PUTANGA ISSUE NO.59

MARSDEN FUND
TE PŪTEA RANGAHAU A MARSDEN

ROYAL SOCIETY TE APĀRANGI

2023

TE PŪTEA RANGAHAU A MARSDEN

MARSDEN FUND UPDATE

Supported by the New Zealand Government with funding
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Te Kāwanatanga o Aotearoa
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The cover is a contemporary design of a tukutuku pattern, purapura whetū, representing stars and the great number of people in our nation.

RĀRANGĪ ŪPOKO CONTENTS

Sir Ernest Marsden

MŌ TE PŪTEA RANGAHAU A MARSDEN

E tautoko ana te Pūtea Rangahau a Marsden i te hiranga i roto i ngā rangahau tino mātāmua rawa i Aotearoa. Ka tīpakohia ngā kaupapa i ia tau mā tētahi tukanga pakari e ngā rōpū whiriwhiri tekau e ārahina ana e ngā whakaaro o ngā kairangahau ā-ao, whakaihuwaka ā-ao hoki. Ko te tikanga ka rato ngā pūtea ki te toru tau mō ia takuhe.

E toru ngā momo takuhe: Atu ki te $3 miriona (kore GST) te wāriu o ngā takuhe a Te Tohu Kaunihera Pūtea Rangahau a Marsden i roto i te toru tau; Atu ki te $960K (kore GST) te wāriu o ngā takuhe Arowhānui mō te toru tau; ā, atu ki te $360K (kore GST) te wāriu o ngā takuhe Arowhānui mō te toru tau mā ngā kairangahau pūhou. Ka utua e ngā takuhe ngā utu ā-tau, ngā tūranga ākonga me te kairangi, me ngā taonga hoki.

He kairapu te Pūtea Rangahau a Marsden, ā, mō ngā kaupapa ā-kaitūhura, ka mutu kāore e herea ana ki ngā kaupapa matua a te kāwanatanga. E whakahaerehia ana e Te Apārangi, ā, nā te Kāwanatanga o Aotearoa te pūtea.

He mea whakaingoa te Pūtea Rangahau a Marsden ki te kaiahupūngao a **Tā Ernest Marsden**. He mea whakatū e te kāwanatanga i te tau 1994. E kīia ana ko te Pūtea Rangahau a Marsden te taumata o te hiranga, e taea ai e ngā kairangahau toa rawa o Aotearoa te hōpara i ō rātau huatau.

MŌ TE APĀRANGI

He whakahaere huamoni-kore motuhake a Te Apārangi e tautoko ana i ngā tāngata o Aotearoa ki te hōpara, tūhura me te tuari mōhiotanga. Ka tuku pūtea mā ana kaupapa me te tuku whai wāhitanga akoranga ki ngā kairangahau, kaiako, ākonga kura, me rātau e pakiki ana ki te ao.

Hei whakanui i ngā tūhuratanga o ngā kairangahau o Aotearoa, ka whakawhiwhia e Te Apārangi ngā mētara me te tohu Pūkenga, he manukura nō ō rātau wāhanga. Ka āwhina ēnei tohunga i te Apārangi ki te tuku tohutohu motuhake ki ngā tāngata o Aotearoa me te kāwanatanga mō ngā take e arohia ana e te iwi whānui.

He whānui te kōtuinga mema me ngā hoa o Te Apārangi puta noa i Aotearoa me te pōhiri i te hunga e kaingākau ana ki ngā mahi a ngā tāngata o Aotearoa ki te hōpara, tūhura me te tuari mōhiohio kia whakauru mai.

Mō ētahi atu kōrero anō haere ki royalsociety.org.nz

ABOUT THE MARSDEN FUND

The Marsden Fund supports excellence in leading-edge research in New Zealand. Projects are selected annually in a rigorous process by ten panels which are guided by the opinions of world-leading, international researchers. Funding is usually spread over three years for each grant.

There are three types of grants: Marsden Fund Council Award grants worth up to $3 million (excl. GST) over three years; Standard grants that can be worth up to $960K (excl. GST) for three years; and Fast-Start grants worth $360K (excl. GST) over three years for early-career researchers. Grants pay for salaries, students and postdoctoral positions, and consumables.

The Marsden Fund is contestable, is for investigator-driven research projects, and is not subject to government priorities. It is administered by Royal Society Te Apārangi and funded by the New Zealand Government.

The Marsden Fund is named after physicist **Sir Ernest Marsden**. It was established by the government in 1994. The Marsden Fund is regarded as a hallmark of excellence, allowing New Zealand's best researchers to explore their ideas.

ABOUT ROYAL SOCIETY TE APĀRANGI

Royal Society Te Apārangi is an independent not-for-profit organisation with a vision for Aotearoa New Zealand to be guided and inspired by science and research. The Society grows pathways of knowledge to enable science and research to be shared for the benefit of all.

The Society's work advances education in science and technology, promotes public understanding of science and research, and supports scientists and researchers through project grants, career grants, journal publications, guidelines, and other knowledge infrastructure. The Society also provides independent advice to New Zealanders and the government on issues of public concern.

The Society achieves its impact through a broad network of members and organisations around New Zealand. To celebrate the achievements of New Zealand researchers, the Society awards medals for research excellence, and elects Fellows and Companions who are leaders in their fields.

To discover more visit royalsociety.org.nz

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PROJECT HIGHLIGHTS FROM NEW MARSDEN FUND AWARDS

SUPPORTING WORLD-LEADING RESEARCH

In 2023, the Marsden Fund allocated $83.59 million (excluding GST) to 123 research projects led by researchers in Aotearoa New Zealand. These grants support excellent research in the humanities, engineering, mātauranga, mathematics, science, and the social sciences for three years.

Established researchers and their teams were awarded 76 Marsden Fund Standard grants, for a total of $66,671,000 (excluding GST), with a success rate of 12.8%. These research projects address a wide range of issues of both local and international importance, including uncovering the molecular mechanisms of migraine, investigating the impacts of generative artificial intelligence on linguistic diversity, characterising the key roles of lanternfish in marine ecosystems, and combining biomolecular methods and mātauranga Māori to interrogate relationships between cetaceans (whales and dolphins) and humans.

The Marsden Fund continues to provide strong support for up-and-coming researchers, with 47 Fast-Start grants awarded, for a total of $16,920,000 (excluding GST). Fast-Start grants encourage the development of independent research and build momentum for exceptional careers in Aotearoa. Funded projects this year cover a broad range of topics including the measurement of seismic activity of faults in the Southern Alps, identifying new chemical compounds for use in next-generation lithium-ion batteries, investigating how bumblebees take to the skies, and exploring how true crime podcasts inform our opinions about pressing social issues.

The successful projects are of world-class standard, having made it through a highly rigorous selection process, including substantial international peer review. Marsden Fund Council Chair Professor Gill Dobbie FRSNZ says, "Te Pūtea Rangahau a Marsden provides support for our leading and early-career researchers to carry out cutting-edge, investigator-led, innovative research. The vast majority of our external expert reviewers are international, and funded projects have been recognised for their excellence and potential for significant scholarly impact, both nationally and internationally.

"Awardees will carry out fundamental research across a huge range of disciplines, including on topics with global significance. Some of these projects will make a transformational difference to how we think about the world and Aotearoa New Zealand's place within it, the hauora health and wellbeing of our people, and our economic growth."

A number of the newly funded researchers are returning to Aotearoa New Zealand after gaining world-class experience and training in international institutions. "The support provided by Te Pūtea Rangahau a Marsden is crucial for attracting and retaining talented researchers and building a vibrant and resilient research community here in Aotearoa", says Professor Dobbie. Early-career researchers are well-represented among the awardees this year, with a success rate of 14.5% (up from 13% last year). Professor Dobbie adds that supporting early-career researchers to establish their independent research careers is an investment in the future of Aotearoa New Zealand.

Especially notable this year is the proportion of successful projects led by researchers identifying as women. "More than half (55%) of the lead investigators on funded projects for 2023 identify as women – this is the highest proportion of female-led projects in the Marsden Fund's history", comments Professor Dobbie. "It is really heartening to see so many wāhine amongst our winners, given the obstacles that continue to discourage women from pursuing careers in research. Increasing inclusion and representation in our research communities will allow us collectively to better serve the country as a whole, as well as creating space for novel ways of thinking and doing research."

The projects funded in this round will help fulfil one of the Marsden Fund Council's goals for the fund:

Ka pūmau tonu te hapori mātanga i te katoa me te whānuitanga o ngā kaupeka rangahau.

Maintain a New Zealand community of experts in the full and expanding range of research fields.

The overall success rate for applicants is 13.3% this year, a slight increase compared to 12.6% last year.

The grants are distributed over three years and are fully costed, paying for salaries, students and postdoctoral positions, institutional overheads, and research consumables.

Read more from Professor Gill Dobbie (page 76).

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KA TAUTOKO TE PŪTEA MARSDEN I NGĀ RANGAHAU AUAHA I AOTEAROA

I NGĀ RANGAHAU MĀTĀMUA O TE AO

Kua tukua e Te Pūtea Rangahau a Marsden te $83.59 miriona (GST kore) ki ngā kaupapa rangahau e 123 e ārahina ana e ngā kairangahau i Aotearoa. E tautoko ana ēnei takuhe i ngā rangahau o te aronui, te pūhanga, te mātauranga, te pāngarau, te pūtaiao, me te mātaipori mō ngā tau e toru.

I whakawhiwhia ki ngā kairangahau haurongo me ō rātou tīma ngā takuhe Standard a Te Pūtea Rangahau a Marsden e 76, arā, $66,671,000 (GST kore) tōpū. Ko te 12.8% te pāpātanga angitutanga. Ka aro ēnei kaupapa rangahau ki ngā take whānui hirahira ā-rohe, ā-ao anō hoki, tae ana ki te huranga o ngā āhuatanga rāpoi ngota o te ānini pākaha, te tūhura i ngā pānga o te atamai hangahanga ki te kanorautanga ā-wetereo, te tārai i ngā mahi matua a ngā ika rātana i ngā pūnaha hauropi moana, me te whakakotahitanga o ngā rautaki rāpoi ngota koiora me te mātauranga Māori ki te tirotiro i ngā hononga o ngā tohorā me ngā aihe ki te tangata.

E tautokona nuitia tonu ana e Te Pūtea Rangahau a Marsden ngā kairangahau e ara mai ana. E 47 ngā takuhe Fast-Start kua whakawhiwhia, arā, $16,920,000 (GST kore) tōpū. Ko te tikanga o ngā takuhe Fast-Start he akiaki i te whakawhanaketanga o ngā rangahau motuhake me te ā i ngā aramahi mīharo I Aotearoa. Kapi ana i ngā kaupapa whai pūtea i tēnei tau ngā horopaki maha, tae ana ki te inenga o ngā rū i Te Tiritiri o te Moana, te tūtohu i ngā pūhui matū hei whakamahi i roto i ngā pūhiko konukōhatu whai katote, te tūhura i tā ngā pī rere ki ngā rangi, me te toro i tā ngā īpāho whāngai i ō tātou whakaaro e pā ana ki ngā take ā-pāpori o te wā.

Kei te taumata ā-ao ngā kaupapa angitu, i puta te ihu i tētahi hātepe kōwhiri taumaha, tae ana ki tētahi arotakenga ā-pia ā-ao. Ko tā te Toihau o te Marsden Fund Council, a Professor Gill Debbie, "Ka tuku tautoko a Te Pūtea Rangahau a Marsden ki ā mātou kairangahau kei te tīmatanga o te aramahi ki te pīkau i ngā rangahau hou, e ākina ana e te pākikī, he 'rangahau pākikī'. Ko te nuinga o ō mātou kaiarotake mātanga ā-waho nō te ao, ā, kua mihia ngā kaupapa i tautokona mō te kounga me te pānga mātauranga kaitā, ā-motu, ā-ao hoki. "Ka pīkau ngā kaiwhiwhi i ngā rangahau tūāpapa e whakakapi ana i ngā Kaupapa huhua, tae ana ki ngā take e hirahira ana i te ao. Ko ētahi o ngā kaupapa nei ka whai pānga huringa nui ki te āhua o ō tātou whakaaro ki te ao me te wāhi ki a Aotearoa, te hauora me te oranga o ō tātou tāngata, me tā tātou tipu ā-ōhanga nei".

He huhua ngā kairangahua whai tautoko hou e hoki mai ana ki Aotearoa i muri i te whai wheako i te pae o te ao me ngā whakangungutanga i ngā whare ā-ao. "He waiwai te tautoko e tukua ana e Te Pūtea Rangahau a Marsden hei tō mai, hei pupuri hoki i ngā kairangahau iho pūmanawa me te whakatōpū i tētahi hapori rangahau muramura, mārohirohi hoki i Aotearoa", tā Professor Dobbie. E whakakanohi paitia ana ngā kairangahau kei te tīmatanga o te aramahi i te puna kaiwhiwhi i tēnei tau. He 14.5% te pāpātanga angitutanga (kua piki i te 13% i tērā tau). I kī hoki a Professor Dobbie ko te tautoko i ngā kairangahau kei te tīmatanga o te ara mahi ki te whakatū i ō rātou aramahi rangahau motuhake, he haumitanga ki te anamata o Aotearoa.

I tino kitea i tēnei tau te pānga riterite o ngā kaupapa angitu e ārahina ana e ngā kairangahau wāhine. "Neke atu i te haurua (55%) o ngā kaitūhura matua i ngā kaupapa whai pūtea tautoko i 2023, e kī ana he wāhine rātou - koinei te panga riterite nui katoa o ngā kaupapa e ārahina ana e te wāhine i te hītori o te Marsden Fund", tā Professor Dobbie. "E muramura ana te ngākau ki te kite i te mahi a te wāhine kua puta nei ngā ihu, i runga i ngā taupā e whakaheke ana i tā te wāhine whai aramahi rangahau. Mā te whakapiki i te kauawhi me te whakakanohitanga i ō tātou hapori rangahau e pai ake ai tā tātou manaaki tahi i te motu, me te whakawātea hoki i te wāhi ki ngā whakaaro hou me te mahi rangahau."

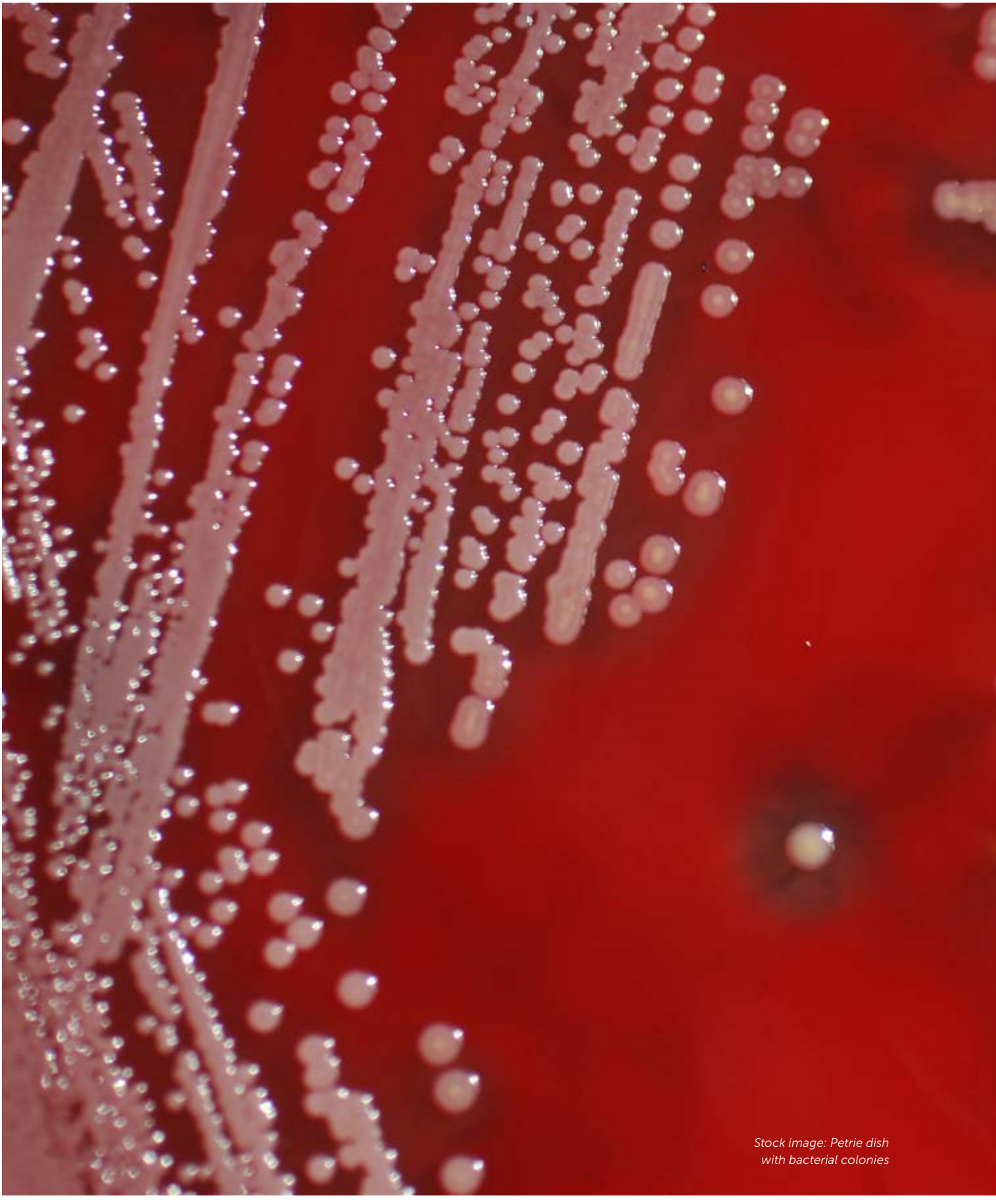
Mā ngā kaupapa e tautokona ana i tēnei rauna e āwhina ki te whakatutuki i tētahi o ngā whāinga o te Marsden Fund Council mō te tahua:

Ka pūmau tonu te hapori mātanga i te katoa me te whānuitanga o ngā kaupeka rangahau.

Ko te pāpātanga angitutanga tōpū i tēnei tau o ngā kairangahau ko te 13.3%, he punua pikinga nō te 12.6% i tērā tau.

Tukua ai ngā takuhe i roto i te toru tau, ā, he kapi-whānui; ngā utu ā-tau, ngā tūranga ā-tauira, ā-kairangi hoki, ngā utu ā-whare, me ngā whakapetonga rangahau.

Read more from Professor Gill Dobbie (page 76).



Stock image: Petrie dish with bacterial colonies

02 /
MARSDEN FUND STANDARD GRANTS

NEW DRUGS FROM BUGS:

AWAKENING DORMANT BIOSYNTHESIS

With antimicrobial resistance (AMR) on the rise, there is an urgent need to discover new, effective antibiotics. Dr Jeremy Owen from Te Herenga Waka—Victoria University of Wellington aims to combat this problem using the hidden potential within bacteria.

The emergence and spread of drug-resistant pathogens is a global threat to human health. As established antibiotics become less effective, there is a growing need to discover new alternatives. The most promising avenue for antibiotic discovery is in nature – numerous bacteria, fungi and plants produce antibiotics that have been co-opted for human use. However, most antibiotic-encoding genes are expressed only under specific circumstances and are usually 'dormant'. How can we identify and isolate the antibiotics produced by dormant gene clusters?

Dr Owen and his team have been awarded a Marsden Fund Standard grant to delve into this untapped potential. They will use state-of-the-art computational methods to scan bacterial genomes and identify gene clusters that are likely to produce new natural products. They will then use modern DNA technologies to try and 'activate' the expression of these gene clusters, either in the host bacterium or by moving the cluster into a different bacterial species. Expressed natural products will then be collected and assayed for potential antibiotic activity.

This research has the potential to discover new antibiotics that are effective against drug-resistant pathogens. More generally, the techniques used here might also facilitate faster and easier discovery of new drugs going forward, giving us an advantage in the race against drug-resistance.

Dr Jeremy Owen

Fermenters in the lab (left)

TIGHTENING THE BELT:

ARE FOOD TAXES IMPROVING PUBLIC HEALTH IN TONGA?

Dr Andrea Teng from Te Whare Wānanga o Otāgo the University of Otago asks if Tonga's approach of taxing unhealthy foods might be an effective way to improve public health.

In Aotearoa New Zealand, growing rates of obesity have increased the prevalence of non-communicable diseases such as diabetes and heart disease, especially among Māori and Pacific communities. In the face of a widespread 'obesity epidemic', the World Health Organization has recommended that countries adopt fiscal policies to promote healthy diets and improve public health. Many countries have implemented this advice in the form of taxes on sugary drinks, but far fewer have attempted to implement taxes on unhealthy foods. The efficacy of these kinds of interventions, and their potential impact on equity, remain poorly understood.

Dr Andrea Teng and Dr Viliami Puloka

Across Moana-nui-a-Kiwa the Pacific Ocean, Tonga demonstrates one of the highest rates of obesity in the world. However, Tonga is also one of the few countries that has made significant progress on taxing unhealthy foods and beverages. Not only has Tonga introduced substantive taxes on over ten different high-fat and high-sugar products, it has also waived import taxes on selected healthy products such as fruit, vegetables, eggs, and seafood.

With their Marsden Fund Standard grant, Dr Teng and associate investigator Dr **Viliami Puloka** will investigate the effects of Tonga's world-leading, comprehensive taxation programme on real-world outcomes – including food prices, import volumes, domestic manufacturing, household expenditure, and equity. They will compare household expenditure on, and consumption of, taxed and untaxed items before and after the changes in tax policy, and explore how these factors are impacted by a household's income. The results of this study will be compared to studies on food taxes elsewhere in the world, producing a synthesised understanding of the consequences of this kind of policy intervention.

This research will be one of the first to evaluate the effects of food taxes outside of Europe and North America, adding to a currently sparse literature on the topic. This important evaluation of Tonga's food taxes is an excellent opportunity for global learning, and will help to inform best-practice policies to improve public health.

USING SAFE-BY-DESIGN APPROACHES TO DEVELOP ALTERNATIVES TO HARMFUL 'FOREVER CHEMICALS'

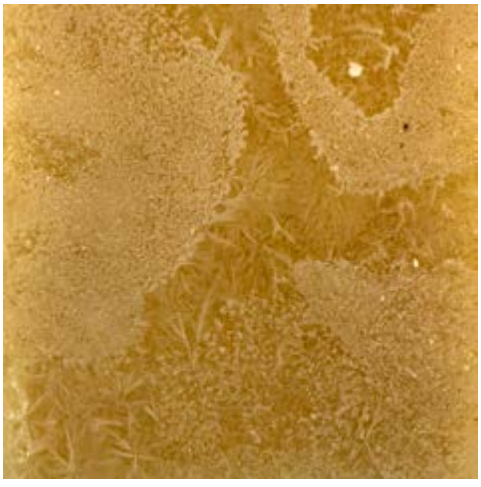
Stable 'forever chemicals' like PFAS have had long-lasting impacts on the environment and on human health. Dr Erin Leitao from Waipapa Taumata Rau the University of Auckland aims to create safer alternatives that won't outstay their welcome.

The chemical bond between carbon and fluorine is one of the strongest in chemistry. Because of this, chemical compounds containing carbon-fluorine bonds are highly stable and have long been prized for their commercial applications; for example, per- and poly-fluoroalkyl compounds (PFAS) have been used in a range of everyday products including contact lenses and non-stick pans.

Decades on, we have come to understand that there is a downside to the stability of these compounds. Due to their widespread use and persistence, PFAS have been detected in soil, water (including rain and drinking water), food, breastmilk, and human blood. When they become concentrated in our bodies they are toxic, causing cancer, developmental abnormalities, and infertility. Manufacture and use of PFAS is now prohibited, and there is an urgent global need to develop alternatives to these 'forever chemicals'.

Dr Leitao has been awarded a Marsden Fund Standard grant to develop 'safe-by-design' replacements for PFAS. To accomplish this, she has brought together a team with expertise in synthetic chemistry, engineering, and environmental science. After designing fit-for-purpose PFAS alternatives, the team will carry out laboratory-based tests to investigate how they behave across a range of controlled environmental conditions. They aim to design alternatives that are stable under normal conditions, but can be triggered to degrade into harmless products.

The development of a new generation of safer PFAS-like substances will help us to continue to make the products we need, while also preserving the environment and our health.



The building blocks of Dr Leitao's next-generation PFAS, a rubbery material containing both sulphur and silicone. Credit: Mahsa Rokni

Dr Erin Leitao in the Lab. Credit: University of Auckland

‘SUPERCORALS’ FIGHT FOR SURVIVAL:

A CLIMATIC BATTLE

Dr Clinton Oakley from Te Herenga Waka—Victoria University of Wellington will lead a team to investigate what makes certain corals ‘super’, with hopes of developing reefs that are more resistant to climate change.

Once a rare phenomenon, coral-bleaching events are now increasing in frequency and severity because of climate change. Corals, marine animals closely related to jellyfish, often contain microscopic algae that help give them striking colours. Both coral and algae benefit from their close relationship: the coral provides shelter for the algae, and the algae provide nutrition for their hosts through photosynthesis. This relationship is disrupted when sea temperatures rise and the algae are expelled from the coral host, leaving the coral pale (“bleached”) and unable to survive.

So how can our coral reefs be saved? Corals that are resistant to bleaching, known as ‘supercorals’, could be the key. Dr Clinton Oakley has been awarded a Marsden Fund Standard grant to research the molecular mechanisms of coral bleaching. By investigating what makes some ‘super’, he aims to inform more direct interventions.

A healthy Acropora coral. Credit: Dr Clint Oakley

Dr Oakley collecting protein samples from corals in Mo’orea, French Polynesia. Credit: Dr Katie Hillyer

The current model of coral bleaching – the ‘oxidative theory’ – suggests that corals expel their algal partners when their antioxidant pathways are overwhelmed by toxic reactive oxygen species, a byproduct of their increased metabolic rate. However, the precise mechanisms by which this might occur remain unclear. Dr Oakley and his international team will use a combination of new molecular systems and techniques to track the bleaching process in coral cells with unprecedented resolution. By measuring the oxidation of thousands of proteins throughout the coral cell at high temperatures, the team will determine whether bleaching is due to indiscriminate damage or the triggering of specific bleaching pathways.

They will then analyse multiple coral species to reveal if these bleaching mechanisms are widespread, and in doing so, identify specific genes which influence bleaching. Finally, the team will investigate existing corals with higher bleaching resilience to validate their findings and define what would make a coral ‘super’. Their findings will have important implications for reef restoration strategies in a warming world.

ORANGA TONUTANGA O NGĀ 'KĀOA HIRAHIRA':

TE WHAWHAI Ā-ĀHUARANGI

Mā Dr Clinton Oakley, nō Te Herenga Waka, e ārahi tētahi tīma ki te tūhura i te take i 'hirahira' ai ētahi momo kāoa, me kore noa e whakawhanake i ētahi pūkawa e mārohirohi ana ki te huringa o te āhuarangi.

Exaiptasia diaphana, a sea anemone that is a model 'lab mouse' for coral research. Credit: Dr Clint Oakley

He āhuatanga o nehe i tētahi wā, engari e piki ana te nui me te kaha o ngā āhuatanga whakatoki kāoa nā te huringa o te āhuarangi. I te nuinga o te wā, he pūkohu wai mōkito kei ngā kāoa, he momo nō te moana e noho whanaunga ana ki te petipeti, he āwhina kia hua ake ai ko ngā tae muramura. Ko te kāoa me te pūkohu wai ka whai hua i taua hononga; ka whakamaru te kāoa i te pūkohu wai, ā, ka tuku te pūkohu wai i te taioranga ki te kaimanaaki mā te ahotakakame. Ka raru tēnei hononga i te pikinga o te pāmahana o te moana, ka panaia ai te pūkohu wai i te kaimanaaki, arā i te kāoa, e tae-tea ai te kāoa (ka 'whakatokihia'), ka mate.

Nā reira me pēhea e ora ai ngā pūkawa? Ko ngā kāoa e mārohirohi ana ki te whakatoki - ngā 'kāoa hirahira' pea te whakautu. Kua whakawhiwhia a Dr Clinton Oakley ki te takuhe Standard nā Te Pūtea Rangahau a Marsden kia mārama ai ki ngā āhuatanga rāpoi ngota o te whakatoki kāoa. Mā te tūhura he aha i "hirahira" ai ētahi, ka whai ia ki te whāngai i ngā hāpaiora hāngai ake.

E ai ki te anga o nāianei o te whakatoki kāoa - te 'ariā ōhikitanga' - ka pana ngā kāoa i ngā hoa pūkohu wai i te wā ka pokea e ngā momo hāora tauhohe tāoke, he hua o te pikinga o te whakarau pūngao. Heoi anō, kāore tonu i te mōhiotia ngā āhuatanga i pēnei ai. Ka whakamahi a Dr Oakley rātou ko tana tīma ā-ao i tētahi kohinga pūnaha rāpoi ngata me ētahi rautaki ki te whai i te hātepe whakatoki i ngā pūtau kāoa ariari hou. Mā te ine i te ōhikitanga o ngā pūmua manomano puta noa i te pūtau kāoa i te pāmahana teitei, ka whakatau mēnā rānei ka hua ake te whakatoki i ngā whakararutanga whakahāwea-kore, i te keunga rānei o ngā ara whakatoki motuhake.

Kātahi rātou ka tātari i ngā momo kāoa maha ki te tūhura mēnā rānei he hōrapa rānei ēnei āhuatanga whakatoki, ā, mā te pērā e tūtohu ai i ngā ira motuhake ka whakaawe nei i te whakatokitanga. Ka mutu, ka tūhura te tīma i ngā kāoa o nāianei e mārohirohi ake ana ki te whakatokitanga ki te whakatūturu i ngā kitenga me te whakamahuki he aha e 'hirahira' ai tētahi kāoa. Ka nui ngā pānga o ō rātou kitenga ki ngā rautaki whakaora pūkawa i tētahi ao māhanahana haere.

NOW I SEE ME:

USING PICTURE BOOKS FOR INDIGENOUS LANGUAGE PRESERVATION AND REVITALISATION

Associate Professor Nicola Daly from Te Whare Wānanga o Waikato the University of Waikato will work with a team of researchers and award-winning Huia Publishers to explore the ways in which Indigenous voices are, and can be, genuinely portrayed in picture books.

Children's picture books are a powerful form of literature. They are a building block for our tamariki, promoting language acquisition as well as a sense of self-identity. But how exactly do they exert this influence? How do publishers use visual elements such as illustrations, font, colour palettes, and layout to shape children's awareness of the world around them? And more specifically, how do picture books represent the complexities of Indigenous language, knowledge, and identity?

Associate Professor Daly has received a Marsden Fund Standard grant to document and explore the ways in which Indigenous voices in Aotearoa New Zealand are, and can be, authentically represented. This research will be carried out in collaboration with the multi-award-winning, Māori-owned publishing company Huia Publishers. Executive Director of Huia Publishers **Eboni Waitere** says they are looking forward to working with the research team.

Multidisciplinary in nature, and driven by kaupapa Māori principles, this exciting and novel project aims to challenge our perspectives of how picture books are published. The team of Māori and Pākēha partners will focus on the tensions of translation, appropriate visual expression of Indigeneity, and how picture books preserve and grow Indigenous languages.

Associate Professor Nicola Daly (University of Waikato), and other project members, Dr Julie Barbour (University of Waikato), Associate Professor Darryn Joseph (Massey University), and Dr Nic Vanderschantz (University of Waikato).

KUA KITEA AHAU:

TE WHAKAMAHI I NGĀ PUKAPUKA PIKITIA MŌ TE WHAKAUKA ME TE WHAKARAUORA REO TAKETAKE

Ka mahi tahi a Ahorangi Nicola Daly nō Te Whare Wānanga o Waikato ki tētahi tīma rangahau me te whare whai tohu nei, ki a Huia Publishers, ki te toro i ngā ara e whakaatuhia motuhengahia ai ngā reo Taketake i ngā pukapuka pikitia.

He mana mātātuhi nui tō ngā pukapuka pikitia tamariki. He pou whanake mō ngā tamariki, e whakatairanga ana i te kapohanga o te reo, waihoki te tuakiritanga. Engari ka pēhea rā tēnei whakaawenga? Ka pēhea tā ngā kaiwhakaputa whakamahi i ngā āhuatanga ataata, pēnei i ngā pikitia whakaari, te momotuhi, ngā tae, me te whakatakotoranga hei whakairo i te tūoho o ngā tamariki ki te ao hurihuri? Ka mutu, ka pēhea tā ngā pukapuka pikitia whakakanohi i ngā matatini o ngā reo Taketake, o ngā mātauranga me te tuakiritanga?

I whakawhiwhia a Ahorangi Daly ki tētahi takuhe Standard nā Te Pūtea Rangahau a Marsden ki te tuhi me te toro i ngā ara e whakakanohihia motuhengahia ai ngā reo Taketake i Aotearoa. Ka pīkauria tahitia tēnei rangahau me te kamupene whakaputa Māori, whai-tohu-maha nei, me Huia Publishers. E ai ki te Tumu Whakarae o Huia Publishers, ki a **Eboni Waitere**, e hiamo ana rātou ki te mahi tahi ki te tīma rangahau.

He aronga kaupapamaha, ā, he mea āki e ngā mātāpono kaupapa Māori, e whai ana tēnei kaupapa whakamīharo ki te wero i ō tātou whakaaro e pā ana ki te whakaputanga o ngā pukapuka pikitia. Ka āta aro te tīma e kī ana i te Māori me te Pākehā ki ngā taukumekumetanga i te wāhi ki ngā whakamāoritanga, ki te whakaputanga ataata o te Taketaketanga e tika ana, me tā ngā pukapuka pikitia whakauka me te poipoi i ngā reo Taketake.

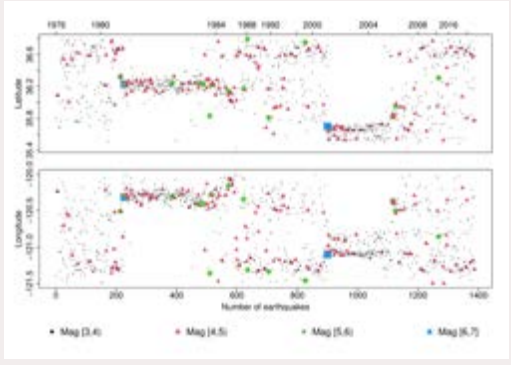
ONE THING LEADS TO ANOTHER:

HOW MATHEMATICAL MODELLING CAN HELP US TO UNDERSTAND THE DOMINO EFFECT

Associate Professor Ting Wang and Professor Boris Baeumer of Te Whare Wānanga o Otāgo the University of Otago will develop mathematical models of the 'domino effect' to better understand and forecast outcomes for real-world systems.

Nature is full of instances where a major destabilising event starts a chain reaction of recurrent cause-and-effect, like an earthquake and resulting aftershocks, or the spread of rumours in a social network. This kind of chain reaction is referred to colloquially as the 'domino effect', in reference to a falling row of dominoes. While events like this are relatively common, their inherent randomness makes it very difficult to forecast their impact, even over short time scales.

Associate Professor Wang and Professor Baeumer have been awarded a Marsden Fund Standard grant to develop a new class of models of the domino effect. These models aim to capture random stochastic recurrence patterns and cause-and-effect processes. Each occurrence in the model will be dependent on the timing and, importantly, the size of previous events, as well as the unobservable overall energy of the system. The models will also exhibit features typical of real-world events such as an initial sharp increase with the destabilising event, followed by a slow decrease afterwards, returning to the normal steady state.



After developing their models, Associate Professor Wang, Professor Baeumer and their team will apply them to different systems, including earthquake sequences, social networks, and financial data, to test their applicability and effectiveness. This research has the potential to improve the accuracy of predictions across many different sectors, with benefits for health, safety, and the economy.

Associate Professor Ting Wang
Professor Boris Baeumer
Figure: A real-world example of the domino effect: Recurrence of mainshock-aftershock sequences in Northern California

TWINKLE, TWINKLE, LITTLE STAR(LING):

ARE SLEEPY BIRDS SLOPPY SINGERS?

Sleep disturbance can impair our mood as well as our ability to learn – but can sleep disruption in our youth have longer-term consequences on learning and performance? Dr Kristal Cain from Waipapa Taumata Rau the University of Auckland will be using vocal learning in birds as a model to delve into this important topic.

Above: Dr Kristal Cain in the field with a kōtare sacred kingfisher. Credit: A Heswell

Below: A female and male zebra finch. Credit: Robert Dugand

Most of us have experienced some form of sleep disruption, and are all too familiar with the effect it has on our physical and mental state. Sleep-loss worsens our mood and increases stress, but it also impairs communication, memory, and learning. These effects are even more pronounced in tamariki; poor-quality sleep early in life hinders vocal learning, resulting in reduced language ability years later.

Songbirds represent a powerful potential model to study the connection between sleep and vocal learning more deeply. Few animals share our vocal abilities, but songbird brains contain specific regions for vocal learning that mirror our own, and juvenile songbirds go through distinct vocal learning stages similar to those observed in human babies.

Dr Cain has previously found that sleep deprivation impairs the vocal performance of adult zebra finches, with implications for their ability to secure a mate. However, it is unclear how sleep deprivation in young birds, at critical stages of cognitive development, impacts vocal learning and subsequent vocal performance as an adult. In this Marsden Fund Standard project, Cain and her team will use state-of-the-art technologies (tiny bird backpacks fitted with microphones) to explore how disrupting the sleep of young zebra finches impairs their vocal learning. Due to the short lifespan of this species, the effect of sleep disruption can be measured all the way into adulthood to see when it arises and how long it persists.

This will be one of the first studies to investigate whether –and how—sleep disruption early in life can affect vocal learning in animals. Perhaps this will help us to better understand the risks for our own tamariki when they don't get a full night's rest.

NAVIGATING LABOUR MOBILITIES:

SEAFARERS AFTER COVID-19

COVID-19 brought about the global 'Crew Change Crisis' which left more than 400,000 seafarers stranded on ships and in ports due to border closures. Dr Maria Borovnik from Te Kunenga ki Pūrehuroa Massey University will investigate the social and economic impacts of this often-overlooked humanitarian crisis, focusing on the dignity of seafarers as enablers of global trade.

Ninety percent of world trade is conducted by sea. When COVID-19 struck, the seafarers transporting these goods became stranded on ships or in unfamiliar ports, separated from their families, sometimes for years.

Many seafarers originate from the Global South, including the Pacific, with backgrounds in societies that nurture strong and collaborative cultural values. Similarly, ship environments naturally emphasise team spirit, where each person has clearly defined tasks that the vessel and crew depend on. Dr Borovnik believes this has provided many seafarers with the tools for resilience and action in such challenging times. Their 'ensembled agency' recognises that they prioritise harmony within social relationships over individual freedoms.

Dr Borovnik and her team, including **Dr Charlotte Bedford** from the Australian National University has received a Marsden Fund Standard grant to investigate this theory by visiting seafarers and their support networks and recording their stories about the COVID-19 pandemic, their current situations, and their futures. This multi-sited research will include seafarers of diverse backgrounds in Kiribati, Tuvalu, Fiji, Australia, and Aotearoa New Zealand. A particular focus is on seafarers from Kiribati – who were separated from their families for two to three years because of border closures. Recognising the importance of a strong understanding of the nuances of Kiribati culture, Dr Borovnik has assembled an I-Kiribati Advisory Team. Working closely with local research associates, she will engage in the 'te maroro' research method of relaxed, informal discussions.

The COVID-19 Crew Change Crisis significantly interrupted global trade and its effects are still apparent through ongoing disruptions and delays. At the heart of the crisis were seafarers themselves, whose agency to choose and negotiate strategies in uncertain situations enacted at different scales, is often unacknowledged. It's time to hear their stories.

Seafarers adjusting a container ship for landing in Yantian District, Shenzhen, China. Credit: Dr Maria Borovnik

TE PŌKAI I TE PANUKU TANGATA TŌHAUNUI:

NGĀ TĀNGATA MOANA I MURI I TE KOWHEORI-19

I hua ake i te KOWHEORI-19 te 'Tairaru Huri Tira' i mau ai te 400,000 neke atu tāngata moana ki ngā kaipuke me ngā pōta nā te katinga o ngā paenoho. Ka tūhura a Dr Maria Borovnik, nō Te Kunenga ki Pūrehuroa, i ngā pānga ā-pāpori, ā-ōhanga anō hoki o tēnei tairaru tāngata. Ka āta tirohia te mana o ngā tāngata moana hei kaituku i te tauhokohoko ā-ao.

Iwa tekau ōrau o ngā mahi tauhokohoko i te ao ka mahia mā te moana. I te pupūnga ake o KOWHEORI-19, i mau ngā tāngata moana e kawe ana i ēnei rawa ki ngā kaipuke, ki ngā pōta rerekē rānei. Ka noho mahue i ō rātou whānau, he tau nei te roa i ētahi wā.

He nui ngā tāngata moana i ahu mai i te Tai Tonga o te Ao, tae ana ki Te Moana Nui a Kiwa, i ngā porihanga e poipoi ana i ngā uaratanga ā-ahurea pakari o te mahi tahi. Waihoki, ko ngā taiao kaipuke ka whakanui i te wairua mahi tahi, e whai ai ia tāngata i tētahi mahi mārakerake e whirinaki ai te waka me te tira. E whakapono ana a Dr Borovnik nā konei i whai mārohirohi ai te huhua tāngata moana i te wā o te taumaha. E kitea ana i tā rātou tiratanga tā rātou whakamātāmua i te wātea ā-takitini i roto i ngā hononga ā-pāpori, ka mātāmuri ko ngā herekoretanga a te takitahi.

Kua whakawhiwhia a Dr Borovnik rātou ko tana tīma, tae ana ki a Dr **Charlotte Bedford** nō te Whare Wānanga ā-Motu o Ahitereiria, ki tētahi takuhe Standard nā Te Pūtea Rangahau a Marsden ki te tūhura i tēnei ariā mā te toro atu ki ngā tāngata moana me ō rātou whatunga tautoko me te tuhi i ā rātou kōrero e pā ana ki te mate urutā o te KOWHEORI-19, ō rātou nohonga ināianei me te anamata. Ka uru atu ki tēnei rangahau wāhi-maha ko ngā tāngata takenga kanorau i Kiripati, i Tuwaru, i Whīti, i Ahitereiria, mei Aotearoa. E āta aro ana ki ngā tāngata moana nō Kiripati (i noho mahue i ō rātou whānau mō te rua ki te toru tau nā te katinga o ngā paenoho). I runga i tana kite i te hiranga o te mōhiotanga pakari ki ngā tangongitanga o te ahurea o Kiripati, kua whakatōpūhia e Dr Borovnik tētahi Tīma Kaitohutohu I-Kiripati. I runga i te mahi tahi ki ngā hoa rangahau o ia takiwā, ka whai ia i te rautaki rangahau o 'te maroro', arā, he matapakitanga tau, ōpaki anō hoki.

I tino whakararu te Tairaru Huri Tira o KOWHEORI-19 i te tauhokohoko ā-ao, ā, e rangona tonutia ana ōna pānga i ngā whakararutanga me ngā takaroatanga ināianei. Kei te iho o taua tairaru ko ngā tāngata moana tonu, ko tō rātou manawhiri rautaki i ētahi horopaki kāore nei e mihia. Me rongo ā rātou kōrero.

Dr Maria Borovnik

WARMER AIR MEANS MORE WATER:

AOTEAROA'S WEATHER EXTREMES IN A WARMING WORLD

Dr Peter Gibson from Taihoro Nukurangi the National Institute of Water and Atmospheric Research (NIWA) and Dr Luke Harrington from Te Whare Wānanga o Waikato the University of Waikato have both received Marsden Fund grants to improve our understanding of land–atmosphere interactions around Aotearoa New Zealand. They will be investigating how climate change could increase the number and magnitude of 'atmospheric rivers' in our skies, and supercharge warming of our land.

Climate change is already impacting Aotearoa. Predicting the severity of future climate events is crucial to prepare for their impacts, but many global climate models lack the spatial resolution required to do this at national and regional scales. These interrelated Marsden grants aim to change this by developing high-resolution models that better predict anticipated weather extremes here in Aotearoa.

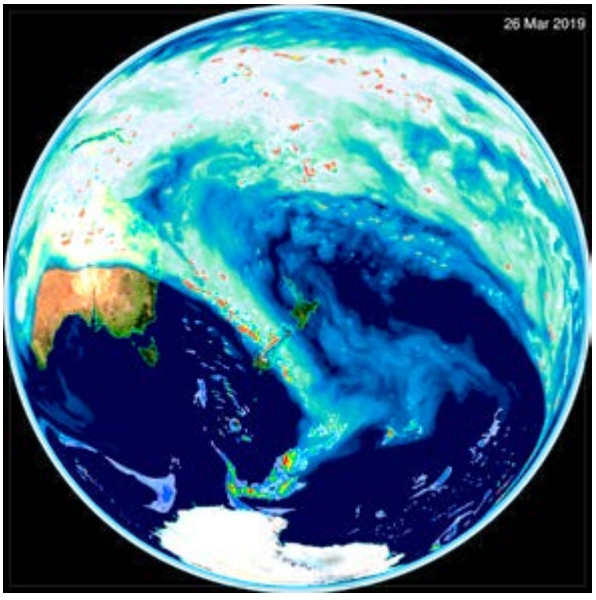


Figure: An example of an extreme atmospheric river impacting New Zealand in high-resolution climate model simulations produced at NIWA. White shading shows elevated atmospheric water vapour and red shading shows extreme rainfall. Credit: Dr Peter Gibson

Atmospheric rivers are concentrated corridors of water vapour transported through the lower atmosphere that can cause devastating flooding, as experienced in Auckland in January 2023. Modelling suggests that atmospheric rivers are expected to increase substantially over certain global 'hotspots', the greatest of which spans a large area of the Southern Ocean centered around Aotearoa. Dr Gibson's Marsden Fund Fast-Start grant will examine how well these global models really capture the expected changes over Aotearoa, since complex topography is a major influence on the path and duration of atmospheric rivers. Dr Gibson and his international team will work to understand the historical trends in atmospheric rivers across Aotearoa and the specific factors underlying the Southern Ocean hotspot, then use high-resolution models to assess whether our local conditions could amplify these factors even more.

Dr Luke Harrington (left) and Dr Peter Gibson (right)

Another prediction regarding climate change is related to the degree of summer-time warming over land. The Intergovernmental Panel on Climate Change (IPCC) recently concluded that Aotearoa is one of the few regions around the world where summer-time warming is expected to increase in line with global average temperatures, but not faster. However, local data shows that the frequency of extreme heat events in many parts of Aotearoa are indeed occurring faster than expected. Dr Luke Harrington and his team, which includes Dr Gibson, suspect that land aridification is to blame. Soil-moisture evaporation uses up a lot of energy, so when soils dry out increasingly early each summer, there is more energy available to heat the atmosphere.

With his Marsden Fund Standard grant, Dr Harrington will use a network of soil moisture and climate observations to develop new models that can quantify the land–atmosphere feedback of our islands at smaller scales than previously achieved.

The effects of climate change on our water, air and land are inextricably entwined. Hotter air promotes evaporation of water from our soils, creating droughts; but the water vapour concentrated in the atmosphere can then be released elsewhere in floods. A holistic understanding of these processes, and how they manifest specifically in Aotearoa, will be essential as we plan for our future in a warming world.

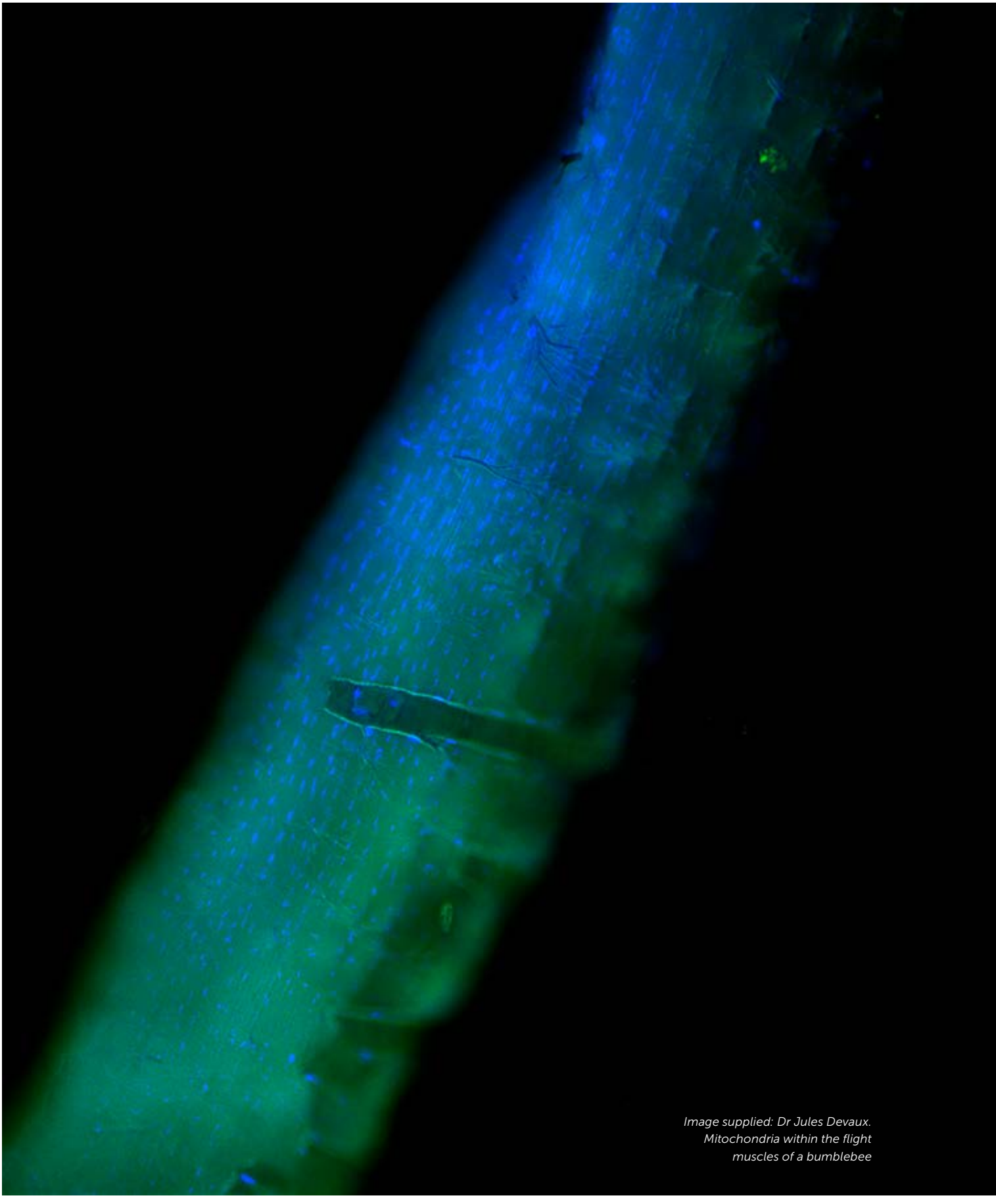


Image supplied: Dr Jules Devaux. Mitochondria within the flight muscles of a bumblebee

03 /
MARSDEN FUND FAST-START GRANTS

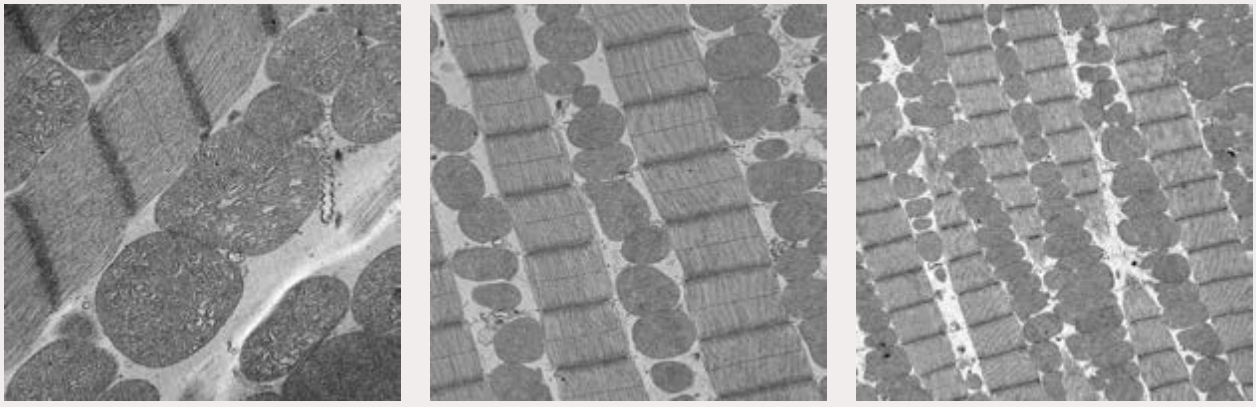
POWERING THE FLIGHT OF THE BUMBLEBEE

Dr Jules Devaux of Waipapa Taumata Rau the University of Auckland will solve the paradox of how bumblebees power the rapid wing movement required for flight, despite lacking key enzymes to ensure energy supply and waste removal.

The bumblebee is the extreme athlete of the insect world, possessing some of the fastest-contracting muscles known to science. These flight muscles allow the bumblebee's disproportionately small wings to flap over 200 times a second in order to achieve flight. However, insect flight muscles lack multiple key enzymes that are required in mammalian muscles to ensure constant energy supply and remove waste products. So how does the humble bumblebee take to the air?

Dr Devaux has been awarded a Marsden Fund Fast-Start grant to determine the biological mechanisms underlying the paradoxical flight of the bumblebee. Dr Devaux hypothesises that the powerhouses within bumblebee muscle cells, called mitochondria, play a critical role in their unique flight abilities. This study will determine if mitochondria within flight muscles are connected to each other through 'nanotunnels', promoting a constant energy flow during flight. Using super-resolution microscopy, Dr Devaux will investigate how the unique enzyme complexes within these mitochondria have been fine-tuned to accomplish superpowered flight. They will also investigate how bumblebee flight muscles defend themselves against the accumulation of toxic byproducts produced by their frantic activity.

This high-flying research programme will determine for the first time the molecular mechanisms permitting the paradoxical flight of the bumblebee.



Mitochondria (oblongs) and muscle fibres (striped columns) within the flight muscles of a bumblebee

Dr Jules Devaux. Credit: Charlotte E. Johnson

SELF-HEALING CONCRETE MARRYING ANCIENT ROMAN KNOWLEDGE AND TE AO MĀORI

Dr Enrique del Rey Castillo from Waipapa Taumata Rau the University of Auckland aims to make a sustainable alternative to concrete with a reduced carbon footprint, inspired by Roman construction and mātauranga Māori.

Dr Enrique del Rey Castillo

Global carbon dioxide emissions must be reduced by 45% by 2030 to prevent severe climate effects. Production of Ordinary Portland Cement (OPC), a major component of concrete, accounts for 5-8% of global greenhouse gas emissions. Ancient Roman concrete, made with lime and volcanic gravel such as pumice, has a comparatively smaller carbon footprint and is also thought to have 'self-healing' properties, where small cracks can close themselves. Modern concretes made with similar materials may therefore be an effective, sustainable alternative to concretes made with OPC.

Dr del Rey Castillo has received a Marsden Fund Fast-Start grant to develop a concrete alternative using materials abundant in Aotearoa New Zealand – volcanic ash (pumice) and kaimoana seashells. Both materials have been used for many purposes by Māori in the past, but neither have been tested thoroughly for their potential in concrete production. Dr del Rey Castillo and their team will investigate the unique material properties of pumice from the rohe of Te Arawa and seashell powder from Ngātiwai aquaculture farms and determine their suitability as partial cement replacements. They will then investigate whether concrete made from these materials displays any of the 'self-healing' properties of ancient Roman concrete. This research plan will be carried out with ongoing input from mana whenua, who are impacted by the polluting industry of concrete production and who stand to benefit from sustainable use of these natural resources.

By marrying ancient Roman knowledge and mindful use of our taonga, this project aims to produce a sustainable concrete that reduces carbon emissions for the benefit of Aotearoa and beyond.

TĀ TE RAIMAMAHU I A IA ANŌ TŪHONO I NGĀ MĀTAURANGA TUAUKI O RŌMANA ME TE AO MĀORI

E whai ana a Dr Enrique del Rey Castillo, nō Waipapa Taumata Rau, ki te hanga i tētahi kraima toitū arokē e heke ai te tapuwae waro. He mea whakaawe e ngā tūāhanga o Romāna me te mātauranga Māori.

Me whakaheke te tukuwaro i te ao mā te 45% i mua i te 2030 hei kaupare i ngā pānga āhuarangi nui. Nā te hanganga o te Raima Pōtarana Noa (OPC), tētahi wāhanga matua o te raima, te 5-8% o te tukunga haurehu kati mahana. He iti noa atu te tapuwae waro o te raima Rōmana Tuauri, kua hangaia i te raima me te tuakirikiri rangitoto pēnei i te pungapunga. Waihoki, he āhuatanga ōna hei mahu i a ia anō (hei tauira, ka piri kuhutahi anō ngā piere iti). Nā reira ka whai hua, ka toitū hoki pea ngā raima hou kua hangaia i ngā rawa ōrite hei kāinga rua mō ngā raima kua hangaia i te OPC.

Kua whakawhiwhia a Dr del Rey Castillo ki tētahi takuhe Fast-Start nā Te Pūtea Rangahau a Marsden ki te whakawhanake i tētahi raima arokē e whakamahi ana i ngā rawa e nui ana i Aotearoa - te pungarehu rangitoto (pungapunga) me ngā anga kaimoana. He nui ngā whakamahinga o ngā rawa nei e ngāi Māori i roto i te wā, engari kāore i āta whakamātauria mō te hanga raima. Ka tūhura a Dr del Rey Castillo rātou ko tana tīma i ngā āhuatanga rawa motuhake o te pungapunga i tō rātou rohe o Te Arawa me te paura anga moana nō ngā pāmu wai o Ngātiwai. Kātahi ka whakatau i te hāngai rānei hei whakakapinga wāhanga raima. Kātahi rātou ka tūhura mēnā e whakaatu ana ngā raima kua hangaia i ēnei rawa i ngā āhuatanga 'mahu i a ia anō' pēnei i te raima Rōmana Tuauri. Ka pīkauria tēnei mahere rangahau i runga i tā te mana whenua whāngai atu, te hunga e pāngia nei e te ahumahi parahanga o te hanga raima, me te hunga hoki ka whai hua i te whakamahinga toitū o ēnei rauemi māori.

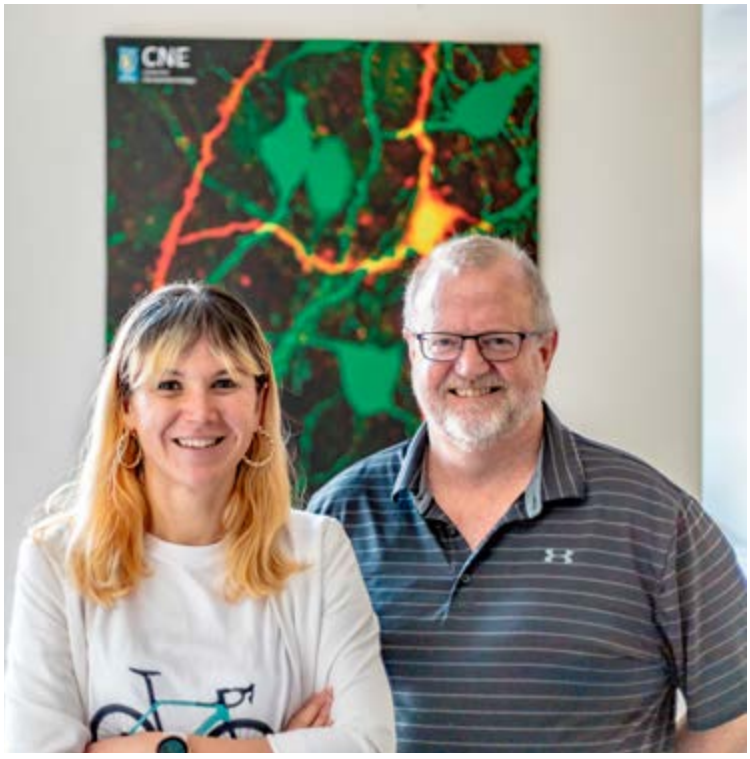
Mā te tūhono i ngā mātauranga tuauki o Rōmana me te whakamahinga tika o ā tātou taonga, ka whai tēnei kaupapa ki te whakaputa i tētahi raima toitū ka whakaheke i te tukuwaro hei painga mō Aotearoa, ā, ā tua atu.

IT'S GETTING HOT IN HERE:

HORMONAL SUPPRESSION OF FEVER DURING PREGNANCY

Dr Teodora Georgescu of Te Whare Wānanga o Otāgo the University of Otago will use state-of-the-art neuroscience techniques to determine how fever is suppressed during late pregnancy to protect the growing foetus.

Experiencing fever during pregnancy can impair foetal development, potentially leading to premature delivery and increased infant mortality. For this reason, the body naturally suppresses its ability to develop a fever during late pregnancy to promote the successful birth of a healthy baby. Dr Georgescu has recently pinpointed the specific neurons responsible for suppressing the fever response during pregnancy, but the signal that triggers them to do so remains unknown.



Dr Teodora Georgescu and mentor Professor Dave Grattan FRSNZ from the Centre for Neuroendocrinology

Dr Georgescu has been awarded a Marsden Fund Fast-Start grant to investigate the trigger for fever-suppression during late pregnancy. She hypothesises that this signal comes from the foetus itself, specifically from the placenta, known as whenua in te reo Māori. During late pregnancy, the whenua secretes elevated levels of the pregnancy hormones prolactin and oestrogen. The fever-regulating neurons have receptors for these hormones on their surface, suggesting that they might be able to respond to these signals. To test this, Dr Georgescu will use state-of-the-art neuroscience techniques to observe how pregnancy hormones alter the activity of fever-regulating neurons in mice, and investigate whether removing their hormone receptors alters the fever response.

Understanding the mechanism behind fever-suppression during pregnancy has significant implications for the health of both pregnant people and their unborn babies. Not only will this study shed light on the adaptive changes that occur during pregnancy, but it could also provide new interventions for managing the symptoms of infection when fever is suppressed.

PREDICTING HOME RANGE FROM THE GENOME:

HOW DOES GENOMIC ARCHITECTURE INFLUENCE SPECIES RANGE LIMITS?

Dr Elahe Parvizi from Te Whare Wānanga o Waikato the University of Waikato is investigating how genome size and composition can influence the ability of a species to colonise new territories.

Dr Elahe Parvizi (top)

"Sea vomit" growing on oysters, aquaculture farm, Spain. Credit: Professor Xavier Turon

Animals and plants vary widely in their ability to colonise new areas. Those that spread easily often become invasive pests, disrupting existing ecosystems, while those that struggle to survive outside of their home range can quickly become threatened if this habitat is degraded. A species' range limits are influenced by life history factors such as reproductive rate, but emerging evidence suggests that the size and composition of the genome can also allow some species to expand their range more easily.

Dr Parvizi has been awarded a Marsden Fast-Start grant to investigate this intriguing link in sea squirts. Sea squirts, or ascidians, are marine filter-feeders that play important roles in marine ecosystems, but can also pose a threat through range expansion. For example, the sea squirt known as 'sea vomit' can smother other marine organisms and has been a major problem for mussel aquaculture in Aotearoa New Zealand. Dr Parvizi and her team will use the latest comparative genomic approaches to study how the size and composition of sea squirt genomes can facilitate range expansion in different habitats around New Zealand, the Trans-Tasman region, and Antarctica. They hypothesise that widespread species with high potential for range expansion will have 'adaptable' genomes with more genes, structural rearrangements and mobile genetic elements called transposons. They will also explore how genomic architecture might influence climate tolerance, and a species' potential for range expansion or restriction due to climate change.

This research will inform range limit models that allow us to better predict the future distributions of organisms in our rapidly changing world. These predictions will be crucial for us to safeguard habitats that are essential for range-restricted species, and for us to manage the spread of plants and animals that threaten our health, environment or economy.

Dr Mevagh Sanson.

A BEGINNING, A MIDDLE, AND AN END?

MAPPING THE EMOTIONAL TRAJECTORIES OF OUR PERSONAL STORIES ABOUT THE PAST

Dr Mevagh Sanson from Te Whare Wānanga o Waikato the University of Waikato will explore the ways in which our emotions shape how we tell and re-tell personal memories.

Despite the variety of stories we hear and share in our lives, through storytelling, books or movies, research suggests that there is really not a lot of variety when it comes to their emotional trajectories – their distinctive patterns of rising and falling fortune. Evidence suggests that most stories in Western fiction follow one of just six emotional trajectories. Even more surprisingly, these emotional paths are also evident in the stories that we tell about our own lived experiences. Why do we tend to fall into these familiar patterns when we talk about our personal history?

Dr Sanson has been awarded a Marsden Fund Fast-Start grant to map the ways that emotion shapes how we talk about our memories. The project will examine the relationship between common fictional story structures and how people describe personal experiences of the past. It will also investigate why most of our real-life stories follow the same emotional routes commonly found in fiction.

A clearer understanding of how humans use emotional trajectories in autobiographical storytelling will contribute to knowledge on our ability to organise and communicate information effectively. One of the reasons we use autobiographical memory is to help us form and maintain relationships with others, by sharing memories with them—which we frequently do. This illustrates an important link to mental health and wellbeing, proving that stories can have a powerful influence on how we experience the world.

PRISONS WITHOUT WALLS:

FROM INCARCERATION TO E-CARCERATION IN AOTEAROA NEW ZEALAND

Dr Liam Martin of Te Herenga Waka—Victoria University of Wellington will investigate the shift from physical incarceration to digital monitoring, and what this means for society.

Aotearoa is paving the way from incarceration inside brick-and-mortar prisons to 'e-carceration' using human tracking technologies. While we are a global leader in reducing prison populations, we now have the highest level of electronic monitoring per capita in the world. This dramatic change in the way we incarcerate creates questions for society about the meaning of incarceration in a digital age.

Much of the technology behind e-carceration has its origins in mobile phones. The typical tracking device is assembled from parts designed for smartphones, uses the same satellites to pinpoint location, and communicates through cell towers and internet cables. In this Marsden Fast-Start project, Dr Martin will engage in fieldwork including interviews with technologists, politicians, policymakers, and people navigating e-carceration day-to-day to understand how the system works and how it affects individuals.

The topic of incarceration raises issues of power and control. The traditional prison has long been recognised by scholars as a dominant institution of social confinement for Indigenous people – how is incarceration then understood and experienced as it moves into people's homes and everyday lives? The government has also announced plans to begin GPS tracking of asylum seekers – how is this type of surveillance to be perceived? And finally, mass surveillance and location tracking are built into almost all new mobile phones today – how is this technology transforming social life more broadly? This project will explore these and other questions in a bid to create a full account of electronic monitoring and its increasing prevalence in our lives.

Dr Liam Martin

Dr Georgia Grant onboard the JOIDES Resolution, International Ocean Discovery Program Expedition 400 to Northwest Greenland

SEDIMENTS, CYCLES, AND SEA LEVEL:

HOW WILL GREENLAND'S ICE SHEET RESPOND TO A WARMER CLIMATE?

Global temperature and ice-sheet melting follow natural cycles influenced by the Earth's orbit, but these cycles are now being overshadowed by human-driven changes to the climate. Dr Georgia Grant from Te Pū Ao GNS Science will study ocean sediments around Greenland to reconstruct the movements of its ice sheet in the warmer recent past, and use this knowledge to inform predictions of future melting rates and sea-level rise.

Subtle variations in Earth's orbit affect the amount and distribution of sunlight that reaches the surface, which in turn influences the advance and retreat of ice sheets. Previously, these orbital cycles have been a key driver of Earth's overall temperature, leading to extremes like ice ages and 'hothouse' periods. It has now become difficult to distinguish the effects of orbital cycles from those of human-driven climate change, complicating our predictions of future sea level rise.

As for many questions around climate, the key to the future may be held in the past. Dr Grant has been awarded a Marsden Fund Fast-Start grant to investigate how the Greenland Ice Sheet responded to a warmer climate in the geologically-recent past, specifically the mid-Pliocene Warm Period around 3 million years ago. Temperatures during this period resemble what is predicted for our near future. She and her team will investigate the sediment record in the oceans around Greenland to look for tell-tale signs of ice sheet expansion and retreat, and compare this to records for Earth's other major ice sheet, the Antarctic Ice Sheet. This project capitalises on the recent collection of rare deep-sea sediment samples collected from around Greenland by the International Ocean Discovery Program.

Racks of core ready for processing by the science party in the ship's core laboratory

Understanding and predicting the response of the Greenland Ice Sheet to natural and anthropogenic changes in temperature will be crucial for the future of Aotearoa New Zealand. Paradoxically, melting of this northern ice sheet will influence the sea level around our coastlines much more significantly than melting of the southern Antarctic Ice Sheet, and the two ice sheets do not respond in the same way to orbital cycles. Research like this will help us plan for our future in a warming world.

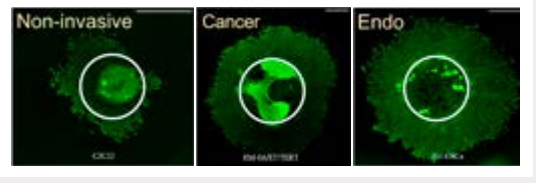
UNDERSTANDING THE INVASIVE MECHANICS OF ENDOMETRIOSIS

By investigating the invasive properties of endometriotic cells, Dr Rachael Wood from Te Whare Wānanga o Waitaha the University of Canterbury hopes to identify new avenues for managing endometriosis.

Endometriosis is an incurable disease that arises when tissue like the uterine endometrium (the lining of the uterus) develops outside of the uterus, for example in the ovaries or fallopian tubes. This can lead to debilitating pain, fatigue and nausea, as well as reduced fertility. Although it affects 10% of wāhine (and those assigned as female at birth) in Aotearoa New Zealand, this disease remains poorly understood and difficult to diagnose and treat.

In a groundbreaking preliminary study, Dr Wood has revealed that endometriotic tissue has similar invasive properties to cancer. Now, with her Marsden Fund Fast-Start grant, she hopes to determine how endometriotic tissue modifies its environment to aid invasion. Dr Wood and her team will measure the mechanical properties of healthy endometrial and diseased endometriotic tissues, and use these measurements to build 3D, gel-based tissue models that can be used for experimental work. By observing how healthy and diseased cells interact with different tissue models, they hope to better understand the onset and progression of endometriosis, and how this compares to cancer.

This project will help to uncover how the mechanical properties of tissue, such as stiffness, are impacted by the invasion of endometriotic cells. Ultimately, this knowledge may help to identify new diagnostic and treatment strategies for endometriosis, bringing relief to millions.



Research group (L-R) Dr Rachael Wood, Katherine Ellis and Deborah Munro

Figure: immunofluorescent image of non-invasive cells (mouse myoblast cell line C2C12), human endometrial cancer cells (EM-E6/E7/TERT), and human ovarian endometriosis cells (iEc-ESCs) showing how endometriosis cells invade further and faster than cancer cells

TE MĀRAMA KI NGĀ ĀHUATANGA KŌKUHU O TE HEKE PŪTAU KŌPŪ

Ka pā te heke pūtau kōpū ki tētahi pānga riterite nui o ngāi Aotearoa, engari he uaua tonu te tūtohu me te rongoā. Mā te tūhura i ngā āhuatanga kōkuhu o ngā pūtau o te kōpū, e manako ana a Dr Rachael Wood, nō Te Whare Wānanga o Waitaha, ki te tohu i ētahi ara hou hei whakahaere i tēnei mate waimaero.

He mate rongoā-kore te heke pūtau kōpū ka hua ake i te wā ka whanake mai he momo pūtautau e ōrite ana ki te kiri o te kōpū i waho o te kōpū, hei tauira, ki ngā wharekano, ngā pūkākano rānei. Ka hua ake ko te waimaero, te ruhi me te paipairuaki, waihoki te hekenga o te matahua. Ahakoa ka pā ki te 10% wāhine (me ērā i tohua hei wahine i te whānautanga mai) i Aotearoa, kāore tonu i te mārama tēnei mate, waihoki he uaua te rongoā.

I tana rangahau tōmua hirahira, kua hura a Dr Wood i te ōrite o ngā pūtautau kōpū ki ngā āhuatanga kōkuhu o te mate pukupuku. Nā, mā tana takuhe Fast-Start nā Te Pūtea Rangahau a Marsden, e manako ana ia ki te whakatau i tā te pūtautau raweke i tana taiao hei kaupare i te kōkuhunga. Ka ine a Dr Wood rātou ko tana tīma i ngā āhuatanga o ngā pūtautau kōpū hauora, me ngā pūtautau kōpū whai mate. Ka whakamahia ēnei inenga ki te hanga i ngā tauira pūtautau hāpia ahutoru kia whakamahia i roto i ngā mahi whakamātautau. Mā te mātai i tā ngā pūtau hauora me ngā pūtau whai mate whai wāhi ki ngā tauira pūtautau kē, e manako ana rātou kia mārama kē atu ki te pānga tuatahi me te whanaketanga o te heke pūtau kōpū, ā, te whakatairite hoki ki te mate pukupuku.

Ka āwhina tēnei kaupapa ki te tūhura i tā ngā āhuatanga o te kiri, pēnei i te kōpā, pā, pāngia anō hoki e te kōkuhunga o ngā pūtau kōpū. I te mutunga iho, ka āwhina pea tēnei mātauranga ki te tūtohu i ngā rautaki rongoā mō te heke pūtau kōpū, hei painga mō te tini tāngata.

SOUND JUDGMENTS?

HOW TRUE CRIME PODCASTS SHAPE PUBLIC OPINION

Dr Collin Bjork from Te Kunenga Ki Pūrehuroa Massey University will explore how true-crime podcasting encourages us to make judgments, and how this is shaped by public discourse.

Dr Collin Bjork

With nearly one billion downloads globally, the skyrocketing popularity of true crime podcasting has sparked intense debate. Some condemn the genre's perpetuation of racist stereotypes, harmful misrepresentations of Indigenous peoples, and misogynistic narratives. Others celebrate its potential to expose systemic crimes against racial minorities and Indigenous communities, and to advocate for social justice. No matter how you feel about it, this polarising genre clearly has powerful potential for influencing public opinion.

'Sound Judgments?' proposes that true crime podcasting can offer new insights into the complex process of making collective judgments in an age of online communication. In this Marsden Fund Fast-Start project, Dr Bjork will survey approximately 1,200 hours of audio from high-profile true crime podcasts produced in 'the golden age of podcasting' between 2014 and 2022. This research will delve into famous and popular podcasts including Serial, S-Town, Caliphate, Ear Hustle, In the Dark, 74 Seconds, The Teacher's Pet, Someone Knows Something, and The Trojan Horse Affair. Dr Bjork will focus on how podcasters use the audio medium to create judgment, and how that judgment is further shaped by public discourse. His findings will be compiled and presented in the form of a book, but also as an innovative, peer-reviewed podcast miniseries.

By recounting real life stories that pass judgment on criminals, victims, and society's values, the narratives presented in true crime podcasting both strengthen and divide communities. This project will ultimately shed light on the perplexing, yet fundamental civic process of making collective judgments in a digital age.

GO WITH THE FLOW:

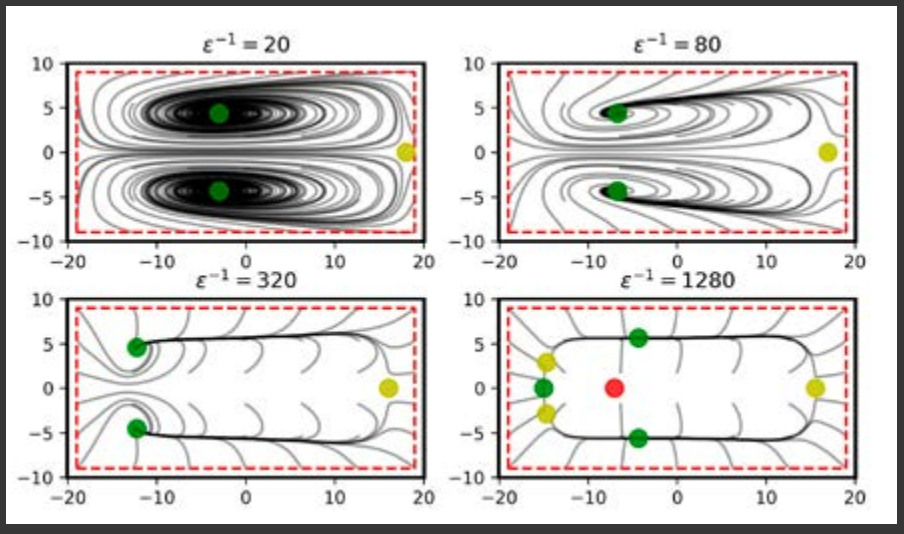
UNDERSTANDING HOW FLUIDS MOVE AT THE MICROSCALE AND BEYOND

Dr Brendan Harding from Te Herenga Waka—Victoria University of Wellington aims to develop models of how fluids move at the micro/nanoscale.

Many modern devices, including computer chips and some medical instruments, rely on the flow of fluid through extremely small, microscale spaces for their functioning. Predicting fluid flow at these scales remains a major challenge for the development and improvement of new technologies. This is particularly true for 'complex fluids' which contain solid particles, such as blood and wine. Current fluid-flow models, based on the Navier-Stokes equations, are unable to describe how complex fluids move at microscales and within microfluidic devices. More work is needed to understand and utilise fluids at this increasingly important scale.

Dr Harding has received a Marsden Fund Fast-Start grant to develop a new model of how fluids move in modern and next-generation microfluidic devices. This model will use a technique called perturbation analysis and computing to accurately map key properties of a fluid (including acceleration and particle velocity) as it moves. The model will then be verified against real world device designs and experimental observations.

This project will help us to understand how fluids move at the microscale, and provide the theoretical basis for next-generation microfluidic devices and processes.



Dr Brendan Harding

Figure: Imagine putting a spherical particle within a volume of fluid which is pumped through a curved microfluidic device. Each panel shows a superposition of particle trajectories (grey curves) towards stable nodes (green dots) within the rectangular cross-section

Stock image: Copper and lithium producing green and red flames, respectively.

PREDICTING THE NEXT GENERATION OF BATTERIES:

NEW MATERIALS FOR BETTER ELECTRODES

Dr Joseph Nelson (Ngāti Tūwharetoa, Ngāti Raukawa) of Lincoln Agritech aims to use simulation to discover new compounds for use in improved rechargeable batteries.

Dr Joseph Nelson

Rechargeable batteries underpin much of modern society, powering everything from devices like mobile phones and laptops, to hybrid and electric vehicles. They are also a critical component in renewable energy networks, smoothing out fluctuations in energy supply. Of all battery classes, few have achieved the success of the lithium-ion battery, with a key international development team receiving the 2019 Nobel Prize in Chemistry for their work on this critical energy source.

Better lithium-ion batteries with higher capacities and reduced environmental impact require new and improved materials. Traditional lab-based experimental studies are time-consuming and labour-intensive, making the discovery of new materials a challenge. In this Marsden Fund Fast-Start project, Dr Nelson will utilise new methods in high-performance computing and quantum mechanical simulations to discover new lithium compounds based on prediction of chemical structure.

Using this state-of-the-art, large-scale approach, Dr Nelson aims to produce a comprehensive database of promising compounds for lithium-ion battery synthesis, and to predict their effects on battery performance. This work will help to inform experimental synthesis efforts in the future but also model the use of structural prediction tools for discovering new compounds.

LIVE OR LET DIE:

ARE HYBRID SPECIES WORTHY OF CONSERVATION?

Dr Aisling Rayne from the Cawthron Institute will investigate the diverse moral and social perspectives on hybrid species and their value in conservation policy and practice in Aotearoa New Zealand and around the world. This research will have important implications for the conservation of taonga species of Aotearoa.

Traditionally, the focus of conservation efforts has been the preservation of individual species. But what should we do when crossbreeding or hybridisation blurs the boundaries between species? Are hybrids worthless mongrels contributing to 'genetic pollution'? Or should we protect hybrids as carriers of the whakapapa of older taonga species? More importantly, what are the diverse values that should inform these important decision-making processes in conservation? What is it that conservation intends to conserve, and why? These questions are becoming more urgent, as species are increasingly interacting due to human-assisted movement, climate change and habitat alteration.

Dr Rayne has been awarded a Marsden Fund Fast-Start grant to map the dominant perspectives and rationale behind hybrid-related decision-making in global conservation efforts. They will then analyse the diverse moral and social perspectives on hybrids from four different communities in Aotearoa: the biological sciences; conservation policy and practice; the hunting, fishing, and recreational communities; and Te Ao Māori. In doing so, this research will uplift the voices of communities who are currently absent from dominant discourses.

An understanding of the diverse values held about hybrids will help foster a broader and socially-just approach to conservation. By addressing this under-researched area, this work will initiate a reshaping of conservation research agendas to meet the complex ecological realities of the modern world, with the aim of informing conservation policy and practice.

Dr Aisling Rayne and colleagues in the field. Credit: Alaric McCarthy

ME TŪ, ME HINGA RĀNEI:

HE HUA TŌ TE WHAKAUKA MOMORUA?

Ka tūhura a Dr Aisling Rayne, nō Cawthron Institute, ngā tirohanga matatika, pāpori kanorau ki ngā momorua me te wāriu i ngā kaupapahere me ngā mahi whakauka i Aotearoa, ā, huri noa i te ao. He hirahira ngā pānga o tēnei Rangahau ki te whakaukatanga o ngā momo taonga o Aotearoa.

I ngā wā o mua, ko te aronga o ngā mahi whakauka ko te tiakitanga o ngā momo takitahi. Engari me aha tātou ina rangirua ai ngā taupā momo i te ranumomo, i te momoruatanga rānei? He mangaru huakore te momorua e whāngai ana i te 'parahanga iranga'? Me tiaki rānei i ngā momorua ina hoki he kaikawe i ngā whakapapa o ngā momo taonga o mua? Waihoki, he aha ngā uaratanga kanorau me whāngai i ēnei hātepe whakatau hirahira i roto i te whakaukatanga? He aha tā te whakaukatanga e whai nei ki te whakauka, ā, he aha ai? E nonoi haere ana ēnei pātai, nā te mea e nui haere ana te noho tahi a ngā momo nā ngā nekehanga e āwhina ana e te hunga tangata, te huringa o te āhuarangi me ngā panonitanga nōhanga.

Kua whakawhiwhia a Dr Rayne ki tētahi takuhe Marsden Fund Fast-Start ki te whakamahere i ngā tirohanga awenui me ngā whakaaro mō ngā whakatau e hāngai ana ki ngā momorua i roto i ngā mahi whakauka ā-ao. Kātahi ka tātarihia ngā tirohanga matatika, pāpori kanorau ki ngā momorua nō ngā hapori e whā I Aotearoa: ngā pūtaiao koiora, ngā kaupapahere me ngā mahi whakauka, ngā hapori whakangau/hī ika/runaruna, me te ao Māori. Mā tēnei rangahau e rangona ai ngā reo o ngā hapori e ngaro ana i ngā kōrero awenui.

Mā te mārama ki ngā uaratanga kanorau e karapoti ana i ngā momorua e āwhina ki te poipoi i tētahi tukanga whakauka e tika ana e ai ki te matatika. Mā roto i te aro ki tēnei wāhanga kāore i te rangahau nuitia, ka tīmata tēnei rangahau i te whakaahuatanga anō o ngā whāinga rangahau hakauka e hāngai ai ki ngā āhuatanga hauropi whīwhiwhi o te ao hou, me te whai ki te whāngai i ngā kaupapahere me ngā mahi whakauka.

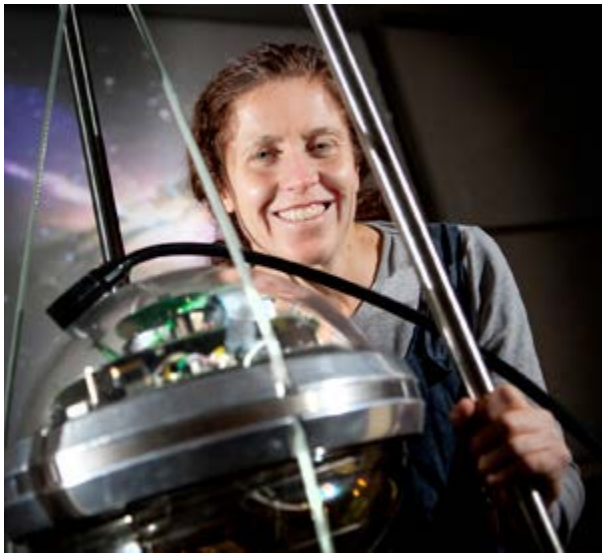
Dr Aisling Rayne

04 /
RESEARCH UPDATES AND MARSDEN FUND IN THE MEDIA

FIRST IMAGE OF MILKY WAY NEUTRINOS DETECTED BY ICECUBE

PROFESSOR **JENNI ADAMS** FRSNZ
Te Whare Wānanga o Waitaha the University of Canterbury, UOC1405
Originally published by the University of Canterbury, 30 June 2023

For the first time, a neutrino image of the Milky Way was produced by an international team of scientists, including researchers from Te Whare Wānanga o Waitaha the University of Canterbury, using a huge Antarctic telescope.



Jenni Adams

The IceCube Neutrino Observatory in Antarctica has produced an image of the Milky Way using neutrinos.

The neutrino portrait of our galaxy reveals high-energy particles from within the Milky Way explains New Zealand scientist Physics Professor Jenni Adams from the University of Canterbury's School of Physical and Chemical Sciences and a member of the IceCube Collaboration.

This research brings humanity closer to finding some of the galaxy's most extreme environments, she says. Our Milky Way galaxy is an awe-inspiring feature of the night sky, viewable with the naked eye as a horizon-to-horizon hazy band of stars. Now the IceCube neutrino observatory has detected high-energy Milky Way neutrinos, with energies millions to billions of times higher than those produced by the fusion reactions that power stars.

Neutrinos are tiny, ghostlike astronomical messengers that offer a unique view into the high-energy Universe. IceCube is a mountain-sized telescope that encompasses a cubic kilometre of deep Antarctic ice instrumented with over 5000 light sensors. The one-of-a-kind detector searches for signs of high-energy neutrinos originating from our galaxy and beyond, out to the farthest reaches of the universe.

"We know there are cosmic engines in our galaxy which are capable of accelerating particles to high energies, but we don't have a detailed model of how these work," says Professor Adams. "We don't know the energy limit of our Galaxy's particle accelerators. Neutrinos are the only direct messenger from these regions and can potentially

reveal hidden features of our galaxy never before seen by humanity."

While IceCube has previously identified two extra-galactic sources of extremely energetic neutrinos, until now a neutrino counterpart to the Milky Way band had proved elusive.

"Observing our own galaxy for the first time using particles instead of light is a huge step", says University of Canterbury undergraduate student Rhia Hewett who is undertaking research to identify the most promising regions in our Galaxy for IceCube to search for neutrinos.

"But the result so far is just a neutrino glow from the whole of the Galaxy. Next, we want to identify individual neutrino sources in our Galaxy. In my research I am making models to predict the neutrino signal close to likely particle accelerators so we can target our searches for neutrinos. It is exciting to be taking part in this ground-breaking research as part of my undergraduate studies."

The two main analysers for this new research are PhD students Mirco Hünnefeld, from the University of Dortmund, and Steve Sclafani, from Drexel University. They developed machine learning techniques to improve the identification of the neutrino signal in IceCube that enabled this breakthrough result.

The University of Canterbury IceCube research has been supported by the Marsden Fund Council from Government funding, managed by Royal Society Te Apārangi. The IceCube Neutrino Observatory is operated by the IceCube Collaboration, consisting of more than 350 scientists at 58 institutions around the world. Major funding comes from the US National Science Foundation, and from funding agencies in all other participating countries.

This research has been published in the journal *Science.*

Additional information:
University of Canterbury press release

Additional information:
Explainer article in *The Conversation*

Stock image: IceCube Neutrino Observatory

INVESTIGATING THE LINK BETWEEN THE GROUP A STREPTOCOCCUS, INFECTION, AND IMMUNITY

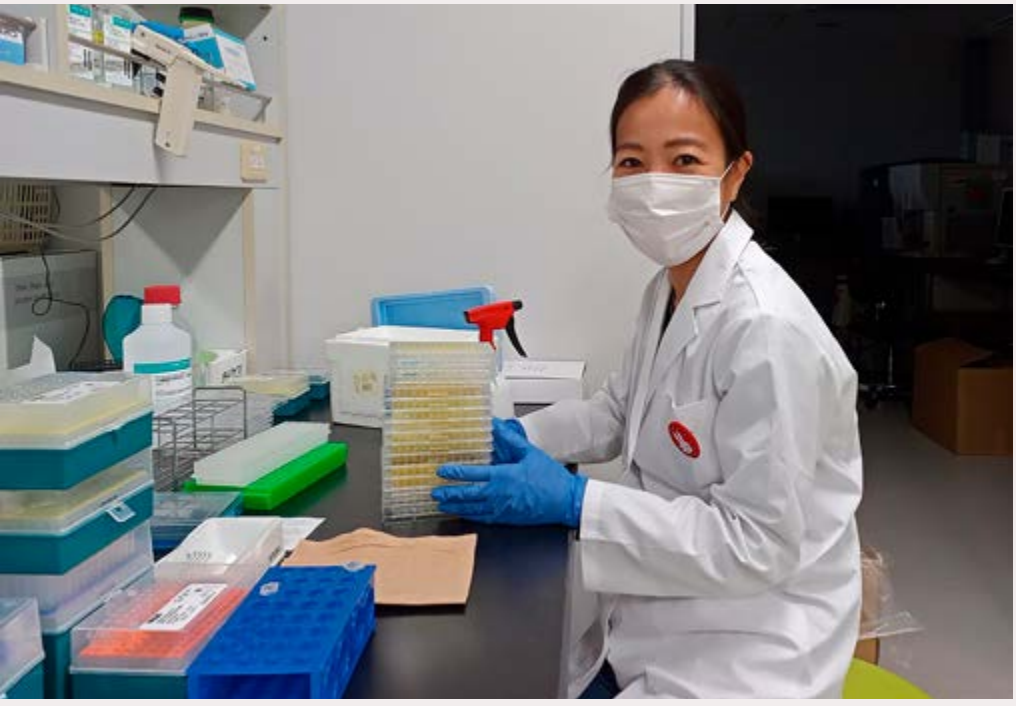
DR **CATHERINE TSAI**
Waipapa Taumata Rau the University of Auckland, UOA2007
Published 11 August 2023

In this Marsden Fast-Start, Dr Catherine Tsai from Waipapa Taumata Rau the University of Auckland wants to know how our immune system recognises key parts of Group A Streptococcus and whether this knowledge will help the fight against other diseases.

Streptococcus pyogenes (Group A Streptococcus, GAS) is a concerning human pathogen that can cause a wide range of diseases from mild skin infections and sore throats to the more serious and potentially deadly necrotising fasciitis (flesh-eating disease), toxic-shock syndrome, and rheumatic heart disease. In Aotearoa New Zealand, these serious complications disproportionately affect Māori and Pacific children, with some of the highest rates in the world – between 4 and 7 times higher than New Zealand Europeans for GAS skin infections and acute rheumatic fever. Meanwhile, cases of this severe invasive GAS are continuing to increase in high-income countries around the world.

Many bacteria including *Streptococcus pyogenes* have long, thin, hair-like structures, called pili (singular: pilus), on their surfaces. These pili are formed by chains of protein subunits that resemble strings of pearls. Due to their important roles in host-cell attachment and colonisation, GAS pili are an important virulence factor and also a promising vaccine target. Most information about pili focuses on their structure and function, while their interactions with the immune system have not yet been investigated. Dr Catherine Tsai wants to know how our immune system recognises GAS pili to mount an immune response, and if the immune response contributes to disease severity. Furthermore, Dr Tsai and her team want to find out if we can harness this ability to enhance immune responses stimulated by vaccines, which can potentially fight not only Group A streptococcus, but a host of other diseases as well.

Inflammation is a host defence necessary for combatting infection, however, excessive, and misdirected inflammatory responses can cause damage. Dr Tsai and her team are investigating if different pilus types correspond to different levels of immune response and disease severity. Their approach uses a related but non-pathogenic bacterial species, *Lactococcus lactis* – a bacterium equally useful in dairy foods production and in science research. The team generated modified strains of *L. lactis* that each expressed a different type of pilus produced by GAS strains. They will test how well these strains provoke an immune response in human immune



Dr Catherine Tsai in the lab with samples

cells cultured in a dish and in living wax worms. This specific insect displays an immune response with remarkable similarities to that of mammals, making them a useful alternative to traditionally used rodents, and with the extra benefit of being easier and cheaper to maintain.

Dr Tsai is also interested in knowing if the immune-stimulating property of GAS pili can be exploited to enhance the efficacy of vaccines. The goal of any vaccine is to stimulate a strong and long-lasting immune response. Thus, Dr Tsai is also testing if GAS pili can be used as a 'shuttle' to safely deliver antigens from another disease to our immune systems. An antigen is the part of an invader that our cells recognise and builds antibodies against. So, when the invader next appears, the circulating antibodies quickly identify and attack it, protecting us against that specific disease. In this area of research, Dr Tsai's team is again using GAS pili grown on *Lactococcus* to deliver a small antigen. In a separate approach, only specific pilus protein subunits instead of a full pili are being trialled as immune-response enhancers ('adjuvants') and fused with antigens. In a recent trip to Tokyo University and Chiba University in Japan, they tested several prototype vaccines containing influenza A virus antigens in mice. This research is still underway, but they are analysing their results to see if the mice display future protection against influenza A, and which vaccine – pili/protein combination was the most effective.

Combining these two studies, Dr Tsai imagines a future where vaccination against serious disease could be as easy as eating a tub of yoghurt – with friendly, modified *Lactococcus* bacteria harnessing the power of GAS pili proteins to induce desirable immune responses.

A QUESTION OF IDENTITY: HOW CONNECTED ARE YOUNG MĀORI TO ANCESTRAL MARAE, AND DOES IT MATTER?

PROFESSOR **MERATA KAWHARU**
Te Whare Wānanga o Otāgo the University of Otago, UOO1832
Published 18 January 2023

DOES BELONGING TO MARAE MATTER TO YOUNG MĀORI?

Most Māori people live away from their ancestral home marae. Evidence suggests Māori seek, but struggle, to remain connected to their marae, language and culture. Home marae communities, generally depopulated and geographically isolated, also seek to strengthen contact with their dispersed descendants. But does belonging to marae matter to young Māori?

In wanting to hear directly from our rangatahi, Professor **Merata Kawharu** (Te Whare Wānanga o Otāgo the University of Otago) and her team of researchers have been speaking to students in high schools throughout Aotearoa to investigate difficult issues about marae hono connection and identity. Although Covid-19 has disrupted parts of the research, schools are eager to join the programme, with teens from Tāmaki Makaurau Auckland, Rotorua, Te Whanganui-a-Tara Wellington, Ōtautahi Christchurch and Ōtepōti Dunedin excited to participate.

TE KAUPAPA | THE PROJECT

Using kaupapa Māori and social network frameworks, this Marsden Funded research aims to advance theories of Māori cultural change using 'marae' as the pivotal indicator. The research will also deepen awareness of the diverse needs in Aotearoa and aspirations of young Māori and their marae people today.

Students participated in a survey that asks if they have any connections with their ancestral marae before being asked their views about how connections should be strengthened. These questions are vital in detailing both physical and spiritual barriers; significant for many young people and their whānau who are geographically far from their marae.

HONO TĀNGATA | CONNECTING PEOPLE

Perhaps unsurprisingly, the team has found that digital means such as the internet and social media are important in building and strengthening connections for rangatahi and their marae. Things like online workshops on tikanga, mātauranga and kōrero relating to the marae and other online forums are popular ideas. Interestingly, Covid facilitated connections as marae/hapū developed initiatives during the pandemic that steered young people toward 'meeting' their extended whānau for the first time. Also being explored in the survey are kānohi ki te kānohi face-to-face learning programmes at marae for rangatahi which offer a variety of cultural, social, environmental, and economic kaupapa topics.

While the extent of interest among rangatahi has been an eye-opening feature of the research, the little engagement of whānau who live far away has also been underscored. This is perhaps not surprising given the geographic distance, if not the cultural disconnection between whānau and marae

"Maori Meeting House". CC image courtesy of Axel Magard licensed under CC BY-NC-ND 2.0

if whānau have not maintained strong connections over a number of years. An important barrier to overcome bringing whānau home is whakamā shyness, or an uncertainty about what coming home means, looks like and is about. The team have begun talking to marae about these issues since many are reaching out to their whānau. They are particularly interested in barriers or challenges to help identify what needs to be addressed to then help strategise and plan easier pathways for all. While marae may run programmes for young people, this research suggests that building wider networks with distant kin and other members who don't often visit their home marae are essential if long-term sustainability and relevance to whānau are to be progressed.

It's also important to find innovative ways to either fund whānau to come home for programmes or to find other ways of bringing them home. In turn, findings suggest local or central government might do more to support these community development initiatives, especially when community development is 'policy' and where marae communities have limited financial means. Supporting marae in these ways also means supporting marae and whānau expressions of rangatiratanga self-determination. Likewise, schools themselves play a crucial role in the lives and development of young people.

BUILDING HONO CONNECTIONS INTO THE FUTURE

This research builds on specific existing initiatives for strengthening connections with marae like www.maorimaps.com – a tool developed by one of the researchers, Professor **Paul Tapsell** and team. They anticipate that schools will use this website too, as part of providing space in their learning programmes to help strengthen connections, knowledge and understanding about the place of ancestral marae.

The findings from this study will provide vital knowledge regarding how whānau, marae, hapū and others can navigate through complex circumstances of our time. With respect to place, nowhere else in the world do living marae exist. It is a defining feature of our people and our nation. This research will therefore offer leading insights and strategies from Aotearoa and contribute to discussions on similar issues facing Māori hāpori communities, and other Indigenous peoples internationally regarding home connection and identity.

Read more: www.maorimaps.com

ANCIENT INDICATORS OF INEQUALITY

PROFESSOR **SIÂN HALCROW**
Te Whare Wānanga o Otāgo the University of Otago, UOO1823
Published 21 September 2023

Bioarcheologist Professor Siân Halcrow from Te Whare Wānanga o Otāgo University of Otago has recently concluded a significant Marsden-funded study into some of the earliest forms of social inequality, emerging from Bronze Age China.

Professor Siân Halcrow

The rise of social inequality played a critical role in the development of state-level societies throughout the world, resulting in detrimental impacts on marginalized social groups. The legacy of this has major repercussions on society today, including the health of women and children. To understand this historical development, Professor Halcrow (Principal Investigator) and her team of Associate Investigators from Aotearoa New Zealand, China, and the USA explored the emergence of gender based inequity in the rise of Bronze Age China (Eastern Zhou) in the Central Plains region (771-221 BCE). The team examined multiple skeletal tissues in cemetery populations to demonstrate how social inequality impacted on health and nutrition over the life-course. Their findings show that the treatment of mothers has detrimental effects on both boys' and girls' development, and that girls are gendered through being fed less nutritious and less culturally valued food.

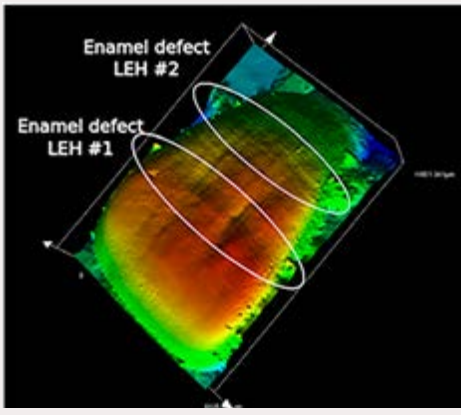
A main focus of the project carried out by Dr **Melanie Miller** (University of Otago / University of California, Berkeley) and Dr **Dong YU** (Shandong University) was investigating relationships between food and gender in early life by studying childhood diets. Using chemical (stable isotope) analysis of dentine incrementally over tooth growth, detailed childhood dietary histories were constructed, with findings showing dietary differences between males and females. These patterns began in early childhood, with males eating more valued grain (millet) and more meat, while females consumed more of the less valued wheat and soybean. Halcrow and her team believe that certain foods were associated with aspects of gender, such as meat and masculinity. These insights reveal a key aspect of the socializing processes of children across generational interactions with their

caretakers, whereby food represents and communicates values about gender, which becomes embodied in the developing child (Halcrow et al. 2022; Miller et al. 2021; Miller et al. 2023 in press).

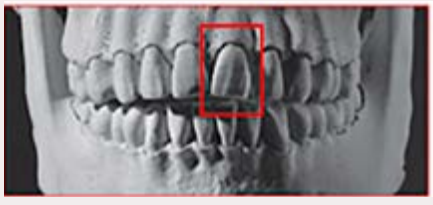
Skeletal and dental remains indicate changes in a person's environment and can encode sex-based differences in types of stress experienced from nutrition and/or infection, including dental enamel defects. Master's student Sunday De Joux undertook a detailed analysis of dental defects from three Eastern Zhou sites, using a new method to assess if there were significant negative deviations on a digitized cross-section of the tooth surface (figure).

She found that all individuals had encountered at least one event of stress on their health (such as disease or famine), with no sex-based differences. These results are interesting, given that historical and archaeological research tells us that female health was negatively impacted by the effects of a heavily male-dominated society and resulted in male-biased differences in both child-rearing and social status. A reason for why sex differences are not observed, Halcrow and her team argue, is because enamel defects develop in infancy and early childhood, and therefore reflect maternal stress.

With such insights into gender-based differences in diet and cultural treatment during the Eastern Zhou, focus now turns to the ways gender 'intersects' with class, disadvantaging individuals further. This expanding research direction involves Ms Qian Zhang — a visiting student from Shandong University. The newly excavated cemetery site of Dahan (大韩) in Shandong provides an opportunity to investigate the intersectional nature of gender, class, and diet and health, with evidence for noble people being buried with companion (sacrificial) burials. There are status-based dietary differences in this cemetery, with nobles consuming more high-protein foods and more valued staple foods (mainly millet) compared with companion human burials, and gender-based differences in diet being specific to class, showing the importance of understanding the intersectional nature of gender (Zhang et al. in review).



"Ritual Grain Server Western Zhou Dynasty China 1045 BCE Bronze" image courtesy of Mary Harrsch, CC BY 2.0



Example of a scanned upper central incisor tooth. The high-resolution scan shows 2 dental enamel defects called linear enamel hypoplasias (LEH). The location of these defects can be estimated to a particular period of dental development. The co-occurrence of LEH defects across multiple teeth with overlapping developmental chronologies is an indicator of a systemic stress event an individual experienced during that specific period of early life

ANAURALIA: THE ENIGMA OF THE SILENT MIND

PROFESSOR **ANTHONY LAMBERT**
Waipapa Taumata Rau the University of Auckland, UOA2108
Published 27 March 2023 and featured in an RNZ podcast

Professors Anthony Lambert (Principal Investigator) and Suzanne Purdy (Associate Investigator) from Waipapa Taumata Rau the University of Auckland have coined a new term for describing the silent mind – 'anauralia'.

Professor Anthony Lambert

Imagine the sound of an ambulance siren, or a favourite song, or the way these words would sound if Sir David Attenborough said them. Most people can imagine voices, music and sounds in their 'mind's ear', but this isn't universal. Some individuals describe a silent inner world, devoid of auditory imagery. We have coined a new term for describing this – 'anauralia'. In this Marsden funded project we are exploring the psychological implications of experiencing anauralia.

Despite its clinical sounding name, anauralia is not a disorder or clinical condition. It's a variety - albeit a somewhat unusual one - of normal experience. It's already clear that experiencing anauralia is no barrier to leading a fulfilling and successful life.

Although our project is still at an early stage, valuable findings are already emerging. Collaborative work with the New Zealand Attitudes and Values Study has shown that the incidence of anauralia in Aotearoa is approximately 0.8 (slightly fewer than one in a hundred). The personality profile of individuals who report experiencing anauralia appears similar to that of individuals who report typical auditory imagery. Moreover, reports of psychological distress were neither higher nor lower in the context of anauralia. In contrast, being unable to imagine visual scenes (as opposed to sounds) was associated with higher perfectionism, lower self-esteem and higher psychological distress.

In addition to participating in surveys, some of our research participants have kindly volunteered to visit our laboratory, performing tasks involving memory, imagination, and music. Our research hypothesis was that anauralia is associated with using distinctive strategies for short-term remembering of both verbal information and music. Interestingly, the results so far indicate that individuals who report experiencing anauralia and those who experience typical auditory imagery remember verbal information in similar ways. Our studies of musical memory are underway, but it's too early to evaluate the results.

Ludovic Rouchy Photography, licensed under CC BY 2.0

Over the next two years we will develop further the work just described, while also exploring several other research avenues. Including studies of long term memory for life events, studies of future thinking and planning, and studies investigating links between varying experiences of auditory imagery and differences in brain structure and function. In the latter studies participants who experience anauralia, as well as participants who experience vivid auditory imagery, will perform tasks involving memory and imagination, while brain activity is monitored using neuroimaging techniques, including magnetic resonance imaging and electroencephalography.

The overall goals of the anauralia project are both scientific and cultural. Scientifically, our findings will provide a unique perspective on the role of auditory imagery in psychological functioning. Moreover, the project aims to have significant cultural impact, by enhancing our understanding and appreciation of the astonishing diversity of the human condition. With this in mind, the final part of the project will involve organising and hosting an international, trans-disciplinary conference. In addition to scientific presentations, we hope that the conference will include personal accounts from individuals who experience anauralia and hyperauralia (the experience of extremely vivid auditory imagery), as well as reflections by writers, poets, and musicians on the role of auditory imagery in their work.

LISTEN: RNZ *Our Changing World* podcast:
The puzzle of the silent mind

NEW TECH COULD OFFER AIR-POWERED ENERGY SOURCE

PROFESSOR **GREG COOK**, FRSNZ
Te Whare Wānanga o Otāgo
Originally published by Radio New Zealand (abridged), 9 March 2023

Scientists have discovered a tool bacteria use to extract energy from hydrogen in the air, and say it could pave the way for clean electricity generation.

New Zealand and Australian scientists working on the project have had their work published in the peer-reviewed scientific journal *Nature*.

University of Otago Distinguished Professor **Greg Cook** was part of the study, and told RNZ's Morning Report that it had been known for some time bacteria in the soil were able to get energy from hydrogen in the air, but not how they did it. The first step in the research was to discover the type of bacteria in the soil that was extracting energy from hydrogen. Then, to find which enzyme that bacteria was using to make the oxidation reaction happen to air molecules - causing energy to be released.

The researchers have now discovered the detailed structure of the protein enzyme the bacteria uses for the reaction, and how the reaction works. They believe producing this enzyme in laboratories would allow it to be used to carry out the same oxidation reaction, to generate clean energy that could be harnessed as electricity, with water as the only by-product.

"For about 50 years, we knew that soils were responsible for oxidising atmospheric hydrogen. With help from the Marsden Fund we basically isolated the organism from soil that was doing that," Cook said.

"We were able to use genetics to then find the genes responsible for the enzyme and then another ten years later, we've solved the high resolution structure of this enzyme. We now have a molecular blueprint that basically shows us how the enzyme is able to extract hydrogen at picomolar concentrations from the atmosphere, and then use that hydrogen to basically energise bacteria."

Cook said there had been a lot of interest in the project, and they were now working on the next steps.

"So now, if you extrapolate a bit further we could take this enzyme and use it to produce energy basically, in a hydrogen fuel cell. The goal now would be to produce this enzyme at a level where we can start to build lab-scale reactors where we can basically take it further and really have proof-of-principle studies that this protein when fed atmospheric hydrogen could deliver protons and electrons to basically make energy and store it," Cook said.

"That's the next exciting phase, which will require some major advances in scaling up the production of this protein."

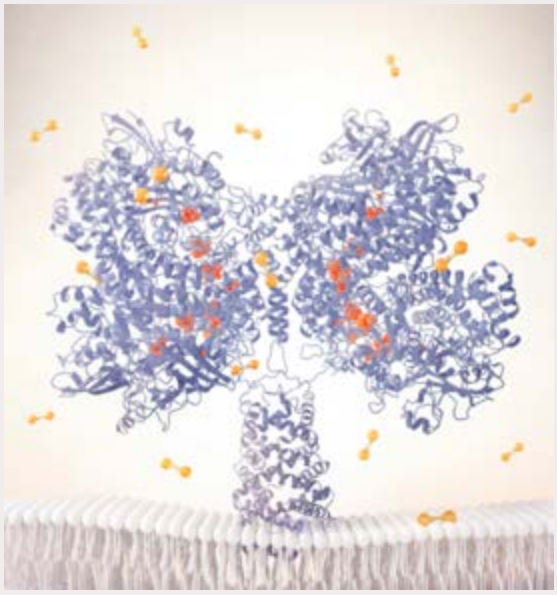
Researchers at the University of Melbourne had already started on the next scaling-up step. The team hopes their work could lead to a new approach to hydrogen fuel cell technology.

"If we think about this process in terms of making hydrogen fuel cells, at the moment we use technology that involves platinum, which is a very rare earth metal, it's expensive, there's a limited supply. That reaction also requires valuable drinking water," Cook said.

"So now we have a system where we can use a protein that we can basically produce in a lab or in some factory, that we can then use to take that hydrogen and convert it into energy. Obviously with the energy crisis we're facing, we know we need things to supplement solar, hydro and wind. This won't be a stand-alone technology, but it'll synergise with those technologies."

Cook said it puts an ancient biochemical process to new use and it was exciting to think a process from nature could be harnessed by humans to help provide energy.

"This is not just something that happens in soils, it happens in Antarctica, desert soils, sea water, any environment where there's hydrogen bacteria have adapted to basically use this as an energy source. This enzyme has been around for hundreds of millions of years, and these bacteria have been using this enzyme to do this. Your body actually is making hydrogen - there are bacteria in your gut that are producing micro-molar amounts of hydrogen, and there are bacteria in your body that are using that hydrogen."



An artist's impression of the new enzyme, named Huc, at work using hydrogen from air. Supplied: Monash, Alina Kurokhtina

Additional information: Radio New Zealand: New tech could offer air-powered energy source (includes interview)

Additional information: Link to *Nature* paper

IMPROVING VACCINE ADJUVANTS

ASSOCIATE PROFESSOR **BRIDGET STOCKER**
Te Herenga Waka—Victoria University of Wellington, VUW1401
Published 29 May 2023

Four kids, four patents, and sixteen publications later.

"It's been a marathon, not a sprint." These are Dr Stocker's sentiments when she reflects on balancing her research into the development of vaccine adjuvants (molecules that improve vaccine efficacy), along with the joys and struggles of raising four kids. "We started our Marden-funded research in 2015, not too long before I had my first child," Dr Stocker said. At the time, she and her partner were contemplating two kids. Four children later, four patents later, 16 publications, and commercial interest which will result in patented adjuvants from the team's research programme entering human clinical trials in 2026, was not something Dr Stocker anticipated. She took periods of maternity leave during the tenure of the grant, completing it in 2022, and noted that parenting is the harder of the two jobs. "Molecules might not do what you want them to do, but at least they don't keep you awake half the night."

Long before the Covid pandemic hit, the research team was focussing on targeting a specific immune cell receptor "Mincle" and using the immune response that was generated to improve the efficacy of vaccines. They did this by designing and synthesising molecules that would better activate Mincle, screening libraries of compounds using immune cells to identify the most potent derivatives,

Dr Bridget Stocker representing the balance of her life in chemical research and raising four kids

Organic and Biomolecular Chemistry journal covers featuring two of Dr Bridget Stocker's Marsden Fund research publications in 2020. Images: Permission granted from RSC Publishing

then teaming up with collaborators, including Professor **Sho Yamasaki** in Japan, who conducted experiments in vaccine models of disease.

The work was a success. Activating Mincle leads to a unique immune profile that can be harnessed in a variety of vaccination settings. In fact, the team's findings were so promising that a US-based biotech company has sought a license on one of their patents. Dr Stocker and her team are inventors on another patent application with a pharmaceutical company in Japan who are developing new vaccine formulations, and they have two further patent applications which they have developed independently for other classes of Mincle ligands. Their Marsden-funded research was also featured on the cover of the journal '*Organic and Biomolecular Chemistry*' on two separate occasions in 2020.

"When we started, the world wasn't as consumed by vaccine research as it is today," Dr Stocker said. "And to be frank, some people criticised my choice of receptor, saying the work wouldn't go anywhere. People are entitled to their opinions. You just have to do the work and do it the best you can." Notwithstanding, Dr Stocker acknowledges how grateful she is for the support of the Marsden Fund for seeing the potential of her research. She is also grateful for her staff, students, and collaborators who made the project a success. "I'm lucky to have had talented people work on this project," she said. "I'm also grateful to those students and staff who were supportive of my changing situation as I moved from being a scientist, to being a scientist and a mum."

Managing work and children is something that has been in the spotlight in recent years, especially on the back of lockdowns, the pandemic, and increases in childhood illnesses that have emerged post-lockdowns. "A science career can be unforgiving", said Dr Stocker. "Funding is scarce, and you can never do enough to get the research done, the grants written, and the networks established. And this was before Covid," she added. "I try to remind myself not to be too harsh on myself. I can't do everything. I can only do what I can do, then I need to sit back and see where life takes me."

Additional information: *Organic & Biomolecular Chemistry* cover article featuring Dr Stocker's research on lipidated derivatives showing promising Mincle-mediated adjuvant activity

Additional information: *Organic & Biomolecular Chemistry* cover article featuring Dr Stocker's research on an exploration of how lipid structure influences Mincle agonist activity

NEW RESEARCH CRACKS CLIMATE-CHANGE MYSTERY OF ANTARCTIC SEA ICE

PROFESSOR **WOLFGANG RACK**
Te Whare Wānanga o Waitaha the University of Canterbury, UOC2205
Originally published by the University of Canterbury, 1 February 2023

Pioneering airborne technology developed by University of Canterbury researchers will be used to map and measure a vast stretch of Antarctic sea ice, revealing more about the critical role it plays in the global climate system.

Glaciologist Professor Wolfgang Rack says it will be the most comprehensive study of coastal sea ice in Antarctica ever carried out, and the resulting data will be internationally significant.

"Using an aircraft survey, we plan to measure the largest stretches of Antarctic sea ice in history," he says. "If we want to be confident in our predictions of sea ice trends and better understand the vital role it plays in a warming climate, we need more accurate information on the thickness of current coastal sea ice.

Professor Rack and his team, which includes research scientist Dr **Daniel Price** from the UC School of Earth and Environment, have been awarded a Marsden Fund grant for the project. It is a collaboration between UC, Lincoln Agritech, the Alfred Wegener Institute for Polar and Marine Research (AWI) in Germany, Australian Antarctic Division, NASA, and ETH Zurich University.

The survey will be carried out in late 2024 in the Ross Sea and Western Pacific areas of Antarctica using a fixed-wing DC3 aircraft provided by Antarctica New Zealand in collaboration with the Australian Antarctic Division. An 'EM Bird' - an electromagnetic induction device provided by a collaborator from AWI - will be suspended 80 metres under the aircraft to measure the thickness of the ice below.

For this project, it will be combined with a built-in snow radar, developed with collaborators at Lincoln Agritech and integrated with the EM Bird system at UC and AWI. In combination, the technology can simultaneously measure ice thickness and the depth of the snow layer on top.

It's an important breakthrough to be able to separate the thickness of the snow and ice, Professor Rack says.

"For the first time we will be able to directly assess the thickness and volume of complex coastal sea ice. We theorise this type of ice is a major factor in the global climate system - if it is changing, then there will be big consequences for our planet."

Sea ice helps sustain Antarctic 'bottom water', which is the deepest, coldest and densest

Professor Wolfgang Rack with the aircraft that will be used in a pioneering, new study of coastal sea ice in Antarctica. Photos: Supplied by Professor Wolfgang Rack

ocean water. This bottom water helps remove carbon dioxide from the atmosphere, storing it at the ocean floor for a long time. It also helps circulate the world's oceans.

"The more sea ice is out there, the more Antarctic bottom water is created, so it's a critical part of oceanic and atmospheric circulation with huge global impacts," Professor Rack says.

Vast areas of Antarctic sea ice cover up to 20 million square kilometres in winter, reflecting sunlight and mitigating its warming effects on sea temperatures.

Sea ice trends are poorly understood because satellites can only reliably map their area. Only a few thickness measurements are taken from the ground every year, and they cover a relatively small area.

"Since the late 1970s, we've observed an increase in the area of coastal sea ice in Antarctica, which is the opposite of what one would expect," Professor Rack says. "Only very recently have we seen a decline, but also much more variability. We need to know more about the thickness of the ice and its overall mass to understand these changes."

The data collected will be used to develop a tailored satellite-derived ice thickness product for Antarctica's coastal region and will also provide observational datasets for computer simulations that will allow better forecasting.

Read more: University of Canterbury media release

TICK TOCK! CIRCADIAN CLOCKS AND CLIMATE-RESILIENT CROPS

DR **SOLEDAD PEREZ-SANTANGELO**
Te Whare Wānanga o Otāgo the University of Otago, UOO1813

In this Marsden Fund Fast-Start project, Dr Soledad Perez-Santangelo from the University of Otago is investigating a key mechanism for how plants may adapt to a changing climate.

Dr Soledad Perez-Santangelo

Climate change is causing increasing temperature fluctuations, droughts, and floods across the planet. These changes affect agricultural land, putting pressure on crop yields and global food production.

Most organisms, including plants, have an internal timing device known as the circadian clock, which senses daily environmental changes and modifies physiology accordingly. The clock helps plants thrive by anticipating environmental changes and controlling biological processes such as water use, carbon use, flowering time, and stress responses. The processes are primed so that they occur at the best moment of the day or season. Plants that have an internal clock that is in sync with their local environment will improve their growth and survival. By studying the natural variation that exists in circadian clock function in plants worldwide, scientists can develop crops better suited to growing in the new environmental conditions which result from climate change.

Dr Perez-Santangelo is studying the natural variation of clock function present in the legume plant family. Legume crops like beans, lentils, and peas are an incredible source of plant-based protein, vital for increasing soil nitrogen through crop cycling. Dr Perez-Santangelo's laboratory works on a legume species known as barrel-clover. This species has the great advantage of having a collection of more than 200 genetically sequenced plant specimens from its native Mediterranean origin, so she and her team have information on the exact geographic location of each specimen and its genetic sequences.

Dr Perez-Santangelo has established an automated method to measure leaf movement – a key process controlled by the clock. Many plants open their leaves just before sunrise to capture the most sunlight for photosynthesis and close them or 'sleep' at sunset for protection. Dr Perez-Santangelo measured leaf movements for a selection of barrel-clover plants from across their natural geographic range, discovering that plants from different regions had different leaf movement timings. She then compared these timings with their genetic sequences and found out which genes are behind the natural variation of the circadian clock. She now has a list of genes that can be targeted to develop legume plants that thrive under a specific range of environmental conditions.

The circadian clock also helps plants cope with daily temperature changes, through a phenomenon known as temperature compensation. The clock can maintain its specific internal timing throughout a range of temperatures without being altered. Interestingly, Dr Perez-Santangelo found a group of plants from her collection that were not able to temperature compensate as expected. These plants changed their internal timing of leaf movement depending on the temperature they were in. This finding has important implications for our increasingly warming world, where plants that are out of sync with the changing environment will be unable to thrive or even survive. Changes were found in candidate clock genes that could be responsible for this behaviour and are currently being investigated.

Based on these findings, Dr Perez-Santangelo will next investigate which genes are involved in perceiving temperature in legumes, and how this information is passed to the circadian clock to coordinate plant developmental responses. By discovering the genes that link temperature sensing and clock function, scientists will be able to apply tools such as genomics-assisted breeding to develop climate-smart crops that are more resilient and can sustainably maintain yield under increasing temperatures.

DR ANDREW BAGSHAW'S FINAL LEGACY – A BREAKTHROUGH DISCOVERY IN THE FIELD OF DNA RESEARCH

DR **ANDREW BAGSHAW**
DISTINGUISHED PROFESSOR **NEIL GEMMELL**
Te Whare Wānanga o Waitaha the University of Canterbury /
Te Whare Wānanga o Otāgo the University of Otago, UOC202
Originally published by the University of Otago, 28 March 2023

The late Dr Andrew Bagshaw has had his final scientific research paper published posthumously, a matter of weeks after his tragic death while volunteering as an aid worker in war-torn Ukraine.

Dr Andrew Bagshaw

The new study, led by geneticist Dr Bagshaw during his time as a researcher within the University of Otago's Department of Anatomy, breaks new ground in humanity's understanding of how DNA sequences bend and change.

Published in the prestigious journal *Nucleic Acids Research*, the study has shown that DNA sequences bend and twist in ways which were previously unknown.

Dr Bagshaw's paper was supervised by the Department of Anatomy's Professor **Neil Gemmell** FRSNZ, the Acting University of Otago deputy Pro Vice-Chancellor of the Division of Health Sciences.

Professor Gemmell says Dr Bagshaw's last finding was an important technical discovery, spanning the fields of genetics, biochemistry and biophysics, with the potential to benefit human health in future years.

"Andrew's remarkable work could lead to a better understanding of how genetic diseases arise and how they can be treated. It also opens up new avenues for research into the mechanics of DNA and could ultimately lead to the development of new technologies for manipulating DNA."

"This paper reflects the work of someone who was exceptionally talented, able to synthesise a great deal of information from subdisciplines and disciplines that don't always connect as

directly as you might imagine, to address how DNA bends and changes, in a new and innovative way," says Professor Gemmell.

"Andrew possessed extremely strong analytical skills and was easily one of the most extraordinary students I have trained. This, his final body of work, is a lasting legacy to a scientist of immense promise and ability."

Professor Gemmell says Dr Bagshaw's work reveals that DNA is bending in a way nobody knew about before.

"This new insight is important because DNA 'secondary structures' can affect how genes are turned on and off, and the way a DNA sequence is bent influences its propensity to change or 'mutate'".

The paper reveals that DNA sequences bend more in regions that are rich in the nucleotides cytosine and guanine, and that bending is particularly pronounced at the start of a sequence, the so-called 5' end. Dr Bagshaw also observed that where sequences are predicted to bend the most is where changes or "mutations" in the DNA are more likely to happen. These findings help establish how DNA functions, how it changes over time, how it folds, and how it is packaged into cells.

Dr Bagshaw, whose death was confirmed in late January, had been working as a volunteer in Ukraine since April last year.

The 47-year-old, along with British colleague Chris Parry, were killed whilst attempting to rescue an elderly woman from Soledar – an area of intense military action in Eastern Ukraine.

Dr Bagshaw completed a PhD in Genetics at the University of Canterbury before joining the University of Otago, Christchurch's, Department of Pathology and Biomedical Science in 2008.

Story on Stuff website: Breakthrough DNA discovery by Kiwi volunteer who died in Ukraine

Additional information: University of Otago media release

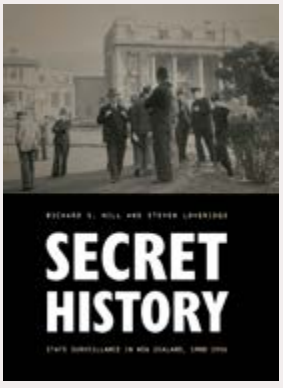
Additional information: Nucleic Acids Research

Professor Alice Te Punga Somerville

BOOK NEWS

OCKHAM NEW ZEALAND BOOK AWARDS

Ka rawe! Congratulations to Marsden-Fund recipient Professor **Alice Te Punga Somerville**. Winner of the Mary and Peter Biggs Award for Poetry for her book *Always Italicise: How to Write While Colonised*, published by Auckland University Press.

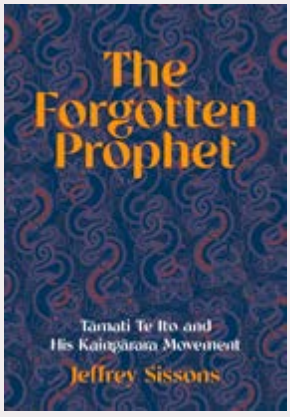


SECRET HISTORY

State Surveillance in New Zealand, 1900–1956
By Richard S. Hill and Steven Loveridge (VUW1413)

In 1900, a handful of New Zealand police detectives watched out for spies, seditionists and others who might pose a threat to state and society. The Police Force remained the primary instrument of such human intelligence in New Zealand until 1956 when, a decade into the Cold War, a dedicated Security Service was created. Over the same period, New Zealand's role within signals intelligence networks evolved from the Imperial Wireless Chain to the UKUSA intelligence alliance (now known as Five Eyes).

The first of two volumes chronicling the history of state surveillance in New Zealand, *Secret History* opens up the 'secret world' of security intelligence through to 1956. *Secret History* explores a hidden and intriguing dimension of New Zealand history, one which sits uneasily with cherished national notions of an exceptionally fair and open society.



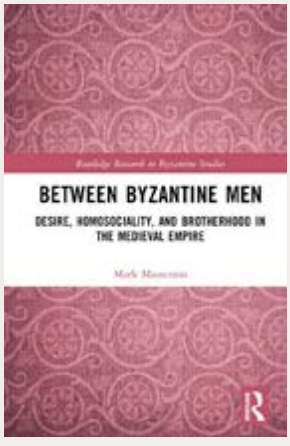
THE FORGOTTEN PROPHET

Tāmati Te Ito and His Kaingārara Movement
By Dr Jeffrey Sissons (VUW1612)

Little-known Taranaki prophet, Tāmati Te Ito Ngāmoke, led the Kaingārara movement in the 1850s. Te Ito's vision was one of pan-tribal unity; he wanted to bring together all the people of Taranaki 'from Mokau to Pātea'. He was revered by tribal leaders as a prophetic tohunga matakite; but others, including many settlers and officials, viewed him as an 'imposter', a 'fanatic'. Despite his influence and leadership, Te Ito's historical importance remains largely unrecognised today.

By the time war broke out in 1860, Te Ito and his followers had established a school and a court system in Taranaki. Striving for the 'fulfilment of the divine order', the Kaingārara movement initiated the 'Taranaki iconoclasm', discarding tapu objects associated with atua (ancestral spirits, which often took the form of reptiles) into massive bonfires. Te Ito was a visionary adviser to Te Ātiawa chief Wiremu Kīngi Te Rangitāke, and played a crucial role in the conflicted region, both before and after the wars of the 1860s. Initially perceived as a rival to the Parihaka leaders, Tohu Kākahi and Te Whiti o Rongomai, he eventually joined the Parihaka community. Jeffrey Sissons's account illuminates this tumultuous chapter in Aotearoa's history.

Long-listed for the Booksellers Aotearoa New Zealand Award for Illustrated Non-Fiction, Ockham New Zealand Book Awards 2024



BETWEEN BYZANTINE MEN

Desire, Homosociality, and Brotherhood in the Medieval Empire
By **Mark Masterson** (VUW1711)

Between Byzantine Men: Desire, Homosociality, and Brotherhood in the Medieval Empire places at centre stage Byzantine men's desiring relations with one another around the imperial court of the 900s. Analysis of Greek sources (many untranslated until now) and of material culture reveals a situation both more liberal than the medieval West and important for its rite of brother-making (adelphopoiesis), which was a precursor to today's same-sex marriage. This book transforms our understanding of Byzantine elite men's culture and is an important addition to the history of sex and desire between men.

THE SHAPESHIFTING CROWN

Edited by Cris Shore and David Williams (UOA1335)

The Crown stands at the heart of the New Zealand, British, Australian, and Canadian constitutions as the ultimate source of legal authority and embodiment of state power. A familiar icon of the Westminster model of government, it is also an enigma. Even constitutional experts struggle to define its attributes and boundaries: who or what is the Crown and how is it embodied? Is it the Queen, the state, the government, a corporation sole or aggregate, a relic of feudal England, a metaphor, or a mask for the operation of executive power? How are its powers exercised? How have the Crowns of different Commonwealth countries developed? *The Shapeshifting Crown* combines legal and anthropological perspectives to provide novel insights into the Crown's changing nature and its multiple, ambiguous, and contradictory meanings. It sheds new light onto the development of the state in postcolonial societies and constitutional monarchy as a cultural system.

Iceberg off the bow of the JOIDES Resolution. Image: Dr Georgia Grant.

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NEWS FROM THE MARSDEN FUND

AUCKLAND WRITERS FESTIVAL

The Auckland Writers Festival is one of this country's premier cultural events, and its largest and most successful literary event, hosting world leading commentators and writers, and attracting upwards of 83,000 attendees.

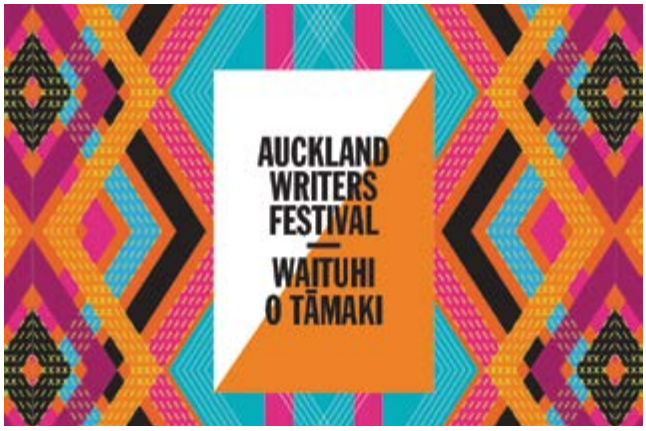
In 2023, the Festival ran over 200 public events from Tuesday 16 to Sunday 21 May to celebrate the world of books and ideas. Marsden Fund Te Pūtea Rangahau a Marsden and Royal Society Te Apārangi jointly sponsored three fascinating events.

In one talk, veteran journalist **Simon Wilson** led a discussion on fresh thinking and action in response to the impacts of climate change. **Jade Kake** (Ngāti Hau me Te Parawhau, Ngapuhi, Te Arawa, Te Whakatōhea), a Papakāinga architect in Northland and author of *Rebuilding Our Kāinga*; researcher **Max Harris**, author of *The New Zealand Project*; **Shaun Hendy** MNZM FRSNZ, Chief Scientist at Toha NZ and author of *#NoFly*; and Dr **Carisa Showden**, of the University of Auckland's sociology department and one of the authors of the youth activism book *Fierce Hope* which received Marsden Fund support, discussed new ways of approaching climate risk and future sustainability.

With open-source AI chatbots capable of generating text that appears increasingly human, our supported event asked if they will replace writers altogether? *Canvas* editor **Sarah Daniell** spoke with novelist **Catherine Chidgey**; **Toby Walsh**, Laureate Fellow at UNSW Sydney and author of *Machines Behaving Badly* and *2062: The World that AI Made*; and **Te Taka Keeghan**, Co-Director at University of Waikato's AI Institute, about AI's usefulness and limitations and what the future might look like for creative writing.

The Festival also invited *Te Rautakitahi o Tūhoe ki Ōrakau* author **Tā Pou Temara** (Ngāi Tūhoe) KNZM CNZM CRSNZ to talk about his book, an account of the battle of Ōrākau in the New Zealand wars. Written in te reo Māori, Tā Pou, who is from Ruatāhuna, where most of the Tūhoe who went to Ōrākau came from, shared stories told to him by his grandfather, great-grandmother, and other kuia and koroua when he was young. Tā Pou, a cultural authority on whaikōrero, tikanga, and karakia, compares his account of events to those of Pākehā writers such as Elsdon Best, Judith Binney, and Vincent O'Malley.

The Festival celebrates curiosity and a sense of intellectual adventure, and the programme is driven by the desire to spark ideas, to get people talking and to give them a time and place to engage with the world, much like the Marden Fund itself.



Credit: Auckland Writers Festival

TE RĀ MAKES A ONCE-IN-A-LIFETIME RETURN TO AOTEAROA

Originally published by Christchurch Art Gallery
Te Puna o Waiwhetū, 14 June 2023

As the only known customary Māori sail in existence, the homecoming of this taonga is a deeply significant moment for all New Zealanders. Held in the collection of the British Museum, the more than 200-year-old taonga has been shown to the public only once in its lifetime.

Representatives from the Marsden Fund attended a celebration to mark the return of Te Rā to Aotearoa New Zealand shores. Christchurch Art Gallery Te Puna o Waiwhetū hosted this special taonga from 8 July to 23 October 2023 in a free exhibition titled Te *Rā: The Māori Sail*. It then travelled to Tāmaki Makaurau Auckland for display at Tāmaki Paenga Hira Auckland War Memorial Museum, November 2023 and May 2024.

"When we bring home Te Rā, we welcome home our tupuna, an ancestor of our nation," said senior weaver **Ranui Ngarimu** ONZM (Kāti Māmoe, Ngāi Tahu, Ngāti Mutunga), a member of the research team who initiated the exhibition of Te Rā at Christchurch Art Gallery.

"Te Rā is one of the earliest surviving examples of the Māori art of raranga. This exhibition is deeply significant for the way it builds on our cultural and historic knowledge of Māori weaving and voyaging. The incredible skill of those early Māori weavers and the innovative techniques and technology they developed are truly awe-inspiring."

In 2017, Ranui Ngarimu, alongside Dr **Donna Campbell** (Ngāpuhi, Ngāti Ruanui) and Dr **Catherine Smith** (Pākehā), received a Marsden Fund grant UOO1731 to complete an interdisciplinary study of Te Rā in order to learn more about this mysterious taonga.

Ms Ngarimu is a member of Te Kāhui Whiritoi, the group of senior Māori weavers whose work was celebrated in the exhibition *Te Puna Waiora: The Distinguished Weavers of Te Kāhui Whiritoi* at Christchurch Art Gallery in 2022.

Te Rā: The Māori Sail, 2023. Courtesy of Christchurch Art Gallery Te Puna o Waiwhetū. Credit: John Collie

"This is where artistry meets history. We warmly invite everyone to come and experience Te Rā in person, because the impressive scale and intricate details are best appreciated up close, and the weight of history is felt most strongly when in its presence," Ms Ngarimu said.

At nearly 4.5 metres long and featuring a complex three-way pattern woven from harakeke, Te Rā is a feat of weaving technology and a reminder of the rich history of Māori sailing and navigation.

Te Rā: The Māori Sail represents a significant collaboration between the British Museum, Christchurch Art Gallery Te Puna o Waiwhetū, and Tāmaki Paenga Hira Auckland War Memorial Museum. This landmark exhibition is celebrated with an accompanying commemorative publication written by **Ariana Tikao** in te reo Māori and English from the point of view of Te Rā and illustrated by **Mat Tait**.

NO TE HURIHURINGA ON REFLECTION

PROFESSOR GILL DOBBIE FRSNZ

CHAIR, MARSDEN FUND COUNCIL

KIA ORA KOUTOU,

Every year, I am impressed by the quality and breadth of new projects funded by the Marsden Fund. This issue highlights projects that imaged the Milky Way with neutrino particles, the first time we've 'seen' our galaxy in something other than light; brought Te Rā, the only remaining traditional Māori sail, back to NZ after 200 years; developed a vaccine adjuvant scheduled for upcoming human clinical trials; and explored the skyrocketing popularity of true-crime podcasting and its powerful potential influence on public opinion. What really stands out for me is also the diversity of outputs and impact that Marsden researchers produce, sometimes years down the road from when their grants finished. I wonder what outputs our latest round of funding will produce in five or ten years? Will we have replaced forever chemicals? Embraced e-carceration? Become more climate resilient? I have learned to expect the unexpected when it comes to our talented Marsden Fund researchers.

It's exciting to see that, this year, 55 per cent of the lead investigators identify as women. This is more than any other year in the Marsden Fund's history —so heartening given the obstacles that continue to discourage women from pursuing careers in research.

Competition for funding is intense and every year many highly innovative projects are not funded, even though the projects and researchers are of truly top international standing. Receiving a Marsden Fund grant is regarded by many as a hallmark of excellence, and we are grateful to the panellists, and national and international reviewers whose expertise and dedication underpins each funding round.

This year, we welcomed **Jan Lindsay** as convenor of the Earth Sciences and Astronomy (ESA) panel and **Stephen MacDonell** to convene the Mathematical and Information Sciences (MIS) panel. We farewelled **Kathy Campbell** (as ESA convenor) who gave 3 generous years of service to the Fund.

As a Council, we continue to focus on key objectives of excellence, connectivity, diversity, and scholarly impact, and our significant role in supporting and retaining the best early-career research talent in New Zealand. We noted with great interest that a number of the newly-funded researchers are returning to New Zealand after gaining world-class experience and training overseas. An opportunity for international connectivity presented itself in April, when we met a delegation from the Human Frontier Science Program. That organisation supports novel, innovative, and interdisciplinary basic research focused on the complex mechanisms of living organisms—specifically approaches that involve scientific exchanges across national and disciplinary boundaries, also an aim of the Marsden Fund.

In October, the Council met in Kirikiriroa Hamilton to progress the next steps in our mātauranga Māori path. This included a visit to Te Parapara, at Hamilton Gardens, a Māori productive garden, and a fascinating kōrero with one of its architects, **Wiremu Puke**.

In 2024 we celebrate the 30th anniversary of the Marsden Fund. This landmark presents a time to consider some big-picture questions. Where are some of our early-funded researchers now? How have research themes evolved over that time? We are looking forward to delving into these questions and reflecting on the tremendous impacts of world-class, New Zealand, investigator-led research.

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MARSDEN FUND RECIPIENTS

Project ID	Panel	Institution	Project	Principal Investigator	Funding (ex GST)
23-AUT-006	EHB	Auckland University of Technology	Revealing the hidden attentional biases embedded by previous experience	Dr DT Henare	$360,000
23-AUT-008	EHB	Auckland University of Technology	Effects of ambient sound on beverage choice and sales: A population level study	Dr MP Phillips	$360,000
23-AUT-010	EHB	Auckland University of Technology	Developing and implementing an integrated system for assessing and improving behavioural time-use and experienced wellbeing	Professor JS Duncan	$870,000
23-AUT-011	EHB	Auckland University of Technology	Networks of power: Gender, race and class in workplace violence	Professor KJ Ravenswood	$870,000
23-CAW-008	SOC	Cawthron Institute	"Live or let die? Hybrids and the future of conservation in the Anthropocene	Dr AL Rayne	$360,000
23-GNS-010	EIS	GNS Science	Quest for flexible thermoelectric generators: modulation of material's crystal symmetry and anisotropy	Dr PP Murmu	$944,000
23-GNS-012	ESA	GNS Science	Filling the seismic-hazard gap - unravelling earthquake activity in the Southern Alps, New Zealand	Dr GL Coffey	$360,000
23-GNS-013	ESA	GNS Science	Greenland and Antarctic Ice Sheet contribution to sea-level	Dr GR Grant	$360,000
23-LVL-002	PCB	Lincoln Agritech Ltd	Lithium sponges: in search of new battery electrode materials	Dr JR Nelson	$360,000
23-MAU-004	HUM	Massey University	Sound Judgments? Assessing the Rhetorics of Civic Deliberation in True Crime Podcasting	Dr CS Bjork	$360,000
23-MAU-022	SOC	Massey University	Dark nudges and sludge: big alcohol and dark advertising on social media	Associate Professor T Huckle	$861,000
23-MAU-062	SOC	Massey University	Misogyny, rhetorical violence and the invisibilised entwining of digital and embodied social worlds	Associate Professor TJ Nicholls	$861,000
		Massey University		Dr SE Wilson	
23-MAU-082	HUM	Massey University	Kua kī taku puku, ko te waha o raro kei te hiakai tonu: The de-sexualisation of te reo Māori domains	Dr HL Black	$360,000
23-MAU-084	SOC	Massey University	Re-imagining health care in Fiji: Exploring health system resilience in the COVID-19 pandemic and beyond	Dr SJ McLennan	$861,000
23-MAU-090	SOC	Massey University	Kua whetūrangihia koe. Linking the celestial spheres to end-of-life experiences.	Associate Professor NA Tassell-Matamua	$861,000
23-MAU-105	SOC	Massey University	Navigating Labour Mobilities: Seafarers after COVID-19	Dr M Borovnik	$784,000
23-NIW-003	ESA	National Institute of Water and Atmospheric Research Ltd	Grounding zone estuaries: How can ocean stratification, baroclinicity, and tides beneath 500 m of Antarctic ice influence global sea level rise?	Dr NJ Robinson	$958,000

Project ID	Panel	Institution	Project	Principal Investigator	Funding (ex GST)
23-NIW-004	ESA	National Institute of Water and Atmospheric Research Ltd	Understanding the changing nature of atmospheric rivers in a warming world	Dr PB Gibson	$360,000
23-NIW-017	ESA	National Institute of Water and Atmospheric Research Ltd	Antarctic seafloor seeps: A driver of coastal change?	Dr SA Seabrook	$958,000
		National Institute of Water and Atmospheric Research Ltd		Professor CS Law	
23-PAF-012	EEB	Plant & Food Research	Sex and the epigenome: how does reproductive mode influence transgenerational epigenomic inheritance?	Dr D Anastasiadi	$360,000
23-UOA-014	EHB	The University of Auckland	Getting in Sync: Creating Connection in Social Virtual Reality	Professor MN Billinghurst	$870,000
23-UOA-019	EIS	The University of Auckland	Advanced computational modelling of the lymphatic system: can we predict lymphoedema development after cancer treatment?	Dr HM Reynolds	$944,000
23-UOA-024	EEB	The University of Auckland	Increased efficiency or cheater inhibition: using synthetic biology, experimental evolution, and modelling to test why reproductive divisions of labour evolve repeatedly	Dr N Takeuchi	$932,000
23-UOA-029	EEB	The University of Auckland	Are sleepy birds sloppy singers? Using songbirds to examine the relationships between sleep and vocal learning	Dr KE Cain	$942,000
23-UOA-043	ESA	The University of Auckland	Uncovering the Mysterious Origin of Mars Trojans	Dr LM Markwardt	$360,000
23-UOA-049	EIS	The University of Auckland	Surface wetting is critical: the role of liquid metals in on-demand hydrogen production	Dr W Zhang	$360,000
23-UOA-050	PCB	The University of Auckland	Structural control of liquid metals using solid supports	Dr C Ruffman	$360,000
23-UOA-053	EIS	The University of Auckland	Alternating photonic Ising machine for combinatorial optimization	Associate Professor SX Coen	$944,000
23-UOA-056	EIS	The University of Auckland	Merging ancient Roman knowledge and Te Ao Māori to create self-healing and sustainable concrete using natural materials	Dr E del Rey Castillo	$360,000
23-UOA-071	PCB	The University of Auckland	The light between: parametrically driven cavity solitons in pure-Kerr resonators	Associate Professor MJ Erkintalo	$941,000
23-UOA-073	SOC	The University of Auckland	Using Virtual Reality to combat racial bias: Immersing teachers into their Māori students' worlds	Dr F Meyer	$861,000
		The University of Auckland		Dr JR Smith	
23-UOA-074	CMP	The University of Auckland	Understanding the Molecular Mechanism behind the Plectin–Plecstatin-1 interaction to Suppress Metastatic Progression	Dr MP Sullivan	$360,000

Project ID	Panel	Institution	Project	Principal Investigator	Funding (ex GST)
23-UOA-080	MIS	The University of Auckland	Contemporary challenges in group theory and its applications	Distinguished Professor MDE Conder	$673,000
		The University of Auckland		Associate Professor J An	
		The University of Auckland		Professor EA O'Brien	
23-UOA-096	EIS	The University of Auckland	Shedding light on the present and the past; a novel environmental/ancient DNA capture system	Dr LI Pilkington	$944,000
23-UOA-112	SOC	The University of Auckland	Confronting truths about sex, gender and violence within emerging sexual trends	Professor NJ Gavey	$859,000
23-UOA-117	MIS	The University of Auckland	Emergence of large structures in random graphs and games	Dr R Nenadov	$360,000
23-UOA-126	EEB	The University of Auckland	Are crustose coralline algae acting as a seed bank in marine ecosystems?	Professor MA Sewell	$942,000
		Tāmaki Paenga Hira Auckland Museum		Professor WA Nelson	
23-UOA-129	EIS	The University of Auckland	Unravelling the role of lymphatics in vaping associated lung injury	Associate Professor KS Burrowes	$942,000
23-UOA-148	MIS	The University of Auckland	Fast statistical methods for enigmatic sensor data	Professor RM Fewster	$712,000
		The University of Auckland		Dr JA Goodman	
		University of Otago		Professor ML Hazelton	
		The University of Auckland		Dr BC Stevenson	
23-UOA-149	PCB	The University of Auckland	The development of effective, easily separable liquid catalysts	Dr CC Weber	$941,000
23-UOA-152	MIS	The University of Auckland	Integrating data-driven methodologies and model reduction for the control of complex networks	Dr LD Smith	$360,000
23-UOA-157	EIS	The University of Auckland	Linguistics inspired approaches to understand the mechanisms underlying language bias in speech technology	Dr J James	$360,000
23-UOA-164	SOC	The University of Auckland	Co-designing and Decolonising Gender Education: Exploring What It Means for Gender Diverse Students to Thrive in Schools	Dr A Pasley	$360,000
23-UOA-167	CMP	The University of Auckland	Tracing the drains: Uncovering a new origin for lymphatic vessels	Dr JW Astin	$942,000
23-UOA-179	MIS	The University of Auckland	Backward Transfer for Knowledge Improvement in Continual Machine Learning	Dr DK Benavides-Prado	$360,000
23-UOA-190	PCB	The University of Auckland	Applying safe-by-design approaches to develop alternatives to harmful forever chemicals	Dr EM Leitao	$941,000
23-UOA-200	EIS	The University of Auckland	Modelling Anterior Cruciate Ligament Graft Loading during Dynamic Movement Tasks	Dr SH Ward	$360,000

Project ID	Panel	Institution	Project	Principal Investigator	Funding (ex GST)
23-UOA-201	BMS	The University of Auckland	Harnessing disease-specific signals to restrict the targeting of gene therapy to vulnerable cells in the brain	Associate Professor DS Young	$941,000
23-UOA-203	ESA	The University of Auckland	Emplacement to Extinction: can crustal carbon release from magmatic heating cause extinction-level environmental change?	Dr JD Muirhead	$958,000
23-UOA-220	CMP	The University of Auckland	Powering flying athletes, paradoxes of bumblebee flight muscles	Dr JBL Devaux	$360,000
23-UOA-231	BMS	The University of Auckland	Advancing cancer immunotherapies with unique gene editing tools	Dr HM Sheppard	$941,000
23-UOC-003	MIS	University of Canterbury	The tree complexity of reticulate evolution	Distinguished Professor CA Semple	$675,000
		University of Canterbury		Distinguished Professor MA Steel	
23-UOC-034	CMP	University of Canterbury	How allosteric tuning influences enzyme promiscuity and host adaptation	Dr JM Johnston	$942,000
23-UOC-045	EIS	University of Canterbury	Mechanical and biomedical modelling of highly invasive endometriotic tissue	Dr RC Wood	$360,000
23-UOC-048	HUM	University of Canterbury	Does Machine-Assisted Writing Erase Linguistic Diversity?	Dr JE Dunn	$660,000
23-UOC-049	EIS	University of Canterbury	Multiferroic solitons at room temperature: A new topological material system for low energy computation	Dr DM Sando	$942,000
23-UOC-053	EIS	University of Canterbury	Listening to the heartbeats of a city: Remote sensing of water usage and pipeline condition by understanding the noise in water supply networks	Dr DZ Li	$360,000
23-UOC-056	CMP	University of Canterbury	Regulation of cell death by amyloid fibrils	Dr VK Morris	$942,000
23-UOC-058	PCB	University of Canterbury	Changing the face of the Universe: Cosmological simulations from first principles in general relativity	Professor DL Wiltshire	$941,000
23-UOC-067	EHB	University of Canterbury	The Perceptual Origins of Core Knowledge and Mathematical Cognition	Dr NJ Morton	$360,000
23-UOC-071	SOC	University of Canterbury	Understanding Technoference from the Child's Perspective	Dr CS Swit	$360,000
23-UOC-082	ESA	University of Canterbury	Exploring strange new worlds: comets and planetary systems around young nearby stars	Associate Professor KR Pollard	$854,000
		University of York		Associate Professor EJ Brunsden	
		University of Central Lancashire		Dr DL Holdsworth	
23-UOC-090	EHB	University of Canterbury	A real-world example of implicit grammar learning	Professor JM King	$870,000

Project ID	Panel	Institution	Project	Principal Investigator	Funding (ex GST)
23-UOC-100	HUM	University of Canterbury	The intersection of physiology and sociolinguistics in the speech of older talkers	Dr L Clark	$660,000
23-UOC-108	CMP	University of Canterbury	Coming together for better or worse? How biomolecular interactions impact the self-assembly and properties of nucleoli-like condensates	Dr NA Yewdall	$360,000
23-UOC-115	PCB	University of Canterbury	Shedding new light on fundamental physics through the scattering of gravitational waves	Dr CZ Stevens	$360,000
23-UOO-012	CMP	University of Otago	TRPV channel heteromers have unique properties for the sensation of mechanical force	Associate Professor M Fronius	$941,000
23-UOO-015	BMS	University of Otago	'Omics led discovery and in vivo screening of Māori and Pacific immune variation	Dr MP Leask	$360,000
23-UOO-022	BMS	University of Otago University of Otago	Tumor-derived WNT signalling reprograms T cell phenotype and function	Professor RA Kemp Dr KA Ward-Hartstonge	$941,000
23-UOO-024	BMS	University of Otago	ORC3: A novel disease gene with a moonlighting role in brain development	Associate Professor LS Bicknell	$941,000
23-UOO-037	SOC	University of Otago	Making a home in employer-provided housing	Dr ES Chisholm	$360,000
23-UOO-043	CMP	University of Otago	Probing functional protein oligomerisation in the crowded cellular environment	Associate Professor EC Ledgerwood	$933,000
23-UOO-044	MIS	University of Otago Monash University	Nonlinear Partial Differential Equations of Wave Type: Singular Dynamics and Asymptotic Data	Dr F Beyer Professor TA Oliynyk	$712,000
23-UOO-057	EEB	University of Otago	Unlocking the past: a novel approach to quantifying biodiversity loss in the fossil record	Dr NJ Rawlence	$942,000
23-UOO-060	SOC	University of Otago	How adults talk to children about maltreatment: Identifying knowledge, gaps and challenges.	Associate Professor DA Brown	$859,000
23-UOO-062	MIS	University of Otago University of Otago	Modelling the domino effect in complex systems	Associate Professor T Wang Professor BB Baeumer	$712,000
23-UOO-095	BMS	University of Otago	The influence of bacterial dormancy - Uncovering factors that affect phage-biofilm interactions	Dr LM Smith	$360,000
23-UOO-105	CMP	University of Otago	Determination of the molecular mechanisms underpinning bacteriophage hitchhiking	Dr SL Warring	$360,000
23-UOO-123	BMS	University of Otago	GnRH neurons: Beyond fertility	Professor RE Campbell	$941,000

Project ID	Panel	Institution	Project	Principal Investigator	Funding (ex GST)
23-UOO-139	EHB	University of Otago	Reconnecting communities and cetaceans using mātauranga Māori and archaeological science	Dr M Tromp	$870,000
		Museum of New Zealand Te Papa Tongarewa		Dr AK Aranui	
23-UOO-144	CMP	University of Otago	A neuronal circuit for stress-induced infertility	Professor GM Anderson	$942,000
23-UOO-145	BMS	University of Otago	Prolactin-mediated suppression of fever during pregnancy	Dr T Georgescu	$360,000
23-UOO-148	MIS	University of Otago	Principled inference for spatial point processes: a unified toolkit	Dr TM Davies	$712,000
23-UOO-155	EEB	University of Otago	Harnessing the power of hybrids to resolve the role of gene expression in evolution	Dr L Dutoit	$360,000
23-UOO-157	EHB	University of Otago	Taxes for a healthier diet? Impact of Tonga food excise taxes and tax subsidies introduced for non-communicable disease prevention	Dr AM Teng	$653,000
23-UOO-158	BMS	University of Otago	Two CGRP-responsive receptors: "double trouble" in migraine?	Professor DL Hay	$941,000
		University of Otago		Dr ML Garelja	
23-UOO-164	EHB	University of Otago	History in the Making: Memories for Historical Offences	Professor RA Zajac	$870,000
		University of Waikato		Professor M Garry	
23-UOO-176	EHB	University of Otago	Hydrogen generation with sustainable resources – a combined molecular, computational and engineering approach	Professor KC Gordon	$941,000
	PCB	Friedrich Schiller University Jena		Dr S Kupfer	
23-UOO-182	ESA	University of Otago	Flicking the master switch: Deconvolving warm-climate carbon cycle and cryosphere interactions in the Pacific sector of the Southern Ocean	Dr CR Riesselman	$958,000
23-UOO-197	HUM	University of Otago	What Roles and Responsibilities for Aotearoa's Non-Lawyer Advocates	Associate Professor BA Toy-Cronin	$360,000
23-UOO-210	BMS	University of Otago	Pregnancy hormones modify synchrony of neuronal activity within a defined neuronal circuit	Professor DR Grattan	$941,000
23-UOO-217	BMS	University of Otago	Understanding bacteriophage-pathogen specificity to support phage therapy.	Dr SA Jackson	$941,000
23-UOO-218	HUM	University of Otago	Mapping Buddhist Law in Asia	Professor BJ Schonthal	$660,000
23-UOW-006	BMS	University of Waikato	Predicting the mutational trajectories behind viral zoonotic events	Dr WJ Kelton	$940,000
23-UOW-011	HUM	University of Waikato	Picturebooks in Aotearoa: The design and content of picturebooks reflecting indigenous language, culture and evolving national identities	Associate Professor N Daly	$660,000

Project ID	Panel	Institution	Project	Principal Investigator	Funding (ex GST)
23-UOW-014	EEB	University of Waikato	What are the key predictors of invasion success?	Dr A McGaughran	$942,000
23-UOW-023	EHB	University of Waikato	The Shapes of Our Stories: Examining the Occurrence and Function of Emotional Trajectories in Autobiographical Memories	Dr M Sanson	$360,000
23-UOW-026	ESA	University of Waikato	Could land aridification supercharge summertime warming rates in a maritime climate like Aotearoa?	Dr LJ Harrington	$958,000
23-UOW-028	EEB	University of Waikato	Understanding cross-boundary effects of biodiversity on ecosystem functioning	Dr FJ Burdon	$942,000
23-UOW-029	EEB	University of Waikato	Turning up the heat on soil food webs: will global warming erode ecosystem resilience?	Dr AD Barnes	$942,000
		Lincoln University		Dr CJ Alster	
23-UOW-037	SOC	University of Waikato	He Rau Ringa: Engaging ethnic communities in a Tiriti o Waitangi-centred framework of sustainable citizenship	Professor D Munshi	$861,000
		University of Waikato		Professor P Kurian	
		University of Waikato		Professor SL Morrison	
23-UOW-048	EEB	University of Waikato	How do genomic architecture and adaptive capacity influence species range limits?	Dr E Parvizi	$360,000
23-UOW-057	SOC	University of Waikato	Marine inequality and environmental demise: Identifying imperial borders in ocean governance	Dr FE McCormack	$861,000
23-UOW-061	HUM	University of Waikato	Chamoru Diasporic Routes: Sharing Our Elders' Stories from Sanlagu (Overseas)	Dr JL Bennett	$360,000
23-VUW-012	SOC	Victoria University of Wellington	Vision Mātauranga: is it past its use-by date?	Dr TG McAllister	$360,000
23-VUW-014	HUM	Victoria University of Wellington	From roots to branches: language evolution in the Austronesian family tree	Dr V Chen	$653,000
		Max Planck Institute for Evolutionary Anthropology		Dr ME Walworth	
23-VUW-018	MIS	Victoria University of Wellington	Unsupervised clustering of complex mixed-type data via a genetic case study	Dr LF McMillan	$360,000
23-VUW-019	EEB	Victoria University of Wellington	Shining a light on lanternfishes to reveal hidden linkages between ecosystems	Professor JS Shima	$942,000
23-VUW-023	SOC	Victoria University of Wellington	Embracing Islam: Conversion, Identity, and Belonging in Aotearoa New Zealand	Dr AZ Arkilic	$360,000
23-VUW-025	HUM	Victoria University of Wellington	Literatures of Environment and Disability from Oceania	Dr BJ Etherington	$360,000
23-VUW-034	SOC	Victoria University of Wellington	Inclusion through difference: Towards a new ethics of engagement with Takatāpui/LGBTIQ+ parents and their families/whānau	Dr GCW Parker	$360,000
23-VUW-043	EEB	Victoria University of Wellington	Examining ecosystem stability in multidimensional space: What drives ecosystem stability now and in the future?	Dr O Peleg	$360,000

Project ID	Panel	Institution	Project	Principal Investigator	Funding (ex GST)
23-VUW-058	EHB	Victoria University of Wellington	Sensory hypothesis of developmental prosopagnosia	Dr T Susilo	$870,000
23-VUW-060	EEB	Victoria University of Wellington	Uncovering the functioning and importance of temperate mesophotic ecosystems	Dr A Rogers	$942,000
23-VUW-061	CMP	Victoria University of Wellington	What makes a coral "super"? Challenging the oxidative theory of coral bleaching to solve the coral reef crisis	Dr CA Oakley	$942,000
23-VUW-062	MIS	Victoria University of Wellington	Mathematical modelling of inertial lift driven particle migration in complex microfluidic devices with applications to periodic duct geometries.	Dr TB Harding	$360,000
23-VUW-084	PCB	Victoria University of Wellington	Deciphering the molecular details of unusual fungal biosynthetic enzymes	Professor EJ Parker	$941,000
23-VUW-118	MIS	Victoria University of Wellington	Connections between Computability Theory, Effective Descriptive Set Theory, and Geometric Measure Theory.	Professor N Greenberg	$712,000
		Victoria University of Wellington		Dr DDC Turetsky	
23-VUW-122	SOC	Victoria University of Wellington	Seeding Hope: The Diverse Roles of Indigenous Women in Food Systems	Associate Professor JT Smith	$861,000
		Papawhakaritorito Trust		Dr JV Hutchings	
23-VUW-144	EIS	Victoria University of Wellington	Capturing the Fleeting: Tracking Photophysics in Organic LED and Laser Materials with Ultrafast Photoluminescence Spectroscopy	Dr K Chen	$926,000
23-VUW-152	SOC	Victoria University of Wellington	Prisons without Walls: from Incarceration to E-carceration in Aotearoa New Zealand	Dr LD Martin	$360,000
23-VUW-155	ESA	Victoria University of Wellington	Next-generation galaxy formation modelling for radio surveys	Dr ARH Stevens	$360,000
23-VUW-175	BMS	Victoria University of Wellington	Awakening dormant drug biosynthesis by decoding regulatory gene networks	Dr JG Owen	$941,000

This list of recipients is abridged.

For the complete list of awarded Marsden Fund investigators, including abstracts of all projects, visit: Bit.ly/MF-awards

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ISSN 1175-0073
Published 2024

MARSDEN FUND
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