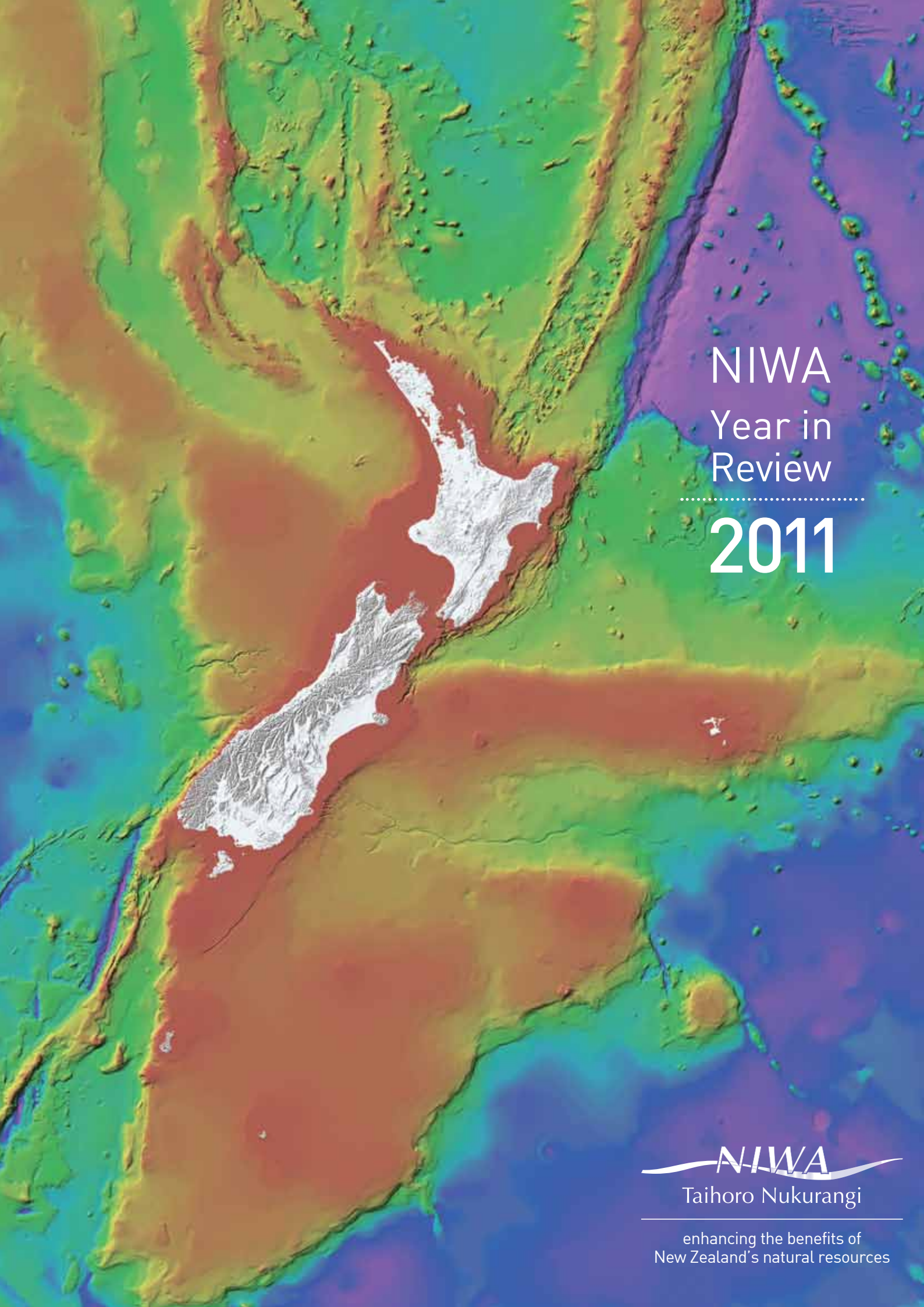


NIWA
Year in Review
2011

NIWA
Taihoro Nukurangi

enhancing the benefits of
New Zealand's natural resources

Front cover: NIWA's iconic Undersea New Zealand graphically identifies New Zealand's ocean estate, the fourth largest in the world.

This page: This NIWA chart reveals the shape of the seabed in Cook Strait, uncovering some of the secrets hidden beneath the ocean (see page 32).

NIWA Year in Review 2011

Contents

From the top of the atmosphere to the bottom of the ocean, NIWA is focused on enhancing the benefits of New Zealand's natural resources

671
staff across 16 sites in New Zealand and Australia

$117.9 million
revenue from research and applied science services

807
current environmental science projects

Enhancing our nation's economic and environmental prosperity

Never before in New Zealand's history has the case for robust, long-term natural resources and environmental research and applied science services been made clearer than in the last financial year.

As a country, we continue to navigate our way through difficult economic times, made worse by unprecedented national disasters, like the Christchurch earthquakes and the Pike River mining tragedy. At the same time, New Zealand faces some very important environmental opportunities and issues which, if not managed effectively, will continue to impact on New Zealand economically. Issues like water quality and water allocation, energy supplies, ocean resource management, the changing climate, how we respond to natural hazards and increasing numbers of extreme weather events, and making greater use of our vast natural resources in a sustainable way.

The Government has recognised the importance that science and innovation will play in New Zealand's future economic and environmental prosperity through the establishment of the new Ministry of Science and Innovation (MSI) – a single agency tasked with driving the science and innovation sector in New Zealand forward. It is a move that the Board of NIWA welcomes, and we are already working closely with MSI to meet our core purpose as New Zealand's leading natural resources and environmental science services provider.

As the Prime Minister's Chief Science Advisor Sir Peter Gluckman noted recently in his discussion paper on policy formation, science creates the platform for effective strategies and wise policy development. The Board of NIWA agrees. NIWA has the skills and expertise to make a significant contribution to how New Zealand tackles the important decisions we will have to make as a country around our natural resources and environment in the coming years.

Despite the challenges of the past year, NIWA has continued to perform positively. Our productivity continues to improve and demand for our services remains high. We continue to invest in essential technology, upgrade existing facilities, and align and strengthen our capabilities to meet the country's science needs, and we are well placed to meet our responsibilities as outlined in our Statement of Core Purpose.

The year ahead will not be without its own challenges, but the Board is confident NIWA is in a good position to face those challenges head on. I would personally like to thank my fellow Directors, CEO John Morgan, his hard working Executive, and all of the NIWA team for their commitment and work this year. In particular I would like to commend the NIWA Christchurch team for their resilience and ongoing commitment.

We can all be truly proud of the contribution NIWA makes to enhancing New Zealand's economic and environmental prosperity through the delivery of outstanding science based services.

Chris Mace
Chairman

$117.9 million
revenue from research and applied science services

$16.3 million
earnings before interest, tax, and depreciation

$1.3 million
profit after tax

$87 million
capital investment over the last 4 years

$139.8 million
total assets

"New Zealand's economic and environmental prosperity depends on robust, long-term science and applied research."

John Morgan, Chief Executive

Chairman Chris Mace (left) and Chief Executive John Morgan.

An unprecedented year

Despite predictions that New Zealand would continue to face significant economic challenges in the 2010–11 financial year, few foresaw the unprecedented economic situation that lay ahead.

Not only did New Zealanders continue to feel the lingering effects of the global economic crisis and our own economic recession, but we also endured some of our nation's greatest tragedies, with significant loss of life. As a result, New Zealand posted its worst-ever deficit in May this year, and the flow-on effects for our economy continue to be felt today.

There is, no doubt, more uncertainty and instability to come before we see a full economic recovery. How quickly and decisively New Zealand responds now will determine our nation's economic prosperity in the years ahead.

The same is true for NIWA. Like other businesses, we have not been immune to the unusually challenging economic environment, and we have had to respond accordingly. Despite the strong demand for NIWA's science based services, we forecast relatively static revenue this year. In reality, it dipped.

We were, however, incredibly fortunate to suffer only very minor damage and disruption to our Christchurch operations after the September and February earthquakes. Although more than half our Christchurch staff suffered damage to their homes, they showed considerable resilience and stoicism. Without their continued dedication to see the job done, our performance this year would certainly have been more significantly affected.

Our response to the challenging economic environment included tightly managing our costs, and carrying out an operational review to ensure our capabilities were aligned with the nation's science needs. This included making changes to our staffing levels, and streamlining our internal systems so our business operates more efficiently.

With this careful planning, and by responding with agility to the quickly changing economic environment, NIWA has continued to be a profitable and thriving business in 2010–11. Our final results show revenue of $117.9 million, with earnings before interest, tax, and depreciation (EBITDA) of $16.3 million and profit after tax of $1.3 million – a sound result, albeit lower than budgeted, given the tough operating environment.

At the same time, we are always looking for ways to improve what we do and meet the demand for our services, including upgrading our national environmental monitoring network and a $25 million refit of our largest research vessel, *Tangaroa*. The refit included the installation of a dynamic positioning (DP2) system – making *Tangaroa* an even more valuable New Zealand asset for ocean science, surveying, and exploration.

With continuing investment in essential technology, including purchasing the Southern Hemisphere's most powerful supercomputer, upgrading our finance and project management systems, and investing in new IT hardware and software, NIWA is well placed to provide science based services that will contribute to the prosperity of New Zealand in the years ahead.

NIWA's supercomputer – greatly enhanced business management with new forecasting accuracy. (Dave Allen, NIWA)

Tangaroa – New Zealand's largest single science asset returns after a $25 million upgrade. (Peter Marriott, NIWA)

Science is at the forefront of New Zealand's future

In his speech at the opening of the new Ministry of Science and Innovation (MSI), Dr Wayne Mapp said "creating a Ministry which spans both science and innovation shows the Government's intent to place science at the forefront of New Zealand's future."

At NIWA, we have long held the view that New Zealand's economic and environmental prosperity depends on robust, long-term research and applied science. The need for NIWA's skills and expertise has never been more evident than now.

The establishment of the new Ministry, along with other initiatives to better align the functions of the Crown Research Institutes with the needs of the sectors they serve, provide the foundation NIWA needs to make an even greater contribution to New Zealand's economic growth.

Contributing to New Zealand's economic recovery and growth

Right now, NIWA has more than 1000 science projects on the go through our National Science Centres. NIWA's science will continue to drive New Zealand's economic recovery and growth by:

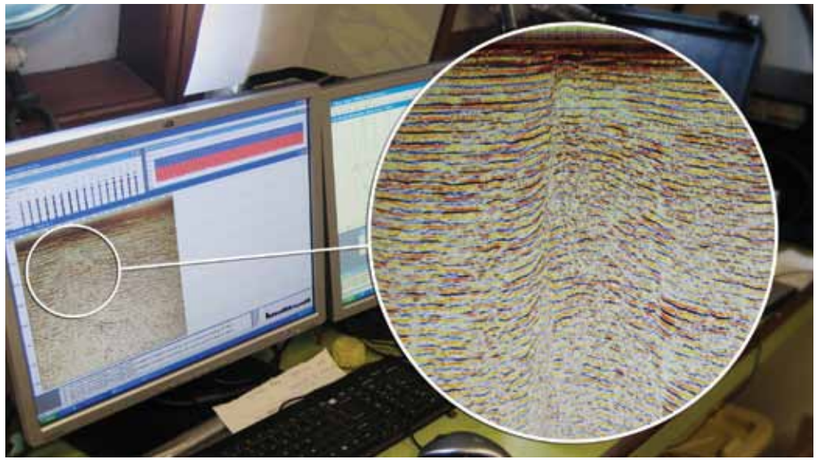
- Identifying ways to make better use of our vast natural resources in a sustainable manner,
- Ensuring New Zealand is better prepared for extreme weather events and natural hazards,
- Seeking to maintain New Zealand's 'clean, green' image, through better management of our natural environment,
- Helping New Zealand contribute to important global environmental issues like the changing climate.

Making greater use of our natural resources

To boost New Zealand's economy, scientists at NIWA are looking at how we can get greater value from our natural resources, in a sustainable way. This year, that research has included quantifying valuable mineral deposits from submarine volcanoes in the Kermadec Arc, and determining how to best protect the unique biological communities of animals which thrive in that hot and chemically rich environment.

We also provide scientific advice to the Ministry of Fisheries on the sustainable harvest of more than 100 fish species, and in July we signed a contract with the Ministry of Fisheries to provide deepwater fisheries research services under the ten year deepwater plan.

We are investigating how New Zealand can grow its renewable energy resources. We have made significant advances in aquaculture research. For example, we are using selective breeding and genomics – the study of gene sequences in DNA – to establish high-performance hāpuku, kingfish, and paua broodstock to help New Zealand's aquaculture industry meet its $1 billion target by 2025.



Science supporting the Christchurch community – showing the largest active fault in Pegasus Bay. (Philip Barnes, NIWA)

Being better prepared for natural hazards

This year we need no reminders of how vulnerable we are to natural hazards. Science not only plays a crucial role in responding to hazards and disasters, but also helps us understand more about their causes, so we can be better prepared for the risks. After the 22 February Christchurch earthquake, NIWA ocean geologists were part of a rapid response effort, managed by the Natural Hazards Research Platform, to undertake a seismic survey in Pegasus Bay, off Banks Peninsula. The survey revealed a previously unknown offshore fault east of Kaiapoi. Combined with onshore geophysical studies by other organisations, this information will help the Government and regional council better understand the future seismic risk for Christchurch and its residents.

When the Chilean volcano Puyehue erupted in June, NIWA scientists were also able to help by providing additional information to aviation authorities about the ash cloud and how it might affect New Zealand's airspace.

Our new $12.7 million supercomputer has also improved our environmental forecasting capabilities, enabling us to work towards providing meteorological forecasts at ultra-high resolution – down to areas as small as 1.5 square kilometres – out to 24 hours in advance, four times daily.

Ensuring our environment is well managed

New Zealand's clean, green image is a drawcard for tourism, and a key ingredient in marketing our produce overseas. We must rise to the challenge of developing the standards to retain our world ranking for environmental management.

This year the Government released two important policy statements to guide the day-to-day management of our coasts and freshwater resources – the New Zealand Coastal Policy Statement and the Freshwater Policy Statement.

NIWA's science is already making an important contribution in these areas. For example, this year we led a ground-breaking study that combined mātauranga Māori with contemporary science to restore the Waikato River. We are also working with the Ministry for the Environment to develop New Zealand's first national-scale environmental monitoring network for our surface waters. Through NIWA's Māori Environmental Research Centre, Te Kūwaha, we are also developing easy-to-use toolkits to help iwi monitor changes in their rohe (region), and empower them to become more involved in resource management processes.

Helping New Zealand fulfil its international obligations

NIWA's science also enhances New Zealand's reputation as a world leader in science and research, helping to understand, and mitigate against, important global issues like climate change and variability.

This year marked the 50th anniversary of NIWA's atmospheric research station at Lauder, in Central Otago. Over the last five decades the research centre has built an international reputation for its work, specialising in measuring levels of chloroflurocarbons (CFC), ozone, ultraviolet (UV) light, and greenhouse gases with an extensive array of world class instruments. International climate experts describe Lauder's work as a vital cog in global climate research.

We are also helping New Zealand fulfil its international science obligations by providing information and scientific advice to international agencies like CCAMLR, the Commission for the Conservation of Antarctic Marine Living Resources, and making lead author contributions to the 5th IPCC Report on Climate Change.

The year ahead

It would be imprudent to suggest that the unusually tough economic conditions we faced in 2010–11 are now behind us, as a company or as a nation. We expect business conditions to remain unsettled over the coming year, and, as a result, we will need to continue to respond with agility, by looking for new ways to improve our efficiency and expand our revenue, and being cautious about our investments.

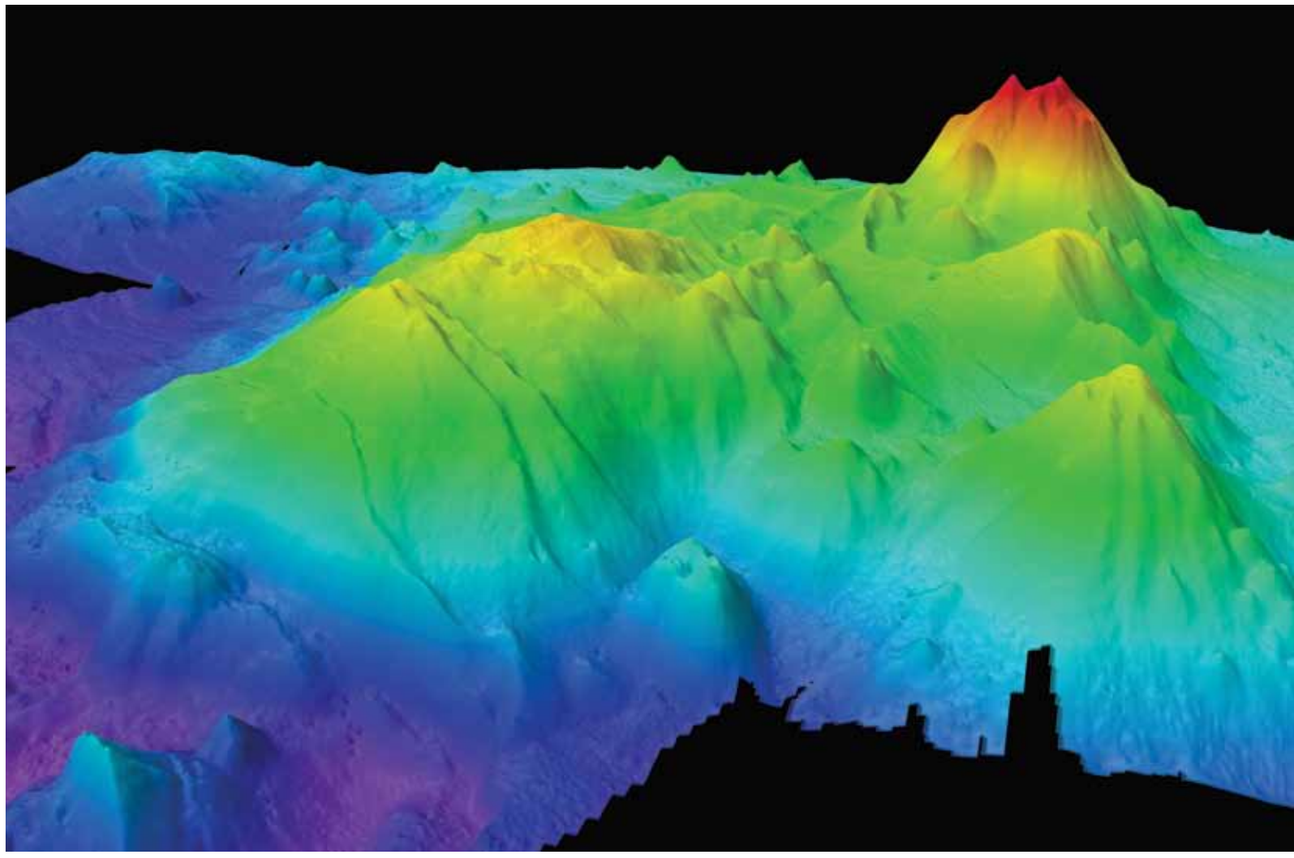
That said, the organisational changes we have made this year, along with our ongoing capital expenditure programme, means NIWA is in a great position to meet the future demand for our science based services. We owe it to our company, our customers, and New Zealand to ensure we maintain the right capabilities to meet the country's science and innovation needs in a cost-effective and competitive way.

I acknowledge that the last year has been an unsettling time for the NIWA team. But I am also very proud of the positive way our staff have responded to the changes. I thank everyone for their continued hard work and commitment to the company.

I also want to personally thank the NIWA Executive Team and the Board for their ongoing support and leadership, through the tough conditions we have faced this year. It has been challenging, but throughout we have proven, time and time again, what an important contribution NIWA is making to New Zealand's future prosperity as the country's leading natural resources and environmental science services provider.

The following pages highlight just a few of our successes this year.

John Morgan
Chief Executive



The Hinepuia Seamount on the Kermedec Arc, as revealed by *Tangaroa*'s seabed mapping technology.

A difficult year

The financial year 2010–11 was a challenging one for many businesses, and NIWA was no exception.

A substantial proportion of revenue comes from government agencies, and revenue from this sector dropped as their spending was constrained or reduced.

In anticipation of the likelihood of a tough year, we began in a cautious mode, focusing on tightly managing costs, while maintaining critical capability for the long haul, and ensuring that our capabilities were closely aligned with demands for NIWA's science based services.

As the year unfolded, and the extent of the reduced demands for NIWA's services became evident, we continuously adjusted our operations and financial planning to ensure we maximised revenue and operated profitability.

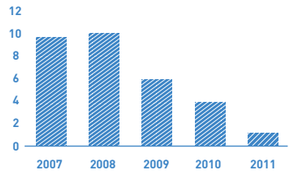
Achieving profitability in such a challenging market required us to respond swiftly to the quickly changing circumstances, leading to a Net Profit after Tax of $1.3 million on revenue of $117.9 million.

Despite the constraints, we maintained our commitment to the completion of NIWA's four year capital investment programme, with the expenditure of a further $22.0 million this year on top of the $30.0 million and $21.2 million in 2009–10 and 2008–09 respectively. This represents a significant commitment to the future of science capability in New Zealand.

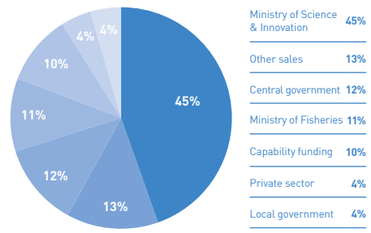
A substantial component of this capital investment was applied to *Tangaroa* and the planned installation of a dynamic positioning system and associated upgrading. With the vessel already in the dry dock in Singapore, we decided to undertake more extensive and expansive upgrade work than was originally envisaged, with the aim of further increasing the vessel's capabilities, its working life, and its revenue generating opportunities. The additional work meant that *Tangaroa* was out of commission for the first half of the year, and this impacted negatively on revenue – a short-term hit for very real long-term gains.

NIWA's cost structure is not elastic, with approximately 50% of costs bound into staff costs.

Net profit after tax
($) in millions



Revenue by source



NIWA is a knowledge-based organisation, and we have a deliberate strategy of continuing to improve remuneration for our highly skilled staff in a very globally competitive marketplace.

Financial Summary

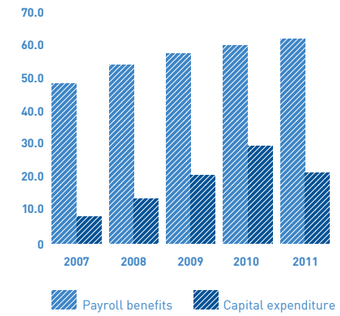
in thousands of New Zealand dollars	2011	2010	2009	2008	2007
Total revenue (includes interest income)	117,861	127,917	120,438	120,671	113,911
– Research	64,624	65,646	58,883	55,536	53,418
– Applied science	53,237	62,271	61,555	65,135	60,493
Net profit before tax	1,860	9,550	9,050	14,309	14,279
Net profit after tax	1,266	4,497	6,011	10,095	9,813
Capital expenditure	21,990	29,985	21,187	13,985	9,107
Adjusted return on average equity (%)	1.9	7.0	9.8	17.9	21.2
Return on average equity (%)	1.4	5.2	7.1	12.8	14.1

The 'adjusted return on average equity' uses a valuation basis comparable to other Crown Research Institutes. This valuation basis arose from the transition to New Zealand international financial reporting standards.

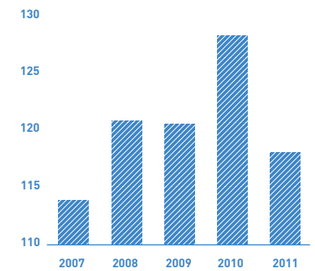
"Responding with agility to the rapidly changing economic environment enabled us to continue to achieve profitability."

Kate Thomson, Chief Financial Officer

Payroll benefits & Capital expenditure
($) in millions



Total revenue (includes interest income)
($) in millions



Although the economic environment remains challenging, NIWA continues to be a high performing Crown Research Institute. Financial strength and flexibility enable us to invest substantially in staff and science capability to ensure we play a leading role in enhancing the benefits of New Zealand's natural resources.

Revenue

After the strong result in the previous financial year, when revenue increased significantly despite the global financial crisis, NIWA's revenue dropped in 2010–11 owing to the impact of the constrained economy on our customers and the unavailability of *Tangaroa* for six months. Total revenue for 2010–11 was $117.9 million (2010: $127.9 million).

The value of NIWA's commercial consultancy to New Zealand was $34.0 million (2010: $36.4); whilst the value of the international consultancy was $6.5 million (2010: $7.4 million).

Expenditure

Personnel Costs

Staff are NIWA's greatest asset, and that is reflected in the deliberate strategy to continue to raise average remuneration. Although this strategy was constrained during 2010–11, total payroll and benefits increased to $62.5 million (from $60.1 million in 2009–10), with average staff remuneration increasing by 3.5%. The realignment of capabilities with the demands for our science and applied research services resulted in one-off termination expenses of $1.2 million.

Earnings before interest, depreciation, and amortisation (EBITDA)

EBITDA was impacted by the reduced revenue; however, it remained strong at $16.3 million (2010: $24.2 million).

Net Profit after tax (NPAT)

NPAT this financial year was $1.3 million (2010: $4.5 million), against a budget of $6.5 million.

Whilst below expectations, the result reflects the determined efforts to generate revenue and constrain costs, despite the difficult economic environment.

Adjusted return on equity (giving a comparative basis with other Crown Research Institutes) was 1.9%.

Financial Position & Cash

Capital

2010–11 was the fourth of a planned multi-year major capital investment programme designed to strengthen infrastructure and equipment to rapidly advance NIWA's science based services, and improve the work environment and facilities for staff.

Despite the tough economic environment this investment continued, taking capital expenditure over the last four years to $87 million. Over that period NIWA's maximum debt has been $19 million, owing to the strong operating cash flows. The most significant elements of this investment were $13 million for the high performance computing facility in Wellington and $25 million for the upgrade to the capability of our flagship research vessel *Tangaroa*. *Tangaroa* now has a market value of $60 million and is one of the most capable research vessels in the world.

Total asset base

Average shareholders' equity at 30 June 2011 was $89.7 million (2010: $86.9 million). NIWA's investment in capital expenditure is reflected in its increased average total assets value, which is now $133.6 million (2010: $121.4 million).

Liquidity

NIWA continues to maintain healthy liquidity and is able to meet all of its obligations as they fall due. The debt balance reached $19 million at its peak during the year, and reduced to a net balance of $13.4 million by 30 June 2011.

Making a positive contribution

NIWA is committed to making a positive contribution to New Zealanders' well-being.

This commitment is reflected in a set of guiding principles that covers our social, economic, and environmental responsibilities. We are dedicated to continual improvement of our policies, practices, and strategies that deliver on these responsibilities.

NIWA is committed to the principles of operation stated in section 5 of the Crown Research Institutes Act 1992, which require:

- that research undertaken by NIWA should be undertaken for the benefit of New Zealand;
- that NIWA should pursue excellence in all its activities;
- that in carrying out its activities NIWA should comply with any applicable ethical standards;
- that NIWA should promote and facilitate the application of the results of research and technological developments;
- that NIWA should be a good employer;
- that NIWA should be an organisation that exhibits a sense of social responsibility by having regard to the interests of the community in which it operates and by endeavouring to accommodate or encourage those interests when able to do so.

Social Responsibility

NIWA is committed to work practices, operations, and science outcomes that support its staff and the wider community. Our approach is one of partnership and inclusion to ensure that we incorporate the interests of others in our activities, communicate our science well, and maximise the benefits our science brings to society.

Caring for our people

We are committed to providing:

- a safe and healthy working environment with zero harm;
- a work-life balance that maintains job satisfaction;
- a working environment, including learning and development opportunities, that enables people to reach their full potential;
- suitable equipment, so that staff can do the job that is asked of them;
- remuneration and rewards that fairly reflect an individual's contribution to the organisation's success;
- a professional, participative, and collegial workplace where people are respected and supported and enjoy being part of.

Working in the community

We are committed to:

- engaging positively with local communities in which we are conducting our science, explaining what we propose to do, respecting local traditions and culture, and keeping them informed of our results;
- supporting science education and knowledge transfer to communities (e.g., Kelly Tarlton's, Science & Technology Fairs, work placements, supervision of postgraduates, educating community environmental groups);
- raising public awareness of the value of science and innovation through public talks, media interviews and releases, our website, and sponsoring local relevant events;
- transferring our knowledge to stakeholders in a way that ensures enduring benefits for communities;
- being an active member of the science community, and collaborating with others to provide a cohesive science system that is effective and efficient;
- contributing to national policy development and decision-making, so our expertise benefits all New Zealanders and helps New Zealand meet its obligations as a global citizen.

Working in partnership with Māori

We are committed to:

- developing and maintaining effective long-term relationships with iwi, hapū, and other Māori organisations throughout New Zealand;
- developing Māori research capability and capacity within NIWA and in our partner Māori organisations;
- sharing our knowledge and skills, so that Māori are better enabled to realise the potential of their resources and exercise kaitiakitanga;
- increasing the capability of our staff to interact with Māori through training in te reo and tikanga.

Working with our customers

We are committed to:

- listening to our customers and understanding their needs and expectations;
- proposing and delivering innovative services and solutions;
- regularly informing customers of progress, and maintaining a 'no surprises' policy;

"We are committed to making a difference."

John Morgan, Chief Executive

407
commissioned reports to users

23
new jobs created

0.02%
lost time from injuries or accidents

73
PhD students supervised

- providing deliverables on time, to budget, and to agreed specifications;
- maintaining professional and ethical standards;
- developing long-term relationships, so that our customers' success is our success.

Economic Responsibility

NIWA is committed to operating with financial discipline, so we retain our long-term viability and thus meet our core purpose science responsibilities. NIWA's knowledge and expertise provide significant opportunities for generating economic benefit for New Zealand, and we have a responsibility to ensure that they do.

Continuing to be financially viable

We are committed to:

- making fiscally responsible decisions and maintaining NIWA's short- and long-term financial viability;
- on-going investment in capital items that enable us to conduct excellent science and continue to generate revenue.

Generating economic benefit for New Zealand

We are committed to:

- using our knowledge to help others derive economic benefit from the efficient and effective use of New Zealand's natural resources and infrastructure;
- providing solutions that reduce or eliminate risks from natural or human-induced environmental impacts on economic activities;
- conducting technical and market assessments of business opportunities arising from our science, so that investment risk is better understood;
- being open to joint ventures with the private sector, where this encourages start-up of new economic activity;
- working collaboratively with other parts of government to ensure that first adopters are appropriately supported and that government investment is aligned and effective.

Environmental Responsibility

NIWA is committed to ensuring that we take due care of the environment when carrying out our activities. Whilst our science contributes strongly to better environmental outcomes for New Zealand, we do have environmental impacts when conducting that science, and such impacts must be minimised. We need to encourage others to use our knowledge to improve the environmental outcomes they have responsibility for.

Ensuring our activities are environmentally responsible

We are committed to:

- ensuring that all operational activities and assets comply with resource consents, relevant environmental standards, biosecurity and biodiversity regulations, and permitting requirements;
- ensuring that all sampling and experiments with live animals comply with the Animal Welfare Act 1999;
- ensuring that all material waste production and water use is minimised, and we make maximum practical use of recycling and electronic media;
- ensuring that energy consumption and greenhouse gas emissions are compliant and the most cost-effective and efficient practice for the activities they relate to;
- making use of environmental initiatives introduced and supported by local industries, councils, and community groups;
- encouraging our employees to take positive actions to reduce the effects of their activities on the environment.

Imparting our knowledge to others to improve environmental outcomes

We are committed to:

- helping others meet their environmental responsibilities by providing objective advice on the impacts of their activities and solutions to mitigate those impacts;
- providing appropriate tools and training for community groups and others to implement environmental monitoring and habitat rehabilitation projects;
- providing information on the nation's unique aquatic biodiversity and threats to it, so that wise decisions can be made.

Our Science

NIWA's science and applied research services are delivered by our National Centres.

Each centre conducts a wide range of research contributing to a high-level outcome for New Zealand.

The following pages provide an insight into our science and applied research.

Peter Marriott, NIWA

Genome power boosts aquaculture

NIWA's aquaculture team are using selective breeding and genomics – the study of gene sequences in DNA – to establish high-performance broodstock for the aquaculture industry.

The development process for the culture of a new species means that, initially, the farmed stocks come from wild-caught undomesticated parents. The offspring of these wild-caught parents have unpredictable performance in an aquaculture setting. Therefore, there is a need to identify elite broodstock through selective breeding, and to develop systems to control reproduction and the production of high quality seed.

"In coordination with our hāpuku hatchery development programme, 8000 hāpuku, representing more than 50 families, were set aside for evaluation for future selective breeding," says NIWA aquaculture scientist Dr Jane Symonds.

NIWA's goal for hāpuku, kingfish, and paua is to spawn sufficient wild broodstock to form a diverse genetic base for future selection, and to identify the best performing individuals by analysing the performance of their offspring.

Dr Symonds says, "the use of microsatellite DNA markers for parentage analysis has allowed us to understand spawning behaviour and how individual broodstock contribute during the reproductive season."

Breeding families established

NIWA now has more than 50 hāpuku families, 25 kingfish families, and a well-established breeding programme for paua, with 95 families. Evaluation of these families has demonstrated that it is possible to select faster growing stocks for the industry – growth rate is a heritable trait.

Identifying specific parents that produce good performing offspring provides the basis for a cost-effective breeding programme for future commercial implementation. The aim is to identify families that not only grow well, but also convert their feed efficiently into body mass.

NIWA's research using chinook salmon families has demonstrated the feasibility of selecting for this economically valuable trait. Achieving efficient feed conversion is important for lowering both the costs of production for the farmer and the environmental footprint associated with unused feed and faeces.

460 million
kingfish eggs collected during spawning

23 million
hāpuku eggs incubated for evaluation

60 000
hāpuku juveniles produced in proof-of-concept trials

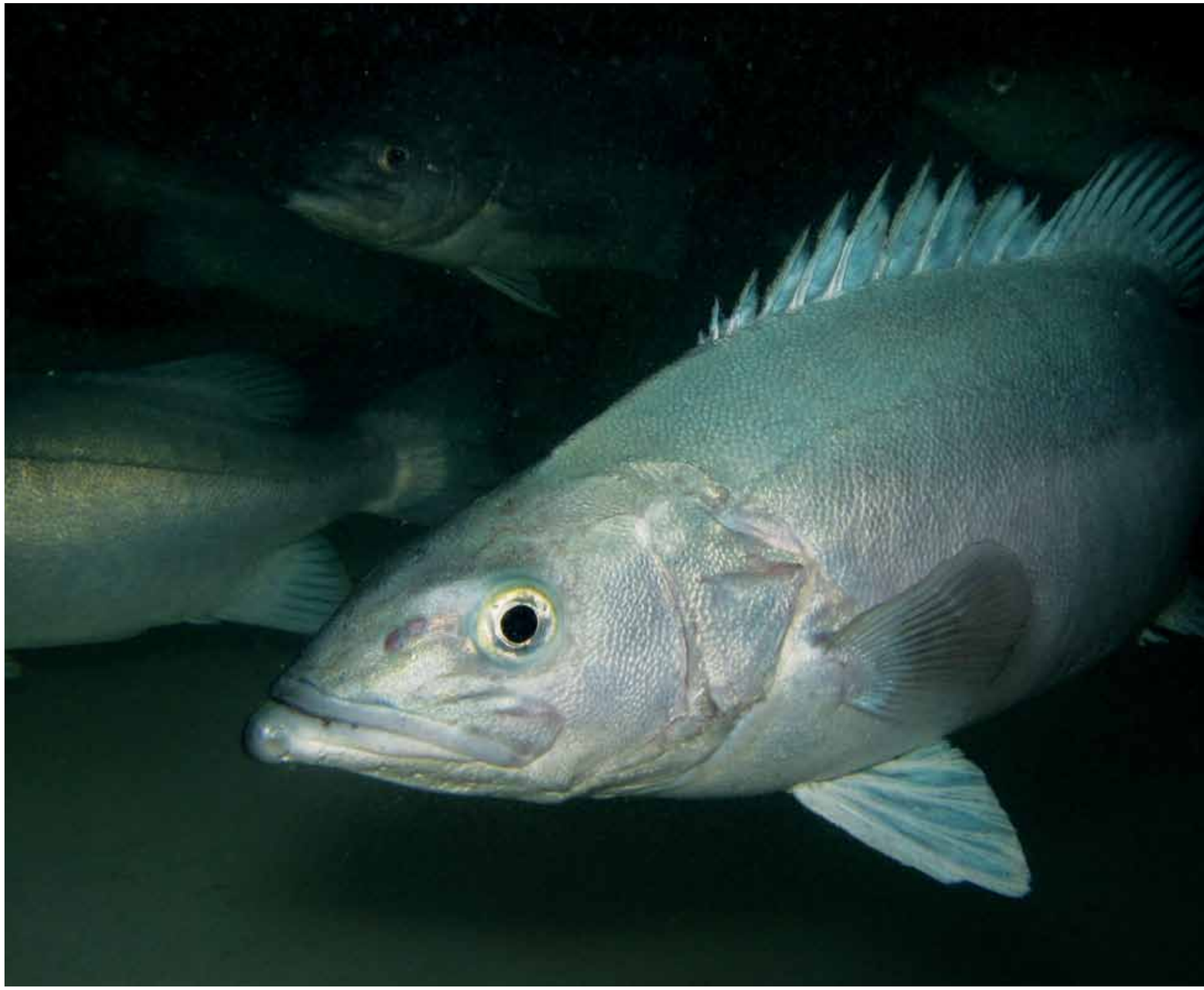
57 178
pedigree paua measured

Collaborators
AgResearch
Abacus Bio
OceaNZ Blue
New Zealand King Salmon

Funder
Ministry of Science and Innovation
New Zealand King Salmon

"We are investing in the future by laying the foundation for tomorrow's domesticated stocks of hāpuku and kingfish."

Andrew Forsythe, Chief Scientist, Aquaculture & Biotechnology



Hāpuku broodstock at NIWA's Bream Bay Aquaculture Park. (Irene Van de Ven, NIWA)

Reaching new heights – Lauder celebrates 50 years of atmospheric research

It is 50 years since scientists established the atmospheric research centre at Lauder, Central Otago. Today, Lauder is the best equipped Southern Hemisphere station, and is home to a team of world-class research scientists and their instruments.

Lauder was initially set up to study the Earth's upper atmosphere. As the problems facing the world have changed over time, so too has the role of Lauder.

Until the 1980s, chlorofluorocarbons (CFCs) were used throughout the world, for example in aerosol spray cans and as refrigerants. CFCs break down once they are in the stratosphere, releasing chlorine and bromine atoms, which then destroy ozone, our shield against ultraviolet (UV) radiation.

The Antarctic ozone hole, discovered in 1985, is in fact a reduction in concentrations of ozone high up in the stratosphere. Lauder was well placed to contribute to research into the causes and effects of ozone depletion; NIWA scientists have been measuring ozone, compounds relevant to ozone chemistry, and UV radiation, at Lauder for more than 25 years.

The ozone hole reached its maximum size of 30 million square kilometres in 2006. In 2010, the maximum size was down to 22 million square kilometres.

Lauder's measurements are widely used in the international atmospheric science community. Lauder and Arrival Heights, Antarctica, are part of the global Network for the Detection of Atmospheric Composition Change. The measurements include most of the gases that contribute to climate change.

Today, ozone appears to be in recovery, due to the 1987 Montreal Protocol that led to the phasing out of CFCs – often hailed as the most successful international environmental protection treaty of all time.

In 2002, Lauder moved into computer-modelling the past and future of the ozone layer, and its role in the climate, using sophisticated chemistry-climate models as part of an international effort.

Lauder now focuses on the links between climate and atmospheric composition change. One such link is the impact the ozone hole has on the climate near the Earth's surface.

"Ozone affects climate throughout the Southern Hemisphere. Recent modelling studies attribute a southward shift of the subtropical dry zone to the ozone hole. This implies drought conditions for some regions that previously had relatively ample rainfall. Conversely, climate change also affects the transport and chemistry of ozone and other constituents in the stratosphere," says NIWA's Dr Olaf Morgenstern.

The foundation for Lauder's future is being laid with new research into the recovery of the ozone layer and climate change.

"Lauder's measurements are widely used in the international atmospheric science community."

Dr Murray Poulter,
Chief Scientist, Atmosphere

22 million km²
the ozone hole in 2010

5
Lauder is one of only five international sites which detect atmospheric composition change

30 million km²
the ozone hole in 2006

11-12
on the ultraviolet index, NZ's highest UVI numbers occur in February

New Zealand Funders
Foundation for Research, Science and Technology,
Ministry of Science and Innovation

Historical images of Lauder and Antarctic operations.

Saving our waterways from alien invaders

On the surface, New Zealand lakes and rivers may appear in good condition, but underwater alien aquatic plants are silently invading our waterways, posing a serious threat to New Zealand biosecurity.

More than 70 freshwater aquatic plants have been introduced into New Zealand, with devastating consequences for our native aquatic plants and other wildlife. Aquatic weeds also cause serious problems for electricity generation by clogging up hydro dams, and making recreational activities, such as swimming and boating, difficult.

"Invasive aquatic weeds are having disastrous environmental impacts on New Zealand's lakes and waterways, costing millions of dollars to remedy. Fast, effective, and innovative tools to control the worst aquatic plant pests, and prevent their spread, are vital," says Dr Barb Hayden, Chief Scientist, Aquatic Biodiversity & Biosecurity.

NIWA's science is helping lake and river managers find solutions to control invasive aquatic weeds, using a mixture of mechanical, chemical (herbicides), and biological means.

Wiping out the world's worst weeds

Hydrilla is known as the world's worst submerged weed. In the United States alone, it has caused serious damage to lakes and rivers, costing about NZ$270 million a year to control. Hydrilla was first discovered in New Zealand in Hawke's Bay in the 1960s. Now, four decades after its accidental introduction, it has been almost completely eradicated from New Zealand waterways, thanks to research and innovative management tools used by NIWA's biosecurity team.

As part of a MAF Biosecurity New Zealand weed eradication programme, NIWA research identified the herbicide endothall as being effective in controlling large beds of hydrilla in lakes, leaving no toxic residue behind. "The New Zealand strain has been very difficult to control," says NIWA freshwater scientist Dr John Clayton, "because it produces small tubers that can lie dormant in lake sediments for more than a decade." In response, NIWA began trialling grass carp, a plant-eating fish, as an additional tool for long-term hydrilla removal. New Zealand is now 99 percent hydrilla free, with minimal risk of it reoccurring, saving millions of dollars of damage and on-going management costs.

Weed-free for a world competition

Another success was the four-year programme, in partnership with Land Information New Zealand, local authorities, and iwi, to reduce water-weed interference at the Lake Karapiro rowing course for the World Rowing Championships last year.

Aquatic weeds, particularly hornwort, another top-ranked invasive weed species, can have a significant impact on rowing regattas, when weeds get caught around the rowers' blades (oars) or the boat's rudder, hindering boat speed and direction. Diquat (a herbicide) was applied to the lake by air to ensure that specific weed beds could be targeted. Dr Clayton says diquat was "a really cost-effective option considering the size of the lake, and there were no adverse effects on fish or water quality. "The racing was unaffected by weeds, and there were substantial flow-on benefits, such as reducing the costs of weed interference on hydro-power generation.

70+
alien aquatic plant species now established in NZ lakes

70 m
the maximum depth at which native plants grow in an NZ lake

77%
of surveyed lakes have at least one alien aquatic plant species

1230
dives carried out by one NIWA diver in invasive weed surveillance

Collaborators
Mighty River Power
Rowing NZ
InGear Global

Funders
MAF Biosecurity New Zealand
Land Information New Zealand
Elliot Chemicals
Foundation for Research, Science and Technology

"Invasive aquatic weeds are having disastrous environmental impacts on New Zealand's lakes and waterways, costing millions of dollars to remedy."

Dr Barb Hayden,
Chief Scientist, Aquatic Biodiversity & Biosecurity

NIWA diver Aleki Taumoepeau (Aquatic Plants) in Lake Waikaremoana. (John Clayton, NIWA)

Glaciers – New Zealand's natural thermometers

New Zealand's glaciers are one of our best bellwethers, says climate scientist Dr Andrew Lorrey, who leads a New Zealand long-term glacier snowline monitoring project.

"One of the things about our glaciers is that they are incredibly sensitive to temperature. It's like having a natural thermometer in the field," says Dr Lorrey. As such, the fortunes of 50 monitored glaciers – scattered mostly along the Southern Alps – indicate how our climate is changing. "Many glaciers are shrinking," Lorrey says. "On a year-to-year basis, we attribute loss largely to warmer-than-normal summer temperatures and below-normal precipitation before and during summer. The compiled losses over the twentieth century are attributed to long-term warming."

The researchers involved (including Andrew Willsman and Dr Tim Kerr of NIWA) have teased apart the complex concert of weather and climate influences that drive glacier activity. Last year, an El Niño drove southwesterlies on to the country, bringing average or below-average temperatures, but record low spring rains over Westland, and near-normal precipitation over the rest of the survey area. Glaciers in the south and west gained a small amount of mass, while those to the north and east of the Southern Alps shrank during 2009–10, largely from a record warm August 2009 and highs and heat waves in February 2010.

A different story emerged this past summer. Dr Lorrey says the most recent survey showed that most glaciers had lost snow and ice during early 2011, and some of the highest snowlines ever were recorded. In essence, the glacier changes are recorded by photographing the absolute positions of the glaciers' snowlines: if the snowline has receded (climbed higher) since the last measurement, it shows that more snow has melted from the glacier than has fallen on it. If the snowline has lowered, the reverse is true.

Work in this area has been led for years by Dr Trevor Chinn, a key member of the monitoring team. Chinn has examined small high-altitude glaciers, and the much larger, longer, valley glaciers, such as the Tasman, over the course of four decades. The monitoring indicates that small glaciers respond very quickly to temperature changes, whereas the effects sometimes take much longer to show in larger glaciers. That is one reason some are still advancing, even as smaller ones "like Mt St Mary, are all but gone" says Lorrey.

NIWA's work provides a vital southern perspective to global glacier studies, Dr Lorrey says. "We're one of few places in the Southern Hemisphere that has a glacier monitoring programme, and it's a very good one – it has a long and interesting history. The data we provide make a valuable contribution towards monitoring the changes that are occurring globally."

Collaborators
University of Otago
Victoria University of Wellington

Funder
Ministry of Science and Innovation

Andrew Lorrey, NIWA

"Our scientists have excellent international reputations, and are addressing issues of both local and global importance."

Dr David Wratt, Chief Scientist, Climate

60%
of New Zealand glaciers have lost permanent ice area since 1977

15 000+
photographs of all glaciers in the Southern Alps from 1977 to 2011

102 down to 41
reduction in hectares of Jalf Glacier on the West Coast – the greatest change observed in any index glacier

3144
the number of New Zealand glaciers bigger than 1 hectare

Forensically uncovering sediment sources

New Zealand's diverse coastline stretches more than 15 000 kilometres, and is vital for recreation, transport, tourism, and biodiversity.

Last year, the Government issued a new Coastal Policy Statement (CPS), which guides local authorities in their day-to-day management of the coastal environment, under the Resource Management Act. One aim of the CPS is to improve coastal water quality, which is affected by sedimentation and other discharges associated with land uses.

"Understanding how land use, human activities, or natural processes impact on our coastal environment will help us find ways to protect these important habitats for generations to come," says Dr Clive Howard-Williams, Chief Scientist, Coasts.

NIWA is using unique methods to help local authorities identify the source and impact of sedimentation and other discharges into coastal environments.

Sedimentation in our estuaries

Walk out on an estuarine intertidal flat suffering the effects of fine-sediment pollution, such as smothered cockles, unhealthy seagrass, or turbid water, and the first question a coastal scientist or coastal manager will ask is: Where did that sediment come from? "It's not an easy question to answer," says Dr Malcolm Green, Principal Scientist of Coastal Physical Processes. "But it's one we must address if we are to effectively target the main sources of sediment pollution to mitigate their impacts."

NIWA's coastal research has developed two solutions to this problem.

The first is the source-to-sink computer model, which predicts erosion of sediment from sources throughout the catchment (such as pasture, gullies, and streambanks), transport of the eroded sediment down through the stream network, passage through tidal creeks, and dispersal and ultimate accumulation in the estuary at the base of the catchment. The model keeps track of the sediments and any attached contaminants, such as heavy metals or pesticides, allowing scientists to work backwards from any part of the estuary to find out where in the catchment the sediment pollution originated.

The second solution comes from the world of environmental forensics – the Compound-specific Stable Isotope (CSI) method. This involves matching the chemical fingerprint of sediments deposited in the estuary with fingerprints of reference samples obtained at sites throughout the catchment. A mathematical model is then used to deconstruct the estuary sediments, identifying the source regions in the catchment, as well as the percentage of the estuary sediment attributable to each source.

Both methods are helping local authorities by providing detailed information on the location, type, and scale of the most effective mitigation measures they can use at a practical level to better manage sediment pollution in their estuaries.

Collaborators
Landcare Research
ESR (Environmental Science and Research)

Funders
Ministry of Science and Innovation
Auckland Council
Bay of Plenty Regional Council
International Atomic Energy Agency (IAEA)
Waikato Regional Council
Land Information New Zealand

Mark Pritchard, NIWA

"Understanding how land use, human activities, or natural processes impact on our coastal environment will help us find ways to protect these important habitats for generations to come."

Dr Clive Howard-Williams,
Chief Scientist, Coasts

300
estuaries included in the New Zealand Estuary classification

17 cm
on average, the sea level rise around New Zealand over the last 100 years

25
years of coastal ecosystem monitoring of Auckland harbours and estuaries by the Auckland Council

15 000+ km
New Zealand's coastline

Biogas: pig power = smart power

NIWA is actively promoting new ideas and concepts that will enhance New Zealand's economic and environmental performance. Recent research has helped to establish some building blocks of future energy systems in New Zealand.

Steve Lepper's 400-sow pig farm in North Taranaki was awarded the 2010 EECA Awards in the Small-Medium Business category.

NIWA identified that anaerobic digestion in covered waste ponds holds significant potential to reduce odour and greenhouse gas emissions, while providing biogas as a local energy source, and designed a purpose-built 7000 m^3 anaerobic effluent pond for Steve's farm.

NIWA's simple and low cost cover design is effective in recovering and storing biogas, and it makes it available for a multitude of uses. In the case of the Lepper farm, it is used for electricity generation and heating in a combined heat and power unit. The generator provides most of the piggery's electricity needs during daytime, and waste heat from the generator is used in a reticulated hot water system for keeping young pigs warm.

The system is saving the farm more than $35,000 a year in electricity costs.

"It was the first system that we designed and provided to industry, and it's been a real success," says NIWA research engineer Stephan Heubeck. Encouraged by the results in Taranaki, NIWA is now collaborating with the Australian pork industry to implement bigger versions of the award-winning system across the Tasman.

Rubbish-powered rubbish truck

The rubbish truck collecting waste for the Redvale landfill in Auckland is powered by what was thrown out in the past.

The collaborative pilot project realised by Transpacific Industries, Greenlane Biogas, NIWA, and DieselGas International has successfully converted landfill gas to vehicle fuel for the first time in New Zealand.

"It's a solution that is economically and environmentally sensible," says Heubeck, who initiated and coordinated this project.

"Up to 5% of New Zealand's current transport fuel requirements could be met with waste-derived biogas from municipal and rural wastes that require treatment and handling," says Heubeck. The 'waste to fuel' project is bringing to life the possibilities that biogas holds for cutting greenhouse gas emissions and diversifying transport fuel needs towards more renewable and domestically sourced supplies.

10 000+

New Zealand farms could use biogas technology

2%

of road transport fuel provided by biogas in Sweden

12 TWh/y

(Terawatt hours per year) electricity produced from biogas in Germany

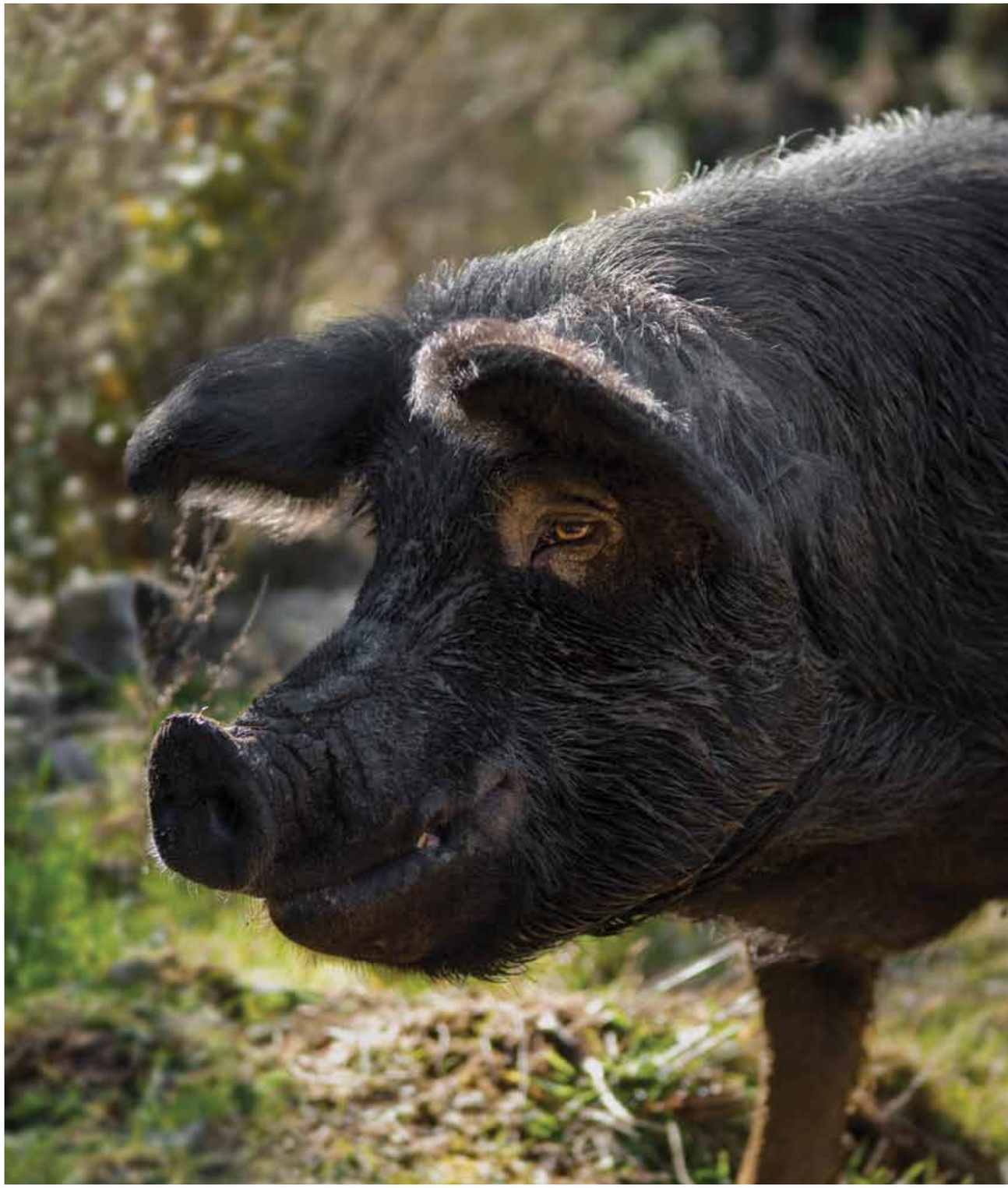
40

manure from 40 pigs can fuel the average New Zealand car

"Our research is helping the government meet its target of generating 90% of electricity from renewable resources by 2025."

Dr Murray Poulter,
Chief Scientist, Energy

Funders and Collaborators
Energy Efficiency and Conservation Authority
Transpacific Industries
Greenlane Biogas
DieselGas International



Dave Allen, NIWA

Surveys help ensure the future for commercial fisheries

Commercial fishing is one of New Zealand's biggest export industries, employing more than 26 000 people. About 130 species are commercially fished in New Zealand. Last year, exports of New Zealand seafood were nearly $1.5 billion.

"Good science is essential to ensure our fisheries continue to provide economic benefits to New Zealand, but are still managed in a sustainable way," says Fisheries Chief Scientist, Dr Rosemary Hurst.

NIWA is New Zealand's main provider of fisheries resource surveys, catch monitoring, and stock assessment research. NIWA fisheries experts provide scientific advice to the Ministry of Fisheries on more than 100 fish species. Recently, NIWA successfully tendered for a Ministry of Fisheries contract to undertake 28 projects under the Deepwater Fisheries 10-year research plan.

20 years studying hoki abundance

This year NIWA fisheries scientists made their 20th consecutive trip on *Tangaroa* to the Chatham Rise to study the abundance of hoki and other commercially important species, such as hake and ling. The Ministry of Fisheries-funded survey is the most comprehensive and consistent time series of species abundance in depths of 200–800 metres in New Zealand's Exclusive Economic Zone.

The Chatham Rise is the main nursery for hoki, New Zealand's largest fishery. In 2009–10 the commercial catch of hoki from the Chatham Rise was 39 000 tonnes. Over the last 20 years the proportion of hoki in the trawl survey catch declined from nearly 60 percent in 1993 to 21 percent in 2004, but has increased again to 30–40 percent of the total biomass in the past six years.

This year's survey shows that both the eastern and western hoki stocks are continuing to rebuild, says NIWA fisheries Principal Scientist, Dr Richard O'Driscoll. "That rebuilding is the result of reduced fishing in comparison with previous levels, but also because of improved recruitment."

"The survey collects essential information to help us assess hoki, hake, and ling stocks, which helps the Ministry of Fisheries set appropriate catch limits, but it also fulfils an important ecosystem-monitoring role by providing additional information to improve our knowledge about species distribution and biodiversity," says Dr O'Driscoll.

Since the surveys began in 1992, scientists have analysed more than one million individual fish, squid, crustaceans, and benthic fauna to help establish biomass trends and spatial and depth distributions. In that time, 558 species or species groups have been identified. Species that can't be identified at sea are taken back to NIWA's laboratory in Wellington for identification. NIWA gifts rare and new-to-science fish to Te Papa, where they are preserved and stored in the National Fish Collection.

Collaborators
BlueWater Marine Research Limited
Kevin Stokes
Paul Starr
Stock Monitoring Services Limited
Trophia Limited

Funders
Ministry of Fisheries
Challenger Scallop Enhancement Company
DeepWater Group Limited
Paua Industry Council
Rock Lobster Industry Council
Seafood Innovations Limited
Shallard and Associates

Rob Stewart, NIWA

"Good science is essential to ensure our fisheries continue to provide economic benefits to New Zealand, but are still managed in a sustainable way."

Dr Rosemary Hurst,
Chief Scientist, Fisheries

12 100
stomachs from 34 fish species on Chatham Rise examined and analysed since 2004

569 141
fish measured by observers and entered into the Central Observer Database

301
species in 112 families included in two New Zealand fish identification guides

35
fisheries databases managed for the Ministry of Fisheries

Aquatic rehabilitation underway

New Zealand's lakes and rivers are a drawcard for tourism. Used widely for fishing and boating, they are also a source of water for drinking, irrigation, and electricity generation. But, in recent years, the health of New Zealand's unique aquatic ecosystems has begun to deteriorate.

Many lakes and rivers are now in a degraded state, which threatens our national 'clean, green' image, and has cultural ramifications for Māori. "Our waterways are a precious taonga, an asset to New Zealand. Urgent restoration and clean-up efforts are essential to ensure that the water quality and ecosystem health of our lakes and rivers are improved," says Dr Clive Howard-Williams, Chief Scientist, Freshwater.

NIWA is actively involved in research and consultation aimed at enhancing efforts by landowners, community groups, industry, iwi, and government to rehabilitate the key values and ecosystem services of degraded rivers and lakes.

Restoring the health and wellbeing of the Waikato River

In late 2010, the Government established a co-management authority (the Waikato River Authority – with 50:50 Crown-Māori membership) to promote an integrated, holistic approach to restoring the health and wellbeing of the Waikato River for future generations. NIWA led a ground-breaking scoping study to define the costs and benefits of various actions the Authority might take to restore the river.

"For the first time, we have combined mātauranga Māori (traditional knowledge) with contemporary social and biophysical science, and economics, to help restore a national asset," says Dr John Quinn, Freshwater Ecology Principal Scientist.

Sixty recommended priority actions were developed for the Authority. Costs, benefits, and co-benefits for restoring key values, and overall economic effects on the region and New Zealand over a 30-year duration were assessed for each action. The actions cover a range of topics, including water quality, recreation, human health, water supply, spiritual values, fisheries, and kai. A novel report-card system was also developed to monitor the progress of each action. The report can be downloaded from the Ministry for the Environment website (www.mfe.govt.nz).

Restoration of the Rotorua lakes

Excessive inputs of nitrogen and phosphorus have degraded several iconic Rotorua lakes, causing potentially toxic blooms of blue-green algae. To control the algal blooms, both the nitrogen and phosphorus loads must be reduced. NIWA is part of a collaborative project looking at ways to reduce phosphorus levels as part of a lake restoration toolbox.

Four sediment-capping agents have been trialled to test their effectiveness in reducing phosphorus leaking from sediments to the overlying lake water and what side effects these agents might have on the lake's ecosystem health. After successfully using a thin layer of natural zeolite clay to reduce phosphorus levels in Lake Okaro, the team is now testing it in the much larger Lakes Rotoehu and Rotorua.

60 km³
the volume of high-quality water in Lake Taupo, New Zealand's largest lake

17%
the proportion of New Zealand monitored lakes that have shown a decline in water quality in the last ten years

76%
the reduction in sediment loss from Mangaotama Catchment (Waikato) following improved farm management and riparian planting

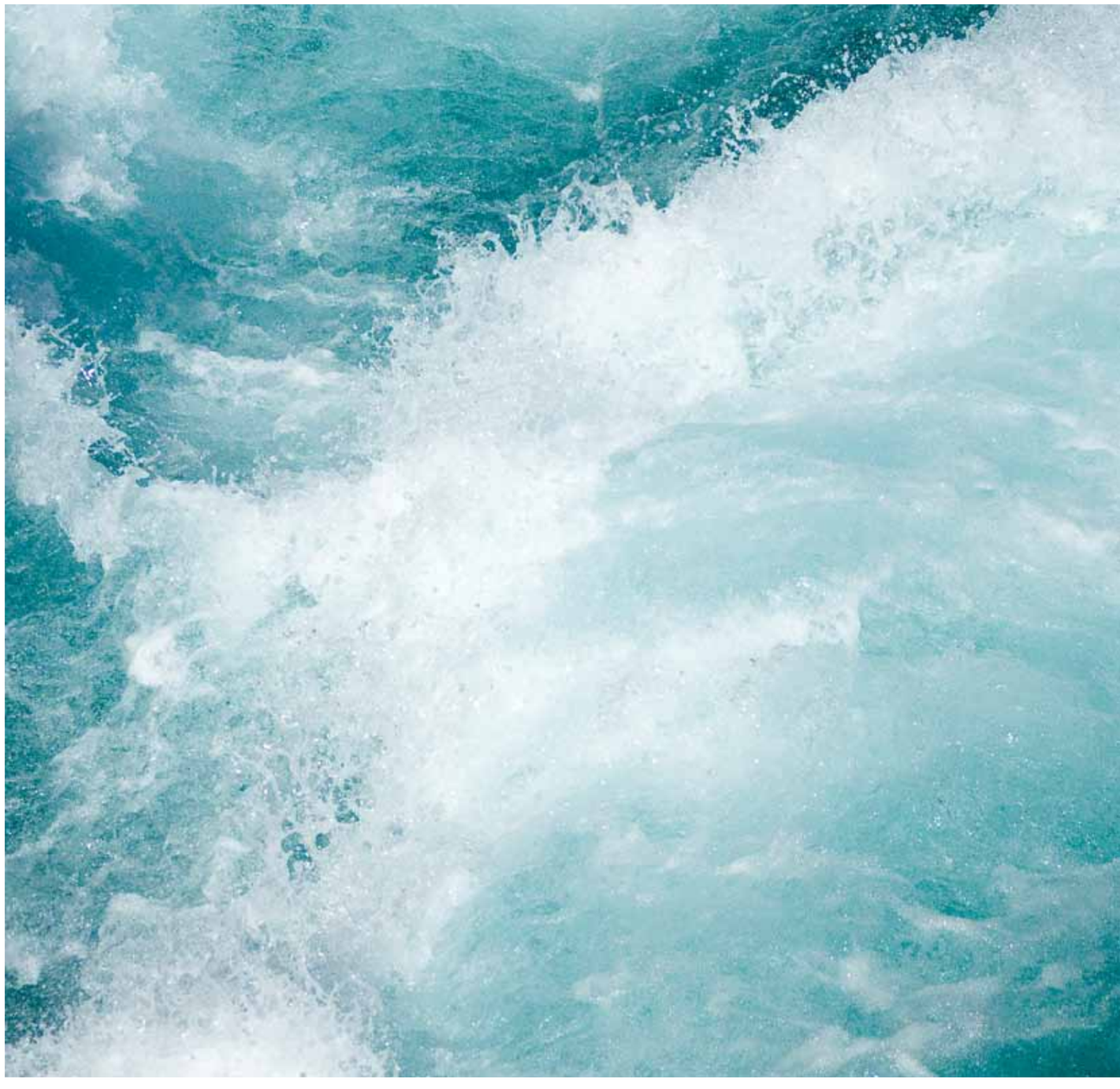
$210 million
the amount of Crown funding allocated to the Waikato River Authority to restore and protect the Waikato River over the next 30 years

Collaborators
AgResearch
Beca
Diffuse Sources Limited
Enveco
Market Economics Limited
Nimmo-Bell & Company Limited
Tipa and Associates
Bay of Plenty Regional Council
University of Waikato
Scion

Funders
Ministry for the Environment
Ministry of Science and Innovation
Bay of Plenty Regional Council

"Our waterways are a precious taonga, an asset to New Zealand. Urgent restoration and clean-up efforts are essential to ensure that the water quality and ecosystem health of our lakes and rivers are improved."

Dr Clive Howard-Williams, Chief Scientist, Freshwater



Dave Allen, NIWA

Rapid response a critical part of hazards science

This year we need no reminders of how vulnerable we are to natural hazards. Science has a crucial role in responding to hazards and disasters, in better understanding their causes and hence the risk.

Rapid response is vital after a hazard strikes. Following the 22 February Christchurch earthquake, NIWA ocean geologists were part of the rapid response effort managed by the Natural Hazards Research Platform. Their job was to undertake a seismic survey in southern Pegasus Bay, off Banks Peninsula. They worked from *Kaharoa*, NIWA's coastal research vessel, and collected seismic data about faults at depths of up to 1.5 kilometres below the seabed. The survey increased understanding of the earthquakes in a regional context, and will contribute to a longer-term understanding of seismic hazards in Canterbury.

"It was great to be able to apply all the knowledge, capability, and tools that we have been developing over two decades to help people," says Dr Philip Barnes, a NIWA ocean geologist and principal scientist. "We had the skills, the equipment, and the databases that were needed to respond very quickly."

The NIWA-led survey revealed a previously unknown offshore fault east of Kaiapoi; it also confirmed that the offshore faults have very low activity rates, implying they generate earthquakes very infrequently. Work continues for the benefit of the public and the Government, in parallel with onshore geophysical studies by collaborators within the Hazards Platform, to better understand the seismic future for Christchurch and its residents.

And when the Chilean volcano's ash approached our airspace, NIWA scientists were also able to respond rapidly to measure the ash cloud over Central Otago. Laser radar (lidar) measurements of small particles in the atmosphere up to about 20 kilometres have been regularly made at Lauder. "Our on-going measurement programme has created the tools and capability to apply to unforeseen events such as the eruption," says NIWA Lauder scientist Ben Liley.

"Our hazards work has been directly beneficial to New Zealand in recent months," says NIWA's Chief Scientist, Natural Hazards, Dr Murray Poulter. "But for us to be able to respond, we have to be ready. This is why continuing investment in skills and technology is so important."

In 2010, NIWA invested over $12.7 million in a new supercomputer, specifically to improve our environmental forecasting capability. The power of the computer, combined with formidable meteorological models, means we are now generating forecasts of hazards, such as intense rainfall, floods, storm surge, and waves, at much higher resolution. The forecasts are delivered via EcoConnect, NIWA's online forecasting and information service. The NZLAM (New Zealand Limited Area Model) at the heart of the system will soon be supplemented by a second model, NZCONV (New Zealand CONVective scale model). NZCONV is a cloud-resolving model, and will provide ultra-high-resolution meteorological forecasts (down to 1.5 square kilometres resolution) out to 24 hours in advance, four times daily.

Collaborator
University of Otago

Funders
Ministry of Science and Innovation
Natural Hazards Research Platform

"But for us to be able to respond, we have to be ready. That is why continuing investment in skills and technology is so important."

Dr Murray Poulter, Chief Scientist, Natural Hazards

$12.7 million
invested in a new supercomputer for environmental forecasting

6.5
days for the ash from the Chilean volcano to travel eastward and reach New Zealand

1.6 m
the largest wave to hit New Zealand's coastline following the Japanese earthquake on 11 March 2011

30
the number of submarine volcanoes on the Kermadec Ridge

Seabed's secrets unfold in New Zealand's marine estate

New Zealand's ocean estate is the fourth largest in the world, and a source of immeasurable economic and environmental wealth. Through fishing and aquaculture, oil and gas exploration and extraction, tourism and recreation, transport and telecommunications links, the ocean is a fundamental key to New Zealand's economic well-being.

Beneath the ocean, the seabed is dynamic, dramatic, and infinitely variable. The ocean floor around New Zealand owes its origins to a complex geological landscape, rough seas, and tidal currents that scour it. Ridges, plateaus, giant landslide-scarred canyons, tectonic fault systems, and seamounts create a massive, diverse underwater environment.

NIWA Chief Scientist, Oceans, Dr Charlotte Severne, says "New Zealand has sovereignty rights to the management and economic exploitation of the ocean throughout the Exclusive Economic Zone (EEZ) and wider limits of the Continental Shelf."

NIWA scientists are proven specialists in fine-detail mapping of the seafloor, and bathymetric (water depth) analysis. Knowing what lies beneath the waves is integral to much of NIWA's ocean-based research, including our fisheries, ocean geology, marine biodiversity, and conservation work. We have a long history of producing maps and charts of the seabed, which are always in demand.

"Discovery, assessment, and sustainable management of oceanic resources require fundamental knowledge of the seafloor, and its biological and environmental uniqueness. These maps combine truly sophisticated seafloor mapping with expert marine geological knowledge," says Dr Severne.

Increasingly sophisticated acoustic technology is revealing the seabed's finer secrets. A multibeam echosounder, mounted on the hull of *Tangaroa*, is our key mapping tool. The echosounder sends out a fan of acoustic beams to depths of up to 5500 metres, up to one kilometre wide. The beams hit the seabed and bounce back, and scientists use the acoustic echoes to build up a 3D picture of water depth and the shape and composition of the seabed.

This year, we made our unique undersea maps of New Zealand's EEZ freely downloadable from our website. The maps are available in a range of formats, from jpegs to high-resolution 250-metre gridded geographical information systems (GIS) products. The maps cover an area of 11.7 million square kilometres, and extend to depths of 11 000 metres.

The Department of Conservation is an avid user of the maps. "NIWA's undersea maps formed the key base data for the Sub-Antarctic Marine Protected Area Forum," says Sean Cooper, DOC's Marine Conservation Manager. "The high-quality maps really brought the seabed to life and assisted the forum to determine Marine Protected Area options for Ministers to consider."

Over 3000 downloads have been made since the launch of the maps in 2010. Users include: fisheries, telecommunications companies, petrochemical and other mineral prospectors, government agencies, schools and universities, and the general public.

A more detailed mapping project in Cook Strait produced three highly acclaimed maps showing the deep seabed of Wellington Harbour and Cook Strait in incredible digital detail. The maps were finalists in Wellington's Gold Awards 2011. A similar project to map Auckland's Hauraki Gulf is almost complete.

Download the seabed at: www.niwa.co.nz/our-science/oceans/bathymetry

Source Information
Bathymetry compiled from data held at the National Institute of Water & Atmospheric Research (NIWA); Hydrographic Office, Royal New Zealand Navy; National Geophysical Data Centre (US.); South Pacific Applied Geoscience Commission (Fiji); published scientific papers; recent swath bathymetric surveys funded by NIWA; Institute Français de Recherche pour l'exploitation de la Mer (IFREMER), France; Seabed Mapping New Zealand Limited; Land Information New Zealand (LINZ)

Funder
Ministry of Science and Innovation

"Discovery, assessment, and sustainable management of oceanic resources require fundamental knowledge of the seafloor and its biological and environmental uniqueness."

Dr Charlotte Severne,
Chief Scientist, Oceans

11.7 million km²
the area covered by NIWA's undersea maps

11 000 m
the depth below the sea to which our mapping extends

10 km³
the size of one landslide in Cook Strait

5.8 billion
soundings used to survey Wellington Harbour

New technology makes every drop count

Much of the available freshwater in New Zealand is already allocated for agriculture, and there is significant interest in expanding production. To make that possible, New Zealand needs to make every drop of water count.

New Zealand's water resources are limited and can be highly variable as river levels rise and fall very quickly. Even worse, climate change scenarios predicting warmer summers and reduced rainfall during the growing season suggest that the water available for irrigation will become scarcer in the future. Much of the available freshwater in New Zealand is already allocated for agriculture, and there is significant interest in expanding production. To make that possible, New Zealand needs to make every drop of water count.

Working closely with the irrigation industry, NIWA has developed its NEON system into a new real-time monitoring and demand-driven control system, which allows visualisation and control of whole irrigation systems through the internet, to meet the water users' requirements within resource consent operating restraints.

Ordering water

The Acton Irrigation Scheme in Canterbury takes water from the Rakaia River at consent flow rates of up to three cubic metres per second (cumecs). Acton is the eighth major irrigation scheme NIWA has automated in just over a decade, but it's quite different to the others. The Acton system not only controls water flow through the irrigation races, but, using the NEON system, water users can also schedule and supply irrigation water to order.

Each night, users place orders for the water they need the next day. The scheme control system manages the reticulation and delivers the required amounts of water to the right place, at the right time, while ensuring that the total amount of water taken remains within Environment Canterbury's consent limits.

Web-enabled irrigation

The Acton scheme has eight automatic water flow-control stations and three buffer ponds. Using NEON, the scheme operator can monitor and control all parts of the system from anywhere with a cellular wireless data connection. The eight control stations send data to the NIWA NEON irrigation server via a cell phone connection. Authorised users can access real-time and historical data on the server via any internet browser on their computer or smartphone.

Text message alerts and alarms can also be sent to nominated mobile phones if any problems occur in the irrigation system – for example if the flow rates exceed the consented rates – allowing the scheme operators to act quickly to remedy the issue.

Chief Scientist, Environmental Information, Dr Jochen Schmidt says the NEON system has provided a unique and innovative solution to a complex problem for irrigators.

"This system allows water users to maximise the amount of water taken within consent conditions. When supply and demand for water is so variable, and the time needed to transport water through the system requires considerable planning and coordination, that's a significant step forward. We really are making every drop of New Zealand's valuable water resource count through NEON."

Collaborators
Environmental Consultancy Services Ltd
Alpine Hydraulics Ltd
Bartlett Electrical
Unidata Pty

Funder
Rooney Earthmoving

"We are making every drop of New Zealand's valuable water resource count through NEON – our innovative, real-time, environmental monitoring and control technology."

Dr Jochen Schmidt, Chief Scientist, Environmental Information

4000
sensors connected to the NEON system

650
monitoring stations connected to the NEON system

5000
automated user reports generated by NEON each day

23 000
transactions received by NEON each day

Nelson Boustead, NIWA

Kiribati plans for climate change

As they develop their economies, Pacific Island nations must plan for the impacts of climate change within most of their sectors, such as infrastructure, says NIWA's Pacific Rim Manager, Doug Ramsay.

"Infrastructure is one particular sector where incorporating climate change considerations is critical because of the long life spans of developments such as roads," says Doug. He and his NIWA team have been working with the Government of the Republic of Kiribati In the central Pacific, to develop climate-related design information to assist with land-use planning and infrastructure decision-making.

They also developed spread sheet based tools to enable Government staff to access and apply climate information as they plan for more resilient infrastructure such as roads, coastal defences, causeways, and stormwater drainage.

The tools were recently used to help design coastal protection for assets on South Tarawa, and to help set minimum ground levels for a new residential development at the eastern end of the atoll.

Kiribati – a cluster of 32 atolls and one raised coral island – is one of the most vulnerable island nations. Much of the main atoll, Tarawa, is barely half a kilometre wide, and lies just three metres above sea level. South Tarawa's high population density, socio-economic conditions, along with the limited land area and low-lying land levels, leave it particularly susceptible to the impacts of coastal flooding and climate change.

South Tarawa consists of many smaller islets, linked by narrow causeways which can be overtopped when large waves combine with high sea levels.

Doug says there are a number of approaches that can be adopted to incorporate climate change considerations into island infrastructure such as these causeways. However, given the current uncertainty over the magnitude of future sea level rise (anything between 50 centimetres to a metre or more by the end of this century) an adaptive management approach may be most effective – staging adaptation activities over time in response to improved climate and sea level rise projections.

Making appropriate decisions demands good information, says Doug, from both historical climate records and future projections. His team compiled both to give the Kiribati Government the best possible foundation for future development.

"But," he says, "getting access to good quality data can be a significant challenge – particularly when you're looking at extreme conditions; you need at least 30 years of good data to derive some of those extremes."

"The tools will be adapted to help with development work elsewhere in the Pacific" says Doug. "We're adapting some of the tools we developed in Kiribati to assess how climate change may impact on coastal flooding and the implications for land-use planning in the Cook Islands.

Collaborators
Secretariat of the Pacific Community
Applied Science and Technology Division

Funders
Kiribati Adaption Project Phase 2: funded by the World Bank and Australian and New Zealand Aid Programmes

Onotoa Atoll, which illustrates the limited land area and low-lying nature of atolls In Kiribati. (Tony Whincup)

"As they develop their economies, Pacific Island nations must plan for the impacts of climate change on their infrastructure."

Doug Ramsay, Manager, Pacific Rim

3 metres
maximum height of Kiribati above sea level

8990
people per square kilometre in the most densely populated areas of South Tarawa

6.5 cm
the rise in sea level around Tarawa since 1974, when monitoring began

Up to 600%
the possible increase of wave volume overtopping the Dia Nippon Causeway during a storm in the next 50 years

Mātauranga Māori key to understanding our environment

Helping Māori organisations with the management and use of natural resources is a key priority of NIWA's Māori Environmental Research Centre, Te Kūwaha.

Māori share a unique relationship with the natural environment. As kaitiaki (guardians) of the land and waterways, iwi have informally gathered information about environmental changes in their rohe (region) for centuries. Māori already monitor various attributes of the environment, including kaimoana, and apply traditional and contemporary management actions, such as rāhui (temporary restrictions).

"Māori knowledge can drive New Zealand's environmental management," says Te Kūwaha Chief Scientist Dr Charlotte Severne. "Mātauranga Māori provides us with detailed information on changes in aquatic ecosystems over centuries, a historical baseline. In turn, we are able to identify monitoring priorities that can inform management and future restoration initiatives."

NIWA has worked closely with iwi, building monitoring tools based on mātauranga Māori, utilising where possible existing technologies to develop easy-to-use, inexpensive toolkits.

Collaborators
Ngāti Hikairo
Ngāti Whanaunga
Ngāti Pūkenga
Aranovus Research
Department of Conservation
Waikato Regional Council
Mansergh Graham Landscape Architects
Ministry of Fisheries
University of Waikato
Wild Earth Media

Funders
Ministry of Science and Innovation
Ministry for the Environment

Ngā Waihotanga Iho

Ngā Waihotanga Iho (what is left behind, lift up) is a toolkit designed to help hapū and iwi measure environmental changes in their estuaries. Environmental changes impacting on an estuary's health include increased water turbidity and sedimentation, loss of species, algal blooms, and contaminated kaimoana. These changes can have a significant impact on Māori, who value estuaries as a source of identity and culture, as a place for learning and recreation, and as a food source.

Designed to help iwi monitor the physical, biological, and chemical health of their estuary, Ngā Waihotanga Iho is broken into 11 modules covering a range of topics. These include habitat mapping, water and sediment quality, plants, fish, and coastal management. Each module is designed to be used separately or together, depending on the environmental issues in different rohe.

"The toolkit is unique because it is based on sound science principles and on Māori values. It has also been translated into te reo, making it more accessible for iwi," says Group Manager, Coastal and Estuarine Processes, Andrew Swales.

Ngā Waihotanga Iho was completed in partnership with Ngāti Hikairo at Kawhia and Ngāti Whanaunga and Ngā Pūkenga at Manaia over six years. Detailed interviews, mapping, and analysis of mātauranga Māori provided the overarching values, which in turn directed the development of the monitoring modules included in the toolkit.

The toolkit will be used as an educational resource and is available from NIWA's website.

Kaitiaki Tools

Kaitiaki Tools focus on freshwater mahinga kai. The toolkit contains information about the environmental impacts of different land uses and industries on water quality and mahinga kai. The toolkit helps people apply this information to the resource consent process.

Kaitiaki Tools is also available from the NIWA website.

Dr Rupert Craggs (Principal Scientist, Aquatic Pollution) and Hinearanganui Little (Ngāti Pūkenga) testing water salinity at Manaia, Coromandel. (Alastair Jamieson)

"Māori knowledge can drive New Zealand's environmental management."

Dr Charlotte Severne,
Chief Scientist, Māori Development

58
active working relationships with whānau, hapū, iwi or Māori organisations in 2010–11

6
customary fisheries assessments undertaken by the Te Kūwaha team

42
NIWA staff attended te reo and tikanga Māori noho marae training courses

86
hui and workshops held with Māori partners

Enhancing New Zealand's ocean science

After a $25 million dollar upgrade to enhance its ocean science and survey capabilities, NIWA's deepwater research vessel *Tangaroa* is back on the water again. *Tangaroa* is New Zealand's only ice-strengthened research vessel, and is NIWA's base for major offshore, international science voyages.

Dynamic positioning (DP)

Tangaroa spent five months in Singapore being fitted with a DP2 system, which uses electrically powered thrusters and computerised controls to enable it to remain on a fixed position, using satellite positioning or transponders on the seabed. It also allows the vessel to navigate a precise course.

DP2 capabilities are essential for ocean science and marine operations undertaken by oil, gas, and mineral industries, where new technologies often require vessels to hold a steady position. This includes the deployment and use of remotely operated vehicles (ROVs), autonomous underwater vehicles (AUVs), manned submarines, seafloor observatories, and other equipment temporarily fixed to the seabed, such as seabed samplers and rock-coring equipment.

NIWA's General Manager, Research, Dr Rob Murdoch, says the upgrade provides New Zealand with a valuable asset to help advance ocean science, surveying, and exploration.

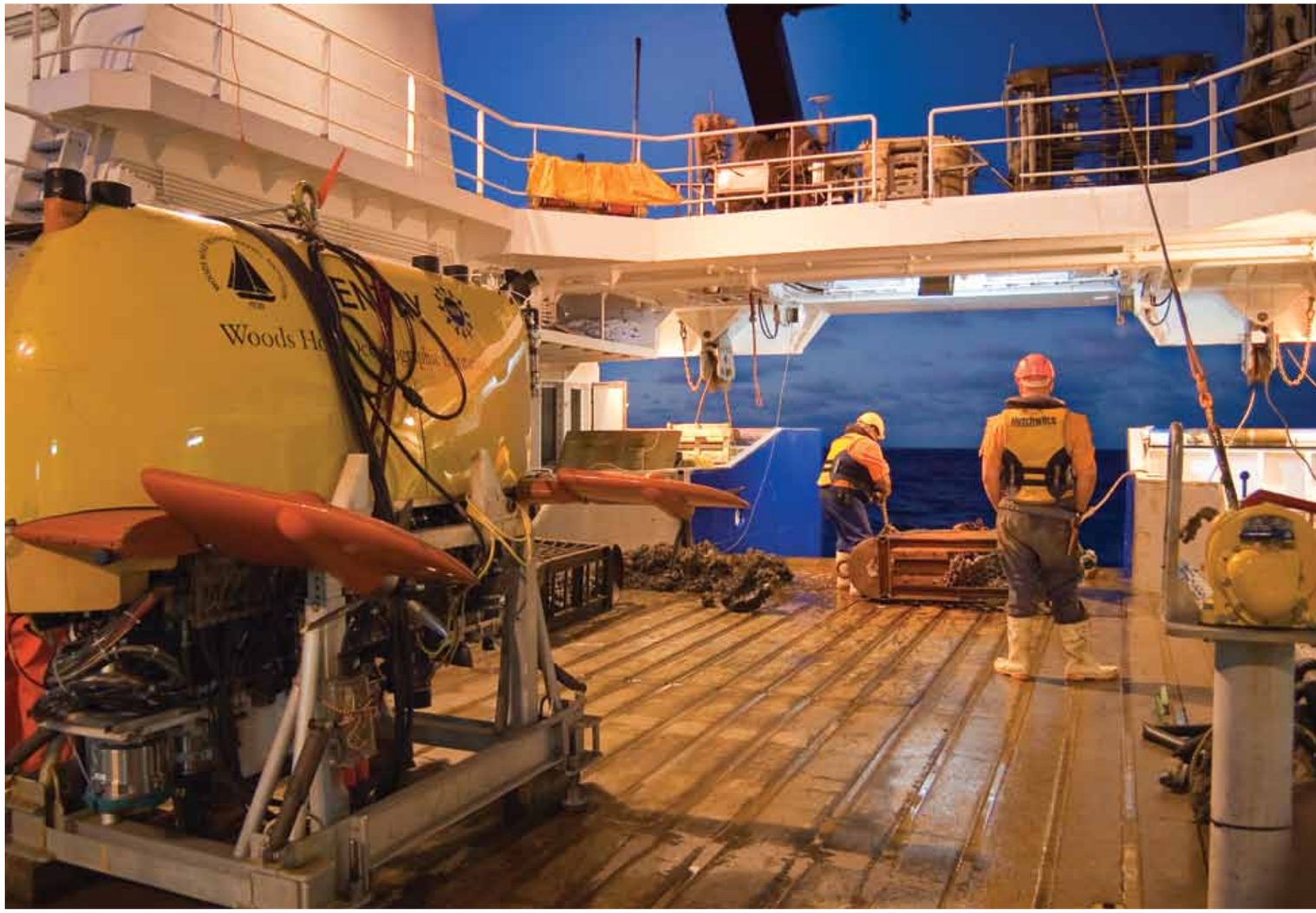
"International demand for research and survey vessels with DP2 capabilities is increasing, especially with heightened activity in the exploration industries. It's a real advantage to New Zealand that NIWA can provide these capabilities, without companies having to look offshore for foreign vessels to do the job."

Investigating our submarine volcanoes

One of *Tangaroa*'s first voyages after the upgrade was an international collaboration, between GNS Science, Woods Hole Oceanographic Institution, and NIWA, to investigate mineral deposits and hydrothermal systems at five major submarine volcanoes in the Kermadec Arc.

Previous research has shown that some of the volcanoes on the Kermadec Arc host extensive polymetallic sulphide deposits. One of the aims of this 25-day voyage was to determine the composition and size of these deposits. Some of the volcanoes also have active hydrothermal vent fields, which are home to unique communities of animals which thrive in a hot and chemically rich environment. The survey used state-of-the-art equipment, including a sophisticated AUV (called Sentry), and a towed digital camera system (TowCam). While Sentry was at work, scientists were able to undertake other activities from *Tangaroa*, such as photographic surveys with TowCam, dredging for rocks and minerals, collecting specimens from the seafloor, mapping hydrothermal plumes, and taking gravity and magnetic measurements. These complementary investigations effectively doubled the productivity of the voyage.

"While the geologists and geophysicists are improving their understanding of the size and distribution of potential mineral resources within the volcanic systems, we are also studying the biodiversity to determine the possible impacts of mining in the future and whether particularly sensitive or unique animals will be affected. The collaboration and technical capabilities on this voyage really gave us a wide spectrum of information and evidence to make future decisions on," says NIWA Principal Scientist Dr Malcolm Clark.



Kareen Schnabel, NIWA

Collaborators
GNS Science
Woods Hole Oceanographic Institution
National Oceanographic and Atmospheric Administration (NOAA-USA)
University of Tasmania
Australian National University
ETH (Switzerland)

Funders
Land Information New Zealand Ocean Survey 20/20 programme
GNS Science
NIWA

"Our deepwater research vessel *Tangaroa* is a national asset, helping to advance ocean science, surveying, and exploration."

Dr Rob Murdoch,
General Manager, Research

$25 million
spent on *Tangaroa*'s upgrade in 2010

3000 kW
the amount of electrical power *Tangaroa* can generate from the new generators

20 kms
the length of new wiring installed during the upgrade

42 tonnes
the weight of *Tangaroa*'s new bow module

Our People

Our success is a team effort.

In the following pages we celebrate some of the achievements of a few of our staff during 2010–11.

Evan Baddock, NIWA

Celebrating our greatest asset

A New Zealand first

It took a truly collaborative team effort by nearly 40 scientists, social scientists, practitioners in mātauranga Māori, farming systems specialists, economists, engineers, planners, and writers to produce the Waikato River Independent Scoping Study – which outlines priority actions the Waikato River Authority might use to restore and protect the Waikato River. Led by NIWA scientists Dr Kit Rutherford and Dr John Quinn, the study makes 60 recommendations on priority actions the Authority might use to restore the river, including management of diffuse and point source contaminant sources, lake restoration, and fisheries protection.
NIWA General Manager of Strategy, Dr Bryce Cooper, says the teamwork involved in such a complex study was vital to its development. "This study is nationally significant because it will guide the most comprehensive co-management agreement established in New Zealand history between the Crown and iwi to restore and protect the health and wellbeing of a national asset. That's a first for New Zealand." Partners in the study included AgResearch, Beca, Diffuse Sources Limited, Enveco, Nimmo-Bell & Company Limited, Market Economics Limited, and Tipa and Associates.

Achieving great heights

Being precariously perched on a cliff edge 2000 metres up a mountain above Milford Track may not be everyone's idea of a good day at the office, but for NIWA hydrologists Evan Baddock and Eric Stevens it comes pretty close to perfection. Evan, Eric, and colleagues from the Department of Conservation spent two days installing New Zealand's highest snow-monitoring station on Castle Mount, Fiordland, in March this year. The snow station is part of NIWA's Snow and Ice Network, which gathers information about the extent, seasonal nature, and long-term changes to snow and ice in the alpine regions of New Zealand. Understanding more about snow levels is essential for hydro-electricity (making up 30 percent of inflows to the South Island hydro lakes), recreation, tourism, and hazard risks from avalanches or snow building up on buildings. "The views were amazing, but safety was a huge concern. We carried survival gear and the helicopter stayed with us, so we could leave quickly if the weather closed in. It's one of those places you always watch your back," Evan says. Watch how they did it at: www.youtube.com/watch?v=CbIu4IyAy8M

Previous pages: NIWA staff installing the snow station on Castle Mount, Fiordland (see story above). (Evan Baddock, NIWA)

Enhancing our ocean capabilities

One of this year's proudest moments was the return of *Tangaroa* from Singapore in December after completion of a $25 million upgrade to enhance its ocean science and marine survey capabilities. Members of the vessels' team spent nearly six months this year living in Singapore, overseeing the upgrade. *Tangaroa* is New Zealand's only ice-strengthened research vessel and NIWA's platform for national and international science work and survey work for the oil, gas, and mineral industries. The upgrade included the installation of a dynamic positioning (DP) system, which allows the vessel to remain fixed in a specific position, despite wind, waves, and currents. No other vessel in New Zealand has the same DP2 capabilities. Other improvements included installing new laboratories, upgrading the air conditioning, refurbishing winches, the galley, and dry stores, installing a new deepsea winch and bridge wing to view gear deployments, and completely stripping and repainting the outside of the vessel. Project manager Allister Taylor and General Manager Fred Smits spent all six months of the upgrade in Singapore, with a full team of fourteen people there during the final months. "The ST Marine shipyard in Singapore was a very hot, noisy, dusty, and humid place to work, but also very exciting," says Fred. "Through a huge team effort, *Tangaroa* has become an even more fantastic asset to New Zealand's sciences and offshore industry."

A vital cog

Transferring technology and knowledge to our customers to help them better manage their lives or their businesses requires science, communications, IT, finance, and many other skills. The project administrators are key elements in this knowledge transfer, and one such person is Christchurch Project Administrator Ruth Cable. Ask people who work closely with Ruth and they will tell you "Ruth is a vital cog in the wheel". Ruth manages the administrative side of our projects, from initial set up and contract through to completion, on time and within budget. At present, NIWA has more than 800 environmental science projects on the go, and highly efficient administration is essential. Ruth has excellent relationships with some of NIWA's most important customers, including Meridian Energy. This year she managed about forty NIWA projects for Meridian. Ruth says her goal is to enable the scientists to do what they do best by "helping our customers through great science, doing what I do best, managing things behind the scenes."

Ruth Cable

Celebrating a 10 year anniversary

2010 marked a special 10 year anniversary for staff involved in NIWA's biophysical moorings programme. In mid-February, the 20th voyage since 2000 to turn around NIWA's two deep-ocean, long time-series biophysical moorings was completed. These 3 kilometre long moorings provide an unprecedented record of physical (temperature, salinity, water currents) and biogeochemical (downward particle fluxes) data from the two main surface water masses around New Zealand (subantarctic and subtropical). Project leader Scott Nodder has been involved from the start, along with team members Matt Walkington and Lisa Northcote. Scott says the highlights are "successfully wrangling the moorings onboard and getting full data sets off the instruments, the oceanic sunsets and sunrises, and the camaraderie onboard *Tangaroa*." Bad moments, he says, are rare, but losing an entire mooring in 2004 was one. "Getting hurled across the mess in rough weather and slicing my elbow open was another. It's a pretty hostile environment we work in sometimes, but it's worth it for the knowledge we gain."

Maori knowledge and science mix

NIWA scientist Darren King is an interdisciplinary research scientist, Darren manages the Climate Applications Group based in Auckland and is also a member of the National Climate Centre and NIWA's Māori Environmental Research Group Te Kūwaha. His research interests include climate induced natural hazards, mātauranga Māori (Māori knowledge) and its relationship with contemporary science, coastal evolution, and tsunami risk. At the moment, Darren is leading research programmes with iwi and hapū in Manaia, Arowhenua, and Hokianga on climate change vulnerability and adaptation. Darren says the best part of his job "is working on the ground with local people on issues that affect well-being and sustainable development. The people I work alongside and get to know are really impressive and uplifting." Darren is also working on his doctorate on tsunami risk and disturbance.

Scott Nodder

Darren King

A gold medal effort

In November, the country's biggest sporting event since the 1990 Commonwealth Games, the 2010 World Rowing Championships, was held at Lake Karapiro – attracting more than 800 athletes from 49 countries. The Championships were a great success, with a record crowd of 66 771 spectators. NIWA played a key role by providing localised event forecasting to the World Rowing Federation (FISA) and the competitors. NIWA scientist Dr Mike Revell was on site every day at the venue, monitoring weather conditions on the course via NIWA's specialised environmental forecasting service EcoConnect. Special mention must be made of environmental technician Kerry Costley, who helped install the climate sensors on the lake for the event. The aquatic plants team from Hamilton also played a key role in a 4-year campaign to reduce water weed interference. Aquatic weeds, particularly hornwort, can have a significant impact on rowing regattas, when the weeds get caught around the rower's blades (oars) or the boat's rudder. The work helped make Lake Karapiro a world-class rowing venue, and will have flow benefits for the hydro-power system.

Helen Neil, Anne-Laure Verdier, Arne Pallentin, John Mitchell, and Kevin Mackay.

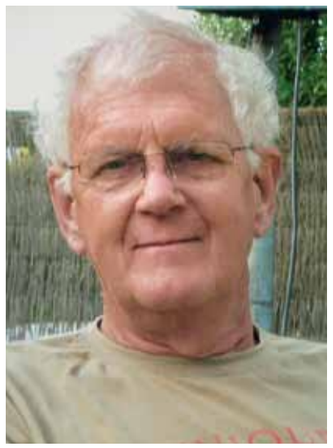
Rallying around our people

NIWA's Christchurch office was extremely lucky to escape with only minor damage after the devastating earthquakes, but staff were not immune to their impact. More than half the staff suffered issues at their homes.
The Crisis Management Team was activated immediately, and all staff were contacted to check on their safety and their properties. Washing machines and dryers were purchased and set up on site to help staff who were without power or water, and teams got together to help dig out staff properties affected by liquefaction. NIWA's offices were also opened to other organisations, like the University of Canterbury and Environment Canterbury, displaced by the earthquakes. As Christchurch Regional Manager Charles Pearson points out, there have been over 2000 magnitude 3 or more quakes since September last year, but all staff have shown incredible resilience. Christchurch staff say Charles, and Assistant Regional Manager Graham Fenwick, deserve a special mention for the way they have guided and supported their staff. "Despite all that, we achieved an excellent regional result this year. You might say they were just doing their job, but the circumstances were exceptional," one team member said.

Charting our undersea environment

For three decades, marine scientists have been studying the seafloor of Wellington Harbour and Cook Strait to understand the processes that shape it and how they might impact on recreation, fisheries, hazard risks, and electricity infrastructure on the seabed. But it took an exceptional collaborative effort by members of NIWA's CANZ (Charting around New Zealand) team to bring that undersea environment to life through the 'Beneath the Waves' submarine chart collection. The charts show, for the first time, in incredible digital detail, the shape of the ocean floor and the secrets it holds – including ridges, plateaus, canyons, tectonic fault systems, sand waves, ship wrecks, and landslides. Details for the charts were captured by the highly skilled team using a high-tech multibeam echosounder mounted on the hull of *Tangaroa*. The charts were also a finalist in the 2011 Wellington Gold Awards 'Discovering Gold' section – which focuses on technological, scientific, and innovative research and development in Wellington.

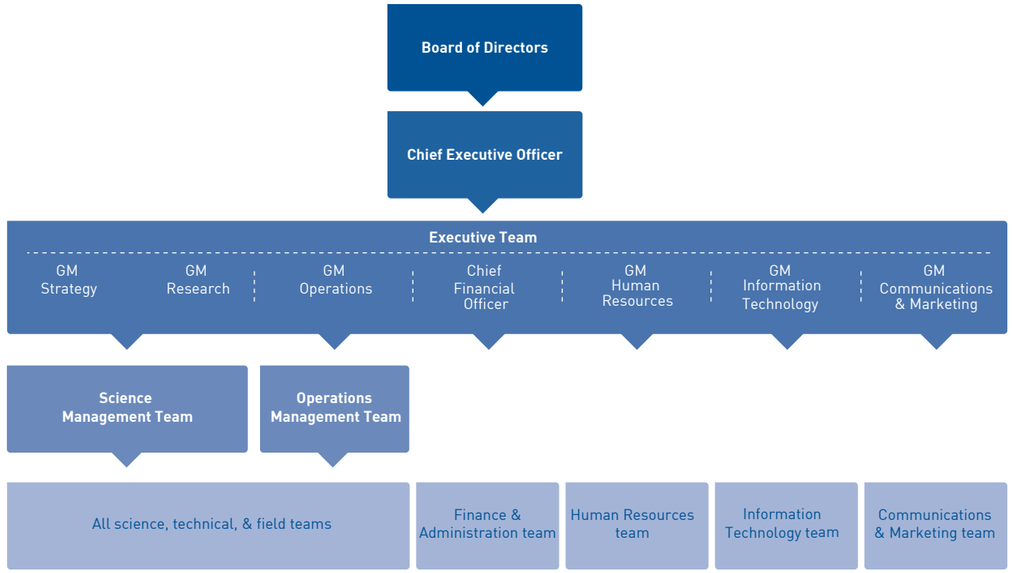
A fallen giant – Bob McDowall, 1939–2011

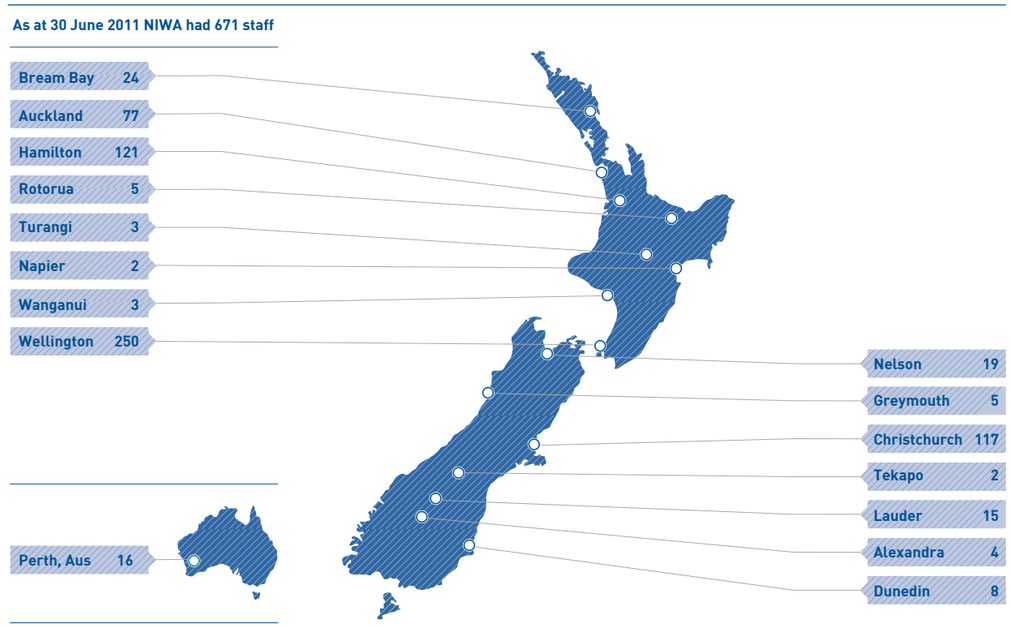


Robert (Bob) McDowall was a widely published author and acknowledged world authority on the taxonomy and biogeography of New Zealand's freshwater fish. During his 40-year career with the Marine Department, Ministry of Agriculture and Fisheries, and NIWA, Bob wrote 230 papers (in 66 different journals), 14 books, and 300+ reports and popular articles on freshwater fish. Another significant contribution of Bob's work was the establishment of the New Zealand Freshwater Fish Database in 1979. This database now contains over 30 000 records of species and their habitats, and has formed the basis of many scientific papers on the distributions and habitat use of native and introduced fish by Bob and others. Prior to his untimely death in February this year, Bob had also just finished an extensive (872 page) book on historic and contemporary Māori freshwater fisheries – 'Ikawai – Freshwater fishes in Māori culture and economy' which will be published in October 2011. Bob was made a fellow of the New Zealand Royal Society in 1984 and an honorary member of the New Zealand Limnological Society in 2000. NIWA colleague Don Jellyman said of Bob: "Māori have a saying that when a respected person dies, a giant tree has fallen in the forest, but its falling makes space for new growth. Bob was that giant in freshwater fisheries. His legacy lives on in his writings and the many students and researchers who are able to build on his scientific discoveries."

Our organisation

enhancing the benefits of New Zealand's natural resources





Board of Directors

Dr Wendy Lawson
Dr Wendy Lawson is a glaciologist with a particular interest in the impacts of climate change and earth systems. She has more than 25 years of remote field science experience in Arctic, Antarctic, and alpine regions. She is Dean of Science and Professor at the University of Canterbury, and serves on the Board of the Antarctic Research Centre at Victoria University.

Dr Helen Anderson
(from July 2011)
Helen Anderson is a board member of DairyNZ and FulbrightNZ. She was Chief Executive of the Ministry of Research, Science and Technology for six years, preceded by six years as Chief Scientific Adviser. Most recently she has reviewed the Defence Technology Agency and been a member of the Ministerial inquiry into the collapse of Christchurch CBD buildings. She is a seismologist by training and regularly speaks to lay audiences about recent earthquakes.

Ed Johnson
Ed Johnson, FInstD, is Chair of Fulton Hogan Ltd, Goldpine Industries Ltd, Indevin Ltd, and Port Marlborough New Zealand Ltd, and a director of several entities. He retired as Chairman and CFO of Shell New Zealand in 2002. In 2001, Ed became the inaugural Honorary Fellow of Massey University's Centre for Business and Sustainable Development and was made a Fellow of the New Zealand Institute of Directors in 2003.

John Morgan
Chief Executive Officer
John joined NIWA as CEO in April 2007. He has extensive senior executive and governance experience in the science sector, including as CEO of AgriQuality Ltd, Executive Director of Orica New Zealand Ltd, and Chair of New Zealand Pharmaceuticals Ltd. John is passionate about the role science can play in transforming New Zealand's economy, society, and global reputation.

Chris Mace
Chairman
Chris Mace is an Auckland-based businessman. He chaired the Crown Research Institute ESR in the 1990s and later Antarctica New Zealand. He was a founding trustee of the Sir Peter Blake Trust and continues as a trustee of the Antarctic Heritage Trust. Chris was awarded a CNZM for services to Antarctica and the community and was appointed Chairman of NIWA in July 2009.

Craig Ellison
Deputy Chairman
Craig Ellison is a director on several boards, including New Zealand Trade & Enterprise, as well as chairing the New Zealand Seafood Standards Council. Dunedin born and bred, Craig now lives in Wellington, but also has commercial interests in Australia. He was deeply involved in the settlement of Māori commercial fisheries claims, and maintains an interest in Māori governance structures and resource management.

Jason Shoebridge
Jason Shoebridge is the Managing Director of TNS New Zealand. Jason has led consulting assignments across a range of industries and disciplines in New Zealand and overseas. Prior to his consulting career, Jason held number of senior commercial and financial management roles internationally and in New Zealand in large corporates, as well as with an international chartered accounting firm.

Helen Robinson
Helen was the founding CEO of TZ1 Registry, acquired by London-based Markit Group Ltd in June 2009. Helen continued to act as Global Managing Director, Environmental Markets until April 2011. Helen has led many technology companies over the past 20 years, including as CEO of Microsoft, NZ and as Vice President of APAC, Pivotal Corporation. Her directorships include NZ Business Excellence Foundation.

Executive Team

Rob Murdoch
General Manager, Research
Rob has a PhD in marine science from the University of Otago and has specialist interests in oceanography and marine ecology. He manages NIWA's relationship with the Ministry of Science and Innovation, and has overseen the planning and direction of NIWA's science and research vessels since 1999.

Mary-Anne Dehar
General Manager, Human Resources
Mary-Anne joined NIWA in March 2008. She has a PhD in psychology and is a registered psychologist, specialising in industrial/organisational psychology. Before joining NIWA, Mary-Anne worked as a senior human resources consultant for 15 years, both in private practice and for several large consulting firms.

Geoff Baird
General Manager, Communications & Marketing
Geoff has a BSc (Hons) in ecology from Victoria University of Wellington. He has more than 25 years' experience in science publishing and communication with the Ministry of Agriculture & Fisheries, MAF Fisheries, and NIWA. He became NIWA's Communications Manager in 2003 and General Manager, Communications & Marketing in July 2007.

Kate Thomson
Chief Financial Officer & Company Secretary
Kate is a Chartered Accountant with a BCom from Canterbury University. An experienced Chief Financial Officer, she held similar roles in the commercial sector, joining NIWA in 2006. Previously she advised a range of businesses on key commercial matters and was also a Policy Analyst with Treasury. Kate is a past member of the Financial Reporting Standards Board (FRSB).

Arian de Wit
General Manager, Information Technology
Arian has an MSc (Hons) in software engineering from the University of Waikato, and a Postgraduate Diploma in management studies. He joined NIWA in 1995 and became General Manager for IT in 2007. Arian and the IT group strive to ensure that NIWA's information and technology infrastructure can readily adapt to NIWA's ever-changing science and organisational needs.

John Morgan
Chief Executive Officer
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.

Bryce Cooper
General Manager, Strategy
Bryce has a PhD in microbiology and 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.

Barry Biggs
General Manager, Operations
Barry is an environmental scientist with degrees in geology and botany from Victoria University of Wellington and a PhD in stream ecology from the University of Canterbury. His research fields include the effects of hydropower development on river ecosystems, environmental hydrology and ecohydraulics, eutrophication of lakes and rivers, stream periphyton ecology, and freshwater bioinvasions. He was appointed General Manager, Operations in July 2008.

Science Management Team

Clive Howard-Williams
Chief Scientist, Freshwater & Coasts
Clive is an aquatic ecologist with a PhD from the University of London. He has specialised in research on water quality, lakes, and wetlands and has worked in a number of countries. He is a Fellow of the Royal Society of New Zealand, an Adjunct Professor at the University of Canterbury, and holder of the New Zealand Antarctic Medal.

Andrew Forsythe
Chief Scientist, Aquaculture & Biotechnology
Andrew Forsythe is a veterinarian with a DVM from the University of Prince Edward Island. He came to NIWA in 2005 with more than 20 years of aquaculture industry experience from North America and Europe, and took up his current role in 2007.

Murray Poulter
Chief Scientist, Atmosphere, Natural Hazards, & Energy
Murray has a PhD in physics and worked in Europe on wave propagation in the atmosphere and space. He worked in New Zealand, Canada, the USA, and Antarctica on radar methods to determine the role of ocean waves in coastal and air-sea interaction processes, before taking on a management role in NIWA.

Charlotte Severne
Chief Scientist, Māori & Oceans
Tēnei te mihi manahau o NIWA ki ngā iwi huri noa i te motu. Ko Charlotte Severne tōku ingoa. He uri tēnei nō Ngāti Tūwharetoa me Ngāi Tūhoe. Heoi anō he Tumu Whakarae ahau mō ngā tūranga e rua o roto o NIWA, arā, tētehi mō te whanaketanga Māori me tētehi atu mō ngā rangahau o te moana. Nāku i whakahaere tō mā tou nei roopu rangahau pūtaiao Māori e kiia nei ko Te Kūwaha. Nō reira tēnā koutou katoa.

Barb Hayden
Chief Scientist, Aquatic Biodiversity & Biosecurity
Barb holds a PhD in marine biology and has a research background in marine biosecurity and in the environmental sustainability of aquaculture. She leads NIWA's aquatic biodiversity and biosecurity research and is also the Deputy Chair of the Biosecurity Ministerial Advisory Committee.

Jochen Schmidt
Chief Scientist, Environmental Information
Jochen holds a PhD in geography from the University of Bonn and has a background in hydrology, geomorphology, soil science, and hazards and risk assessment. He joined NIWA in 2003 and has been recently appointed to coordinate NIWA's systems for collecting, managing, and delivering environmental information to ensure they are robust and meet best practice standards.

Rosemary Hurst
Chief Scientist, Fisheries
Rosemary has a PhD in zoology and has worked in fisheries research in New Zealand since 1979. She is a specialist in middle depth and inshore fisheries resources surveys and stock assessment, climate effects on fisheries, and fish communities. She was also a Regional Manager at NIWA Wellington for eight years.

Douglas Ramsay
Manager, Pacific Rim
Doug has degrees in Civil and Water Engineering, an MBA, and is a Chartered Engineer. He joined NIWA in 2003 and specialises in coastal hazard management. Doug coordinates NIWA's international commercial work focusing on the Pacific and Asia regions.

Mark Bojesen-Trepka
Manager, Marketing & Industry Engagement
Mark is a career industrial marketer. He has led the marketing, technology transfer, and business development effort for a number of industrial firms in a range of industry sectors in New Zealand and abroad. Mark has a Bachelor of Social Science, an MBA, and a PhD on marketing's role in technology transfer.

David Wratt
Chief Scientist, Climate
David has a PhD in atmospheric physics and has worked in the USA, Australia, and New Zealand on climate and meteorology. He is also the Director of the New Zealand Climate Change Centre, a Companion of the Royal Society of New Zealand, a member of the Royal Society's New Zealand Climate Expert Panel, and a member of the Bureau of the Intergovernmental Panel on Climate Change.

Fred Smits
Manager, Marine Resources
Fred is a geotechnical engineer with an ME from the University of Auckland. He has worked in many countries as a contracts manager for major onshore and offshore civil engineering projects. Fred joined NIWA in 1994 as marine business development manager. Between 2004 and 2010 Fred was in charge of NIWA's research vessels, *Tangaroa* and *Kaharoa*, and is currently General Manager Marine Business Services.

Alan Grey
Manager, MSI Research
Alan holds an MSc in geology and has a background in ecology and fluid dynamics. He has extensive experience in research administration and science and technology programme evaluation. He oversees NIWA's obligations to government-funding agencies as well as the impact of its research in providing benefit to New Zealand.

Greg Foothead
General Manager, Vessel Operations
Greg is a certified Automotive Engineer and holds an NZCE (Mechanical). Before joining NIWA Vessels as Engineering Manager in 2004, he managed a marine and industrial supply and repair company. He also worked for Mitsubishi Motors, in various technical roles, in NZ, Australia, and Europe. Greg has been in charge of NIWA's research vessels *Tangaroa*, *Kaharoa*, and *Ikatere* since December 2010.

Operations Management Team

Ken Becker, Auckland & Bream Bay
Ken Becker is currently the Regional Manager at NIWA Auckland and Bream Bay Aquaculture Park. He has 30 years' experience in marine science. Before joining NIWA 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.

David Roper, Hamilton
David has a PhD in marine science from the University of Otago. He has worked as an environmental scientist for the past 30 years, specialising in environmental impact assessment and resource management with NIWA and then ECNZ (later Mighty River Power), before returning to NIWA as a Regional Manager in 2002.

Charles Pearson, Christchurch & Lauder
Charles is a hydrologist with a BSc (Hons) from the University of Canterbury and an MSc (Hons) from the National University of Ireland. He specialises in the analysis of hydrological and other geophysical and climate data for purposes such as estimating flood risks. He is a member of NZ's Hydrological and Meteorological Societies and is the World Meteorological Organization's Hydrological Adviser for New Zealand.

Julie Hall, Wellington
Assistant RM
Julie is a marine and freshwater biologist with a PhD from the University of Manitoba, Canada. She has spent 20 years with the DSIR and then NIWA, specialising in phytoplankton, microbial food web, and zooplankton studies. She joined the Operations Management Team in July 2008.

Andrew Laing, Wellington
Andrew is a marine meteorologist and physical oceanographer with a PhD in fluid mechanics from the University of Canterbury. He had more than 20 years' experience with the NZ Meteorological Service, in the UK, and at NIWA, before becoming Wellington's Operations Manager in 2000.

Ken Grange, Nelson
Ken is a marine ecologist with a PhD in marine ecology from Florida International University. He initially researched the marine environment in NZ fiords, particularly the ecology of black corals, with the Oceanographic Institute, DSIR, and then NIWA, in Wellington, before moving to Nelson as Regional Manager in 1994.

Graham Fenwick, Christchurch
Assistant RM
Graham is an ecologist and crustacean systematist with 30 years' research and consulting experience on the biodiversity of shallow marine and groundwater ecosystems. He has a PhD and Dip. BA from the University of Canterbury, and joined the Operations Management Team in 2006.

National Institute of Water & Atmospheric Research Ltd

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Craig Ellison (Deputy Chairman)

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Dennis Cairns (resigned 30 June 2011)

Ed Johnson

Dr Wendy Lawson

Helen Robinson

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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'.

This 'Year in Review' is a companion volume to NIWA's official Annual Report 2011.
That report, including full financials and other statutory reporting, is available at www.niwa.co.nz/pubs/ar or request a hard copy through scicomm@niwa.co.nz

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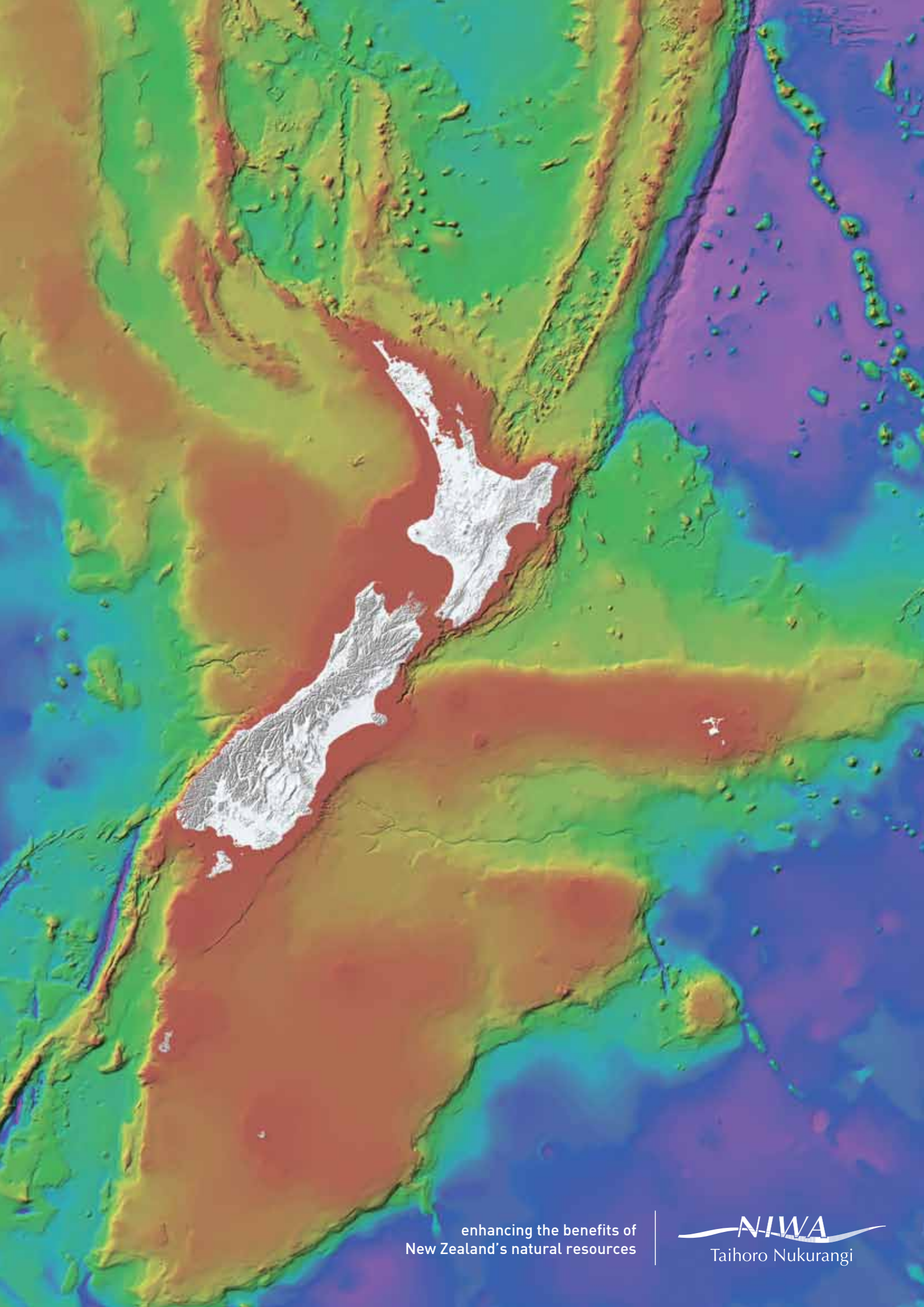

enhancing the benefits of
New Zealand's natural resources

NIWA
Taihoro Nukurangi