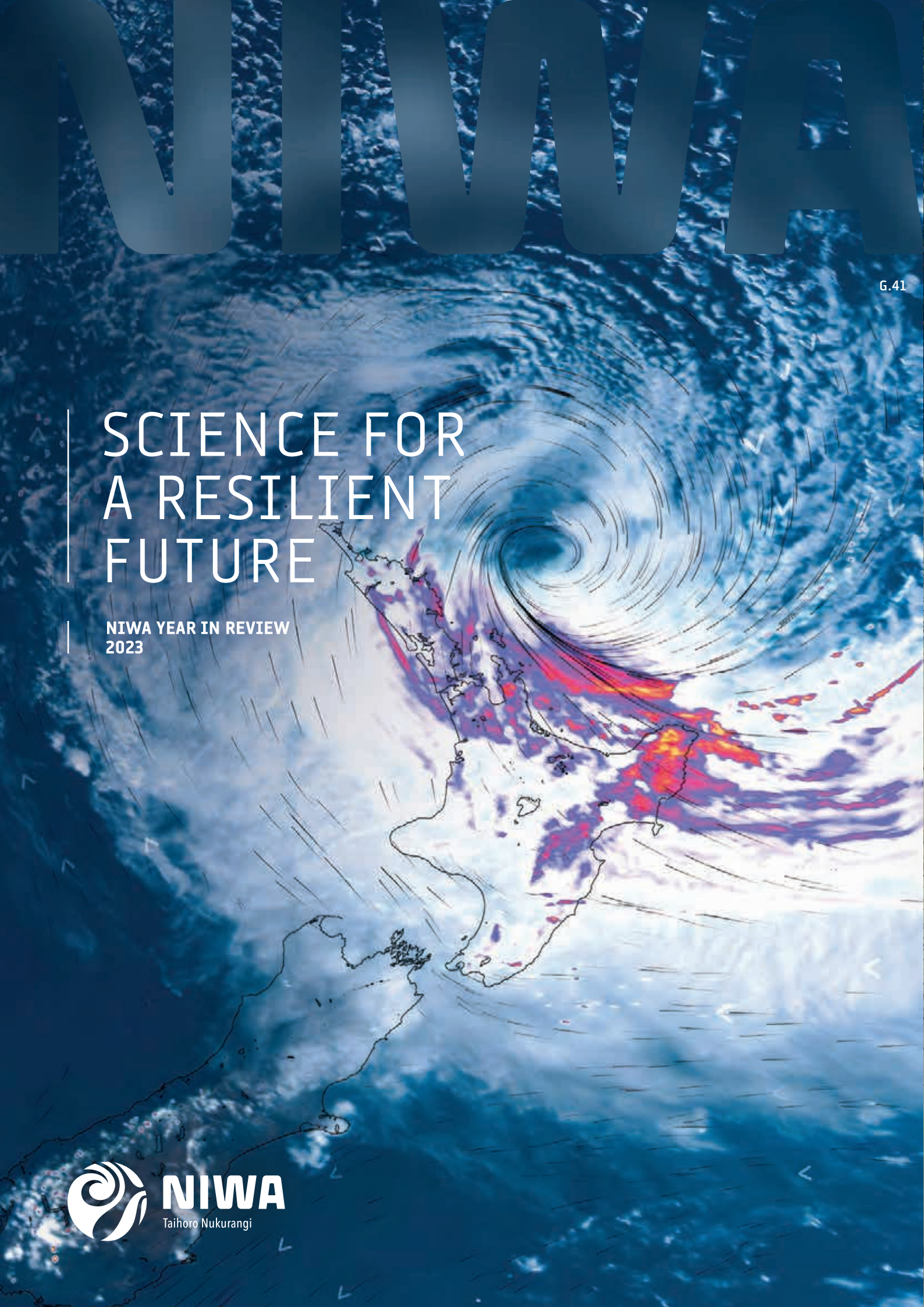

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SCIENCE FOR A RESILIENT FUTURE

NIWA YEAR IN REVIEW 2023

NIWA
Taihoro Nukurangi

NIWA YEAR IN REVIEW 2023

Cover: This is one of the final visible satellite frames of Cyclone Gabrielle on 13 February 2023 before the sun set. NIWA's high-resolution rain and wind forecast is overlaid, and it accurately tracked the cyclone as it approached New Zealand. NIWA models accurately predicted more than half a metre of rain across inland Gisborne and Hawke's Bay. [NIWA]

Inside cover: A Hawke's Bay apple orchard submerged metres-deep in silt after Gabrielle's flood waters had receded. [Rebekah Parsons-King]

OUR SCIENCE

CLIMATE

New Zealand's pre-eminent provider of atmospheric and climate science

- Climate change and variability
- High-precision weather forecasting
- Weather-related hazard forecasting
- Adaptation and mitigation

230 Science staff
New Zealand's largest team of climate scientists

$42M Annual investment
In weather and climate research

6,500 Climate stations
The National Climate Database with information from 6,500 climate stations covering New Zealand, South-West Pacific and Antarctica

$18M Supercomputer
Enabling precise, highly localised forecasts

FRESHWATER

Supporting the sustainable management of our freshwater resources

- Freshwater quality and quantity
- Biodiversity and biosecurity
- Sustainable use
- Flood forecasting

240 Science staff
New Zealand's largest team of freshwater scientists

$40M Annual investment
Increasing knowledge of water quantity and quality

A national flood forecasting service
Providing river flow forecasts for 50,000 catchments nationwide

500 Hydrological monitoring stations
A nationwide network of water and soil moisture monitoring stations

MARINE

Understanding, managing and maximising the benefits of our marine estate

- New Zealand's Marine Estate
- Fisheries stock assessment
- Sustainable use of marine resources
- Biodiversity and biosecurity
- High-value species aquaculture

260 Science staff
New Zealand's largest team of ocean scientists

$67M Annual investment
In coast and ocean, fisheries and aquaculture science

Northland Aquaculture Centre
New Zealand's leading science facility for aquaculture R&D with an experimental Recirculating Aquaculture System to demonstrate the viability of commercial-scale production of high-value species on land

State-of-the-art research vessels
Supporting the New Zealand science community

SCIENCE FOR A RESILIENT FUTURE

NIWA YEAR IN REVIEW
2023

NIWA
Taihoro Nukurangi

FORECASTING IMPACT

CHAIRMAN AND CHIEF EXECUTIVE REVIEW

"We must brace ourselves for more frequent and intense storms in the years ahead".

We wrote that opening message only 12 months ago, for NIWA's last Year in Review. At the time, we were reflecting on 2022's West Coast deluge, when hundreds of people were evacuated to escape record river flows.

But we were not expecting the benchmarks for extreme weather to be reset so quickly.

As Aucklanders geared up to celebrate their anniversary holiday weekend, the heavens opened. On Friday 27 January, catastrophic flash flooding swept across the city. Our meteorologists reported that an entire summer's worth of rain fell in one day. Four people lost their lives. It was the worst flood that Auckland had experienced in living memory.

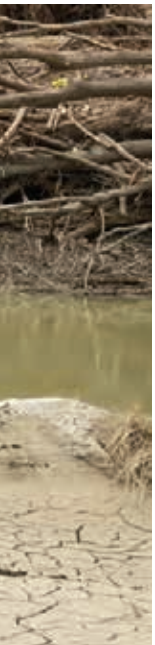
As Auckland's clean-up began and the nation reflected, more trouble was already brewing in the north Pacific. NIWA's Forecasting Services team watched in alarm as Cyclone Gabrielle began to form in the northeastern Coral Sea.

Worried by its size, the team alerted agencies to Gabrielle's progress. A string of briefings followed for Fire and Emergency New Zealand, the Department of Conservation and the Ministry for Primary Industries, with officials from the National Emergency Management Agency and local authorities also sitting in. These briefings were interspersed with ongoing media interviews and updates on social media.

With the cyclone's track still uncertain, our coastal science and river flow specialists added their expertise. Our natural hazards scientists combined coastal storm surge predictions with forecasts for all the possible cyclone tracks. Another group of experts focused on river catchments – pinpointing the areas most likely to be impacted by high river flows by using a new modelling tool that combines rainfall forecasts with a hydrological model.

Other scientists looked at landslide risks. Over the past year NIWA has been working with GNS Science on a pilot study to predict rainfall-induced landslides in Wellington – combining NIWA's near real-time rain forecasts with GNS's land stability data. As Cyclone Gabrielle approached, GNS trialled the tool across much of the upper North Island to create impact forecasts for houses, roads and rail networks. These were shared

Above: Flash flooding in a Mt Albert street after the Auckland Anniversary Weekend deluge. [Stuart Mackay]



Left: Hydrodynamics technician Jochen Bind assesses high water flows in the immediate aftermath of Cyclone Gabrielle. [Rebekah Parsons-King]

with councils, central government and emergency response agencies to inform decisions about evacuations and road closures.

The cyclone hit on Sunday 12 February. An estimated 225,000 homes lost power, sediment buried houses to their rooftops and roads were destroyed. More than 10,000 people were displaced, and the entire city of Napier was cut off for weeks. Sadly, Cyclone Gabrielle claimed 11 lives and became the costliest tropical cyclone on record in the Southern Hemisphere, with total damages estimated at more than NZ$13.5 billion.

But having the science expertise on hand was invaluable, and the toll could have been much worse without it. In the lead up to and during such extreme weather events, weather forecasters need to be tied to scientists who understand the downstream impacts – meteorologists working alongside hydrologists and coastal scientists, for example, so they can provide advice about likely river flooding and coastal inundation.

In the days that followed, NIWA's river flow experts and hazard scientists rushed to Hawke's Bay to capture vital data. Their mission was to measure and map the flood levels and extent to calibrate our flood models and help pinpoint the mechanisms driving sediment transport and stopbank breaches. That will be key to designing new flood defences, future-proofing property and infrastructure and helping New Zealand recover from similar events.

Our sediment scientists sampled 50 sites across Esk Valley to understand more about particle size distribution and stratification, and contamination by toxic chemical and biological substances. Our air quality experts set up monitoring networks across Hawke's

Bay and Tairāwhiti to gain insights into what people were inhaling. Their findings helped councils and communities decide how best to tackle recovery.

And it wasn't just on land that NIWA scientists marshalled their resources. Millions of tonnes of sediment also poured into the ocean. In April, NIWA began a huge project with Hawke's Bay Regional Council to map 200km² of seabed using multibeam echosounder technology. This information will build on that from surveys we carried out six years ago, allowing us to determine where the sediment outwash settled and the possible impacts on biodiversity and the marine environment.

Of course, it wasn't just NIWA scientists who responded immediately to Gabrielle's wrath by reprioritising and redirecting people, projects and resources. AgResearch, ESR, GNS Science, Manaaki Whenua, Plant & Food Research and Scion – all the Crown Research Institutes – universities, independent research agencies did so. Everyone who could help, did help, in an extraordinary demonstration of collaboration, collegiality and capability. Collectively, the National Environmental Data Centre – key environmental data sources from all CRIs – is being expanded to enable the location and sharing of emergency event data from multiple organisations.

Looking into the longer term, NIWA also released extreme coastal flooding maps for New Zealand to help shape decisions on how we adapt to sea-level rise. Rising sea level is already causing more frequent flooding along many coasts, and will greatly increase the frequency and consequences of flooding in future. These maps show coastal flooding during a storm event with large tides, waves and storm surge under a range of sea-level rises.

The maps help identify the changing risk to land, property and infrastructure from rising seas, at a regional and national scale. They were widely publicised and used within days of release, raising awareness and helping local and central government know where to conduct detailed investigations when developing adaptation strategies to protect our coastal communities. The maps also help the finance, insurance, infrastructure and other service providers risk assess their portfolios.

It's been quite the year – one that's kept the nation on its toes and the science community in full throttle action. But there is an elephant in the room, and that is, of course, climate change. In March, we joined an international cohort of scientists and organisations to publicly state that climate change was in "no doubt" behind Cyclone Gabrielle's intensity. Human-caused warming is driving increased rainfall and making extreme rainfall events more likely. It is no longer something we can debate and ponder about for the next few decades. We need to do more, now.

Extraordinary demand for our services

The exceptional demand for our services is unabated. This year we established 28 new positions to help meet this challenge, growing our total staff to 741.

Thanks to the commitment of our staff and management in pursuing all revenue opportunities, careful handling of costs and maximising operational productivity and efficiency, NIWA's full year revenue was $186.04 million. That was $8.41 million above budget, and $15.81 million more than last year – reflecting the substantial and growing demand for the answers our science can provide. Despite that strong performance, inflationary pressures on salaries, materials and supplies, travel and accommodation, vessel fuel costs, and a higher than budgeted level of subcontracted science work resulted in gross margin being 4.7% less than budgeted.

Furthermore, the challenge in recruiting the staff we needed to complete our booked work remained throughout the year, resulting in $12 million of booked revenue being rolled into the new financial year. Consequently, we started the new financial year with $142 million already booked for 2023/24 – our highest ever start to a year.

We recently launched a $5 million per year package of new projects aiming to tackle some of New Zealand's most pressing challenges. The package includes an additional $2.3 million per year for extreme weather research, including forecasting impacts and supporting climate-change resilient infrastructure development.

An additional $1.85 million per year has been allocated to work with Māori on climate adaptation and to improve delivery of NIWA science to iwi, hapū and Māori businesses. We are also investing in new projects to fast-track solar and wind forecasts for renewable energy production and to measure and verify agricultural greenhouse gas emission reductions.

NIWA already undertakes extensive research in forecasting, climate change and extreme weather, natural hazards, atmospheric, freshwater and marine science, and in Māori environmental research. These new investments will allow us to double down on efforts in these areas.

Financial summary for the year ended 30 June 2023

In thousands of New Zealand dollars	2023	2022	2021	2020	2019
Revenue and other gains	186,036	170,233	176,887*	158,860*	161,292
– Research	101,063	95,614	109,111	93,800	94,901
– Commercial science	84,972	74,618	67,775	65,059	66,390
– Other income	1	1	1	1	1
Profit before income tax	7,764	8,958	22,594	9,982	8,708
Profit for the year	5,938	6,470	16,263	7,370	6,247
Capital expenditure	45,270	40,817	23,080	14,757	21,460
Adjusted return on average equity (%)	4.4	5.0	13.9	6.9	6.2
Return on average equity (%)	3.8	4.3	11.6	5.7	5.1

* Includes $8.27 million from the Government's COVID-19 Response and Recovery Fund (CRRF).

Principal Technician Gordon Brailsford briefs US Ambassador Thomas Udall, with embassy staff Ashley Pettard and Lauren Herrington, on NIWA's atmospheric gas monitoring programme. [Lana Young]

Science highlights

Despite the challenges and disruptions, we achieved all 15 science Key Performance Indicators we identified for the year. We worked on 1,356 science projects during the year, 99.5% of which were completed within customer-agreed timeframes. We comment on some of those projects below.

Climate science

It's been a huge year for climate extremes worldwide. We witnessed devastating hurricanes and cyclones, wildfires on an unprecedented scale, catastrophic floods and record droughts. New Zealand and the Pacific Islands were not immune to these disruptions, and, as noted above, NIWA's climate scientists were in extraordinary demand.

This year, we contributed to the first ever stocktake of global greenhouse gas emissions in a project involving over 60 researchers who tracked emissions from more than 100 countries. NIWA provided remote sensing and ground-based measurements from our Baring Head clean air station near Wellington, home to the longest-running continuous CO_2 measurements in the Southern Hemisphere. This input was especially pertinent because New Zealand's size and complex topography make measuring CO_2 via satellites difficult, so these ground-based readings contributed more accurate data to an international effort.

We welcomed US Ambassador Thomas Udall to Greta Point earlier this year. The focus of his visit was to see NIWA's work on CarbonWatchNZ – the MBIE Endeavour programme that's led by Dr Sara Mikaloff-Fletcher – which aims to improve understanding of greenhouse gas emissions and uptake across our forests, farms and cities. This programme is internationally significant because no other country is producing national-scale CO_2 uptake and emission estimates based on atmospheric data.

In collaboration with NASA's Goddard Flight Center in the United States, the science team at our Atmospheric Research Station in Lauder, Central Otago discovered that the 2020 Australian bushfires caused a chemical reaction in the atmosphere that had never been seen before. At roughly 16–20km above the Earth's surface, where our protective ozone layer resides, they noted changes in several chlorine-containing gases. This mainly involved hydrogen chloride – a gas that can be converted into a reactive form that destroys ozone. The changes occurred gradually over a 4–5 month period after the fires, before reversing over another 4 months. The finding revealed an important gap in our understanding of ozone chemistry.

NIWA is working in Invercargill and Alexandra with Environment Southland, Otago Regional Council, Te Whatu Ora and the South Alive Community Group with the aims of improving air quality across the region, and helping households make their homes warmer and healthier. We have developed world-leading, low-cost sensors and sensor networks to learn more about air quality inside and outside individual homes and across a town. Our science team also hosted two Swedish researchers from Gothenburg University and Chalmers University of Technology to help with the project.

Freshwater science

New Zealand has an abundance of freshwater, but it's not always available in the right place at the right time and in the right volumes.

Every year, NIWA carries out an end-of-summer snowline survey. This long-standing project captures an aerial portrait of over 50 Southern Alps glaciers at a similar time each year to track how they are changing. This year's survey was the 46th undertaken in a collaboration between NIWA, Victoria University of Wellington and the Department of Conservation. The global climate has warmed significantly since the snowline survey began in 1977, and this year's observations confirmed the ongoing trend in ice loss, with some index glaciers

having to be abandoned because their snowlines and meaningful ice volume have completely disappeared.

Glaciers are global indicators of climate change, but they are also huge reservoirs of freshwater, and these losses in volume have substantial social, economic and ecological consequences all over the world. In New Zealand, snow melt contributes as much as 30% of the intake of our major hydroelectricity lakes, and large areas of the South Island rely on meltwater for irrigation. NIWA maintains a network of snow and ice monitoring stations which play a pivotal role informing power planners and hydrologists, farmers and ski field operators of the state of this critical resource.

NIWA was contracted by the Bay of Plenty Regional Council to install specialised monitoring equipment in Bay of Plenty estuaries to understand whether our coastal wetlands can survive the threat of inevitable sea-level rise. With the rate of sea-level rise accelerating around the New Zealand coast at different rates, it was an opportunity to work with the council to manage these systems and understand the pressures on them. Coastal wetland survival is critical because they also function as a long-term sink for stormwater contaminants, support biodiversity and act as nurseries for estuarine and coastal species.

A NIWA field team (foreground), shoulder deep in mangroves, install sea-level monitoring equipment in the Athenree Estuary, Bay of Plenty. [Lana Young]

We are also looking at estuaries from the perspective of their health in a two-year project, Ki uta ki tai: Estuaries, thresholds and values. The programme is assessing how different land contaminants interact with each other and affect estuarine health. Twelve estuaries are being used as case studies, and our researchers are working with whānau, hapū, iwi and community groups to identify their aspirations for their estuary, and present uses and stressors.

The first nationwide assessment of river fragmentation was conducted this year by freshwater ecologist Dr Paul Franklin. Paul found that nearly half of New Zealand's river network is partially or fully inaccessible to migratory fish, because of structures like dams, culverts and weirs. New Zealand has some of the highest densities of barriers to fish passage in the world, and this research will help us assess what adjustments need to be made to allow fish to pass up and down rivers more easily.

NIWA has carried out aerial surveys of over 50 South Island glaciers every year for more than four decades because glaciers are highly sensitive indicators of changes in climate. [Rebekah Parsons-King]

Marine science

Our experimental, commercial-scale Recirculating Aquaculture System (RAS) at NIWA's Northland Aquaculture Centre in Ruakākā is nearly in full swing. Built as a joint venture with Northland Regional Council, the system is designed to demonstrate the viability of commercial-scale production of high-value seafood on land. The facility is the first of its kind in New Zealand, and is designed to produce more than a quarter of a million kingfish (600 tonnes) annually. Tens of thousands of kingfish are now thriving in the eight 350,000 litre tanks, and the entire system is expected to be fully operational over the next quarter, with the first commercial harvest scheduled in November 2023.

Assessing the state and health of New Zealand's marine life is a key pillar of NIWA's work. This year, we conducted successful stock assessments of many popular fish species, including snapper, hoki and orange roughy. The information is used by the fishing industry and Fisheries New Zealand and informs key policy decisions such as total allowable catch.

A research project commissioned by Fisheries New Zealand found that 85% of recreationally caught snapper survived when released. The work was done in collaboration with Ngāti Kuta, LegaSea and Bluewater Marine Research with the aim of reducing fish mortality rates and helping fisheries managers set optimal fishing regulations.

A two-year study investigating the marine environment of Hawke Bay highlighted the vulnerability of the seafloor ecosystem. In a Sustainable Seas National Science Challenge project, in collaboration with Hawke's Bay Regional Council and the Hawke's Bay Marine and Coast Group, we tested three scenarios – reductions in bottom trawl fishing, reductions in sediment deposition from rivers and introducing more closed fishing areas. None of the scenarios came close to returning the seafloor habitat to its baseline condition of 200 years ago. However, the options could double or triple the current seafloor habitat. This study was a vital step in demonstrating the value of a holistic approach to local marine management using the principles of ecosystem-based management.

When fully operational, these eight 350,000 litre tanks will produce more than 600 tonnes of kingfish annually. [Stuart Mackay]

NIWA and Scripps Institution of Oceanography completed a 14-day expedition to release Deep Argo floats in the Kermadec Trench, one of the least explored parts of the ocean. The floats will collect information on the ocean temperature, salinity and water flow over six years, sending data back via satellite every 10 days. The objective is a better understanding of long-term trends in the deep ocean environment.

The Kermadec Trench was also the focus of a two-month collaborative scientific voyage with the Institute of Deep-Sea Science and Engineering, Chinese Academy of Sciences. NIWA marine biologist Dr Kareen Schnabel and submersible pilot Deng Yuqing became the first women to dive to Scholl Deep, 10 km below sea level in the Kermadec Trench. They spent six hours at the bottom of the trench with pilot Yuan Xin filming and collecting water samples, sediments, rocks, biological samples and environmental data in what was only the second crewed visit to Scholl Deep. One of the aims of this voyage of discovery was to provide a baseline survey to observe how this fragile ecosystem changes over time.

NIWA and Victoria University of Wellington PhD student Katie Bigham found that Kaikōura's seabed was showing astonishing resilience to the physical and biogeochemical disturbance caused by the 2016 Kaikōura earthquake. A comparison with imagery and data from earlier NIWA

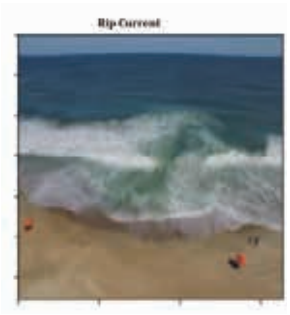
surveys to those collected several weeks, months and years after the earthquake, showed that parts of the Kaikōura Canyon were already well on the way to full recovery. The study gave encouraging evidence for the long-term efficacy of the Hikurangi Marine Reserve, as well as having implications for how human-induced impacts on fisheries could be managed.

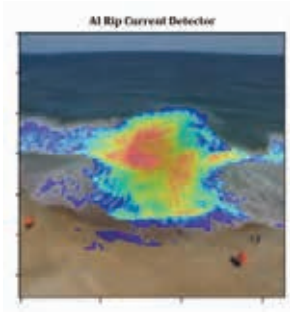
Data science & AI

Recent advances in both atmospheric modelling and artificial intelligence, coupled with the processing power of the latest generation supercomputers, mean that the science of forecasting can be pushed out much further and with a higher degree of both certainty and resolution. NIWA has capitalised on this with our new drought forecasting project, NIWA35, which delivers projections of dryness and drought risk out to 35 days ahead, and at much higher resolution than currently available. The forecasts will provide farmers with a reasonable estimation of a best-case and worst-case scenario over the next five weeks, to significantly improve their operational planning. It's a one-of-a-kind product in New Zealand, and novel on an international scale. If the 2009 drought forecasting model was a Ford Model T, the NIWA35 model is a Tesla Model Y.

NIWA and Surf Life Saving New Zealand have developed a state-of-the-art rip-current identification tool through the use of artificial intelligence and deep

Marine biologist Dr Kareen Schnabel spent six hours in this Chinese deepwater submersible filming and gathering samples from Scholl Deep, 10km below the surface in the Kermadec Trench. [Stuart Mackay]





Researchers used thousands of images to train an AI-based model to accurately detect dangerous rips (above) or invasive weeds in Central Otago's waterways (right). [NIWA]

NIWA's new forecasting tool delivers drought projections out to 35 days ahead, enabling farmers to respond early to extended dry spells. [Caroline Beamish]

learning. When tested on a large batch of visuals showing different coastal settings, it accurately detected rip currents 90% of the time, regardless of weather conditions or camera angles. The next stage will be developing an app that uses this technology to give real-time rip current alerts to help keep beachgoers safe.

Principal Technician Jeremy Bulleid has been using AI to help manage invasive aquatic weeds. Earlier this year, the team carried out the first live detection trials in Lake Wakatipu and the Kawarau River. The trials showed that 'real-time, end-to-end, automatic invasive species surveillance' from a boat, using an underwater camera, was feasible – and increases accuracy, efficiency and safety.

A new data-sharing agreement between NIWA and New Zealand's 16 regional and unitary councils has been established after several years of negotiations. The agreement sets out the terms and conditions for sharing environmental data, with the aim of helping NIWA fulfil its research and applied science services objectives, and assisting councils with their operational duties and responsibilities in areas such as flood management.

Antarctic research

Twenty scientists and 18 crew travelled 11,500km onboard RV *Tangaroa* into the Ross Sea Marine Protected Area on a six-week Antarctic voyage, marked this year by a pronounced lack of summer sea ice. A particular focus of the research was to better understand what was happening to this environment as the climate changed.

The voyage had 15 objectives – including studying coastal ecology, fluid dynamics and biogeochemistry – all to better understand the processes governing this region, as well as the role of the Marine Protected Area (established in December 2017) in protecting this environment. The team processed 15,000 litres of seawater, captured 25 hours of video footage of the seafloor, collected more than 5,000 biological specimens and deployed 10 new moorings to collect additional data over the next two years.

Earlier in the year, marine physicist Dr Natalie Robinson received a surprise visit while working in Antarctica from the then Prime Minister, Jacinda Ardern. With just twenty minutes warning, Natalie and her team arranged a tour of the facilities, described their research, and did some filming with Ms Ardern for an upcoming documentary, The Climate Canary.

Investing in bespoke science facilities

As our facilities near the end of their useful lives, we plan to replace them with specially equipped, state-of-the-art, sustainable developments that will underpin NIWA's ability to deliver its leading science for the foreseeable future. Their design reflects our values and support for our people, collaborators, customers and students, with outstanding layout and use flexibility, extensive collaborative spaces and enhanced technology throughout.

The new NIWA Hamilton research facility – the first of our main centre sites to be rebuilt – was officially opened by Research, Science and Innovation Minister Ayesha Verrall on 4 August 2023. The $45 million state-of-the-art facilities were completed on time, to specification and within budget,

Housing more than 150 scientists, technicians and support staff, NIWA's new 45,000m² Hamilton site provides state-of-the-art laboratory and research facilities. [Stuart Mackay]

> State-of-the-art development that will underpin NIWA's ability to deliver its leading science for the foreseeable future.

Record-low summer sea-ice coverage greeted researchers onboard RV *Tangaroa* on the six-week Antarctic science voyage earlier this year. [Joshu Mountjoy]

despite the challenges of COVID-19, supply chain constraints and inflation. Several hundred guests and staff attended the live-streamed ceremony, which began with the unveiling of the punga (anchor stone) by NIWA chairman Barry Harris and Māori King Tūheitia's representative, Hone Tamehana. The punga is called Te Tipua and contains 32 traditional stories and symbols of scientific relevance which link NIWA's work in freshwater, marine and climate science, depicting the integration with ancient oral tradition to make sense of nature, the universe and connection, past and future.

Te Kūwaha environmental researcher Tekiteora Rolleston-Gabel (one of our first Te Kūwaha graduate interns) and Minister Verrall then unveiled the magnificent 6-metre-long hoe whakatere (paddle) carved from three kahikatea trees. Called Taihoro Nukurangi, it represents the coming together of people to steer NIWA's science into the future for the benefit of our world. NIWA's partnership with Waikato-Tainui and presence on the University of Waikato campus was emphasised by speakers on the day – Chairman Barry Harris, Chief Executive John Morgan, Waikato-Tainui kaumatua Taituha Karena, the King's representative Hone Tamehana and Minister Verrall, who declared the facilities officially open.

Meanwhile, demolition and clearance work on the site for NIWA's new Christchurch facilities is complete and an application for building consent has been submitted. Redevelopment of NIWA's 25,000m^2 waterfront site at Greta Point in Wellington is on hold, pending the development of a business case for the Wellington Science City hub for oceans, climate and hazards research.

As noted above, the experimental, commercial-scale Recirculating Aquaculture System (RAS) at NIWA's Northland Aquaculture Centre is well on track and expected to be fully operational in this year.

Our new mid-sized marine research vessel, designed to replace RV *Kaharoa* is making extraordinary progress and slipped gracefully down the slipway into the waters of northern Spain to settle alongside the wharf where it will undergo its final fitout. The construction is also on track, to specification and within budget. Commissioning is expected in December, with handover occurring in late January-early February 2024. The delivery voyage back to New Zealand will not merely be a familiarisation exercise, the crew will also continue the *Kaharoa* tradition of Argo float deployments – in this instance, across the Atlantic and down through the Pacific after the new vessel transits the Panama Canal. The vessel is expected in its home port of Wellington in April for an official greeting.

Māori King Tūheitia's representative, Hone Tamehana unveils the basalt punga (anchor stone) at the entrance to the new Hamilton building. [Stuart Mackay]

Shortly after sliding down the slipway in the Armon ship building facilities in northern Spain, the second NIWA research vessel to carry the *Kaharoa* name heads for the wharf to begin the final fitout programme. [Armon]

94% of NIWA's research projects involved collaboration with other organisations.

Partnering with Māori

NIWA's Te Kūwaha group is leading a pan-CRI project to better understand what motivates Māori graduates in their studies and career aspirations, and the institutional and systemic barriers Māori face within the science system more generally. This is the first comprehensive diversity, equity and inclusion assessment of Māori researcher experiences in the CRI sector, and the information will be used to develop enhanced pathway models for Māori graduates at each individual CRI and on a pan-CRI level.

With Vision Mātauranga Capability Funding, NIWA is supporting Kahukuraariki Trust Board to help realise their vision for revitalising tribal rock oyster aquaculture in Te Tai Tokerau. Their rohe moana was once renowned for its native rock oyster beds, which supported a thriving trade into the restaurants and bars of Auckland and were exported to Australia. The aim of this programme is to provide a solid basis on which to build a sustainable new aquaculture enterprise that restores the mana of the native rock oyster, while uniting, empowering and enhancing northern iwi/hapū economic wellbeing, providing both employment and upskilling opportunities.

NIWA has been engaged by a newly appointed trustee for the Lake Ōmāpere Trust, Dr Marise Stuart-Kerehi, to support them in revitalising restoration activities in this Māori-owned lake. NIWA has a long-standing relationship with the Trust, and we have institutional knowledge that would be beneficial to the current trustees and their work programmes. The Trust is currently re-establishing the partnerships they will need, and NIWA is supporting them with the provision of previous research knowledge, the development of funding applications and their vision of a research centre at the lake.

L-R: Te Kūwaha Graduate Interns Ruby Mckenzie-Sheat, Rose Kuru and Natalie Taufa. The graduate intern programme was established to help support and create tangible pathways for the next generation of Māori researchers. [Rebekah Parsons-King]

Working with others

Ninety-four percent of NIWA's research projects this year involved collaboration with other science organisations. Nine NIWA staff were seconded to government agencies and stakeholders during the year, six staff held appointments with New Zealand universities, and many others held adjunct roles.

One of NIWA's highest profile successes of the year was the ongoing work of the Tonga Eruption Seabed Mapping Project (TESMaP) – a mission to discover the undersea impacts of the Hunga Tonga–Hunga Ha'apai eruption. It was a huge collaborative effort with The Nippon Foundation, SEA-KIT International, and the Kingdom of Tonga, and a rare opportunity to improve understanding of the nature and impact of a major volcanic eruption. It remains the fullest investigation into the event.

Almost 10km^3 of seafloor was displaced – the equivalent to 2.6 million Olympic-sized swimming pools and one-third more than initial estimates – with two-thirds coming from the summit and the rest from the surrounding flanks. Further evidence showed that the caldera was still erupting, and mysteries of the pyroclastic flow were solved.

On top of the scientific work for TESMaP, an extensive science communications campaign was carried out because of the global impact and interest in the eruption and lessons that may be learned and applied to future such events. Using a mixture of media conferences, journalist collaboration, video production and social media, NIWA developed a 12-month-long story with an astonishing level of coverage that cut through a jam-packed news agenda. It went global across traditional and social media, with the YouTube video exceeding 775,000 views and the project being covered in outlets including BBC News, CNN, Disney+ and National Geographic. For their efforts, the NIWA Communications Team won the Public Relations Institute of New Zealand's 2023 Supreme Award.

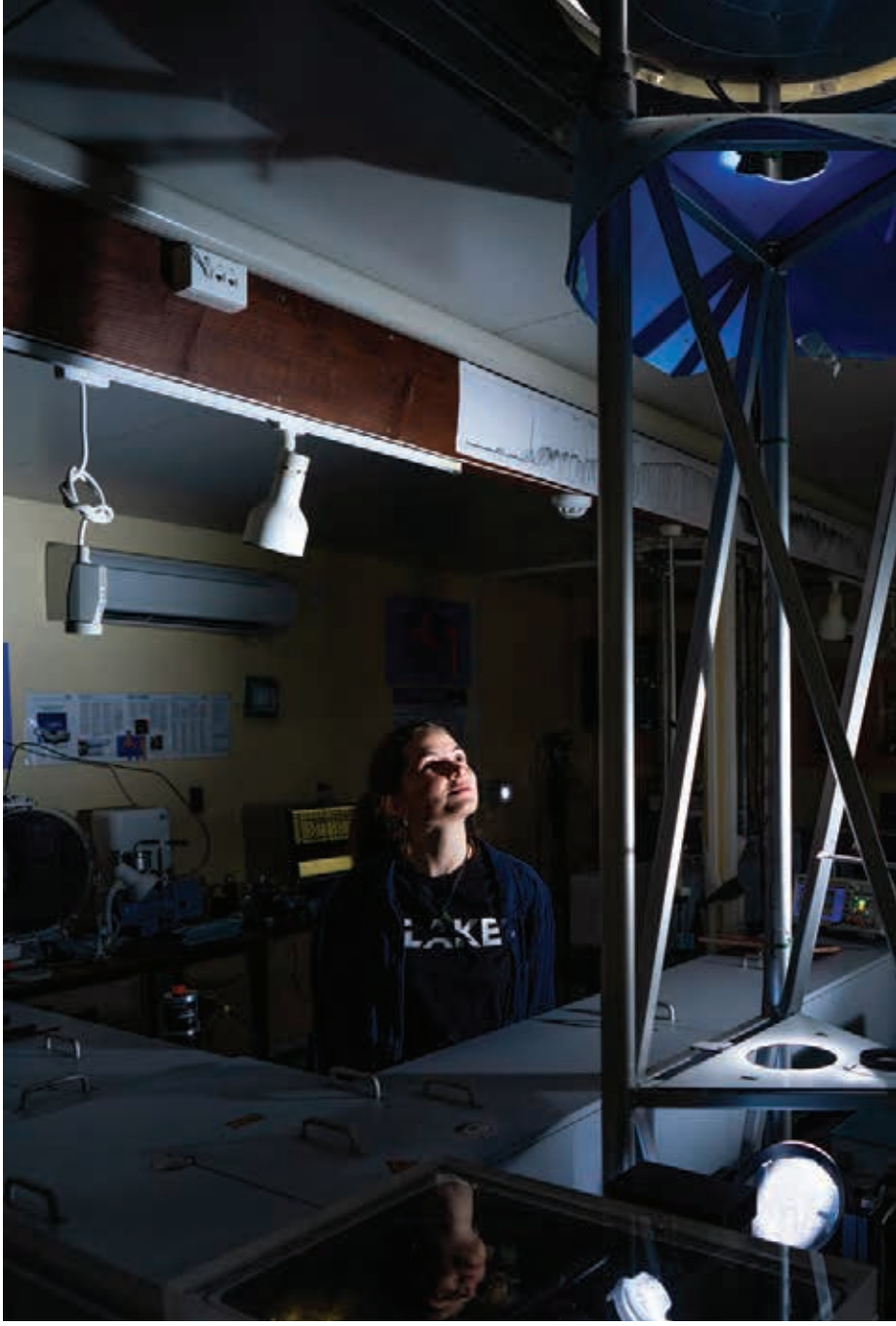
NIWA marine invertebrate systematist Dr Rachael Peart and marine biologist Dr Kareen Schnabel successfully co-hosted the prestigious 10th International Crustacean Congress at the Museum of New Zealand Te Papa Tongarewa. The week-long congress attracted carcinologists from all over the world for the first-ever Crustacean Society meeting to be held in New Zealand. The congress also aligned with the opening of the new NIWA/Te Papa exhibition Mawhiti Tino Rawe – Clever Crustaceans, an interactive exploration of the bizarre and diverse world of marine crustaceans. This exhibition is the first of its kind we have undertaken with Te Papa as a component of our MOU. It was designed to be packed up and toured to regional galleries, many of which don't often get such opportunities.

The South & West Pacific Centre of Seabed2030 held its 5th annual meeting this year in Lima, Peru with marine geologists Kevin Mackay and Belen Jimenez Baron representing NIWA. Kevin delivered a captivating narrative of the Hunga Tonga–Hunga Ha'apai eruption and an exposition of the subsequent *Tangaroa* survey and its scientific findings.

Researchers aboard RV *Tangaroa* carefully recover a sediment core sample taken from the seafloor at the base of the Hunga Tonga–Hunga Ha'apai underwater volcano. [Rebekah Parsons-King]

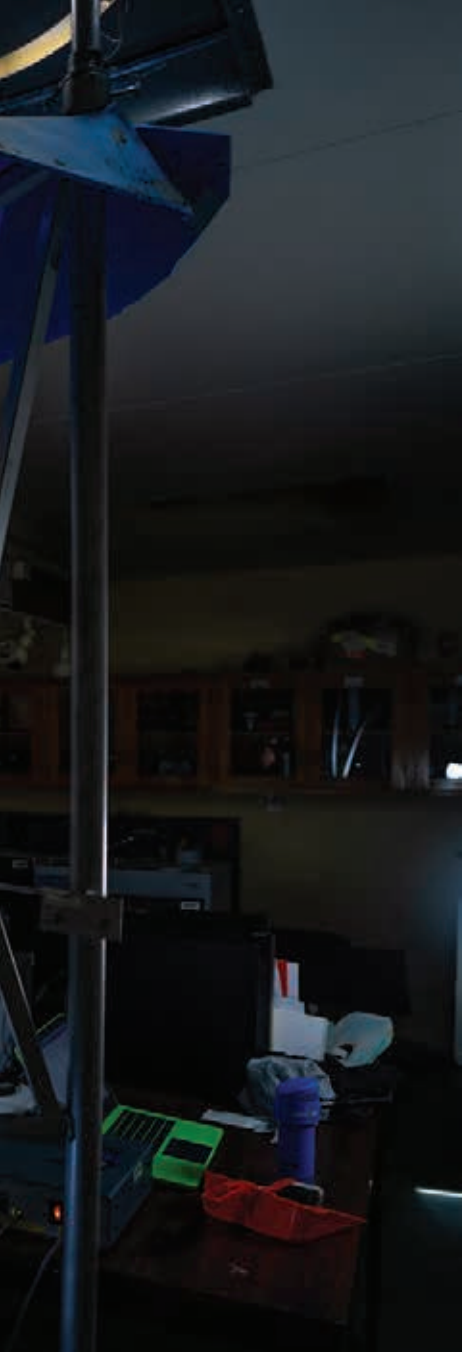
NIWA has joined the Aerospace New Zealand associate programme as a business associate. This recognises NIWA's contribution to building our nation's aerospace ecosystem. Recent projects include the international space mission, MethaneSAT, to help tackle climate change. We also support satellite observations with our long time-series datasets and conduct specific overpass-timed ground-based measurements as part of satellite calibration/validation activities. NIWA has been an early adopter and pioneer of remote sensing using a variety of data types, including early work with ground penetrating radar and LIDAR.

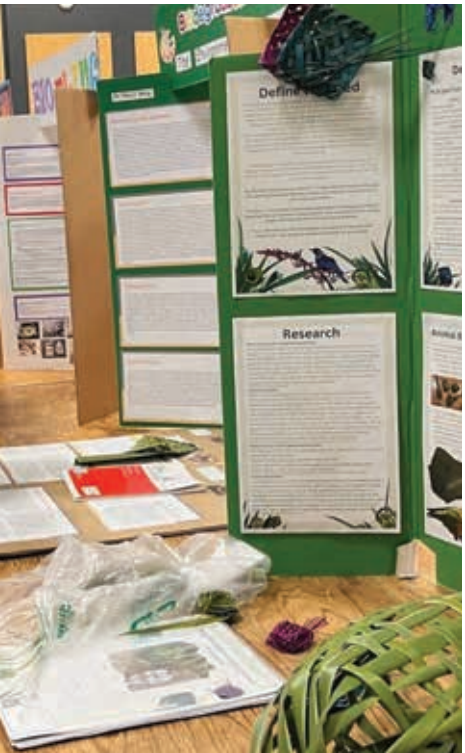
In March, we hosted experts from around the Pacific and South-East Asia as part of a global initiative to better understand regional water resources and to reduce the effects of water-related hazards on people, economies and environments. This programme is led by the World Meteorological Organization and is contributing to the development of plans that will define regional priorities for operational hydrology.



One of four NIWA BLAKE Ambassadors, Zoe Barbenel with the Bruker spectrometer at the Lauder Atmospheric Research Station. [Lana Young]

Year 11 and 12 Wellington students question female NIWA staff about their work during a "speed dating" event to encourage young women to consider careers in science. [Lana Young]





Young Cook Island students put their own spin on NIWA's climate change adaptation serious game with environmental social scientist Melanie Mayall-Nahi in Rarotonga. [Doug Ramsay]

Fostering the next generation

NIWA is committed to building a highly skilled and diverse workforce to ensure the science sector continues to deliver the innovation, creativity and solutions required to meet current and future global challenges. This year NIWA supervised 56 PhD, 18 Masters and 3 Bachelor students, and also supported 9 international students (6 PhD and 3 Masters).

Secondary school Science and Technology Fairs were back again strongly this year, and we are proud to be lead sponsors of seven main city fairs and eight regional fairs. We have a core interest in raising the constituency of science, particularly among young New Zealanders, fostering an awareness of science as a solution provider and promoting science careers. Our sponsorship provides the authority, the resources and the promotion the regional committees need to grow and deliver their annual fairs.

Every year we host many visits for young people at our sites. One, in particular, stood out this year for its very real engagement. We welcomed 40 students from the Innovative Young Minds Residential Programme to our Wellington site, where they joined our people for a round of 'Science Speed Dating' in which the students got to speak with female staff about what they do, how they got interested in their field and the pathway they took.

As the principal science partner for BLAKE, we work closely with them to support their focus on environmental leadership, especially with the nation's youth. Over summer this year, four young up-and-coming scientists/science communicators were placed within our research programmes as part of the BLAKE Ambassadorship programme. This year's placements included a week at our Lauder Atmospheric Research Station and at our Northland Aquaculture Centre.

We also supported the inaugural Cook Islands Science Expo in Rarotonga. This multi-partner expo aimed to encourage young Cook Islanders to learn more about science and technology, particularly the synergies between traditional knowledge and science. It was experienced by 1,500 children over three days. NIWA's stand featured a sea-level rise serious game adapted for unique Pacific challenges, where rising sea levels and storm damage are an increasing threat to a coastal way of life. The children also had a chance to talk to two of NIWA's Māori Environmental Scientists, Tekiteora Rolleston-Gabel and Melanie Mayall-Nahi about their experiences as young Māori scientists. In collaboration with Otago Museum, we also presented a new Pacific-themed version of our 2050 weather forecast as well as our Far from Frozen planetarium show in their portable Sky Dome.

Left: NIWA-sponsored Science and Technology Fairs help foster an interest in science for tens of thousands of secondary school students across the country. [Melissa Bray]

This hoe in NIWA's new Hamilton facility represents the coming together of people to steer NIWA's science into the future for the benefit of the nation. [NIWA]

What the future holds

Years like this one don't come along often. Mercifully. Or so we used to think. We know that climate change is bringing increased intensity and frequency of extreme events, coupled with incremental increases in many variables that may be small in themselves on an annual basis, but are happening at a speed that challenges humanity's ability to adapt – sea-level rise, ocean acidification, marine heatwaves, increased frequency and severity of floods and droughts, catastrophic wildfires and the like. Many, if not all, of these challenges pose demands on science, and many, if not all of them, fall within the areas of science in which NIWA is a key authority. We accept these challenges and are well prepared to face them.

On that note, we were pleased to see the Treasury and MBIE review of New Zealand's weather forecasting system announced by State Owned Enterprises Minister Duncan Webb. We believe that it's time, for all the reasons mentioned in the Minister's statement and the terms of reference for the review, to take a broader look at the combined capabilities of NIWA and MetService and consider how they might deliver better outcomes for New Zealand, which could include putting the organisations back together again.

As the nation builds its resilience to a changing climate, particularly in the face of increased frequency and intensity of extreme weather events, it makes sense to integrate ocean, climate, weather and freshwater science to enable better prediction of impacts, such as floods and drought, coastal inundation and erosion, and forest fires – thereby improving adaptation, mitigation, response and recovery. Ultimately, better short, medium and long-term forecasting will achieve that.

We look forward to the outcome of the review.

The extreme weather events we faced as a nation this year compounded the disruption that was initiated by COVID-19 and the spiralling negative effect that had on the global society and economy. Despite all these challenges, NIWA maintained its strategic investment schedule during the year to ensure that our people have the best contemporary science facilities and kit for years to come – the highlights for the year being the new $45 million state-of-the-art facilities in Hamilton, a new $35 million worldclass marine research vessel and the $18 million Recirculating Aquaculture System at Bream Bay, Ruakākā.

We thank everyone at NIWA – the Board, the Executive Team and all our staff – for their dedication, support, skills and commitment. We will need more of the same over the next year to respond to the growing demands for our science. That's the easiest forecast we'll get to make this year.

We would particularly like to thank and farewell NIWA Board Deputy Chairman Nick Main for his outstanding governance contribution over the past 9 years, during which he chaired the Board's Audit and Risk Committee and Future Property Programme Committee.

Barry Harris
Chairman

John Morgan
Chief Executive

The following section of this Year in Review, 'NIWA Science', pp. 17–49, includes selected examples of how our science is applied for the benefit of the nation.

NIWA SCIENCE

SCIENCE OUTCOME 1

INFORMING ADAPTATION TO A CHANGING CLIMATE

SCIENCE OUTCOME 2

MITIGATING THE DRIVERS OF CLIMATE CHANGE

SCIENCE OUTCOME 3

ENHANCING RESILIENCE TO EXTREME WEATHER AND OCEAN HAZARDS

SCIENCE OUTCOME 4

PROTECTING OUR BIODIVERSITY

SCIENCE OUTCOME 5

IMPROVING ENVIRONMENTAL HEALTH

SCIENCE OUTCOME 6

ENABLING WATER SECURITY

SCIENCE OUTCOME 7

GROWING A RESILIENT SEAFOOD SECTOR

SCIENCE OUTCOME 8

GROWING SUSTAINABLE RENEWABLE ENERGY

Multiple braids characterise the mouth of the Tasman River as it flows into Lake Pukaki. [Adrian Aarsen]

INFORMING ADAPTION TO A CHANGING CLIMATE

PLANNING FOR AND ADAPTING TO THE IMPACTS OF CLIMATE CHANGE

- Providing climate projections to 2100
- Determining the impact of climate change on extreme weather, including cyclones, floods and droughts
- Developing rapid climate change attribution capability
- Refining adaptation pathways and decision-support frameworks
- Quantifying climate change exposure, risks and impacts across multiple environments

REDUCING THE ADVERSE EFFECTS ON AQUATIC ECOSYSTEMS

- Improving ecosystem models of surface and groundwater and river and lake responses
- Determining the impacts of sea-level rise on coastal lowlands and communities
- Outlining the impacts of ocean change on marine ecosystem health, fish and shellfish
- Providing climate projections for aquaculture development

FUTURE-PROOFING WATER SECURITY

- Assessing water demand, allocation and use under different scenarios
- Improving predictions of the effects of climate change on hydrological processes and water resources

Environmental monitoring technician, Andrew Willsman servicing NIWA's Mount Larkins Snow and Ice Monitoring Station. [Adrian Aarsen]

Conformal Cubic Atmospheric Model (CCAM) output showing clouds and heavy precipitation (red shading). [CSIRO]

Climate projections support a climate-resilient New Zealand

Updated national climate projections will support New Zealand's transition to a low-emissions, climate-resilient economy. Knowing what the future holds in store will help us better understand the climate-related risks and improve our decision making as to how we adapt and build resilience to extreme weather events.

We have selected six global models spanning the very large set of models used for the IPCC Sixth Assessment Report published in August 2021. In addition, we are experimenting with three regional models and sophisticated statistical/machine-learning approaches to develop the next suite of high-resolution projections specific to New Zealand, via a process known as downscaling.

Published alongside this model suite will be downscaled projections from the New Zealand Earth System Model (NZESM), developed through the Deep South National Science Challenge to improve our understanding of the Southern Hemisphere processes that strongly influence our climate.

The work is funded by the Ministry for Business, Innovation & Employment, contracted by the Ministry for the Environment and will be completed in 2024.

Sea-level rise maps reveal places at risk

New maps from NIWA and the Deep South National Science Challenge show areas across New Zealand that could be inundated by extreme coastal flooding during a large storm-tide event and with sea-level rise driven by climate change.

Coastal flooding is particularly likely when high tides, storm surges and large waves occur simultaneously. At these times, low-lying areas are inundated when high seas overtop or even break barriers and cause rivers to back up inland. This can destroy property and infrastructure, severely affect the natural environment and threaten lives.

The publicly available maps will help councils, the financial industry and national infrastructure and service providers assess the risk to their portfolios. They can help shape decisions on how we adapt to sea-level rise.

The maps were used in research that examined New Zealand's increasing exposure to coastal flooding with sea-level rise. It showed that small amounts of sea-level rise will drive a rapid increase in cumulative flooding from increasingly frequent coastal-flood events, and that 30% more land area would be regularly flooded after 0.3m of relative sea-level rise.

Parts of Wellington's south coast are already vulnerable when high tides combine with storm surges. [Lana Young]

MITIGATING THE DRIVERS OF CLIMATE CHANGE

REDUCING AGRICULTURAL GREENHOUSE GASES

- Measuring greenhouse gas emissions from farm to global scales
- Leading MethaneSAT to locate and quantify methane emissions worldwide
- Attributing greenhouse gas emissions from different land uses
- Assessing emission reduction management and policy
- Maintaining long time-series observations of key atmospheric gases, supporting global science and diplomatic efforts to reduce greenhouse gas emissions

QUANTIFYING AND PROMOTING GREENHOUSE GAS UPTAKE AND SEQUESTRATION

- Quantifying carbon uptake and sequestration by indigenous forests
- Developing decision-support tools with Māori partners and stakeholders to promote low emission approaches
- Investigating the impact of pest control on carbon uptake by indigenous forests
- Determining the potential for carbon sequestration in coastal and marine environments

Native beach dominates the forests of the Makarora River valley, Mount Aspiring National Park. [Lana Young]

Can kelp capture enough carbon?

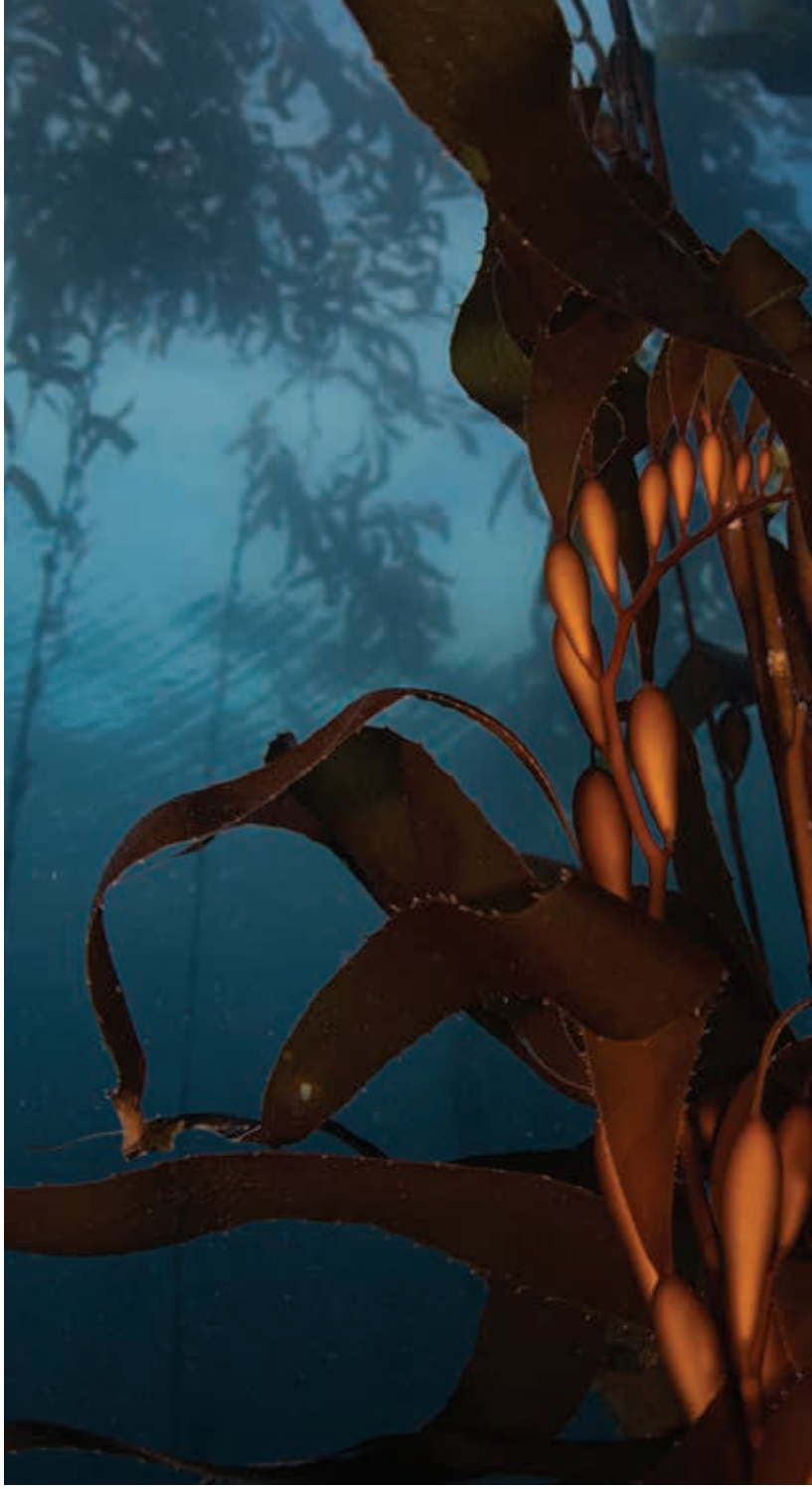
Our oceans provide a natural way of reducing the impact of greenhouse gases through the capture and sequestration of carbon in marine ecosystems – a term known as Blue Carbon.

NIWA is aiming to provide New Zealand's first national estimate of the role of kelp in this process, and its ability to reduce carbon in the atmosphere. The Quantifying Kelp Blue Carbon project uses a combination of fieldwork and experiments at the Marine Environmental Manipulation Facility at NIWA's Greta Point laboratory in Wellington to replicate this natural process in research tanks.

Data on the distribution of kelp beds, their productivity rates, ocean currents and seabed topography, will allow an estimate of the overall transport to the kelp beds and the natural sequestration rate of kelp-carbon in coastal sediments. Radiocarbon and lead isotope dating will determine kelp-carbon accumulation rates and the longevity of kelp-carbon sequestration.

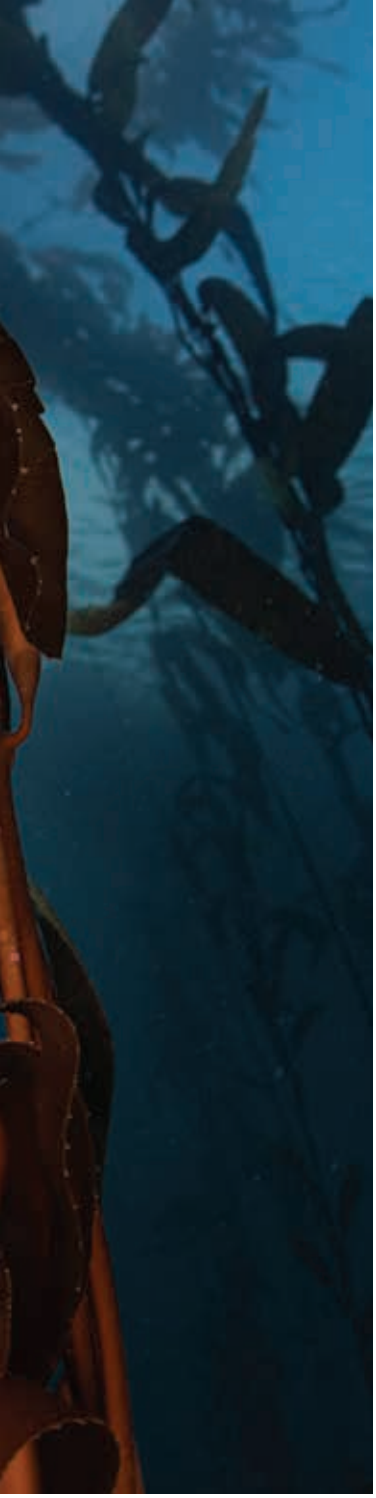
Estimates suggest that about 11% of the carbon drawdown by kelp could be sequestered for thousands of years in deep marine sediments. The figure may be higher for New Zealand because of connections to deep water via submarine canyons that extend close into the coast, a hypothesis that the study team are investigating.

The research is being carried out with Blue Carbon Services, and the findings could lead to additional conservation or expansion of existing macroalgae beds.



New Zealand giant kelp (*Macrocystis pyrifera*) is one of the fastest growing organisms on the planet. [Crispin Middleton]

PhD student Mari Deinhart is conducting kelp degradation experiments from samples gathered along Wellington's coast. [Lana Young]



MethaneSAT, due to be launched early next year, will be the most advanced methane tracking satellite in orbit, measuring methane emissions across the globe. [MethaneSAT]

An eye in the sky

MethaneSAT is an agricultural research programme that is part of an international space mission helping to tackle climate change. Led by NIWA, MethaneSAT's core purpose globally is to gather data to inform a reduction in methane emissions from oil and gas sources. But the research in New Zealand – funded by the Ministry for Business, Innovation & Employment – is focused on reducing global emissions from agriculture.

The New Zealand-based team has identified about 200 agricultural targets – including several in New Zealand – focused on ruminant farming and rice growing. Ground-based measurements and modelling of these targets has been carried out in preparation for the satellite's launch in early 2024.

The New Zealand researchers are also working alongside MethaneAIR – a specially equipped jet aircraft that's tracking methane in the United States ahead of MethaneSAT's launch. MethaneAIR has captured data from some of the agricultural targets in the US, and it is being processed and analysed. Ultimately, the findings from MethaneSAT will help identify globally where emissions can be reduced or eliminated most effectively.

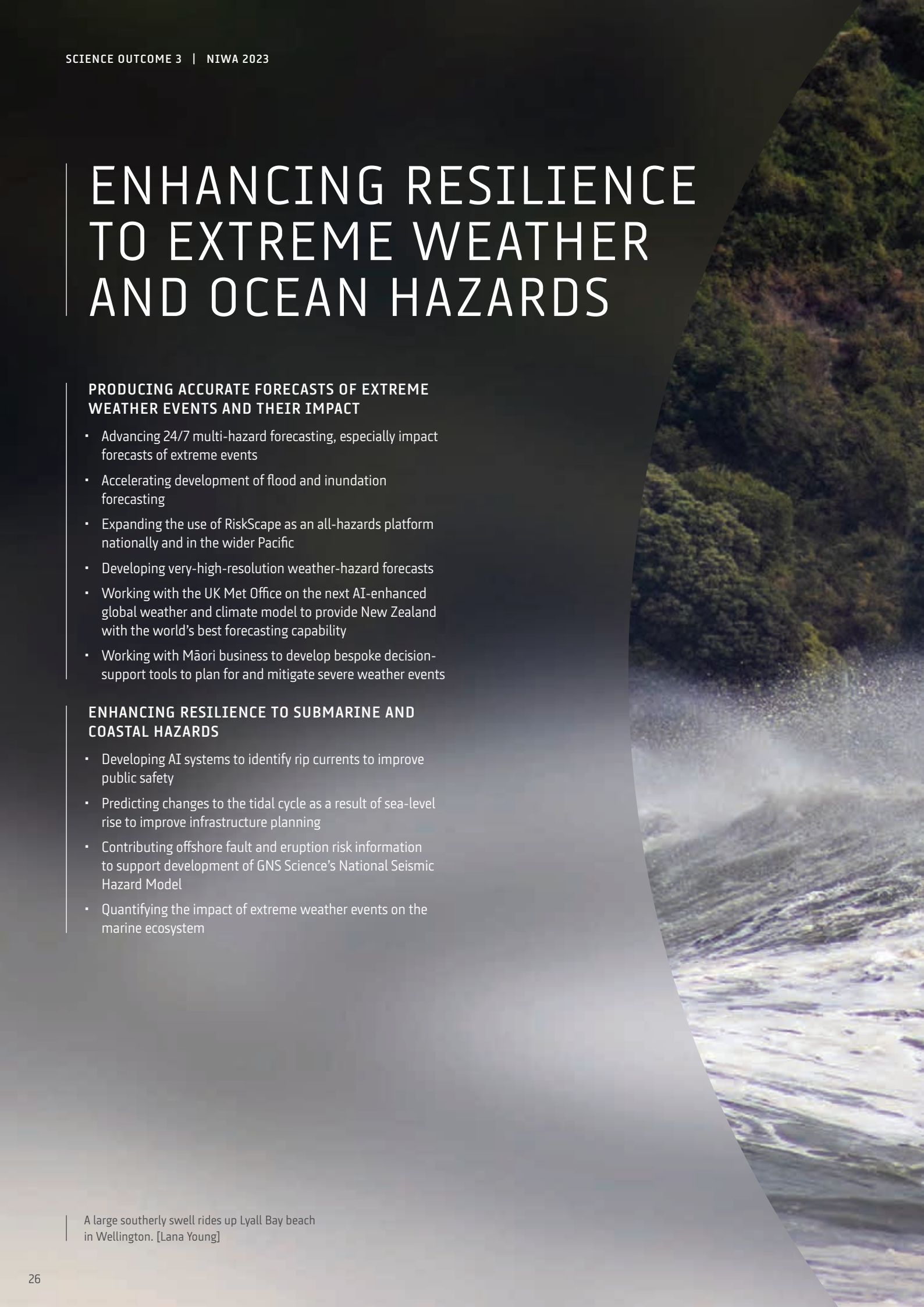
ENHANCING RESILIENCE TO EXTREME WEATHER AND OCEAN HAZARDS

PRODUCING ACCURATE FORECASTS OF EXTREME WEATHER EVENTS AND THEIR IMPACT

- Advancing 24/7 multi-hazard forecasting, especially impact forecasts of extreme events
- Accelerating development of flood and inundation forecasting
- Expanding the use of RiskScape as an all-hazards platform nationally and in the wider Pacific
- Developing very-high-resolution weather-hazard forecasts
- Working with the UK Met Office on the next AI-enhanced global weather and climate model to provide New Zealand with the world's best forecasting capability
- Working with Māori business to develop bespoke decision-support tools to plan for and mitigate severe weather events

ENHANCING RESILIENCE TO SUBMARINE AND COASTAL HAZARDS

- Developing AI systems to identify rip currents to improve public safety
- Predicting changes to the tidal cycle as a result of sea-level rise to improve infrastructure planning
- Contributing offshore fault and eruption risk information to support development of GNS Science's National Seismic Hazard Model
- Quantifying the impact of extreme weather events on the marine ecosystem



A large southerly swell rides up Lyall Bay beach in Wellington. [Lana Young]

Understanding Cyclone Gabrielle to aid recovery and reduce future risk

Cyclone Gabrielle claimed 11 lives, destroyed hundreds of homes and devastated huge swathes of agricultural and horticultural land. It was the most expensive weather event to hit New Zealand, with its impact expected to be in excess of $13.5 billion.

NIWA researchers have contributed to understanding what happened in many ways – from weather, storm surge and landslide forecasting as the cyclone approached, through to gathering LiDAR data in the immediate aftermath, assessing flood extents and stopbank breaches, and studying sediment deposition on land and in the sea. Researchers have also been involved in multiple analysis and modelling projects to inform recovery and understand future flood risk.

The findings from this work are helping iwi, government agencies, emergency responders, councils, infrastructure providers and many other partners across the cyclone-hit regions to understand the event. They are also crucial in helping communities make informed decisions about their future, particularly in the context of our changing climate.

Floodwaters from Hawke's Bay's Tūtaekurī River swept through productive horticultural land when stopbanks burst during Cyclone Gabrielle. [Rebekah Parsons-King]

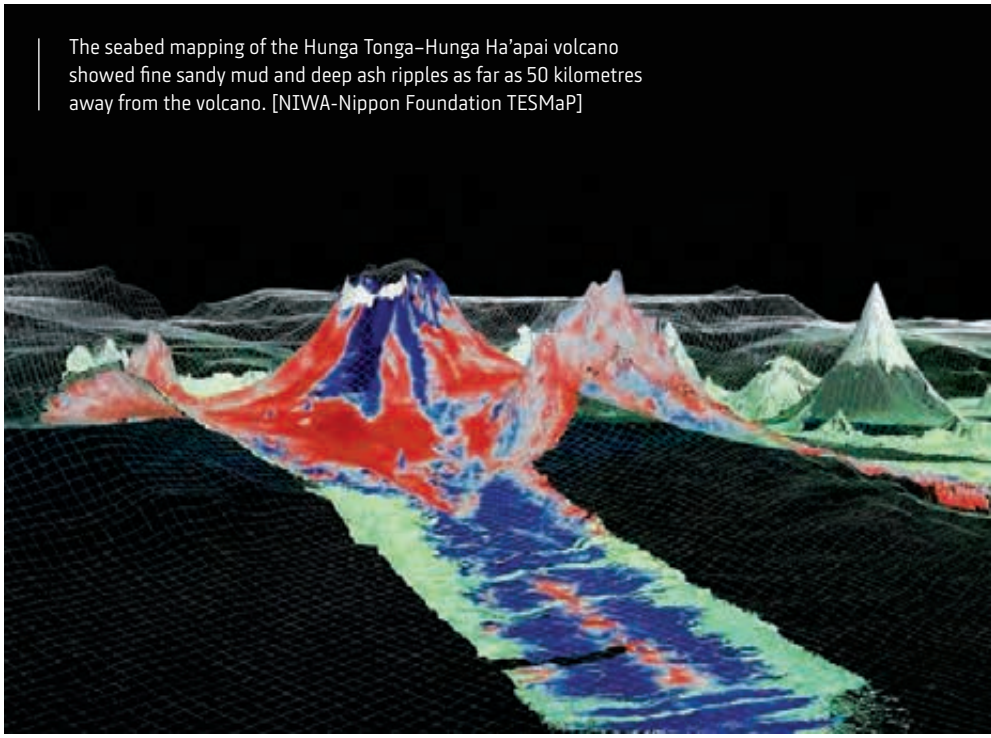
Results flow from Tongan volcanic eruption

The discoveries continue to stream from NIWA's undersea survey of the largest submarine volcanic eruption in nearly 150 years. The eruption of Hunga Tonga–Hunga Ha'apai had global implications which united scientists worldwide in support of our Pacific neighbours.

The collective goal was to help understand what happened in the immediate aftermath and what the long-term consequences might be. NIWA's part in this response was spearheaded through the Tonga Eruption Seabed Mapping Project, a partnership with the Nippon Foundation. This collaboration allowed scientists from across the world to analyse data and samples collected during the month-long, immediate post-eruption expedition on RV *Tangaroa* and via SEA-KIT International's Uncrewed Surface Vessel, USV *Maxlimer*. What was available to the scientists worldwide included 14,000km^2 of previously unmapped seafloor NIWA charted as part of The Nippon Foundation GEBCO Seabed 2030 project.

One of the central points of exploration was the destructive power of the pyroclastic flows after the eruption, which decimated life and severed the trans-Pacific network of telecommunications cables. NIWA analyses of sediment cores showed pyroclastic deposits some 80km away from the volcano, and almost 10km^3 of seafloor was displaced. Data acquired as part of the voyage was also used to reconnect the island communities, including the repair of the severed cable in February. A follow-up *Tangaroa* voyage is planned for late 2024 to determine short-term resilience and longer-term recovery.

The seabed mapping of the Hunga Tonga–Hunga Ha'apai volcano showed fine sandy mud and deep ash ripples as far as 50 kilometres away from the volcano. [NIWA-Nippon Foundation TESMaP]



PROTECTING OUR BIODIVERSITY

HELPING PROTECT AND RESTORE NEW ZEALAND'S BIODIVERSITY

- Measuring the ecological functions and values of biodiversity and biogenic habitats
- Working with Māori to develop maps of habitats to support cultural outcomes and delivery of key ecosystem functions and services
- Developing tools to anticipate the impacts of climate change on aquatic biodiversity

IMPROVING THE MONITORING AND MANAGEMENT OF AQUATIC BIODIVERSITY AND HABITATS

- Developing technology-based methods to survey and map biodiversity
- Working with Māori to develop methods to assess mahinga kai
- Developing modelling and visualisation tools for biodiversity and habitat management

PROTECTING THE AQUATIC ENVIRONMENT FROM PESTS AND DISEASES

- Partnering with Māori to develop new tools and techniques
- Developing new surveillance and diagnostic systems to reduce response times and costs
- Co-developing low-impact, culturally acceptable methods for responding to, eradicating and controlling pests and diseases

A school of native smelt in Lake Benmore. [Mary de Winton]

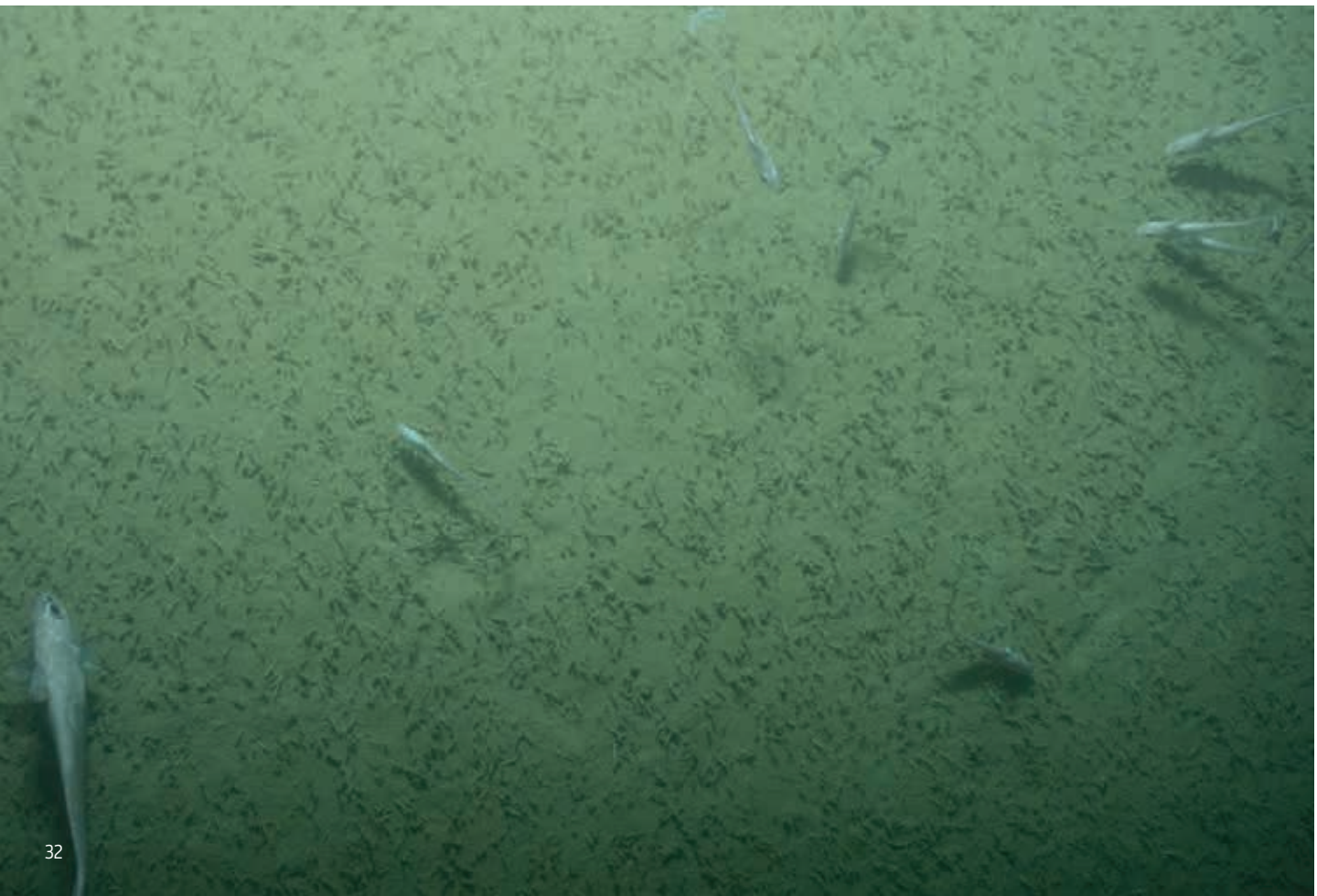
Kaikōura's deep seabed recovers rapidly

The Kaikōura Canyon, in the Hikurangi Marine Reserve, ranked among New Zealand's most biologically productive deep-seabed environments, but the 7.8 magnitude earthquake in 2016 appeared to wipe out many of its ecosystems.

This hugely destructive event gave NIWA scientists the rare opportunity to study the impacts of an underwater earthquake on seabed communities and uncover the extent to which they could recover. NIWA has access to a wealth of information on Kaikōura's deepsea environment as a result of earlier surveys in the canyon producing thousands of images and datapoints. Comparisons between that information and data collected several weeks, months and years after the earthquake shows a remarkable recovery.

Many organisms have returned, and some parts of the canyon are well on the way to being fully recovered. The outcome is encouraging for the future health of the Hikurangi Marine Reserve, and the research will help with modelling recovery timelines for future events.

NIWA's deep-towed underwater cameras reveal a range of fish species and multiple seafloor organisms returning to parts of the Kaikōura Canyon seafloor just four years after the 2016 earthquake. [NIWA]



NIWA and Chinese representatives celebrate the completion of the first leg of the collaborative voyage to the Kermadec Trench with the team for the second leg. [Stuart Mackay]

An upside-down anglerfish at a depth of 5,700m in the Kermadec Trench. [HOV *Fendouzhe*, IDSSE]

Shining light on the depths

Late in 2022, NIWA was involved in extraordinary new observations about the diversity and abundance of life at one of the deepest places in the world.

Working aboard the Chinese research vessel *Tansuoyihao*, a multinational group of scientists explored the geology and ecosystem of the Kermadec Trench at Ranghitāhua. This work was carried out at what's known as hadal depths – 6 to 11km below the surface. NIWA scientists completed a number of dives using the deep ocean submersible, *Fendouzhe*, including the first female-crewed dive.

Highlights of the voyage included dozens of deepsea fish, thousands of crustaceans gorging on the corpse of a large sunfish and the intact vertebrae of a 4-metre-long shark. Deployments of other independent samplers – such as a lander, CTD (water sampler) and a gravity corer – shed further light on this remote environment.

Such collaborations and technologies give the world a better understanding of New Zealand's deepest environment, and the impacts that humans may have on it.

IMPROVING ENVIRONMENTAL HEALTH

IMPROVING ENVIRONMENTAL HEALTH REPORTING

- Providing long-term environmental monitoring required for State of the Environment reporting and the National Planning Framework
- Developing new programmes, networks and technologies for key environmental indicators in aquatic environments
- Developing spatial reference datasets for science, products and response to extreme events

SUPPORTING THE ESTABLISHMENT OF ENVIRONMENTAL LIMITS AND TARGETS

- Predicting estuarine and marine ecosystem response to changes in climate, land use and habitat
- Developing tools and models to trace the source of sediments and identify measures for erosion control
- Calculating sediment load limits to meet estuarine health targets
- Working with forest industry partners and government to forecast sediment loss to rivers and coastal zones

RESTORING AND REHABILITATING DEGRADED AQUATIC ECOSYSTEMS

- Partnering with Māori to restore ecosystems and their cultural values
- Developing procedures to maintain endangered aquatic plant species for restocking
- Working with industry on pollution mitigation in rural and urban landscapes
- Developing best practice in riparian planting

A NIWA-designed wetland constructed on an Awatuna dairy farm in South Taranaki. [Stuart Mackay]

Awatuna constructed wetland, Taranaki. L-R Donna Cram (Farmer, DairyNZ Leaders Group, Taranaki Regional Councillor), Chris Tanner (NIWA Principal Scientist), Regan Phipps (Manager - Science and Technology, Taranaki Regional Council). [Stuart McKay]

Building back our wetlands

Often described as the kidneys of the landscape, wetlands are important for filtering nutrients, controlling floods, and as wildlife habitats. Ten percent of New Zealand was once covered by wetlands – 90% of those original wetlands have now been drained.

In 2020, NIWA researchers launched a 4-year, $1.95 million project, funded by the Ministry for Primary Industries, to custom-build and measure the performance of wetlands for mitigating pollution from rural run-off.

NIWA worked alongside landowners and councils – in Tasman, Taranaki, Hawke's Bay, Bay of Plenty and Canterbury – to identify sites and design the wetland systems, advise on plant selection, estimate contaminant removal and install monitoring equipment.

The councils are assisting with wetland monitoring, which will help improve understanding of the ability of constructed wetlands to reduce the flow of nutrients, suspended solids and faecal microbes into waterways.

NIWA also released its Constructed Wetlands Practitioner Guide last year – a joint initiative with DairyNZ to help landowners through the process of designing, constructing and maintaining wetlands.

Targeting healthy ecosystems

A team of NIWA experts has provided advice to the Ministry for the Environment on a suite of proposed estuarine and coastal attributes they are considering for adoption into the first National Planning Framework.

Estuaries and saltmarshes are areas of water on the coast where seawater mixes with freshwater from rivers and streams. Sediment washed down through waterways can affect the plants, animals and values associated with these environments. Managing the impacts of sediment is vital to the ongoing health of these biologically productive ecosystems.

NIWA's sediment management recommendations stem from knowledge collected over 20 years and support the development of estuarine and coastal water attributes for the environmental limits and targets section of the new Natural and Built Environment Act.

Evidence has been synthesised into an action plan format based on attributes of a healthy ecosystem. End users, such as regional councils and communities, have been kept in mind, with the attributes focused on being evidence-based, measurable, transparent and accessible.

NIWA is providing sediment management recommendations to the Ministry for the Environment to help manage the ongoing health of estuaries and saltmarshes. [Lana Young]

ENABLING WATER SECURITY

IMPROVING WATER ALLOCATION AND RESOURCE MANAGEMENT

- Developing models and tools for planning and decision making
- Identifying locations for storage and hydropower
- Providing guidance on water allocation frameworks

IDENTIFYING FLOW LEVELS NEEDED TO MEET CULTURAL, BIODIVERSITY AND ECOSYSTEM REQUIREMENTS

- Partnering with Māori to assess cultural, environmental and economic flow needs
- Predicting flow requirements for a range of ecosystem health indicators

SUPPORTING LAND MANAGEMENT AND WASTEWATER TREATMENT THAT PROTECTS HUMAN AND ECOSYSTEM HEALTH

- Developing models that predict the effects of alternative land use on aquatic ecosystems
- Developing appropriate wastewater treatment methods
- Developing standards and guidance for urban and rural pollution mitigation

Flow rates over the Huka Falls fluctuate between 32 and 270 cubic metres per second. [Lana Young]

Going to sea for freshwater

NIWA has used several new techniques to map and understand the Waiwhetū Aquifer, a reservoir of freshwater that lies beneath the Hutt Valley and Wellington Harbour, and provides up to 70% of the capital's drinking water.

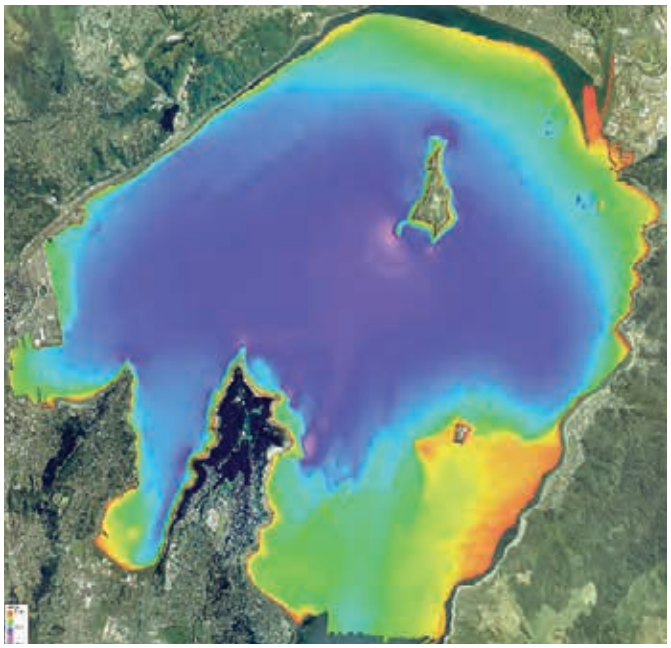
Natural freshwater springs are found in the ocean, as well as on land, but finding them can often prove challenging and involve expensive drilling programmes.

Wellington Harbour was a perfect site for testing new techniques, and NIWA marine researchers have used a combination of acoustic measurements, remotely operated vehicles, and seafloor and seawater sampling to track the harbour-based freshwater springs.

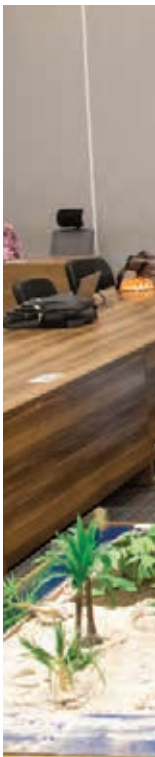
Video footage and acoustic soundings have revealed freshwater flowing out of hundreds of pockmarks in the harbour, the largest of which is more than 100m across.

The team is working on a detailed map of their findings, which will help with ongoing management of the aquifer.

A resident collecting water from a central filtration plant. [Mario Tama]



NIWA researchers applied new techniques to find and map underwater springs from the Waiwhetū Aquifer in Wellington Harbour. [NIWA]



Supporting Tuvalu's water security

Tuvalu is made up of nine small Pacific islands that are highly susceptible to the impact of climate change and water-related hazards. Rainwater is the primary source of drinking water, so regular droughts pose significant water security risk to this remote atoll nation.

The Tuvalu Integrated Water Resource Management project has produced localised plans linked with water resource forecasting tools, to give decision makers and community leaders the support to act early in the case of drought. NIWA has partnered in this project by leading the development of the Tuvalu Drought Forecasting tool that expands RiskScape to include all islands of Tuvalu and provide near real-time drought forecasting.

Tailored water dashboards deliver information to government, stakeholders and communities – providing a powerful decision-making tool to support the development of Tuvalu's water, sanitation, and drought action plans. Users can look at varied responses to forecast drought and manage limited assets, such as the centralised pool of desalination units deployed to islands with water shortages.

Training for Tuvalu users is planned for late 2023 and will include representatives from the Marshall Islands. They face many of the same water security issues, and planning is underway to expand the tool capability to their island group.

NIWA researchers are working closely with government, stakeholders and communities in Tuvalu to support the development of water, sanitation and drought action plans in the atoll nation. [Uatea Salesa, SPC]

GROWING A RESILIENT SEAFOOD SECTOR

ENABLING SUSTAINABLE FISHERIES MANAGEMENT

- Assessing and monitoring fish populations and communities
- Outlining the impacts of fishing and environmental change to improve management
- Partnering with Māori to support sustainability goals
- Increasing understanding of biological processes to improve single-species management

DIVERSIFYING AQUACULTURE BY DEMONSTRATING COMMERCIAL-SCALE, LAND-BASED CULTURE OF KINGFISH

- Demonstrating the economic and operational feasibility of land-based finfish farming by expanding production of market-sized kingfish to 600 tonnes per annum in NIWA's experimental commercial-scale Recirculating Aquaculture System (RAS)
- Maximising the quality and production of kingfish through ongoing broodstock, nutrition and systems development
- Increasing the productivity of existing cultured species and investigating the feasibility of culturing new species
- Working with Māori to explore the feasibility of culturing or enhancing target species

INCREASING RESILIENCE IN THE FACE OF ENVIRONMENTAL CHANGE

- Developing smart surveillance and diagnostic systems for biosecurity threats
- Developing solutions to manage the impacts of pests and diseases
- Developing ecosystem-based fisheries management, incorporating climate-change impacts on fisheries and marine ecosystems
- Partnering with Pacific Island fisheries agencies and stakeholders to diversify fisheries and improve food security in the Pacific
- Increasing knowledge of storm impacts, including sediment, carbon and pollutants, on the oceans and fisheries habitats to inform decision making and event recovery
- Developing climate impact predictions for marine heatwaves and other extreme events through AI and modelling

Ramping up kingfish production in NIWA's Recirculating Aquaculture System. [Stuart Mackay]

Assessing fish stocks

New Zealand's seafood industry plays a key role in the country's economy, generating nearly $2 billion in export earnings annually. NIWA provides scientific advice on fish stocks around New Zealand as part of our work for the Ministry for Primary Industries.

Stock assessments allow us to describe how fish populations have changed, and what the effects of different management decisions (e.g., quotas) are likely to be on future yields. Our models incorporate estimates of the productivity of the fish stock, data on the quantity, age and size structure of the catch and indices of abundance measured by surveys and other scientific research, alongside environmental indicators.

In 2022–23, NIWA carried out stock assessments for hoki, orange roughy, southern blue whiting, Antarctic toothfish, blue cod, scampi, silver warehou, trevally, and snapper. Assessments were supported by nine research surveys, catch sampling of more than 400 commercial landings, characterisations of commercial fisheries, projects on recreational fisheries, ageing of more than 15,000 fish otoliths, ongoing monitoring for Bonamia in oysters and studies on the environmental impacts of fishing.

RV *Kaharoa* hoki stock assessment survey. [Rebekah Parsons-King]

Yellowtail kingfish. [Stuart Mackay]

Commercial-scale aquaculture on land

NIWA's premium kingfish – Haku – are now ensconsed in New Zealand's first commercial-scale Recirculating Aquaculture System (RAS) at the Northland Aquaculture Centre in Ruakākā. The construction of eight 350,000-litre fish tanks, with two independent water treatment plants, is complete and operational.

A joint venture with the Northland Regional Council, the RAS project has been a key strategic priority for NIWA. It represents the next stage in proving the economic, operational and environmental viability and benefits of growing kingfish to market size in a land-based aquaculture system. When operating at full capacity, the unit will demonstrate the practical use of this technology for the commercial, whole-of-cycle production of finfish – sustainably producing about 600 tonnes of kingfish every year.

This is the realisation of years of research and development that will help the aquaculture sector move towards its goal of $3 billion by 2035. The product is a white-fleshed fish with outstanding growth credentials and unequalled taste characteristics, grown in a fully controlled environment with an extraordinarily low footprint. This RAS technology could be replicated in many other coastal sites around New Zealand, and it could be used to produce other high-value species – including hāpuku, salmon or rock lobsters.

GROWING SUSTAINABLE RENEWABLE ENERGY

ACCELERATING GROWTH OF RENEWABLE ENERGY

- Identifying renewable energy generation and storage options
- Developing new renewable energy technologies
- Supporting small-scale, multi-source power schemes for rural communities

ENABLING ENERGY INFRASTRUCTURE RESILIENCE UNDER CLIMATE CHANGE

- Testing future generation, demand and transmission against climate-change scenarios
- Advising infrastructure agencies on hazard, risk and resilience
- Using AI to optimise electricity generation
- Partnering with Māori to understand risks and impacts of electricity generation under a changing climate

MINIMISING THE ENVIRONMENTAL IMPACT OF THE ENERGY SECTOR

- Advising existing and new renewable energy operations
- Developing approaches to reduce the environmental impacts of electricity generation
- Helping hydropower companies design environmentally sustainable water flow regimes
- Supporting development of the offshore wind industry through environmental assessment and impact services
- Partnering with Māori to reduce the environmental impact of electricity generation

Each turbine at Mercury's Mahinerangi Wind Farm, 50km west of Dunedin, can generate up to 3MW of renewable energy. [Lana Young]

Informing New Zealand's renewable energy strategy

Over 80 percent of the electricity generated in New Zealand comes from renewable sources – wind, sun, geothermal and water; most of which is hydro generated. To reach the 100% renewable energy target by 2030 New Zealand's long-term energy strategy needs to understand the effects of a changing climate on the critical inflow into our hydro lakes, and how wind and solar power generation options can be integrated and optimised to meet the increasing demand for power.

NIWA modelling underpins the bulk of potential renewable energy predictions in New Zealand. A recent assessment for the Ministry for Business, Innovation & Employment looked at the correlation between historical climate variability and renewable energy generation, including an assessment of New Zealand's ability to generate renewable energy under future climate scenarios.

These climate and energy predictions support government energy investment decision making and will ensure New Zealand has the efficient and reliable renewable sources of power to meet our future demands. This information will also inform a national policy statement for the management of water in hydro catchments, balancing downstream ecological needs with sufficient and efficient renewable energy production.

The Benmore hydro station generates enough electricity to supply approximately 298,000 average Kiwi homes per year. [Meridian Energy]

Offshore wind farms

High-speed, consistent ocean winds offer the potential for significant electricity generation. With its long coastline and prevailing westerlies, New Zealand is well positioned to take advantage of one of the best offshore wind energy resources in the world.

The Government has signalled it wants to encourage the development of offshore generation to help New Zealand meet its target of 100% renewable electricity generation, along with net-zero emissions by 2050. The Ministry for Business, Innovation & Employment has been charged with developing regulatory settings to enable investment in offshore generation and expects this framework to be in place by 2024.

Power generators are already considering potential options and will need considered designs supported by scientific evidence to advance to ultimate completion.

NIWA is providing advice to potential developers to allow better understanding of the environmental impacts offshore developments may have on seabirds, fish, benthic communities and marine mammals.

Offshore wind farm [Tom Buysse]

OUR PEOPLE

Twenty scientists and 18 crew travelled onboard RV *Tangaroa* to the Ross Sea on a six-week Antarctic voyage over the 2022–23 summer. [NIWA]


YAMAHA

OUR PEOPLE

NIWA freshwater ecology technician Rochelle Petrie, Principal Technician – Environmental Chemistry Greg Olsen and Bay of Plenty Regional Council's Darryn Hitchcock (standing) install Rod Surface Elevation Tables (RSET) in the saltmarshes of Athenree Estuary to help monitor the extent to which the wetland can adapt to sea-level rise. [Lana Young]

The scientific and technical knowledge and expertise of our high calibre workforce is in increasing demand to provide solutions for some of the most pressing issues of our time.

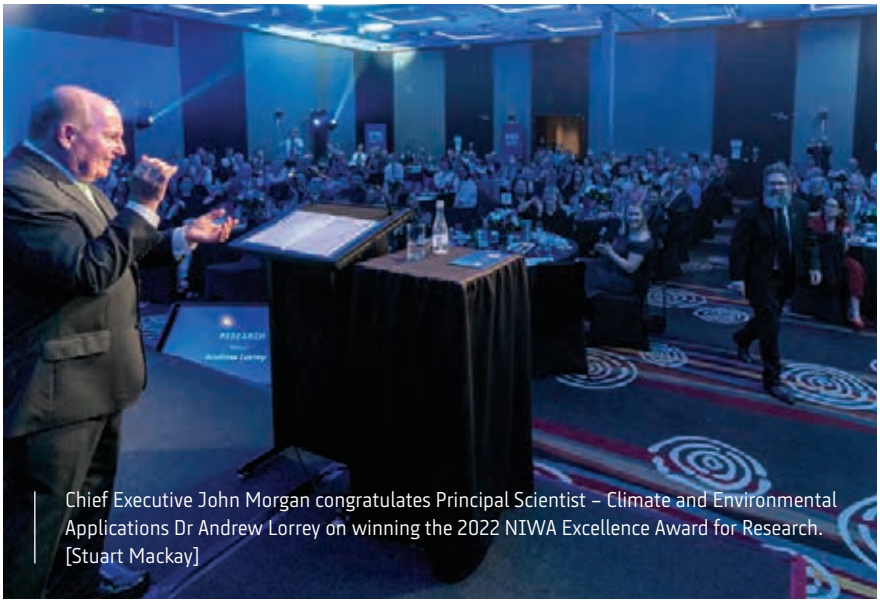
Attracting and retaining talent

The employment market remains highly competitive and required our ongoing focus to ensure we attracted and retained the key skills we need. Demand for our scientific services led to an additional 28 new permanent positions being created over the course of the year, and we continue to successfully source the skills and expertise we need, both from within New Zealand and internationally.

Our approach to recruitment and selection reflects best practice principles and methods, with a structured, competency-based selection process undertaken for all appointments. An in-depth induction covering generic and job-specific information is provided for all new staff, to ensure their early experience of NIWA is supportive and welcoming. A post-entry interview is carried out after three months to ensure new staff are settling in well and to enable any issues they may be experiencing to be identified and addressed. We regularly review the induction process to ensure its relevance, quality and consistency.

Fisheries acoustic scientist Alina Madita Wieczorek and marine ecology technician Oliver Evans sort through scampi on the deck of RV *Kaharoa* during a six-week voyage to the Auckland Islands to survey scampi populations. [Tran Lawrence]

Keen staff at NIWA Wellington braved a blustery southerly and plunged into the 11°C harbour waters as part of the annual midwinter swim. [Rebekah Parsons-King]



Chief Executive John Morgan congratulates Principal Scientist – Climate and Environmental Applications Dr Andrew Lorrey on winning the 2022 NIWA Excellence Award for Research. [Stuart Mackay]

Continuing our commitment to health and safety

NIWA maintains a constant emphasis on the health, safety and wellbeing of all those involved in our work. Continuous improvement is central to this approach, and adjusting our health and safety management system is an ongoing activity that is risk-focused, driven by staff and aimed at safer work practices. The use of additional dashboards to display health and safety data over the last year has provided valuable insights into the risk profile of our operations and assists with prioritising the allocation of resources to risk-reduction activities that will have the most impact.

A health and safety lens was applied across the construction of new facilities at our Bream Bay and Hamilton sites, and it helped identify changes in work practices and the layout of work areas to enable safer work. The need for COVID-19 response protocols dropped off for most of our operations over the year. However, diligence was still required on our vessels, with COVID protocols remaining in place to reduce the risk of on-board transmission and disruption to a voyage. Ensuring effective management of our critical risks and controls will remain the key focus in the coming year.

Employment relations, engagement and collaboration

We are committed to the good employer requirements of Section 118 of the Crown Entities Act 2004, and our People & Capability practices and policies are consistent with the fair and proper treatment of staff in all aspects of their employment.

Engagement regarding workplace practices and policies between management, employees and employee representatives occurs on an ongoing basis. The Executive Team holds several Roadshow events each year at our main sites to provide an update on organisational priorities, objectives and performance, and to engage with staff on topical issues. Staff and their unions are consulted on any proposed changes to employment policies and terms and conditions, with their input influencing the final outcomes.

There is regular engagement with staff and their representatives relating to our multi-year property development programme, to facilitate ongoing constructive partnership on this project.

A NIWA-PSA Pay Equity Working Group was established in 2022 to implement the government's Kia Toipoto gender and ethnic pay equity initiative. This group has met regularly and worked constructively over the year to conduct and report on pay gap analyses, consult with staff, and produce and implement the Kia Toipoto Action Plan for the 2023 calendar year.

An Early Career Research group including staff and tertiary students who are hosted or supported by NIWA was recently established. Initial discussions have been productive, with the intention of ongoing liaison and dialogue with the Executive Team.

Talent development

We prioritise investment in continual professional development of our highly skilled and educated workforce. A range of leadership and management workshops

are offered annually, including Recruitment & Selection, Crucial Conversations, Mental Health Awareness, Challenge of Change – Resilience, Personal Effectiveness and Coaching. We recently introduced a Leadership Development Seminar series, where lunchtime webinars are run for interested staff on aspects of leadership, followed by a one-hour virtual interactive workshop for those wanting more information and skills application. Topics have included Maximising Your Development, Thriving in Uncertainty, Emotional Intelligence and Feedback. A variety of other seminars and workshops are also offered across the regions. Most staff also receive three personal development leave days per year to undertake activities to enhance their wellbeing and broader personal development.

Our annual organisation-wide workforce planning process considers capability and capacity requirements for our science and support staff in light of market and workforce dynamics. Succession plans are reviewed, and talent acquisition and transition plans are established in relation to staff signalling departure. High-potential and high-performing staff are identified, along with those requiring additional support to lift their performance to required levels. This sets the broader context for annual Performance and Development Reviews and half-year Progress Reviews, where managers and team members come together to review performance and development objectives, agree new objectives, discuss accomplishments and consider career development aspects.

The NIWA Te Kūwaha team at Te Papa Tongarewa, Wellington. [Rebekah Parsons-King]

Developing senior leaders

The Senior Leadership Development Programme is now in its third year. This programme identifies high performing and high potential current and future leaders, and provides an intensive development experience for them over a three-year period. Participants experience psychometric assessment, 360-degree feedback, peer coaching, mentoring from

Researchers work with crew onboard RV *Tangaroa* to prepare a sediment trap mooring for deployment to recover deepsea samples from the Southern Ocean seafloor. [Joshu Mountjoy]

Pou Maherehere – Māori Project Coordinator Sam Toka leads the waiata at the opening of the new NIWA Hamilton office. [Stuart Mackay]

senior leaders, action learning opportunities and discussions of contemporary leadership literature. Programme content includes personal effectiveness, coaching, emotional intelligence, bicultural competency, strategic thinking and leading in complexity. A new cohort of 12 began their programme in February 2023.

Promoting diversity, inclusion and wellbeing

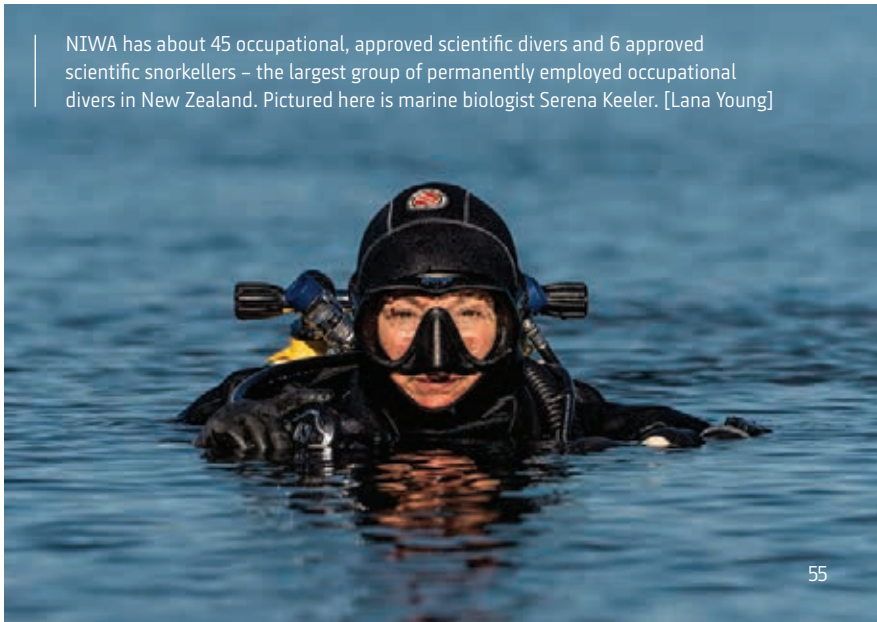
We have continued to promote our in-house Understanding Gender Dynamics in the Workplace training module for managers, which emphasises the principles of fairness, equity and non-discrimination in employment. Completing this training is now compulsory for all new managers within two months of assuming their management position. We also offer an online training course on Unconscious Bias, which is available to all staff through the Digital Learning Hub, and has been refreshed and expanded. This is now compulsory for NIWA managers and staff serving on interview panels, Level Review committees, Excellence Award panels, and other decision-making panels.

We continue to enable a group of staff trained as contact people to support our Unacceptable Behaviour Policy & Resolution Process and be available as a first point of contact if others require assistance. We remain committed to improving awareness of family violence and ensuring staff who may be impacted by family violence are safe and supported in the workplace, providing training for contact people and managers, and promoting access to SHINE, a specialist family violence support organisation. Our recruitment advertising emphasises that we welcome a diverse range of candidates, including members of the Rainbow community.

We provide a family-friendly workplace, with flexible start and finish times, part-time working arrangements and opportunities for staff to make arrangements that help them balance personal and work commitments, in discussion with their manager. We promote the value and importance of attendance at the physical workplace as the primary place of work, however, in achieving maximum individual and team productivity and wellbeing.

In terms of staff wellbeing, managers are the primary point of connection and support for staff – helping their teams bolster resilience, identifying and mitigating risks and connecting staff who need support with appropriate services. NIWA has a strong element of pastoral care running through its culture, and our managers regularly go above and beyond to ensure staff are supported and enabled in this respect.

From a physical wellness perspective, we offer opportunities including workstation assessments, free on-site skin checks, manual handling training and flu vaccinations for all staff. The People & Capability team maintain an intranet Wellness Hub with a range of physical, mental, financial and social wellness resources.



NIWA has about 45 occupational, approved scientific divers and 6 approved scientific snorkellers – the largest group of permanently employed occupational divers in New Zealand. Pictured here is marine biologist Serena Keeler. [Lana Young]

Recognising, rewarding and celebrating our people

This year we celebrated 35 science level promotions, which follow a comprehensive peer review process and represent years of practical application and knowledge development. Our remuneration framework includes regular internal and external benchmarking to ensure staff receive fair and competitive remuneration compared with the market, and have an attractive package of employment terms and conditions. We continue to apply the Living Wage as the minimum across the organisation, and to offer an annual cost-of-living salary adjustment for all staff, subject to affordability.

The annual NIWA Excellence Awards recognise outstanding performance across 12 categories, and the annual staff photography competition has 6 award categories.

The NIWA Communications Team's campaign highlighting research into the Tongan underwater volcanic eruption won the Supreme Award at the 2023 PRINZ Awards. [PRINZ]

Principal Scientist – Climate and Environmental Applications Dr Andrew Lorrey and University of Otago colleagues dig a snowpit on Brewster Glacier for mass balance monitoring. [Gregor Macara]

Developing future talent

NIWA's people frequently have lead roles in national and international conferences, workshops and working groups. Staff showcased NIWA expertise and collaboration, held chairing roles, presented keynote addresses and contributed to international councils and advisory groups. With the return to in-person attendance at international forums, 105 staff attended international conferences. Of these, 65 were funded via the NIWA Overseas Travel fund and the remainder by conference bodies, the United Nations or associated entities. In addition, over 130 staff attended about 40 domestic conferences. Resumption of international travel also saw at least 89 trips undertaken for project work, predominantly in the Pacific, and eight staff were able to undertake their QEII Technician, Royal Society of New Zealand Catalyst and other training awards overseas.

About 80 workshops were run and attended by NIWA staff in conjunction with central and local government, iwi/hapū, Pacific Island entities, large commercial clients and international and United Nations bodies. These included research and strategy co-development with stakeholders, education and training, project partnership meetings and knowledge and tool sharing.

Meteorologist Chris Brandolino explaining NIWA's Drought Forecasting tool at the 2023 National Agricultural Fieldays. The tool delivers projections of dryness and drought risk out to 35 days ahead. [Lana Young]

Nine NIWA staff were seconded to government agencies and stakeholders during 2022–23, and six NIWA staff held appointments with New Zealand universities, with many others holding adjunct roles. NIWA supervised 56 PhD, 18 Masters and 3 Bachelor students nationwide and 1 postdoctoral and 20 PhD positions were financially supported. In addition, NIWA staff supervised nine international students – six PhD and three Masters. Several staff are undertaking PhD graduate programmes with Victoria University of Wellington and the University of New South Wales, supported by their NIWA activities.

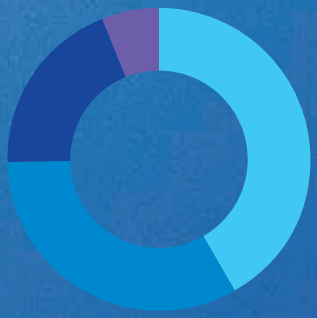
Trainees from Pacific and other countries, as well as a wide range of researchers, interns and students – including 11 domestic, 6 international interns, 4 BLAKE Ambassadors and 1 Wintec placement – trained or worked on science projects alongside NIWA staff.

NIWA continues to support the major school science and technology fairs in Auckland, North Harbour, South & East Auckland, Waikato, Bay of Plenty, Wellington and Canterbury-Westland, as well as regional fairs, through sponsorship, promotion and staff involvement in judging and award ceremonies.

After a three-year hiatus due to COVID-19 restrictions, staff at NIWA Wellington were excited to compete in the annual Poultice event, celebrating the shortest day of the year. [Caroline Beamish]

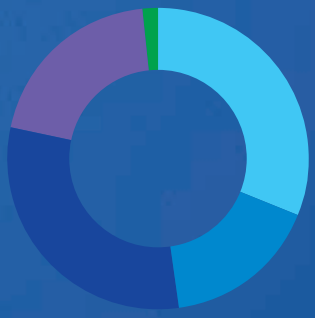
NIWA BY THE NUMBERS

ROLES



- **Scientists** 41.9%
- **Technicians** 33.0%
- **Support** 19.2%
- **Operational support** 5.9%

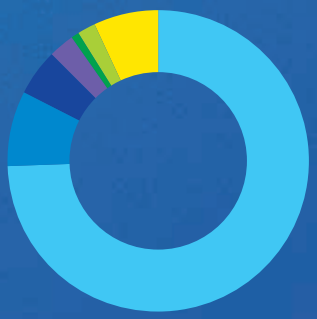
HIGHEST QUALIFICATION



- **Doctoral degree** 31.3%
- **Master's degree** 16.5%
- **Bachelor's level*** 30.6%
- **Other** 20.0%
- **No qualification** 1.6%

* Includes Graduate Certificates and Diplomas, Bachelors (Honours) and Postgraduate Certificates and Diplomas.

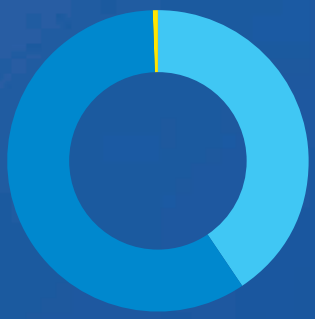
ETHNICITY



- **European** 74.7%
- **Asian** 7.8%
- **Māori** 5.1%
- **MELAA** 2.8%
  (Middle Eastern/Latin American/African)
- **Pacific Peoples** 0.9%
- **Other** 2.0%
- **INP** 6.7%
  Information not provided

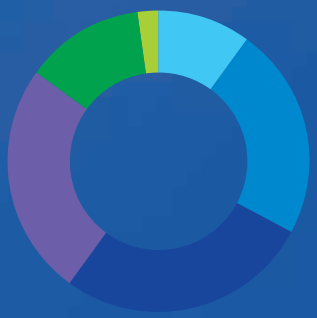
* Some employees identified with more than one ethnicity and some staff did not provide this voluntary information. The percentages represented are based on all ethnicities reported.

GENDER



- **Female** 40.7%
- **Male** 59.0%
- **INP** 0.3%
  Information not provided

AGE



- **20–29** 10%
- **30–39** 23%
- **40–49** 27%
- **50–59** 25%
- **60–69** 13%
- **70+** 2%

RECRUITMENT

28 approved new permanent positions

71 approved permanent replacement positions

22 approved fixed-term positions

EMPLOYMENT STATUS

95% Permanent

5% Fixed-term

WORKING ARRANGEMENTS

89% of staff work full time

LEVEL PROMOTIONS

32 Level Promotions

TURNOVER

8.28% turnover to the end of June for the NIWA Group

DISABILITIES

13% of NIWA staff identified that they have a form of disability

PERSONAL DEVELOPMENT LEAVE (NIWA SCIENCE)

3 days of Personal Development Leave is provided for staff members, excluding those on management employment agreements

NIWA GROUP BY LOCATION

741
NIWA STAFF

706
FULL-TIME EMPLOYEES

79
NEW EMPLOYEES

2023 NIWA EXCELLENCE AWARD WINNERS

APPLIED SCIENCE

Dr Cyprien Bosserelle

Cyprien is an internationally regarded hydrodynamic modeller, working in NIWA's environmental hazards team. His expertise is pivotal in the development of fast, accurate open-source solutions to complex physical processes and hazards phenomena.

Of particular note is his development of two highly efficient GPU-enabled software modelling tools – BG-Flood, one of the first open-source pluvial, fluvial and coastal flood models available, and XBeach-GPU, an adaptation of an existing storm process model. He has also developed a real-time, tsunami inundation and impact forecasting system for Samoa and Tonga.

Cyprien leads the application of these and other tools in numerous projects, working closely with regional, national and international stakeholders to increase understanding of environmental risk.

RESEARCH

Dr Céline Cattoën-Gilbert

Céline leads NIWA's national flood flow forecasting work. The scientific challenge is massive, particularly in ungauged catchments, and her ensemble flood forecasting plays a pivotal role in shaping New Zealand's resilience to future climate challenges.

Céline's collaboration with international agencies, rain radar experts and NIWA data scientists underpins her flood forecasting expertise, and her close engagement with central and local authorities enables continuing improvement and fine tuning of her regional flooding and catchment models. After Cyclone Gabrielle, Céline developed an extreme event version of flood forecasting, allowing both expected return period and likelihood of an extreme event to be displayed simultaneously for each river reach.

The regard with which her research is held is underscored by her recent appointment as co-chair of the Integrated Hydrology and Precipitation Project of the World Weather Research Programme.

PROJECT DELIVERY

Dr Alan Orpin

Alan is a highly experienced ocean sedimentologist, who has become a key project manager, taking responsibility for an impressive dossier of research projects from proposal through to final delivery, across the marine environment.

These projects range from seismic investigations of the Hikurangi Subduction Zone to hydrographic surveys of Lyttleton Harbour – NIWA's shallowest-ever marine seismic survey – along with numerous and occasionally sensitive environmental and seabed investigations for external clients.

Many of these assignments have involved disciplines outside Alan's core expertise, and it is a testament to his project management skills that he has consistently planned, resourced, administered and delivered these large-scale projects, on time and within budget – delivering excellent outcomes for both NIWA and our clients.

SCIENCE COMMUNICATION

Rebekah Parsons-King

Rebekah has had a stellar year in her role as NIWA senior visual content producer, with her compelling imagery taking NIWA's science to new audiences, on both a national and global scale.

A natural, imaginative and innovative storyteller, Rebekah works alongside researchers in the field, capturing still and video images and compiling them into communication packages that explain how and why NIWA science makes a difference.

From Cyclone Gabrielle to snowline surveys, the impact of her portfolio is profound – her 15-minute YouTube documentary about NIWA's Tongan volcanic eruption research voyage has already registered over 750,000 views – NIWA's most successful video production ever.

LEADERSHIP

Dr Pablo Escobar-Flores

As manager of the Fisheries Monitoring and Acoustics group, Pablo leads a high-performing team of researchers and technicians focused on contributing to a resilient New Zealand seafood sector.

Pablo prioritises the professional and personal development of his team, enabling them to secure key contracts and deliver significant fisheries monitoring projects across the sector – including leading surveys and other significant projects, such as fisheries trawl surveys, scampi surveys and acoustic surveys.

His exceptional leadership is particularly demonstrated by his ability to support individual growth, promote leadership, facilitate research engagement, resolve conflicts and create a collaborative work environment.

EARLY CAREER SCIENCE

Rebecca Welsh

In little over two and a half years since joining NIWA, Rebecca has developed a growing reputation as a remarkable climate and hazard risk modeller, showing extraordinary initiative, versatility, research excellence and communication skills.

Her research has already been incorporated into models for New Zealand's coastal floodplain risk – extreme sea-level flooding maps providing the first national view of coastal flood hazard exposure with rising sea levels – and is also being implemented across six Pacific countries to profile building, infrastructure and primary production sector economic risks to coastal flooding and sea-level rise.

Rebecca is an equally accomplished climate change adaptation and risk communicator. She led NIWA's Climate Change Adaptation Toolbox project, developing and presenting lesson plans to teachers, students and communities across the country.

Her work has been published in national hazard risk journal articles, and she now trains and mentors new staff in risk analysis and the multi-hazard software application, RiskScape.

2023 NIWA EXCELLENCE AWARD WINNERS

CUSTOMER FOCUS

Sarah McDermott

In her role as Research Development Manager, Sarah supports staff in their bids for research funding and has a significant impact in shaping the success of NIWA's science.

Her expertise in moulding initial research ideas into high-quality funding proposals, along with her deep knowledge and understanding of the expectations of funders, directly benefit our researchers, collaborators and customers.

Working proactively with science leads and funding agencies, Sarah helped identify urgent research needs in the immediate aftermath of the extreme weather events earlier this year. This intervention directly enabled the rapid deployment of researchers from NIWA and our collaborating organisations into the field to obtain time-critical data to support the national response and recovery efforts.

OPERATIONAL INNOVATION

Grace Frontin-Rollet

Grace has consistently demonstrated her commitment to new initiatives in her drive to attain laboratory operational excellence. She has improved all aspects of laboratory operation – streamlining processes and instituting new operating requirements to improve effectiveness, without compromising safety protocols or operational requirements, and upgrading equipment to improve effectiveness and delivery.

Her work in developing and implementing shipboard trace metal analysis was central to the science achieved on the Tongan volcanic eruption voyage and the recent Antarctic voyage. She developed a world-first prototype leaching column to study the effects of volcanic ash on the seafloor, water column and benthic communities, and the sedimentology laboratory she manages is fully booked months in advance, demonstrating the success of her innovation and its usefulness to a range of users across the science sector.

SUPPORT SERVICES

Victoria McIntyre

Victoria leads the Wellington region support team responsible for administrative services for the 300 staff, students and visitors working at NIWA's Wellington and Lauder sites.

While managing a team of 11 fulltime and casual staff, Victoria also provides support to the three Wellington Regional Managers and oversees the Site Safety Administrator role.

No task is too complex or difficult for Victoria, and she is the go-to person for anyone seeking a solution to their operational needs. The efficient, positive and responsive support from Victoria, and her team, is a testament to her leadership, knowledge and dedication.

HEALTH & SAFETY

Jan Stuart

Jan's knowledge of NIWA's processes and operations, drive for solutions, and superb organisational skills mean she is a crucial element in NIWA's health and safety network.

She has been instrumental in ensuring key safety messages are delivered across the organisation. As a member of the NIWA National Emergency Response Team, Jan played a key role during and after events such as the Christchurch earthquakes, 2019 mosque attack and NIWA's COVID response. During the height of the pandemic, she was influential in producing and administering many of the operational processes that NIWA relied on to be compliant and keep staff functioning well.

She has also worked proactively to improve Business Continuity Plans and training and Coordinated Incident Management System training and scenario exercises for national and regional response teams.

TEAM

Caulerpa Biosecurity Team – Irene Middleton, Crispin Middleton, Oliver Evans, Richie Hughes, Roberta D'Archino, Jessie Scarrott

This team has been at the spearhead of the national biosecurity response to two invasive marine algae, *Caulerpa brachypus* and *C.parvifolia*, in the Hauraki Gulf and Te Tai Tokerau.

After caulerpa's initial discovery on Aotea Great Barrier Island in 2021, the team has worked across Biosecurity New Zealand's response, from detection, delimitation and eradication to ecological impacts research and engagement with mana whenua. In the first year alone, this work involved more than 60 days in the field and more than 400 dives.

This year the team returned to Aotea to examine the effects of caulerpa on native species, guiding national management efforts, and in May they responded immediately to reports of caulerpa in the Bay of Islands and then coincidently sighted another new incursion at Kawau Island.

The team routinely responds at short notice, showing great agility, creativity and professionalism, with the highest standards in stakeholder engagement, health & safety planning and meticulous specialised marine operations.

TE PUĀWAITANGA

Dr Joshu Mountjoy

Joshu has been instrumental in setting up and chairing the voyage protocols working group, which has outlined new protocols to significantly improve NIWA's practices over iwi and hapū engagement in ocean research. He is open and respectful of tikanga and protocols set by iwi and hapū, and what is expected by Māori communities.

He is leading key aspects of offshore surveys into the impact of Cyclone Gabrielle and other extreme weather events in Te Tairāwhiti, and is leading NIWA's response to an urgent request from Tūwharetoa Māori Trust Board for technical expertise to support investigations into the impact of seismic activity in Taupō Moana.

Joshu's cultural competence has enabled him to navigate Te Ao Māori issues to ensure NIWA's engagement with Māori is tika, and he is committed to helping grow the cultural competency and awareness of other non-Māori staff.

EXTERNAL AWARD WINNERS

Dr Phil Barnes
Francis P. Shepard Medal

Principal Scientist Phil Barnes has been awarded this prestigious medal for excellence in marine geology by the Society for Sedimentary Geology. Phil's is one of New Zealand's premier geoscientists, working primarily on plate boundary tectonics and active seabed processes.

Dr Kim Currie
Marine Sciences Society Award

Marine chemist Kim Currie was recognised for her long-running Munida Time Series and ongoing research into the uptake of atmospheric CO_2 in the waters of the South Pacific. Kim's enthusiastic support for involving students in her work was also acknowledged.

Karen Thompson
Queen Elizabeth II Technicians' Award
SETAC AU Technical Award

Principal Technician, Karen Thompson received two awards this year. She travelled to Melbourne to investigate ecotoxicology testing methods for her QEII study award and was also recognised by the Australasian Society of Environmental Toxicology and Chemistry for her work on testing protocols for native species.

Dr Ashley Rowden
John Morton Medal

Principal Scientist – Marine Ecology, Ashley Rowden was acknowledged by the Marine Sciences Society for his work in the advancement of marine conservation and sustainability. Ashley is globally recognised for his research on conservation of deepsea ecosystems in the face of anthropogenic impacts.

Jeff Forman
Queen Elizabeth II Technicians' Award

Fisheries technician and QEII award winner Jeff Forman used his award to travel to Oxford University Museum of Natural History to study shrimp identification systems and advanced taxonomy techniques.

Daniel Morrish
Queen Elizabeth II Technicians' Award

Air quality technician Daniel Morrish used his QEII study award, along with MBIE Catalyst funding, to investigate air quality research programmes at institutes and universities in the United Kingdom, Germany, Norway and Sweden.

Dr Emily Lane
Outstanding Reviewer

Principal Scientist for natural hazards and hydrodynamics, Dr Emily Lane has been recognised by the American Geophysical Union as an Outstanding Reviewer for the Journal of Geophysical Research – Oceans.

NIWA Communications Team – Sarah Fraser, Rebekah Parsons-King, Jessica Rowley & Rory Newsam
Public Relations Institute of New Zealand – Gold and Supreme Awards

"A Shotgun Blast from The Deep" – the NIWA Communications Team's campaign highlighting research into the Tongan underwater volcanic eruption, won Gold in the Best Use of Media Relations category at the PRINZ 2023 Awards. The judges then voted the team's campaign Supreme Award winner, across all categories – the first time a science-based project had won the Supreme Award in more than a decade.

Nava Fedaeff
Eagle Technology Esri 2022 StoryMap Award

Climate, Atmosphere & Hazards Manager Nava Fedaeff's innovative depiction of climate data to help explain NIWA's Annual Climate Summary was recognised with Nava winning the NZ Esri User Conference StoryMap competition.

Science New Zealand Awards

NIWA's climate and marine science was recognised at the 2022 Science New Zealand Awards.

Marine sedimentologist Dr Katie Maier won Early Career Researcher for her work on submarine canyons and their potential as carbon sinks.

The Lifetime Achievement Award was awarded to Principal Scientist for Climate and Environmental Applications, Dr Andrew Lorrey. Drew leads multiple projects in historic and paleoclimatology research and has greatly enhanced our understanding of New Zealand and South-West Pacific climate variability.

The Team Award was won by the National Marine High Risk Site Surveillance Field Team Leaders. The Field Teams are engaged in the early detection of marine pests at ports and harbours around New Zealand – a critical component of Biosecurity New Zealand's work to protect our marine ecosystem and maritime industries from unwanted incursions.

National Marine High Risk Site Surveillance Field Team

Dr Katie Maier

Dr Andrew Lorrey

NIWA PHOTOGRAPHY AWARDS

AFTERGLOW - Jill Scott
PHONE PHOTO

For months after the 2022 Tongan volcanic eruption, New Zealand experienced vibrant pink and purple 'afterglow' sunsets and sunrises due to aerosols ejected from the volcano, seen here in Wellington.

PELAGICA BLOOM - Richie Hughes
OUR PEOPLE

Marine ecology technician Richie Hughes captures himself diving with mauve stinger jellyfish in the Poor Knights Islands in an image the judges described as "taking selfies to the next level".

SEA PEN GARDEN FIORDLAND - Irene Middleton
OUR PLACES

It was the surreal, otherworldly feel of this image of a garden of sea pens in the Te Awaatu Channel Marine Reserve in Doubtful Sound that captured the judge's attention.

WHEELHOUSE SMILES - Tran Lawrence
OUR WORK

The documentary style of this photograph, taken during a six-week scampi survey voyage off the Auckland Islands, stood out for the judges.

CRAYFISH RIDING JELLYFISH – Irene Middleton
SPECIAL AWARD

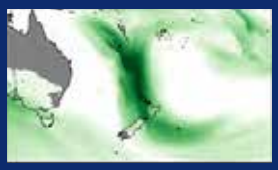
A slipper lobster phyllosoma hitches a ride on a mauve stinger jellyfish in New Zealand's northeastern waters.

TWO SIDES OF EXPERTISE - Tran Lawrence
PEOPLE'S CHOICE

The public loved this shot, voting it their favourite in an online competition, and Tran's chosen charity the Aotearoa NZ Breast Cancer Community has benefited from his $1,000 win.

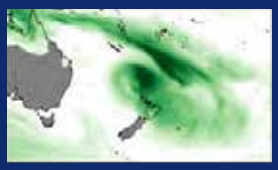
THE YEAR OF THE ATMOSPHERIC RIVER - Ben Noll
DATA VISUALISATION

The data visualisation category was created to encourage the creative presentation of information. The inaugural winner was meteorologist Ben Noll with his presentation of the atmospheric rivers that impacted New Zealand this year. These long, moisture-laden, plume-like rivers in the sky made frequent landfall on our shores.

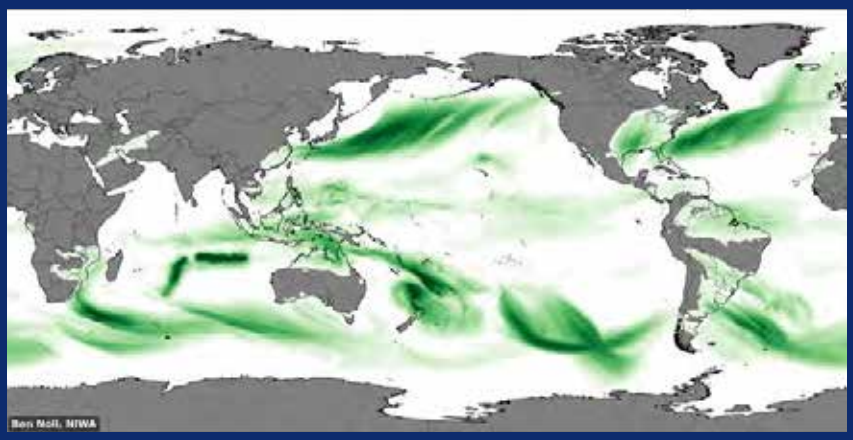


Nelson Floods - Aug 2022

Auckland Floods - Jan 2023



Cyclone Gabrielle - Feb 2023



Cyclone Gabrielle - Feb 2023

FIORDLAND - Katie Cook
EMERGING PHOTOGRAPHER

Katie captured this image during a wet and misty tramp up to Lake Marian in Fiordland National Park.

NIWA Photo Competition entry – Central Otago.
[Adrian Aarsen]

BOARD OF DIRECTORS

BARRY HARRIS

Chairman

Chairman Barry Harris is a company director with extensive governance and executive experience. Barry has held a number of chief executive roles including Environment Waikato, Greater Wellington Regional Council and Hamilton City Council. He was also a senior executive with Fonterra for five years. Barry currently chairs Food Innovation Waikato, OSPRI, McFall Fuel, Hamilton Airport Company and Wel Networks. Previous boards include DairyNZ, Primary ITO, CentrePort, RD1, AgResearch, International Nutritionals, Hamilton Riverside Hotels and Local Authority Shared Services. Barry has a Masters of Agricultural Science (Honours).

DR TRACEY BATTEN

Tracey is an experienced non-executive director who serves on the boards of EBOS Group Limited, Medibank Private Limited and the Accident Compensation Corporation, where she is Deputy Chair. She was previously a director of Abano Healthcare Group Limited and other healthcare-related research institutes, charities and industry and government bodies. During her executive career she was Group Chief Executive of Imperial College Healthcare NHS Trust in the United Kingdom, Group CEO of St Vincent's Health Australia and CEO of a number of other healthcare groups in Australia. Tracey is a qualified medical practitioner with an MBA from Harvard University. She is a Fellow of the Australian Institute of Company Directors and a Chartered member of the New Zealand Institute of Directors.

MARY-ANNE MACLEOD

Mary-Anne is a professional director and also provides strategic advice principally to local and central government agencies. She is currently on the boards of the Environmental Protection Authority, DairyNZ, AgResearch, Fire and Emergency New Zealand, and on the University of Waikato Council. She has previously served on the boards of Bay Venues Limited, Quayside Holdings Ltd and House of Science. She was the Chief Executive of the Bay of Plenty Regional Council for seven years and held senior roles in the Ministry for the Environment. She worked internationally in multi-national environmental and engineering companies, where she specialised in environmental management providing advice across a range of sectors. Mary-Anne has a Master of Science (Hons) in Earth Sciences and Geography.

DEAN MOANA

Dean has held various director and senior management roles in Aotearoa's food and seafood sectors. He was Managing Director and CEO of Prepack Ltd and previously held Chief Executive and General Manager roles within Aotearoa Fisheries Group, New Zealand's largest Māori-owned fisheries company. He is a director of Plant & Food Research and AsureQuality, as well as serving on the board for Akaroa Salmon NZ and Port Nicholson Fisheries. Of Ngāti Porou and Apanui descent, Dean is also a Director of Te Runanganui o Ngāti Porou and its commercial entity Ngāti Porou Holdings Ltd. He is a Fellow Chartered Accountant, has a BCA from Victoria University of Wellington and has worked in audit and business advisory for Ernst & Young.

LIVIA ESTERHAZY

Livia is a strategic business leader with experience across various sectors, including marketing, communications, finance, business, science and the environment. She has led retail brands in the IT and banking sectors, including the Commonwealth Bank of Australia and Kiwibank. She has also worked in the advertising sector, leading agencies including Clemenger BBDO, The Assignment Group, Saatchi & Saatchi and Ogilvy. She was most recently CEO of WWF New Zealand, which included participation in the Prime Minister's Chief Scientist panel for the future of commercial fishing in Aotearoa New Zealand. Livia has been a director both locally and globally and is currently a director of GNS Science, the Programme Director for A Lighter Touch and CEO of The Thrive Collective.

JANICE FREDRIC

Janice is a professional director with over 20 years' governance experience. She has a broad portfolio of current and past directorships with significant experience in commercial, public sector and not-for-profit sectors. She is currently Chair of the Civil Aviation Authority and the Aviation Security Service, a director of Mainpower NZ Limited and Aurora Energy Limited, Ministerial Appointee to the Lincoln University Council, an independent member of the Timaru District Council Audit and Risk Committee, and a trustee of the NZ Shipwreck Welfare Trust. Janice has held senior executive positions in the professional services sector and the finance and banking sectors both in New Zealand and internationally. She is a Chartered Fellow of the Institute of Directors and a Chartered Accountant. She has a Bachelor of Commerce and a Master of Business Administration.

PROF. MARGARET HYLAND

Margaret is Deputy Vice Chancellor Research at Victoria University of Wellington. She is a director of Cirrus Materials Science, a deep-tech spinout from university research, and a trustee of the Karori Sanctuary Trust (Zealandia). She previously held the position of Chief Scientist at MBIE. Prior to that she was Deputy Dean of the Faculty of Engineering at the University of Auckland and a director of the Science for Technological Innovation National Science Challenge. Margaret was also a member of Te Pae Kahurangi, the independent review of how well the CRIs were positioned to meet New Zealand's current and future needs.

EXECUTIVE TEAM

JOHN MORGAN

Chief Executive

John has extensive senior executive and governance experience in public and private sector organisations covering a range of markets and activities, including business, science, education and sport. His science sector roles have included Chairman of Science New Zealand, CEO of AgriQuality Ltd, Executive Director of Orica New Zealand Ltd, and Chairman of New Zealand Pharmaceuticals Ltd. John is passionate about the role science can play in transforming New Zealand's economy, environment, society and global reputation.

DR ROB MURDOCH

Deputy Chief Executive & General Manager, Science

PhD (Marine Science), University of Otago

Rob has a specialist interest in oceanography and marine ecology, and has been a practising scientist on projects associated with the Southern Ocean, aquaculture, oil and gas exploration and marine conservation. He has overseen the planning and direction of NIWA's research and the operation of the research vessels since 1999, and helps manage NIWA's relationships with key stakeholders and collaborators. Rob spent seven years on secondment to the Ministry of Business, Innovation & Employment as a Departmental Science Advisor.

WARRICK JOHNSTON

General Manager, Technology & Innovation

NZCE Civil, BSc (Geology), University of Otago, Dip Sci Computing, DCD (IOD)

Warrick joined NIWA as General Manager, Technology & Innovation in 2020. He has a passion for strategy, science and technology, and strives for innovative uses that positively impact businesses and people. He developed his skills through a career in start-ups, ISVs, niche technology companies and product companies such as Microsoft and ESRI. With more than 26 years' experience in strategy and development, product development, service creation and delivery and niche technologies, Warrick has the ability to understand complex technology combined with a practical nature and an understanding of market and business needs.

DR HELEN NEIL

General Manager, Operations

PhD (Earth Sciences), University of Waikato

Helen is an experienced geologist with interests in seabed mapping, oceanography, and stable isotope geochemistry. Her expertise has been applied to the management and delivery of large-scale, multidisciplinary projects and research voyages. Helen previously led the Ocean Sediments Research Group, joined the Operations Management Team in 2016 as National Projects Manager, and was appointed General Manager, Operations in July 2018.

GEOFF BAIRD

General Manager, Communications & Marketing

BSc Hons (Ecology), Victoria University of Wellington

Geoff has extensive experience in science publishing and communication from working with the Ministry of Agriculture and Fisheries, MAF Fisheries and NIWA. He became NIWA's Communications Manager in 2003 and General Manager, Communications and Marketing in July 2007, with a focus on reinforcing the values underlying the NIWA brand, enhancing communication and uptake of NIWA's science and demonstrating how NIWA enhances the benefits of New Zealand's natural resources.

PATRICK BAKER

Chief Financial Officer

MEng, Brunel University, London; BBus (Accounting and Management), GDip (Professional Accounting), Open Polytechnic of New Zealand; CA

Patrick is a Chartered Accountant. He began his career as an engineer with Ford Motor Company in the United Kingdom before moving into financial management. He served in senior country finance management positions in Europe and the Middle East before joining Ford New Zealand in 2004. After choosing to settle permanently in New Zealand in 2012, he was appointed CFO of The Network for Learning Limited. He joined NIWA as CFO in May 2014.

DR MARY-ANNE DEHAR

General Manager, People & Capability

PhD (Psychology), PGDipPsych (Comm), University of Waikato

Mary-Anne is a registered psychologist, specialising in industrial/organisational psychology. Before joining NIWA in 2008, she practised as a consultant psychologist for 15 years, both in private practice and for several large consulting firms. Prior to that she worked in evaluation research with a range of community, justice, public health and health promotion programmes. Mary-Anne has extensive experience in psychological assessment, learning and development, executive coaching, leadership development, and organisational change and performance improvement initiatives.

MARINO TAHI

General Manager, Māori & Pacific Partnerships

MBA, Massey University, BA (Māori Resource Management) and BCA (Management and commercial law), Victoria University of Wellington

Marino provides strategic leadership for NIWA's research and applied science services for Māori and the Pacific, with the aim of maximising the transfer of environmental and natural resource scientific knowledge to whānau, hapū, iwi, Māori communities and the Pacific islands – for the economic, social, cultural and environmental benefit of the nation. He joined NIWA in 2015 from Landcare Research, where he was the Māori Partnerships Manager – Business Development since 2006. His tribal affiliation is Ngāi Tūhoe, and he comes from Ruatahuna, a small settlement in Te Urewera.

DR ALEX THOMPSON

General Manager, Research Strategy

PhD (Atmospheric Chemistry), York University of Canada

Alex joined NIWA in 2017 after a decade in government in climate policy advice and as a science investment manager. Before returning to New Zealand, Alex was a founding editor of Natural Geoscience, and previously held scientist roles at British Antarctic Survey in Cambridge UK, University of California at Berkeley, and Forschungszentrum Jülich in Germany.

JULES MAXEY

Executive Assistant to the NIWA Board and Chief Executive

SCIENCE MANAGEMENT TEAM

ANDREW FORSYTHE

Aquaculture – Chief Scientist

DVM, University of Prince Edward Island

Andrew joined NIWA in 2005, after more than 20 years' experience in North American and European aquaculture. He has extensive expertise in the design and operation of recirculating aquaculture systems and has managed freshwater production for a major salmon farming company. Andrew took up his current role in 2007.

DR ANDREW TAIT

Climate, Atmosphere & Hazards – Chief Scientist

PhD (Climatology), University of Colorado

Andrew joined NIWA in 2000. His research areas of interest are climate change impacts and implications, adaptation to climate change, spatial modelling of climate, and sector and business applications of climate data. He was seconded to MPI in 2017 to contribute to the Primary Sector Science Roadmap and to DOC from 2017 to 2019 to work on their Climate Change Adaptation Action Plan.

NAVA FEDAEFF

Climate, Atmosphere & Hazards – Manager

BSc (Hons) Geography, University of Auckland

Nava joined NIWA in 2014 as a climate scientist, initially focusing on climate cycles and climate change projections. She upskilled in operational meteorology with the UK Met Office and began working with NIWA's Forecasting Services team to deliver forecasts, develop new products for clients and visualise data in innovative and engaging ways. Nava regularly engages with the public, media, business and other organisations about weather and climate.

DR SCOTT STEPHENS

Coasts & Estuaries – Chief Scientist

PhD (Earth Sciences), University of Waikato

Scott is a coastal hazards scientist who joined NIWA in 2001. He specialises in extreme sea-level and wave analysis and assessment of coastal hazards for adaptation to sea-level rise. Before becoming Chief Scientist, Coast & Estuaries in 2021, Scott was Assistant Regional Manager in Hamilton.

DR DREW LOHRER

Coasts & Estuaries – Strategy Manager

PhD (Ecology & Evolutionary Biology), University of Connecticut

Drew has worked for NIWA since 2002 and has extensive expertise in marine seafloor ecology in temperate coasts and estuaries and Antarctic coastal environments. This includes primary production and nutrient dynamics in soft-sediment habitats, animal-sediment interactions, disturbance-recovery processes, and ecosystem functioning. He took up his current role in 2021.

DR JOCHEN SCHMIDT

Environmental Information – Chief Scientist

PhD (Geography), University of Bonn

Jochen has a cross-disciplinary research background in hydrology, geomorphology, soil science, geoinformatics, and hazards and risk assessment. He joined NIWA in 2003 and since 2010 has led NIWA's environmental information research and developments, ensuring that systems for collecting and managing NIWA's data are robust and meet best-practice standards.

DR RICHARD O'DRISCOLL

Fisheries – Chief Scientist

PhD (Marine Science), University of Otago

Richard specialises in research aimed at improving estimates of fish abundance using acoustics, trawling and complementary technologies. He has extensive seagoing and practical fisheries experience in New Zealand and overseas, including the Antarctic. Richard is a past chair (2017–19) of the ICES Working Group on Fisheries Acoustics Science and Technology. He has worked at NIWA since 2000 and took up his current role in 2021.

CHLOE HAURAKI

Fisheries Centre Operations – Manager

BSc Marine Biology, University of Waikato

Chloe has a diverse background in project and programme management. During her studies she worked with Ngāi Te Rangi funding to explore habitat construction and reseeding of juvenile pāua in the Tauranga Moana Mātaitai. Since joining NIWA in 2015, Chloe has held previous roles with the Fisheries Centre, and as Challenge & Engagement Manager of the Sustainable Seas National Science Challenge.

DR SCOTT LARNED

Freshwater & Estuaries – Chief Scientist

PhD (Ecology and Evolution), University of Hawai'i

Scott is an ecosystems ecologist with expertise in freshwater and marine water quality and algae. He has carried out research in settings including coral reefs, rivers, rainforests, estuaries, lakes and aquifers. At NIWA, Scott has led research in water quality, environmental flows, and surface water-groundwater science since 2001 and took up his current role in 2018.

DR NEALE HUDSON

Freshwater & Estuaries – Manager

PhD (Environmental Chemistry), Queensland University of Technology

Neale is an organic chemist with a research background in natural product chemistry and organic synthesis, odour emission and mitigation research and water quality assessment. Recently he has focused on understanding information hidden within high-frequency water quality data and evaluating the efficacy of devices used for mitigating agricultural contaminants. He joined NIWA in 2007 and was appointed to his current role in 2019.

DR MIKE WILLIAMS

Oceans – Chief Scientist

PhD (Physical Oceanography), University of Tasmania

Mike's background is multidisciplinary marine and climate research, including oceanography, ocean acidification, climate change and ocean interactions with Antarctic sea ice and ice shelves. He joined NIWA in 2001, and prior to taking up his current role in 2021, was Director of the Deep South National Science Challenge.

DR JOSHU MOUNTJOY

Oceans – Strategy Manager

PhD (Geological Sciences), University of Canterbury

Joshu joined NIWA in 2006 as a Marine Geoscientist and is now a key part of the Oceans Centre management team. He completed his PhD on seafloor geomorphology and has led research around New Zealand's EEZ and in Antarctica. His recent focus is on establishing NIWA's presence in the renewable energy sector, especially offshore wind, and building links with rūnanga, iwi and hapū.

SCIENCE MANAGEMENT TEAM

DR JESS ROBERTSON

High Performance Computing & Data Science – Chief Scientist

PhD (Geophysical Fluid Dynamics), The Australian National University

Jess joined NIWA in 2023 and has a science background in geology, fluid dynamics, machine learning and data science, particularly in the resources and energy sectors, as well as policy and regulatory experience within the New Zealand public sector. Prior to his NIWA appointment, he led Innovation Policy within the Research, Science and Innovation portfolio at the Ministry of Business, Innovation & Employment.

DOUGLAS RAMSAY

Pacific Rim – Manager

MSc (Water Engineering), University of Strathclyde

Doug is a chartered engineer. He joined NIWA in 2003, following roles with HR Wallingford in the UK and the Government of Kosrae in the Federated States of Micronesia. He specialises in coastal hazard management and coordinates NIWA's international commercial work, focusing on the Pacific and Asia regions.

DR GRAEME INGLIS

Marine Biodiversity & Biosecurity – Chief Science Advisor

PhD (Marine Ecology), University of Sydney

Graeme has a background in coastal ecology, environmental assessment, marine tourism and biosecurity. He joined NIWA in 2000 and he has led national and international programmes of research on risk assessment, surveillance and control of invasive marine species and has provided technical training and advice on marine pests and their management around the world.

SOL FERGUS

Vessels Operations – General Manager

BCA (Hons) International Business, Victoria University of Wellington

Sol joined NIWA in 2022 and oversees the general operations of NIWA's research vessels *Tangaroa*, *Kaharoa*, *Kaharoa II* and *Ikatere*. He has a background in development and management of vessel operations policies, directives and staff training. Before joining NIWA, Sol held Commercial Manager, and General Manager roles at New Zealand Diving and Salvage Ltd.

GREG FOOTHEAD

Ship Technical Director

NZCE (Mechanical), Central Institute of Technology

Greg has a background in automotive and industrial engineering. He joined NIWA in 2000 as Engineering Manager for NIWA's vessel fleet and became General Manager – Vessel Operations in 2010. In 2022, Greg took up the role of Ship Technical Director, where he oversees the replacement of NIWA's vessel fleet and acts as a technical advisor for the vessels' operations team.

ROB CHRISTIE

Marine Resources – Manager

BSc (Hons) (Environmental Science & Technology), Middlesex University

Rob is a chartered scientist with more than 27 years' international experience. He has held senior management positions in environmental consultancy and science sectors in the UK, Australia and New Zealand. Rob joined NIWA in 2013 and has oversight of the NIWA vessel fleet and the application of marine science.

DR MARK BOJESEN-TREPKA

Marketing & Industry Engagement – Manager

PhD (Marketing and Technology Management), University of Waikato

Mark is an industrial marketer, and has led the marketing, product development, technology transfer and business-development effort for firms in the plastics, steel and primary sectors. He joined NIWA in 2009 and his past roles include National Marketing Manager for BHP Steel Building Products, National Marketing Manager for ICI Resins and Adhesives Division and General Manager for NorthFert.

ALAN GREY

MBIE Research – Manager

MSc Hons I (Geology), University of Canterbury

Alan has a background in ecology and earth sciences and extensive experience in research administration and RS&T evaluation. Alan joined NIWA in 1998 and oversees contractual and reporting obligations to government funding agencies, covering research benefitting all New Zealanders, and evaluation of the quality, impact and value of NIWA research.

DR CHRIS DAUGHNEY

Chief Science Advisor

PhD (Environmental Geochemistry), McGill University, Canada

Chris joined NIWA as Chief Science Advisor in 2020. Most recently he held roles as Principal Science Lead at the Ministry for the Environment, and as Director of the Environment and Materials Division at GNS Science. He has research interests in groundwater quality, geomicrobiology and numerical flow and transport modelling of hydrological systems.

SARAH MCDERMOTT

Strategy and Research Office – Research Development Manager

BA (History), Victoria University of Wellington

Sarah joined NIWA in 2022. Her background is in the public sector and fund management in areas such as the environment, tertiary education and foreign affairs. She has spent a decade working in science funding, including on MBIE's Endeavour Fund.

DR BARB HAYDEN

Marine – Science Advisor

PhD (Marine Biology), University of Otago

Barb has a research and policy development background in marine biosecurity, shellfish recruitment processes and the environmental sustainability of aquaculture. Prior to her current role, Barb spent 9 years as Chief Scientist – Coasts and Oceans, focusing on ecosystem-based approaches to managing activities in New Zealand's marine estate, so that economic and social benefits are realised while vulnerable components of the ecosystem are protected.

OPERATIONS MANAGEMENT TEAM

JONATHAN MOORES

Auckland & Ruakākā – Regional Manager

MSc (Hydrology for Environmental Management), Imperial College, University of London.

Jonathan joined NIWA as an urban aquatic scientist in 2005, where he led applied research and consultancy studies to inform improved stormwater management in our towns and cities, and became Group Manager of the Urban Aquatic Environments team. He has been Regional Manager of NIWA's Auckland office since 2019 and of NIWA's Northland Aquaculture Centre at Bream Bay since July 2022.

DR PHILLIP JELLYMAN

Christchurch – Regional Manager

PhD (Ecology), University of Canterbury

Phil was employed by NIWA during 2005–07 and returned as a freshwater fisheries scientist in 2012, specialising in freshwater resource management and conducting research on freshwater fisheries and food webs. Prior to becoming Assistant Regional Manager in 2018, he was the Freshwater Ecology Group Manager in Christchurch. Phil was appointed as the Christchurch Regional Manager in 2021.

DR MICHAEL BRUCE

Hamilton – Regional Manager

PhD (Aquaculture), University of Stirling

Michael joined NIWA in 1999, and he has more than 25 years' experience in aquaculture research and working with industry. In 2011 he was appointed Assistant Regional Manager for Auckland, managing our Northland Aquaculture Centre at Bream Bay. In 2019 he was appointed Regional Manager for the Hamilton region.

CHARLES PEARSON

Environmental Information Operations – National Manager

MSc Hons (Engineering Hydrology), National University of Ireland

Charles is a hydrologist specialising in the analysis of hydrological and other data for purposes such as estimating flood risks. He is also the World Meteorological Organization's Hydrological Adviser for New Zealand. Charles joined NIWA in 1982 and has extensive staff and operations management experience. He was appointed to his current position in January 2016.

DR HELEN ROUSE

Science Delivery – National Projects Manager

PhD (Physical Geography),University of Hull

Helen trained as a coastal geomorphologist. She joined NIWA in 2007, first as a resource management scientist, then from 2014 as National Projects Manager. She was Christchurch Regional Manager from 2016 until taking up her current role in 2021. Helen also chairs the NIWA Remote Air Operations Control Board.

DARCEL RICKARD

Māori Organisational Development – Manager

MSc Hons (Environmental Science), University of Waikato

Darcel's focus is the implementation of NIWA's bicultural organisational development strategy – enhancing existing processes, developing and leading new initiatives, and providing strategic advice and support. She also leads the science communication and outreach programme for Te Kūwaha, NIWA's Māori workforce development and cultural competency programme, and Te Piko o te Māhuri, NIWA's Māori capability development programme.

DR ALISON MACDIARMID

Wellington – Senior Regional Manager

PhD (Zoology), University of Auckland

Alison has broad experience in marine behavioural ecology, reef ecology and management, marine ecosystem risk assessment, closed area management, and historical marine ecology. She joined NIWA in 1993 and now leads the Wellington Regional Management Team, with a particular focus on the Future Property Programme. She also chairs NIWA's Diving Control Board.

STEVE WILCOX

Wellington – Regional Manager

NZCE Electronics and Computer Science

Steve joined NIWA in 1991 and has worked within the marine geotechnical and hydrographic community for the last 36 years. During this time Steve has been on over 120 scientific and commercial voyages as well as over 30 land-based nearshore and lake surveys. Prior to his appointment as Regional Manager in 2019, Steve was the Group Manager Marine Technology.

DR JUDY SUTHERLAND

Wellington – Assistant Regional Manager

PhD (Biochemistry), University of Otago

Judy joined NIWA in 2015 as a molecular biologist. She has worked on the application of molecular biology to projects in biodiversity, biosecurity, aquaculture and fisheries. Judy was Group Manager, Environmental Isotopes and Molecular Biology before her appointment as Assistant Regional Manager in 2020. In 2023, she was appointed interim Regional Manager at NIWA Nelson. She also chairs NIWA's Hazardous Substances Critical Risk Team.

DIRECTORY

Directors

Barry Harris
Chairman

Nicholas Main
Deputy Chairman (until 31 May 2023)

Livia Esterhazy
(from 1 June 2023)

Janice Fredric

Prof. Margaret Hyland

Mary-Anne Macleod

Dean Moana

Executive Team

John Morgan
Chief Executive

Dr Rob Murdoch
Deputy Chief Executive and
General Manager, Science

Geoff Baird
General Manager, Communications & Marketing

Patrick Baker
Chief Financial Officer

Dr Mary-Anne Dehar
General Manager, People & Capability

Warrick Johnston
General Manager, Technology & Innovation

Dr Helen Neil
General Manager, Operations

Marino Tahi
General Manager, Māori & Pacific Partnerships

Dr Alex Thompson
General Manager, Research Strategy

Registered office and address for service

41 Market Place
Auckland Central 1010
New Zealand

Auditor

Troy Florence with the assistance of PricewaterhouseCoopers on behalf of the Auditor-General

Bankers

ANZ Bank New Zealand Ltd

ASB Bank Ltd

Westpac New Zealand Ltd

Solicitors

Meredith Connell

Atkins Holm Majurey

Insurance broker

Marsh Ltd

Head office

41 Market Place
Auckland Central 1010
Private Bag 99 940
Newmarket 1149, Auckland
New Zealand

Tel +64 9 375 2050

Fax +64 9 375 2051

Website and social media

www.niwa.co.nz

weather.niwa.co.nz

facebook.com/nzniwa

twitter.com/niwa_nz

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Taihoro Nukurangi

NIWA's Māori name Taihoro Nukurangi describes our work as studying the waterways and the interface between the Earth and the sky. Taihoro is the flow and movement of water (from tai 'coast, tide' and horo which means 'fast moving'). Nukurangi is the interface between the sea and the sky (i.e., the atmosphere). Together, we have taken it to mean 'where the waters meet the sky'.

NIWA
Taihoro Nukurangi

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