Science for a resilient future

NIWA YEAR IN REVIEW
2021

![NIWA logo] **NIWA**
Taihoro Nukurangi

NIWA
Year In Review
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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'.

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Lyall Bay. [Rob Murdoch]

NIWA
Taihoro Nukurangi

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Embracing the future

Chairman and Chief Executive

On a chilly June day in Hamilton, NIWA whānau and dignitaries gathered to mark the start of a new phase in our history. The occasion was a soil-turning ceremony for our new science premises in Hamilton. More than 120 invitees, including Waikato-Tainui partners and special guests, watched as soil was dug from the new site at the University of Waikato and transferred into an urn for placement into the building's foundations.

The soil represents the mauri or wellbeing and protection of the building and all involved. Within a week, the diggers arrived, and construction began – the first step in one of the most significant investments in science in the Waikato region and nationally, and the first phase of NIWA's multi-site redevelopment plans. Wellington and Christchurch will follow as we seek to provide contemporary and environmentally sustainable facilities with the flexibility required to meet the future needs of our scientists, technicians and enabling services staff and their climate, freshwater and marine science.

After the COVID-related challenges thrown at us all over the past 18 months, it was a singularly positive occasion, celebrating a new chapter. It was a tangible representation of years of planning and discussion, and a clear path to the future of vital scientific research for the nation.

Our confidence to push ahead with NIWA's long-planned Future Property Programme, despite the challenge of a global pandemic, is due in no small part to support for the Crown Research Institutes (CRIs) from the Government's COVID-19 Response and Recovery Fund.

This fund, earmarked to help retain capability, ensure continuity of critical science services and long-term investment plans, ensured NIWA began the financial year confidently, fully resourced and able to respond to the increasing demand for our science.

Extraordinary demand for our science and services

It has been an extremely busy and highly productive year for NIWA. Demand for our services continues to grow, and to meet those needs we created 14 new permanent and 18 fixed-term positions during the year, taking our total staff to 712.

We set a conservative budget for the year, reflecting the uncertainty generated by the pandemic and any associated economic downturn. However, performance during the year significantly exceeded our expectations, with revenue $17.1 million and profit $9.4 million higher than budget.

Breaking the ground. NIWA Chairman Barry Harris, the Māori King's representative Te Ariki Tamaroa Whatumoana Paki, Waikato-Tainui Chief Executive Donna Flavell and NIWA Chief Executive John Morgan were the first of 13 people to place soil in the urn, representing the mauri of NIWA's new Hamilton building. [Peter Drury]

Science highlights

Overall, we achieved 22 of the 24 science Key Performance Indicators we set for the year. The two not fully achieved were related to timelines for the design of the land-based recirculating aquaculture system and the design of a vessel to replace *Kaharoa*. Considerable progress has nonetheless been made with both projects.

Climate science

The number of extreme weather events in New Zealand over the past year has more than ever emphasised the need for NIWA expertise in building resilience in our communities. The high demand for our services reflects the urgency with which this is required.

This was reinforced by the latest Intergovernmental Panel on Climate Change (IPCC) report released in August – with significant NIWA contribution – which confirmed human-induced climate change was already affecting weather and climate extremes in every region across the globe.

The NIWA-led research programme, 'Mā te haumaru ō nga puna wai ō Rākaihautū ka ora mo ake tonu: Increasing flood resilience across Aotearoa', will reveal how our flood risk might change over the next 100 years because of changes to rainfall and sea level attributable to climate change and land-use changes.

Our climate scientists are also developing a tool for the banking and insurance sectors to assess the exposure of their building and other assets to flooding and sea-level rise risks. High-resolution coastal wave modelling is being used by councils in their long-term district plans to inform them about changes to coastal-inundation risk associated with sea-level rise.

New Zealand is participating in the MethaneSAT space mission as part of a global effort to combat climate change. MethaneSAT is a state-of-the-art satellite designed to detect global methane emissions with unprecedented accuracy. A multi-institution, multi-disciplinary team of New Zealand's leading researchers in atmospheric science and remote sensing, led by NIWA's Dr Sara Mikaloff-Fletcher, is working on ground-based measurements in preparation for the satellite launch next year.

A NIWA-led collaboration with the United States Antarctic Programme, Antarctica New Zealand and Toitū Te Whenua Land Information New Zealand is seeing atmospheric measurements taken from Antarctica's Ross Island added to the highly respected international climate data reference network GRUAN (Global Climate Observing System Reference Upper-Air Network). This is a state-of-the-art global network of high-quality measurements of climate variables in the upper atmosphere, and the Ross Island site is only the second place in the Southern Hemisphere (after NIWA's Atmospheric Research Station in Lauder), and the thirteenth worldwide, to achieve GRUAN certification, after a rigorous two-year certification process led by Lauder Group Manager Dr Richard Querel.

We were particularly proud to see The National Climate Change Risk Assessment win yet another award – this time it was the 2021 Supreme Award from Engineering New Zealand. This project was commissioned by the Ministry for the Environment, and the multi-organisational assessment identified the most significant climate-change risks. The Supreme Award judges said the assessment report would "shape government policy and assist central agencies to make key decisions and flow into the work of iwi, hapū and local government".

We were similarly proud of our 'Irrigation Insight' team being selected as finalists at the 2021 Primary Industry Awards for their work in developing knowledge and tools to support environmentally responsible and economically sound irrigation decision making by farmers. The team brought together several industry and research organisations to support dairy farmers with irrigation strategies that account for current demand and future supply.

NIWA deepwater research vessel *Tangaroa*'s fourteenth voyage to Antarctica in January 2021 was one of the few full scientific voyages to the continent since the global outbreak of COVID-19, and the third in a series providing baseline information about the Ross Sea Marine Protected Area. [Stuart Mackay]

Financial summary for the year ended 30 June 2020

In thousands of New Zealand dollars	2021	2020	2019	2018	2017
Revenue and other gains	176,887	158,860	161,292	151,416	142,618
– Research	109,111	93,800	94,901	91,516	81,417
– Commercial science	67,775	65,059	66,390	59,899	61,200
– Other income	1	1	1	1	1
Profit before income tax	22,594	9,982	8,708	9,074	5,950
Profit for the year	16,263	7,370	6,247	6,472	4,250
Capital expenditure	23,080	14,757	21,460	33,573	13,053
Adjusted return on average equity (%)	13.9	6.9	6.2	6.9	4.8
Return on average equity (%)	11.6	5.7	5.1	5.5	3.8

The 'adjusted return on average equity' uses a valuation basis comparable to that used by other Crown Research Institutes. This valuation basis arose from the transition to New Zealand Equivalents to International Financial Reporting Standards in 2006/07 and reverses the effect of the revaluation of certain land and buildings.

Southern Waiotauru River. [Rebekah Parsons-King]

Freshwater science

With water quality and management issues remaining a high priority for stakeholders and the New Zealand public, demand for our freshwater science and services remains strong. In particular, we are helping clients and the government deliver freshwater reforms incorporated in the National Policy Statement for Freshwater Management.

We were major contributors on the Science and Technical Advisory Group providing scientific expertise on the policy, and this year we focused on solutions to meet policy requirements – including launching the 'eFlows Explorer' webtool to aid broad-scale river flow management planning across the country. This tool helps understanding of how minimum flow and total allocation can be set for all river reaches across a catchment or region.

We have also produced guidance on constructed wetlands and riparian buffers, which, when well-designed, can significantly reduce contaminant levels in aquatic ecosystems. This guidance will give councils more confidence to recognise how these mitigation systems can help meet requirements to reduce contamination.

We are connecting water quality and ecological effects models to provide stakeholders with the tools they need to set limits on land use, as required in the new policies. And we have provided advice and guidance on native macrophyte propagation and planting for a range of iwi partners undertaking restoration projects around rivers, lakes, wetlands and estuaries.

Marine and aquaculture science

At NIWA's Northland Marine Research Centre (Ruakākā) we are seeing the realisation of many years' research and development, with building under way on an experimental commercial-scale recirculating aquaculture system (RAS). This is a joint venture with the Northland Regional Council, and the next stage in proving the economic, operational and environmental viability of growing kingfish to market size in a land-based aquaculture system.

Once it's completed, the system will be capable of producing 600 tonnes of kingfish a year and will help the aquaculture sector in its goal of $3 billion by 2035. This RAS project has been a key strategic priority for NIWA and offers

near total control over the stock as well as removing many of the barriers to aquaculture growth in New Zealand. The technology is transferable to other coastal sites and could also be used to produce other high-value species.

A new administration block has already transformed the facilities at the Centre, and construction and operation of the experimental RAS unit will provide a substantial boost to the Northland economy. We anticipate that demand for this high-value kingfish product will see the establishment of a 3,000-tonne kingfish RAS operation within five years, creating another 75 local jobs.

In February, our deepwater research vessel *Tangaroa* returned from a successful six-week voyage to Antarctica designed to increase our knowledge about the key environmental and biological processes in the Ross Sea Marine Protected Area (MPA). This multi-disciplinary voyage aimed to provide baseline information to help assess the effectiveness of the MPA, in a wide range of programmes looking at everything from phytoplankton, water chemistry, oceanography, and fish stocks to the distribution of whales – in a whole of ecosystem approach.

The new administration building at NIWA's Northland Marine Research Centre has transformed the facilities at the Centre. The experimental, commercial-scale recirculating aquaculture system is being constructed on the left of the new building. [Cato Brand Partners]

COVID-19 restrictions prevented the planned international participation in the voyage, but we successfully completed all nine science objectives in what was *Tangaroa*'s fourteenth voyage to Antarctica.

NIWA assesses many of the fish stocks around New Zealand as part of our work for Fisheries New Zealand. These assessments are based on industry, recreational and customary catch, catch and effort data, scientific sample voyages, biological information and sophisticated mathematical models. These help us understand the status of the stock and describe the likely effects of different management decisions.

Last year we carried out 81 research projects for Fisheries New Zealand. They included 14 research surveys, 21 fish stock assessment projects, 6 recreational fisheries projects: land-based catch sampling for six species, ongoing monitoring for *Bonamia* in oysters, and ageing more than 14,000 fish.

Tangaroa was also used to deploy a network of 12 tsunami buoys from New Zealand up into the Pacific to help keep communities safe. These DART buoys provide high-speed early warning of tsunami activity, triggering alert systems for vulnerable communities. This was a collaborative project with the National Emergency Management Agency, the Ministry of Foreign Affairs and Trade and GNS Science.

Lake Mackenzie, Routeburn Track. Trampers in our national parks now have access to 'Parks Weather', a collaboration between NIWA and DOC to provide better weather information for all 13 national parks. [Nava Fedaeff]

highly specialised data scientists recruited

One international collaboration that was able to go ahead involved a 6.5-metre autonomous underwater vehicle, *Rán*, from Sweden's Gothenburg University. Fully equipped with its own suite of sensors for remotely scanning the seafloor and monitoring oceanographic conditions, *Rán* was also accompanied by two European technicians, who had to undergo full quarantine procedures before joining the voyage on *Tangaroa* to the Kaikōura Canyon.

Pre-programmed and deployed from the stern of *Tangaroa*, *Rán* descended to the canyon floor and surveyed more than 2,000km of seafloor at resolutions 25 times higher than that surveyed earlier, giving unprecedented insight into how submarine canyons were created and how much this one had changed since the 2016 earthquake. That magnitude 7.8 quake dislodged 850 million tonnes of mud and sediment from the canyon rim, down the canyon and up to 700km north, instantly turning the

canyon floor from a biodiversity hotspot of marine life into a barren, almost uninhabited seascape.

This was the first time this kind of technology had been used to survey submarine canyons in New Zealand and was enabled through the European research alliance, Eurofleets+. NIWA is the only Southern Hemisphere member of this 27-country alliance.

Responding to the demand for data science

In response to the demand for advanced data science capability and support in areas such as artificial intelligence and computer vision, this year we advertised and recruited eight highly specialised data scientists, with the aim of reinforcing NIWA as a leader and innovator in this burgeoning scientific domain. The aim of the new team is to offer data science as a service to researchers, as well as undertaking complex machine learning, artificial intelligence and computer vision

(high-level understanding from digital images or videos) projects for internal and external customers.

Data science has huge potential to be used across a range of sectors, including primary production, where many businesses are weather dependant. It is also likely to play an increasingly important role in helping New Zealand become carbon neutral and adapt to our changing climate.

We are already using computer vision in areas such as biosecurity to identify invasive weeds, and there are test projects for determining kelp density, shellfish identification and distribution, and river flow monitoring.

Machine learning is also used widely in our climate science to enhance our forecasting abilities, and it was a key component of the sophisticated, high-resolution forecasting provided to Emirates Team New Zealand for their successful defence of the America's Cup.

Named after the Norse Goddess of the Sea, *Rán*, is a 6.5m autonomous underwater vehicle deployed from *Tangaroa*, named after the Māori God of the Sea, to collect information on how much the Kaikōura Canyon had changed since the 2016 earthquake. [Lana Young]

NIWA's ultra-high-resolution forecasting, which coupled wind and ocean data, contributed to New Zealand becoming the first nation to successfully challenge and defend the America's Cup twice. [ETNZ]

Advancing national recovery

NIWA's environmental data, data management systems and modelling expertise provide fundamental information and advice to help realise opportunities and mitigate environmental risk more effectively. The development of tailored products and services provides significant opportunities to grow national and regional economies, and we are committed to helping New Zealanders realise those benefits.

Our forecasting services offer a standout example of this. Bespoke, high-resolution weather information is now almost essential for weather-dependant ventures, and it can be adapted for any situation – agriculture, horticulture, viticulture, events or recreation, for example.

Over summer, many New Zealanders were captivated by the spectacular sight of America's Cup yachts racing on foils on the Hauraki Gulf. We were no different, except that we had a heightened appreciation for the sophisticated

technology and skill that went into making these boats look as if they were flying above the waves.

Since 2019, NIWA has been working with Emirates Team New Zealand, supplying data on likely conditions above and below the waterline through the key design and testing phases.

On race days we supplied the team with ultra-high-resolution weather and sea-state information (wind, tide, current, wave height) to help them make winning decisions on the water. This ultra-high-resolution service – five times more precise than normal forecasts, and developed in-house by NIWA's climatologists, oceanographers and modellers – was an evolutionary change in bespoke forecasting, powered by developments in data science and the capacity of our supercomputers to process phenomenal amounts of information.

In the Spark 5G Race Zone on Auckland's waterfront during the regatta we turned our forecasting data into visual animations that enabled people to

interact with our forecasted conditions. This highly popular display was visited by more than 30,000 people during the Cup campaign.

At the same time we were refining our forecasting for Emirates Team New Zealand, we were also working with the Department of Conservation (DOC) to develop 'Parks Weather', which sits on the NIWA website.

Parks Weather provides tailored forecasts for all 13 of our national parks and about 50 huts or other specific locations. Hazards, such as heavy rain or low temperatures, are highlighted to help people plan their trips, armed with the knowledge they need to stay safe. Videos showing forecasted river flows in the area also help visitors and workers plan for the likely conditions.

This collaboration with DOC continues to evolve, with ongoing refinements to the weather forecasting resource, and innovative additional services for back country staff in the pipeline.

Pou Whakarae Dr Erica Williams and other NIWA scientists have been working with Te Tai Tokerau hapū to assess the health of juvenile tuna (eel) populations in Northland's Wairua River catchment since 2017. [Rebekah Parsons-King]

Graduate internships creating more visible career pathways for Māori science graduates

Partnering with Māori

We continue to strengthen our ties and partnerships with Māori on projects such as management of natural hazards and climate-change risks – informed by mātauranga Māori.

Our Te Kūwaha National Science Centre works with whānau, hapū and iwi throughout New Zealand, undertaking research and providing services across our science. We are committed to effective long-term partnerships, one of which this year saw the completion of the first Climate Change Vulnerability Assessment.

This research, carried out with Te Wai Māori Trust, assessed 10 taonga freshwater species, and gave them a ranking based on their exposure to changes in climate and their ability to cope with those changes. Some of these iconic species will be facing an uphill battle for survival under a changing climate.

Meanwhile, Cultural Keystone Species – an important four-year research programme funded by the Ministry of Business, Innovation and Employment – concluded this year. This programme studied freshwater species central to the identity and wellbeing of many Māori communities. Research methods and tools were successfully co-developed to enhance the protection, restoration and economic development of these precious taonga.

One of the unique aspects of this programme was the development of different ways to assess and communicate how taonga species were faring, to help hāpu make the best management decisions.

Hapū-driven research has been at the heart of this programme, which values mātauranga Māori alongside other knowledge. The involvement of our Māori graduate interns gave them first-hand experience of the benefits of such partnerships. Another two graduates were incorporated into this successful programme – established to create more visible pathways for Māori science graduates into postgraduate opportunities and career pathways.

Working remotely with our Pacific neighbours

There is no denying our work in the Pacific has been disrupted by COVID-19. Since the first lockdown, all travel to the Pacific Islands has been suspended. However, our work in the region continued, and through the effective use of technology and ingenuity, and after decades of building enduring relationships, we have been able to carry on delivering our commitments and supporting our colleagues.

This collaborative work ranges from baseline weather, climate and hydrological monitoring, and the development of early and impact warning systems, to fisheries management and water security.

Working with a number of agencies in Samoa we have delivered an operational, flood impact-warning, decision-support system for the Vaisigano catchment in Apia. This included the remote installation of weather and water-level stations, with training and support to technicians in Samoa delivered via video calls.

A commitment to zero carbon

NIWA is committed to a sustainable future for our organisation and for New Zealand. For us, that includes operating in an environmentally responsible manner and providing leadership and guidance. Over the past year we have focused on environmental sustainability – building on our organisational sustainability framework. Consistent with the Government's objective, we have a target of carbon neutrality by 2025 and have established a carbon footprint baseline for verification.

We continue to make good progress towards that target, with a significant sustainability focus, including reduced energy use incorporated into our new buildings programme, appropriate vehicle replacement when that falls due, and ensuring future vessels include low emission propulsion.

We have substantially reduced air travel and continue to invest in science that supports transitioning to low carbon use. The next stage is to investigate carbon emissions' offsetting. A multi-disciplinary, multi-site Environmental Sustainability Team has also been established to investigate options and channel advice to the executive sustainability oversight committee.

Marine Ecology technician Nichola Salmond demonstrating macrofauna sampling with BLAKE Inspire students on the intertidal flats in Raglan. [Courtney Davis]

We have a target of carbon neutrality by 2025

The next generation

We have an ongoing commitment to building science capability and leadership and are proud of our contribution in this area. This year NIWA supervised 130 PhD and MSc graduate students from universities around the country – a significant increase on last year. We are also continuing to build Māori science capability through our oversubscribed Māori graduate intern programme.

NIWA sponsors seven main city science and technology fairs and eight regional fairs, and our staff serve on the judging panels and provide insights into the variety of careers science offers. Last year several NIWA-sponsored science fairs joined the throng of events happening virtually. Just as they were about to begin in person again in August, lockdown was on us once more, and they were back to being online. However, entry numbers were up, reflecting a burgeoning interest in science among school students.

We are the principal science partner with BLAKE and work closely with them to support their focus on environmental leadership, especially with the nation's youth. We sponsor the environment category of their annual awards, our NIWA/BLAKE Ambassador Programme annually supports up to six outstanding young New Zealanders who work on our research programmes, and we help inform their 'Inspire for Teachers', an environmental education and leadership development programme for teachers.

We are also part of the collective CRI sponsorship of the Sir Paul Callaghan Eureka Awards, and we provide an additional scholarship for a secondary or tertiary student who delivers the best presentation on climate, freshwater or marine science.

The road ahead

As we mentioned at the beginning, work has begun on our new Hamilton premises – despite a year which has placed unprecedented pressure on the construction industry. Our other site upgrades remain largely on track. The new administration building at the Northland Marine Research Centre was completed and has added substantially to science infrastructure in Northland, our new field office in Twizel is nearly finished, and in Christchurch we are working with Scion on an agreed joint briefing and concept design. In Wellington, work on the implementation business case is well advanced.

In addition to the progress on our new premises this year, we have also made significant investments in computing equipment, a marine multi-channel seismic system and oceanographic moorings.

We would like to thank the NIWA Board, Executive Team and staff for their work and support, especially their positive response to the challenges COVID brought. We would also like to sincerely thank outgoing board members Dr Helen Anderson and Prof. Gillian Lewis for their years of support and sage stewardship.

A year ago we knew we were facing the unexpected. We were confident our science would continue to play a critical role in guiding a resilient future, but we were also aware of the challenge ahead in navigating through unprecedented challenges. We have emerged stronger, busier and more focused. Our multi-disciplinary, collaborative approach is the bedrock of our science and provides NIWA – and Aotearoa New Zealand – with the solid foundation on which to best respond to the challenges and opportunities of the future.

Finally, we must acknowledge the extraordinary contribution of Dr Bryce Cooper, who has led NIWA's strategic development for the last 20 years, before stepping down earlier this year. Bryce has been instrumental in setting strategic direction to ensure a continually successful organisation – scientifically, culturally and financially. Thank you Bryce.

Barry Harris
Chairman

John Morgan
Chief Executive

Cape Palliser Lighthouse under the Milky Way

It was the surprising composition of this photograph that captured the judges' interest. They commented that it was not only technically well captured, but also just a little unexpected.

Lake Onslow Sunset

This strong and beautiful landscape shot stood out for the judges because of the dramatic light and clean lines combining with the warm colours of the land and the cooler colours of the lake.

NIWA Science

OUR MISSION

To support the wellbeing of Aotearoa New Zealand people and business through

- improved management of the environment
- sustainable use of natural resources
- effective responses to global change

OUR AIM

To deliver the science that will enable Aotearoa New Zealand to meet its environmental challenges and thrive in a rapidly changing world

We will innovate, generate new knowledge, and apply our science to

- provide industry opportunities
- transition to a low carbon economy
- adapt to a changing climate
- improve the health of our waterways and oceans
- care for our unique biodiversity

To achieve these advancements

- we will partner with Māori
- embrace new technologies
- support major science infrastructure
- collaborate with other science organisations and the sectors that apply our science products and services

OUR SCIENCE

Will support the realisation of these national outcomes by applying innovative technology across multidisciplinary teams.

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

7,500 Climate stations
The National Climate Database with information from 7,500 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 66,000 catchments nationwide

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

OCEAN

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 finfish aquaculture

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

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

Northland Marine Research Centre
New Zealand's leading science facility for finfish aquaculture

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

NIWA CLIMATE, FRESHWATER & MARINE SCIENCE

Healthy waterways
- improving water quality
- ecosystem-based management
- assessing the environment

Climate change adaption
- planning for climate change
- improving resilience
- reducing impacts

Adapting to a changing climate

Improving our waterways and oceans

Transitioning to low carbon

Providing industry opportunities

Caring for our biodiversity

Investing in science skills and assets

Embracing new technologies

NIWA SCIENCE FOR A RESILIENT FUTURE

Partnering with Māori

Working with others

Growing industry
- advancing sustainability
- growing regional economies
- diversifying aquaculture
- allocating water better

Caring for biodiversity
- enhancing protection
- restoring ecosystems
- combating invasive species

Low carbon future
- supporting a just transition
- exploiting renewable energy
- mitigating emissions

Providing industry opportunities

Advancing sustainability

- High-resolution environmental forecasting
- Climate projections to inform land use
- New tools to monitor fish populations and ecosystems

Growing regional economies

- Forecasting for weather-sensitive industries
- Climate projections for regional planning
- Forecasting to improve tourism operations

Diversifying aquaculture

- Recirculating Aquaculture Systems (RAS)
- Commercial-scale trials of kingfish
- Improved mussel and oyster productivity

Allocating water better

- Effect of climate change on water use
- Flow forecasting
- Tools to increase water-use efficiency

3,000
tonne operation creating 75 new jobs regionally

The initial unit will produce 600 tonnes of kingfish a year and is expected to lead to a 3,000-tonne operation, creating 75 new jobs for the region within 5 years.
[Stuart Mackay]

Commercial-scale culture of kingfish – realising the vision

NIWA's Northland Marine Research Centre is Aotearoa New Zealand's largest and best equipped warm water marine research facility, with the capacity to collaborate with a wide variety of researchers and private companies. Our vision to prove the commercial viability of land-based culture of high-value finfish species is now a step closer to reality.

In collaboration with Northland Regional Council, work is underway to build a commercial-scale recirculating aquaculture system to produce premium yellowtail kingfish. Land-based recirculating aquaculture systems have long been recognised as best-practice for the large-scale production of salmon smolt, and we intend to demonstrate the technical and economic feasibility of farming kingfish in tanks at commercial scale.

Our product testing with top chefs and restaurants has already demonstrated the unquestionable quality, remarkable shelf-life and high demand for our kingfish, and this technology opens the opportunity to introduce such high-value aquaculture to any coastal area of New Zealand – contributing significantly to the sector's revenue target of $3 billion annually by 2035.

NIWA-supplied automation controls water in and out of the Rangitata South Irrigation Scheme ponds. The ponds are about 1km across at the widest point and 5km long. [Rooney Earthmoving]

Precision irrigation producing economic and environmental benefits

Providing the right amount of water, at the right time, and in the right place

NIWA has been involved in irrigation at the scheme level since the 1990s, and our support has evolved from simple monitoring systems into sophisticated integrated control systems.

Management of irrigation scheme water use is becoming increasingly precise as scrutiny of water use intensifies. Innovations in automation have added to that precision with economic and environmental benefits, including reducing the need for hands-on round-the-clock management by irrigation scheme staff.

NIWA-provided instrumentation ensures that the scheme's water take is within consented limits by monitoring river flows in real-time, with controls that manage intake automatically, in harmony with demand requirements and storage capacity.

Automation also plays a part as the water moves through pipes and channels that supply farms downstream. Storage pond capacity, travel time of water through the piped systems and assessment of the draw on that supply by downstream users can all be measured and controlled through NIWA-supplied instrumentation and software, without the need for human monitoring and intervention.

Precision irrigation scheme control, supported by automation, is not only delivering the right amount of water for use at the right time and place on the farm, but it also produces sound economic and environmental benefits for Aotearoa New Zealand.

Blue cod are one of our most popular recreational fish species and support a small, but important, commercial catch. [Rob Stewart]

Pumped water storage for hydroelectricity generation

NIWA is helping the Ministry of Business, Innovation and Employment to investigate the feasibility of pumped water storage to support hydroelectricity generation during dry years, when there is insufficient water storage in existing hydropower lakes.

We are leading three projects – a nationwide GIS scan of potential sites for a 5–12TWh pumped storage scheme; assessing the variability and correlation between hydro, wind and solar energy in Aotearoa New Zealand to look at the impacts of climate change on these three sources of power; and assessing the potential environmental impacts of a pumped storage scheme on the leading candidate for a storage reservoir, Lake Onslow in Central Otago.

NIWA researchers have completed a bathymetric survey and assessed potential locations for climate stations and telemetered monitoring buoys in Lake Onslow. The resulting climate and limnology data will be used to predict the effects of pumped hydro operations on the lake's water quality and ecosystem health.

Hydrodynamics and GIS Technician Jo Bind setting up a small autonomous survey boat on Lake Onslow. [Andrew Willsman]

Enhancing fisheries management

In August 2020, NIWA formally released an advanced software package for modelling the population dynamics of marine species.

Called CASAL2, this new tool is a significant advance on its predecessor, CASAL, which was released in 2012. It has benefited from collaborative development and testing and has already been internationally recognised for its strengths as a next-generation, integrated, population assessment tool.

During 2020-21, CASAL2 allowed stock assessments to model sex-change and growth for blue cod, and to utilise novel fish-weight data from fishery landings for bluenose. Its flexibility will allow important new features to be added to future fish stock assessments, improving the quality of scientific advice to support management.

NIWA assesses many of the fish stocks around Aotearoa New Zealand as part of our work for Fisheries New Zealand to help ensure sustainable catches. The assessments are based on industry, recreational and customary catch, catch and effort data, scientific voyages, biological information, and sophisticated mathematical models, like CASAL2. They help us understand what has happened and describe the likely effects on fish stocks of different management decisions.

Leading the transition to low carbon

Supporting a just transition

- Tools and advice to support climate change adaptation and mitigation
- Measure and understand greenhouse gas sources and pathways
- Communicate the science of climate change

Exploiting our renewable energy sources

- Customised data and tools for optimal electricity generation
- Minimise potential environmental impacts from renewable energy
- Small-scale, multi-source power for self-sufficiency and resilience

Mitigating greenhouse gas emissions

- Determine local to global sources and sinks of greenhouse gases
- High-precision, long-running measurement series to understand the drivers of climate change
- Assess the effectiveness of measures aimed at reducing greenhouse gas emissions

TRANSITION TO LOW CARBON
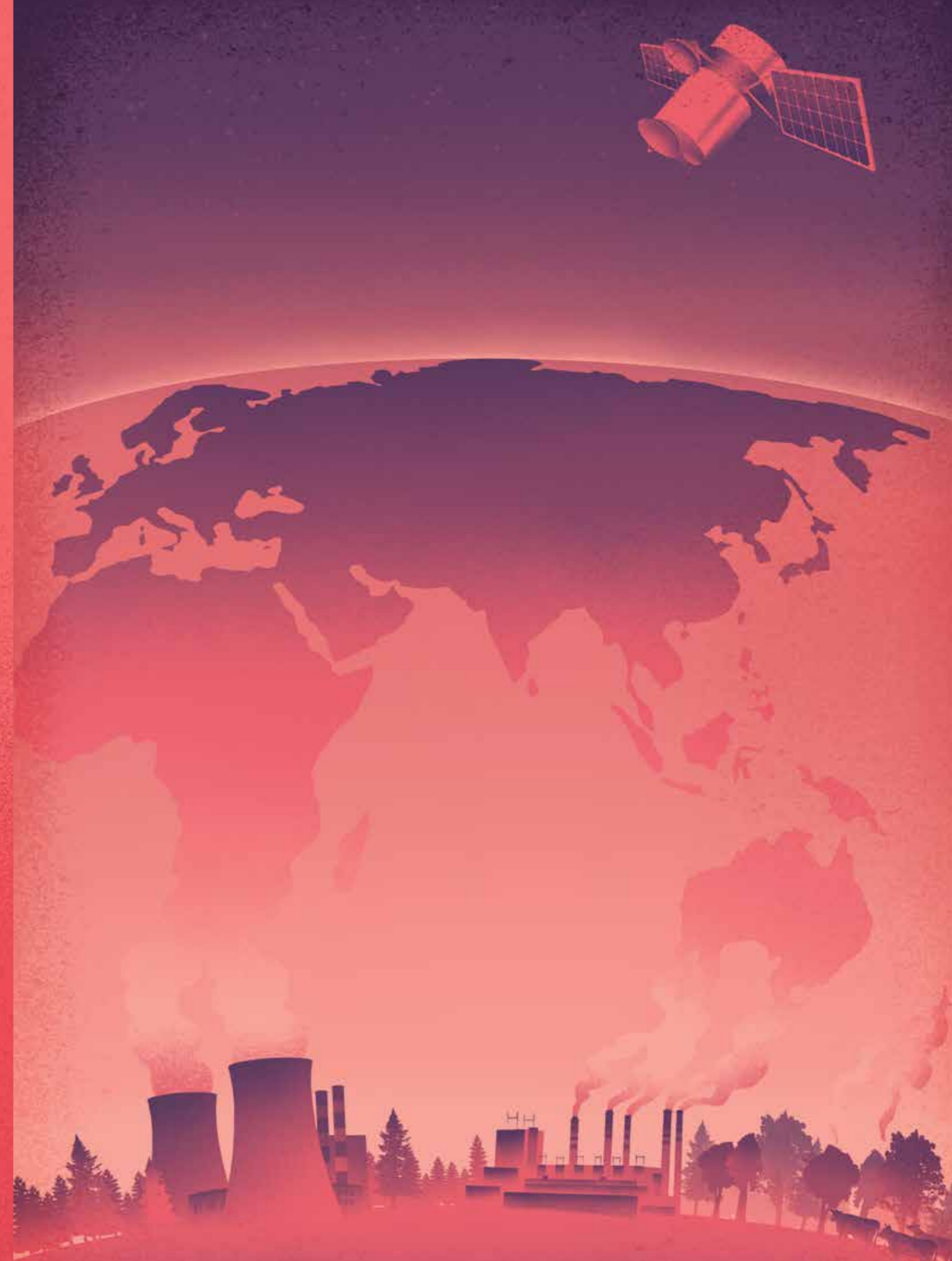
Ground-based atmospheric measurements at NIWA's Atmospheric Research Station at Lauder, Central Otago are a critical part of the MethaneSAT research. [Rebekah Parsons-King]

Tracking agricultural methane emissions

In 2020 NIWA's Dr Sara Mikaloff-Fletcher was announced as lead scientist for the Ministry of Business, Innovation and Employment-funded MethaneSAT, an international space mission helping tackle climate change.

MethaneSAT is Aotearoa New Zealand's first official space mission. Internationally, its core purpose is to gather data to reduce methane emissions from oil and gas globally by 45%. The US-based team is focused on using a satellite to tackle this problem.

In New Zealand, the project intends to provide a clearer picture of agricultural emissions, help us track the effectiveness of emissions reduction strategies, and establish us as world leaders in methane research. The science project is also responsible for developing a strategy for how MethaneSAT can be used globally to help reduce methane emissions from agriculture.

Dr Mikaloff-Fletcher has assembled a team of New Zealand and international atmospheric scientists and is now leading the early stages of the research programme. The satellite will be launched in late 2022 or early 2023. In the meantime, the team is starting ground-based observations and modelling that will enable them to make the most of the satellite data.

NZ's contribution to understanding atmospheric change

NIWA's inverse modelling estimates for methane have been included for the first time in Aotearoa New Zealand's National Inventory Report for greenhouse gases.

This work is part of the NIWA-led programme, CarbonWatch NZ, which is assessing carbon dioxide and methane emissions and uptake across our cities, forests and farms. Refinement of the national inventory is crucial to support verification of emissions and mitigation efforts as we transition to a low carbon economy.

Results from CarbonWatch in 2021 continued to point to persistently stronger than expected carbon uptake by forests between 2014 and 2020. The findings suggest that much of the additional carbon dioxide sink originates from mature, indigenous forests in the Fiordland region, and that such environments might have the potential to absorb more carbon than previously thought.

This could potentially impact New Zealand's land management. Further work is underway with New Zealand's terrestrial biosphere community to understand the processes driving these carbon dioxide sinks. Once these processes are identified, it is likely that this work will also be included in the national inventory.

Hollyford River, Fiordland National Park. CarbonWatch NZ results this year pointed to persistently stronger uptake of carbon than expected by Fiordland native forests. [Rebekah Parsons-King]

Helping keep the lights on

Aotearoa New Zealand's electricity network is built to withstand weather extremes, but outages and interruptions can still happen. A prototype web tool developed in conjunction with electricity distribution businesses is helping the energy sector better manage and plan for those risks.

The web tool features alerts and filters in a dashboard format, combining five-day NIWA forecast data with maps of power company infrastructure and assets. It provides a forecast for each asset, letting providers schedule maintenance during fair weather windows, and it anticipates and mitigates unplanned weather-related outages – for example, when strong wind is likely to cause vegetative matter to 'short out' the lines.

Five lines companies are trialling a prototype of the tool, with the aim of ensuring security of supply for customers is the best it can be – rain, hail or shine. Opportunities for future development include adding climate change scenarios to help with long-term asset planning and using real-time outage data to automatically recalibrate operational risk thresholds and alerts.

A NIWA-developed web tool allows electricity lines operators to manage weather risk for their assets. [Lana Young]

Adapting to a changing climate

Planning for climate change

- High-resolution projections of climate and ocean state
- Increased understanding of the impacts of climate change
- Guidance and tools to support better planning for climate change

Improving resilience to natural hazards

- 24/7 multi-hazard forecasting system
- Enhanced tools and guidance to help mitigate weather and climate hazard impacts
- Work with international partners to advance weather, climate and hazard forecasting

Reducing adverse effects of climate change

- Hydrological models to inform changes in water flows and storage
- Predict the effects of sea-level rise on coastal ecosystems and infrastructure
- Increase understanding of the effects of ocean acidification on ecosystems, including in Antarctica
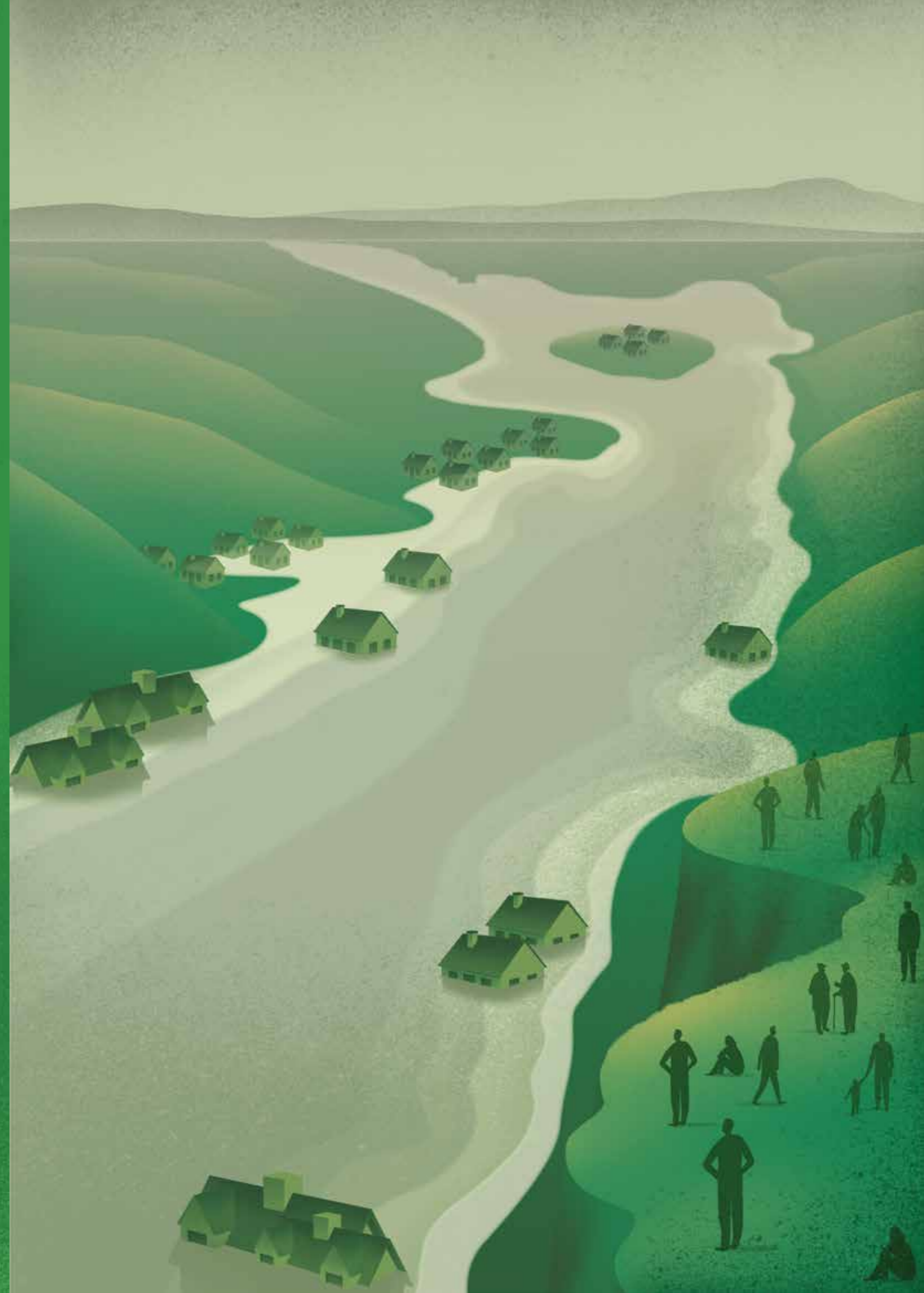
ADAPTING TO A CHANGING CLIMATE

Banks can now analyse sea-level rise risk to their portfolio of mortgaged properties thanks to a new NIWA-developed tool. [Dave Allen]

The dollars and cents of sea-level rise

$19 billion dollars' worth of buildings in Aotearoa New Zealand face higher levels of coastal risk exposure because of climate change-induced sea-level rise. A new tool developed by NIWA especially for the financial sector assesses which residential and commercial properties could be exposed over a mortgage timeframe.

The interactive tool combines sea-level data from the Ministry for the Environment, storm/tide data from NIWA and elevation and property data from Toitū Te Whenua Land Information New Zealand and the banking sector. A customisable dashboard lets financial institutions look at different climate change scenarios for their mortgaged coastal properties, understand potential risks and translate those into dollar terms.

Better understanding the present, medium and long-term impacts of sea-level rise on lending portfolios is central to the future security of people and profits, and access to comprehensive modelling data like this is critical to the integration of climate risk into new and existing banking products and mortgage lending processes.

Forecasting river flooding

Aotearoa New Zealand experienced record-breaking floods in 2021. These floods uprooted communities and caused millions of dollars in damage.

NIWA is developing a national river flow forecasting system that provides hourly forecasts, with a 48-hour lead time, for approximately 60,000 river reaches across the country.

The system publishes daily forecast videos that indicate river flow levels as categories ranging from below normal to extremely high for flood awareness.

A calibrated catchment-scale version of the model was used to help predict the flooding that devastated Westport when the Buller River broke its banks in July 2021.

The Buller council accessed the system to forecast and estimate flooding, and it provided key decision-making information during a critical, and short, timeframe.

Climate change will only continue to exacerbate future flooding frequency and effects on communities, increasing the need for reliable and accessible river forecasting.

NIWA recorded a flow of 7,640 cubic metres per second for the Buller River during the July 2021 flood – the highest of any New Zealand river since 1926, and 17 times its mean flow of 454 cumecs. [West Coast Regional Council]

Coastal inundation modelling leads to citizen science initiative

NIWA coastal researchers and social scientists are working with residents of Wellington's South Coast to help refine modelling of large storm events in the area. The initiative follows a large southerly storm that swept into Wellington in June 2021, during which NIWA advice contributed to the precautionary evacuation of residents.

Wellington City Council had previously commissioned high-resolution modelling from NIWA after the coast received a battering and some houses were looded in 2020. This work was almost complete when the June 2021 storm was forecast. Hydrodynamic modeller Dr Cyprien Bosserelle and coastal modeller Dr Christo Rautenbach were able to use the model to urgently assess how people and property might be affected this time. With the results showing substantial risk, the NIWA team was brought into emergency

NIWA coastal modeller Dr Christo Rautenbach recording coastal features during a post-storm walkaround with residents. [Stacy Mohan]

preparedness meetings with the council and others. Although the worst-case scenario did not eventuate, the team are now working to further improve the model for future events. They're harnessing local knowledge of the coastline using residents' photographs and videos and through interviews about their past storm experiences.

Improving flood impact warning for Apia

Residents in the Vaisigano catchment on Samoa's Upolu Island were successfully evacuated ahead of flooding in December 2020, thanks to an early warning system developed by NIWA for the Samoan government.

The flood impact warning and decision support system integrates global numerical modelled rainfall forecasts, real-time rain and river-level monitoring data, simulated rainfall-runoff modelling, and return period flood inundation maps to estimate and forecast flood exposure levels and threat to safety of residents, buildings, roads and road usage.

The information is integrated into a flood decision web portal system, enabling flood officers to monitor, forecast and alert the relevant disaster management authorities of imminent flood events and their likely impacts, with adequate lead time. This information enables

The Samoan Ministry of Natural Resources and Environment and NIWA worked closely together to develop a flood warning and decision-support system for a weather-ready Samoa. [Shaun Williams]

emergency responders to better plan and execute their response functions.

All training, mentoring and installation support to Ministry of Natural Resources and Environment staff in Samoa was delivered remotely, due to COVID-19 restrictions. This has helped build local capability and confidence in the use, maintenance and ongoing development of the new technology.

Improving
the health of our waterways & oceans

Reversing decline in water quality

- Modelling tools to predict the impact of contaminants
- Contaminant mitigation systems
- Quantify the occurrence and distribution of microplastics

Ecosystem-based approaches to resource use

- Enhanced understanding of ecosystem processes and interactions
- Coupled models to link catchment land use and contaminant dispersion
- Models to predict degradation and potential recovery of aquatic ecosystems

Measuring the state of our environment

- Measurements and forecasting to meet or exceed national and international standards
- Best practice data management, analysis, visualisation and accessibility
- Curation of internationally significant collections and samples

IMPROVING THE HEALTH OF OUR WATERWAYS & OCEANS

Newly discovered *Galeolaria* tubeworm beds in the Hauraki Gulf. [Shane Kelly]

Artificial intelligence technology developed by NIWA scientists, and being trialled here by Aleki Tamoepeau and Daniel Clements, to identify underwater pest weeds and map their locations has huge potential to improve the health of freshwater ecosystems in New Zealand. [Mary de Winton]

Helping restore the Hauraki Gulf

NIWA was commissioned by the Ministry for Primary Industries to carry out a review to help inform restoration of the Hauraki Gulf.

The review summarised marine restoration terminology and definitions, and how these relate to the Gulf. The Gulf was found to be fundamentally different in the present day compared with its historical state, with large declines in the numbers and sizes of many species. However, the lack of well documented habitats has highlighted the difficulty of setting restoration targets.

Recommendations as a result of the review included increased seafloor habitat mapping, capturing historical habitat and species information and addressing horse mussel and subtidal seagrass meadows habitat loss, as significant steps towards filling in knowledge gaps.

In June the Government announced a plan to revitalise the Gulf that will see trawl fishing heavily restricted and 18 new marine protection areas created. The move was broadly welcomed as a first step towards ecosystem-based management. Knowledge gained from Hauraki Gulf restoration could be replicated in other declining marine environments around Aotearoa New Zealand.

AI goes underwater to identify invasive plants

The detection and management of freshwater invasive submerged weeds costs millions of dollars annually. NIWA researchers are developing a way to detect and identify target species by using artificial intelligence. This technique will enable surveying of far larger areas more efficiently than is currently possible, and could lead to much faster and more effective responses to new incursions.

NIWA's prototype, portable, invasive species detector module can be strapped to survey boats. It is housed in a small waterproof case with an underwater video camera attached.

Inside is a computer containing an artificial intelligence-based detector that has been trained to identify invasive weed species and log their locations in real-time. Trials have provided proof-of-concept results for two of Aotearoa New Zealand's worst invasive freshwater weeds – lagarosiphon and hornwort.

Significant gains are expected by operating the modules from fully autonomous surface vessels that don't require constant supervision. Further field training data collection, software detector development and integration into the detector module will evaluate accuracy and potential.

Lake Tarawera was one of the three New Zealand lakes used in the global study of lake oxygen level change as a result of climate change. [Tracey Burton]

The world's lakes are rapidly losing oxygen as the planet warms

Collaborative NIWA research examined the change in dissolved oxygen in lakes in a changing climate. More than 45,000 dissolved oxygen and temperature profiles were collected from 400 lakes around the world, including three in Aotearoa New Zealand.

The results of the study showed that surface-water oxygen levels in temperate-zone lakes declined by 5% and deepwater oxygen levels declined by 19% since 1980. These trends are 3–9 times greater than in the world's oceans.

The rapid decline in oxygen levels in temperate freshwater lakes is driven largely by climate change, and this new research provides evidence of climate-change effects and a valuable benchmark.

Delivering guidance on constructed wetlands

Constructed wetlands mimic the ability of natural wetlands to improve water quality by intercepting water from farm streams, runoff and groundwater, and removing sediment, nutrients and pathogenic microbes.

Guidance documents for building and maintaining constructed wetlands have been developed by NIWA in partnership with DairyNZ.

The guidance will help farmers build effective constructed wetlands that can reduce contaminant losses from land. It will also help the rural contractors, environmental consultants and regional council advisors who design, review plans and construct wetlands. And it will give councils the confidence to incorporate constructed wetlands in environmental policies and catchment management plans.

NIWA data show that well-designed wetlands can reduce nitrate and fine sediment loads from farms by 20–50% as wetland size is increased from 1% up to 5% of the contributing catchment area.

The NIWA-designed Lake Okaro constructed wetland is the first in New Zealand to be designed specifically to protect a lake from natural run off, as opposed to effluent. [Chris Tanner]

Caring
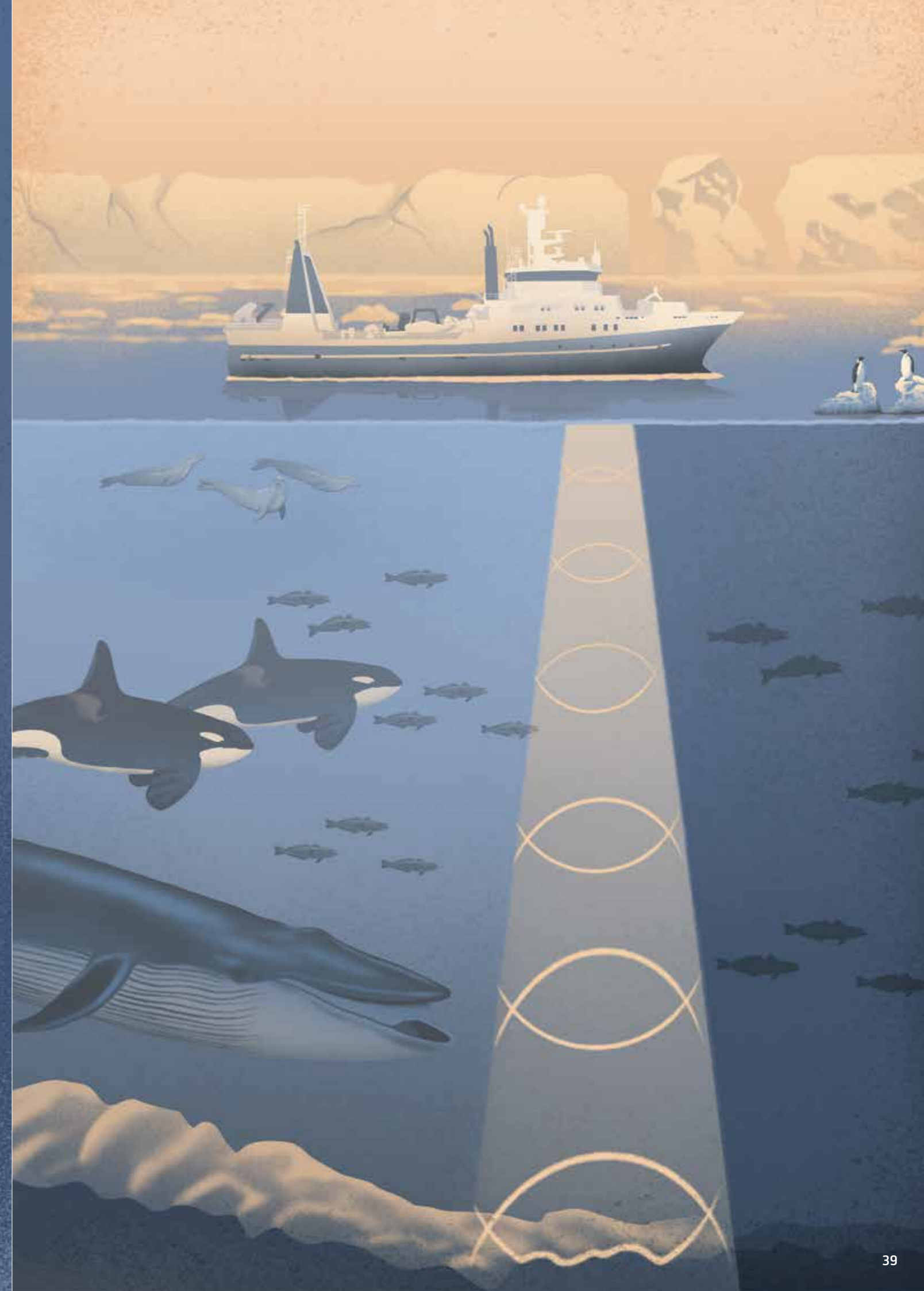# for our unique biodiversity

Enhancing biodiversity protection

- Improved understanding and quantification
- Innovative approaches to ecosystem monitoring, protection and management
- Tools and products for sustainable management and restoration
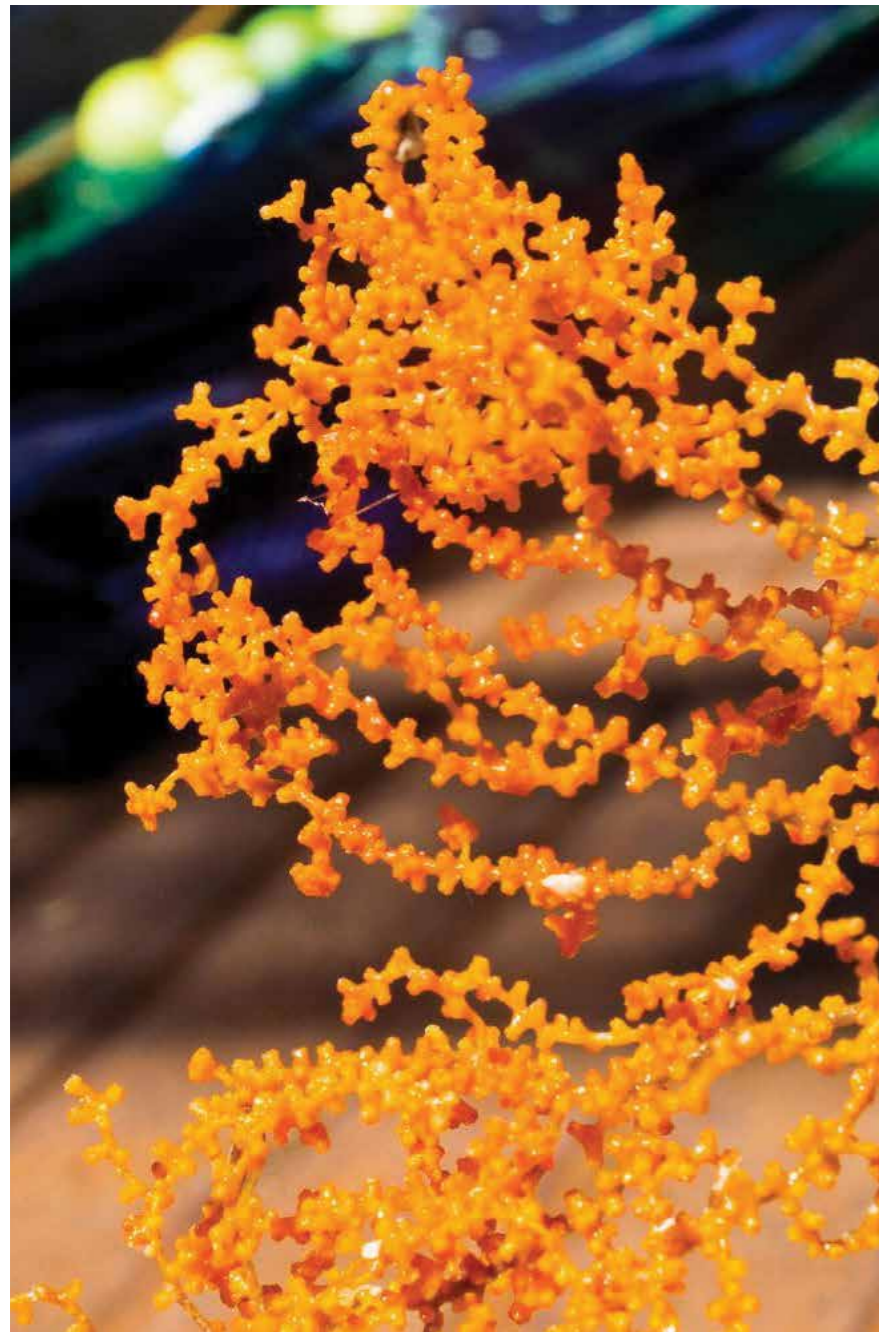
Restoring degraded aquatic ecosystems

- Identify and quantify environmental stressors
- Tools and strategies to restore and rehabilitate
- Tools and strategies to reduce the impact of extractive industries such as fishing and mining

Protecting aquatic environments from invasive species

- Understand emerging threats and develop best practice management
- Models to predict future impact of aquatic pests
- Strategies for eradication and control of established pests

CARING FOR OUR UNIQUE BIODIVERSITY

Helping understand Rangitāhua's environment

Te Mana o Rangitāhua is a five-year MBIE Endeavour-funded research programme led by Ngāti Kuri in partnership with Auckland Museum and NIWA.

The vision of this programme is to transform Aotearoa New Zealand's environmental stewardship and leadership through an indigenous-led research programme for Rangitāhua (Kermadec Islands).

The programme's mission is to generate new models of understanding to safeguard Rangitāhua's ecosystems, promote resilience and wellbeing, and create platforms for ecological reform. NIWA is contributing to this programme through biodiversity, ecological and oceanographic expertise.

Two fundamental research questions are being addressed. What are the main contributors to a thriving and healthy ecosystem for Rangitāhua? How can knowledge from indigenous and scientific research be applied to ensure ecosystem resilience in the face of future environmental challenges?

Te Mana o Rangitāhua is based on a high-trust and enduring partnership, established by Ngāti Kuri and Auckland Museum, with multidisciplinary expertise and skills from scientists, iwi researchers and practitioners.

NIWA has undertaken many expeditions to Rangitāhua (Kermadec Islands) over the years, studying the area's biodiversity and collecting deepsea samples, such as this bright orange gorgonian coral. [NIWA]

First climate change vulnerability assessment of taonga freshwater species

A NIWA-led study has identified seven freshwater species native to Aotearoa New Zealand that will likely be highly, or very highly, vulnerable to climate change.

The research assessed the vulnerability of 10 taonga (treasured) freshwater species to climate change, according to an internationally recognised method known as a Climate Change Vulnerability Assessment. This is the first time an assessment of this kind has been carried out for freshwater species in New Zealand. It designates vulnerability rankings by combining two criteria – exposure of a species to projected changes in climate, such as changes in temperatures and rainfall, and the species' ability to cope with those potential changes, based on their unique characteristics.

The assessment allocates climate change vulnerability rankings for each species from low to very high. It also supports management planning by providing insights into how the exposure of some of our freshwater taonga species to climate change may vary nationally, and how each species may respond differently, depending on where they are located and their unique life-cycle requirements.

Understanding the exposure and vulnerability of our freshwater species to climate change will underpin protection and restoration management strategies for our native taonga.
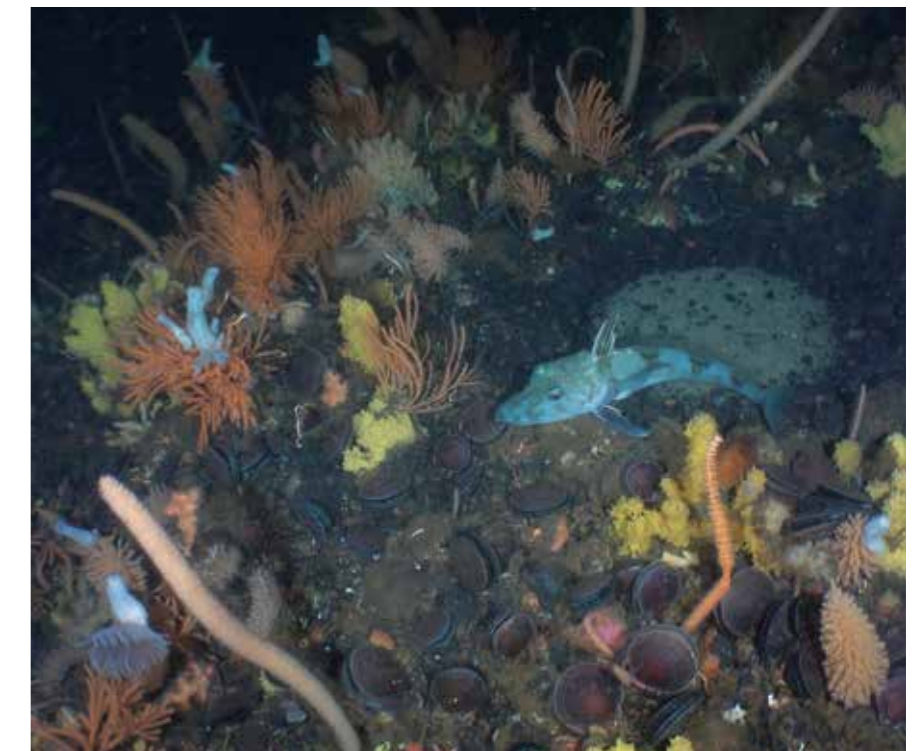
Ross Sea life in a changing climate

A six-week voyage to Antarctica by NIWA's deepwater research vessel *Tangaroa* in January–February 2021 was one of the few scientific expeditions to the continent since the global outbreak of COVID-19.

It was the third in a series of voyages focused on providing baseline information about the Ross Sea Marine Protected Area (MPA), which was established in 2017. The aim was to study the effectiveness of the MPA and improve our understanding of likely responses to future climate change.

The voyage objectives were funded by the MBIE Endeavour Fund Ross-RAMP Programme, Antarctic Science Platform, NIWA, University of Auckland, University of Otago, and the New Zealand Defence Force Defence Technology Agency.

Researchers and crew made 187 deployments during the voyage, including oceanographic and acoustic moorings, Argo floats, wave measurement buoys, and an assortment of nets. They also collected observations on everything from water chemistry to fish and whales. Water samples were collected and incubated onboard to provide information on phytoplankton, microbes and biogeochemistry in the upper ocean. In addition, a dedicated science programme used underwater cameras to study the animals that live on the seabed in the nearshore coastal region.

The Boxfish remote operated vehicle (ROV) was successfully deployed from *Tangaroa* at multiple coastal locations along the northern Victoria Land coast, providing some of the first views of these poorly studied, shallow coastal ecosystems. Here a crocodile icefish guards a nest of eggs among a groomed garden of sponges, corals and scallops. [NIWA]

Our people

There She Goes

This ozonesonde launch at Lauder was judged to be a lovely, well-balanced vertical composition with strong colour and a striking, almost surreal feel. The judges said it was eye-catching with the good use of colour and a bit of humour thrown in for good measure.

14
new permanent positions

Talented, agile, innovative and committed to scientific discovery and the application of knowledge that benefits New Zealand and the world. The retention, recognition, development and safety of our exceptional talent is a continuous priority.

Attracting and retaining talent

During the last financial year, we established 14 new permanent positions, mostly science positions, to respond to the growing demand for our expertise. Talent retention remains high at 92%, a testament to our strong employer brand and positive working environment.

We focus on applying best practice principles and methods in the recruitment and selection process. New staff receive a thorough induction covering job-specific and general information to provide a supportive and welcoming experience. These processes are continually reviewed to ensure their relevance, quality and consistency remain high.

Facilitating talent development

We annually review market demand and opportunities for our science, and the requirements of the support functions to enable delivery. Each year, managers work with team members to plan and deliver individual development activities that support personal goals and aspirations and align with organisational needs. This year, we put additional emphasis on the quality of these development conversations.

As a knowledge-based workforce, we encourage professional development across a wide variety of platforms, including external conference participation. Our performance and development review process is integral to supporting our people's current and future development. During the year, we spent $310,000 on professional development.

The People & Capability team regularly provide in-house workshops to support management and leadership capabilities, including Crucial Conversations, Recruitment & Selection and Developing Others. A range of other workshops is available to all staff, such as the Challenge of Change – Resilience, Family Violence Awareness & Prevention, and Unacceptable Behaviour, and there are online modules on a Digital Learning Hub. Additional workshops and seminars are organised and delivered at the regional level.

BLAKE Ambassador Melanie Hayden with fisheries scientist Pablo Escobar-Flores on a *Tangaroa* voyage collecting data on sub-Antarctic fisheries. [BLAKE]

130

graduate students supervised by NIWA staff

Ensuring diversity and inclusion

We have an ongoing focus on diversity and inclusion (including recognition of the rainbow community), ensuring that all policies, guidelines and practices are based on the principles of fairness, equity and non-discrimination. We also have a flexible working, family-friendly approach, and have part-time working arrangements with 13% of staff as well as other flexible working options, such as variable start and finish times.

We offer Informal Interventions training to help managers and staff maintain a constructive and professional work environment. There are Unacceptable Behaviour contact people at the main sites, and this support is underpinned by the Unacceptable Behaviour Policy and Resolution Procedure.

We hold Domestic Violence Free certification (DVFree) from SHINE – a specialist family violence support organisation – and are committed to improving awareness of family violence, providing a safe working environment for staff experiencing family violence and helping staff be safe outside of work. Regular Family Violence awareness training is provided for managers and Family Violence contact people.

A three-module, interactive training course on Unconscious Bias (developed by Diversity Works) was provided on the Digital Learning Hub and is available to all staff. Our Te Kūwaha team developed a Māori cultural competency app which is available to all staff.

Prioritising employee wellbeing

We continued to prioritise employee wellbeing in a year marked by ongoing adaptations to the COVID-19 pandemic. Managers are the primary point of connection and support for staff, helping their teams bolster resilience and identify and mitigate risks, and connecting staff who need support with the appropriate services. At the organisational level, a recent review highlighted the range of practices already in place to support employee wellbeing. These include our values, our supportive culture, and the generous benefits around flexibility and leave. We offer a range of workshops to support psychological wellbeing, including Mental Health 101 to identify and respond to mental health issues, Challenge of Change to help build resilience, Riding the Rapids to help navigate change, Crucial Conversations to facilitate effective communication, and Personal Effectiveness to help people operate effectively (productively and sustainably). We also offer Employee Assistance and Return to Work Programmes for those who need additional support. In terms of physical wellbeing, workstation assessments, skin checks and flu vaccinations are available for all staff, alongside specific health and safety training and development where relevant.

A new Personal Effectiveness workshop was developed and introduced this year and is being rolled-out across the country. This workshop guides staff in exploring and clarifying their professional and personal priorities, as well as presenting a range of tools and techniques to help them find efficient ways to optimise their time management.

Developing senior leadership

A new Senior Leadership Development Programme has been created and is underway, with the first cohort of 12 leaders beginning the programme in March 2021. Over a three-year period, in addition to individually tailored development activities, participants will attend workshops on topics such as personal effectiveness, emotional intelligence, cultural competence, navigating complexity and strategic thinking. They will participate in regular small group discussions on contemporary leadership topics, take part in peer coaching, and meet specifically with a senior management mentor twice-yearly. Our annual Leaders' Forum for managers across the organisation was held in reduced format this year because of COVID-related restriction uncertainty.

Facilitating good employment relations, engagement and collaboration

Regular engagement between employees, employee representatives and management occurs for the ongoing development and refinement of workplace policies and practices, and for employment negotiations. The Future Property Programme includes a participation forum involving staff representatives to enable ongoing collaboration on this significant project. The Executive Team also deliver roadshows throughout the year to update all staff on business performance and strategic initiatives, and for direct two-way communication on topical matters.

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

The annual midwinter Poultice is billed as a fancy dress, semi-sports, teams event for Wellington staff to help lighten the gloom of the shortest days of the year. [Dave Allen]

OUR PEOPLE

The 20 science staff and 19 crew on this year's *Tangaroa* Antarctic voyage were tested for COVID-19 ahead of departure as part of an international effort to keep Antarctica virus-free, and, for the first time in many years, all were New Zealand-based, due to international COVID-19 travel restrictions. [Stuart Mackay]

Rewarding and celebrating our people

We recognise the importance of acknowledging and rewarding staff for their contributions to our success. Although the uncertainty of the COVID-19 pandemic thwarted our annual general adjustment and performance reward processes for remuneration, our level promotion process continued as usual. We celebrated 26 science staff being awarded the significant achievement of a level promotion during the year. Level promotions represent the culmination of years of science knowledge development and practical application and involve a comprehensive peer-assessment process.

Exceptional achievements were also recognised by the annual NIWA Excellence Awards and staff photography competition, under 12 Excellence and 6 Photography Award categories.

The Living Wage continued to be applied as the minimum wage across the organisation.

Contributing to the development of future science talent

The ongoing development of science talent is critical to enable us to continue to deliver high quality science innovation. We are the principal sponsor of seven main city science & technology fairs and contribute to a further eight regional fairs, helping promote science careers and awareness to the next generation of New Zealanders. A similar outcome is achieved through the Sir Paul Callaghan Eureka Awards and in partnership with BLAKE and Sea Life Kelly Tarlton's.

Our staff supervised more than 130 PhD, Master's and Bachelor's degree students nationwide, and we additionally supported the development of science careers by contributing funding towards 11 PhD scholarships and 11 postdoctoral fellowship positions. We also hosted 46 science visitors and a wide range of interns and students for research work experience, including four Māori graduate interns and four BLAKE Ambassadors under their environmental leadership programme to work on science projects alongside our staff.

Continuing our total commitment to safety

As we continually adapt to the COVID-19 environment, our focus on working safely at all times assumed another dimension, with continual enhancements to existing practices. Across the organisation this year, our staff spent about 700 hours on training requirements associated with health and safety competencies.

Notable health and safety achievements for the year included tertiary level accreditation for the fourteenth consecutive year under the ACC Accredited Employer Programme, the creation of a robust method for capturing proactive health and safety performance measures and the implementation of an improved incident management tool for analysing incident trends to inform our health and safety decisions.

Ensuring that everyone has what they need to make sound health and safety choices in a changeable work environment is key to enabling our people to work safely.

Howling southerlies, 12-degree water and a 30cm chop greeted NIWA Wellington staff on the site's annual mid-winter swim in June. [Lana Young]

NIWA sponsors the Sir Paul Callaghan Eureka Awards, a science, technology, engineering and mathematics communication competition for high school and university students. This year's finalists, with NIWA Award Winner and Victoria University of Wellington student Isla Day top right, were hosted at Parliament by the Hon Andrew Little. [Simon Woolf]
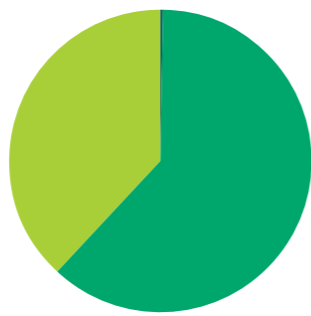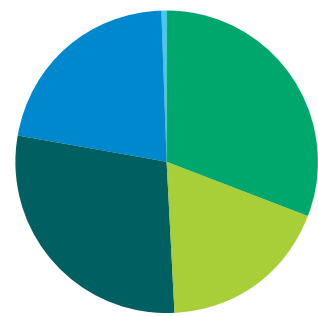
NIWA BY THE NUMBERS
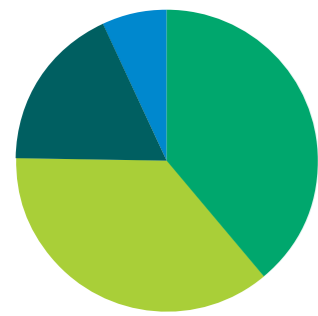
Roles

- Scientists 38.9%
- Technicians 36.4%
- Support 17.8%
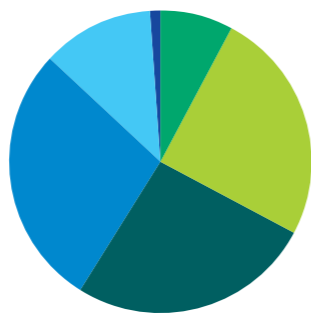- Operational support 6.9%

Gender

- Male 61.7%
- Female 38.2%
- Other gender identity 0.1%
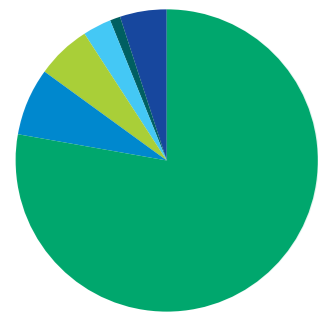
Highest Qualification

- Doctoral degree 31.0%
- Master's degree 18.4%
- Bachelor's level* 28.4%
- Other 21.8%
- No qualification 0.4%

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

Age

- 20–29 8%
- 30–39 25%
- 40–49 26%
- 50–59 28%
- 60–69 12%
- 70+ 1%

Ethnicity

- European 78%
- Asian 7%
- Māori 6%
- African/Middle Eastern/Latin American 3%
- Pacific 1%
- Other 5%

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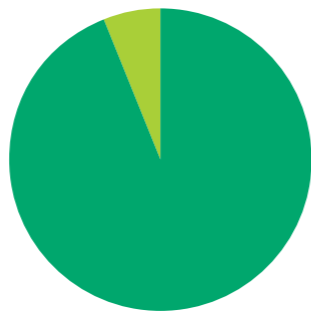
Employment status

- Permanent 94%
- Fixed term 6%

NIWA GROUP BY LOCATION

721 NIWA staff

71 New employees

- Ruakākā 26
- Auckland 85
- Hamilton 117
- Rotorua 9
- Napier 1
- Whanganui 2
- Nelson 22
- Wellington 296
- Greymouth 4
- Christchurch 113
- Tekapo 2
- Lauder 11
- Alexandra 3
- Dunedin 8
- Perth 13

Recruitment

14 approved new permanent positions

31 approved permanent replacement positions

18 approved fixed-term positions

Turnover

Turnover to the end of June for the NIWA Group was 8.27%

Working Arrangements

87% of staff work full time
13% of staff work part time

Level Promotions

26 Level Promotions

Disabilities

6.9% 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

2021 NIWA Excellence Awards

Our Annual Excellence Awards celebrate the achievements of staff who have made an extraordinary contribution.

Staff are nominated by their peers, and finalists are then selected by a representative panel of staff, for ratification by the Executive Team.

Beauty and the Beast

A beautiful clown nudibranch climbs biosecurity enemy number one, the Mediterranean fanworm in Whangārei Harbour. The judges said this shot had a cool flow, with the brightness of the neon orange creature contrasting well with the muted tones of the plant.

EXCELLENCE AWARD WINNERS

Research

Dr Sara Mikaloff-Fletcher

Sara's research focuses on global biogeochemical cycles of carbon dioxide, methane and other trace gases associated with climate change. She is a leader nationally and internationally, influencing the direction of research and helping build the world's first complete national-scale picture of a country's carbon profile based on atmospheric data. Sara is also the Science Leader for MethaneSAT, a joint US/NZ space mission to locate and measure methane from human sources around the globe – New Zealand's first official space mission.

Applied Science

Dr MS Srinivasan

MS has led the Irrigation Insight team to deliver exceptional science that is useful, useable and needed to support improved environmental and productive outcomes for farmers. Through his focus on the pragmatic environmental, social and economic aspects of irrigation, and working with a collective of stakeholders, MS has influenced timing and volume of irrigation and created a learning experience for participants – translating data, information and findings into beneficial tools and knowledge.

Richard Measures

Richard played a crucial role supporting the West Coast Regional Council and Buller Emergency Operations Centre during the July 2021 Westport flood. He monitored forecast rainfall and river flow, provided advice for colleagues communicating information to the public and ensured the council had access to the NIWA data and advised on its interpretation. Operations centre staff praised him for the difference his advice made and for the confidence it gave the council in their evacuation decisions.

Early career science

Dr Alex Geddes

Alex brought a deep knowledge of remote sensing and a growing background in the modelling tools used to infer methane emissions from satellite data through his work leading the development of our first national-scale methane inverse model. He is the task leader for satellite and ground-based remote sensing work and has major stakeholder recognition as a leader in agricultural emission research. Alex's skills and innovations have also helped futureproof measurements at NIWA's globally recognised Lauder Atmospheric Research Station.

Leadership

Julie Rea

Julie has had a significant impact across NIWA as national health and safety manager, initiating a wide range of improvements after systematically reviewing practice and procedure. She challenges herself and others to identify opportunities, and promotes a culture of continual improvement.

A highly collaborative leader who builds positive and productive relationships across the organisation, Julie also took a lead role to help ensure safe operation during the COVID pandemic.

Project Delivery

Dr Chris Woods

Chris exemplifies project delivery from inception to final delivery, underlined by outstanding client communications. He was responsible for the successful delivery of the Biosecurity NZ National Marine High Risk Site Surveillance programme, a complex nationwide port surveillance project involving more than 50 NIWA staff annually. All performance measures were met, on time and within budget, and a twelfth site, Napier, has since been added to the contract.

EXCELLENCE AWARD WINNERS

Customer focus

Annette Semadeni-Davies

Annette has an outstanding record of delivery and an enduring commitment to customer satisfaction. She builds strong relationships with customers, ensuring the scope is understood, challenges are signalled and solutions are considered collaboratively. In multi-disciplinary projects ranging from water quality to the impact of vehicle emissions, her focus helps ensure fit-for-purpose applied science is considered during local and central government decision making.

Operational innovation

Dr Stuart Moore

Stuart led the delivery of the operational, high-resolution, weather forecast model that provided the weather information Emirates Team New Zealand needed in their successful defence of the America's Cup. The 300m scale model covering the Hauraki Gulf was a fully supported part of the NIWA operational forecast suite, running four forecast cycles per day, and delivering vital high-resolution data to ETNZ ahead of their race-day decision making. The system went beyond anything implemented anywhere else in the world.

Te Puāwaitanga

Dr Eimear Egan

Eimear exemplifies cultural competency and awareness and has passionately enhanced NIWA's delivery of excellent research of benefit to Māori. She mentors Māori science capacity and capability, including university interns as well as NIWA Māori graduate interns. Eimear led the Cultural Keystone Species research programme and a project that developed a climate change vulnerability assessment for ten freshwater taonga. She embraces every opportunity to work with Te Kūwaha and implement a best practice approach to the co-development and delivery of research with iwi/hapū.

Science communication

Chris Brandolino

Chris is an extraordinary science communicator who is regularly sought out by media for his professional and hugely engaging forecasts, and to explain complex meteorological events. He has had an exceptional year, including numerous appearances on TVNZ's America's Cup coverage, a weekly slot on TV3's AM Show and multiple interviews on RNZ's key programmes. He was also an integral part of the team which delivered a bespoke forecasting service to the Department of Conservation.

Dr Richard O'Driscoll

New to the role of Chief Scientist - Fisheries, Richard has made it a priority to communicate the importance of fisheries science to a wide audience. He is a natural communicator, evident in multiple media engagements over his leadership of this year's *Tangaroa* voyage to Antarctica. He has negotiated complex and sensitive issues with a calm but authoritative voice, motivated by the desire to ensure the facts are front and centre of discussions that can often veer towards advocacy. He also encourages good science communication amongst his team and has earned the praise of stakeholders for his approach.

EXCELLENCE AWARD WINNERS

Support Services

Caroline Anderson

Caroline provides outstanding support to scientists and managers in her role as legal counsel at NIWA, particularly with the complexities imposed by contractual agreements. She is renowned for her diligence in scrutinising contracts and her diplomatic liaison with clients. She works with the project leader to ensure she understands the nature of the project, and any potential risks, to enable her to provide clear advice and defensible agreements.

Health and Safety

Greg Olsen

Greg has been a champion of safe working practices at NIWA Hamilton for more than 20 years. He manages the dangerous goods stores, played a leading role in the design of the new stores and is integral to the use, storage and transport of hazardous substances. Greg is NIWA's representative on the CRI/university working group consulting WorkSafe NZ on the interpretation of health and safety at work.

Team Excellence Awards

Scallop Survey Dive team – James Williams, Crispin Middleton, Richie Hughes, Oliver Evans, Dane Buckthought, Jon Stead

NIWA was contracted to conduct a series of scallop surveys around the upper North Island and in the Marlborough Sounds in a very constrained timeframe. Over two months, the team completed a total of 509 individual dives, swam more than 60km and surveyed nearly 14,000m² of seabed, spending the equivalent of 15 days underwater. In spite of these challenges, the team completed all survey work safely, on time and to budget and successfully trialled novel AI survey techniques.

Bonamia team – Anjali Pande, Keith Michael, Jaret Bilewitch, Debbie Hulston, Graeme Moss, Daniel Rexin

Evidence of Bluff oysters infected with the exotic parasite *Bonamia ostreae* at the start of the oyster season required NIWA Environmental Isotopes and Molecular Biology group staff to prepare for a massive, rapid testing programme. Under intense time pressure, and working closely with the MPI incursion response team, a survey to determine the spread and infection rate of the parasite within the fishery area was designed and successfully completed, sampling 19 sites in two days.

The 'NIWA Forecasting team' – One.NIWA
Hauraki Gulf weather, wave, current and tide forecasts for Emirates Team New Zealand, 36th America's Cup DOC Mountain Weather Forecast Service

In accordance with our practice of assembling the best team for any project (One.NIWA), our 'Forecasting Team' included meteorologists, oceanographers, atmospheric modellers, software developers, high-performance computer technicians, bid writers, science communicators and science leaders – too many to acknowledge individually. The extraordinary successes this year were the ultra-high-resolution forecasting for ETNZ's successful defence of the America's Cup and launching the Department of Conservation's Mountain Weather Forecast Service.

EXTERNAL AWARD WINNERS

Darren King – Hochstetter Lecturership

Dr Darren King was jointly awarded the Geoscience Society of New Zealand's 2021 Hochstetter Lecturership. By challenging notions that mātauranga Māori is incompatible with science, his research has helped deepen understanding of geological history, geomorphology, climate change, geohazards and human-environment interactions across Aotearoa New Zealand.

National Climate Change Risk Assessment wins multiple awards

NIWA researchers Dr Andrew Tait, Dr Paula Blackett, Dr Sam Dean, Petra Pearce and Dr Darren King were recognised with four separate awards for their contribution to New Zealand's ground-breaking National Climate Change Risk Assessment. Alongside engineering firm AECOM, the NIWA team won the Engineering Impact Award and the Supreme Award at Engineering New Zealand's 2021 ENVI Awards, the Climate Business Journal Business Achievement Award for Industry Leadership and recognition from the Resource Management Law Association of New Zealand.

Benjamin Popovich – 2020 De Paepe-Willems Award

Hazard and risk analyst Dr Benjamin Popovich won the 2020 De Paepe-Willems Award for a research paper on the tsunami resilience of pile-supported wharves. Benjamin's research gives a comprehensive evaluation of the structural impacts on New Zealand wharves from tsunami.

Marine restoration project wins Cawthron Award

A mussel restoration project involving University of Auckland and NIWA Nelson-based PhD student Emilee Benjamin won the Marine category at the 2021 Cawthron Marlborough Environmental Awards. Collaborating with scientists from both organisations, Emilee trialled different restoration methods – placing live mussels in plots on the seafloor to grow and spread, and using waste mussel shells to create reefs for live mussels to settle on.

Brit Finucci – 2021 Eugenie Clark Award

Fisheries scientist Dr Brit Finucci won the 2021 Eugenie Clark Award – presented by the American Elasmobranch Society and established in memory of pioneering female shark researcher Dr Eugenie Clark. Brit is a member of the Society and was honoured for her research into shark management and conservation.

EXTERNAL AWARD WINNERS

Malcolm Clark recognised by ECO Magazine

Principal Scientist, Fisheries Dr Malcolm Clark was named a Deep-Sea Hero by ECO Magazine. Recognised for his extensive publication record, Malcolm has been involved in a broad range of research over many years, including stock assessments, deepsea ecosystems and biodiversity, seamounts, marine life censuses, submersible dives and international work in the Antarctic and southwest Pacific.

Wendy Nelson – Nancy Burbidge Medal

Principal Scientist, Marine Biology Dr Wendy Nelson MNZM was awarded the 2020 Nancy Burbidge Medal – the highest award bestowed by the Australasian Systematic Botany Society – for her longstanding and significant contribution to Australasian systematic botany.

Science New Zealand Awards

NIWA marine and freshwater researchers were honoured at the 2020 Science New Zealand National Awards. Ocean modeller Dr Erik Behrens won the Early Career Researcher Award for his technically excellent and internationally sought-after work on ocean modelling. Chief Scientist, Māori Environmental Research Dr Erica Williams won the Individual/Lifetime Achievement Award for her work on restoration of cultural keystone species. Sadie Mills, Diana Macpherson, Dean Stotter and Caroline Chin won the NIWA Team Award for their guardianship of the NIWA Marine Invertebrate Collection – a nationally significant collection of more than 300,000 specimens.

Andrew Tait honoured for Pacific leadership

Chief Scientist, Climate Dr Andrew Tait won the Tagaloa Award in recognition of his stewardship of, and service to, the Pacific Islands Climate Services Panel, which he chaired for five years. Andrew has been involved with the panel since its inception, not only as Chair, but also by building relationships and providing ongoing scientific advice and support.

Rob Bell – Kudos Lifetime Achievement Award

Principal Scientist, Coast & Estuarine Physical Processes Dr Rob Bell was joint winner of the 2020 Kudos Lifetime Achievement Award. Rob's remarkable career began with a series of engineering projects to clean up wastewater outfall discharges into our coastal waters. 106 scientific publications, 140 consultancy reports and more than 150 external presentations later, he is regarded as New Zealand's leading expert on coastal hazards and risk.

Manukau Heads

A dramatic and elegant photograph which the judges said showed how small human forms can really make the shot – creating balance and a point of interest. They also said it was the use of black and white with graduated greys of the hills and the backlit people that really pulled this out of the ordinary.

BOARD OF DIRECTORS

Barry Harris

Nick Main

Dr Helen Anderson

Dr Tracey Batten

Prof. Gillian Lewis

Mary-Anne Macleod

Barry Harris
Chairman

Barry is a company director with extensive governance and executive experience. He has held several 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 is currently chair of Food Innovation Waikato, McFall Fuels, OSPRI and Hamilton Airport and is a director of WEL Networks Limited and Ultra Fast Fibre. Previous boards include Wintec, Waikato River Authority, AgResearch and DairyNZ. Barry has a Master of Agricultural Science (Honours). He was appointed Chairman of NIWA in July 2018.

Nick Main
Deputy Chairman

Nick is a Chartered Accountant and was CEO and later Chairman of Deloitte in New Zealand. More recently, he was Deloitte's Global Managing Partner of Sustainability and Climate Change Services and Global Chief Sustainability Officer, based in London. He has also served as Deloitte's Global Chief Ethics Officer. Nick currently chairs the Middlemore Foundation for Health Innovation, chairs the Westpac New Zealand Sustainable Business External Advisory Panel, and is a member of the Westpac Australia Stakeholder Advisory Council and a trustee of BLAKE.

Dr Helen Anderson

Helen chairs the BRANZ Board, Scion and Studio Pacific Architecture. She is an independent director of DairyNZ and Antarctica NZ and is on the Risk and Assurance committees for MPI and Statistics NZ. She was Chief Executive of the Ministry of Research, Science and Technology for six years, preceded by six years as Chief Science Adviser. Helen chairs or is a member of advisory boards for DIA, MBIE, NZ Police and ClearPoint Ltd. She has a PhD in geophysics from Cambridge University and enjoys keeping up-to-date with the latest science developments.

Dr Tracey Batten

Tracey has 15 years' experience as CEO for large healthcare organisations in both Australia and the UK and has worked closely with businesses in the hospital, aged care and medical research sectors. Tracey was Chief Executive of Imperial College Healthcare NHS Trust in the UK. Prior to that she was Chief Executive of St Vincent's Health in Australia. She has held governance positions with private and public organisations and is a director of Abano Healthcare, Medibank Private Limited (Australia) and ACC. Tracey qualified as a doctor at the University of Melbourne and has a Master of Health Administration from the University of New South Wales and an MBA from Harvard.

Prof. Gillian Lewis

Gillian is a Professor of Environmental Microbiology and Associate Dean for Sustainability in the Faculty of Science and University Proctor at the University of Auckland. She was formerly Associate Dean of Research, Head of the School of Biological Sciences, held a leadership role in the Joint Graduate Schools between the Faculty of Science and CRIs or research organisations. Gillian is a former President of the New Zealand Microbiological Society. She has a PhD in Microbiology from the University of Otago. Her research focuses on the interactions of complex microbial communities and their response to natural and anthropogenic impacts in freshwater environments.

Mary-Anne Macleod

Mary-Anne is an independent director for the Bay Venues Limited and the Environmental Protection Authority. She has previously held governance roles with House of Science, Quayside Holdings Limited, Priority One and the Bay of Plenty Local Areas Shared Service organisation. She was the Chief Executive of the Bay of Plenty Regional Council for seven years and has also held other senior positions in local and central government agencies. Mary-Anne has also worked at a senior level in international consultancies where she specialised in environmental management. She has a Master of Science (Hons) in Earth Sciences and Geography.

EXECUTIVE TEAM

John Morgan

Dr Rob Murdoch

Geoff Baird

Patrick Baker

Dr Mary-Anne Dehar

Warrick Johnston

Dr Helen Neil

Marino Tahi

Dr Alex Thompson

Dr Bryce Cooper

Jules Maxey

John Morgan
Chief Executive

John joined NIWA as CEO in April 2007. He 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 and 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 has been seconded part time to the Ministry of Business, Innovation & Employment as a Departmental Science Advisor since 2017.

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 UK 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, a Crown company established to deliver managed internet services to New Zealand's schools. 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.

Warrick Johnston
General Manager, Technology & Innovation

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

Warrick has more than 20 years' experience in strategy, product development, service creation and delivery, and niche technologies. He has the ability to understand complex technology combined with a practical nature and the experience to understand the market and business needs. Warrick possesses expertise in all things spatial, with many years' experience working in developing the GIS market. He developed his skills through a career in start-ups, ISVs, niche technology companies and product companies such as Microsoft and Esri. He joined NIWA as General Manager, Technology and Innovation in 2020.

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.

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, with the aim of maximising the transfer of environmental and natural resource scientific knowledge to whānau, hapū, iwi, Māori entities and communities – 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.

Dr Bryce Cooper
General Manager, Strategy

PhD (Microbiology), University of Waikato

Bryce is a graduate of the London Business School Senior Executive Programme. He has held research leader and regional manager roles in NIWA, and currently oversees NIWA's strategy development, including initiatives to transfer research to end users and the building of partnerships with businesses and central and local government.

[Bryce stepped down from this role in May 2021]

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.

Petra Pearce
Climate, Atmosphere & Hazards – Manager

MSc Hons (Geography), University of Auckland

Petra joined NIWA in 2008. Her research background is in historic climate and climate data rescue. She provides climate change advice to regional councils, government agencies, and businesses, and she regularly engages with the public, media, businesses and other organisations about climate change in New Zealand.

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

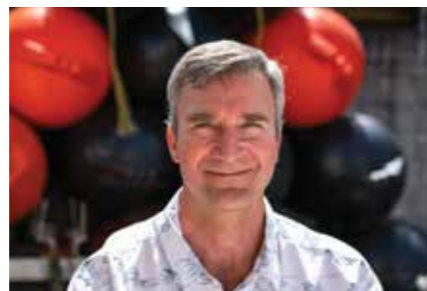*PhD (Ecology and Evolution), University of Hawai'i*

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 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, geo-informatics, 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 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.

Kameron Christopher
High Performance Computing & Data Science – Chief Scientist

PhD (Engineering and Computer Science), Victoria University of Wellington

Kameron has a research background in artificial intelligence (i.e., ML, DL and RL), digital signal processing (i.e., image, audio and sensors), and cognitive and affective neuroscience. He has extensive experience leading data and data science across a range of industries, including the financial and science sectors, and joined NIWA in 2019.

Erica Williams
Māori Environmental Research – Chief Scientist
Pou Whakarae – Te Hiringa Taiao

PhD (Biological Sciences), University of Auckland

Erica joined NIWA in 1995 and has been a member of NIWA's Te Kūwaha team since 2001. She has been involved in a wide range of research areas including bioaccumulative contaminants in mahinga kai species, understanding the values and priorities of Māori communities for the restoration of their freshwaters, taonga species-related research, and capacity building and monitoring frameworks for Māori communities.

SCIENCE MANAGEMENT TEAM

Dr Mike Williams
Oceans – Chief Scientist

PhD (Physical Oceanography),
University of Tasmania

Mike joined NIWA in 2001 and has a science background in physical oceanography, ocean acidification, climate change and ocean processes associated with Antarctic sea ice and ice shelves. Prior to his appointment as Chief Scientist, Oceans in 2021, Mike held a joint appointment as Director of the Deep South National Science Challenge and Principal Scientist, Marine Physics.

Dr Joshu Mountjoy
Oceans – Strategy Manager

PhD (Geological Sciences), University of Canterbury

Joshu has worked for NIWA as a marine geologist for over 16 years. His areas of research expertise include active seafloor and sub-seafloor processes, with particular focus on active tectonics and earthquake hazards, submarine landslides and canyons, and offshore groundwater and fluid flow systems. He took up his current role in 2021.

Graeme Inglis
Marine Environment Platform – Manager

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.

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. He has extensive experience in research administration and science and technology programme evaluation. Alan joined NIWA in 1998 and oversees NIWA's obligations to government funding agencies and responsibilities for undertaking research for the benefit of all New Zealanders, and evaluation of the impact and value of NIWA Research.

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.

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.

Greg Foothead
Vessel Operations – General Manager

NZCE (Mechanical),
Central Institute of Technology

Greg is a certified automotive engineer. Before joining NIWA Vessels as Engineering Manager in 2004, he managed a marine and industrial supply and repair company. He has also worked for Mitsubishi Motors, in various technical roles, in New Zealand, Australia and Europe. Greg has managed NIWA's research vessels *Tangaroa*, *Kaharoa* and *Ikatere* since December 2010.

Rob Christie
Marine Resources – Manager

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

Rob is a chartered scientist with more than 26 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 Barb Hayden
Science Advisor, Marine

PhD (Marine Biology), University of Otago

Barb has a research background in marine biosecurity and the environmental sustainability of aquaculture. Today she leads NIWA's coasts and oceans research, which focuses 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 – 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.

Dr Phillip Jellyman
Christchurch – Regional Manager

PhD (Ecology), University of Canterbury

Phil is a freshwater fisheries scientist specialising in freshwater resource management and conducting research on freshwater fisheries and food webs. He currently leads large freshwater reconsenting projects for NIWA's hydropower clients. He first joined NIWA in 2005, became Assistant Regional Manager in 2018 and was appointed to his current role 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 Marine Research Centre at Bream Bay. In 2019 he was appointed Regional Manager for the Hamilton region.

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 Emergency and Crisis Management Critical Risk Team.

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 is a molecular biologist specialising in phylogenetics and systematics. Since joining NIWA in 2015 she has led the NIWA Molecular Biology team, which works across several areas including biodiversity, biosecurity, aquaculture and fisheries. She was Group Manager, Environmental Isotopes and Molecular Biology before her appointment as Assistant Regional Manager in 2020.

Dr Darren Ngaru King
Nelson – Regional Manager

PhD (Applied Geology), University of New South Wales

Darren is a research scientist with experience spanning the earth and human-system sciences. He joined NIWA in 2001. In addition to being the Regional Manager for Nelson, he leads NIWA's Māori Environmental Research Programme 'Hazards, Climate and Māori Society' and holds a joint position on the Kāhui Māori for the Deep South National Science Challenge and the Antarctic Science Platform.

Ken Becker
Ruakākā – Regional Manager

BSc Hons (Marine Biology), University of Liverpool

Ken has nearly 40 years' experience in marine science. Before joining NIWA as a regional manager in 2005, he worked for Auckland Regional Council on resource management regulation, planning and policy development in water quality, wastewater treatment, stormwater management and water resource allocation.

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 and was appointed to his current position in January 2016.

Brian Bell
Business Operations – National Projects Manager

MA Hons (GIS/Geography), State University of New York

Brian has a background in geospatial science and technology, including over 20 years of operational and innovation management in the environmental science domain. He is certified in programme management, product management and design thinking. Brian relocated to New Zealand from America in 2015 and was the GM of Products & Partnerships with MetService before joining NIWA as National Projects Manager in 2019.

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.

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.

DIRECTORY

Directors

Barry Harris
Chairman

Nicholas Main
Deputy Chairman

Dr Tracey Batten

Mary-Anne Macleod

Dr Helen Anderson
(until 30 June 2021)

Prof. Gillian Lewis
(until 30 June 2021)

Executive Team

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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

Dr Bryce Cooper
General Manager, Strategy
(until 31 May 2021)

Registered office and address for service

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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

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