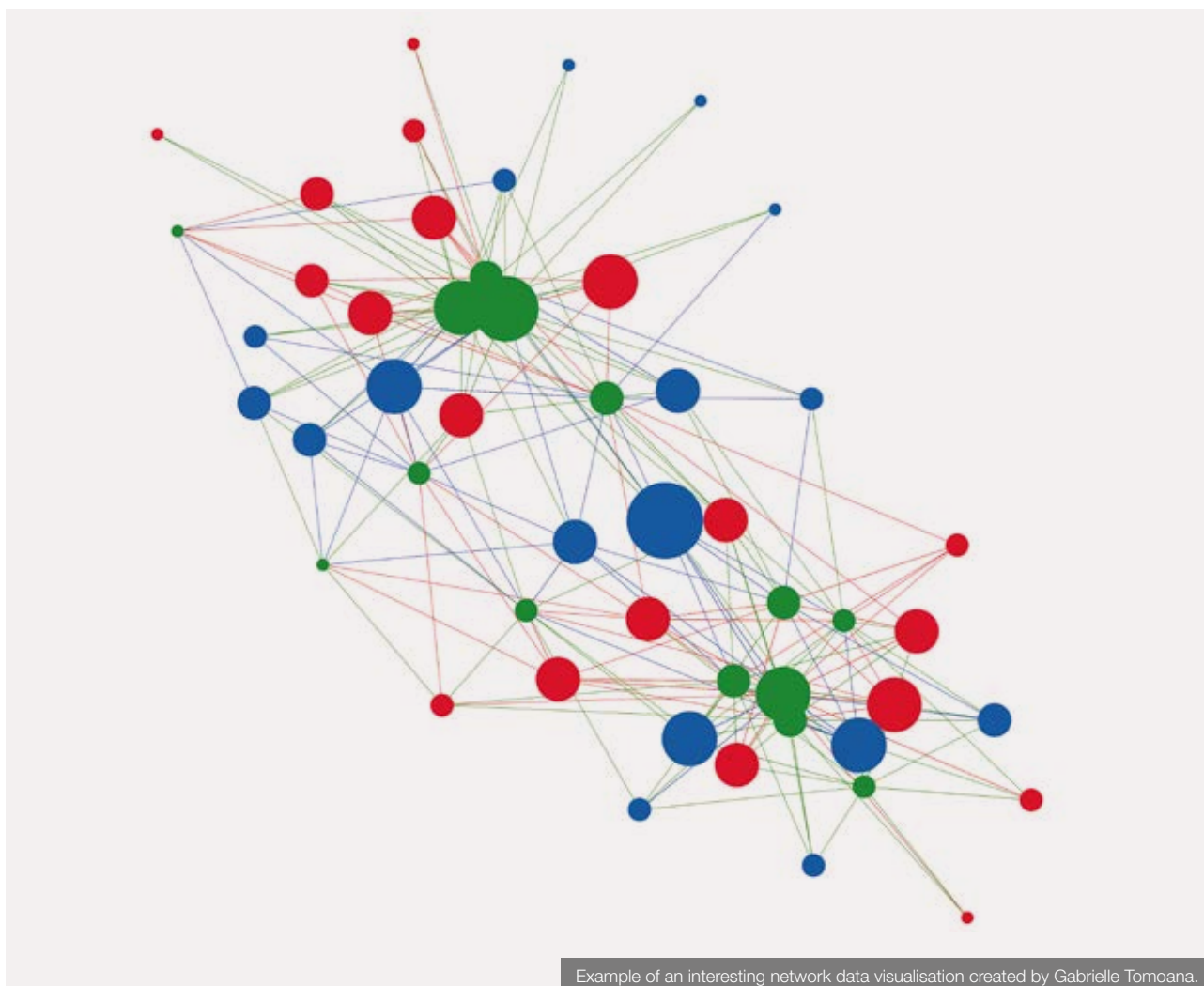
Example of an interesting network data visualisation created by Gabrielle Tomoana.

Partnerships with Māori

Te Pūnaha Matatini partners with Māori organisations and communities to support the distinctive contribution of Māori to complex systems and networks in Aotearoa New Zealand.

In 2016, we established a significant relationship with and participation within two Māori business and innovation networks.

Te Waka o Tama-rereti is funded by the Vision Mātauranga Capability Fund through a collaboration between the Science for Technological Innovation National Science Challenge, the Biological Heritage National Science Challenge, and Ngā Pae o te Māramatanga to network Māori expertise in genomics, informatics, and technology. The network includes smaller ICT, informatics, and genomics businesses, iwi representatives, and Māori researchers. Te Pūnaha Matatini gave two presentations to this forum. Te Pūnaha Matatini has undertaken to present to the forum in 2017 about the Kia ora Hiri project.

In 2016, we continued to partner with the Māori Centre of Research Excellence, Ngā Pae o te Māramatanga, to directly fund paid internships on research projects for Māori postgraduate students.

We trialled a team-based student internship programme with teams funded by stakeholders to work on projects within organisations and businesses. Toni Wi, a Masters of Antarctic Science student of Māori descent, was team leader for the three-person team that worked on a project within the Social

Investment Unit, Ministry of Social Development, looking at direct benefits of the social investment approach. Gabrielle Tomoana, a Masters of Applied Statistics student at Victoria University, Wellington was team leader for the planned project with Statistics New Zealand which was unable to take place because of the Kaikoura earthquake and damage to Statistics House. Gabrielle led a team working on a digital humanities project supervised by investigator Dion O'Neale.

Te Pūnaha Matatini collaborates with the Participatory Science Platform for South Auckland, South Sci, which is an MBIE-funded science outreach programme focused on hard-to-reach communities, to provide scientific expertise to community-led science projects and to develop paid internship positions for undergraduate and postgraduate students from those communities.

In 2016, we funded an internship at the NGO Sustainable Coastlines for an engineering student of Samoan descent, Shannon Leota, who worked on a project, Best practice in litter data collection: What are the characteristics/core elements that contribute to the success of effective methodologies?

Left to right: Keoni Mahelona, Te Hiku Media, Jamie Chow, Intern, and Shaun Hendy, Te Pūnaha Matatini Director.

Kia Ora Hiri – Complexity science aids language revival and use

Advances in computer learning algorithms have revolutionised voice recognition technology in the last few years, but this is still only available for the world's most widely spoken languages.

In New Zealand, a lack of digitised text and spoken recordings means that spoken Te Reo Māori must be manually transcribed. New Zealanders cannot yet kōrero in Te Teo Māori with digital assistants like Siri.

With its expertise in machine learning and data science, Te Pūnaha Matatini has partnered with Te Hiku Media and Dragonfly Data Science to build an extensive written and spoken corpus of digitised Te Reo Māori in order to create a language model for computer processing of Māori. Te Hiku Media (a charitable joint-Iwi venture between the Far North Iwi of Ngāti Kuri, Te Aupouri, Ngai Takoto, Te Rārawa and Ngāti Kahu) is the kaitiaki and copyright holder of the spoken corpora, which entrusts them with representing the interests of the kaikōrero. Dragonfly Data Science recently developed Kōkako, cloud-based software that digitally monitors the pro-portion of spoken Te Reo Māori language broadcast on radio and television.

This research programme will result in software that will be able to transcribe years of language archives for further learning and research and to provide adaptive video captions for language learners. The software will also be made freely available to other New Zealand organisations for research and licensed for use by commercial organisations. The Māori language has been identified as one of the world's endangered languages. Teaching computers to listen to, and speak, Te Reo Māori will not only provide enhanced access for speakers in to today's digital society, but also help promote, strengthen, and raise awareness of the language world-wide.

Te Pūnaha Matatini has partnered with Te Hiku Media and Dragonfly Data Science to build an extensive written and spoken corpus of digitised Te Reo Māori.
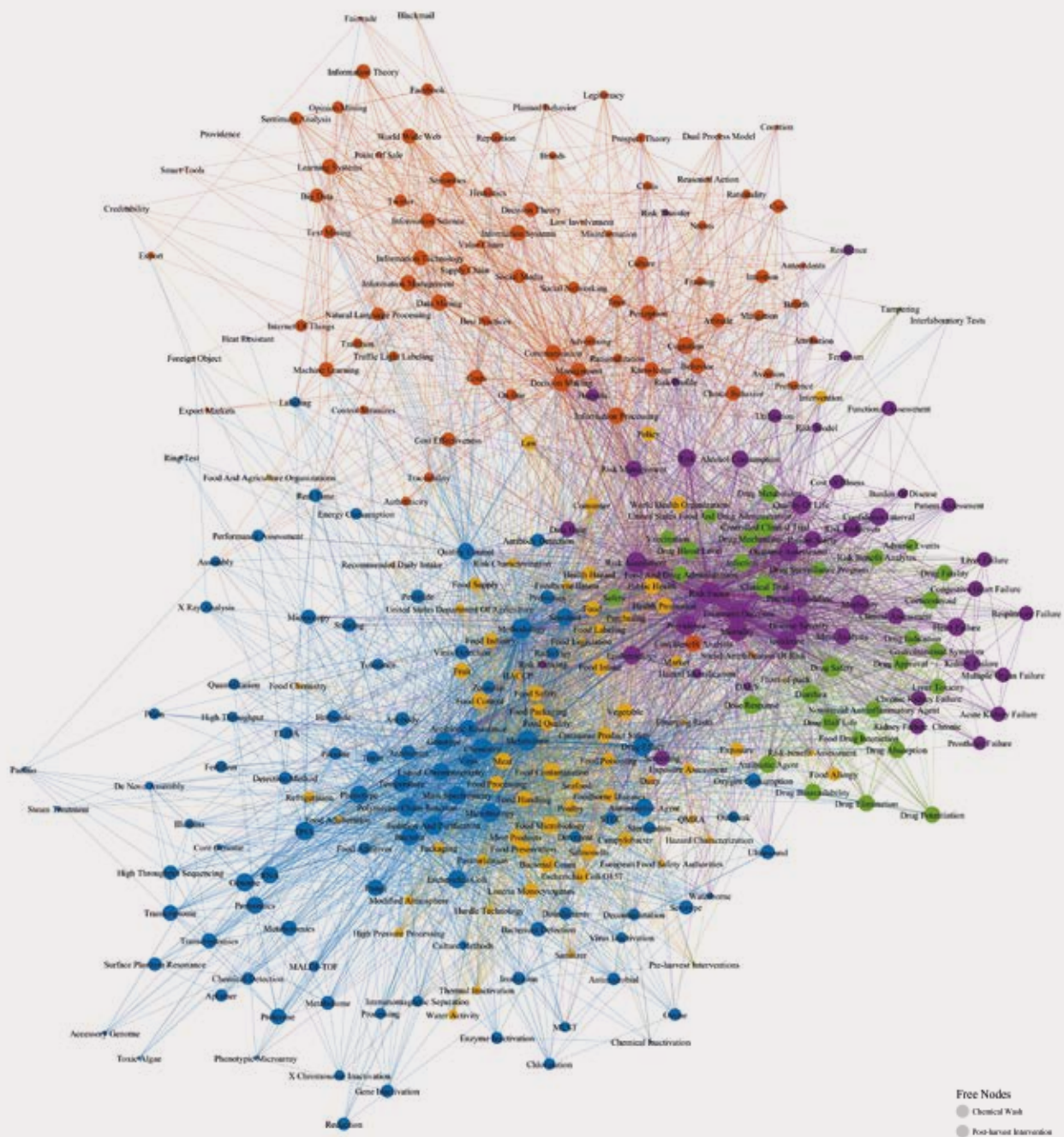
Worldwide Community Detection

Example of a world map of food safety-related topics and their
inter-relationships, developed by Te Pūnaha Matatini researchers for
the New Zealand Food Safety Science and Research Centre.

Communities %

- 30.2181 – Metabolism
- 24.9221 – Decision Making
- 20.8723 – Food Contamination
- 14.3302 – Risk Factor
- 9.6573 – Clinical Trial

Professor Sally Davenport, Principal Investigator at Te Pūnaha Matatini and Director of the Science for Technological Innovation Science Challenge.
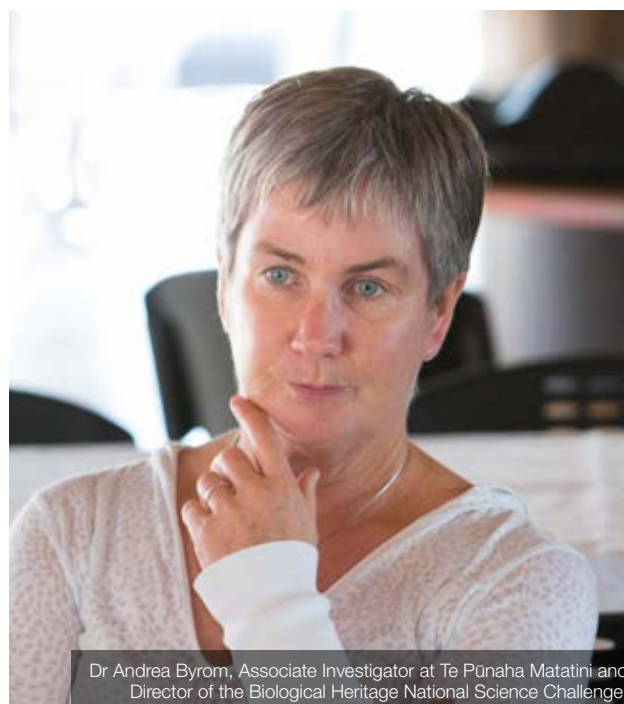
Dr Andrea Byrom, Associate Investigator at Te Pūnaha Matatini and Director of the Biological Heritage National Science Challenge.

Collaboration across the science and innovation system

Te Pūnaha Matatini investigators collaborate with and participate in many other national research collaborations such as the New Zealand Food Safety Science and Research Centre (NZFSSRC), the National Science Challenges, and other CoREs.

These relationships and collaborations leverage the government's investment by ensuring that the unique capabilities and skills being developed by Te Pūnaha Matatini are also available to the rest of the research community.

For instance, a Te Pūnaha Matatini team used its bibliometric mapping expertise to construct a capability map for the NZFSSRC. Using a keyword co-occurrence method, Bonnie Yu, Nickolas Morton, Shaun Hendy, and Frédérique Vanholsbeeck (NZFSSRC), constructed a world map of food safety related topics and their inter-relationships. The capabilities of different countries and regions in each topic were then calculated using revealed comparative advantage. This provides an indication of the strengths and weaknesses of food safety science systems around the world, including the New Zealand system and major trading partners such as China. This will guide the NZFSSRC in making strategic investments in research projects in food safety science.

Te Pūnaha Matatini Investigators Sally Davenport and Andrea Byrom lead the Science for Technological Innovation and the Biological Heritage National Science Challenges respectively, while many other investigators are involved in research projects funded by these Challenges. Te Pūnaha Matatini investigators are also involved with the Deep South and Building Better

Homes, Towns and Cities Challenges. In some instances, Challenges-funded projects have grown out of Te Pūnaha Matatini research projects.

Te Pūnaha Matatini also works closely with other CoREs, co-funding summer scholarships with Ngā Pae o te Māramatanga, and sharing investigators with Ngā Pae, the MacDiarmid Institute for Advanced Materials and Nanotechnology, the Bioprotection Centre, and the Maurice Wilkins Centre for Molecular Biodiscovery. Te Pūnaha Matatini also collaborated with the Dodd-Walls Centre for Photonic and Quantum Technologies on the Maths Craft Festival.

Realising Our Values
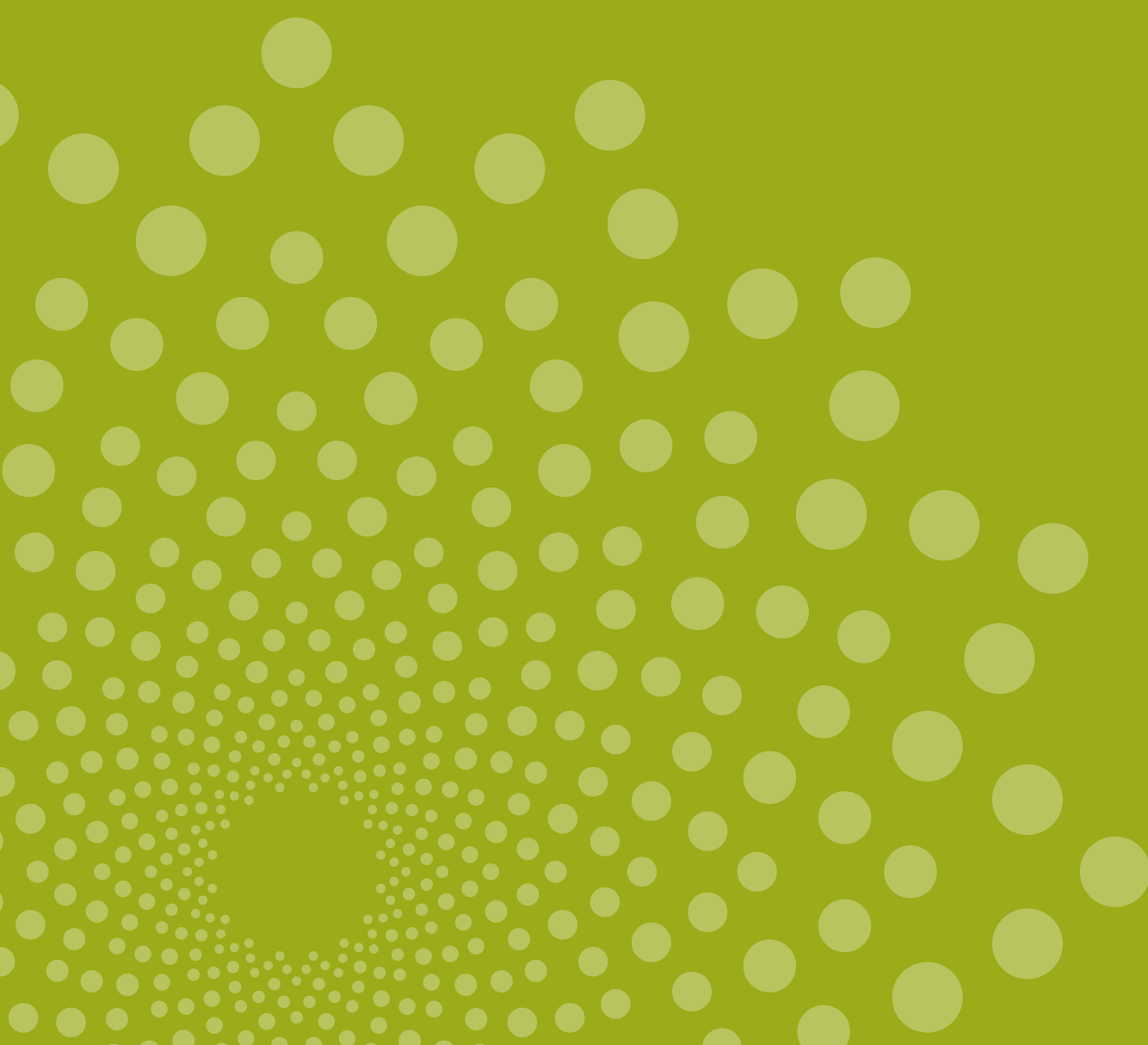
A complex systems approach to studying DNA

Te Pūnaha Matatini Associate Investigator Professor Murray Cox is applying the tools and methodologies of complexity science to explore some of the enduring mysteries of human and agricultural genetics. His transdisciplinary DNA detective work could lead to new health treatments or the development of green pesticides.

I find it really interesting that complex systems or complexity science has such a wide scope," says Murray, a computational biologist based at Massey University's Palmerston North campus.

Working at the Santa Fe Institute, a world-renowned complex systems research centre for two years, proved influential to Murray's work and he has maintained his international connections. But it was the advent of Te Pūnaha Matatini that had him excited about the future of complexity science in his home country.

"Te Pūnaha Matatini is not only driving a lot of new professional connections, but it's also introducing many underexposed fields, like genetics and anthropology, to the powerful tools of complex systems to help solve some really challenging problems."

Murray Cox, Professor in Computational Biology at Massey University.

Studying human DNA

A combination of genetics, anthropology, and computational biology has enabled Murray and an international team of researchers to investigate the origins of the first people to settle in the Pacific. Their findings confirm Asian farming groups were the first to reach Pacific Islands, with later migrations bringing Papuan genes into the region.

Murray says the research demonstrates an interesting dynamic between how society operates and how genes respond – a case of social norms determining who can marry whom and therefore influencing genetic mixing. "That's obviously a complex system, although geneticists probably wouldn't have naturally thought of it in that way."

The international study, published in *Nature*, gave the first basic picture of the genomic make-up of Pacific Islanders. Unlike European New Zealanders, where scientists can leverage from research done in the UK and USA, very little was known about the genomes of Pacific Islanders and Māori.

"We knew that they had a mixture of both Asian and Papuan ancestry, but had no idea how this came about or when," Murray says.

"Knowing this is important because some of the genetic variations caused by this population mixing will likely be linked to health outcomes. Ultimately, understanding this DNA may give us new ideas for health treatments."

Agricultural genetics

The other side of Murray's work explores the interactions between the environment and agricultural genes to explain the spectrum of beneficial and non-beneficial pathogens. For instance, the Epichloë fungus found inside some grass species can produce compounds to deter insects, preventing the need to spray insecticides.

Investigating those complex interactions and underlying genetics could lead to the development of new natural pesticides. "We spray lots of quite nasty chemicals to get rid of pests," Murray says. "But there are some natural pesticides already developed by microbes that we can perhaps co-opt."

Whether he's studying human or agricultural genomes, or combining anthropology with biology, mathematics and statistics, a common thread in Murray's work is a complex systems approach.

"When complex systems approaches are applied to many of these questions, it's exciting to see how those approaches can drive science in completely new directions."

Professor Murray Cox talks about his research using DNA to show that Asian farmers were the first people to settle in the Pacific: http://bit.ly/2egctis

Maths Craft Festival unravels mysteries of mathematics

Enjoy craft? Then you probably enjoy mathematics too, you just may not know it. That was the idea behind the Maths Craft Festival – an event designed to celebrate the many links between mathematics and craft.

Armed with crocheted hyperbolic planes and origami dodeca-hedrons, Te Pūnaha Matatini Principal Investigator Dr Jeanette McLeod from the University of Canterbury brought maths to the masses at the inaugural Te Pūnaha Matatini Maths Craft Festival.

The festival, sponsored by Te Pūnaha Matatini, was the creation of Jeanette McLeod and Dr Julia Collins visiting from the University of Edinburgh. Together with Dr Phil Wilson from the University of Canterbury, they established the first ever event of its kind in New Zealand. They also busted a few myths about maths along the way.

After much planning, crafting, and volunteer training, the festival was held at the Auckland Museum on September 3 and 4 and attracted over 1,800 attendees. The festival combined eight hands-on craft stations with a series of public talks, and was immensely popular, even making an appearance on 1 News. The crowd of attendees, ranging from toddlers to grandparents, got to try their hands at a range of mathematical crafts: crocheting hyperbolic planes, building fractal sculptures, making Möbius strips, and folding origami dodecahedrons. The public talks were given by mathematicians and crafters, and covered topics ranging from the mathematics of knitting and the four colour theorem, to fractals in art and nature, and chaos and the crocheted Lorenz Manifold.

The festival was an experiment, born of a desire to share the beauty of the mathematics in crafts, and it really hit a nerve. The positive feedback was overwhelming, with comments like:

"What a great event, our whole family has enjoyed it, from age 7-47!"

"Thank you for putting up such a cool event! Math is awesome."

School teachers were inspired and indicated that they came away with some fabulous ideas to share with their colleagues and their classrooms across Auckland. In fact, the most common piece of feedback can be summed up by this comment: "Loved it, please repeat!"

The Maths Craft Festival proved to be so popular that the Auckland Museum have asked for it to be run again in 2017. The organisers have been inundated with requests to take Maths Craft to other centres around the country. So we are delighted to announce that they recently received $120k from MBIE's A Nation of Curious Minds fund to take Maths Craft back to Auckland and on the road. In 2017 they'll be packing up craft supplies and taking the quirky brand of maths outreach around New Zealand.

For more information about Maths Craft, or in case you're yearning to fold an origami dodecahedron or crochet a hyperbolic plane, please visit mathscraftnz.org.

In the media: Maths and craft combine at Auckland festival (TVNZ). http://bit.ly/2ppa754

Supporting community-driven science:
Digging the data on rubbish around our coastlines

SouthSci is the South Auckland pilot of the government's Participatory Science Platform, which encourages communities and scientists to work together on research projects.

In 2016 Te Pūnaha Matatini worked with Sustainable Coastlines, Papatuanuku Kokiri Marae, and Koru School to investigate the patterns of litter collected from around the Manukau Harbour.

The team at Sustainable Coastlines had noticed a link between the rubbish found in drains and the rubbish found on beaches. They wanted to explore, with local students, the link between littering and rubbish on our beaches.

The kids collected litter from a beach in Mangere. At the same time, they recorded data about the litter, learning data collection and sampling skills. They used the data to build a database and took part in a workshop with experts from Te Pūnaha Matatini, Fisher & Paykel Healthcare, and Sustainable Coastlines. Our investigators worked with the students to conduct data analysis and visualisation. The graphs they produced showed the break-down of types of litter – from coke cans to car tyres with the aim of understanding the patterns of litter distribution.

A Te Pūnaha Matatini junior data poet, Nickolas Morton, helped the children create the data visualisation that allowed them to identify sources for rubbish around the community.

The last stage of the project was a Policy Makers' Hui, where the students presented their results and interpretation of how littering behaviours in their area affect the Manukau Harbour. The hui was attended by an MP, a local board member and representatives from Auckland Council.

The students' ideas to reduce the impact of littering included lobbying the Minister for Environment with data to ban single-use plastics in New Zealand, starting with plastic shopping bags. Engineers from Fisher & Paykel Healthcare worked with the students on product packaging redesign to reduce waste.

The project was a great example of how data science can be used by communities. The students identified a problem that concerned them, collected and analysed the data they needed, and used this to engage with policymakers. Te Pūnaha Matatini engaged in the project co-development as well as introducing complex data skills. The students developed an understanding of what this type of analysis can do for them.

AUCKLAND | 22 MARCH

DR ADAM RUTHERFORD

Gene Genie

It's just a matter of time until we decipher the whole human genome. This knowledge will present us with wonderful opportunities but also many tricky ethical questions. To what extent can we, and should we, manipulate human and other genomes? BBC 4 science presenter and geneticist Dr Adam Rutherford looks at the implications for sex, paternity, medicine, weight control, species restoration and perhaps even human survival.

Equitable sponsorship

Te Pūnaha Matatini instituted a sponsorship policy – to ensure that events we support reflect our diverse, 21st century society.

In 2016, we worked with the following events, informing the relevant organisations of our stance, and offering to assist with identifying suitable speakers and panellists:

- Adam Rutherford Gene Genie speaking tour March 2016
- Royal Society Te Aparangi Research Honours Dinner
- New Zealand Maths Colloquium Women in Maths Event
- Women in Physics and Maths Retreat
- The Great Southern Unconference
- Maths Craft Festival

Principles of our policy

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

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

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

Adam Rutherford Gene Genie Tour

Te Pūnaha Matatini was proud to support a variety of events in 2016. In particular, the Royal Society New Zealand's Gene Genie tour featuring British science writer and broadcaster Dr Adam Rutherford (pictured above) was an excellent example of diversity in science in action.

The panels convened during Dr Rutherford's tour of New Zealand were particularly successful in terms of their gender balance.

Initiatives promoting positive organisational change

In 2016, Te Pūnaha Matatini's Executive Manager Kate Hannah highlighted the absence of women from the Royal Society of New Zealand's annual prizes, awards, and events.

Kate has also actively promoted both organisational and grassroots approaches that lead to intersectional diversity, supporting institutional approaches such as the University of Auckland's Women in STEMM working group, as well as developing unconscious bias workshops for Te Pūnaha Matatini students and staff. These workshops are frequently requested by other organisations: Rutherford Discovery Fellows, the Department of Physics at the University of Auckland, the Australia New Zealand Society of Nephrology, MBIE, for example.

Te Pūnaha Matatini Executive Manager Kate Hannah (left).

A commitment to diversity

Te Pūnaha Matatini has a strong commitment to diversity – which we understand encompasses equity, access, and inclusion – in science.

In 2016, building on the national leadership role undertaken in 2015, Te Pūnaha Matatini spearheaded a number of initiatives designed to support equity, access, and inclusion in science in New Zealand.

Critical to these initiatives was the decision to codify our diversity and inclusion statement as a policy, and to develop a sponsorship policy for public dissemination via the website. This enables investigators and students to share the policies with organisations and institutions to which they belong, or with event organisers who are seeking sponsorship from Te Pūnaha Matatini, or asking Te Pūnaha Matatini investigators to speak or participate.

Alongside the sponsorship policy, an event code of conduct was developed for Te Pūnaha Matatini events or events that we sponsor. Both the sponsorship policy and code of conduct were benchmarked against international best practice in both science and technology.

The decision to develop these written, public policies was made, both to support the activities of the Te Pūnaha Matatini community, but also to provide examples of that international best practise within a New Zealand context. Our policies have been widely shared within the New Zealand scientific community, and have provided impetus to other organisations

to begin to develop similar policies or guidelines, including: the Faculty of Science at the University of Auckland, the MacDiarmid Institute, the New Zealand Ecological Association, and the Association of CoREs (aCoRE).

The unconscious bias workshops that Executive Manager Kate Hannah developed and facilitated in 2015 for Te Pūnaha Matatini investigators and students have gone on to have a national impact, with the Royal Society Te Aparangi, on behalf of the Rutherford Discovery Fellows, asking Kate to run a workshop at the Fellows' annual meeting in November 2016. Kate presented 'He kanohi kitea: working against implicit bias', and workshopped a series of implicit bias and privilege activities with the more than 50 Rutherford Discovery Fellows, acknowledged future leaders in New Zealand science. Kate was also invited to present 'Kanohi ki te kanohi: unconscious bias and decision-making in clinical practice' as keynote at the annual meeting of New Zealand's Nephrology specialists in October 2016.

Te Pūnaha Matatini's leadership in diversity and inclusion, and development of policies, processes, and training opportunities related to increasing equity, access, and inclusion, are a critical starting point for our public engagement and other activities, which reflect our focus on equity, access, and inclusion.

5cm

Pre-European Māori obsidian artefacts. *Image credit: Associate Professor Mark McCoy.*

Māori social systems focus of novel research collaboration

Archaeology and modern network science are combining to investigate the development of Māori social networks over time as part of a new three year Marsden-funded project.

Oral information passed through generations has long provided the best evidence of the complex and dynamic nature of Māori social organisation. But now a team of Te Pūnaha Matatini principal investigators are using a novel combination of archaeology and network science to provide new insights into these social changes.

Principal Investigators Professor Thegn Ladefoged and Dr Dion O'Neale and PhD student Caleb Gemmell from the University of Auckland, are investigating the development of Māori social networks over time as part of a new three year Marsden-funded project.

Thegn explains that over centuries relatively autonomous village-based Māori groups have transformed into larger territorial hapū lineages, which later formed even larger iwi associations:

"We can reconstruct historical systems of inter-iwi trade by researching ancient obsidian tools and their movement across New Zealand".

The research group will then combine this archaeological and location data with social network analysis modelling and local iwi input to provide new insights into how Māori society was transformed from village-based groups to powerful hapū and iwi.

Te Pūnaha Matatini Whānau PhD student Caleb Gemmell says they are able to analyse data from a set of obsidian artefacts, including the archeological site where each artefact was discovered as well as the original location where pre-European Māori sourced it from.

"Previously, papers had focussed on a small collection of sites, but social network analysis aims to study the total dataset as a network, and analyse the properties of this network. The property we focussed on was the idea of 'community detection' in which an algorithm divides the network into smaller groups basised on where the archaeology sites were getting their obsidian."

The collaborative research project also aims to connect or reconnect Māori with their taonga held in museums and university archaeology collections.
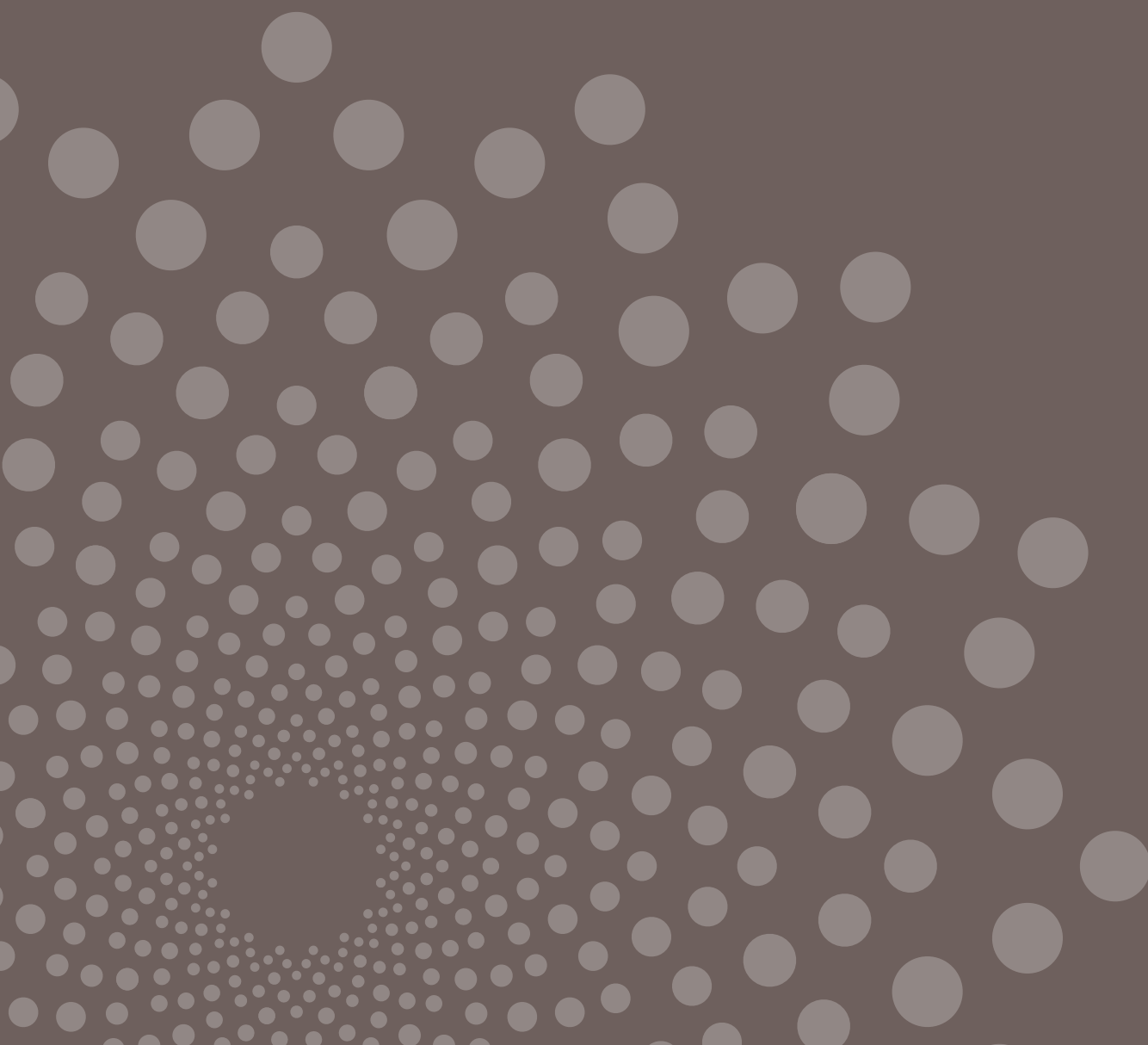
Te Pūnaha Matatini Director Shaun Hendy says the project demonstrates the ability of New Zealand's Centres of Research Excellence to connect and amplify the efforts of researchers across a wide range of fields and locations. "We all know that research needs to become more interdisciplinary, but we also know that this is easier said than done. I am really pleased that Thegn and his team have taken advantage of Te Pūnaha Matatini's diverse network of researchers to tackle such an exciting project."

The research team also includes Associate Professor Mark McCoy from the USA's Southern Methodist University, and Alex Jorgensen from the University of Auckland who will use portable X-ray fluorescence to characterize and source obsidian artefacts. Assistant Professor Chris Stevenson from Virginia Commonwealth University will develop obsidian hydration dating of artefacts to establish tight chronological control of changing levels of interaction.

International collaborations

Pierre Roudier	Australian Antarctic Division, Hobart, Australia. Research topic: Antarctic bioregionalisation.
Stephen Marsland	Beijing International Mathematics Research Centre, Beijing, China. Research topic: Sparse Locally Linear Embedding. (Funded visit)
Roger Pech	China Agricultural University, Beijing, China. Research topic: Ecology and management of out-breaking pest species.
Andy Philpott	Ecole des Ponts, Paris, France. Research Topic: Risk averse competitive equilibrium. SESO programme funded by Programme Gaspard Monge d'Optimization (PGMO).
Adam B. Jaffe	Ecole Polytechnic de Lausanne, Lausanne, Switzerland. Research topic: Patent quality.
Stephen Marsland	Fields Institute, Toronto, Canada. Research topic: Kernels: A Geometric Perspective. Marsland was invited to give a series of lectures and collaborate with Adrian Nachmann and Boris Khesin.
Andy Philpott	INRIA, Ecole Polytechnique, Paris, France. Research topic: MIDA. Joint research under Programme Gaspard Monge d'Optimization (PGMO).
Stephen Marsland	Institute for Mathematical Sciences, Singapore. Research topic: Shape analysis.
Michael O'Sullivan	MBI, TU Graz, Graz, Austria. Research topic: Simulation – Conceptual Modelling and Implementation.
Adam B. Jaffe	Queensland University of Technology, Brisbane, Australia. Research topic: The scientific roots of green innovation in electricity supply.
Murray Cox	St John's College, Oxford, United Kingdom. Research topic: Modeling Population Structure in ISEA. 2016 Visiting Fellowship, awarded by Governing Body of St John's College, University of Oxford and admitted to the Senior Common Room. Principal Investigator; £2,989 (NZD$6,934). AND 2016 ACU Titular Fellowship at the University of Oxford Awarded by the Association of Commonwealth Universities (ACU) for a visiting scholarship at Oxford University. Taken at St John's College, Oxford (DF-2015-60). Principal Investigator; £4,989 (NZD$11,882).
Mark Wilson	University of California Irvine, Irvine, CA, USA. Research topic: Electoral systems.
Andy Philpott	University of Sydney, Sydney, Australia. Research topic: Robust optimization (Marsden research).
Suzi Kerr	University of the Andes, Bogota, Colombia. Design of an ETS for Colombia.
Ilze Ziedins	University of Twente, Enschede, Netherlands. Research topic: Sequentially assigning and prioritizing patients at emergency departments. Short visit for a PhD and conference, and an excellent opportunity to interact with the Centre for Healthcare Operations Improvement and Research (CHOIR) at the University of Twente.
Dion O'Neale	USDA-NRC, Sonoma, USA. Research topic: Soil Networks.

Awards, Media, and Whānau

A CoRE of leading researchers

In 2016, several Te Pūnaha Matatini investigators received awards recognising their research efforts, leadership skills, and science communication activities.

Dr Rebecca Priestley

Dr Rebecca Priestley, a Senior Lecturer in the Science in Society Group at Victoria University of Wellington, was awarded the 2016 Prime Ministers Science Communication Prize. Rebecca's passion for science from a young age, as well as her love of reading and writing, inspired her to embark on a long and rewarding career in the field of science communication and the history of science. Rebecca has numerous publications to her name and is a regular contributor to the New Zealand Listener. Since receiving the 2016 Prime Minister's Science Communication Prize, she has established the Aotearoa New Zealand Science Journalism Fund.

Rebecca Priestley – New Zealand Herald
http://bit.ly/1ZzcT1u

Dr Siouxsie Wiles

Dr Siouxsie Wiles from the University of Auckland was named a Blake Leader 2016 by the Sir Peter Blake Trust. Siouxsie is an award-winning scientist who has made a career of manipulating microbes. She and her team make bacteria glow in the dark to understand how infectious microbes make us sick and to find new medicines. Siouxsie is also an enthusiastic tweeter, blogger, artist, curator and media science commentator and has won numerous prizes for her efforts.

Siouxsie Wiles – New Zealand Herald
http://bit.ly/2GPQ9rE

Other awards

Dr Alex James: Principal Investigator Alex James received the Fellowship of the New Zealand Mathematical Society at the NZMS colloquium.

Dr Cate Macinnis-Ng: Dr Cate Macinnis-Ng received the Roger Slack Award for Excellence in Plant Science from the New Zealand Society of Plant Biologists.

Professor Murray Cox: Professor Murray Cox received the Massey University Research Medal (Team) for his work 'Decoding the Molecular Basis of Fungal-Plant Interaction'. Murray was also awarded the Humboldt Research Fellowship for Experience researchers from the Alexander von Humboldt Foundation, Germany.

Dr Troy Baisden: Dr Troy Baisden received the Editor's Award from the Journal of Hydrometeorology, for excellence in reviewing at the American Meteorological Society Annual Meeting (New Orleans, Jan 2016).

In the media

As leading researchers and science communicators, Te Pūnaha Matatini investigators were regularly sought after by local and international media in 2016 to offer expert opinion and comment on a vast range of subjects.

- The launch of Te Pūnaha Matatini was profiled by RNZ's Our Changing World – (Science of complex systems.)

Shaun Hendy has a regular slot as Physics Correspondent on Radio New Zealand Nights and has done more than a dozen public talks. Shaun is regularly approached for comment on science and policy by the media.

- Shaun Hendy – Silencing Science (Radiolive)
- The high public cost of muzzling scientists (Stuff.co.nz)
- Prominent scientist talks about Silencing Science (NZ Herald)
- Are New Zealand's scientific experts really dead – or just resting? (The Spinoff)
- Silencing Scientists: Shaun Hendy on why science should be 'open' (RNZ)

Rebecca Priestley, winner of the 2016 Prime Ministers Science Communication Prize, is a regular contributor to the New Zealand Listener and has also appeared regularly in a variety of other media over 2016.

- Rebecca Priestley: anthologising Antarctica (RNZ)
- Antarctica Q&A: Dr Rebecca Priestley (NZ Herald)
- Rebecca Priestley's Dispatches from Continent Seven (Stuff.co.nz)
- Q&A with Mark Broatch, NZ Listener (NZ Listener)
- Individualistic behaviour is increasing energy use, 9 August 2016 (NZ Listener)
- Melted ice age (NZ Listener)
- Long-term hazards of Taupo's supervolcanoes (NZ Listener)
- Rosetta spacecraft: Comets could have played a crucial role in the emergence of life on Earth (NZ Listener)
- The "sound" of black holes banging together (NZ Listener)
- The effects of plastic microbeads in facial scrubs (NZ Listener)
- Kermadec Ocean Sanctuary (NZ Listener)
- Trappings of success (NZ Listener)
- Silencing Science by Shaun Hendy (NZ Listener)
- The intersection of astrophysics and matauranga Maori (NZ Listener)

Siouxsie Wiles, named a Blake Leader 2016 by the Sir Peter Blake Trust, is a regular science commentator on RNZ and also appeared regularly throughout the media in 2016.

- Funds needed to fight superbugs (NZ Herald)
- Brave Eva Mitchell's new challenge (NZ Herald)
- Making science cool for our kids (NZ Herald)
- Prominent scientist talks about Silencing Science (NZ Herald)

- Scientists hope NZ fungi offer 'treasure trove of new anti-biotics' (NZ Herald)
- Siouxsie Wiles is on the hunt for a cure (Stuff)
- The Big Read: Is the world on the brink of an antibiotic apocalypse? (NZ Herald)
- Summer reissue: Who needs scientists when Mike Hosking is here to school us? (The Spinoff)
- In the fight against the superbug apocalypse, don't fall for the idea that infectious diseases only happen somewhere else (The Spinoff)
- Superbugs spark fears of superbug apocalypse (Otago Daily Times)
- Urgent action needed to combat killer infections (Stuff)
- Superbugs found in everyday activities, but don't fret over them (Stuff)
- Calling a vagina a vagina: why cutesy code words are terrible for our sexual health (The Spinoff)
- 2016 Blake Medallist and Leaders named (NBR)
- Glow-in-the-dark bugs bring art to life (NZ Herald)

Michelle Dickinson, winner of the Callaghan Medal for science communication, is a trusted name in science media in New Zealand. Michelle was regularly a featured contributor for NZ Herald, RadioLive and Newshub.

- Nanogirl Michelle Dickinson joins Sainso before the 'Little Bang, Big Bang' live science tour (Radiolive)
- Nanogirl – Dr Michelle Dickinson (RNZ)
- Michelle Dickinson: "There is a little girl out there, nine weeks old ... she is genetically half mine" (Noted)
- Michelle Dickinson on getting kids into science (ASB)
- Nano Girl Michelle Dickinson: The quality of science (NZ Herald)
- Nano Girl Michelle Dickinson: NZ could be medicinal cannabis pioneer (NZ Herald)
- Extra day to make our calendars stay in line (NZ Herald)
- Michelle Dickinson – Dream Team session (The Sir Peter Blake Trust)
- Vodafone xone Innovators Series: Michelle Dickinson (AKA Nanogirl) on changing kids' attitudes towards science and technology (Idealog)
- Nanogirl Michelle Dickinson will travel the country to show science is 'cool, loud, fun' (Stuff.co.nz)

Isabelle Sin

- Employee trial period a failure – report (RNZ)
- 90-day trials 'aren't doing much at all' – research (Stuff.co.nz)
- John Key dismisses research that finds 90-day trial doesn't boost employment (NZ Herald)

- Key dismisses report (TVNZ)
- 90-day trial law a 'paper tiger' (Newshub)
- Ninety-day trial period has no impact on hiring (NBR)
- 'We're comfortable law is working' – Key dismisses report on 90-day trials (TVNZ)

Other Te Pūnaha Matatini investigators whose research featured in the media in 2016:

Murray Cox
- DNA detectives rewrite human history (NZ Herald)
- Skeletons reveal ancestors of Māori (NZ Herald)
- New research on ancient Pacific skeletons reveals Māori ancestors (Stuff.co.nz)
- Ancient DNA shows Asian farmers first Pacific people (RNZ)
- DNA shows first inhabitants of Vanuatu came from Philippines and Taiwan (The Guardian)
- DNA reveals Lapita ancestors of Pacific Islanders came from Asia Personal profile in the Dominion Post (ABC Australia)
- Delving deep into the genetic code (The Dominion Post)

Andrea Byrom
- Andrea Byrom: science challenges and pests (RNZ)
- Restoring freshwater ecosystems (Regional Newspapers)
- Cash to give pests run for money (NZ Herald)

Cate Macinnis-Ng
- Government lays out scientific roadmap (RNZ)
- Climate change needs to be treated with more urgency, says scientist (NZ Herald)
- Auckland mayoral candidate Vic Crone defends climate change comments (NZ Herald)

Kate Hannah
- In 2016, the Massey chancellor says women vets are worth 'two fifths' of men. And we wonder why there are too few women in science (The Spinoff)

Richard Easther
- Scientists say they've found a planet in a habitable zone – and it's Earth-sized (Stuff.co.nz)
- Science report with Professor Richard Easther (Radiolive)
- The Kaikoura quake brought out the best in GeoNet. Not so much in some politicians (The Spinoff)

Dan Hikuroa
- Transforming Māori communities (Stuff.co.nz)
- Dan Hikuroa looks at Māori involvement in the formation of a new plan for the Gulf (Gulf Journal)

Rachael Ka'ai-Mahuta
- Indigenous voices with Dr Rachael Ka'ai-Mahuta (Born Digital 2016)
- Maori Language Week 2016: Facebook in deal to take native language to modern day (NZ Herald)

Dion O'Neale
- Māori social systems focus of a novel research collaboration (Scoop)

Pierre Roudier
- Soil science with Pierre Roudier on RNZ Nights (RNZ Series)

Rhian Salmon
- Ice Science (RNZ)

Suzi Kerr
- Assessing the impacts of Motu's Low-Emission Future Programme (Blog)

Tava Olsen
- Tava Olsen: Here is a hot solution to Auckland's traffic congestion (NZ Herald)
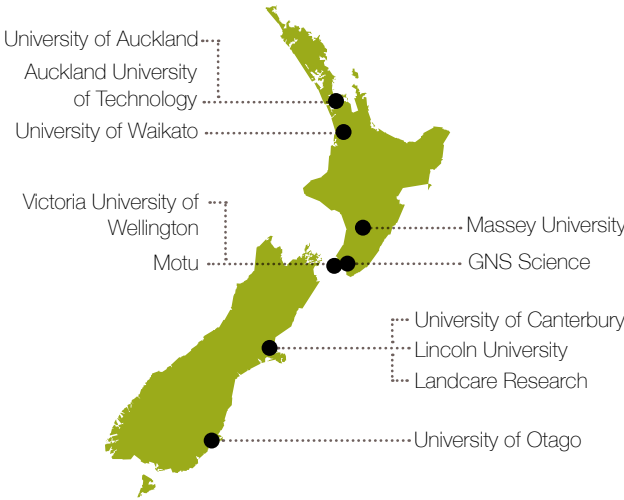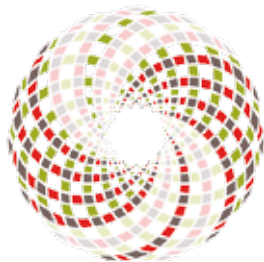
Back row (from left): François Vallée (Massey), Rachelle Binny (Landcare Research), Jonathan Goodman (Canterbury)
Front row: Kyle Higham (VUW), Catriona Sissons (Auckland), Oscar Dowson (Auckland), Audrey Lustig (Landcare), Ben Curran (Auckland).

Te Pūnaha Matatini Whānau

Te Pūnaha Matatini Whānau is a network for the emerging scientists of Te Pūnaha Matatini. The Whānau is an active transdisciplinary community, with a shared interest in complex systems and networks. The Whānau has 60 postgraduate students, postdocs and early career researchers from all over New Zealand.

Te Pūnaha Matatini Whānau is a meeting place for early career researchers to develop new skills, in particular leadership and entrepreneurship, and acquire the tools needed to become successful scientists and entrepreneurs in New Zealand. Whānau provides a space for collaboration and skill sharing and members are encouraged to take an active role in shaping shared goals and activities.

University of Auckland
Auckland University of Technology
University of Waikato
Victoria University of Wellington
Motu
Massey University
GNS Science
University of Canterbury
Lincoln University
Landcare Research
University of Otago

Strengthening networks

2016 proved a busy year for the Whānau, with the many great events organised by members providing opportunities to build technical skills, form new collaborations, and strengthen our network of emerging complex systems researchers. The first major event organised by members of the Whānau was held in June, a one-day workshop on scientometric analysis and topic modelling at the University of Waikato. This workshop, in addition to laying the groundwork for the first Research Bootcamp, provided an opportunity for members to capitalise on the diversity of skills present within the Whānau and learn the fundamentals of one of many fields of complex systems research.

In August, the inaugural Research Bootcamp was held at the remote, distraction-free University of Auckland field station at Leigh, and was designed to promote research collaboration among Whānau members. By bringing a group of four members together to tackle a research project over an intensive five-day period, participants were able to produce a draft manuscript by the end of the week. There are plans to submit this paper to a journal in the coming months. The project involved applying techniques from the workshop to create networks of NZ MPs based on their parliamentary speeches topics and represented a true cross-disciplinary collaboration resulting from the existence of the Whānau network.

Many Whānau have expressed interest in attending future bootcamps, which we plan to hold at other remote locations, as well as options for less-intensive formats to accommodate those who are unable to spend a week away.

A two-day Whānau October event in Auckland saw members participate in a cross-CoRE commercialisation workshop (in conjunction with Return on Science and the Dodd-Walls Centre) and a technical skills workshop run by NESI (New Zealand eScience Infrastructure), focused on resources available for high-powered computing and identifying needs for future computation workshops. Participants found both events highly valuable, as many had not had exposure to the possibilities available in either of these realms.

The last, and largest, event of the year for the Whānau ran in parallel with the Te Pūnaha Matatini End-of-Year Hui held in Wellington in December. Members participated in a wide range of activities including a workshop on entrepreneurship with local entrepreneurs, a hands-on technical computing workshop, and brainstorming activities and planning for the coming year. It also featured social team building activities. The high attendance meant many people were able to meet face to face for the first time, which we see as essential for our geographically dispersed network.

Our Research

Risk, Uncertainty, and Decision-Making

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

Our work

The measurement, interpretation, and communication of complexity and risk is a key part of modern science.

Researchers working within Te Pūnaha Matatini's Risk, Uncertainty, and Decision-Making theme (formerly called Complex Data Systems) are developing tools for understanding and dealing with complex systems. Using a mix of qualitative and quantitative research methods, their work includes optimising stochastic systems from supply chains to healthcare, inferring numbers of New Zealand birds from their calls (AviaNZ), building a library of New Zealand soils from the spectral signatures, and developing new mechanisms for reflexive analysis of science communication activities by scientists. Public engagement with science is also a key part of Te Pūnaha Matatini's

work, and the researchers in this theme are working on ways to foster scientist-public interactions.

This theme has received substantial additional funding from the Science for Technological Innovation (SfTI) National Science Challenge, the Marsden Fund, and from external stakeholders.

Our impact

Data-driven optimisation techniques developed in our Risk, Uncertainty, and Decision-Making theme will spill over into analytics applications, guiding support systems in the fields of manufacturing, primary production, healthcare, environment, social development, and services. The models and algorithms produced will also aim to communicate risk development of relationships between diverse stakeholders.

Our team

University of Auckland

Principal Investigators:
Ilze Ziedins, Dion O'Neale, Mark Gahegan, Tava Olsen, Mike O'Sullivan, Richard Easther, Andy Philpott
Associate Investigators:
Dan Hikuroa, Michelle Dickinson, Siouxsie Wiles

Victoria University of Wellington

Principal Investigator:
Marcus Frean
Associate Investigators:
Rebecca Priestley, Rhian Salmon

Massey University

Principal Investigator:
Stephen Marsland

Landcare Research

Associate Investigator:
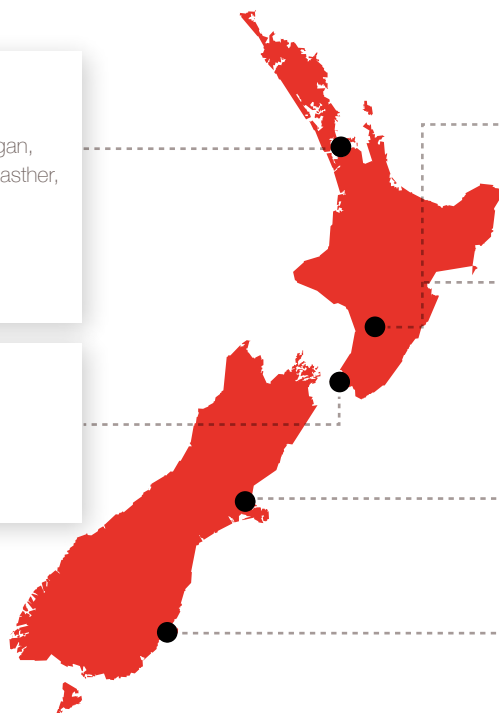Pierre Roudier

University of Canterbury

Principal Investigator:
Jeanette McLeod

University of Otago

Associate Investigator:
Rebecca Ford

Our research

Te Pūnaha Matatini is developing and applying advanced analytics methods including network analysis, methods from dynamical systems and statistical physics, graph theory, generative and agent-based modelling, advanced visualisation techniques, and optimisation to enable understanding and management of increasingly complex systems and networks.

Researchers in Te Pūnaha Matatini work in a variety of areas concerned with this work, much of which underpins our application-focussed work in the other themes.

This theme has changed its scope in response to the developing needs of Te Pūnaha Matatini and evolving trends in our research programme. In particular, at our 2016 cross-theme hui, investigators identified the need for a research project to understand and assess our efforts in science communication and public engagement.

Investigators Dr Rhian Salmon and Dr Priestley will lead a project, The Reflexive Scientist, that builds on a recent paper by Salmon et al. proposing that new mechanisms are required for reflexive analysis of science communication activities by scientists. These mechanisms involve unpacking and articulating the communication objectives of individual science communication practitioners and their organisations, as well as the political and cultural context in which they operate.

Equilibria and dynamics in networks and supply chains:

Tava Olsen

Ilze Ziedens

Andy Philpott

Stephen Marsland

Marcus Frean

Risk, Uncertainty, and Decision-Making

Optimisation of complex information networks:

Andy Philpott

Ilze Ziedens

Michael O'Sullivan

James Sneyd

Marcus Frean

Healthcare analytics:

Ilze Ziedens

Peter Davis

Tava Olsen

Andy Philpott

James Sneyd

Alex James

Stephen Marsland

Find out more about our Risk, Uncertainty, and Decision-Making research.

http://bit.ly/2DHyu2f

Research highlight:
exploring the world with network science

Principal Investigator Dr Dion O'Neale from the University of Auckland.

Associate Investigator Dr Pierre Roudier from Landcare Research.

Te Pūnaha Matatini Principal Investigator Dr Dion O'Neale from the University of Auckland and Associate Investigator Dr Pierre Roudier from Landcare Research are applying network science methods to visualise, analyse, and explore large soil survey data sets as part of a MBIE-funded study.

Using high performance computing, Pierre, Dion and colleagues are collating multiple large data sets from Antarctica, including information on land surface temperature, altitude, wind, and soil environments. A range of numerical methods will then be used to compare the environmental datasets with records of organisms. Researchers can then quantify the relative influence of these factors on life distribution on the frozen continent and the potential impact of changes in these environmental factors, such as temperature.

The use of network science to explore soil survey data in this way provides a new tool for soil scientists, and a contemporary way to extract and infer new knowledge previously hidden by the complexity of the original data sets.

The results will aid the development of environmental risk assessment tools to inform and meet New Zealand's obligations under the Antarctic Treaty. Representing soil survey data as networks also has potential applications in determining a soil's conservation value or informing agricultural practices.

This project demonstrates the innovative development of new techniques on existing data resources. The outputs will include specific outcomes for the management of Antarctica and tools, which may have much wider uses.

Antarctica's Miers Valley. *Image courtesy Pierre Roudier.*
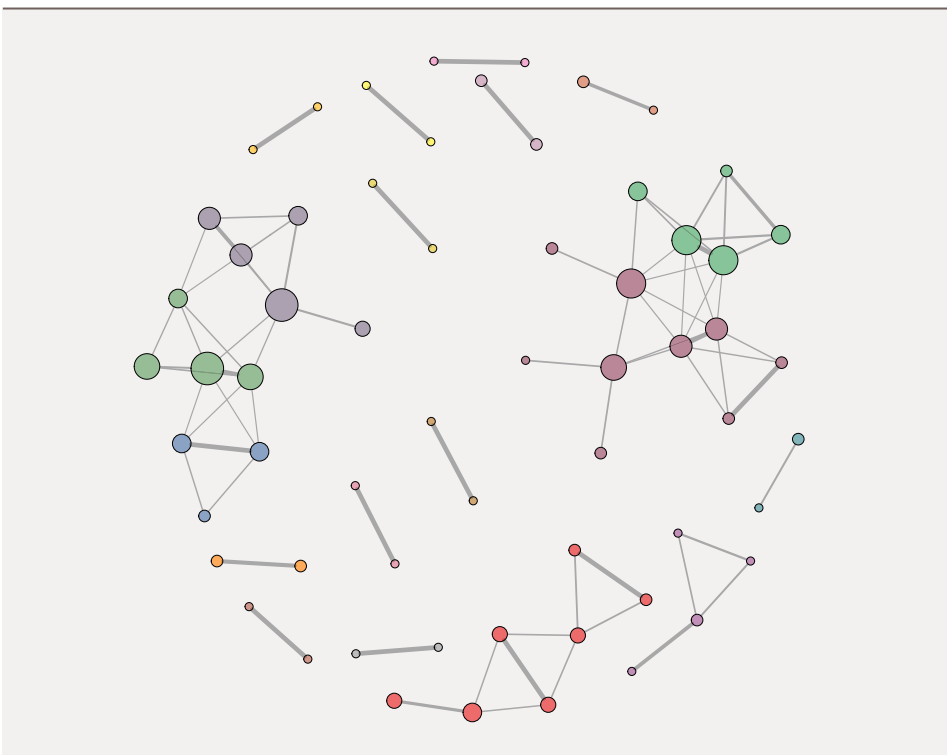
A soil network diagram

Different colours represent different soil communities, and different nodes show different soil types. The network diagram shows the relationships between the soil types and communities.

Complex Economic and Social Systems

The last decade has seen dramatic advances in our understanding of complex economic networks. We're applying new methods from complexity science to better understand New Zealand's economic and innovation performance and social systems.

Our work

New Zealand's inability to close the gap in GDP with other advanced economies has been attributed to our small scale and distance from major markets, but the manner in which these factors influence the New Zealand economy's ability to capture and benefit from knowledge spillovers is largely unexplored.

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

Our impact

Understanding the potentiality of spillovers from diversity will inform government policy and decision-making, and will assist in the evaluation of the effectiveness and impact of government policies.

Our team

University of Auckland

Principal Investigators:
Dion O'Neale, Shaun Hendy, Tava Olsen, Peter Davis
Associate Investigators:
Barry Milne, Mark Wilson, Michelle Dickinson

Waikato University

Associate Investigator:
Les Oxley

Victoria University of Wellington

Principal Investigators:
Marcus Frean, Michele Governale, Sally Davenport, Uli Zuelicke

PhD Student:
Kyle Higham

Massey University

Principal Investigator:
Stephen Marsland

Motu Research

Principal Investigators:
Adam Jaffe (Theme Leader), David Maré, Izi Sin

University of Canterbury

Principal Investigators:
Alex James, Jeanette McLeod, Mike Plank
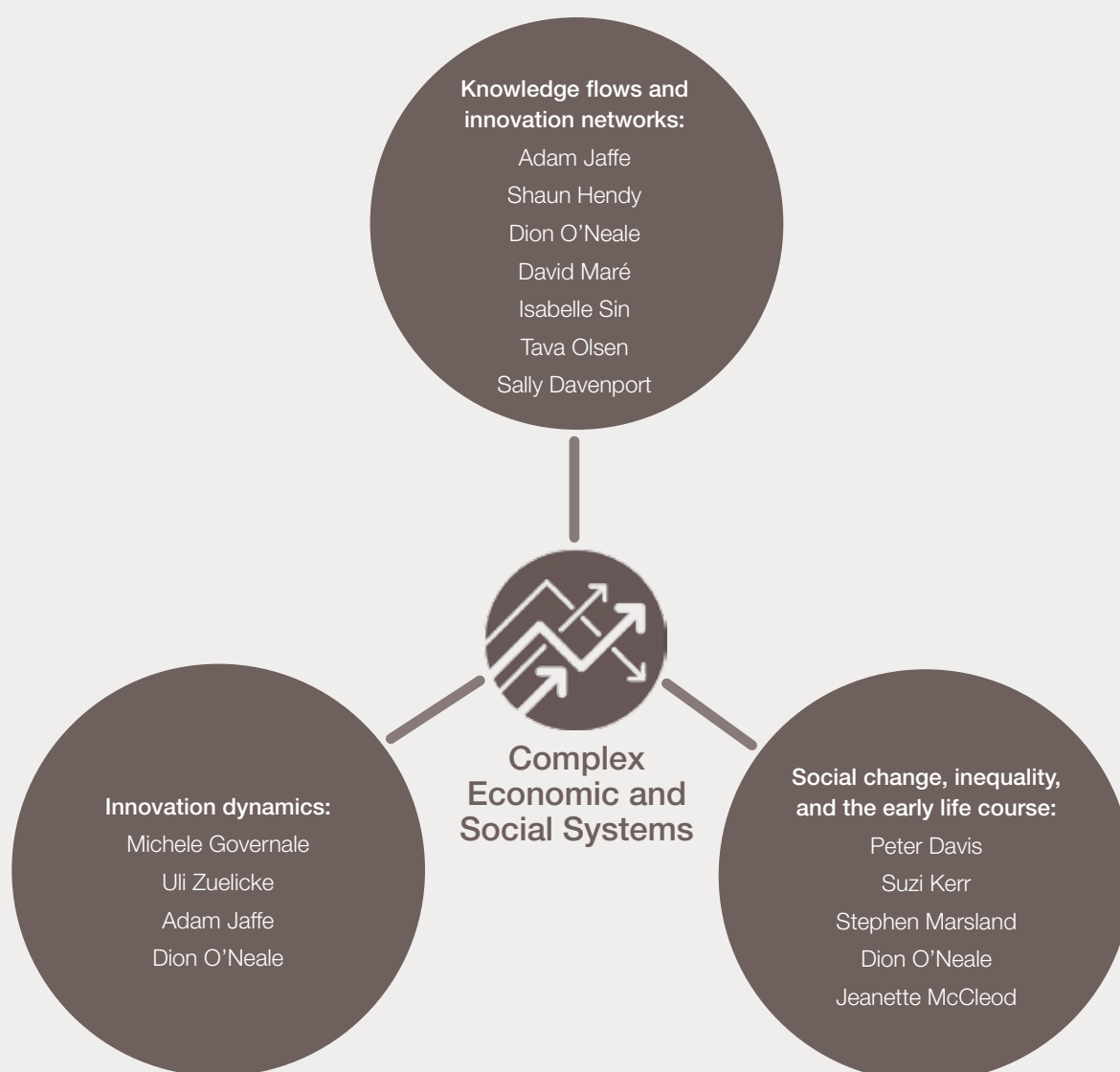
Postdoctoral Fellow:
Daniel Lond

Our research

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

Applications of new methods for looking at New Zealand's social development data form the basis of the partnership that Te Pūnaha Matatini established with the Ministry of Social Development in 2015, with $114,000 of funding for a postdoctoral fellowship examining predictive risk modelling for child protection.

The project (Network Science for the Social Services Sector) has used social network analysis to develop a new model that uses relationship information held by the Ministry to assess risk to children. The project has also enabled a postdoctoral fellow Daniel Lond to work closely with Ministry data analysts, enabling him to widen his networks within government, and allowing these analysts to absorb the latest network analysis methods.

In 2016, Te Pūnaha Matatini and Motu Research completed the two-year research programme with the Productivity Commission "Research Partnership for the Longitudinal Business Data'.

Knowledge flows and innovation networks:
Adam Jaffe
Shaun Hendy
Dion O'Neale
David Maré
Isabelle Sin
Tava Olsen
Sally Davenport

Complex Economic and Social Systems

Innovation dynamics:
Michele Governale
Uli Zuelicke
Adam Jaffe
Dion O'Neale

Social change, inequality, and the early life course:
Peter Davis
Suzi Kerr
Stephen Marsland
Dion O'Neale
Jeanette McCleod

Find out more about our Complex Economics and Social Systems research.
http://bit.ly/2u5oErt

Research highlight: knowledge flows and innovation networks
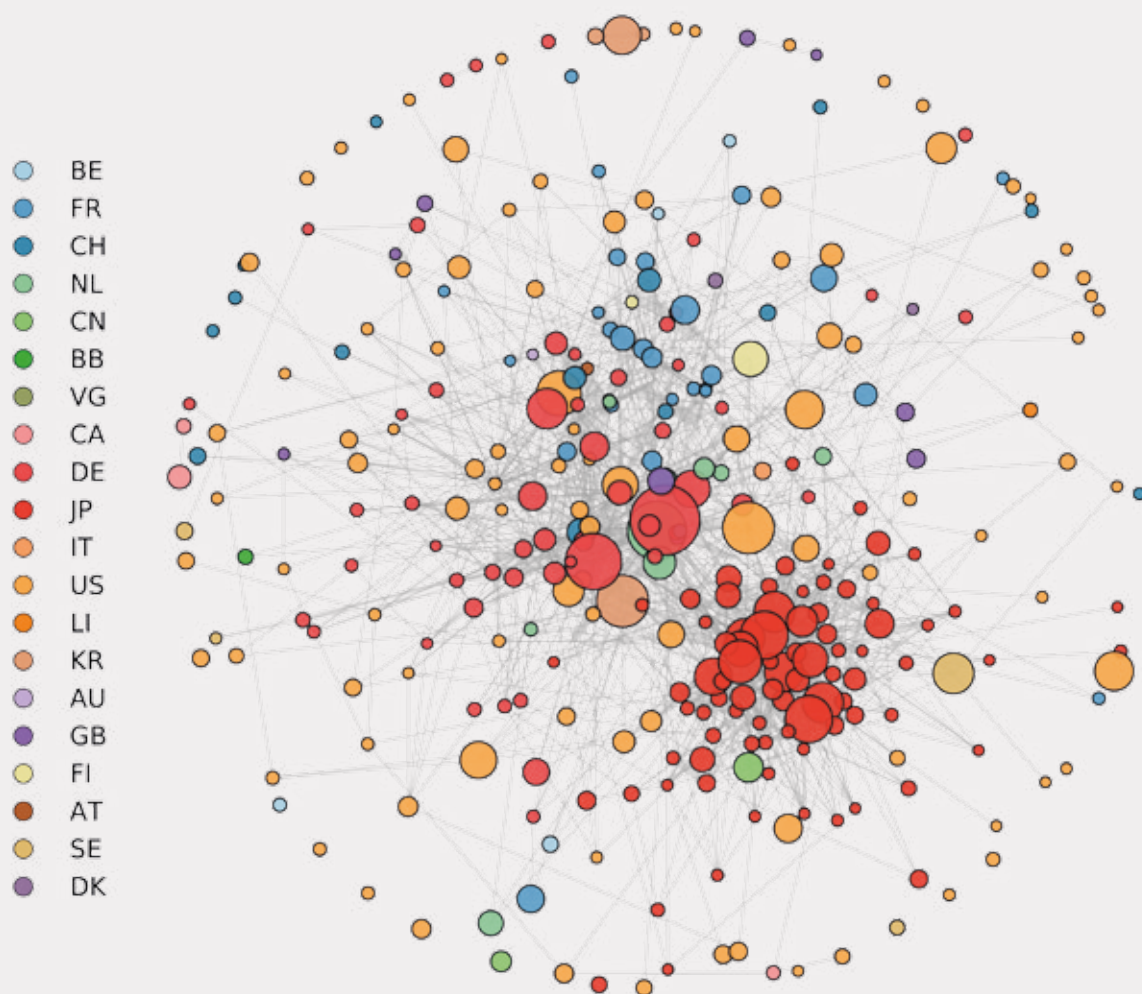
This is a network of the institutions with more than 1,000 patent applications under the European Patents Office. Each node is a different institution. Node size is proportional to the number of patents and node colour is the country of the institution. Links represent collaborations between two institutions and the width of the link is proportional to the number of patents they have collaborated together. The network is a result of a force-directed model that combines an attractive force (which pulls connected nodes toward each other) and a repulsive force (which disperses them).

Understanding how scale, diversity, and connectivity affect the ability of firms to capture and benefit from knowledge spillovers is critical for the development of better innovation policies and practises in New Zealand.

Professor Shaun Hendy, Dr Dion O'Neale, and PhD students, Demival Vasques Filho and Catriona Sissons, have continued their network-based analyses of patent data. A gravity model has been developed to describe features of a collaboration network between firms and other organisations using patent co-ownership data at the country and regional levels. Collaboration between firms across national or regional borders is found to decay strongly with distance and is roughly proportional to country or regional patent abundance, leading us to introduce a new measure called revealed collaborative preference. A similar gravity model has been used to describe features of a collaboration network between universities using bibliometric co-authorship data. Collaboration between universities is also found to decay strongly with distance and is approximately homogeneous with total university output. The resulting collaborative network can also be examined using revealed collaborative preference. MBIE funded a Te Pūnaha Matatini summer intern, Samin Aref, to apply some of these methods to their bibliometric data set.

Professor Jaffe has continued his work on evaluating public research support programmes. He served on the Steering Group for MBIE's review of the Marsden Fund, as co-Chair of the OECD Global Science Forum Experts Group on 'Effective Operation of Competitive Funding Systems,' and was elected Chair of the New Zealand ORCID Consortium Advisory Committee.

Patent network science PhD students Demival Vasques Filho (left) and Catriona Sissons (right).

🌿 Complexity and the Biosphere
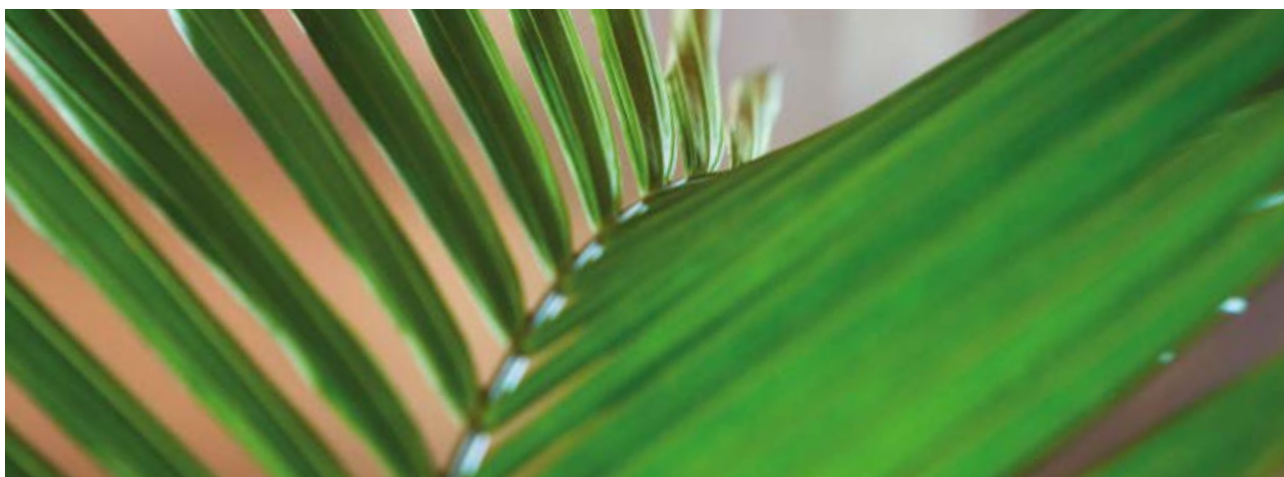
We're making use of data concerning New Zealand's biodiversity in order to better understand New Zealand's unique flora and fauna.

Our work

The diversity of life on Earth is the planet's most striking feature; recent estimates are that fewer than a million of approximately eight million animal species have been described. New Zealand's native flora and fauna are a unique taonga to be preserved for future generations. We are very excited to be playing our part in the government's recent commitment to Predator Free New Zealand by 2050.
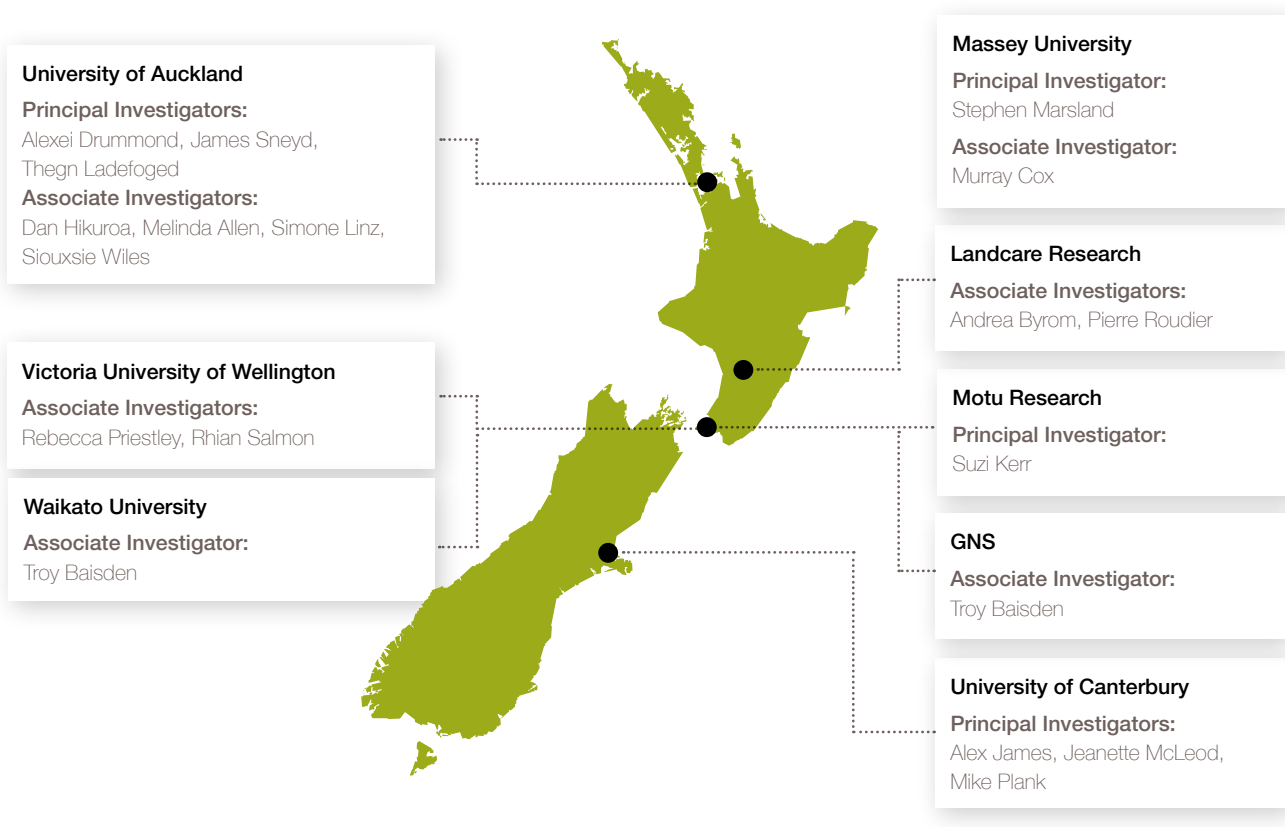
We're applying network analysis, complexity theory, and dynamical systems methodologies to understand the biosphere; developing models that couple the interactions between bio-diversity, the economy, and human decision-making.

Our impact

Our Complexity and the Biosphere research helps to inform national and local government policy and decision-making, and aims to provide the data that New Zealanders can use to better understand the relationship between us and our unique flora and fauna.

Our team

University of Auckland

Principal Investigators:
Alexei Drummond, James Sneyd, Thegn Ladefoged
Associate Investigators:
Dan Hikuroa, Melinda Allen, Simone Linz, Siouxsie Wiles

Victoria University of Wellington

Associate Investigators:
Rebecca Priestley, Rhian Salmon

Waikato University

Associate Investigator:
Troy Baisden

Massey University

Principal Investigator:
Stephen Marsland

Associate Investigator:
Murray Cox

Landcare Research

Associate Investigators:
Andrea Byrom, Pierre Roudier

Motu Research

Principal Investigator:
Suzi Kerr

GNS

Associate Investigator:
Troy Baisden

University of Canterbury

Principal Investigators:
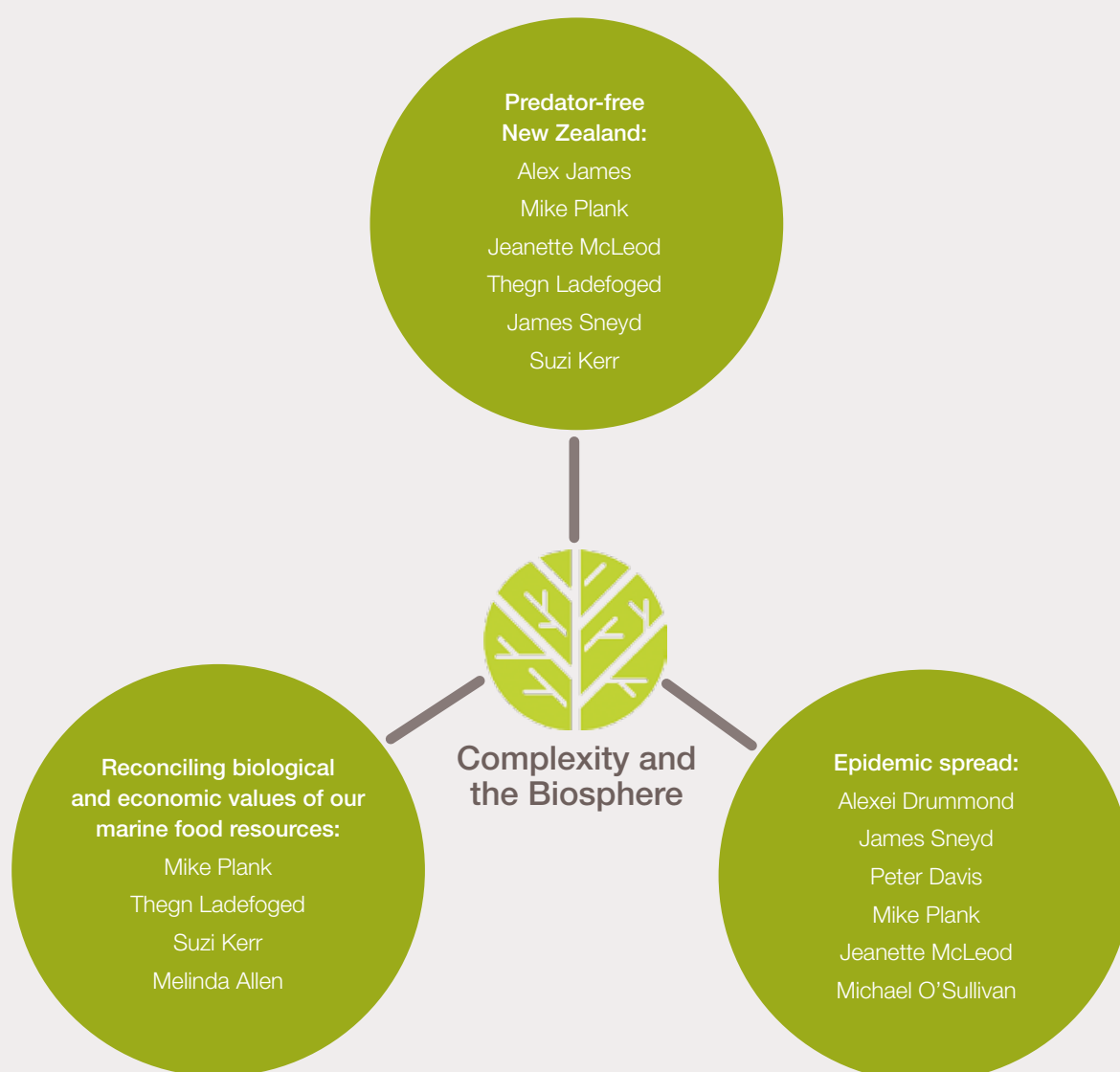Alex James, Jeanette McLeod, Mike Plank

Our research

Making use of data concerning New Zealand's biodiversity will enable better understanding of our unique flora and fauna. This research theme has a close partnership with the New Zealand's Biological Heritage National Science Challenge, via investigator Dr Andrea Byrom, its Director.

We work closely with colleagues at Landcare Research; co-funding and co-supervision of PhD students and postdoctoral fellows are a feature of this partnership. Our Biosphere theme leader, Assistant Professor Alex James, is a supervisor and mentor of Dr Rachelle Binny, a postdoctoral fellow and Associate Investigator based at Landcare research. Conversely Landcare Research has provided co-funding and co-supervision for a new PhD student developing methods for using Citizen Science data. Through Associate Investigators Dr Roger Pech and Dr Rachelle Binny, Landcare provides co-supervision of a PhD student

working on pest control in Greater Wellington and a postdoctoral fellow developing pan-regional models of predator control, both based at the University of Canterbury. Finally, the data at the heart of a third Te Pūnaha studentship on possum networks has also been provided by Landcare Research.

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

With Te Pūnaha Matatini, the Complexity and the Biosphere theme is also working across centres. Our project on evolutionary games for small scale fisheries is a joint venture between Principal Investigators Assistant Professor Mike Plank (UC) and Dr Suzi Kerr at Motu.

Predator-free New Zealand:
Alex James
Mike Plank
Jeanette McLeod
Thegn Ladefoged
James Sneyd
Suzi Kerr

Complexity and the Biosphere

Reconciling biological and economic values of our marine food resources:
Mike Plank
Thegn Ladefoged
Suzi Kerr
Melinda Allen

Epidemic spread:
Alexei Drummond
James Sneyd
Peter Davis
Mike Plank
Jeanette McLeod
Michael O'Sullivan

Find out more about our Complexity and the Biosphere research.
http://bit.ly/2HSiPzJ

Image credit: Troy Baisden.

Research highlight: pan-regional pest control

Postdoctoral fellow Audrey Lustig, with supervisors Mike Plank and Alex James at UC and Roger Pech at Landcare Research, is developing a pan-regional model of pest control built on both social and economic data.

Pests are everywhere, from urban gardens to national parks, but agreeing how to control them is not always straightforward. One third of New Zealand's land area is classed as protected, but this still leaves a huge area where the conservation effort has a relatively low priority. Much of this unprotected area is in the hands of private individuals who have a range of views on pest control so land management decisions have to be carefully negotiated and agreed to by a range of different stakeholders from cat-lovers to rabbit-haters. The first major exception is the Cape-to-City project, 'large scale' predator control covering 26,000 ha of agricultural land in Hawkes Bay. This is just a start for a much more ambitious project proposed by four regional councils for the southern part of the North Island. In addition, initiatives like 'Predator-free New Zealand 2050' have a national-scale vision for pest eradication. A major challenge is to make this work in production, peri-urban and urban areas where participation and buy-in from private individuals will be essential. The potential impacts of this large scale control include: improvements in biodiversity and agricultural production, improvements in wellbeing and health for everyone from whanau to iwi through better relationships with the land.

Our approach is to use socio-economic models to assess the feasibility of scaling-up management of invasive mammals outside traditional conservation areas.

This project has strong links with Landcare Research, the Biological Heritage National Science Challenge and the Geospatial Research Institute at UC. It will provide useful information and outcomes to Regional Councils, initially in the lower North Island, and subsequently at a national level.
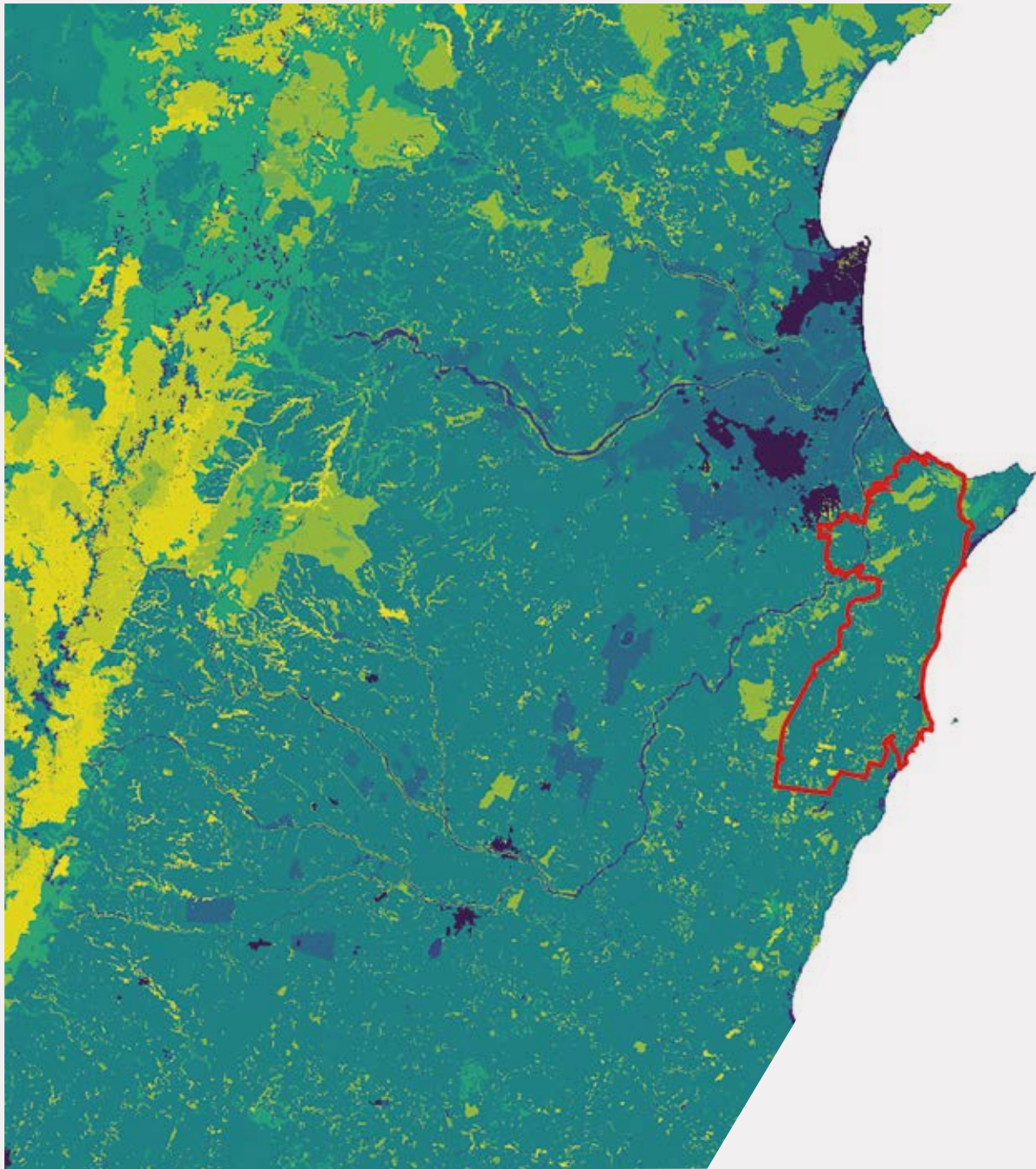
Cape-to-City project, Hawkes Bay

Map of estimated densities of possums in various classes of habitat, characterized by the land-cover they contain (purple colour indicates low densities and yellow colour indicates high densities) across the lower North Island. Such maps form the basis of a generic modelling approach for predicting hot-spots of top mammalian predators activity in an uncontrolled landscape. Such modelling can be refined to predict the abundance and likely persistence of four of New Zealand's top mammalian predators in the light of potential changes in management effort across human-dominated landscapes. We used the Cape-to-City area (red outline) in Hawke's Bay (39°47 0 S; 176°57 0 E) as a case study.

Research Outputs

58
journal
articles

5
books/
book chapters

13
conference
papers

11
international
conference
invitations

Publications and Presentations of Note

Golnar Behzadi, **Michael O'Sullivan**, **Tava Olsen**, Abraham Zhang. 'Designing Models of Resilient and Robust Supply Chain in Agribusiness Under Supply Disruption' *Manufacturing and Service Operations Management Conference*

Binny RN, Haridas P, James A, Law R, Simpson MJ, **Plank MJ**. (2016) 'Spatial structure arising from neighbour-dependent bias in collective cell movement' *PeerJ* 4:e1689

Byrom Andrea E., Innes John, **Binny Rachelle N**, 'A review of biodiversity outcomes from possum-focused pest control in New Zealand' *Wildlife Research* 43(3): 228-253, June 2016

Shaun C. Hendy, 'Science for Policy: the need for a Commission for Science' *Policy Quarterly* 12(3): 46-49, August 2016

Hendy S. *Silencing Science*. Bridget Williams Books

Hikuroa D. Mātauranga Māori – the ūkaipō of knowledge in New Zealand. *Journal of the Royal Society Te Aparangi*

Ka'ai, Tania, Kumar, Benita, **Ka'ai-Mahuta, Rachael**, Patolo, John, and Mahuta, Dean. 'Contemporary issues at the intersection of migration and identity in the Pacific' *International Indigenous Research Conference*

Lay-Yee, R., Pearson, J., **Davis, P**., von Randow, M., Kerse, N. and Brown, L. (2016) 'Changing the balance of social care for older people: simulating scenarios under demographic ageing in New Zealand' *Health Soc Care Community*

Trinh Le & **Adam B. Jaffe** (2016). 'The impact of R&D subsidy on innovation: evidence from New Zealand firms' *Economics of Innovation and New Technology*

Catriona M.O. Macinnis-Ng, Melanie J.B. Zeppel, Anthony R. Palmer, Derek Eamus. 'Seasonal variations in tree water use and physiology correlate with soil salinity and soil water content in remnant woodlands on saline soils' *Journal of Arid Environments* 129: 102-110, June 2016

Philpott, A., Ferris, M. & Wets. 'Equilibrium, uncertainty and risk in hydro-thermal electricity systems' *R. Math. Program.* (2016)

Priestley R. *Dispatches from Continent Seven: an Anthology of Antarctic Science*. Awa Press

Priyadarshani N, **Marsland S**, **Castro I**, Punchihewa A (2016) 'Birdsong Denoising Using Wavelet' *PLoS ONE* 11(1): e0146790

Salmon RA, **Priestley R**, Goven J. The reflexive scientist: an approach to transforming public engagement. *Journal of Environmental Studies and Sciences*

Neda Sakhaee, **Mark Wilson** and Golbon Zakeri. 'Structural Analysis of Legislation Networks' *JURIX* 2016.

Sin I, Chappell N. The effect of trial periods in employment on firm hiring behaviour. *Treasury Working Paper*

François Vallée, Aurélien Luciani and **Murray P. Cox**. 'Reconstructing Demography and Social Behavior during the Neolithic Expansion from Genomic Diversity across Island Southeast Asia' *GENETICS* Early online September 28, 2016

Publications

Journal articles

Allen, M.S., Morrison, A.E., Lorrey, A.M., Zhao, J-X And Jacobsen, G.E., *Archaeology in Oceania* 51(2): 108-121, Timing, magnitude and effects of late Holocene sea level drawdown on island habitability, Aitutaki, Cook Islands.

Emma Best, Tony Walls, FRACP; Melanie Souter; Michel Neeff; Murali Mahadevan; Trevor Anderson; Zahoor Ahmad; **Cameron Walker**; David Murdoch; Nikki Mills, *Vaccine*, Pneumococcal vaccine impact on otitis media microbiology: a New Zealand cohort study before and after the introduction of PHiD-CV10 vaccine.

Binny, Rachelle N., Parvathi Haridas, **Alex James**, Richard Law, Matthew J. Simpson, and Michael J. Plank, *PeerJ*, Spatial structure arising from neighbour-dependent bias in collective cell movement.

Brucato, Nicolas, Pradiptajati Kusuma, **Murray P. Cox**, Denis Pierron, Gludhug A. Purnomo, Alexander Adelaar, Toomas Kivisild, Thierry Letellier, Herawati Sudoyo, and François-Xavier Ricaut, *Molecular biology and evolution*, Malagasy genetic ancestry comes from an historical Malay trading post in Southeast Borneo.

Andrea E. Byrom, John Innes, and **Rachelle N. Binny**, *Wildlife Research*, A review of biodiversity outcomes from possum-focused pest control in New Zealand.

Campbell, Matthew A., Austen RD Ganley, Toni Gabaldón, and **Murray P. Cox**, *The American Naturalist*, The Case of the Missing Ancient Fungal Polyploids.

Chen, Daniel; Anderson, Iain; **Walker, Cameron**; Besier, Thor, *IEEE Trans Haptics*, Lower Extremity Lateral Skin Stretch Perception for Haptic Feedback.

Chuan Kong Koh, Jonathan Marsh, MD, Dragana Drinković, **Cameron Walker**, Peter Poon, *Journal Shoulder and Elbow Surgery*, Propionibacterium acnes in primary shoulder arthroplasty: Rates of colonization, patient risk factors and efficacy of perioperative prophylaxis.

Cox, Murray P., Georgi Hudjashov, Andre Sim, Olga Savina, Tatiana M. Karafet, Herawati Sudoyo, and J. Stephen Lansing, *Molecular Biology and Evolution*, Small Traditional Human Communities Sustain Genomic Diversity over Microgeographic Scales despite Linguistic Isolation.

de Jong, Jamie Victoria, **Jeanette C. McLeod**, and Mike Steel, *SIAM Journal on Discrete Mathematics*, Neighborhoods of Phylogenetic Trees: Exact and Asymptotic Counts.

Dorner, Zack, and **Suzi Kerr**, *Climate Policy*, Implications of global emission policy scenarios for domestic agriculture: a New Zealand case study.

Edwards, Andrew M., James PW Robinson, **Michael J. Plank**, Julia K. Baum, and Julia L. Blanchard, *Methods in Ecology and Evolution*, Testing and recommending methods for fitting size spectra to data.

Grafton, R. Quentin, and **Suzi Kerr**, *Australian Journal of Agricultural and Resource Economics*, Comment: Future directions for Australasian environmental economics.

Greene, Carol Ann, Colin R. Green, **Michelle E. Dickinson**, Virginia Johnson, and Trevor Sherwin, *Experimental cell research*, Keratocytes are induced to produce collagen type II: A new strategy for in vivo corneal matrix regeneration.

Hanley, Nick, **Les Oxley**, David Greasley, Eoin McLaughlin, and Matthias Blum, *Environmental and Resource Economics*, Empirical testing of genuine savings as an indicator of weak sustainability: a three-country analysis of long-run trends.

Hazelton, Martin L., and **Murray P. Cox**, *Computational Statistics and Data Analysis*, Bandwidth selection for kernel log-density estimation.

S.C. Hendy, *Policy Quarterly*, Science for Policy: the need for a Commission for Science.

Hikuroa, D, *Journal of the Royal Society Te Aparangi*, Mātauranga Māori – the ūkaipō of knowledge in New Zealand.

Hong, Shangqin, **Les Oxley**, Philip McCann, and Trinh Le, *Applied Economics*, Why firm size matters: investigating the drivers of innovation and economic performance in New Zealand using the Business Operations Survey.

Huber, Katharina T., **Simone Linz**, Vincent Moulton, and Taoyang Wu, *Journal of mathematical biology*, Spaces of phylogenetic networks from generalized nearest-neighbor interchange operations.

Huebert, Jennifer M., and **Melinda S. Allen**, *Quaternary Science Reviews*, Six centuries of anthropogenic forest change on a Polynesian high island: Archaeological charcoal records from the Marquesas Islands.

Daniel H. Huson, **Simone Linz**, *IEEE/ACM Transactions on Computational Biology and Bioinformatics*, Autumn algorithm: computation of hybridization networks for realistic phylogenetic trees.

Kolding, Jeppe, Alida Bundy, Paul AM van Zwieten, and **Michael J. Plank**, *ICES Journal of Marine Science*: Journal du Conseil, Fisheries, the inverted food pyramid.

Law, Richard, **Michael J. Plank**, and Jeppe Kolding, *Fish and Fisheries*, Balanced exploitation and coexistence of interacting, size-structured, fish species.

Lay-Yee, Roy, Janet Pearson, **Peter Davis**, Martin Randow, Ngaire Kerse, and Laurie Brown, *Health & Social Care in the Community*, Changing the balance of social care for older people: simulating scenarios under demographic ageing in New Zealand.

Lay-Yee R, Pearson J, **Davis P**, von Randow M, Kerse N, Brown L., *New Zealand Medical Journal*, Rebalancing health service use for older people: simulating policy-relevant scenarios under demographic ageing.

Le, Trinh, and **Adam B. Jaffe**, *Economics of Innovation and New Technology*, The impact of R&D subsidy on innovation: evidence from New Zealand firms.

Macinnis-Ng, Catriona MO, Melanie JB Zeppel, Anthony R. Palmer, and Derek Eamus, *Journal of Arid Environments*, Seasonal variations in tree water use and physiology correlate with soil salinity and soil water content in remnant woodlands on saline soils.

Mark, Sarah, **Jeanette C. McLeod**, and Mike Steel, *Journal of Graph Algorithms and Applications*, A navigation system for tree space.

Isaac H. McIvor, **Thegn N. Ladefoged**, Archaeology in Oceania, A multi-scalar analysis of Maori land use on Ahuahu (Great Mercury Island), New Zealand.

Mohd, Mohd Hafiz, Rua Murray, **Michael J. Plank**, and William Godsoe, *Ecological Modelling*, Effects of dispersal and stochasticity on the presence–absence of multiple species.

Alex E. Morrison, **Melinda Allen**, *Quaternary International*, Agent-based modelling, molluscan population dynamics, and archaeomalacology.

Morrison, A.E., **Allen, M.S.**, *Société Préhistorique Française 7*, Modelling prey population resilience in ancient marine ecosystems: an agent-based model application.

Norton, David A., Laura M. Young, **Andrea E. Byrom**, Bruce D. Clarkson, Phil O'B. Lyver, Matt S. McGlone, and Nick W. Waipara, *Ecological Management & Restoration*, How do we restore New Zealand's biological heritage by 2050?

Pagani, Luca, Daniel John Lawson, Evelyn Jagoda, Alexander Mörseburg, Anders Eriksson, Mario Mitt, Florian Clemente, **Murray P. Cox** et al, *Nature*, Genomic analyses inform on migration events during the peopling of Eurasia.

Patil, Komal M., **Michelle E. Dickinson**, Thomas Tremlett, Stephen C. Moratti, and Lyall R. Hanton, *Crystal Growth & Design*, Synthesis of Diamondoid and Lonsdaleite Networks from the Same Ag (I)–Ligand Combination, with Lonsdaleite the Softer Network.

Pfannkuch MJ, Budgett SC, Fewster R, Fitch AM, Pattenwise S, Wild CJ, **Ziedins I**, *Journal of Statistics Education*, Probability modelling and thinking: What can we learn from practice?

Phillips, A.E., **Walker, C.G.**, Ehrgott, M. et al., *Ann Oper Res*, Integer programming for minimal perturbation problems in university course timetabling.

Philpott, Andy, Michael Ferris, and Roger Wets, *Mathematical Programming*, Equilibrium, uncertainty and risk in hydro-thermal electricity systems.

Plank, M.J., *ICES Journal of Marine Science*, Balanced harvesting is the bioeconomic equilibrium of a size-structured Beverton-Holt model.

Plank, Michael J., Jeppe Kolding, Richard Law, Hans D. Gerritsen, and David Reid, *Fish and Fisheries*, Balanced harvesting can emerge from fishing decisions by individual fishers in a small-scale fishery.

Plank, Michael J., Jonathan W. Pitchford, and **Alex James**, *Bulletin of mathematical biology*, Evolutionarily Stable Strategies for Fecundity and Swimming Speed of Fish.

Layne C. Price, Hiranya V. Peiris, Jonathan Frazer, **Richard Easther**, *Journal of Cosmology and Astroparticle Physics*, Designing and testing inflationary models with Bayesian networks.

Priyadarshani, Nirosha, **Stephen Marsland**, **Isabel Castro**, and Amal Punchihewa, *PloS one*, Birdsong denoising using wavelets.

Rhian A. Salmon, Rebecca Priestley, Joanna Goven, *Journal of Environmental Studies and Sciences*, The reflexive scientist: an approach to transforming public engagement.

Sin, Isabelle, and Steven Stillman, *IZA Journal of Migration*, Economic liberalisation and the mobility of minority groups: evidence from Māori in New Zealand.

Skoglund, Pontus, Cosimo Posth, Kendra Sirak, Matthew Spriggs, Frederique Valentin, Stuart Bedford, Geoffrey R. Clark, **Murray P. Cox** et al, *Nature*, Genomic insights into the peopling of the Southwest Pacific.

Sreenivasan, D., P. T. Tu, **M. Dickinson**, M. Watson, A. Blais, R. Das, J. Cornish, and J. Fernandez, *Computers in biology and medicine*, Computer modelling integrated with micro-CT and material testing provides additional insight to evaluate bone treatments: Application to a beta-glycan derived whey protein mice model.

Ter-Sarkisov, Aram, and **Stephen Marsland**, *Soft Computing*, K-Bit-Swap: a new operator for real-coded evolutionary algorithms.

Vallée, François, Aurélien Luciani, and **Murray P. Cox**, *Genetics*, Reconstructing Demography and Social Behavior During the Neolithic Expansion from Genomic Diversity Across Island Southeast Asia.

Van Iersel, Leo, Steven Kelk, Nela Lekić, and **Simone Linz**, *Theoretical Computer Science*, Satisfying ternary permutation constraints by multiple linear orders or phylogenetic trees.

van Zwieten, Paul AM, Jeppe Kolding, **Michael J. Plank**, Robert E. Hecky, Thomas B. Bridgeman, Sally MacIntyre, Ole Seehausen, and Greg M. Silsbe, *Canadian journal of fisheries and aquatic sciences*, The Nile perch invasion in Lake Victoria: cause or consequence of the haplochromine decline?

Viscarra Rossel, RA, T. Behrens, E. Ben-Dor, D. J. Brown, J. A. M. Demattê, K. D. Shepherd, Z. Shi, **P. Roudier** et al, *Earth-Science Reviews*, A global spectral library to characterize the world's soil

Waite S.J., Cater J.E., **Walker C.G.**, Amirapu S., Waghorn G.C., Suresh V, *International Journal for Computational Methods in Engineering Science & Mechanics*, Passive Mechanical Properties of Ovine Rumen Tissue.

Walker, C. G., M. J. O'Sullivan, I. Ziedins, and N. Furian, *Healthcare*, Faster Cancer Treatment: Using timestamp data to improve patient journeys.

Williams, Rebecca, and **Les Oxley**, *Australian Economic History Review*, The Geography of Inventiveness in the Primary Sector: Some Initial Results for New Zealand, 1880–1895.

Wu, A., **Philpott, A.** and Zakeri, G., *Energy Systems*, Investment and generation optimization in electricity systems with intermittent supply.

Zhu, Yanjie, **Les Oxley**, Hengyun Ma, and Wenchao Wang, *Economics of Transition*, The emergence of convergent price clusters in China.

Books

G. Dupont, M. Falcke, V. Kirk, **J. Sneyd**, *Models of Calcium Signalling*, Springer

Shaun Hendy, *Silencing Science*, Bridget Williams Books

Partnership for Market Readiness and International Carbon Action Partnership. Co-led by **Suzi Kerr** and Ruben Lubowski, Emissions Trading in Practice: A Handbook on Design and Implementation. World Bank, Washington, DC. https://open-knowledge.worldbank.org/handle/10986/23874 License: CC BY 3.0 IGO."

Rebecca Priestley, *Dispatches from Continent Seven: an anthology of Antarctic Science*, Awa Press

Book chapters

Donovan, Carl, John Harwood, Stephanie King, Cormac Booth, Bruno Caneco, and **Cameron Walker**, Expert elicitation methods in quantifying the consequences of acoustic disturbance from offshore renewable energy developments, from *The Effects of Noise on Aquatic Life II*, Springer New York

Other publications

Invited blog, **Hikuroa, D**, He aha te mea nui? Invited blog for Reframing Innovation – a collaboration between Te Pūnaha Matatini and Figure NZ

Treasury Working Paper, **Isabelle Sin** and Nathan Chappell, "The effect of trial periods in employment on firm hiring behaviour"

Published conference papers

Thomas Adams, **Michael O'Sullivan** and **Cameron Walker**, 'A Solution Technique for Rostering in Hospital Departments', *2016 Joint NZSA+ORSNZ Conference*, Auckland, New Zealand

Golnar Behzadi, **Michael O'Sullivan**, **Tava Olsen**, Abraham Zhang, 'Designing Models of Resilient and Robust Supply Chain in Agribusiness Under Supply Disruption', *Manufacturing and Service Operations Management (MSOM) Conference*, Auckland, New Zealand

Yukio Fukuzawa, **Stephen Marsland**, Matthew Pawley, and Andrew Gilman, 'Segmentation of harmonic syllables in noisy recordings of bird vocalisations', *Image and Vision Computing New Zealand (IVCNZ) 2016*, Palmerston North, New Zealand

Nikolaus Furian, Dietmar Neubacher, Siegfried Vössner, **Michael O'Sullivan** and **Cameron Walker**, 'A Generic Open Source Toolkit for Health Care Simulation', Proceedings of the *30th European Simulation and Modelling Conference*, Las Palmas, Canary Islands

O. Johnson, D. Schluter, **C.Walker**, 'A guideline for optimizing tibial resection in valgus knee Total Knee Joint Replacement', *NZOA Paper Day 2016*, Auckland, New Zealand

M Mahdavi and **T.L. Olsen**, 'How To Design Effective Supply Chain Strategies Based On The Product And Demand Characteristics', *INFORMS National Meeting*, Nashville, TN, USA

Mojtaba Mahdavi and **Tava L. Olsen**, 'Analysis of Product-driven Supply Chain Strategies and the Impact of Product Life Cycle', *ANZAM OM Symposium*, Sydney, Australia

Seyedhamid Mashhadi Moghaddam, **Michael O'Sullivan** and **Cameron Walker**, 'Decrease SLA Violations and Data Centre Energy Consumption via Prediction with a Hybrid algorithm', *1st International Workshop on System Analytics and Characterization*, Antibes Juan-Les-Pins, France

J. Omagbon, J. O'Sullivan, **C. Walker**, **M. O'Sullivan**, 'Experiences During the Inverse Modeling of the Leyte Geothermal Production Field', *38th New Zealand Geothermal Workshop*, Auckland, New Zealand

Xiaoyan Qian, **Tava Olsen**, 'Operational and Financial Decisions Within Proportional Investment Cooperatives', *Manufacturing and Service Operations Management (MSOM) Conference*, Auckland, New Zealand

T.M.P. Ratouis, **M.J. O'Sullivan**, **C.G. Walker** and J.P. O'Sullivan, 'Statistical Analysis of the Temperature Variations in Geothermal Surface Features Using a Numerical Model of Rotorua', *22nd European Meeting of Environmental and Engineering Geophysics*, Barcelona, Spain

Neda Sakhaee, **Mark C. Wilson**, Golbon Zakeri, 'New Zealand law network', *JURIX 2016*, Sophia Antipolis, France

Quan Zhou and **Tava L. Olsen**, 'An Empirical Analysis of Exporter's Supply Chain Strategies and Practices', *ANZAM OM Symposium*, Sydney, Australia

Governance and Management

Financial Report 2016

|	2016 Actuals $000
Funding received	
Tertiary Education Commission grant	2,194
Total Funding received	**2,194**
Expenditure	
Salaries	
Director and Principal Investigators	565
Associate Investigators	25
Research/Technical assistants	68
Others	116
Total Salaries & Salary-related costs	**773**
Other costs	
Overheads	753
Project Costs	142
Travel	104
Postgraduate students	132
Total Other Costs	**1,143**
Total Expenditure	**1,917**
Net Surplus/(Deficit)	**277**

Notes

This report covers the period from 1 January 2016 – 31 December 2016 and details funding received and funds distributed to collaborative partners of the CoRE.

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

The net surplus will be carried forward into 2017 to fund future expenditure of the CoRE.

2016 Summary

Broad category	Detailed category	Yr2
Value of CoRE funding from TEC ($M)		2,193,500
FTEs	Principal investigators	3.60
by category	Associate investigators	0.20
	Postdoctoral fellows	1.00
	Administrative/support	2.00
	Total	6.80
Headcounts	Principal investigators	22
by category	Associate investigators	25
	Postdoctoral fellows	1
	Administrative/support	2
	Research students	86
	Total	136
Peer reviewed research	Books	4
outputs by type	Book chapters	1
	Journal articles	67
	Conference papers	14
	Other	2
	Total	88
Value of external research	Vote Science and Innovation contestable funds	18,388,264
contracts awarded by source	Other NZ Government	4,516,063
	Domestic – private sector funding	65,250
	Overseas	261,654
	Other	177,130
	Total	23,408,361
Commercial activities	Patent applications	2
	Total	2
Students studying at CoRE by level	Doctoral degree	26
	Other	60
	Total	86
Number of students completing	Doctoral degree	4
qualifications by level	Other	8
	Total	12
Immediate post-study graduate destinations	Further study in NZ	39
	Further study overseas	5
	Employed in NZ	11
	Unknown	32
	Total	87
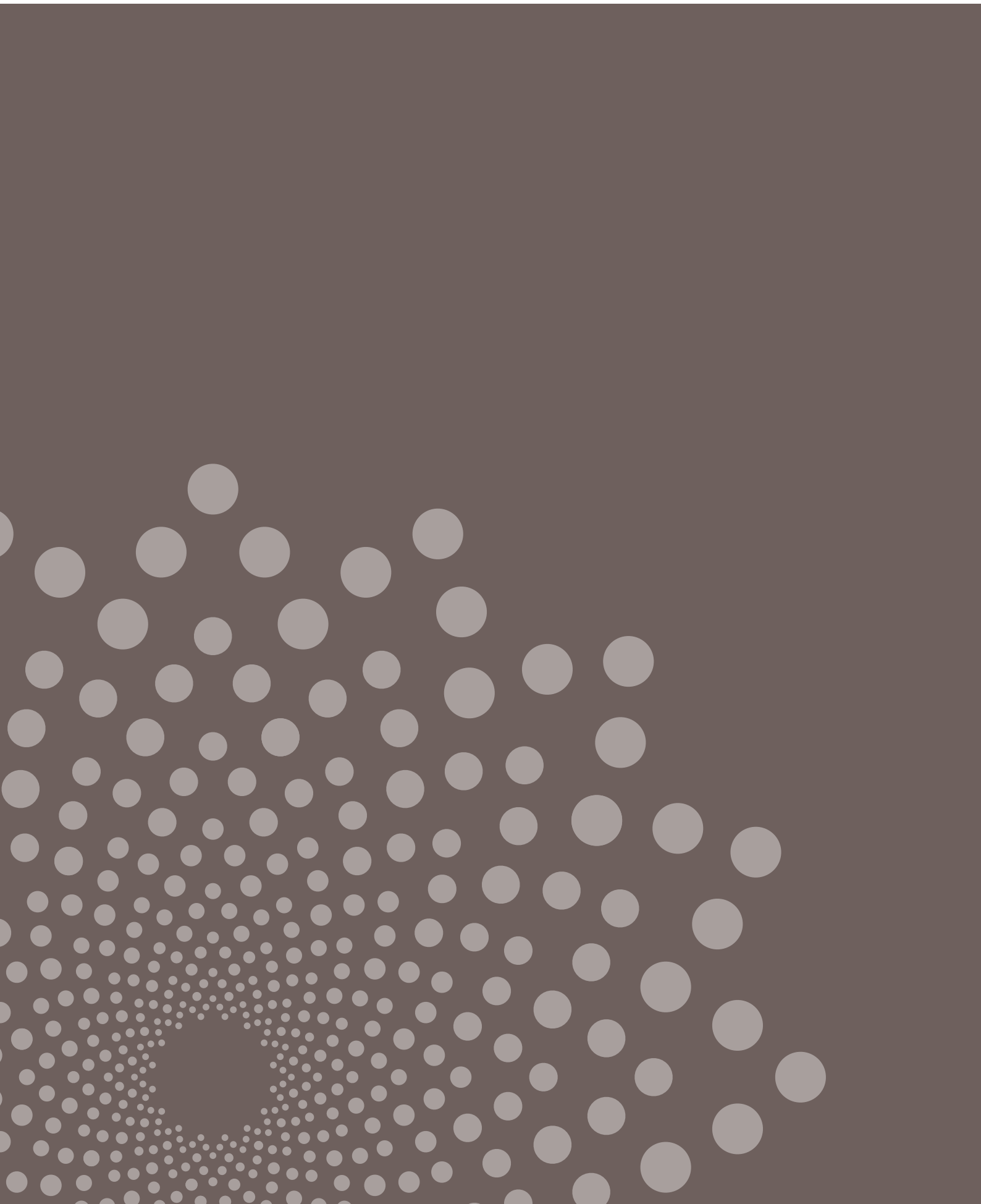
Meeting Our Strategic Outcomes

Research Excellence

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

- After two years Te Pūnaha Matatini is beginning to see tangible evidence of the operation of our collaborative networks. For instance, there is evidence of collaboration in bibliometric records e.g. a recently accepted paper by a Motu/VUW economics-physics collaboration – Kyle Higham, Michele Governale, Adam Jaffe, and Uli Zülicke. "Fame and Obsolescence: Disentangling growth and ageing dynamics of patent citations." *Physical Review* E (2016). In addition, in 2016, an Auckland-Wellington mathematics and anthropology team were successful in obtaining a Marsden Fund grant – Thegn Ladefoged, Dion O'Neale, and Marcus Frean "The making of Māori society: an archaeological analysis of social networks and geo-political interaction." $895,000 (2017-2020). The researchers had not met each other before joining Te Pūnaha Matatini, so this is strong evidence that real collaborations are forming.

- As detailed throughout this report, Te Pūnaha Matatini investigators are involved in the New Zealand science and innovation system at the highest levels of excellence, winning numerous awards, fellowships, and prestigious grants.

- Te Pūnaha Matatini's expertise is in demand from stakeholders and end-users, as shown by high levels of funding, co-funding, and funding in-kind by end-user organisations. Investigators are regularly invited to give talks, presentations, and workshops for stakeholder and end-user organisations, and several investigators sit on or have sat on key stakeholder advisory boards.

Sought-After Graduates

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

- After two years, none of the PhD students funded by the Centre have graduated. However, there is good evidence that these graduates will be in demand once they enter the job market following our 2016-17 internship programme. Twelve Te Pūnaha Matatini students (both graduate and under-graduate) were placed for 10 weeks at stakeholder and end-user organisations with joint internal and external supervisors. The internships were funded or co-funded by the external organisations (SIU, MBIE, Te Hiku Media, Ripe Time). In some instances students worked individually, but at the SIU we were able to trial a team-based approach, where a PhD student led a team of two undergraduate students. This team-based approach worked very well, and both the students and SIU were very pleased with the outcome.

- Overall these internships were deemed to be very successful, despite the Kaikoura earthquake eliminating access to Statistics New Zealand and its Integrated Data Infrastructure for much of the summer. The students rated the experience as highly valuable, and the external organisations were also very satisfied.

- One of the interns worked with Te Hiku Media, building them a dashboard for tracking their audience analytics. At the conclusion of the project Te Hiku Media had a working tool and will continue to employ the student part-time in the coming year to add extra features.

Research Uptake

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

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

- Te Pūnaha Matatini was commissioned by the New Zealand Food Safety Science Research Centre (mixed public-industry consortium) and the Concrete and Cement Association of New Zealand (CCANZ, an industry consortium) to produce bibliographic capability maps for use in planning their research and development strategies. CCANZ commented: "Taking an idea and shaping it into a quantifiable statement and marshalling the data needed to turn a subjective opinion into an objective measurement is no small feat. This work is a credit to TPM and its wider research team." (Joe Gamman, CCANZ R&D manager).

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

- Te Pūnaha Matatini has worked with the Ministry of Social Development to provide network analysis tools for identifying at-risk children. Researchers characterised the networks that exist in their relational client database and provided workshops to MSD staff in using network tools. Funding has been granted to a post-doctoral fellow, who has worked along MSD analytics staff to facilitate diffusion of network analysis methods into the Ministry.

Partnership Models

In building close engagement with Māori communities and developing opportunities for Māori capability-building, the distinctive contribution of Māori to complex systems and networks will enhance social, economic, and environmental outcomes for New Zealand.

Capability-building

- We have a growing partnership with Te Hiku Media, a charitable joint-Iwi venture between the Far North Iwi of Ngāti Kuri, Te Aupouri, Ngai Takoto, Te Rārawa and Ngāti Kahu. A jointly-funded intern was placed at Te Hiku from December 2016 to build a dashboard and will continue in part-time employment this year.

- Te Pūnaha Matatini is participating in two Māori business networks. The first – Te Waka o Tama-rereti – has been organised by the Science for Technological Innovation National Science Challenge and involves smaller ICT businesses, iwi representatives, and some Māori researchers. The second – Te Tira Toi Whakangao – is run by New Zealand Trade and Enterprise and involves medium-sized technology companies and investors.

- There are several Te Pūnaha Matatini research projects that will enable the distinctive contribution of Māori, focusing on the interaction of mātauranga Māori with complex systems and networks methods and approaches.

- Te Pūnaha Matatini partners with Ngā Pae ō te Māramatanga, the Māori Centre of Research Excellence, on paid internship projects for Māori postgraduate students; there is also a partnership with the Participatory Science Platform for South Auckland, SouthSci, an MBIE-funded science outreach project into hard-to-reach communities, to provide scientific expertise to community-led science projects and to develop paid internship positions for undergraduate and postgraduate students from those communities.

Improved Decision-Making

Through knowledge-sharing and best practice, our research will inform and improve decision-making in policy and public debate in New Zealand on issues related to complex systems and networks and their role in society, the economy, and the environment.
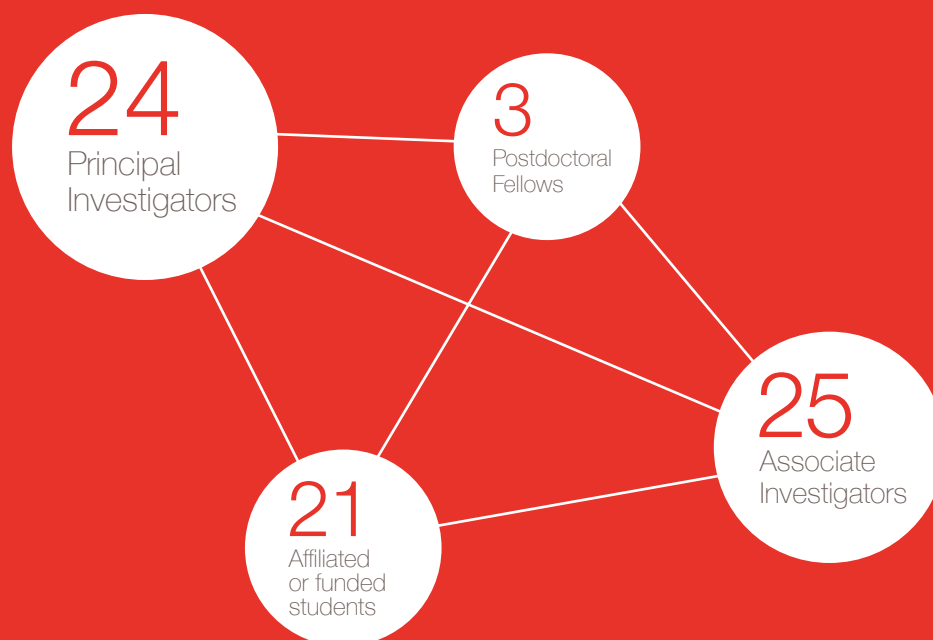
- Te Pūnaha Matatini has led the national discourse on the public responsibilities of scientists to communicate their work and participate in public debate. Four Te Pūnaha Matatini investigators have won the Prime Minister's Science Communication Prize (Priestley (2016), Dickinson (2014), Wiles (2013), Hendy (2012)) and three have won the Callaghan Medal for science and/or technology communication (Dickinson (2015),

Wiles (2013), Hendy (2012)). Books such as *Silencing Science* (Hendy 2016) and the *Fukushima Effect: A New Geopolitical Terrain* (Priestley 2016) have also contributed to international discourses around the responsibilities of scientists to the public.

- Principal Investigator Isabelle Sin's work on the New Zealand government's 90-day employment trials policy (commissioned by Treasury) sparked national debate, both about the policy itself, which Sin's work had shown had had no net effect, but also about the use of evidence by government. The current government has been championing the use of data through its social investment approach, but in rejecting the conclusions of Sin's work appeared to undermine that. The government also managed to delay the release of the work, prompting proposals for new institutional arrangements to prevent publicly-funded research from being suppressed.

- Te Pūnaha Matatini has run national media campaigns "Reframing Innovation" (August 2016) and "InfectedNZ" (November 2016) to promote the using of data and evidence in public discourses. The InfectedNZ campaign sought to highlight the harm caused by infectious disease in New Zealand. It was based on an online blogging campaign that ran over the week 21-25 November, culminating in a live Twitter Q+A session on 29 November. It generated 11 major media spots, more than 5000 web-site views and 70000 Twitter impressions.

- Te Pūnaha Matatini has become well-known for leadership in collaborative management, advising other CoREs and research centres on structure and operational matters, governance, and policies for growing diversity. Several other CoREs have adopted Te Pūnaha Matatini's diversity policies and the Royal Society Te Aparangi has changed its practices in the course of responding to our sponsorship policies.

- Investigator Jeanette McLeod and team organised the Mathscraft Festival at the Auckland War Memorial Museum in a weekend in September 2016. The event combined arts and craft work stations with a mathematics theme, interwoven with public talks on mathematics throughout the weekend. The event attracted more than 1700 attendees over the two days, making it one of the biggest events the Museum has hosted in the last year, and featured on TV One's six o'clock news bulletin. The festival has uncovered a huge unmet interest and will be run again in 2017.

Our People

24 Principal Investigators

3 Postdoctoral Fellows

25 Associate Investigators

21 Affiliated or funded students

Executive team

Professor Shaun Hendy
University of Auckland
Director, Te Pūnaha Matatini

Shaun Hendy is Director of Te Pūnaha Matatini and Professor of Physics at the University of Auckland. His interest in the science of complexity stems from a conversation at a lunchtime journal club at Industrial Research Ltd about Geoffrey West's work on the increase in the number of patents per capita with city size in the US. Hendy then downloaded an international patent database and found that the difference in patents per capita between Australia and New Zealand could be explained by the difference in population distributions.

Dr Siouxsie Wiles
University of Auckland
Deputy Director, Public Engagement

Siouxsie has made a career of combining her twin passions of bioluminescence (think glow worms and fireflies) and infectious diseases. In a nutshell, Siouxsie and her team make nasty bacteria glow in the dark to better understand how superbugs cause disease and to find new medicines. Siouxsie is also a keen blogger, podcaster, artist, curator and media science commentator and has won a hat trick of prizes for her efforts.

Professor Tava Olsen
University of Auckland
Deputy Director – Industry and Stakeholder Engagement

Tava Olsen is Professor of Operations and Supply Chain Management and Director of the Centre for Supply Chain Management at the University of Auckland Business School. Tava's research interests include supply-chain management, pricing, and inventory control, and stochastic modelling of manufacturing, service, and healthcare systems. Tava is a past president of the Manufacturing and Service Operations (MSOM) society and has been awarded the Auckland Business School's sustained research excellence award.

Dr Alex James
University of Canturbury
Deputy Director, Education and Outreach
Theme Leader – Complexity and the Biosphere

Alex James was told by a high school teacher that she couldn't be a mathematician because they "didn't exist" so she followed her dreams and became one. Not only has Alex proven her high school teacher wrong, she's committed to showing students that with a bit of effort, anyone can pursue a career in Mathematics or Science – she'll be working to ensure that Te Pūnaha Matatini research reaches students and communities.

Dr Michael Plank
University of Canterbury
Theme Leader – Complexity and the Biosphere (Maternity leave cover for Dr Alex James)

Mike Plank's research is in mathematical modelling, particularly in ecology and physiology. The motivation for this research comes from real-world problems and the emphasis is on qualitative mathematical models that capture the essential behaviour of a particular phenomenon. He has research interests in a variety of applications: ecology and exploitation of fish communities; collective cell behaviour; complex ecological networks; invasive species; epidemiology; animal movement; neurovascular coupling. His research uses methods from a range of areas in mathematics including: dynamical systems; partial differential equations; perturbation theory; stochastic processes; and data science.

Professor Stephen Marsland
Massey University
Theme Leader Complex Data Analytics

Stephen Marsland is Professor of Scientific Computing at Massey University. He arrived at Massey in 2004 following various postdoc roles, a PhD from Manchester University and a degree from Oxford University. His research interests are in the applications of mathematics, especially (but not only) differential geometry to a wide variety of problems such as birdsong recognition, shape and medical image analysis, machine learning, and smart homes for the elderly. He also works in complexity science, including complex networks and agent-based models.

Adam Jaffe
Motu Research
Theme Leader – Complex Economic and Social Systems

Dr Adam Jaffe arrived in New Zealand in the autumn (fall) of 2013, joining Motu Economic and Public Policy Research, as its director, with a significant research programme focusing on technological innovation and its diffusion; in particular diffusion effects in environmental and energy technologies. He's leading a group of diverse researchers investigating the impact of scale, diversity, connectivity, and dynamics on social and economic systems.

Kate Hannah
Executive Manager, Te Pūnaha Matatini

Kate Hannah has a Master of Arts in 19th Century American Cultural History, and has worked as a writer, editor, historical consultant, and in research analysis and development. She is interested in science communication, public understanding of science, and science's understanding of the public. At Te Pūnaha Matatini, she'll be encouraging good grammar, the use of the Oxford comma, and consideration of the humanity behind the data.

Sarah Hikuroa
Centre Coordinator, Te Pūnaha Matatini

Ngā Puhi | Waikato | Ngāti Maniapoto. Sarah has a very creative background. She is a Multimedia Artist/ Designer and is part of the Tai Tokerau Māori Art Collective and Te Atinga. Her other interests include research in higher education and innovation, project management, and efficiency. She's keen to see how complex data and research can become innovative knowledge to benefit Aotearoa. At Te Pūnaha Matatini she'll be encouraging the daily use of Te Reo Māori and making sure everyone is where they should be.

Danene Jones
Communications and Marketing Advisor, Te Pūnaha Matatini

Danene Jones has a passion for capturing and creating engaging stories that showcase scientific research. Her background in science communication has taken her around Australia, working in a penguin colony, schools, and remote outback communities. At Te Pūnaha Matatini she'll be building the profile of the research group by developing and executing engaging marketing communications and campaigns for multiple audiences across a range of platforms.

Catriona Sissons
Chair, Te Pūnaha Matatini Whānau

Catriona Sissons is a PhD student at the University of Auckland with a background in physics, law and philosophy. Her research interests are related to applying tools from network science of complex systems to study social and economic development. Currently she is investigating collaboration in technological innovation by building patents networks. She loves the transdisciplinary nature of complex systems research, where she can use tools from the mathematical and physical sciences to the study of human socio-economic systems.

Advisory Board

Richard Aitken
Advisory Board Chair
Executive Chairman, Beca (New Zealand)

Through his 45-year career at Beca, Richard has played an active part in growing this professional services consultancy to a team around 3000-strong throughout New Zealand, Australia and Asia. He has served in several executive positions and held a range of directorships both internal and external. Before taking up the Chairmanship of the Beca Group in 2009 he held the lead role of Group Chief Executive for a decade.

Richard has in-depth experience in engineering project management and with partnering and alliance contracting. Current external directorships are with Trustpower Ltd and Panuku Development Auckland Ltd (Deputy Chair) and since February 2015 the Te Pūnaha Matatini Advisory Board (Chair). Richard has represented Beca on the Project Alliance Board for the Waterview Project (Auckland) for the last 5-years and was appointed to the Chair in late-2015. He remains a member of the Construction Strategy Group (a high-level industry body) having chaired it from inception for nearly 5-years.

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

Lillian Grace
CEO and Founder of Figure.NZ

Lillian is CEO and Founder of Figure.NZ, the first organisation globally to designate everyone as a user of data and to build systems and software to deliver to this standard. As a purpose-driven social enterprise, Figure.NZ is committed to creating a data democracy and helping everyone to make sense of data so we can see New Zealand clearly.

Lillian is on the board of the NZ Innovation Partnership and on the NZ Data Futures Partnership Working Group. Previously Lillian was at Academy Award-Winning Massive Software at think tank The New Zealand Institute.

Arthur Grimes
Senior Fellow, Motu Economic and Public Policy Research

Arthur completed his PhD in Economics at the London School of Economics in 1987 following his BSocSc (Hons) at University of Waikato. He is a Senior Fellow at Motu Research, an Adjunct Professor at Victoria University of Wellington, Board Member of the Financial Markets Authority, and chairs the Hugo Group. He was Reserve Bank of New Zealand Chair from 2003–2013.

Prior to his time at Motu, Arthur was Director of the Institute of Policy Studies (Victoria University of Wellington), Chief Executive of Southpac, and Chief Economist at both the Reserve Bank of New Zealand and the National Bank of New Zealand.

In 2005, Arthur was awarded the NZIER Economics Award recognising excellence in economics related to New Zealand's economic welfare. His current research centres around urban economics, the economics of wellbeing, and aspects of central banking (including exchange rates and currency union).

Professor John Hosking
Dean of Science, University of Auckland

John is Dean of Science at the University of Auckland assuming the role in June 2014. Immediately prior to that he was Dean of Engineering and Computer Science at the Australian National University and before that was Professor of Applied Computer Science in the Department of Computer Science at the University of Auckland including a six-year term as Head of Department between 1999 and 2005.

John's research career has been in software engineering, with over 200 publications to his name, and a long history of university-industry research engagement. He has been awarded both an FRSNZ in recognition of his research activities and a National Tertiary Teaching Excellence award reflecting his passion for teaching.

Professor Wendy Lawson

Pro-Vice-Chancellor Science, University of Canterbury

Professor Wendy Lawson is the Pro-Vice-Chancellor of Science at the University of Canterbury. She is a glaciologist with a passion for fieldwork and more than 30 years of experience of remote fieldwork in polar and alpine environments including in Greenland, Svalbard, Alaska and Arctic Norway – as well as Antarctica.

Her previous roles include Dean of Science and Head of Department of Geography at the University of Canterbury and as an academic at the University of Auckland. She has a range of academic and Crown sector strategic science sector governance experience including Ministerial appointments as a Board Director of NIWA and of Antarctica New Zealand.

Her PhD is from the University of Cambridge and her most recent qualification awarded in 2008 is a Postgraduate Certificate in Public Administration from the University of Warwick Business School. One of her career highlights of which she is most proud is the naming of stream in Antarctica – Lawson Creek – in her honour in 1995.

James Mansell

Business owner at Noos Ltd

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

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

In 2011 James was awarded the public sector's Leadership Development Centre (LDC) fellowship prize. This was used to study leadership at Harvard the Wharton School and Centre for Creative Leadership. He holds a first class honours degree in Philosophy from Victoria University of Wellington.

Professor Jim Metson

Deputy Vice-Chancellor (Research), University of Auckland

Arthur completed his PhD in Economics at the London School of Economics in 1987 following Professor Jim Metson is the Deputy Vice-Chancellor (Research) at the University of Auckland. He recently stood down from his role as Chief Science Adviser for the Ministry of Business, Innovation and Employment. With experience in academic research, working with industry and also with government, his past positions include: Deputy Dean of the University of Auckland's Faculty of Science, Associate Director of Light Metals Research Centre (LMRC), a Councillor for the Australian Institute of Nuclear Science and Engineering, the Chair of the Australian Synchrotron Science Advisory Committee, the former Head of the School of Chemical Sciences, chair of the Research Infrastructure Advisory Group (RIAG) for MBIE's predecessor MoRST, and a Principal Investigator of the MacDiarmid Institute.

Dr Kevin Ross

Research Director, Orion Health

Dr Kevin Ross is Research Director at Orion Health where he leads a program to utilise analytics and data science to improve clinical workflow, decision-making, and patient-centered care. Prior to joining Orion Health, Kevin was Chief Scientist of Optimisation Modelling at Fonterra. In 2013, he founded the New Zealand Analytics Forum – a group of professionals committed to learning and sharing best practice analytics to help make a positive impact in the country. Prior to joining Fonterra in 2012 he was an Associate Professor of Technology and Information Management at the University of California Santa Cruz. His research and teaching focussed on network scheduling and optimisation including contributions to air traffic management and call centre design. He has consulted for energy telecommunication and public service organisations. Dr Ross holds a PhD from Stanford University in Management Science and Engineering and a BSc(Hons) from the University of Canterbury in Mathematics.

International Advisory Board

Professor Alan Hastings
University of California, Davis

Professor Alan Hastings is interested in a range of topics in theoretical ecology and population biology, and more generally in mathematical biology.

He is a Professor in the Department of Environmental Science and Policy and also a member of the Centre for Population Biology. Alan completed his Ph.D. in Applied Mathematics at Cornell University in 1977 under the supervision of Simon A. Levin and have been at UC Davis (located in beautiful Davis, California) since 1979. He is the founding Editor in Chief of the journal Theoretical Ecology, published by Springer.

Professor Bronwyn H. Hall
University of California, Berkeley

Bronwyn H. Hall is Emerita Professor at the University of California at Berkeley, a Research Associate of the National Bureau of Economic Research and the Institute for Fiscal Studies, London, and a Visiting Fellow at NIESR, London. She currently serves as an associate editor of the Economics of Innovation and New Technology, and of Industrial and Corporate Change. She is also a member of several advisory boards (Solvay Brussels School of Economics and Management, European Patent Office, DIW - German Institute for Economic Research). She received a B.A. in physics from Wellesley College in 1966 and a Ph.D. in economics from Stanford University in 1988.

Professor Frank Kelly
Fellow of Royal Society
Professor of the Mathematics of Systems
University of Cambridge

Frank Kelly is Professor of the Mathematics of Systems in the University of Cambridge. He was elected a Fellow of the Royal Society in 1989, and a Foreign Member of the National Academy of Engineering in 2012. In 2013 he was awarded a CBE for services to mathematical sciences.

His main research interests are in random processes, networks and optimization. He is especially interested in applications to the design and control of networks and to the understanding of self-regulation in large-scale systems.

From 2003 to 2006 he served as Chief Scientific Adviser to the United Kingdom's Department for Transport. He was chair of the Council for the Mathematical Sciences, and a member of the RAND Europe Council of Advisors.

Professor Ian Foster
Director, Computation Institute
University of Chicago

Ian Foster, Senior Fellow, is Director of the Computation Institute, a joint institute of the University of Chicago and Argonne National Laboratory. He is also an Argonne Senior Scientist and Distinguished Fellow and the Arthur Holly Compton Distinguished Service Professor of Computer Science.

Ian received a BSc (Hons I) degree from the University of Canterbury, New Zealand, and a PhD from Imperial College, United Kingdom, both in computer science. His research deals with distributed, parallel, and data-intensive computing technologies, and innovative applications of those technologies to scientific problems in such domains as climate change and biomedicine. Methods and software developed under his leadership underpin many large national and international cyberinfrastructures.

Dr. Foster is a fellow of the American Association for the Advancement of Science, the Association for Computing Machinery, and the British Computer Society.

Professor Julia Lane
Wagner School of Public Policy at New York

Julia Lane is a Professor in the Wagner School of Public Policy at New York University. She is also a Provostial Fellow in Innovation Analytics and a Professor in the Centre for Urban Science and Policy. Julia has published over 70 articles in leading economics journals, and authored or edited ten books. She has been the recipient of over $50 million in grants and has organized over 40 national and international conferences, received several national awards, given keynote speeches all over the world, and serves on a number of national and international advisory boards.

Professor Manuel Trajtenberg
Tel Aviv

Manuel Tajtenberg is an economist and chair of the Planning and Budgeting Committee of the Council for Higher Education in Israel. Manuel graduated from the Hebrew University of Jerusalem with a major in economics in 1973 and completed a master's degree in economics and sociology in 1976, also at the Hebrew University. In 1984 he received his PhD from Harvard University for work entitled "Economic Analysis of Product Innovation: The Case of CT Scanners." Upon completing his PhD, he returned to Israel, and has since been serving as a professor in the Tel-Aviv University School of Economics.

Trajtenberg has served in several public roles. He was a consultant to the Ministry of Industry, Trade and Labour and to the Prime Minister's Office. In 2006 he was appointed the first chair of the Israeli National Economic Council.

Professor Philip McCann
Groningen

Philip McCann trained as an economic geographer. He studied at and gained his PhD (1993) from the University of Cambridge (UK) and then worked at the University of Pennsylvania in the US (1993-1995), the University of Reading (UK) (1995-2005) and the University of Waikato in New Zealand. At Reading he was a professor of Urban and Regional Economics, in Waikato a professor of Economics. He has also been a guest professor in the US, Japan, Thailand and Italy. He has long had an intensive relationship with the Faculty of Spatial Sciences in Groningen, which he regularly visits for guest lectures, seminars and PhD ceremonies.

Philip McCann's research covers a wide range of topics. Much of his research has been financed by extra-university clients such as the British Ministry of Trade and Industry, the EU and the OECD.

Research Committee

Dr Isabelle Sin
Motu Research

Uli Züelicke
Victoria University of Wellington

Alexei Drummond
University of Auckland

Professor Adam Jaffe
Motu Research

Associate Professor Alex James
University of Canterbury

Professor Andy Philpott
University of Auckland

Kate Hannah
University of Auckland

Dr Rachelle Binny
University of Canterbury

Professor Shaun Hendy
University of Auckland

Te Pūnaha Matatini Whānau

Catriona Sissons (Chair)
University of Auckland
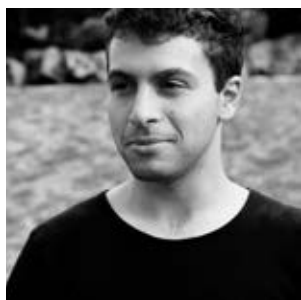
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Landcare Research

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Oscar Dowson
University of Auckland

Dr Ben Curran
University of Auckland

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Motu Research

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University of Canterbury

Professor Alexei Drummond
University of Auckland

Professor Andy Philpott
University of Auckland

Dr Dave Maré
Motu Research

Dr Dion O'Neale
University of Auckland

Associate Professor Ilze Ziedins
University of Auckland

Dr Izi Sin
Motu Research

Professor James Sneyd
University of Auckland

Dr Jeanette McLeod
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Professor Mark Gahegan
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Professor Mike O'Sullivan
University of Auckland

Associate Professor Mike Plank
University of Canterbury

Professor Peter Davis
University of Auckland

Professor Richard Easther
University of Auckland

Professor Sally Davenport
Victoria University of Wellington

Professor Shaun Hendy
University of Auckland

**Associate Professor
Stephen Marsland**
Massey University

Dr Suzi Kerr
Motu Research

Professor Tava Olsen
University of Auckland

Professor Thegn Ladefoged
University of Auckland

Professor Uli Zuelicke
Victoria University of Wellington

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Landcare Research

Dr Barry Milne
Compass

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Dr Cate Macinnis-Ng
University of Auckland

Dr Dan Hikuroa
University of Auckland

Dr David Welch
University of Auckland

Dr Emily Harvey
Massey University

Associate Professor Isabel Castro
Massey University

Professor Les Oxley
Waikato University

Dr Mark Wilson
University of Auckland

Associate Professor Melinda Allen
University of Auckland

Dr Michael O'Sullivan
University of Auckland

Dr Michelle Dickinson
University of Auckland

Professor Murray Cox
Massey University

Dr Pierre Roudier
Landcare Research

Dr Rachael Ka'ai-Mahuta
Auckland University of Technology

Dr Rachelle Binny
Landcare Research

Dr Rebecca Priestley
Victoria University of Wellington

Dr Rhian Salmon
Victoria University of Wellington

Dr Roger Pech
Landcare Research

Mr Roy Lay-Lee
Compass

Dr Simone Linz
University of Auckland

Dr Siouxsie Wiles
University of Auckland

Dr Steffen Lippert
University of Auckland

Dr Troy Baisden
GNS Science

Postdoctoral Fellows

Postdoctoral fellow	*Supervisor*
Dr Daniel Lond	Mike Plank, Jeanette McLeod, Alex James
Dr Quan Zhou	Tava Olsen
Dr Addison Pan	Steffen Lippert

PhD Students

Name	*Supervisor*	*Institution*
Kyle Higham	Adam Jaffe, Michele Governale, Uli Zuelicke	Victoria University of Wellington
Elisenda Ortiz	Marcus Frean	Victoria University of Wellington
Leila Rajabi	Shaun Hendy	University of Auckland
Catriona Sissons	Shaun Hendy, Dion O'Neale	University of Auckland
Jiří Moravec	Murray Cox	Massey University
Samin Aref	Mark Wilson	University of Auckland
Neda Sakhaee	Mark Wilson	University of Auckland
Michael Hackney	Mike Plank, Alex James	University of Canterbury
Stephen Merry	Mike Plank, Jeanette McLeod, Alex James	University of Canterbury
Demi Filho	Dion O'Neale	University of Auckland
Jonathan Goodman	Rachelle Binny, Alex James	University of Canterbury
Reno Nims	Melinda Allen, Thegn Ladefoged	University of Auckland
Xiaoyan Qian	Tava Olsen	University of Auckland
Mojtaba Mahdavi	Tava Olsen	University of Auckland
Simon Stewart	Troy Baisden	Waikato University
Daniel Bengt Emanuelsson	Troy Baisden	Victoria University of Wellington
Oscar Dowson	Andy Philpott	University of Auckland
Raneetha Abeywickrama	Ilze Ziedins	University of Auckland
June Lau	Ilze Ziedins	University of Auckland
Niffe Hermansson	Ilze Ziedins	University of Auckland
Alex Wang	Ilze Ziedins	University of Auckland

Honours Students

Name	Supervisor	Institution
Aisha Ajmal	Marcus Frean	Victoria University
Tony Butler-Yeoman	Marcus Frean	Victoria University
David Chan	Roy Lay-Yee	University of Auckland
Nathan Chappell	Adam Jaffe, Dave Mare	Motu Research
Luis Escalante Tito	Dion O'Neale	University of Auckland
Yukio Fukuzawa	Stephen Marsland	Massey University
Megan Ganley	David Welch	University of Auckland
Steven Turnbull	Dion O'Neale	University of Auckland
Di Zhu	James Sneyd	University of Auckland
David Waters	James Snyed	University of Auckland

Masters Students

Name	Supervisor	Institution
Allannah Kenny	Mike Plank	University of Canterbury
Tim Arnold	Stephen Marsland	Massey University
Mashall Aryan	Marcus Frean	Victoria University
Nico Despares	Marcus Frean	Victoria University
Amir Ghodrati	Stephen Marsland	Massey University
Michelle Goss	Stephen Marsland	Massey University
Bianca Grizhar	Marcus Frean	Victoria University
Justin Gunter	Barry Milne	University of Auckland
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