Office of the Prime Minister's Chief Science Advisor
Kaitohutohu Mātanga Pūtaiao Matua ki te Pirimia

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ANNUAL REPORT 2020

Mahi Tahi 2

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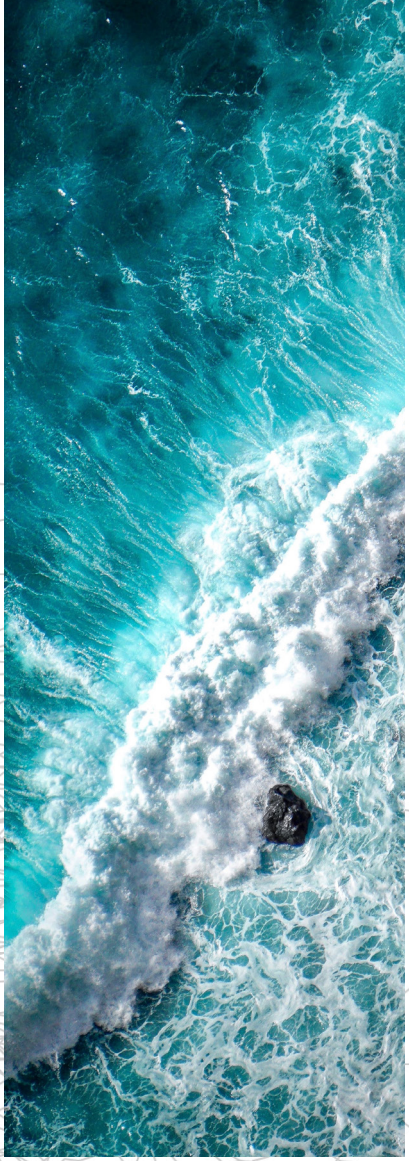
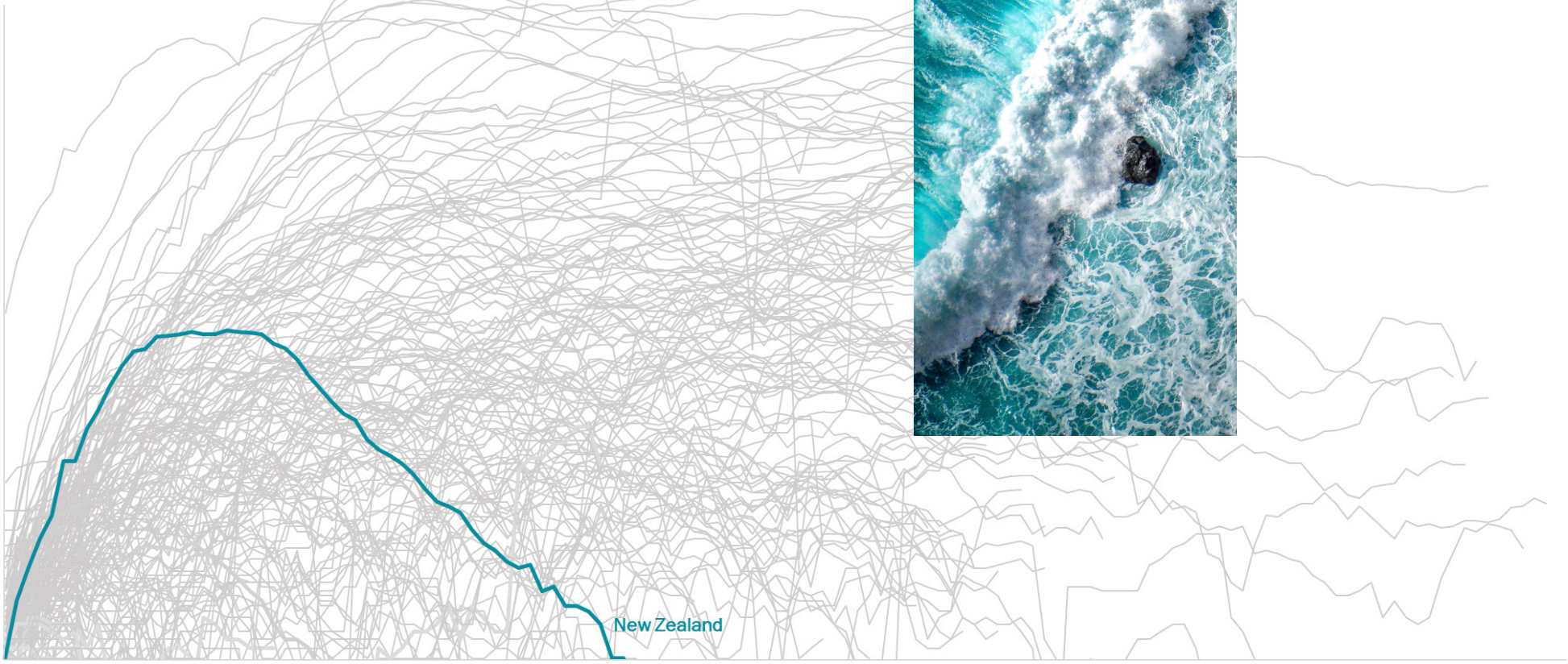




Mā tātou anō e hanga tō tātou whare.
Ko te whare nei ko te kaupapa kei mua i
te aroaro.
Kia noho tonu tātou i tēnei āhuru mōwai i
raro i ngā tikanga o te aroha, o te manaaki
me te whakaute, tētahi ki tētahi.
Mā te mahi tahi, ka ora tātou katoa.

– *Kīngi Tāwhiao*

TE KARERE A TE PIRIMIA

Opening remarks

From the Rt Hon Jacinda Ardern

"My Chief Science Advisor played a bigger role than anyone will ever know. And it is I think probably one of the most important roles that we have in government whether it is March 15, or Whakaari/White Island, Dr Juliet Gerrard has played an enormous role, for the better."

- Rt Hon Jacinda Ardern, speaking to Matt Nippert, *New Zealand Herald*, 27 June 2020.

During the last year, science, scientists and science communicators have been at the forefront of the Government's response to enormous and unprecedented challenges – first the tragedy at Whakaari/White Island, and then the fight to eliminate COVID-19 in New Zealand. Juliet has been there, by text, phone or in person to explain the science and provide me with advice about the way forward, and to connect me and other Ministers with the wide range of scientific experts and communicators, both in New Zealand and overseas. Juliet, her team, and the many scientists and communicators have been invaluable during a very challenging time for New Zealand, and the rest of the world.

While it may feel hard to remember the time before COVID, Juliet and her team, especially Dr Rachel Chiaroni-Clarke, also produced the massive report *Rethinking plastics in Aotearoa New Zealand* at the end of 2019. This report outlines a way forward for 'making best practice, standard practice.' It was a pleasure to join the team at the launch at Sustainable Coastlines and I know this report will provide direction for our policies on reducing waste for years to come. And it was made into a movie by the fabulous documentary maker Shirley Horrocks, with a premiere at Government House in Wellington.

Another big focus for Juliet has been working to amplify the voice of Māori researchers and promoting diversity, equity and inclusion in science. As we have seen this year, scientists have made a massive contribution, and imagine what we can achieve if we can harness all of the talent available in New Zealand.

Finally, I want to take this opportunity to acknowledge and thank all of the science community for their contribution over the last year. And thank you to Juliet – for all the late night and early texts, discussions, and advice over the last year.

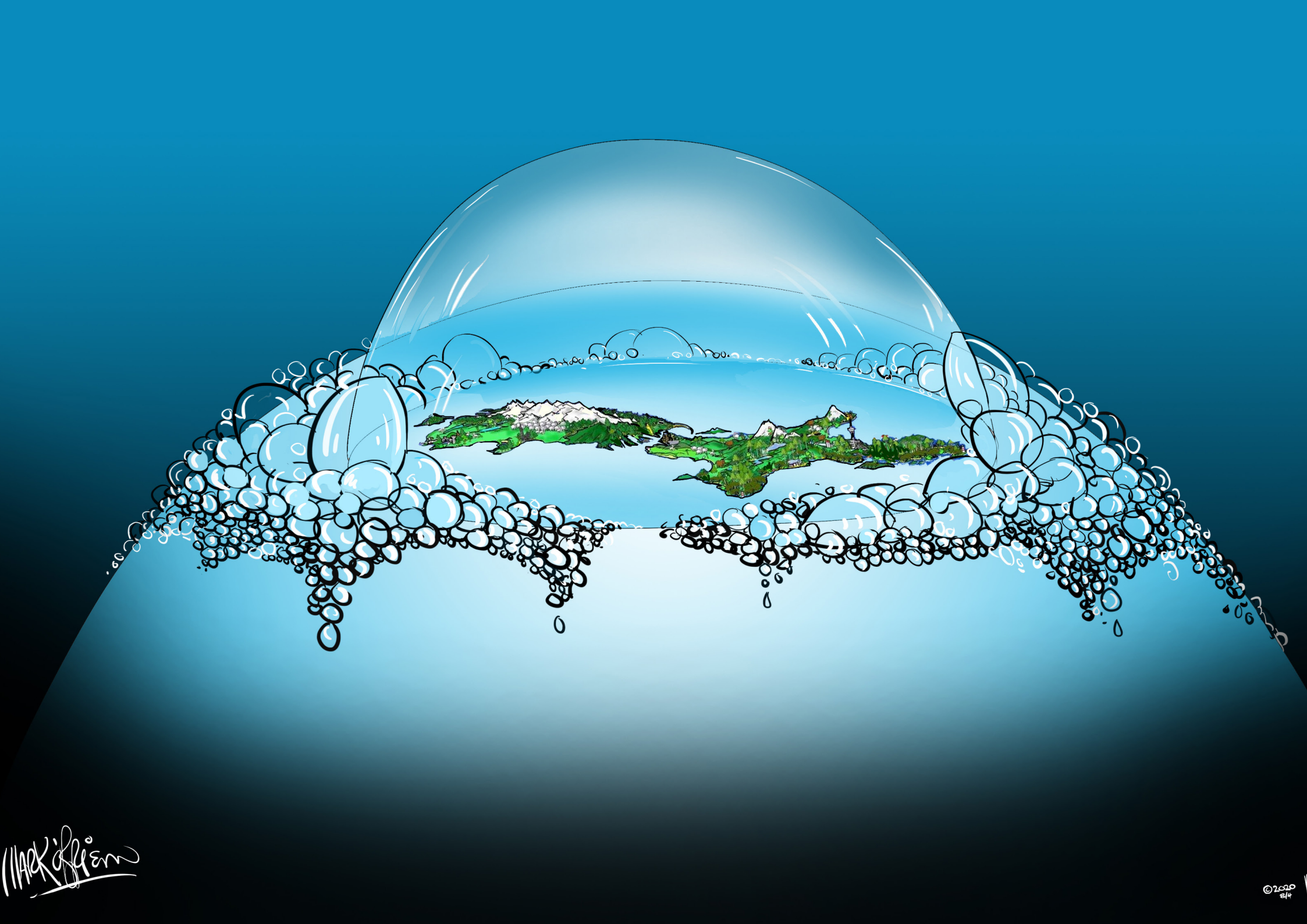
Rt Hon Jacinda Ardern
Prime Minister

Rt Hon Jacinda Ardern at the launch of the *Rethinking plastics* report, with the Hon Eugenie Sage, Professor Juliet Gerrard, and other members of the team.

Contents

Right: the Aotearoa New Zealand bubble © Mark O'Brien/ monsta.co.nz

Cover Image: Chart of new confirmed COVID-19 cases for each country; seven-day rolling average of new cases by number of days since one average case per day recorded. Graphed in-house.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FOREWORD

This year has been a rollercoaster

Responding to emergencies, addressing public concerns and delivering detailed evidence syntheses – our work this year has spanned the full spectrum of science advice.

Tēnā koutou katoa, ngā mihi o te wā ki a tātou.

Ahakoa ngā ārai, ahakoa ngā aupiki me ngā auheke, mā te āta wānanga me te mahi tahi e whai rongoā, e whai rautaki kia anga whakamua ai tātou katoa.

Kei te ao hurihuri tātou e noho nei engari mā te titiro ki ngā rā o mua me ngā kōrero o nehe, kei reira kitea ai he oranga mō tātou.

Nā reira, anei ētahi pitopito kōrero.

It is hard to know where to start when introducing our second annual report. Last year I described a whirlwind year, in which a lot of time was invested building a team and strengthening networks, visiting sites all over Aotearoa, and connecting with and listening to as many different communities as possible. This year we have drawn on those communities intensively as we have been asked for advice at a variety of different paces – in response to emergencies, to address public concerns, or to deliver detailed evidence syntheses to inform long-term policy. I am hugely proud of the way in which our scientists have stepped up and leant into unprecedented challenges. Ngā mihi nui e hoa. Thank you. In the pages to follow you will find a taste of our activity. Throughout, we stuck to our four principles: transparency, accessibility, inclusivity and rigour.

Mahi Tahi 2 began in July 2019 with a trip to the UK, Canada and the US to connect with their Chief Scientists and build relationships. This, and the strong trans-Tasman connection, proved vital this year as we faced a global pandemic. I also spent some time visiting different research communities in Aotearoa, reporting back in many cases on kōrero that I had begun the year before.

A big focus this year has been engagement with Māori researchers, and later in this report you can read about the fruits of this labour with more than 100 Māori researchers engaging in a series of hui. This culminated in a hui with the Hon Dr Megan Woods, Minister of Research, Science and Innovation, and senior MBIE officials, to share a common understanding of how the strengths of te ao Māori can be embraced within our research communities. It was heartening to see priority given to this kaupapa in the Budget this year. In my foreword to Mahi Tahi 1, I foreshadowed a long hard path ahead to build a working partnership around science advice that is truly bicultural. I hope that this year we have taken a few significant steps forward on this journey.

We delivered our first major report *Rethinking plastics in Aotearoa New Zealand* – the culmination of a long and detailed project ably led by Dr Rachel Chiaroni-Clarke from the Office, and with contributions from a hard-working and creative panel and a large number of stakeholders. The report was launched by the Prime Minister and the Hon Eugenie Sage, Associate Minister for the Environment, and the recommendations were well received, with a large amount of press interest. We are hugely grateful for the positive engagement and

Right: Juliet meets young scientists at Te Herenga Waka–Victoria University Wellington as part of the Innovative Young Minds programme in July 2019.

"I am hugely proud of the way in which our scientists have stepped up and leant into unprecedented challenges.

Ngā mihi nui e hoa."

energy that this project created. We are particularly grateful for the parallel independent film project undertaken by Shirley Horrocks to create a short documentary on our plastics work (available on our website) and launched by the Governor General. We are continuing the collaboration this year and look forward to the next instalment.

The Prime Minister also asked us to put out some accessible public-facing explainers – one on 5G, and another on cannabis, ahead of the referendum. These are web-based and link through to trusted evidence, to enable anyone to access reliable details themselves, having read our non-technical summaries. We also worked on lots of smaller pieces of advice, some direct to the Prime Minister, such as our briefing on the Royal Society Te Apārangi's report on genetic editing, and others behind the scenes, contributing to discussions with senior decision makers on hazard and risk, defence technologies and sensitive technologies.

Our next two projects arrived unexpectedly and under considerable urgency. As tragedy unfolded in the aftermath of the eruption of Whakaari White Island, I spent an intense week in and around the bunker supporting the amazing scientists from GNS Science to help the recovery efforts. And then of course, 2020 has been dominated by a long-predicted and yet still unexpected global pandemic, in the form of COVID-19. It has been an absolute privilege to work with Professor Ian Town, our Chief Science Advisor for health, to support our many excellent experts to provide science advice to the Prime Minister and Government, complementing the public health response.

Finally, an acknowledgement of the enormous support the office has received throughout the year from hundreds of scientists. I do not set myself up as the expert in all fields of science; rather as the pathway from the experts to the Prime Minister. This year that path has been well trodden. We have made a difference.

Ngā mihi nui

IN BRIEF

The year in numbers

14k
followers (↑ 85%)
Twitter verification
Tweets featured in national and international press

13
new publications
including our first major report
Rethinking plastics

19k+
unique visitors and

16
blog posts

30+
talks and presentations

2.7k
followers (↑ 115%)

6
weeks working remotely from our bubbles

4
new team members

19
interns and fellows

20+
media interviews


1.5 Degrees Live!
SUNDAY STAR TIMES
Range of opportunities
Enjoy a vine romance in craggy Hawke's Bay
DRASTIC PLASTICS BAN
Govt to ditch fruit stickers, plastic cutlery and cotton buds in latest salvo in the war on waste and single-use, non-recylable plastic
NEWS PAGE 3
36% OF PLASTIC PRODUCED IS SINGLE-USE
7.55 MEET THE TEENS HELPING OUT AT A CAMP FOR KIDS WITH SPECIAL NEEDS
Rethinking Plastics in Aotearoa New Zealand
Haere mai
Welcome
2
metres
'MAKE BEST PRACTICE, STANDARD PRACTICE'
PLASTIC PACKAGING & CONTAINERS NEXT TARGET IN BID TO REDUCE WASTE

WHO WE ARE

The team

Te amorangi ki mua, te hāpai ō ki muri.

The Office of the Prime Minister's Chief Science Advisor (OPMCSA), based at the University of Auckland, is independent of government and provides nonpartisan advice directly to the Prime Minister.

The PMCSA advises the Prime Minister on scientific evidence, acts as a conduit of alerts between the research community and government, and engages in activities to raise the profile of science in Aotearoa.

In the last year, we said goodbye to Christine Price, Dr Victoria Metcalf and Dr Ben Jeffares. Kia ora!

Read more about the team online

Professor Juliet Gerrard FRSNZ HonFRSC has held the position of PMCSA since June 2018. She is seconded from her role as a professor at the University of Auckland. Juliet provides advice to the Prime Minister and convenes the Chief Science Advisor (CSA) Forum. She aims to create a trusted bridge between science, society and government. Juliet develops wide networks among scientists and science advisors nationally and internationally to enable this.

Julie Bringans is the office manager and executive assistant to Juliet. She brings comprehensive EA/PA experience from across the private, public and education sectors.

Dr Susie Meade is the principal advisor to Juliet. Her role also supports the CSA Forum and she splits her time between Auckland, Christchurch and Wellington. Susie was raised on the family farm, has a PhD in chemistry and more than 20 years' experience in research and science management in Aotearoa – most recently at QuakeCoRE, the NZ Centre for Earthquake Resilience.

Dr George Slim, based in Wellington, provides policy advice to the OPMCSA as a consultant. George has more than 30 years' experience across academia, government, small business and the government research sector as both a scientist and a bureaucrat. He is ably assisted by chief cat-napper and office mascot Wallace.

Dr Rachel Chiaroni-Clarke is a senior research and policy analyst. She completed her PhD in medical genetics at the University of Melbourne and Murdoch Children's Research Institute. Prior to joining the team, Rachel worked as a writer at a healthcare communications agency in Melbourne.

Ellen Rykers is a research analyst and writer. An award-winning science writer, Ellen has written for *New Zealand Geographic* and *The Spinoff*, among other publications. Previously, she worked in communications and outreach at the Australian Academy of Science.

Celia Cunningham is a research analyst and writer. Prior to joining the office, Celia spent six years in risk management consulting. She has also worked as a policy analyst for the Ministry for Primary Industries, as well as undertaking a variety of internships across the government and private sectors.

Below: members of the PMCSA team visit the HMNZS Manawanui, a state-of-the-art Navy vessel.

WHO WE ARE

Chief Science Advisor Forum

He Rauhinga Tohu Pūtaiao. Ehara taku toa i te toa takitahi, engari he toa takitini.

The Prime Minister's Chief Science Advisor convenes a forum of chief science advisors (CSAs) from across government departments, ministries and agencies. The Forum receives additional support from co-opted members and connects widely with the research community to ensure it can provide comprehensive advice and an extensive range of expert contacts. The Forum meets around ten times a year, and has honed its Zoom skills in 2020 – a practice which will be adopted for half our meetings from now on. Sub-groups of the Forum also come together periodically to provide specific advice on cross-sector issues.

This year the Forum was delighted to welcome two new members. Professor Tracey McIntosh MNZM is the Chief Science Advisor for the Ministry of Social Development (MSD) – Te Manatū Whakahiato Ora. Tracey is of Ngāi Tūhoe descent and is Professor of Indigenous Studies and co-head of Te Wānanga o Waipapa (School of Māori and Pacific Studies) at the University of Auckland. Previously, she was the co-director of Ngā Pae o te Māramatanga – New Zealand's Māori Centre of Research Excellence. Tracey's recent research has focused on incarceration (particularly of Māori and Indigenous peoples), gang whānau issues and issues pertaining to poverty, inequality and social justice. In addition to her role at MSD, Tracey is co-chair of the PMCSA expert panel on cannabis.

Dr Kay Saville-Smith MNZM is the inaugural Chief Science Advisor for the Ministry of Housing and Urban Development. She is director of the Centre for Research, Evaluations and Social Assessment (CRESA) and has built up more than 20 years' expertise in community and social policy research with a focus on housing.

We are pleased to have shifted the demographics of the Forum to be more representative than the group we inherited, but there is still more to do.

Top: Professor Tracey McIntosh MNZM.
Bottom: Dr Kay Saville-Smith MNZM.

Meet the CSA Forum

Juliet Gerrard – PMCSA, Kaitohutohu Mātanga Pūtaiao Matua ki te Pirimia

Michael Bunce – Chief Scientist, Environmental Protection Authority (EPA)|Te Mana Rauhī Taiao

Alison Collins – Departmental Chief Science Advisor, Ministry for the Environment (MfE)|Manatū Mō Te Taiao

Gary Evans – Chief Science Advisor, Ministry of Business, Innovation and Employment (MBIE)|Hīkina Whakatutuki

Vince Galvin – Chief Methodologist, Statistics New Zealand|Tatauranga Aotearoa

Ken Hughey – Chief Science Advisor, Department of Conservation (DOC)|Te Papa Atawhai

Gill Jolly – co-opted CSA forum member, Earth Structure and Processes Manager, GNS Science|Te Pū Ao

Simon Kingham – Chief Science Advisor, Ministry of Transport (MoT)|Te Manatū Waka

Tahu Kukutai (Ngāti Tiipa, Ngāti Kinohaku, Te Aupōuri) – co-opted CSA forum member, Professor of Demography at the National Institute of Demographic and Economic Analysis (NIDEA)|Te Rūnanga Tātari Tatauranga

Ian Lambie – Chief Science Advisor, Ministry of Justice – Tāhū o te Ture

Tracey McIntosh (Ngāi Tūhoe)– Chief Science Advisor, Ministry of Social Development (MSD)|Te Manatū Whakahiato Ora

Stuart McNaughton– Chief Education Scientific Advisor, Ministry of Education (MoE)|Te Tāhuhu o Te Mātauranga

Rob Murdoch – Departmental Science Advisor, Ministry of Business, Innovation and Employment (MBIE)|Hīkina Whakatutuki

Tim Ng – Deputy Secretary and Chief Economic Adviser, The Treasury|Te Tai Ōhanga

Richie Poulton – Chief Science Advisor, Social Wellbeing Agency|Toi Hau Tāngata & to the Minister for Child Poverty

John Roche – Chief Science Advisor, Ministry for Primary Industries (MPI)|Manatū Ahu Matua

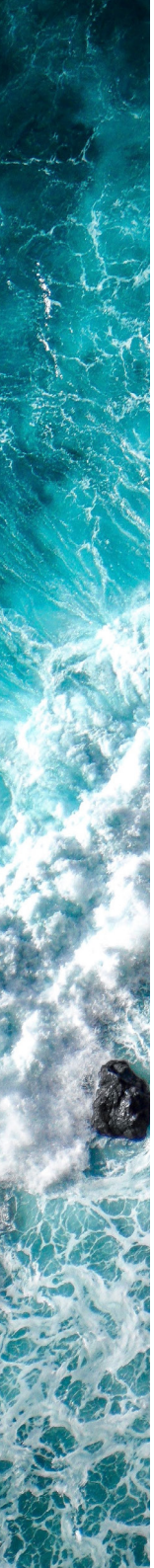
Kay Saville-Smith – Chief Science Advisor, Ministry of Housing and Urban Development

Hamish Spencer – Departmental Science Advisor, Ministry of Business, Innovation and Employment (MBIE)|Hīkina Whakatutuki

Hema Sridhar – Chief Advisor Industry and Science, New Zealand Ministry of Defence|Manatū Kaupapa Waonga

Ian Town – Chief Science Advisor, Ministry of Health (MoH)|Manatū Hauora

Read more about the CSA Forum on our website



WHAT WE DO

Rethinking plastics

In December 2019, we published *Rethinking plastics in Aotearoa New Zealand* – the first major report from our office.

Plastics was our major focus for the second half of 2019, and it soon became clear that there was no silver bullet to fix this issue. Tackling plastic waste needs a systems change: a collection of adjustments – some large, some small – across all aspects of society. Through talking with many different people from community groups, businesses and government, we discovered that there were already plenty of examples of best practice – what was needed was to make that best practice standard practice. This became the headline message for our advice. Kia tika, kia pono ngā mahi i ngā wā katoa.

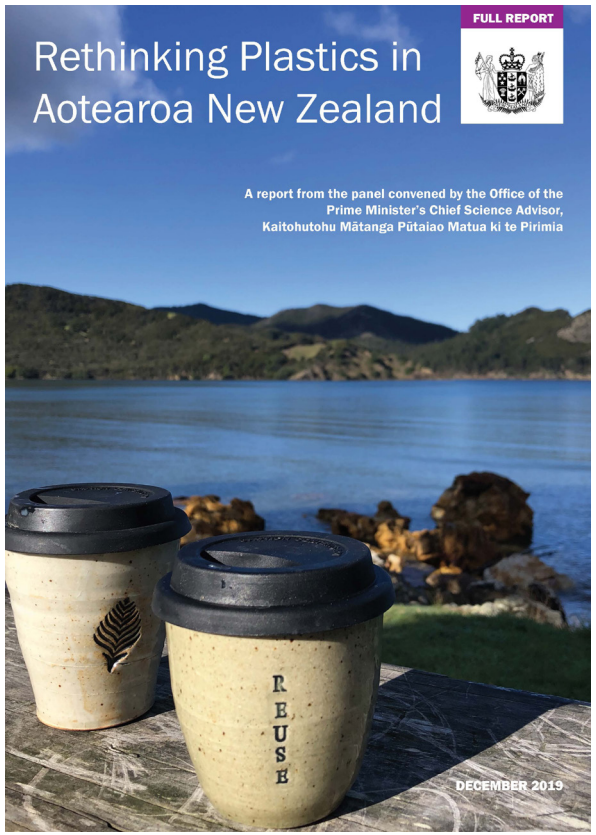
Mai i ngā maunga ki ngā moana
Mai i uta ki tai
Ahakoa ki hea i te taiao
He kirihou, he kirihou, he kirihou!

The evidence, new ideas and examples of best practice formed the basis of a detailed report, led by Dr Rachel Chiaroni-Clarke. This was accompanied by a series of recommendations on how to mitigate the negative impacts of plastic, while retaining its many benefits. Under the umbrella of a National Plastics Action Plan, there were detailed recommendations to achieve the following:

- Improve plastics data collection
- Embed rethinking plastics in the government agenda
- Create and enable consistency in design, use and disposal
- Innovate and amplify
- Mitigate environmental and health impacts of plastic

The full report was also summarised into 'key messages', an 'at a glance' summary, and made into a website – all available online.

See all plastics content on our website



Talking plastics

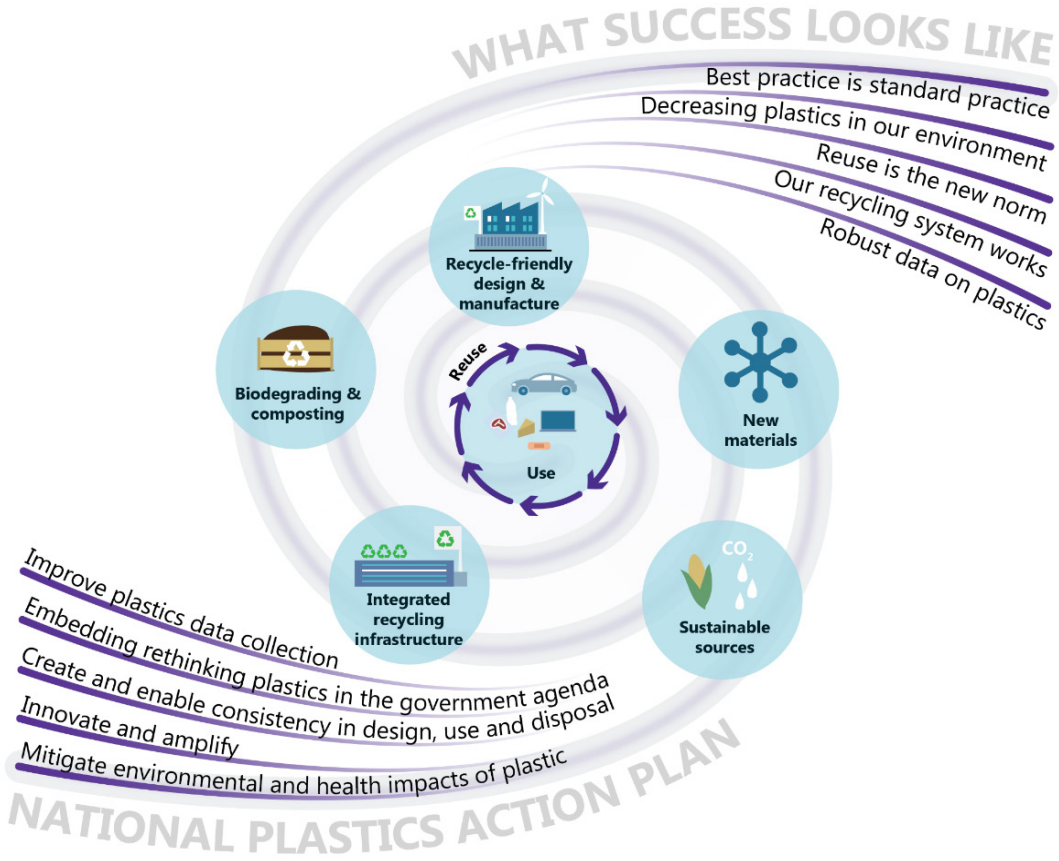
Over the course of the project, the team were involved in a range of events, talks and panel discussions about plastics. This helped to build the evidence base for the report and provided opportunities to share our progress. Highlights included:

- the Sustainable Business Network's conference on 'The End of Plastic Waste As We Know It' in August 2019 where Juliet gave a presentation on rethinking plastics, alongside the Hon Eugenie Sage, Associate Minister for the Environment,
- Rachel's talks at the Life Cycle Assessment Conference and Packaging Forum meeting,
- a conversation in which Juliet joined the Prime Minister and Jane Goodall to talk plastics, and
- the WasteMINZ and Ministry for the Environment waste disposal levy workshop, attended by both Rachel and Juliet.

Visits to Visy recycling and the Redvale Landfill and Energy Park also helped the team develop a full picture of what plastic waste management looks like at the coalface.

Launching the report

We celebrated the launch of *Rethinking Plastics* in Auckland on 8 December 2019. The team at the Sustainable Coastlines flagship education centre generously hosted the OPMCSA, the Prime Minister Jacinda Ardern, and the Associate Minister for the Environment, Eugenie Sage. We were also joined by members of our panel, and the many stakeholders who supported the work through consultation and peer review, along with the press.



At the launch, the Prime Minister and Minister Sage announced that the government was signalling the need to move away from the use of PVC and polystyrene in packaging – two problematic plastics highlighted in the report. They also committed the Ministry for the Environment to respond to the recommendations within six months.

The next day, independent filmmaker Shirley Horrocks launched a movie version of the report – a short documentary called 'Science and the Plastics Problem'. The film premiere was generously hosted by Dame Patsy Reddy and Sir David Gascoigne at Government House in Wellington.

Following the launch, there has been much interest from media, industry and researchers about rethinking plastics. Both Juliet and Rachel are still giving talks about the work – and keeping a keen eye on how implementation of the recommendations is progressing.

WHAT WE DO

5G in Aotearoa New Zealand

He maurea kia whiria!

5G is a technological advancement that presents opportunities for innovation but has also caused some people concern. The OPMCSA researched and provided science-backed information on our website that addressed many of these concerns, at the request of the Hon Kris Faafoi, Minister for Broadcasting, Communications and Digital Media.

The 5G information page is one of the top-performing pages on our website, attracting thousands of visitors since its launch in November 2019.

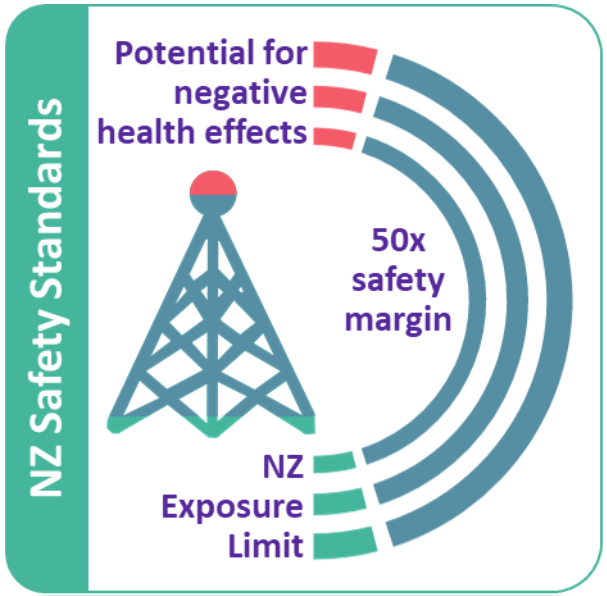
The work has also led to several news stories online and on television, with the media regularly calling on the OPMCSA to provide expert commentary on the 5G issue.

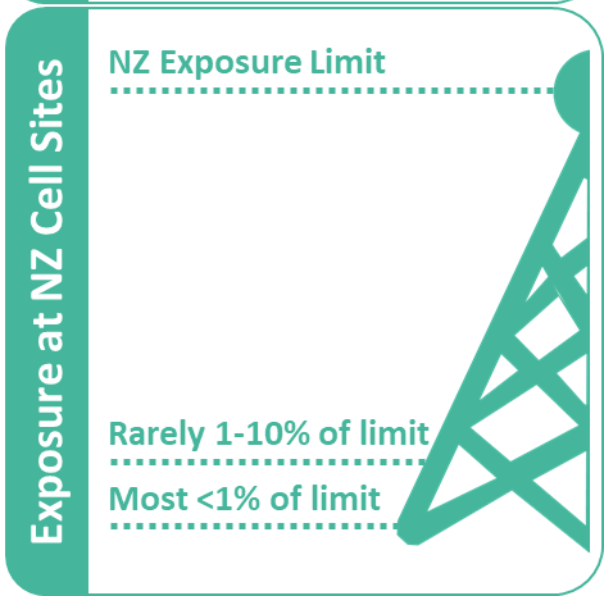
5G is similar to previous cellular networks – it uses radio waves to transmit data. It is different in that it will use higher frequency radio waves. These radio waves don't penetrate obstacles as easily and so will require more towers to ensure coverage. Aotearoa has standards that limit exposure to radio waves with a large safety margin built in. These standards apply to 5G the same as they do with previous cell networks.

While some people have safety concerns about the technology, the current scientific evidence makes it extremely unlikely that there will be any adverse effects on human or environmental health.

5G will be faster, have lower latency, have more connectivity, and a larger network capacity. These will translate into opportunities for massive productivity benefits and enable new technologies in transport, medicine, farming and many other sectors.

As we look forward to the continued rollout of 5G and the technology it enables, Aotearoa will need to continue to monitor risks and emerging research, including ensuring that our standards are adhered to.





Visit the '5G in Aotearoa New Zealand' webpage

Eradication nation: *Mycoplasma bovis* still on target

Aotearoa is aiming to become the first country in the world to eradicate the bacterial disease *Mycoplasma bovis* from its national cattle herd.

Dr John Roche, Chief Science Advisor to the Ministry for Primary Industries (MPI) is coordinating science advice for the eradication efforts as chair of the *M. bovis* Strategic Science Advisory Group.

M. bovis was first detected in Aotearoa in 2017. Since then, MPI and industry bodies DairyNZ and Beef + Lamb New Zealand have led an ambitious eradication effort, setting a 10-year timeframe to rid the country of the disease.

Just like COVID-19 (or any other infectious disease outbreak), fast contact tracing is key to stamping it out. Once an infected herd is identified, any animals that were sold or moved must be traced and their close contacts tested.

In 2018-19, the surveillance of *M. bovis*-infected herds was, in many instances, taking too long. John led an investigative report that identified issues and areas for improvement, which have been implemented to impressive effect. The programme is currently considered to be performing well and on track to achieve eradication.

The *M. bovis* Strategic Science Advisory Group have also dedicated attention to the issue of diagnostic testing.

M. bovis is a bacterium that affects cattle, causing incurable mastitis (inflammation of the mammary gland and udder tissue) and significant calf mortality, among other diseases. The bacteria can remain dormant and undetected by the animal's immune system, until stress leads to a flare up of symptoms. This period of latency makes *M. bovis* difficult to control.

Infected herds must be culled – a difficult reality for affected farmers, but one that is necessary for the long-term health of Aotearoa's cattle farming industry.

Indeed, other countries "live with" *M. bovis*. But

with his significant involvement in farming, John is familiar first-hand with the devastation of *M. bovis* and believes that eradication is the best goal.

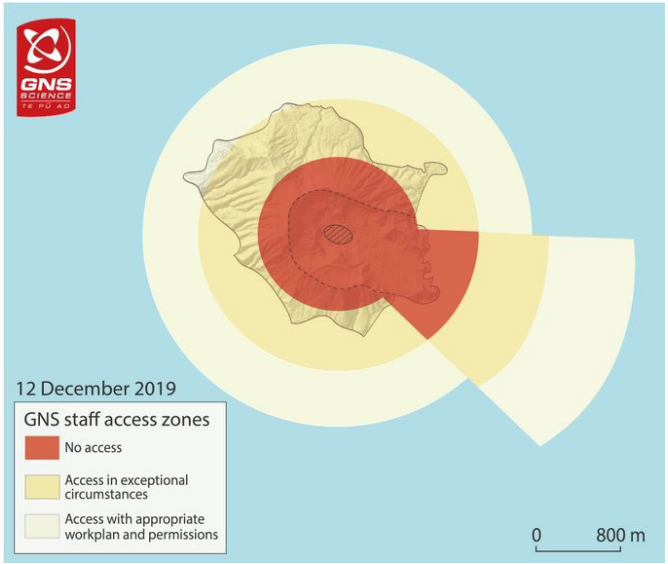
He is optimistic about the eradication effort. "All of the indications to date will give us confidence that we are actually getting ahead of this disease," he told *Stuff* in June 2019.

WHAT WE DO

Whakaari White Island response

On 9 December 2019, Whakaari White Island erupted, and the science advisory system leapt into action.

As we were launching the documentary on our *Rethinking plastics* report, we received the tragic news that Whakaari had erupted, claiming the lives of many of those visiting the island. Juliet was asked to support the Prime Minister and key decision makers in the recovery efforts. Like the COVID-19 response that came just a couple of months later, her role was not as a subject matter expert on volcanoes or recovery operations. Rather, it was to connect with experts, interpret their knowledge, work with them and lift their voice within the government to develop trust and understanding of key scientific insights. In the Whakaari case, these efforts supplemented the official advice through GNS Science. Juliet worked closely with key volcanologists, especially Dr Graham Leonard and Dr Nico Fournier, whose expertise, dedication and tenacity were crucial in recovery efforts. She was supported in this by one of our co-opted chief science advisors, Dr Gill Jolly, and well connected to the scientific and technical advisory committee which was stood up to support the response.



The recovery operation was critically dependent on understanding the risk that the volcano might erupt a second time, endangering the lives of rescuers. Juliet supported the production and communication of daily risk maps (an example of which is shown on the left) to enable the operational teams to assimilate complex calculations and understand the highly uncertain situation.

Six of the bodies were able to be recovered in a complex mission during which the estimated fatality risk was 6%. Sadly, two were never found. The science, and the scientists, played a vital role in enabling these challenging risk assessments to be made under urgency.

Next page: Whakaari White Island after erupting on 9 December 2019. Image by Nico Fournier on a New Zealand Police reconaissance flight.

WHAT WE DO

COVID-19 response

Mā mua ka kite a muri, mā muri ka ora a mua.

It started as a smudge of cloud on the distant horizon. But even from those first reports in December 2019 of a mystery respiratory virus in Wuhan, China, it was clear there was potential for a public health storm.

In Aotearoa, the Ministry of Health first alerted health professionals on 6 January 2020, asking them to keep an eye out for pneumonia patients who had travelled to Wuhan. The alert was updated on 10 January with a reference to Severe Acute Respiratory Syndrome (SARS) and Middle East Respiratory Syndrome (MERS) – coronaviruses that have caused outbreaks in the past.

But this novel coronavirus was different. Eventually, it received the name SARS-CoV-2, reflecting its relatedness to the original SARS virus. The disease caused by SARS-CoV-2 infection was later dubbed COVID-19 by the World Health Organization (WHO).

The COVID-19 storm clouds build

In the early stages of the pandemic, we watched the numbers in Wuhan grow – alongside increasing international concern – and connected with Chief Science Advisors overseas to understand as quickly as possible what it might mean for the world. We posted our first piece – a 'hot topic' summary – on the OPMCSA website on 22 January, just as the WHO confirmed human-to-human transmission and the Ministry of Health started issuing daily situation reports across Government.

Two days later, the Ministry of Health assembled the initial Interagency Pandemic Group, and a flurry of activity ensued. While Wuhan went into lockdown (with 571 official cases and 17 reported deaths), the Aotearoa government established a Coronavirus Watch Group and activated the Officials Committee for Domestic and External Security Coordination (ODESC), on which Juliet sits, as soon as a public health emergency of international concern was declared by the WHO .

"There is early evidence that the crisis has engendered a greater trust in science and scientists among Aotearoa's public"

The situation continued to deteriorate in Wuhan. On 30 January, New Zealand nationals in Wuhan boarded a repatriation flight from the virus epicentre bound for home. At the time, this felt like a big, complex decision and a challenge to ensure the safety of both travellers and people on Aotearoa shores. But the situation continued to escalate, and the Ministry of Health continued to gear up. Border closures, including Aotearoa's restrictions

Above left: Juliet, the Rt Hon Jacinda Ardern, Prime Minister, and Dr Michelle Dickinson sat down for a Q&A video, viewed more than 1.8 million times, as the pandemic began to take off. **Above right**: Prime Minister Jacinda Ardern holds a graphic by Associate Professor Siouxsie Wiles and Toby Morris to illustrate the concept of "flattening the curve".

on travel from China, began to put pressure on our economy but proved vital pillars of the health response.

Next, New Zealanders aboard the virus-afflicted cruise ship *Diamond Princess* were brought home and quarantined. This was quickly followed by Aotearoa's first confirmed case of COVID-19, an arrival from Iran.

Attention shifted to Italy, where the world's worst fears crystallised. Aotearoa's science communicators were busy explaining what the bottom of an exponential curve looked like. All the preparation was quickly put into effect as the previously unthinkable became the inevitable – and then became urgent. Twenty-two days after our first case, with our total cases at 102, Aotearoa went into lockdown.

Our role in the COVID-19 response

Juliet and the team were involved in the pandemic response from the start, working very closely with Professor Ian Town, Chief Science Advisor for the Ministry of Health. The OPMCSA role focused on connecting nationally and internationally, staying abreast of rapidly evolving science developments globally, and advising key decision makers across Government to address the developing emergency. Juliet regularly spoke with Prime Minister the Rt Hon Jacinda Ardern to keep her abreast of the evidence and support communication of the science – with its certainties and uncertainties – as the world learned more about the virus.

Juliet's role was not as a subject matter expert on COVID-19 or infectious diseases. Rather, it was to connect with the experts, interpret their knowledge, work with them and lift their voice within the government to develop trust and understanding of key scientific insights. This supplemented the official advice through the Technical Advisory Group to the Ministry of Health.

Ka mate te kāinga tahi, ka ora te kāinga rua

As the pandemic progressed, the OPMCSA team, boosted by interns, scanned and summarised the growing tide of international literature, developing resources to be at the ready for when specific questions were raised under urgency. International information from big data sites such as Johns Hopkins University and Worldometer was synthesised with information from other sources, such as country health departments, and insight from the international community of chief science advisors. This was then broken down into easy-to-read charts showing what happened when. When the Prime Minister and Ministers asked a question, it was vital to have advice that was solidly backed and easy to follow for rapid decision making.

While this hive of activity continued behind-the-scenes, the best people to convey the science to the public were the experts. We commend Associate Professor Siouxsie Wiles, the Science Media Centre, Dr Michelle Dickinson, Professor Shaun Hendy, Professor Michael Baker, Dr Ayesha Verrall and many other colleagues. They were beacons of clear science communication among the reckons of armchair experts.

Juliet also gave some detailed interviews – available on our website – explaining the evidence base for key decisions. All this supplemented the excellent official advice from the public service, communicated brilliantly via the Director General of Health Dr Ashley Bloomfield – himself a subject matter expert in public health. Ian Town provided a critical connection between the science advice and public health advice throughout the response.

We won't know how well Aotearoa has come through this pandemic for some time, but at the time of writing, we have eliminated COVID-19 with the sad deaths of 22 individuals. The government has been widely supported for its evidence-based approach to a public health crisis. There is also early evidence from the New Zealand Attitudes and Values Survey that the crisis engendered a greater trust in science and scientists among Aotearoa's public – a trend not necessarily observed worldwide.

See our work on COVID-19 on our website

Above: Professor Ian Town, Chief Science Advisor to the Ministry of Health.

THE MAGNIFICENT 7

Science heroes of the pandemic

The Covid-19 crisis has brought some of New Zealand's top science experts to the fore, some already well known, and some less so. Science reporter **Jamie Morton** profiles seven of them

Dr Ashley Bloomfield

1

We typically think of public servants as bland, square and more about policy than personality.

That makes the love affair the country has developed with the man they call The Curve Crusher all the more fascinating.

Even after becoming director general of health in June 2018, Bloomfield had been relatively unknown to the public. The father of three came from the clinical frontline, spending much of the 1990s as a public health specialist. The path to the top job included stints as the ministry's chief public health adviser and head of the Hutt Valley and Capital and Coast DHBs.

Then came Covid-19. In early February, Bloomfield was pushing the Government to expand its limited travel ban. But it was the 1pm briefings that thrust him into the limelight. Kiwis were reassured by his savoir-faire – something less surprising to colleagues who knew him as measured, methodical and hyper-competent.

For many, admiration gave way to adoration, and Bloomfield, 54, found himself the unlikely subject of fawning TikTok videos, media stories and fan accounts on Twitter. As ex-PM Sir Geoffrey Palmer put it: "It is a long time since a public servant has become so well-known."

Professor Juliet Gerrard

2

Barely a year and a half into her tenure as Prime Minister Jacinda Ardern's chief science adviser, Gerrard faced her biggest challenge.

The University of Auckland biochemist was tasked with helping the PM keep up to date on Covid-19 science – as fresh studies rolled in and new evidence emerged.

"My approach is to draw on as many science voices as possible," was how she explained her role to the *Herald*. "I'm not setting myself up as an expert but the pathway to experts."

The job has also been public-facing – and that hasn't always been easy: "People do get very energised – that's the nicest way of putting it – and my inbox does fill up with some quite strident opinions."

Still, she said there was evidence to suggest Kiwis already had a high level of trust in experts before the crisis – and the Government had "huge social and cultural licence" to follow advice and act.

Gerrard has been happy to give her take on those steps, saying that while a centralised data management system would have been good, she generally agreed with international praise of New Zealand.

"We still need to be vigilant, but it is hard to imagine that we could have been in a better position at this stage."

Professor Michael Baker

3

Baker was one of the first in New Zealand to realise the world had a crisis on its hands.

The Otago University epidemiologist was just back from Christmas break when he began receiving unusual reports of pneumonia out of China. By January, it was clear what was unfolding, and Baker was urging the Government to be more proactive.

He's now calling for "mass-masking" on crowded trains and buses, and a new dedicated agency.

A physician and one-time environmental activist, Baker has been a consistent and articulate voice for public health on everything from campylobacter contamination in chicken, to the threat that polluted rivers pose to drinking water.

But he described the two weeks he spent trying to lobby policy staff and politicians to stop treating the coronavirus like the flu as the most "intense and surreal experience of my working life".

"It also became clear that we didn't have enough systems in place to stop the virus, so I began advocating for a lockdown to give us a chance at elimination."

On the day Ardern said we were moving to level 4, he wept with joy.

Associate Professor Siouxsie Wiles

4

She's New Zealand's greatest science communicator – and Covid-19 proved her time to really shine.

Wiles' efforts to break down Covid-19's complexities have been stunning and relentless.

A microbiologist who specialises in infectious diseases, Wiles is set apart by her signature pink hair. She leads the University of Auckland's Bioluminescent Superbugs Lab, while also working on finding new antibiotics by screening 10,000 New Zealand fungi for possible medical use.

Along with teaching, Wiles has found time to be the most accessible voice of science throughout the pandemic.

"Because I've been doing science communication ever since I came to New Zealand, in many respects I've been training for this role for the past 10 years – blogging and podcasting, making kids' TV shows and building a skillset to communicate complex things."

"That is really needed right now and my family make it possible for me to do it. I'm good at multi-tasking, but I wouldn't be able to do what I'm doing if I had younger children or a partner who couldn't pick up the slack."

Professor Shaun Hendy

5

Three years ago, researchers at Te Punaha Matatini, then a freshly formed centre of research excellence, started looking at whether they'd be able to effectively map the spread of flu using cellphone data.

It was a hypothetical exercise, but one they didn't realise would help prepare them for a crisis that would bring their modelling expertise to the fore.

Its leader, prominent physicist Hendy, and his colleagues were swiftly able to offer policymakers a look at the scenarios we might soon face. The worst-case scenario then was grim, projecting up to 80,000 Kiwis could die if strict measures weren't used and Covid-19 ran riot.

By April 9, New Zealand's lockdown had headed off the outbreak – and Hendy's team showed that, instead of 29 new cases that day, there could have been 200.

Hendy ran this operation from the kitchen table of his Grey Lynn home throughout the lockdown: his desktop, laptop and iPad screens set up before him. He was fortunate to have with him top researchers such as Michael Plank, Rachelle Binny, Alex James, Nic Steyn and Audrey Lustig, but also years of experience as a leading science communicator. Hendy has been a frequent face in the media and authored several books.

Dr Ayesha Verrall

6

Articulate, honest and open – they're all qualities that define another of the pandemic's most-visible epidemiologists, Otago University's Verrall.

The infectious-diseases doctor was also one of the most vocal experts about New Zealand's ability to manage the pressures of Covid-19, particularly when it came to our early feeble contact tracing capacity.

On March 17, 12 cases had been identified out of 125 already in the country – and there was only capability to trace 10 active cases.

The next week, in an Otago University release, Verrall called for an urgent and massive scale-up. She knew the public health units didn't have enough staff to stay ahead of a major outbreak, and had previously tried unsuccessfully to have that changed.

In April she carried out an audit for the Ministry of Health, which picked up most of her recommendations, including that New Zealand should be able to handle 1000 cases.

"Not everything is perfect but things are manageable now. I started out thinking there were problems with everything – the border, the testing and case-contact management, and the physical distancing. Now we're just talking about nuance with all of those things."

Asked about the publicity that had come with advocating improvement, she said there were times she felt like turning off her phone: "But it felt very important to spend a lot of time explaining both contact tracing itself and the changes that needed to happen."

Sir David Skegg

7

The *Herald*'s Derek Cheng called Skegg a "hurricane of fresh air" when he took our leadership to task over their handling of Covid-19.

Before Parliament's Epidemic Response Committee in late March, our pre-eminent epidemiologist was a commanding presence, bluntly telling officials it was make-or-break time.

"If we don't eliminate it in the next few weeks," he said, "the shutdown will continue for many months, or we will have a series of shutdowns that will paralyse our society for a year or 18 months, and it will never be the same again".

He chastised them over everything from tracing and testing to border measures and strategy.

It wasn't just a case of speaking truth to power, but a refreshing change to careful government messaging that would convince Kiwis that all was fine. His arguments resound all the more strongly because he is immensely respected in public health and in science more widely.

A former chair of the Health Research Council, the Science Board and the Public Health Commission, a former president of Royal Society Te Apārangi, former vice-chancellor of Otago University, and a former consultant to WHO, Skegg has never shied from being brutally forthright about New Zealand's public health failings.

"There is no longer a critical mass of public health expertise in the Ministry of Health," he wrote in his 2019 book, *The Health of the People*.

"The vacuum of leadership must be addressed without delay."

Top: quiet motorways in Tāmaki Makaurau during lockdown.

Above: artwork by Brianna Ng, 12 years old.

Left: article in the *New Zealand Herald* by science journalist Jamie Morton, profiling several of the scientists who contributed to Aotearoa's pandemic response.

WHAT WE DO

Science in emergencies

With the PMCSA and members of the Chief Science Advisor forum regularly called on to provide advice during unexpected and rapidly evolving situations, developing a framework for response has become a key focus of the OPMCSA this year.

Principal Advisor Dr Susie Meade has been active in the 'science in emergencies' space, visiting the UK to take part in a scenario planning exercise with the Scientific Advisory Group for Emergencies (SAGE). While there, Susie also met with Professor Virginia Murray, the head of Global Disaster Risk Reduction at Public Health England, and Dr Marsha Quallo-Wright, the deputy director for floods, water and CBRN (chemical, biological, radiological and nuclear) emergencies at the Department for Environment, Food and Rural Affairs. Virginia later visited Aotearoa and met with Juliet as well as Ian Town.

Fighting fire with fire

In the wake of the tragic Australian bushfires, the international science advisor community started to connect on the topic of bushfires. To strengthen connection to our local expertise, things got a little heated for Susie in early March, when she travelled to Rakaia Gorge in Canterbury to spend the day with the Scion Rural Fire Research group.

The Scion team, led by Dr Tara Strand, was conducting a research burn – the second in a series of three burns aiming to investigate a theory of wildfire spread. The research, an international collaboration, is examining the role of convective heat transfer through a trilogy of highly controlled fires: the first in cereal crop stubble, the second (this one) in gorse scrub, and the final in wilding pine forest to be carried out in 2021.

While the scientists collected data, Fire and Emergency New Zealand (FENZ) staff and firefighters were onsite too. The FENZ team burned comprehensive perimeter firebreaks and continued to monitor the site for 24 hours post-burn.

Involving FENZ allows rapid uptake of knowledge discovered by the researchers into real-life practice, and dialogue that can inform the research that best meets FENZ's needs. Research burns are useful exercises for firefighters (both staff and volunteer) to watch and respond to a real fire on a reasonable scale without the pressures of an emergency response.

In Aotearoa, wildfires burn through around 6000 hectares, directly costing more than $100 million annually.

It will take the team around six months to gather data collected during the research burn, before they prepare for the wilding pines experiment in 2021.

We thank Tara and the Scion Rural Fire Research group for hosting Susie and enabling us greater insight into wildfire research in Aotearoa.


scion
Fire Research

EQUITY, DIVERSITY & INCLUSION

Accelerating Māori in STEAM

Moving away from competition, colonisation and fragmentation towards contribution, mana ōrite and whanaungatanga – from mātauranga at the periphery to mātauranga at the core.

An important focus for the past year has been building a bridge between the science advisory system and te ao Māori to support the acceleration of Māori in STEAM (science, technology, engineering, the arts and maths). Juliet, Professor Tahu Kukutai and Professor Gary Evans MNZM led this for the Chief Science Advisor Forum.

We were fortunate to have the engagement and collective thinking of more than 100 Māori leaders, researchers, rangatahi and policymakers to build the foundations for this work. This occurred over two hui. The first was a two-day Vision Mātauranga Leadership hui held on 30-31 October, convened by Rauika Māngai at Te Wai o Horotiu Marae. The second was focused on transforming the future of Māori in STEAM, hosted by Tahu and Dr Jessica Hutchings at Waipapa Marae on 19 November.

The voices and ideas heard at these larger hui were brought together and shared at a third, smaller hui with the Hon Dr Megan Woods, Minister of Science, Research and Innovation, on 11 December. Representing the collective thinking of the wider group, Jessica, Tahu, Michael Ahie, Reece Moors, Holden Hohaia, Naomi Manu, Melanie Mark-Shadbolt, Nikora Ngaropo, Kirikowhai Mikaere, Te Taiawatea Moko-Mead and Marie Cocker met with Minister Woods. Juliet was hugely disappointed to miss the hui as she was in the bunker supporting the science response to the Whakaari eruption, but it was expertly facilitated by Michael Ahie in her absence. Gary, Dr Prue Williams, Dr Susie Meade, Carolyn Tremain and Sarah Townsend were generously welcomed as guests.

In the months following the hui with Minister Woods, the ideas were tested and refined. A consensus view was reached: there is a clear path forward to enable Māori to participate equitably in and lead a STEAM-focused future. There are actions and opportunities that, if implemented, would be effective in building a new generation of dual knowledge navigators. For example, we know there are numerous Māori-led initiatives and ropū already underway to support this kaupapa. Identifying these and ensuring they have adequate support to continue is crucial to their success. Changing the perception of science and technology at an early age will also make a significant difference to engaging rangatahi in these fields.

We thank Minister Woods for her enthusiastic engagement and support of this kaupapa, including in the 2020 Budget. Many thanks also to the Māori research community for their enormous energy and time given during 2019.

Ki te kāhore he whakakitenga ka ngaro te iwi

Other actions and opportunities stemming from this work, along with a vision of what success would look like, are available on our website.

Read the vision for success online

Top left: Attendees at the 11 December hui on Accelerating Māori in STEAM, chaired by Michael Ahie and led by Professor Tahu Kukutai, Dr Jessica Hutchings and Professor Gary Evans MNZM, with special guests the Hon Dr Megan Woods, Minister of Science, Research and Innovation and Carolyn Tremain, the Chief Executive at MBIE.

Bottom right: participants in the 19 November hui at Waipapa Marae.

EQUITY, DIVERSITY & INCLUSION

Mātauranga and science

Embracing a vision, crystallised in a special issue of *New Zealand Science Review*, where mātauranga flourishes again and creates collective benefit.

Towards the end of 2019, the *New Zealand Science Review* dedicated a special issue to Mātauranga and Science in Practice. Juliet and Professor Tahu Kukutai, a member of the CSA Forum, were honoured to co-author a foreword pondering the interface of Aotearoa's two knowledge frameworks. The foreword is reproduced here with permission.

Foreword by Juliet and Tahu

It is our great pleasure to write the foreword to this special issue of *New Zealand Science Review*, which is the first of two dedicated to Mātauranga and Science in Practice. These landmark publications provide a timely contribution to ongoing dialogue about what a distinctively Aotearoa science system should look like, informed by the research and experiences of those working at the nexus of mātauranga and science. There is much to learn from them.

Like many other countries, Aotearoa is confronted with enormous environmental, societal and technological challenges that require our scientists and researchers to go beyond the ordinary. Māori are often at the pointy end of these challenges but are unlikely to be in positions of power to define and drive responses. This needs to change. We need multiple ways of thinking, knowledge systems and approaches to understand and respond to complex challenges including climate change, food insecurity, biosecurity, health inequities, poverty and the disruptive impacts of digitalisation. This means investing in our comparative advantages, making the most of the opportunities that they present, and enabling communities to contribute to solutions.

The interface of science and Indigenous knowledge is an obvious area where Aotearoa is genuinely unrivalled. Mātauranga Māori – defined as Māori knowledge, Māori methods of knowledge creation and Māori ways of knowing (Mercier & Jackson, this issue) – is the Indigenous knowledge system of this land. Mātauranga has survived and evolved as a dynamic and generative knowledge system despite extensive efforts to expunge it through legal, social and political means (Simon & Smith, 2001; Smith, 1999; Ward, 1995). The vision, crystallised in this issue, is for mātauranga to flourish again and to create collective benefit in ways that are context appropriate and acceptable to Māori.

We have solid foundations on which to build. The significance of mātauranga in the Aotearoa science system, including through the Vision Mātauranga policy (MBIE, 2018), has few parallels in other countries. Thanks largely to the incredible commitment of Māori leaders, there are significant cohorts of Māori PhDs and sufficient Māori Principal Investigators to 'fill an Air New Zealand Airbus

"We need multiple ways of thinking, knowledge systems and approaches to understand and respond to complex challenges including climate change, food insecurity, biosecurity, health inequities, poverty and the disruptive impacts of digitalisation."

A320' compared to a telephone box 20 years ago (Ruru et al., this issue). The achievements of Ngā Pae o te Māramatanga in this regard is stellar, with hundreds of Māori PhD graduates emerging from this Centre of Research Excellence. Increasingly, Māori researchers operate comfortably in two or more knowledge systems and are adept at interfacing mātauranga with diverse disciplinary knowledge. Working across knowledge systems requires an intellectual flexibility that provides a space for innovative thinking to 'expand the intellectual scope of our nation' (Walker, 2005). The papers in this issue that describe efforts to build capacity and capability are inspiring, emphasising the focus on ensuring veracity and rigour as part of teaching practice. It is a pleasure to see the mātauranga-science interface blossom with a focus on the future. The Prime Minister is personally supportive of this kaupapa and is supporting two internships to undertake a future-focused project centred on Te Tairāwhiti.

However, as this issue reminds us, there is still much to do. One of the barriers is an inadequate understanding of mātauranga within the broader science community. The question of whether there is such a thing as 'Māori science' pops up from time to time and the ensuing debate is often less than constructive. The measured account of this debate from Georgina Tuari Stewart and her answer: 'there is no right or wrong answer to the question of Māori science and the question can never, therefore, be considered fully settled' is both insightful and challenging. It challenges readers to be comfortable with incommensurability, provides a useful way of coming to that conclusion and inspires exploration of the interface of orthogonal

"Scientists may get further by stepping off their self-appointed pedestal and listening to other views and other ways of knowing in order to retain and regain societies' trust."

Left: Juliet visited Te Reureu Valley in July 2019 to understand how science and agritech might support the local hapū.

knowledge systems. Here it is instructive to reflect on Tā Mason Durie's (2005) observation that, just as Indigenous knowledge cannot be verified by scientific criteria, nor can science be adequately assessed according to the tenets of Indigenous knowledge. Rather, 'Each is built on distinctive philosophies, methodologies and criteria'. Contests about the validities of the two systems distract from 'explorations of the interface, and the 'subsequent opportunities for creating new knowledge that reflects the dual persuasions' (p. 2).

Tuari Stewart's paper underscores the inherent power imbalance between mātauranga and science, and the wrongheaded sentiment that one has to claim features of the other in order to gain legitimacy and resource. It also cautions against a reductionist approach that would view mātauranga solely as an 'input' into science solutions, or as supplementary to 'real' scientific knowledge (Broughton & McBreen, 2015), which detracts from the opportunities that solving problems using dual knowledge systems might provide.

This issue also shows how much science has to learn from mātauranga and kaupapa Māori approaches. The latter approach of embedding practice in society and grounding the project in a community of acceptance before it starts, is the very model of ensuring impact and connectivity. Often those trained in Western traditions, however fine, struggle to grasp this until it is perhaps too late. How many technologies will be developed in isolation before we learn that we need to engage our publics sooner, not later, to make sure there is cultural license to proceed? To turn the tide on anti-science sentiment we need to reframe our science as 'here to serve', and 'here to listen'. Science in Aotearoa, and indeed the world, has much to learn from Māori ways of doing, as well as ways of knowing, to bridge these divides. The Hepburn paper describes this beautifully in their comparison of scientific process and community-led decisions. And this blurring of benefit, participation and knowledge is eloquently described in Ruckstuhl and Marti's piece. Those trained in Western traditions

Jessica Hutchings, Tahu Kukutai and Juliet at a hui focused on transforming the future of Māori in STEAM in 2019, held at Waipapa Marae.

might dismantle this way of working as not 'pure', hypothesis-driven science, but this unpicking presents no advantage for understanding and harnessing a knowledge system that was not designed as such, and has no desire to meet this particular abstract, (and yes, undeniably powerful in other contexts) ideal. Why not see what advantages it might bring to the practice of using knowledge to make te ao hurihuri better for all? Why not complement science's great reductionist strength with more holistic thinking, and see what we find at the interfaces? In short, scientists may get further by stepping off their self-appointed pedestal and listening to other views and other ways of knowing in order to retain and regain societies' trust. In so doing, let's make the most of our excellence in 'arguably one of the newest research fields on the block, albeit with ancient veins' (Smith, 2018, p. 22).

Finally, we wish to thank the Editors Ocean Mercier and Anne-Marie Jackson for the opportunity to reflect on this special issue. As remarkable wāhine Māori working at the mātauranga-science interface, both have worked tirelessly to uphold the mana of mātauranga in a system that has often been less than welcoming. This impressive collection of papers is a testament to those efforts.

Read the NZSR special issue on Mātauranga and Science online

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WHAT WE DO

Legalising cannabis: What does the evidence say?

Ngā mihi maioha ki te rōpū nei. He kaupapa whakahirahira, hei whakarongo ki te whakakotahi o ngā whakaaro kē.

When we head to the polls for the 2020 election, we will also decide whether to legalise the recreational use of cannabis or continue to prohibit its use.

To inform this decision, it's important to have accessible information from trusted sources on cannabis use and impacts. This is where we come in: the Prime Minister asked Juliet to assemble a panel of experts and develop a suite of evidence-backed information for the public – not to make recommendations on how people should vote, but to support the decision.

The topic is complex and multifaceted. We need to consider the wide-ranging impacts of changing the law – from health-related harms associated with cannabis to social outcomes and the criminal justice system. We also need to acknowledge that the current law disproportionately harms Māori and pay attention to how a law change would impact tangata whenua.

Juliet was joined by Professor Tracey McIntosh (an expert in social justice and the new Chief Science Advisor to the Ministry of Social Development) to co-chair a panel that included nine other researchers and clinicians. The panel members have deep knowledge spanning the health, social, legal and policy implications of cannabis law reform. We were lucky to have strong Māori and Pacific expertise on our panel to provide a much-needed focus on these communities. The panel met four times and provided a rich collection of local and overseas evidence that formed the basis of the public-facing material.

A communication challenge

It is essential to communicate that, despite being illegal, cannabis is out there and its use is common. For most users, cannabis doesn't cause harm. But for some it does. The vote isn't about whether individuals agree with cannabis use or not – because people will continue to use it regardless of the referendum outcome. Rather, it's about whether they believe that a regulated framework will reduce or increase cannabis-related harm.

To support this framing, we drew on two main bodies of evidence – the evidence that tells us what is currently happening here in Aotearoa as a result of cannabis prohibition, and the evidence that tells us what has happened in places that have already legalised recreational cannabis. The overseas examples, including Canada, Uruguay and some states in the US, give us clues about the possible impacts of legalisation in Aotearoa. However, the evidence is uncertain – reflecting the short time since changes were made and the different regulatory approaches. The Aotearoa experience would depend on our unique environment and approach. Our summary highlights how overseas regulations align to the draft legislation released by the Ministry of Justice on 1 May 2020.

Helping people decide

We have released a comprehensive summary of the evidence around cannabis legalisation on our website. It includes:

- an explanation of our current laws and why we are considering legalisation
- an 'at a glance summary' of what it might look like if we vote 'yes' or 'no' to legalising cannabis
- detailed FAQs that address a range of issues related to cannabis legalisation
- overseas case studies of cannabis law reform
- further reading for a deeper dive into certain issues
- links to key cannabis articles in the news
- more detail about our panel members

Read the summary 'Legalising cannabis: What does the evidence say?' on our website

Meet the panel

- Professor Tracey McIntosh MNZM (Co-chair), University of Auckland
- Professor Joseph Boden, University of Otago
- Dr Hinemoa Elder, University of Auckland
- Professor Benedikt Fischer, University of Auckland
- Professor Michelle Glass, University of Otago
- Associate Professor David Newcombe, University of Auckland
- Associate Professor Khylee Quince, AUT
- Professor Doug Sellman FRANZCP, University of Otago
- Associate Professor Tamasailau Suaalii-Sauni, University of Auckland
- Associate Professor Chris Wilkins, Massey University

with support from Dr Michelle Sullivan.

WHAT WE DO

Fishing in Aotearoa New Zealand

Something fishy has been going on in the Office, as the team dives into the complexities of fisheries science.

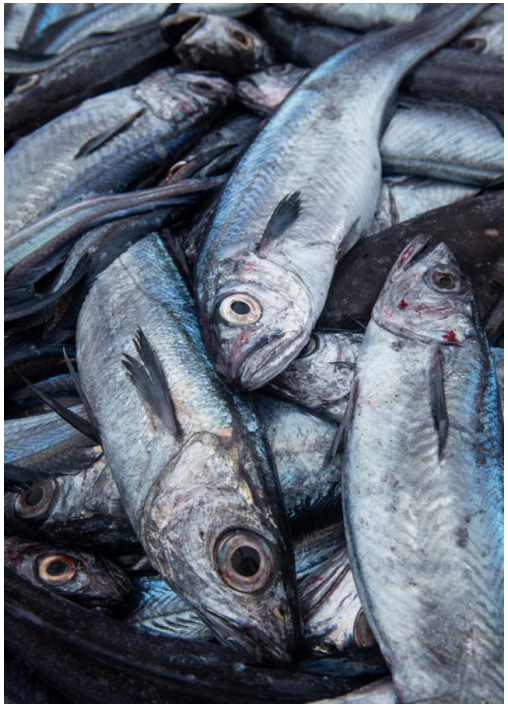
Aotearoa's fisheries are a significant economic, cultural, social, and ecological natural resource. Maintenance of this resource and respect for our taonga species requires management that ensures sustainability of fisheries stocks and the wider marine ecosystem. As technology has developed and international and national attention turns towards integrated management systems that combine the best of quota management with protection of ecosystems, Aotearoa has an opportunity to lead with innovative approaches.

We are currently undertaking a project that seeks to support this goal. The aim of the project is to develop a vision for 2040 that harnesses our best science, technology and data management tools to put us at the forefront of commercial fishing. We will also help identify ways to reduce the gaps in data and knowledge in the fisheries sector to chart a path along this journey. This is important to ensure that fishing is being undertaken sustainably and to meet Aotearoa's commitment to taking a more integrated approach to fisheries management, which includes consideration of the wider environment and its inhabitants.

The research builds on work undertaken by the Parliamentary Commissioner for the Environment in their review of our environmental reporting systems in 2019. The report commented that:

> "Current fisheries management systems… rarely take into account the effects of fishing on the wider ecosystem."

The project has convened an expert panel which seeks to identify innovative technologies and methods that can be applied to fisheries to achieve these goals. The report will contain recommendations on how Aotearoa can move towards a vision for a modernised, data-driven approach to efficient and effective fishing which preserves this resource for future generations.



Hoki (*Macruronus novaezelandiae*) by Rebekah Parsons-King/NIWA.

Meet the panel

- Craig Ellison (Co-chair), Seafood New Zealand and more
- Dr Chris Cornelisen, Cawthron Institute/ Sustainable Seas
- Livia Esterhazy, WWF-New Zealand
- Dr Rosemary Hurst, NIWA
- Dr Andrew Jeffs, University of Auckland
- Anaru Luke, Cawthron Institute
- Raewyn Peart, Environmental Defence Society (not pictured)
- Professor Michael Plank, University of Canterbury
- Dion Tuuta, Te Ohu Kaimoana
- Dr Maren Wellenreuther, Plant & Food Research/University of Auckland

The aims of the panel are to:

- Reduce the gaps in data and knowledge, and improve data accessibility, in the commercial fisheries sector.
- Identify ways to help ensure that fishing is being undertaken sustainably.
- Consider the wider environment, ecosystem, and its inhabitants; and
- Help Aotearoa commit to a more integrated approach to fisheries management.

Keep up with the latest fish news on our website

WHAT WE DO

What were they thinking?

A discussion paper presents the evidence for the over-representation of people with brain injuries in Aotearoa's criminal justice system.

The report is the fourth in a series on criminal justice issues prepared by Professor Ian Lambie, Chief Science Advisor for the Ministry of Justice. Released in late January by the OPMCSA, the paper outlines the prevalence of brain injuries and disorders among both victims and perpetrators.

These neurological differences – such as concussion, ADHD and autism spectrum disorder – pose unique challenges for the criminal justice system. Ian poses the question, "If either a victim, witness or offender cannot concentrate, process information, hear or grasp basic concepts – let alone deal with stressful questioning or court proceedings – we have to wonder: is fair and smart justice being delivered?"

This challenge is epitomised by the high-profile case of Teina Pora, whose Fetal Alcohol Spectrum Disorder led him to confess to a crime he did not commit. Ian argues that this is simply the tip of the iceberg.

Ian also offers general solutions and ways the system can improve, including increased community awareness and earlier intervention for children and young people with brain and behaviour issues.

The report generated media coverage across multiple publications, including *Stuff* and *RNZ*.

Ian is a professor of clinical psychology at the University of Auckland. His specialist clinical and research interests are in child and adolescent mental health, childhood trauma and youth justice.

The criminal justice report series also includes:

- Every four minutes: A discussion paper on preventing family violence in New Zealand
- It's never too early, never too late: A discussion paper on preventing youth offending in New Zealand
- Using evidence to build a better justice system: The challenge of rising prison costs.

Visit our website to download the criminal justice reports

Professor Ian Lambie, Chief Science Advisor for the Ministry of Justice.

WHAT WE DO

Internship and fellowship programme

Building links between science, research and policy.

After a successful pilot period, our internship programme has expanded to encompass fellowships for seconded researchers. Nineteen interns and fellows have completed or are working on various projects: from environmental wellbeing to science outreach to COVID-19.

We gratefully acknowledge the MacDiarmid Institute for Advanced Materials and Nanotechnology for funding seven internship placements.

We also thank the Dodd-Walls Centre for Photonic and Quantum Technologies for funding two internship placements.

Thank you also to the Prime Minister who generously funded two Tairāwhiti internship placements (yet to be commenced) though the Prime Minister's Emerging Priorities Fund.

This support is instrumental in our mission to strengthen the research-policy interface in Aotearoa.

Read more about internships and fellowships

The MacDiarmid Institute for Advanced Materials and Nanotechnology

Dodd-Walls Centre for Photonic and Quantum Technologies

Science outreach and education

Abi Thampi is a PhD candidate at the University of Auckland's Department of Physics, researching optical coherence tomography to study the quality of biological tissues. His project is exploring best practice monitoring methods to evaluate the impacts of science education and outreach programmes. This knowledge would help organisations evaluate outcomes of their outreach more effectively, and ultimately, lead to policies that increase the impact of outreach and education programmes.

Dr David Pomeroy, a mathematics education lecturer at the University of Canterbury, is also working on an education project for the OPMCSA – specifically, mathematics education. With the guidance of Professor Stuart McNaughton, the Chief Science Advisor for the Ministry of Education, David is producing a synthesis of research about achieving equity and excellence in mathematics education. He draws on his experience teaching high school mathematics and his PhD research into socioeconomic, ethnic and gender inequalities in Aotearoa Year 9 maths.

Environment and wellbeing

Dr Anne-Gaelle Ausseil is a researcher at Manaaki Whenua – Landcare Research, where her work focuses on land use and climate change impacts on biodiversity and ecosystem services. For her fellowship project, Anne-Gaelle is working with Dr Alison Collins, the departmental Chief Science Advisor at the Ministry for the Environment. She is exploring different frameworks that connect humans' wellbeing and the environment. In December 2019, Anne-Gaelle and Alison published a summary of various government initiatives that link environmental quality with wellbeing.

Casey Spearin's intern project was also in the environment and wellbeing space. With a background in conservation and science education, Casey is completing a Master's degree in Science in Society at Te Herenga Waka – Victoria University of Wellington. Supervised by Anne-Gaelle and Alison, Casey investigated initiatives linking environment and wellbeing through the lens of cultural health indicators – diverse recreational, educational, spiritual and social benefits derived from healthy ecosystems.

COVID-19

In the wake of the pandemic, the MacDiarmid Institute supported two placements for interns to synthesise evidence and emerging research on COVID-19. **Stephen Lo**, a PhD candidate in chemistry at the University of Auckland, produced a summary on seasonality and tracked different interventions being implemented worldwide to stop the spread. **Cherie Tollemache**, a PhD candidate in chemical sciences at the University of Auckland, investigated the potential link between vitamin D and severity of COVID-19 and summarised the evidence for SARS-CoV-2 infection in animals such as cats and dogs.

Insect decline

Dr Jono Barnsley completed his PhD in physical chemistry before embarking on an internship investigating the "insect apocalypse". Working with the chief science advisors for the Ministry for Primary Industries and the Department of Conservation, Jono researched the state of biodiversity monitoring efforts both nationally and internationally and assessed the evidence for insect decline in Aotearoa. Jono was interviewed on *RNZ* about this work. After his internship, Jono spent time at StatsNZ before joining MPI in a policy role.

Artificial intelligence

Fang Ou, a PhD candidate in physics at the University of Auckland, undertook an internship under the guidance of Professor Stuart McNaughton, Chief Science Advisor for the Ministry of Education. Fang's project analysed the potential impact of artificial intelligence on learning, teaching and education in Aotearoa.

Kyle Webster completed his internship in July last year, scoping the long-term impacts of artificial intelligence on Aotearoa society and policy. He also co-authored an article on *The Conversation* titled 'AI is here to stay. Now we need to ensure everyone benefits'.

Equity, diversity and inclusion

Dr Ankita Gangotra completed her PhD in the Department of Physics at the University of Auckland. For her internship with the Ministry of Business, Innovation and Employment (MBIE), she explored initiatives to improve equity, diversity and inclusion, such as the Athena SWAN accreditation framework and Pleiades Awards. Ankita subsequently pursued a postdoc in the US which enabled her to keep a dual research and policy focus.

Dr Tara McAllister (Te Aitanga ā Māhaki) is a

research fellow with Te Pūnaha Matatini. Her internship, working with MBIE, examined numbers of Māori in science. Tara has published several papers on equity and diversity issues, including 'Why isn't my professor Māori?' in 2019.

Antimicrobial resistance

Ben Jones undertook his internship as part of his science communication studies at the University of Otago. Ben collated resources on antimicrobial resistance, worked with the Ministry of Health for World Antibiotic Awareness Week, and worked on developing a communication framework for future OPMCSA topics.

Photonics

Dr Madhuri Kumari is a postdoctoral fellow in the University of Otago's Department of Physics. For her internship, Madhuri created a map of organisations working within the photonics sector in Aotearoa. Her survey revealed that the current research and business activities related to photonic technologies play key roles in advancing agritech, enabling telecommunications, and empowering manufacturing industries.

Energy

Dr Georgina Shillito completed her PhD in chemistry at the University of Otago, investigating how transition metal complexes interact with light. This neatly dovetailed with her intern project, examining current solar energy use in Aotearoa and evaluating emerging energy technologies and their potential impact on energy use and policy.

Dr Odile Smits is a postdoctoral researcher in nuclear physics. Aside from her interest in the fundamental laws of nature, Odile is keen to apply her knowledge to environmental issues. She explored different ways to distribute and store energy efficiently for transport, with a view to minimising carbon footprints.

Plastics

Associate Professor Duncan McGillivray is a materials science researcher at the University of Auckland. He is currently a visiting fellow at the OPMCSA, investigating nanoplastics – super-tiny particles resulting from the degradation of plastic.

Shinji Kihara submitted his PhD thesis in physical chemistry in June 2020 at the University of Auckland. His research focused on the corona-like structure proteins that form around plastic nanoparticles and assessed their biological impacts. Shinji's internship is examining the regulatory framework for nanomaterials safety in Aotearoa.

Quantum computing

With a background in maths and physics, **Dr Wayne Crump** completed his internship in July 2019, scoping the potential impacts of quantum computing technology on Aotearoa industry and society. Wayne developed an accessible information summary on quantum computing and compiled a list of resources. He is now a postdoctoral researcher in Helsinki, Finland.

Page 36: Abi Thampi and David Pomeroy.

Previous page: Anne-Gaelle Ausseil, Casey Spearin, Stephen Lo, Cherie Tollemache, Jono Barnsley, Fang Ou, Kyle Webster, Ankita Gangotra.

This page: Tara McAllister, Ben Jones, Madhuri Kumari, Georgina Shillito, Odile Smits, Duncan McGillivray, Shinji Kihara, Wayne Crump.

WHAT WE DO

International engagement

International science advisory networks have been especially active this year, as the OPMCSA continues to strengthen overseas ties.

The PMCSA continues to have a primary focus on science here in Aotearoa, but international networks are an important part of connecting our science to the world. This has proved especially true this year.

In July 2019, Juliet did a whistle-stop tour to visit her counterparts in the UK, US and Canada, building relationships that proved vital later in the year. In September 2019, Juliet met with the Forum of Australian Chief Scientists in-person in Adelaide, and again in March 2020 via Zoom in place of the planned meeting in Tasmania. In September 2020, if the trans-Tasman bubble is operational, we hope to host the Forum of Australian Chief Scientists in Aotearoa for the first time.

This year we also connected with senior Australian researchers who are experts in equity, diversity and inclusion (EDI): Professor Lisa Harvey-Smith, Australia's inaugural Women in STEM Ambassador, and Professor Jenny Martin AC FAA. In November, the pair joined a diverse group of women scientists for a dinner co-hosted with the Hon Dr Megan Woods, Minister of Research, Science and Innovation. Lisa and Jenny spent some time in Wellington exchanging information with senior officials to inform our own EDI efforts.

> "This community enabled the best ideas to be used as the basis of advice to governments."

In late January 2020, Dr Susie Meade visited the Scientific Advisory Group for Emergencies (SAGE) in London and observed one of their desktop training exercises. She also had a series of meetings with the SAGE team, met with the Department for Environment, Food & Rural Affairs (DEFRA) to discuss water resilience, and met with Virginia Murray, Head of Global Disaster Risk Reduction, Public Health England. Susie then winged her way across the Atlantic to San Francisco, where she was hosted by Kate MacDonald, the Aotearoa fellow at the World Economic Forum's Centre for the Fourth Industrial Revolution. While there Susie learned about several significant artificial intelligence projects.

These international relationships were extremely helpful during the COVID-19 response. As early as January, the international community of chief science advisors began swapping notes on possible pathways as the outbreak of a new SARS-like disease emerged in Wuhan, China. This community enabled the best ideas to be used as the basis of advice to governments. At the height of our COVID-19 outbreak, Juliet connected with this community weekly on a call convened from the White House.

Top right: Juliet meets with Dr Mona Nemer CM CQ FRSC, Chief Science Advisor to Canada's Prime Minister, Minister of Science and Cabinet.

Middle right: Juliet with Sir Patrick Vallance FRS FMedSci FRCP, UK Government Chief Scientific Adviser.

Bottom right: Juliet with Dr Kelvin Droegemeier (right), Director of the Office of Science and Technology Policy and Science Advisor to the President, and Chris Liddell, the President's Deputy Chief of Staff for policy coordination.

Above: attendees at the women in science dinner, hosted by the Hon Dr Megan Woods, Minister of Research, Science and Innovation, with special guests Professor Lisa Harvey-Smith and Professor Jenny Martin AC FAA from Australia.

FINANCES

2019–2020

Budget estimates plus in-kind contributions.

	1 July 2019 – 30 June 2020	1 July 2020 – 30 June 2021	TOTAL
Funding received from DPMC for operations of the Office under the MoU	795,000	795,000	1,590,000
Funding received from MBIE for operations of the Office under the MoU*	375,000	500,000	875,000
Breakdown of MoU funding			
Salaries/people costs	915,000	1,040,000	1,955,000
Research costs	120,000	120,000	240,000
Operational costs	50,000	50,000	100,000
Domestic travel, Wellington	35,000	35,000	70,000
Other domestic travel	30,000	30,000	60,000
International travel	20,000	20,000	40,000
Total expenses	1,170,000	1,295,000	2,465,000

Honorarium to Juliet Gerrard (this is a direct payment outside the MoU)	50,000	50,000	100,000

The activities of the Office of the Prime Minister's Chief Science Advisor (OPMCSA) operate under a Memorandum of Understanding (MoU) between the University of Auckland and the Department of Prime Minister and Cabinet (DPMC) and Ministry of Business, Innovation and Employment (MBIE). The forecasted expenditure from this contract is included here, for transparency. These are budget estimates, not financial statements. The University of Auckland continues to support the activities of the OPMCSA by providing institutional support, meeting facilities, and access to financial and administrative services. We would like to particularly acknowledge the following key individuals within the University for their support: Louise Brewster, who keeps an eye on our finances; Ranmali Mada in the Office of the Vice Chancellor, who provides a vital link to administrative services; and Rebecca Adams of Uniservices, who has been key to supporting our intern and forum activities in the Wellington office of the University of Auckland. We also thank the DPMC for providing hot desk facilities and general support, in particular Sacha O'Dea and Chris O'Gorman.

The Participatory Science Programme was funded under a separate contract from MBIE and was run in collaboration with MBIE and the broader Curious Minds programme at the Royal Society Te Apārangi. The finances for the Participatory Science Programme programme are not included under the MoU and are not included in the totals. The PMCSA component of the Participatory Science Programme concluded on 31 December 2019.

*The MBIE funding commenced in October 2019.

E tipu e rea mō ngā rā o tō ao
Ko tō ringa ki ngā rākau a te Pākehā hei ora mō tō tinana
Ko tō ngākau ki ngā taonga a ō tīpuna Māori
Hei tikitiki mō tō māhuna
Ko tō wairua ki tō Atua, Nānā nei ngā mea katoa

- *Tā Apirana Ngata*

Click here for more information on the whakataukī in Mahi Tahi 2

Ngā mihi nui
ki a koutou katoa

Annual Report 1 July 2019 – 30 June 2020

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