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**2008-09**

**Year in Review**

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Taihoro Nukurangi

**leading environmental science**

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# NIWA – leading environmental science

## The key focuses of our expertise are:

- aquaculture
- atmosphere
- biodiversity & biosecurity
- climate
- coasts
- energy
- fisheries
- freshwater
- Māori development
- natural hazards
- oceans
- Pacific Rim

NIWA was established as a Crown Research Institute in 1992. It operates as a stand-alone company with its own Board of Directors and Executive Team, and is wholly owned by the Crown. As at 30 June 2009, NIWA has 748 staff, revenue of \$120 million, and assets of \$115 million.

[www.niwa.co.nz](http://www.niwa.co.nz)

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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'.

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“As New Zealanders, we need economic prosperity whilst protecting our environment ... and it can be done”

John Morgan, CEO



# CHAIRMAN & CEO

## From our new Chairman

It is a privilege to be appointed to the Board of NIWA and to take over the role of Chairman from Sue Suckling.

As a high performing Crown Research Institute, NIWA has made considerable progress in developing the skills and capability to meet the demands of the modern world for environmental science. NIWA has specialist knowledge to assist with sustainable management of our oceans, freshwater, and atmosphere – natural resources so critical to our economic well-being. That is the key focus of the highly skilled scientists and technicians who make up the NIWA team.

We anticipate strong growth as the current global recession eases. This growth will come from increasing demand for environmental science, improving our efficiency, and making the most of opportunities to commercialise IP developed by our science teams.

In chairing the NIWA Board for the last eight years, Sue Suckling made an outstanding contribution to one of New Zealand's most successful crown entities. Sue's strategic foresight and leadership set a very high standard for NIWA's future governance.

I look forward to the future with confidence.



**Chris Mace**  
Chairman

## A strong performance

No one needs reminding that this year has been marked by the most severe global economic downturn since the 1930s, yet when we were discussing this report we found ourselves returning not to today's 'crisis', but to the longer-term environmental issues which drive NIWA's science.

There is no doubt 2008–09 has been tough from a financial point of view. We had to be fiscally cautious and manage our activities carefully to ensure we delivered the best to our customers, and that we received maximum value for every dollar we spent. Despite the recession, however, NIWA's performance has been strong and our expertise remains more relevant than ever.

## Generating respect for New Zealand

In fact, world-leading environmental science is even more critical as we seek opportunities as a nation to climb out of the recession and improve our economic performance.

Environmental sustainability is not just about the issue of the moment, it is about how New Zealand commands respect internationally. And respect matters, particularly for an export-reliant country that uses its environmental reputation and performance to differentiate itself in a very competitive global marketplace; whether it be for high quality primary products or international tourists.

NIWA is privileged to be home to the nation's environmental science capability (people, tools, and networks) in many areas of vital importance, including water allocation, water quality, high-value aquaculture, climate impacts, fisheries, renewable energy, weather-related hazards, aquatic biodiversity and biosecurity, and marine resources.

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# \$120million

total revenue including interest income

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# 9.8%

return on equity

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# 748

staff, our greatest asset

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# 84 million+

images taken by our  
Cam-era system to monitor  
rips, erosion, & other  
beach processes

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# 400 000+

people visited the  
Kelly Tarlton's facilities  
we sponsor

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# 11

regional & local  
Science & Technology  
Fairs sponsored

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## Improved pastoral productivity

What will happen to this country's primary production as changes in our climate compound the effects of natural climate variability and intensified agriculture?

NIWA's research to date suggests that the country may get drier in the east and wetter in west, and droughts may become more frequent. According to a report commissioned by the Ministry of Agriculture and Forestry, the 2007-08 drought cost the New Zealand economy \$2.8 billion.

As Agriculture Minister David Carter said in releasing that report, "Not having a plan is planning to do nothing." NIWA is working closely with the farming sector on a raft of measures to adapt to a changing climate. We are also developing tools to forecast water supply and climate conditions in order to provide scientific advice to manage competing water uses, including ecological values, so individual irrigators can get the best from their allocation.

## Cleaning up freshwater

What attracts visitors to our country in their thousands?

In large part, it's our mountains, lakes, rivers, waterfalls, snow, lush green bush, deep fiords, and beaches. Once again, we come back to water – clean and plentiful. That fresh water is vital to our tourism industry, as well as to New Zealanders' way of life.

This year, we celebrated 20 years of continuous water quality monitoring through NIWA's National River Water Quality Network. The work done by NIWA staff collecting and analysing river water samples every month shows that New Zealand has cleaned up 'point source discharge', from factory pipes and the like, but that land-use intensification is adding extra nutrients to our rivers. We use this long-term monitoring in our search for solutions, working hard alongside Dairy NZ and others to demonstrate win:win approaches.

Good water quality and intensive agriculture can go hand in hand, but this requires scientific knowledge and data, significant planning, robust regional rules, strong partnerships with farmers, and central government policy leadership.

## Ocean resources

For too long, humanity has taken ocean productivity for granted. New Zealand is often touted as having one of the best fisheries management regimes in the world. That regime needs good science, and NIWA is by far the largest provider of this science. We have the smartest, best equipped, and most experienced fisheries research team in the country, working closely with the Ministry of Fisheries and the seafood industry.

But ocean resources are about more than just fish. New Zealand's exclusive economic zone, at over 4 million square kilometres, is about 15 times its land mass. NIWA has been collaborating closely with many partners, including LINZ, GNS Science, and the Royal New Zealand Navy, to understand more about this vast marine estate. And understand it we must, if we are to reap greater economic benefit in a sustainable way.

This year alone, NIWA registered 16 472 new samples in our marine invertebrate database, primarily from Ocean Survey 20/20 projects, exploration of seamounts, and fisheries survey work.

## Sustainable food

New Zealand has built its economy on world-leading farming practices. Now, NIWA is developing exciting world firsts in the farming of finfish. With growing global demand for protein, there is great economic opportunity in farming high-value finfish in an environmentally responsible manner. That takes diligent and intelligent commercially-oriented research.

NIWA's work with our industry partners means fully commercial marine farming of kingfish is now possible, with proper (hapuka) not too far behind. Finfish aquaculture could economically transform the seafood sector, provided the appropriate sea space is made available in a timely manner.

# CHAIRMAN & CEO

## Managing through the recession

NIWA felt the brunt of the recession early this year as our customers cut back to manage their own way through the downturn.

Given the circumstances, however, we returned a pleasing result. NIWA remains a profitable company delivering great value to its shareholders and therefore to the public of New Zealand.

We are extremely proud of the effort from our staff to maintain revenue at similar levels to last year despite a slow start. We kept tight control of costs, made efficiencies in our operations, and focused on delivering our customers' requirements in full and on time.

We are budgeting for another solid financial result in 2009–10. That said, we are running a very lean ship and we recognise this is putting extra pressure on staff. We are thrilled with the way they have responded, getting value out of every dollar in tight budgets. In NIWA today there is a stronger emphasis than ever on re-thinking the way we do things, implementing best practice, and taking opportunities to improve performance.

## An eye to the future

Whilst being very conscious of the need to carefully manage resources, we are keeping our eye on the long-term by ensuring the company is well equipped for the future.

Our strategy requires:

- Staff with appropriate skills and expertise, and a human resources strategy which develops and rewards them and keeps them safe
- State-of-the-art facilities, including appropriately located offices, laboratories, resources, and infrastructure
- Comprehensive and robust environmental monitoring networks
- A unique fleet of some 30 vessels to explore our oceans, estuaries, rivers, and lakes; and suitably rugged land-based vehicles for reaching remote parts of the nation

- IT that supports one of the world's leading knowledge-based companies
- The ability to share our scientific knowledge through effective communications

In 2009–10 we expect research revenue to increase slightly, and revenue from applied science services to remain level as some customers put projects on hold. But while there is a temporary flattening in demand, the important environmental issues remain. We are predicting that demand for NIWA's research and applied science services will double within a decade, requiring significant increases in the number of skilled staff we need to employ. That is an immense challenge in a world that, notwithstanding the current recession, will be hungry for the high quality environmental science skills and capability that NIWA has.

We will, therefore, continue to retrain and upskill staff where appropriate. Alongside this, we are improving the efficiency and effectiveness of our support services and processes so that science staff do less administration and have more time available for delivering science.

We are using the strength of our balance sheet to invest for the future, too. This year saw us halfway through a three-year \$60 million capital expenditure programme. We made a \$15 million commitment to oceans research through the purchase of a highly-advanced (DP2) dynamic positioning system for RV *Tangaroa* which will be installed progressively over the next 18 months. This will ensure that *Tangaroa* continues to be the best equipped research vessel in New Zealand.

We have also decided to replace our Cray T3E supercomputer with an IBM Power 575 supercomputer at a cost of \$12.7 million. This increases 100-fold our current supercomputing capability. It will, for instance, provide computational power for NIWA's world-class environmental forecasting system EcoConnect, which supplies continually updated forecasts of weather-driven hazards such as flooding, for port companies, regional councils, energy companies, and other customers.

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**\$60 million**  
capital investment in science  
over 3 years

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**2569**  
reports, publications,  
& formal presentations

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**900 000**  
requests for climate  
data processed

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# CHAIRMAN & CEO

In December 2008, we were delighted that Hon Dr Wayne Mapp, Minister of Research, Science and Technology, could open our new Head Office near Auckland's Viaduct Basin. The new premises reflect the professional nature of the research, applied science, and administrative services we strive to deliver to our customers.

## Changes to the NIWA Board

2008–09 saw the most significant changes in our Board composition for some time, with the retirement of Sue Suckling after eight years as Chair of NIWA. It is indicative of Sue's contribution that two of the most significant strategic initiatives in NIWA's history – the decisions to install a dynamic positioning system on RV *Tangaroa* and to replace the supercomputer – were supported by the Board under her leadership.

We also farewelled Dr Graham Hill who has been a major contributor to the governance of NIWA since 2002.


We were pleased when Chris Mace was appointed as our new Chairman from 1 July 2009. Chris is a former Chairman of the Crown Research Institute ESR; former Chairman of the New Zealand Antarctic Institute (now Antarctica New Zealand); founding trustee of the

Sir Peter Blake Trust; founding member of the New Zealand Institute; trustee of the Antarctic Heritage Trust; and supporter of marine science facilities and projects at the University of Auckland and the University of Otago.

We also welcome new director Jason Shoebridge, who comes to the Board with a wealth of commercial expertise.

## Economic & environmental prosperity

As New Zealanders, our fresh water, clean air, wide oceans, and maritime climate are our greatest assets. We want to protect our environment, but we also want economic prosperity. Let's not shy away from the fact that to get the best of both worlds, the government will have to make some tough decisions. These decisions will need to be informed by good science. At NIWA we have bright minds, great facilities, and incredible talent focused on helping to lift economic prosperity by solving some of the most pressing environmental problems of the day. We firmly believe it can be done.



**John Morgan**  
Chief Executive

# 16472

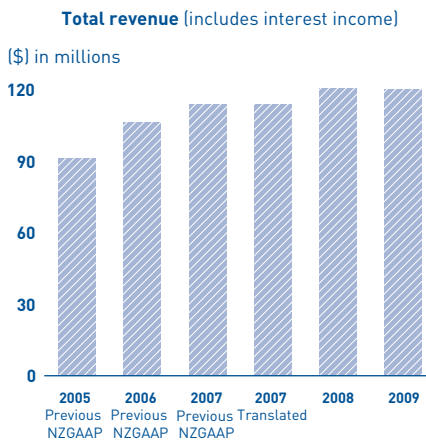
new marine invertebrate samples registered in NIWA's collection

	2009	2008	2007 Translated	2007 Previous NZ GAAP	2006 Previous NZ GAAP	2005 Previous NZ GAAP
	\$'000	\$'000	\$'000	\$'000	\$'000	\$'000
Total revenue (includes interest income)	120,438	120,671	113,911	113,911	106,414	91,137
– Public Good Science	58,883	55,536	53,418	53,418	50,374	43,729
– Ministry of Fisheries	14,121	15,127	17,183	17,183	16,060	16,626
– Commercial and other	47,434	50,008	43,310	43,310	39,980	30,782
Net profit before tax	9,050	14,309	14,279	15,843	15,706	9,654
Net profit after tax	6,011	10,095	9,813	10,461	10,342	6,434
Capital expenditure	21,186	13,985	9,107	9,107	8,480	7,348
Adjusted return on average equity (%)	9.8	17.9	21.2	22.6	24.4	13.5
Return on average equity (%)	7.1	12.8	14.1	22.6	24.4	13.5

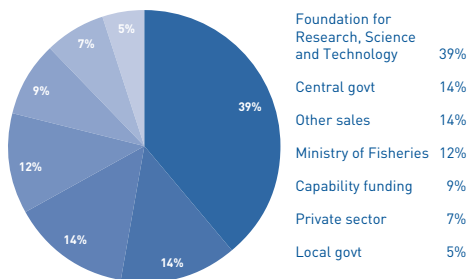
The Group changed its accounting policies on 1 July 2006 to comply with New Zealand International Financial Reporting Standards. The transition required the statement of comprehensive income to be translated for the year ended 30 June 2007 as shown above. The 'adjusted return on average equity' uses a valuation basis comparable with other Crown Research Institutes.

# “We are weathering this financial storm well”

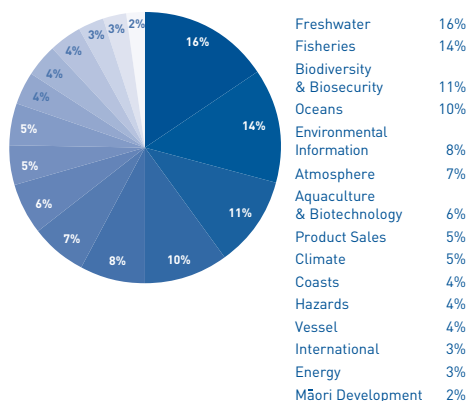
Kate Thomson, Chief Financial Officer



## Revenue by source



## Revenue by national centre



## Highlights

NIWA’s 2008–09 results are remarkably good. Despite the global economic recession, our achievements include:

- Stable revenue at \$120 million (including interest income)
- Operational expenditure trimmed to \$111 million, against budget of \$115 million
- Net profit after tax of \$6 million
- Dividend paid of \$5.6 million

The Group did not meet its budget targets in 2008–09, notably our budgeted revenue, which we had set at an ambitious \$125.6 million. This was mainly due to the cancellation or deferment of three vessel charters, and it was a significant achievement to roughly match last year’s revenue in such tough times.

We are doing well at gaining research and consultancy contracts in an extremely competitive environment, and at managing our cost structure, which is not particularly elastic. The reality is that half our costs are in staff and, as a knowledge-based company, our people also drive our revenue. As a result, many costs continue even if we have fewer contracts. Similarly, the company’s large capital expenditure programme increases our depreciation costs and it also represents investment in scientific capability intended to position us well for the eventual upturn. This combination of the nature of NIWA’s business, our future-focused capital spend, and a tough external environment means that the coming financial year (2009–10) will be challenging.

NIWA is weathering the global financial storm well. We will continue to maintain tight fiscal discipline and focus on delivering projects to our customers’ specifications, on time, and within budget, to ensure NIWA remains the country’s most successful Crown Research Institute.

Kate Thomson, Chief Financial Officer

## Revenue

NIWA managed to hold its revenue roughly stable in the face of global economic recession. In 2008–09, NIWA’s total revenue was \$120.4 million. This was slightly less than the previous year (2008: \$120.7 million), and down on budgeted revenue of \$125.6 million.

The proportion of NIWA’s revenue from its main sources remains reasonably stable. Science staff had a remarkably successful year in winning public good science funding, with revenue rising from \$55.5 million in 2007–08 to \$58.9 million in 2008–09. Overall, this represented 49% of NIWA’s revenue in 2008–09. This is comprised of contestable research funding from the Foundation for Research, Science and Technology (39%; \$48.3 million) and capability funding from the Ministry of Research, Science and Technology (9%; \$10.5 million).

NIWA’s second largest single source of revenue was contestable fisheries research contracts from the Ministry of Fisheries (12%; \$14.1 million). NIWA lost over \$1 million in revenue from this source in 2008–09, mainly due to the postponement of one vessel charter, now scheduled for 2009–10.

The remainder of NIWA’s revenue (39%; \$47.4 million) largely consisted of commercial consultancy work. Contracts in this area were hard to obtain early in the financial year, but worked picked up as the year progressed. This was partly the result of customers no longer being able to defer essential work, and partly thanks to intensive business development efforts by key staff.

# FINANCIAL SUMMARY

## Expenditure

### Personnel

Staff are fundamental to NIWA's earnings, and represent about 50% of the company's costs. This year, personnel costs rose by \$2.3 million. This reflects increasing average remuneration per staff member, with an average 4% pay rise awarded in the July 2008 salary round combined with the full annual impact of the additional one-off pay rise from December 2007.

### Capital

Last year, NIWA embarked on a three-year \$60 million capital expenditure programme to:

- strengthen infrastructure and equipment to rapidly advance NIWA's science
- improve the work environment and facilities for NIWA staff
- pursue commercialisation opportunities

Despite the recession, the company has continued this investment. Capital expenditure in 2008-09 was \$21.2 million, up from \$14 million in 2007-08 and \$9 million in 2006-07.

With additional multi-million dollar expenditure planned in 2009-10 on a high performance computing facility at NIWA Wellington and a dynamic positioning system for RV *Tangaroa*, this capital investment represents a bold vote of confidence in the future of environmental science in New Zealand.

### Total asset base

Average shareholders' equity at 30 June 2009 totalled \$84.5 million (2008: \$84.2 million).

Total average assets were \$114.6 million at 30 June 2009 (2008: \$109.5 million).

## More information

The audited financial statements of the National Institute of Water & Atmospheric Research Ltd and Group for the financial year ended 30 June 2009 can be found on pp. 32-59 of NIWA's Annual Report 2009, or on-line at [www.niwa.co.nz/pubs/ar](http://www.niwa.co.nz/pubs/ar). This Financial Summary is not part of NIWA's audited accounts.

On 1 July 2006, the Group changed its accounting policies to comply with the New Zealand International Financial Reporting Standards (NZ IFRS). Where applicable, we show the figures for 2006-07 both as originally reported (NZ GAAP) and 'translated' according to the new standards.

## Net surplus

This financial year the NIWA Group achieved a net surplus of \$6.0 million (2008: \$10.1 million) against a budgeted net surplus of \$7.7 million.

The result reflects NIWA's decision to continue to invest for future growth despite tight economic times.

## Dividend

NIWA has a track record of returning healthy dividends to its shareholder (the government of New Zealand) without compromising investment in scientific research.

In 2008-09, NIWA made dividend payments of \$5.6 million. In total, NIWA has paid \$33.9 million in dividends to the Crown over the past five years.

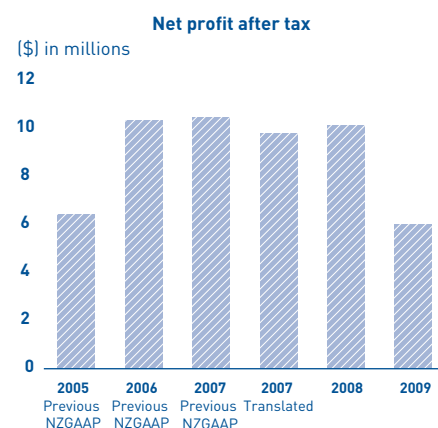
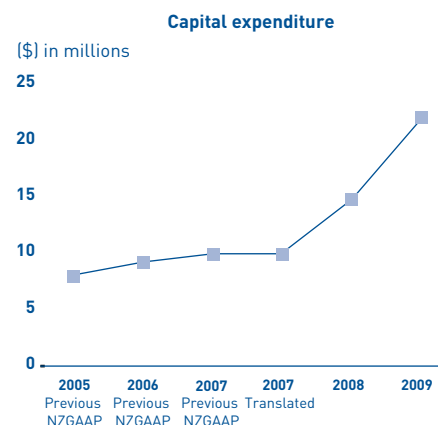
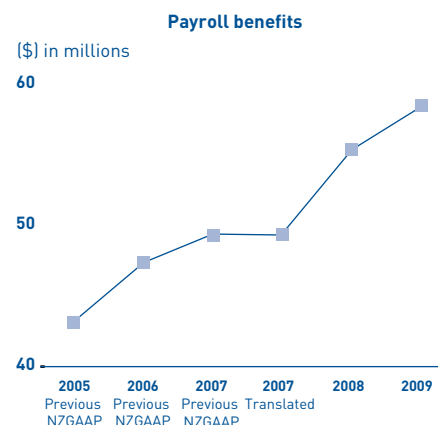
## Profitability

NIWA continues to be a profitable company. In light of our extensive capital expenditure programme, the Group budgeted for a lower than usual return on equity this year. On the basis of comparable valuations with other Crown Research Institutes (CRIs), NIWA's return on equity was 9.8%. Shareholding Ministers expect CRIs to deliver a 9% return on equity as a long-term average.

## Liquidity

NIWA has healthy liquidity, with greater assets than liabilities, in line with budget expectations.

	2008-09	2007-08
Current ratio	1.2	1.5
Quick ratio	1.6	2.1



# “Sustainability is what we do”

Barry Biggs, General Manager – Operations

## How we report on sustainability

The sustainability section of NIWA’s Annual Report is summarised in this Year in Review. It uses guidelines and indicators from the international standard in sustainability reporting, the Global Reporting Initiative [GRI G3], for performance against environmental, economic, labour, and social/cultural indicators.

# 740

number of hours spent video-conferencing this year

# 439

the number of days allocated to personal training leave

Our vision is to conduct leading environmental science. Quite simply, sustainability is what we do. We endeavour to act in an environmentally responsible manner every day.

We are a key provider of advice on sustainability to government agencies, the private sector, and the general public. We arm decision-makers with high quality information in such areas as fish stocks, air pollution, and energy supply. Our environmental information helps individuals and companies throughout New Zealand better manage their businesses and their lives. We work with a wide range of organisations to develop innovative solutions to environmental challenges, such as how to minimise the water quality effects of intensive agriculture.

In our operations, we maintain a careful balance: conducting research to provide much-needed information while minimising our own impact on the environment.

We take our role seriously and will continue to invest in the best technology and scientific minds available so we can continue to provide superior environmental information that leads to sustainable outcomes.

## Environmental

### An ongoing balancing act

We have implemented various initiatives to address our environmental impacts. One area where we have made considerable progress is in the use of solar power and telemetered data loggers at network stations, thereby reducing energy used and our carbon tyre print to collect data.

### Operating responsibly

Energy consumption is our most significant environmental impact. Diesel used to power our fleet of research vessels is the single biggest contributor of greenhouse gas (GHG) emissions. This year we have reduced diesel use from 2.4 million litres to 1.6 million litres. This 33% saving, however, reflects the postponement or cancellation of three vessel charters. We are constraining fuel usage by maintaining the lower cruising speed of our ocean vessels first introduced in 2008.

During the year, we upgraded our video-conferencing system, which reduced the number of flights taken by staff and Board members. We use hybrid vehicles for city-based transport, share vehicles for fieldwork where appropriate, and carefully consider the whole-of-life cost of any vehicle before purchase. We have instituted a clear policy that, where suitable models are available, we prefer hybrid or diesel vehicles over petrol-only vehicles.

We are continuously looking for energy efficiency where this can be done without affecting our ability to deliver robust science to our customers.

## How we will minimise our consumption:

- Improve efficiency by using a minimum of 5% biofuels on our larger ocean-going vessels and continue to research biofuel technology
- Convert some smaller vessels to 4-stroke engines, using only small amounts of petrol
- Provide guidelines for new buildings and renovations, and encourage staff behavioural changes to help reduce energy consumption
- Make better use of initiatives introduced by local industries, councils, and community groups, such as waste recycling.

## Economic

### We arm decision-makers with the information they require

Decision-makers at all levels are seeking pragmatic, evidence-based advice from environmental experts. Across NIWA’s activities, our science provides high quality insights to underpin important decisions and innovative solutions.

As a Crown Research Institute we are required to operate in a financially responsible manner and return a profit to the Crown. Prudent financial management has always been a core focus. Despite the economic downturn, we have maintained revenue and, as a result, we can continue to invest in the people and equipment necessary in order to remain at the forefront of science.

# SUSTAINABILITY SUMMARY

## Exporting scientific solutions

This year we generated \$3.2 million by exporting our science. For example, we provided climate data training in Singapore, developed a sustainable water supply and treatment system for a coastal village in Fiji, and worked with the Cook Islands to monitor offshore water quality on Rarotonga and Aitutaki – a vital project for the islands which rely on tourism and oyster cultivation as their primary source of income.

More information on NIWA's financial performance is in the Financial Summary on the preceding pages of this review.

## Social

### Representing New Zealand on the world stage

Our scientists represent New Zealand on the international stage. Many are leaders in their fields and their research underpins commercial and economic decisions both here and overseas. In addition to definitive scientific outcomes, our scientists enhance New Zealand's global reputation as a hub for leading-edge scientific research. Over time, our challenge is to attract and retain such talent in a very competitive global market.

### Staff retention

NIWA's staff retention rate was especially high this year, with a turnover of only 6.3%, well below the typical average 17–20% for New Zealand organisations in general. Key staff, including senior scientists, had a 0.6% turnover.

NIWA strongly believes staff should have a balanced life combining work and outside activities. We have a strong Family and Work policy as well as training, staff individual development plans, and personal development opportunities.

In our 2008 staff engagement survey, 76% of staff saw themselves working for NIWA in 12 months' time. Our target is to have 70% of staff planning to be working for us in three years' time.

## Cultural

The natural environment, which is the focus of our research and development, is of immense significance to Māori. We place high priority on developing and maintaining effective long-term relationships with iwi, hapū, and other Māori organisations throughout the country.

### Making Māori perspectives heard

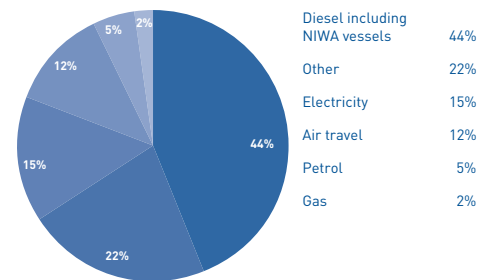
Our long-term relationships with Māori are managed through our National Centre of Māori Environmental Research, Te Kūwaha o Taihoronukurangi. Twelve of NIWA's Māori staff are dedicated to Te Kūwaha. The centre's overarching goal is to unlock the innovation potential of Māori knowledge, resources, and people to assist New Zealanders to create a better future.

For Te Kūwaha, its key challenge is continuing to improve the way we carry out our work, including formalising relationships with Māori and representative organisations within an increasingly complex context of sustainability.

### Significant research projects included:

- Two Te Kūwaha staff were hosted by the BC Centre for Aquatic Health Sciences (Vancouver Island, Canada) as part of the Building Aquatic Science Capacity in Aboriginal Communities project.
- Te Kūwaha, in partnership with Ngāti Rongomai and GNS Science, concluded a three-year study investigating natural hazard planning issues facing Māori communities.
- The Te Wai Māori funded tuna survey of the Lake Omapere and Utakura River catchment was completed with the assistance of the Lake Omapere Trust and Ngāpuhi Fisheries Limited.

NIWA's GHG emissions profile 2008–09



Note: 'Other' GHG emissions include freight and couriers, employee commuting, solid waste, and supply chain.

# 21%

reduction in number of injuries compared with previous year

NIWA's full sustainability report, and supplementary material including GRI G3 indicators, can be found at [www.niwa.co.nz/pubs/ar](http://www.niwa.co.nz/pubs/ar)





# “With good science, we can build a sustainable, billion-dollar industry”

Andrew Forsythe, Chief Scientist – Aquaculture & Biotechnology



# AQUACULTURE

## Industry on track to reach billion target

New Zealand is on track to achieve its 2025 target of a one billion dollar aquaculture industry. Caged rearing of two key species, kingfish and hapuka, will deliver the “lion’s share” of the growth in the value of the industry, says Andrew Forsythe, Chief Scientist–Aquaculture & Biotechnology.

“Reaching that billion dollar industry, by adding these two, high-value finfish, is realistic. My confidence is based on our research and the historic growth of finfish industries in other developed economies.”

Finfish cultivation is a “great fit” with leading developments in New Zealand premium products that meet consumers’ expectations for attractive, delicious, wholesome food, he says. “First and foremost, people buy with their eyes and their mouths – the fish has to look and taste good. Wholesomeness must be a given. Consumers also want to know it’s produced in a socially and environmentally sustainable manner, so all aspects of production have to be transparent and verifiable. If we get established with all those elements in place, our market position will be unassailable.”

NIWA is working to commercialise these high value opportunities appropriately.

### **Finfish successes: hapuka and kingfish**

This year, NIWA exceeded its hapuka juvenile production target thanks to hatchery advancements and the work of our biotechnology team improving understanding of fish health management. This success enabled advancement of performance trials.

Meanwhile, kingfish farming is poised for commercial uptake. NIWA has proven juvenile production capacity for several hundred thousand kingfish a year and developed breeding and nutrition programmes to support the industry. This year, NIWA completed comparative kingfish rearing trials in research cages at Mahanga Bay and in tanks at Bream Bay, and quantified the performance advantages of warm northern waters.

### **Nutrition research: largest in Australasia**

In 2009, NIWA commissioned a nutrition trials unit – the largest in Australasia. Nutrition is a dominant factor in the cost of production and in managing the environmental footprint of finfish cultivation. Ingredients, formulation, and management have near-field and far-field effects. Research is focused on food use efficiency and growth for kingfish, hapuka, salmon, and paua, with the aim of optimising production while maintaining or potentially enhancing product quality for the consumer.

### **Elite broodstock**

NIWA is developing elite broodstock through selective breeding for key species hapuka, kingfish, and paua, together with systems for the reliable production of high quality seed. Progress to date includes:

- completing the wild brood collections
- developing microsatellite DNA markers for the three species capable of determining parentage (with AgResearch)
- estimating relatedness among individuals

### **Collaborators**

AgResearch  
Fundacion Senca, Region de Murcia, Spain  
New Zealand King Salmon  
OceaNZ Blue  
Sealord  
University of Auckland  
University of Otago

### **Funders**

Foundation for Research, Science and Technology  
NIWA Capability Fund

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**17.1 million**  
hapuka eggs incubated

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**02**  
sea-cages of hapuka in growth trials – a world first

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**03**  
novel artificial diets tested on butterfish

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**160**  
families of salmon evaluated for performance & genetics

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# “We’re helping reduce greenhouse gas emissions and pollutants”

Dr Murray Poulter, Chief Scientist – Atmosphere



# ATMOSPHERE

## Glacial ice gives up its secrets

Tiny bubbles of air trapped about 12 000 years ago in a Greenland glacier are shedding new light on the risk of man-made global warming triggering massive release of greenhouse gases from natural reservoirs.

NIWA atmospheric scientists have been part of a four-year international research effort which has overcome unprecedented logistical, technical, and analytical challenges to extract and radiocarbon date the ice-age methane.

Scientists are concerned that global warming caused by human activities could lead to the release of methane contained in gas hydrates or clathrates in ocean sediments in quantities exceeding all carbon stored in conventional oil and gas fields.

To evaluate if clathrates pose a future risk, the scientists from New Zealand, the USA, Denmark, Canada, and Australia set out to examine how clathrates reacted to warming in the past. The study was published in the prestigious journal *Science*.

### NIWA lab selected in worldwide search

NIWA scientist Dr Hinrich Schaefer says ice core samples from Greenland and Antarctica show large and rapid variations in atmospheric methane concentrations in response to climate change. The causes of these fluctuations have sparked intense scientific debate.

“One theory is that when it is warmer and wetter, wetlands in the tropics produce more methane. Another theory is that clathrates become unstable with climate change and release large amounts of methane into the atmosphere. We wanted to distinguish between these two possible natural scenarios by dating the trapped gas.”

To extract the samples for each measurement, one metric tonne of glacial ice had to be cut with chainsaws, cleaned, and melted to yield a volume of methane smaller than the size of a sugar cube.

NIWA’s gas laboratory under guidance of Gordon Brailsford and Dr Katja Riedel developed innovative techniques to separate out the less than one millionth part of each sample that constituted methane. The main challenge was to preserve the original carbon-14 content, critical to accurate dating of the gas, throughout the procedures.

Several laboratories worldwide were approached to take on this task, but they all agreed that the NIWA gas laboratory was the most likely to succeed.

### Catastrophe unlikely

As a definitive test of the competing hypotheses, the scientists carbon-dated the minute samples of ice-age methane, using accelerator mass spectrometry of the carbon-14 content. If the methane turned out to be much older than the ice enclosing it, this would show that it was at least partially derived from clathrates, not wetlands.

Dr Schaefer says the research found only minor amounts of “old methane” in the ice.

“In the light of our study, a catastrophic scenario where human-induced global warming destabilises these clathrates and leads to a runaway greenhouse effect appears unlikely.

“But we plan to do more research in Antarctica to address some still unanswered questions.”

### Collaborators

Scripps Institution of Oceanography,  
University of California  
Australian Nuclear Science and  
Technology Organisation  
Department of Geosciences,  
Oregon State University  
School of Earth and Ocean Sciences,  
University of Victoria, Canada

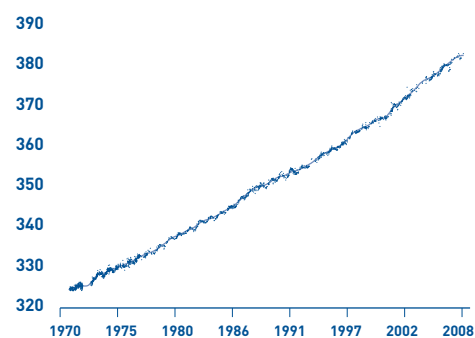
### Funders

Foundation for Research, Science  
and Technology  
US National Science Foundation

# 384 parts per million

CO<sub>2</sub> in atmosphere measured  
by NIWA at Baring Head,  
Wellington

Growth of CO<sub>2</sub> in the atmosphere (ppm)  
at Baring Head, Wellington.



Our measurements are the longest running  
series in the southern hemisphere.

# 35 km

height above ground to which  
our ozonesonde balloons travel,  
measuring ozone above Lauder,  
central Otago

# “We provide the science to sustainably manage ecosystems and deal with aquatic pests”

Dr Don Robertson, Chief Scientist – Aquatic Biodiversity & Biosecurity



# AQUATIC BIODIVERSITY & BIOSECURITY

## Fanworm threat triggers action

The discovery of an invasive marine pest, the giant Mediterranean fanworm (*Sabella spallanzanii*), in Lyttelton Port triggered a five-year, \$3.6 million programme to control the worm and prevent its spread to other New Zealand coastal waters.

MAF Biosecurity New Zealand (MAFBNZ) contracted NIWA to work with a private company, Diving Services New Zealand, on a programme to rid Lyttelton of the pest. The fanworm is one of eight officially designated “unwanted marine organisms”. It was detected last year by a NIWA dive team during routine marine pest surveillance for MAFBNZ.

NIWA taxonomist Dr Geoff Read identified it as *Sabella spallanzanii*, distinguishing it from New Zealand’s native, tube-dwelling fanworm species.

The flower-like Mediterranean fanworm is a very effective filter feeder, typically found in estuaries or sheltered sites. It grows up to 40 cm tall, carpeting pontoons, piles, hulls, floats, and ropes, as well as spreading across the seabed and crowding out other species. It is highly invasive with no known predators.

NIWA Principal Scientist in marine biosecurity Dr Graeme Inglis says since discovery of the first Mediterranean fanworm last year, divers have removed over 200 specimens from the harbour. Efforts are continuing to reduce the population and ultimately aim to eliminate the fanworm.

### Early detection gives us “a good shot”

“We’re fortunate. New Zealand is one of the few countries in the world to have implemented a surveillance programme for marine pests, and it’s working,” says Dr Inglis.

“This fanworm was one of the unwanted species targeted by the programme. The Lyttelton population was detected while it was still very small and localised. This gives us a good shot at removing it before it can become firmly established in New Zealand.”

As part of MAFBNZ’s incursion response to the fanworm, NIWA is providing technical and scientific support. This includes ongoing surveillance to direct commercial divers to areas in the harbour where the organism is most likely to be found. The effectiveness of the elimination programme is being evaluated using data collection and statistical approaches.

Divers are undertaking systematic searches of port structures, boats, and the seabed every three months, and removing any specimens. This may continue for up to two years.

### Monitoring juveniles

NIWA is also monitoring whether the fanworm is reproducing by deploying settlement panels and collection devices for larvae to attach to, which are inspected every eight weeks.

“This provides another way to measure whether the worm population is successfully reproducing because it allows us to pick up juveniles that might not be visible to the divers,” says Dr Inglis.

MAFBNZ fanworm programme manager Dr Peter Stratford says the elimination programme’s success relies on the support of many groups and agencies associated with the port, and to date the programme has been a good example of the effectiveness of such collaboration.

### Collaborators

Diving Services New Zealand

### Funders

MAF Biosecurity NZ

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# 59

new species identified from NIWA’s marine invertebrate collection this year

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# 28

specimens unique to the world held only in the NIWA marine invertebrate collection

---

# 2217

requests for freshwater fish data

---

# 4035

baited traps retrieved in port surveys to inventory fish, crabs, and other mobile invertebrates over past six years

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# “We’re helping build resilience to climate extremes and change”

Dr David Wratt, Chief Scientist – Climate



# CLIMATE

## Working with farmers

At first glance it might seem reasonable to assume that frost risk will decline as global climate change occurs. Despite this, some agricultural regions have experienced more frost in the last three decades. These findings come from NIWA's latest frost research – one of two very different studies designed to strengthen farmers' resilience to extreme weather and climate change.

The frost trend detection study commissioned by the Ministry of Agriculture and Forestry analysed data from 1972 when temperature data became more comprehensive.

The second project, funded by the Ministry of Agriculture and Forestry Sustainable Farming Fund, and Environment Bay of Plenty, focused on farmer workshops in the Bay of Plenty to examine opportunities and threats related to climate change, and ways of adapting to it.

### Frost risks

The frost research found strong evidence that across the country as a whole frosts decreased in the period, consistent with what one might expect under climate change. But it also found significant regional variation, including more frost in some agricultural regions. Such regional variability is consistent with New Zealand's maritime climate, topography, and the expected effects of natural variability in climate.

Climate Scientist Dr Anthony Clark says "the prospect of fewer frosts is attractive for New Zealand growers and agriculture because of potential reductions in physical impacts and costs of managing frost risk. But this study illustrates that directly applying national and global trends at a local and regional level may not be good practice."

Dr Clark says adaptation to changing climate by modifying frost risk management will need to be carefully targeted to address the drivers and effects of frost in a particular area, as well as the future frequency of frosts, and the specific challenges of a site.

### Bay of Plenty

Working with Dr Gavin Kenny of Earthwise Consulting, NIWA contributed to a series of farmer workshops on climate change and adaptation. Agricultural Climatologist Alan Porteous says dairy farmers in coastal Bay of Plenty are particularly vulnerable to the effects of climate change.

"The workshops were an opportunity to exchange information - for farmers to talk about climate change and ways of adapting to it, and for us to hear about any changes they were experiencing and their concerns."

The workshops highlighted that farmers are already observing changes in rainfall patterns, lack of frosts, and increased prevalence of plant and insect pests. A range of management responses emerged, including investment in irrigation, biological and organic farming, and grazing to manage sub-tropical grasses.

Farmers believed any adaptations to climate change should balance sustainability and profitability, with incentives for change rather than more regulation and costs. The project made a number of key recommendations to support adaptation of dairy farming in the region, and results from the workshops were collated into a fact sheet distributed to local farmers.

### Collaborators

Earthwise Consulting

### Funders

MAF Sustainable Farming Fund  
Environment Bay of Plenty

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# 16617mm

most rain recorded in a calendar year (Cropp River, near Hokitika, 1998)

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# 71 days

longest period recorded without rain (Wai-iti, Marlborough, from 8 February 1939)

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# 42.4°C

highest NZ temperature (Rangiora, 7 February 1973)

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# -26.6°C

lowest NZ temperature (Ophir, 3 July 1995)

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“Our extensive coastal zone is one of our greatest assets ... and one of our most vulnerable”

Dr Clive Howard-Williams, Chief Scientist – Coasts



# COASTS

## Shellfish vital in a healthy estuary

Healthy shellfish beds are not only an important, traditional food source, they play a vital role in maintaining the quality and biodiversity of estuarine and coastal environments.

Marine ecologist Dr Drew Lohrer says bivalves, such as mussels, cockles, oysters, scallops, and pipi, are not simply a rich food source, they contribute many important "services".

"If we lose our shellfish resources, we won't just lose a good feed every now and again, we will fundamentally shift the way our seafloor looks and functions, and there could be significant changes to the waters of our coasts and estuaries as well," he says.

### Filter-feeders matter

Many of New Zealand's large shellfish are filter-feeders, slurping water into their shells and filtering out any nutritive particles floating in it.

"Because shellfish can occur at very high densities, they can collectively filter vast quantities of water and significantly improve the clarity and the quality of the water," says Dr Lohrer.

Filter-feeders are especially likely to be sensitive to contaminants and increased amounts of sediment in the water.

These factors reduce their feeding rates and their ability to keep the water clear.

Wading shorebirds feed on shellfish, and shellbanks provide nesting sites and high-tide roosts. Shellfish that live further offshore, such as horse mussels (*Atrina zelandica*), also enhance biodiversity, providing settlement sites and hiding places for a variety of organisms including juvenile fish. Dense beds can even modify patterns of water movement, creating turbulence or skimming flows as the tide races past.

### Climate change could affect them

To grow their shells, shellfish secrete calcium carbonate, using carbonate ions present in sea water. But as atmospheric concentrations of carbon dioxide increase, the oceans are becoming more acidic and the concentration of carbonate ions is falling.

"At some point in the future, as soon as 2050 for the Southern Ocean, calcium carbonate levels are expected to be so low that shellfish will have difficulty in making their shells. In fact, the acidity could even begin to dissolve their shells. This could have major implications for Antarctic and eventually temperate food webs."

The range of NIWA's coastal research is wide. NIWA researchers are conducting ocean acidification experiments with Antarctic shellfish species to begin to understand the ramifications of elevated atmospheric carbon dioxide, as well as a number of other projects aimed at better understanding how shellfish contribute to the health of our inshore marine environments.

### Collaborators

University of Waikato  
University of Canterbury  
University of Auckland  
Massey University  
Lincoln University  
Finnish Institute of Marine Research  
Nagasaki University  
Ngāti Whātua O Orakei  
Hauraki Gulf Forum  
Whangarei Harbour Kaitiaki Roopu  
Antarctica New Zealand

### Funders

Foundation for Research, Science and Technology  
Ministry of Fisheries  
Auckland Regional Council  
Northland Regional Council

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# 55 000 km<sup>2</sup>

of coastal marine habitats less than 50 metres deep in New Zealand

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# 209 million tonnes

of sediment wash off New Zealand each year – about 1% of the total input to the world's oceans

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# 40 km/h

speed of the tip of a bull kelp frond as it is whiplashed by a large wave – we use the special techniques developed to calculate this figure to measure movements in buoys and mussel farms

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# “We’re driving research to power New Zealand without costing the Earth”

Dr Murray Poulter, Chief Scientist – Energy



# ENERGY

## World first in bio-oil

Twelve years' research by NIWA's aquatic pollution group has culminated in the world's first large-scale trial of the production of algae bio-oil using wastewater treatment ponds.

The commercial feasibility of producing bio-oil from wastewater algal biomass is being tested at Christchurch's wastewater treatment plant where five hectares of ponds have been converted to high rate algal ponds.

Carbon dioxide from the exhaust of biogas-driven electricity generators is being added to the ponds to enhance wastewater treatment and promote algal growth, a technique pioneered by the NIWA group.

High rate algal ponds are shallow, raceway ponds which are much more cost-effective than energy intensive, mechanical wastewater treatment systems. Gentle mixing with paddlewheels stimulates algal growth and assists with disinfection of the wastewater by sunlight.

### Greater efficiency

These ponds are far more efficient than conventional oxidation ponds, primarily as a result of intense algal photosynthesis, which provides saturated oxygen to drive aerobic treatment, and assimilates wastewater nutrients into algal biomass.

Harvested algal biomass is converted into bio-oil using super critical water reactor technology developed by Christchurch company, Solray Energy. The technology uses heat and pressure to convert biomass sources into crude bio-oil. The trial will determine the energy efficiency and economics of this process at large scale.

Dr Rupert Craggs, NIWA's Group Manager Aquatic Pollution, says there is tremendous potential in the production of biofuels from algae, but it is currently too expensive as a standalone venture.

"By tacking algal biofuel production on to enhanced wastewater treatment, as we are doing, it becomes commercially viable to harvest the algal biomass and to use it to make biofuel."

The opportunity to trial the large-scale construction, operation, and performance of the technologies, and to provide an economic analysis of the complete process pathway, is very exciting, says Dr Craggs.

"We also want to demonstrate that conventional wastewater treatment ponds can be upgraded with low-cost, energy-efficient enhanced ponds, rather than mechanical treatment systems, with the added benefits of biofuel production, nutrient recovery for fertiliser, and greenhouse gas abatement."

### Cost-effective biogas capture

Another key research focus is on capturing methane gas from municipal and farm wastewater solids. NIWA has developed a cost-effective Covered Anaerobic Pond (CAP) to improve digestion of wastewater solids and capture biogas. This has been successfully demonstrated at a 1200 pig-fattening unit in the Waikato. The biogas can be flared to reduce greenhouse gas emissions, to generate electricity or, following purification and compression, to fuel CNG or diesel vehicles.

Dr Craggs says overall annual biogas production from CAPs is similar to that of more expensive, sophisticated waste digesters, and the cover has the additional benefit of providing gas storage. The five-year research programme has led to consultancy projects for communities and dairy and pig farms here and in Australia.

### Collaborators

Solray Energy  
Christchurch City Council

### Funders

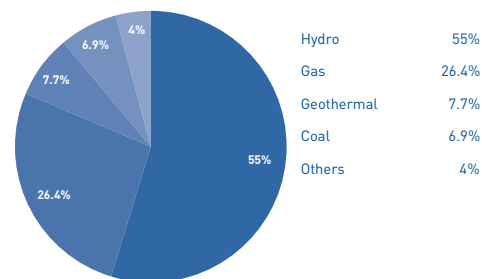
Foundation for Research, Science and Technology

# 40 kilowatts per metre

## typical offshore wave energy along the New Zealand coast

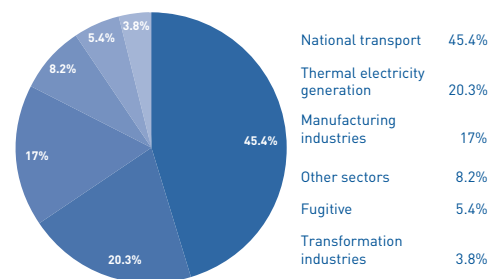
(20 kW/m is considered the minimum for economic viability)

### Shares of net electricity generation



Source: MED 2008

### Shares of CO<sub>2</sub> equivalent emissions by sector



Source: MED 2008

# “No good science – no good fisheries management – end of story!”

Dr John McKoy, Chief Scientist – Fisheries



# FISHERIES

## Sustaining good oyster harvests

The start of the Bluff oyster season in Foveaux Strait makes national news headlines every year, such is the level of interest among oyster lovers. To make sure the iconic oysters continue to tickle our palates, NIWA is working with the fishing industry to better inform management of this valuable resource.

A key focus of the research is the parasite, *Bonamia exitiosa*, which killed an estimated one billion oysters between 2000 and 2002, reducing the average value of the industry from a peak of \$35 million in the 1980s to \$12 million a year.

Coastal fisheries scientist Keith Michael says NIWA has a long history of working closely with all those associated with the oyster fishery, especially the skippers of the eleven vessels which harvest the oysters, and the oyster management group facilitated by the Ministry of Fisheries.

Many of the skippers are linked to local Māori at Awarua Marae, who have customary rights to the oysters and a significant stake in the commercial quota.

### Strong links with skippers

"These links are really important because the success of the oyster fishery management plan depends on good two-way communication," says Mr Michael.

"The skippers have vast experience – they are often second or third, and sometimes fourth generation fishers. We work with them to identify specific management issues and their goals for the fishery. Then we design research to underpin those goals. They all have input and they all benefit from the work we do together."

Although bonamia caused short downturns in the fishery in the 1960s, it has been more destructive since the mid-1980s. To better understand why and to reduce losses from bonamia, NIWA is developing tools to identify very low levels of infection, and to determine whether oysters are infected with other similar organisms.

NIWA is also investigating what drives oyster production. This includes research on oyster biology and ecology, environmental factors, other seafloor organisms, and the response of the oyster fishery to fishing.

As well as stock assessment and bonamia surveys, a number of other key research projects are underway. These include the development and evaluation of new dredge designs and fishing methods, and research into partition of the fishery into spatial-management areas with high and low productivity.

### Science helps efficient harvesting

Building capacity for science within the industry is also an important part of NIWA's role, providing the ability to record information that can be directly applied for better fishing strategies and management.

Two examples are the fishers' logbook and spat monitoring programmes. These provide a complete snapshot of the fishery and some ability to predict where to fish to ensure market demand for Bluff oysters can be met even when there is a disease outbreak.

### Collaborators

Bluff Oyster Management Company  
Ministry of Fisheries  
Seafood Innovations  
Fouveau Strait Dredge Oyster Fisheries  
Plan Advisory Group

### Funders

Bluff Oyster Management Company  
Ministry of Fisheries  
Foundation for Research, Science and  
Technology (Seafood Innovations)

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# 205 823

people interviewed since 2001 to assess the nature and extent of New Zealand's recreational fisheries

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# 202 000

fish and shellfish measured by NIWA in fisheries research surveys this year

---

# 2615km

travelled by a great white shark tagged by NIWA at the Chatham Islands, found off Tonga

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# 01

main nursery for snapper on the west coast of the North Island (Kaipara Harbour)

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# “It’s time to clean up and allocate wisely”

Dr Clive Howard-Williams, Chief Scientist – Freshwater



# FRESHWATER

## Balancing demands for water

Strong competing demand for water, particularly in areas like Canterbury, is driving several of NIWA's freshwater research programmes.

To enable wise allocation of this precious resource, research is focused on better knowledge and prediction of supply, making the best use of available water, predicting impacts, and advising on the bottom lines for sustaining in-stream ecosystems.

### NIWA system forecasts flows

The South Island is known for its hydrological extremes – the West Coast has a peak annual rainfall exceeding 12 000 mm, while to the east annual rainfall drops to less than 600 mm.

Climate change projections indicate that average rainfall may gradually increase in the headwaters of Canterbury rivers in winter and early spring, while river flows in summer may become less reliable even if average annual rainfall is increasing.

To better manage and use fluctuating water supplies in alpine rivers, NIWA scientists have developed a system which forecasts flows, linked to a computer model that simulates irrigation in the plains. Farmers are forewarned of scarce times, enabling them to explore management alternatives.

NIWA Chief Scientist–Freshwater Dr Clive Howard-Williams says it is important to quantify the magnitude and variability of water supplies for sustainable management.

“Competition for water resources among various end-users has triggered our ingenuity. Our water science has thrived and often excelled under such challenging situations,” he says.

### Optimising irrigation

NIWA has worked with farmers and irrigation scheme operators to address the challenges facing canal-based water distribution systems fed from rivers.

An important objective is to improve supply to farms so that more sophisticated on-farm water and feed management systems dependent on reliable supply can be used more widely to boost productivity and environmental performance.

NIWA has developed a simple ‘monitor-match-manage’ tool where irrigation is controlled, based on monitoring by farmers of soil moisture levels, water conserved, and the usefulness of improved irrigation.

The approach demonstrates the benefits of improved on-farm water management. Results show the tool can:

- reduce irrigation frequency by a third compared with supply-controlled irrigation
- reduce irrigation losses to streams and groundwater
- increase security of supply

### Sustaining aquatic ecosystems

One of the biggest challenges for decision-makers when allocating water is maintaining sufficient river flow to sustain aquatic ecosystems.

This requires them to predict the effects of water takes on a particular river, and “flow-response relationships” could be a useful tool for this purpose. But the range of rigorously tested, flow-response relationships is currently quite limited. NIWA scientists are developing new flow-response models using multiple flow components to provide better support for water managers.

### Collaborators

Cawthron Institute  
Tipa and Associates  
Cemagref, France  
Lincoln Ventures  
Waimakariri Irrigation

### Funders

Foundation for Research, Science and Technology  
Environment Canterbury  
Hydropower and irrigation industries  
Fish and Game New Zealand

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## 20 years

continuous monitoring of river water quality by NIWA

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## 84 500

requests processed for data from our Water Resources Archive this year

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## 76%

reduction over 4 years in the amount of sediment suspended in the river on the Whatawhata research property thanks to planting pines, riparian buffers, and livestock changes

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## 50 cubic kilometres

the amount of water stored as ice in New Zealand glaciers

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# “We’re unlocking the innovation potential of Māori”

Dr Charlotte Severne, Chief Scientist – Māori



# TE KŪWAHA O TAIHORO NUKURANGI

## Building resilience

Like many groups in society, Māori vulnerability to natural hazards is the result of complex relationships between humans and the natural elements. Research by Te Kūwaha o Taihoro Nukurangi (NIWA's Māori Environmental Research Centre) has identified barriers to Māori communities' capacity to tackle natural disaster, providing a framework to strengthen community resilience.

Working alongside Ngāti Rongomai, the study examined the issues and challenges facing the hapū (sub-tribe) in relation to natural hazards management and planning. Recommendations from the study provide a basis for addressing the alignment of present hazard and management policy with Māori needs.

Ngāti Rongomai is a central North Island hapū of Ngāti Tūwharetoa, located on the outskirts of Tūrangi on the lower reaches of the Waiotaka River catchment. Hapū members fully participated in the research project, initially proposed by GNS Science and Te Kūwaha o Taihoro Nukurangi, having input into the design and setting of research objectives, process, and outputs.

### Hapū identifies flooding hazard

Participants identified ongoing flooding of the Waiotaka River as the most serious hazard facing Ngāti Rongomai. They attributed this to historical human development in the area, changes in land use, construction of a stopbank, and the spread of willows.

Commenting on the 2004 flood, which left many people stranded at Rongomai marae, one hapū member said: "The saddest thing was the lack of contact by local council authorities."

Interviewees, however, noted that Ngāti Rongomai has a strong social network and that whānau, hapū, and iwi will help each other out.

### Recommendations address barriers

The study makes wide-ranging recommendations to address perceived institutional and socio-cultural barriers in seven key areas:

- resourcing
- local capacity and representation
- participation and governance
- relationships
- information
- clarity, consistency and accountability
- traditional and customary process

Climate research scientist Darren King says while many of the issues are not new, articulation of them in natural hazards planning is an elementary step in helping local authorities and Māori to tackle them.

More training for hazard planners and authorities to better understand the Māori way, together with increased levels of engagement and participation for Māori in local government hazard policy and processes, would greatly improve the design and implementation of hazard plans.

"Perhaps above all else, this study indicates the need for local authorities to form stronger relationships with hapū and iwi to support more effective communication among different agencies and organisations, and to help ensure Māori participate and understand the planning process", says Mr King.

"It's hoped that this report will provide a reasoned basis for bridging the existing gaps and finding the best means of integrating Māori hazard policy and planning in New Zealand."

### Collaborators

GNS Science  
Ngāti Rongomai  
Te Kūwaha

### Funders

Foundation for Research, Science and Technology

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# 12

full-time staff members of Te Kūwaha

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# 85

ongoing working relationships with Māori groups

---

# 40

hui where we presented our research this year

---

# 59

staff attended Māori language and culture noho marae courses

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# “Our science will prevent property damage and save lives”

Dr Murray Poulter, Chief Scientist – Natural Hazards



# NATURAL HAZARDS

## Coping when disaster strikes

When a natural disaster strikes, ongoing operation of infrastructure and essential services is critical to how well a community copes. Using tsunami and flood scenarios in RiskScape, a unique loss-modelling tool developed jointly with GNS Science, NIWA scientists have assessed the exposure of Christchurch City's water supply, sewage, and stormwater systems to these natural hazards.

The project, commissioned by the New Zealand Local Authority Protection Programme, analysed the effects of a 1:100 year tsunami and a 1:200 year flood on the city's pumping stations and pipe network, by overlaying these hazard scenarios with infrastructure and asset data supplied by Christchurch City Council.

### Tsunami & flood vulnerability assessed

The tsunami vulnerability analysis was undertaken using an undersea earthquake scenario with a magnitude of 9.1 which occurred off the coast of Peru in 1868.

It looked at two scenarios – the likely effects of a tsunami at mean sea level, and at a mean high water spring tide.

Although the difference in sea level between the two tides was only 110 centimetres, the potential direct costs of damage to the city's 'water' infrastructure and clean-up costs jumped from an estimated \$250,000 to \$10 million.

This was due to projected higher inundation levels and the location of a treatment plant on the Christchurch estuary. Inclusion of residential and commercial buildings increased the cost of damages to about \$85 million at a mean high water spring tide. A 1:200 year flooding of the Heathcote River cost an estimated \$1.5 million.

RiskScape is a powerful, loss-modelling software package which currently covers five natural hazards: earthquake shaking, volcanic ashfall, tsunami, river flood inundation, and wind storms. Hazard information can be overlaid with data on assets, infrastructure, and demographics to assist users with responsibility for providing effective emergency response, asset, or land-use plans, and to help prioritise resources for risk reduction.

### Glowing international review

In 2008, a panel of international experts evaluated RiskScape. Following the evaluation, the Foundation for Research, Science and Technology awarded funding to RiskScape of \$16 million over eight years to take it to the next stage.

Risk engineer Dr Stefan Reese says RiskScape offers a range of benefits which make it unique. RiskScape:

- is affordable (uses open source software)
- addresses multiple hazards and a range of impacts
- is easy to use
- can be customised

"Because of all these features, the international panel considers RiskScape is of enormous significance to New Zealand."

RiskScape will now be developed to become operational New Zealand-wide. Hazard models will be extended to include climate-change effects, storm surges, landslides, snow, pyroclastic flows, and lahars. It will become capable of evaluating mitigation options.

"This will transform RiskScape from an impact-assessment tool to a true decision-support tool for sound risk management," says Dr Reese.

### Collaborators

GNS Science

### Funders

Foundation for Research, Science and Technology

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# \$73 million

estimated cost of the three worst storms of winter 2008

---

# 3500

vehicles dented by hail in 2008

---

# 25 000+

lightning strikes recorded in the North Island, 18-20 July 2008

---

# \$960,000

total insurance payout for a single tornado, Cambridge, 17 October 2008

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# “Scientific evidence: number one requirement for oceans management”

Dr Charlotte Severne, Chief Scientist – Oceans



# OCEANS

## 'Backscatter' signals reveal undersea mysteries

Scientists worldwide are seeking smarter and more efficient ways to map the geology of the ocean floor and its biological habitats to aid sustainable management of marine resources. A NIWA project in Cook Strait and the southern Kermadec Arc has demonstrated the value of 'backscatter' acoustic signals in recognising the composition of the seafloor geology and identifying the habitats of bottom-dwelling species.

Traditionally, habitat mapping has relied on experts manually identifying and categorising patterns from acoustic images. However, says Dr Geoffroy Lamarche, Principal Scientist in marine geology and geophysics, this is labour intensive and yields largely subjective maps.

"The amount of digital data generated by multibeam echosounders is enormous, calling for innovative automated approaches. There's also an increased need for reliable, quantitative information for resource assessment and to determine potential threats to the environment," he says.

Backscatter signals are collected routinely from multibeam echosounders attached to the hull of a vessel. Although used as a qualitative indication of the nature of the seafloor, and its detailed morphology, backscatter signals tend to be considered merely a by-product of the echosounders.

"Because the substrate is the physical habitat of benthic (bottom-dwelling) species, backscatter data would seem an ideal tool for use in habitat diversity studies," says Dr Lamarche.

### Mapping biodiversity predictions made easier

The NIWA project set out to demonstrate the value of quantitative analyses of the backscatter signals to characterise and map seafloor habitats and biodiversity in environments ranging from shallow continental shelf to deep ocean water depths.

Using multibeam sonar technology, the researchers analysed echosounder data, augmented by extensive geological sampling and seafloor photos, resulting from eight years' Cook Strait research. Together these provided opportunities to "groundtruth" their approach of habitat mapping using multibeam bathymetry and backscatter signals.

For groundtruthing the echosounder data, the team analysed 260 sediment samples collected in Cook Strait.

"We wanted to identify potential relationships between the sediment grain size, expressed as mud, sand, or gravel, with the intensity of the backscatter signal," says Dr Lamarche.

Habitat diversity is a useful measure of species diversity. At the Haungaroa volcano on the southern Kermadec Arc, the team correlated habitat heterogeneity derived from the backscatter map with biodiversity, to produce a map of the submarine volcano biodiversity.

The results, says Dr Lamarche, improve understanding of the degree and form of the relationship between physical variables and the distribution of benthic marine life, providing a simple method to map the predicted biodiversity remotely over large areas of the seafloor.

### A big step forward

Dr Lamarche says the project resulted from a strong collaboration with Dr Xavier Lurton of IFREMER, France, one of the world's leading marine acousticians.

"Their interest was acoustics, ours was geology. Although we did not develop the technique, we worked together to push it one big step further."

### Collaborators

Tasmanian Aquaculture and Fisheries Institute, University of Tasmania  
Acoustics and Seismic Dept, IFREMER, France

### Funders

Foundation for Research, Science and Technology  
Royal Society of New Zealand, International Science and Technology Programme

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# 310 000 km<sup>2</sup>

of New Zealand's seafloor mapped by NIWA since 2001

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# 641

'Argo' ocean-profiling floats deployed from RV *Kaharoa* – a world record for a single ship

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# 2681 m

depth of the deepest canyon in Cook Strait

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# 170+

giant submarine landslides scarring the walls of Cook Strait's canyons

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# “We’re working in partnership with our Pacific neighbours”

Doug Ramsay, Manager – Pacific Rim



# PACIFIC RIM

## Protecting a precious resource

Sustainability of the tourist and aquaculture industries in the Cook Islands is critically dependent on good water quality. Rapid development is putting pressure on the lagoons and reefs which are essential to the health and well-being of local communities and socio-economic development.

NIWA scientists are undertaking a collaborative project with the Ministry of Marine Resources (MMR) in the Cook Islands to monitor offshore water quality on the main islands of Rarotonga and Aitutaki, where tourism is the mainstay of economic activity, and on the islands of Manihiki and Penrhyn, where pearl oyster cultivation is a primary source of income.

### Monitoring network

As well as training MMR staff, the project has improved and extended local initiatives to develop an integrated water quality monitoring network to provide baseline information to MMR and the Ministries of Environment and Health in the Cook Islands. That data will inform future decision-making.

The monitoring network provides early warning of water quality issues that could effect coral reef health. It also enables assessment and monitoring of the potential impacts of new developments such as aquaculture and tourism ventures in the Cook Islands.

A key focus of the project is building the knowledge and skills of MMR staff so that they can sustain the water quality monitoring programme themselves when NIWA's role ends. Water quality scientist Dr Julie Hall says training local people will promote good management of the water quality of the lagoon and assist with evaluations of future developments.

### Lagoon report card developed

A programme of monthly sampling of lagoon waters at 14 sites on Rarotonga and 15 on Aitutaki to measure water temperature, nutrients, chlorophyll a, suspended solids, and bacteria is now well-established.

The monitoring has revealed low levels of indicator bacteria, which indicates good or excellent water quality. However, at all but three sites on Rarotonga and five at Aitutaki, nutrient levels were above those recommended for the protection of coral reefs, and water clarity was poor.

Activities such as pig farming, cutting down trees, and farming of crops close to streams can increase the levels of nutrients in streams flowing into lagoons. Nutrients such as nitrogen and phosphate are found in fertilisers, and in human and animal waste. Higher than recommended nutrient levels may lead to promotion of algal growth and decreased water quality.

Dr Hall says many parts of the community are intensely aware of the importance of good water quality and a number of village initiatives underway to reduce nutrient run-off into streams. MMR recently released a Water Quality Report Card at an island-wide annual lagoon day on Rarotonga to inform the community of the project's findings.

"Knowledge of water quality and whether it is changing is vital if precious marine resources are to be effectively managed," says Dr Hall.

### Collaborators

Ministry of Marine Resources, Cook Islands

### Funders

NZAID

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# \$3.2 million

international consultancy contracts

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# 537

research collaborations with overseas organisations

---

# 80

staff on 110 international committees

---

# 68

international visiting scientists

---





# “No other New Zealand fleet has better survey and research facilities”

Fred Smits, General Manager – Vessel Operations



# RESEARCH VESSELS

## Supporting exploration & discovery

64,350 nautical miles: that's how far our flagship ocean-going research vessels, *Tangaroa* and *Kaharoa* travelled in 2008–09, from the sub-Antarctic to the Bay of Islands and beyond.

These two purpose-built ships provide the platform for New Zealand's ocean research ranging from fisheries assessments to seafloor mapping to mineral exploration to the discovery of new species.

Some of our voyages, especially *Tangaroa*'s trips to Antarctica, are well known. But few people realise that NIWA has a fleet of over 30 vessels. Alongside our flagship ocean-going vessels, we operate Maritime New Zealand certified vessels from 11 bases around the country, and we even use non-motorised craft (kayaks, canoes, and dinghies) to visit remote study sites.

2008–09 was a year of upgrades and additions to the fleet.

### Dynamic positioning for *Tangaroa*

This year we prepared to install a dynamic positioning system in *Tangaroa*, boosting the ship's versatility and maintaining its position as one of the most capable scientific research vessels in the Southern Hemisphere.

The new system will allow *Tangaroa* to stay in one place (within a few metres), or, if required, move unerringly along a path, improving its ability to deploy or operate increasingly-precise scientific, fishing, or mining equipment, such as seabed samplers, soil and rock testing equipment, seabed drill rigs, and remotely operated vehicles.

Ocean researchers and other users of NIWA vessels increasingly want to use equipment that currently cannot be deployed from *Tangaroa* without a dynamic positioning system. There are no New Zealand vessels with such a highly-advanced (DP2) dynamic positioning capability, so the upgrade will significantly advance New Zealand's ocean sciences and boost NIWA's opportunities to support oil, gas, and mineral exploration within New Zealand and further afield.

The new system will also provide *Tangaroa* with an alternative propulsion system, making it safer to operate in high-risk areas such as the Southern Ocean and Antarctica.

### Major investment

While preparation began in 2008–09, installation proper started in August 2009. Then in mid-2010, the vessel will be laid up

for several months, including about four weeks in dry dock. The system will finally be commissioned by 1 October 2010.

The installation of the DP system and associated maintenance and upgrading work on the ship will cost almost \$20 million – making it one of the most significant investments NIWA has ever made in scientific 'hardware'.

The life of a vessel is often determined by its technical obsolescence, and, with the installation of the DP system, *Tangaroa*'s life will be extended to at least 40 years, 10 more than envisaged when it was built in 1991.

### New 14-metre vessel

This year work began on NIWA's new purpose-built high speed coastal research vessel. The yet-to-be-named vessel is being built in Wanganui by Q-West. It will be used for coastal survey work, complementing the work done by *Kaharoa* in biology, ecology, geology, and sedimentology, and enabling more research in shallower waters. When commissioned, it will be based in Wellington, near NIWA's Greta Point campus.

# 30+

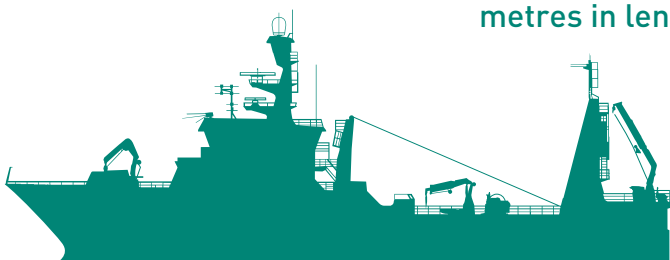
few people realise that NIWA owns a fleet of more than 30 vessels

# 80

about 80 science staff are qualified to operate NIWA's research boats under 7.5 metres in length

# 310 000

square kilometres of NZ's seafloor mapped by *Tangaroa* & *Kaharoa* since 2001



*Tangaroa* (70m)



*Kaharoa* (28m)



New vessel (14m)



*Pelorus* (10.5m)

# “Over 1300 monitoring sites; it’s a huge network”

Michael Bargh, Manager – Environmental Information



# ENVIRONMENTAL MONITORING NETWORKS

## Our unique backbone

Standing knee-deep in a freezing stream to gauge its flow or collect scummy water samples is not glamorous. Yet our long-term monitoring networks and the people who service them are the unsung heroes of environmental science, gauging the health of our rivers, lakes, mountains, oceans, and atmosphere.

### 20 years of water quality data

This year we celebrated two decades of water quality monitoring, helping to care for New Zealand's iconic rivers.

Every month since 1989, NIWA field staff have visited 77 sites on 35 of New Zealand's larger rivers to take measurements and collect samples. This complements monitoring on smaller waterways carried out by regional authorities.

The monitoring shows:

- overall New Zealand's river water quality is in good condition by international standards, especially rivers in native forest and high country areas
- rivers running through pastoral areas are degraded by nutrient enrichment, fine sediment, and faecal contamination

Trend analysis shows that New Zealand rivers get less 'point source' pollution (such as wastewater from towns and industries) than 20 years ago, but nitrogen and phosphorus levels have increased at many sites, mostly due to 'diffuse pollution' from pastoral farming.

### Massive hydrometric upgrade

NIWA operates New Zealand's National Hydrometric Network, comprising over 300 monitoring stations measuring lake levels and river flows around the country. One obvious, critical use of the data is in the energy sector, and 146 of the network stations are co-funded by the hydro-power industry.

In 2008-09, we upgraded over 50 hydrometric sites across the country to improve the robustness and reliability of data collected from them. We replaced ageing equipment, installed back-up data loggers, added telemetry to sites where real-time data are required, and strengthened site structures.

As well as physically upgrading the sites, we are working closely with regional councils to develop quality standards for hydrometric monitoring and data, and to improve staff training.

### Snow & ice network developing

We continue to build our national snow and ice monitoring network, installing three new stations this year. Data from this network, combined with advanced model capabilities, will improve scientific understanding of seasonal snow in New Zealand and help us assess the mass-balance of glaciers in the Southern Alps.

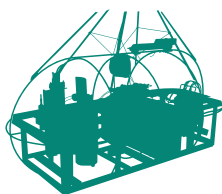
Seven sites are now operational, thanks to concessions from land owners, especially the Department of Conservation. These are providing high quality data on snow depth and snow density, as well as standard climate parameters. Density measurements not only tells us how much water is stored in the snowpack, they have important applications for avalanche forecasting because layers of snow of distinctly different densities can enhance avalanche risk.

In all our networks, we work collaboratively to complement the activities of other agencies. For example, we now have a snow and ice monitoring station at Albert Burn in association with Otago Regional Council, and a station planned for the Brewster Glacier (above Haast Pass Road) will assist university researchers.

# 600+

# million

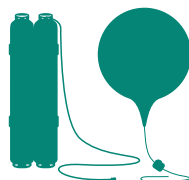
measurements, in our national databases



Undersea camera

# 719

'Argo' ocean-profiling floats deployed by NIWA, and we continue to deploy more



Weather balloon

# 11

field teams across New Zealand



Anemometer



Ocean profiler

# “IT and science together can tackle some of the world’s most challenging problems”

Arian de Wit, General Manager – Information, Systems, & Technology



# IT

## NZ computing takes another leap forward

After several years of planning, our Cray supercomputer is to be replaced by an IBM Power 575 supercomputer, at a cost of \$12.7 million. This represents one of the most significant single investments in science in New Zealand.

Designed to tackle some of the world's most challenging problems in fields such as energy, aerospace, and weather modelling, NIWA's supercomputer will be the most powerful climate research supercomputer in the Southern Hemisphere and the 15th largest in the world. The new supercomputer will have 100 times the computational power and five hundred times the storage of our current machine. It will be capable of performing 33.7 trillion calculations per second, increasing to 65 trillion calculations per second after an upgrade in 2011. That is equivalent to about 5000 laptops working together simultaneously.

The new system is about 100 times faster than the previous system. Model runs that used to take 80 minutes to complete using 40% of the previous supercomputer will now take 8 minutes using just 4% of the new system.

In terms of storage, the two Automatic Tape Libraries can hold the equivalent of more than a million DVDs. This means that if a DVD were written to the tape libraries at the rate of one every minute, it would take more than 2 years before their capacity was exhausted.

### Better hazards forecasting

In the case of hazards forecasting, the bottom line will be more accurate and more reliable forecasts of hazards, especially flooding and storm surge.

Already our world-class environmental forecasting system, EcoConnect, assimilates data from NIWA's extensive environmental monitoring networks. EcoConnect provides continually updated forecasts of weather-driven hazards, suitable for port companies, regional councils, energy companies, and other customers. With the new computing power, we will extend EcoConnect by including data from external sources such as horticultural groups. Such improvements will help us predict future climate in unprecedented detail – for example, for precise geographic areas – and with greater confidence.

### Better scientific modelling

Our climate-chemistry modelling is also set to improve. Gases move between the ocean, the atmosphere, and the land in very complex ways with myriad feedbacks as parts of the system respond to each other. Researchers on such important issues as climate change and ozone depletion need to simulate these interactions in detail. On the new machine, we can run more comprehensive simulations at a better resolution that will span centuries, resulting in much better quality science.

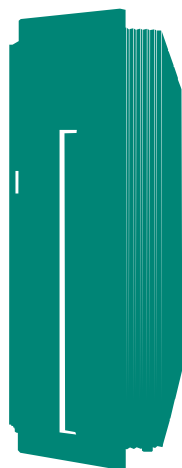
### Innovative cooling system

Our IBM Power 575 will be cooled by an innovative water system, reducing air-conditioning needs by 80%; in turn, reducing typical energy consumption used to cool the data centre by 40%.

Its total electrical load is equivalent to around 250 households (about 500 kilowatts). Three quarters of this is to drive the computer while the remaining quarter is needed to cool it. During winter, we will use sea water to cool the system, saving the equivalent of 50 households of electricity.

# 12.7 million

cost of our new supercomputer – one of the most significant single investments in NZ science



# 33.7 trillion

calculations per second – the supercomputer's initial computational power



# 120 000 million

increase in NIWA's hard disk storage capacity this year – and we're planning the same again next year



# “We’re creating wealth and reducing costs”

Nicholas Bain, Manager – Commercialisation



# COMMERCIALISATION

## Novel solution to lake weed

We are developing a variety of new products and business opportunities based on science and innovation. The ultimate aim is to generate wealth for New Zealand in a sustainable way.

One product we're developing offers a natural solution to a costly environmental problem: aquatic weeds. Introduced freshwater weeds have successfully invaded many New Zealand lakes and waterways, with serious impacts on biodiversity, hydroelectricity generation, water extraction, and amenity values. We estimate this costs New Zealand up to \$40 million per year in economic losses and control.

Current control methods all have specific disadvantages, including high costs, failure to provide long-term control, decreased water quality, and spill-over environmental damage. The search is on for an alternative weed control solution that is safe, natural, effective, and sustainable.

Mycoherbicides offer this solution. These naturally-occurring fungal pathogens are small biological bullets able to destroy target plant populations with minimal or no effects on non-target organisms. They can be incorporated into formulations that are applied in the same manner as a chemical herbicide, but without the downside of environmental contamination, and with the benefit of longer-lasting control.

### Successful NZ-US partnership

NIWA is developing a mycoherbicide from a fungus that occurs naturally in New Zealand. Together with leading US aquatic weed control company SePRO Corporation, we aim to develop a commercial product that is target-specific, biodegradable, and will not leave toxic residues.

SePRO and NIWA are combining their expertise in mycoherbicides to jointly develop the technology. SePRO is a world leader in these products, with technological expertise in developing aquatic herbicide formulations. NIWA has complementary expertise in mycoherbicide development, along with recognised world expertise in the control and management of aquatic plants, and field trial research.

"Partnering with a world-class company puts us in a much stronger position," says Nicholas Bain, NIWA's Commercialisation Manager. "NIWA and SePRO have joined their considerable intellectual property in aquatic weed control to create something entirely new."

While sharing information and expertise, we each retain the right to commercialise our products in our respective countries. NIWA also gains access to international

licensing revenues through the arrangement with SePRO. Some of the financial risk has been alleviated by funding through the New Zealand Government's Pre-Seed Accelerator Fund.

### Progress and long-term benefits

So far, we've developed a New Zealand mycoherbicide formulation which we've proven in the laboratory and are now testing on weed beds in hydro lakes. We have patent applications in the pipeline and are working towards launching a market-ready product in June 2010.

A key outcome sought from this project is the development and transfer of a new technology that can generate significant benefits for New Zealand in the short, medium, and long term.

The main environmental benefit stands to be a reduction in freshwater weed infestation. Potential financial benefits are threefold: reduction in commercial losses from weed infestation, reduction in control costs, and revenue from returns and licensing royalties from mycoherbicide products sold. New Zealand also stands to gain from manufacturing the NIWA product.

# \$40 million

annual cost of lake weeds  
We are commercialising  
a solution



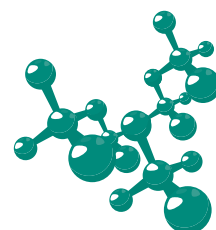
# 09

projects in our  
commercialisation pipeline



# 135

new or improved products,  
processes, and services  
developed this year



# “We have some of the best staff in the world”

John Morgan, Chief Executive



# OUR PEOPLE

## Our greatest asset

**1620**

billable projects on the go

**681**

commissioned reports to users

**349**

peer-reviewed articles



**64350**

nautical miles travelled in  
*Tangaroa & Kaharoa*

**3307**

scientific dives logged

**1165**

people-days at sea on fisheries  
surveys alone



**748**

staff

**52**

PhD & MSc students supervised

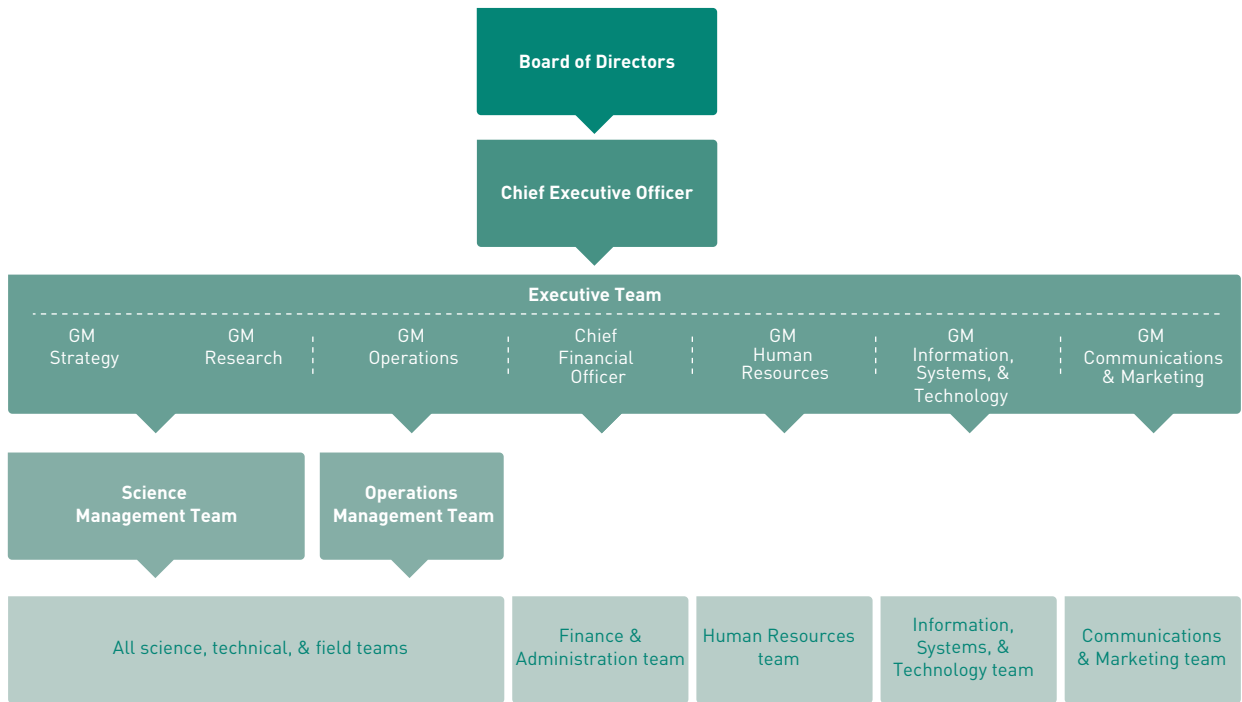
**10**

postdoctorates funded

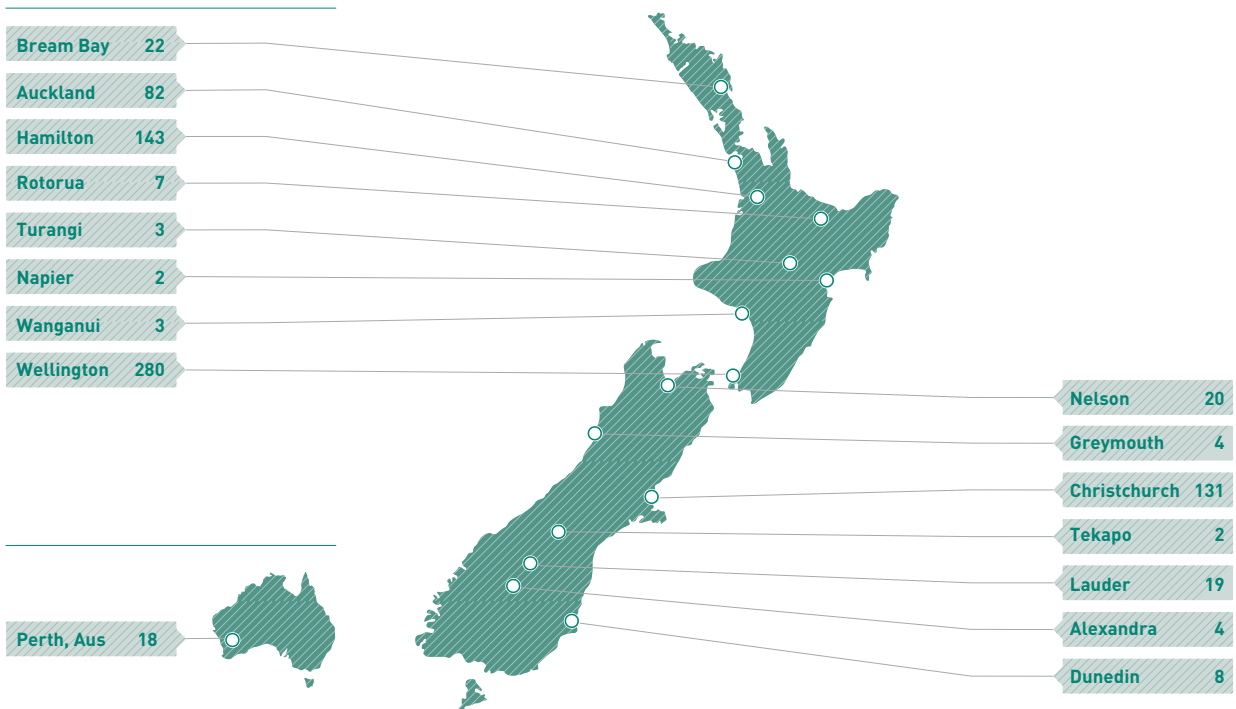


# THE ORGANISATION

## Leading environmental science



As at 30 June 2009 NIWA had 748 staff



# OUR PEOPLE

## Board of Directors

Jason Shoebridge, Wendy Lawson, Craig Ellison, Dennis Cairns, Chris Mace, John Morgan (CEO), Ed Johnson, Helen Robinson



### **Jason Shoebridge**

Jason Shoebridge is an Auckland-based management consultant and chartered accountant, who has led consulting assignments across a range of industries and disciplines in New Zealand and overseas. Jason has had a number of senior commercial and financial management roles internationally in large corporates, as well as with an international chartered accounting firm.

### **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 head of the Department of Geography and Professor at the University of Canterbury, and serves on the Board of the Antarctic Research Centre at Victoria University.

### **Craig Ellison (Deputy Chairman)**

Craig Ellison is a director on several boards, including Airways Corporation of New Zealand, and New Zealand Trade & Enterprise, as well as chairing the New Zealand Seafood Standards Council. Craig was deeply involved in the settlement of Māori commercial fisheries claims and maintains an interest in Māori governance structures and resource management. He currently chairs the joint industry/government Business Capability Partnership.

### **Dennis Cairns**

Dennis Cairns farms a hill property in Southland. He has held management positions in the mercantile and meat industries and currently holds directorships on several private companies. Dennis was Board member and Chair of the Southland District Health Board from 2001 until 2008. He was also an executive member and Chair of DHBNZ before joining the NIWA Board.

### **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.

### **Ed Johnson**

Ed Johnson, FInstD, is Chair of Fulton Hogan Ltd, Goldpine Industries 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.

### **Helen Robinson**

Helen is the founding Chief Executive, TZ1 Registry (now Markit Environmental Registry). 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, Auckland Plus, and MGL Services NZ. She chairs Auckland Metro Project's Innovation Strategy.

# OUR PEOPLE

## Executive Team

John Morgan, Barry Biggs, Bryce Cooper, Kate Thomson, Geoff Baird, Rob Murdoch, Mary-Anne Dehar, Arian de Wit



**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.

**Barry Biggs**  
General Manager, Operations

Barry is an environmental scientist with a PhD in stream ecology from the University of Canterbury. He has worked on the effects of hydropower development on river ecosystems, water allocation, eutrophication of rivers, stream periphyton, and bioinvasions. He was appointed General Manager, Operations in July 2008.

**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 strategic initiatives, including commercialisation of research and building partnerships with central and local government and industry.

**Kate Thomson**  
Chief Financial Officer & Company Secretary

Kate is a chartered accountant with a BCom from the University of Canterbury. An experienced Chief Financial Officer, she held similar roles before joining NIWA in 2006. Kate was previously a policy analyst with the Treasury. Kate is member of the Financial Reporting Standards Board (FRSB).

**Geoff Baird**  
General Manager, Communications & Marketing

Geoff has a BSc (Hons) in ecology from Victoria University of Wellington. He has more than 20 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.

**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 Foundation for Research, Science and Technology, and has overseen the planning and direction of NIWA's science and NIWA Vessel Management Ltd 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.

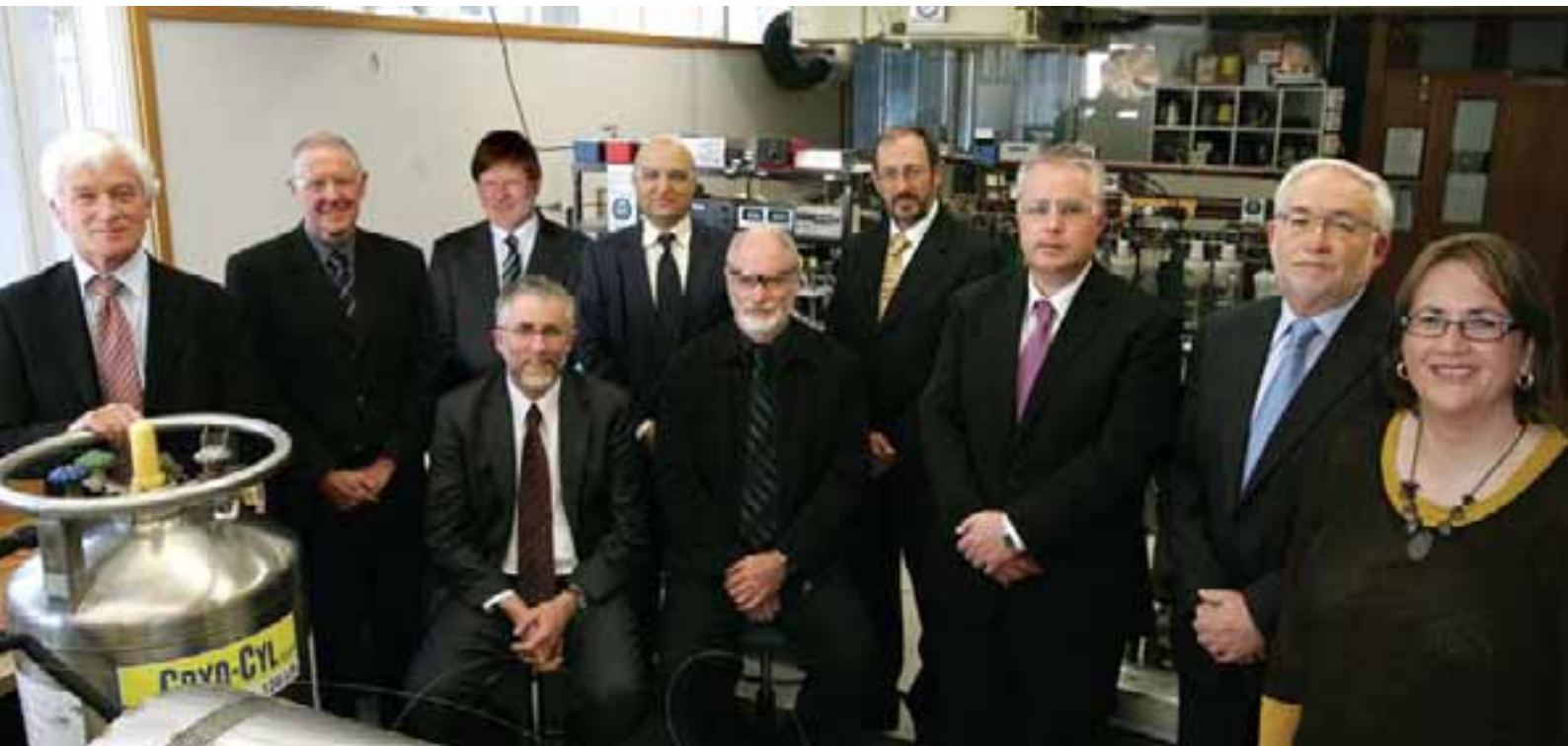
**Arian de Wit**  
General Manager, Information, Systems, & Technology

Arian has an MSc in software engineering from the University of Waikato, and a Postgraduate Diploma in management studies. He joined NIWA in 1995 and became General Manager, Information Systems in 2007. Arian works to ensure that the development of information systems and IT infrastructure supports NIWA's overall strategic direction.

# OUR PEOPLE

## Science Management Team

Murray Poulter, Clive Howard-Williams, Fred Smits, David Wratt, Nicholas Bain, Don Robertson, Andrew Forsythe, Doug Ramsay, John McKoy, Charlotte Severne



### **Don Robertson**

#### **Chief Scientist, Aquatic Biodiversity & Biosecurity**

Don holds a PhD in marine biology from the University of Otago. His research interests have included deepwater fisheries and Antarctic marine resource management. He leads NIWA's marine and freshwater biodiversity and biosecurity research. He is also New Zealand's representative on the Governing Board of the Global Biodiversity Information Facility.

### **Andrew Forsythe**

#### **Chief Scientist, Aquaculture & Biotechnology**

Andrew Forsythe is a veterinarian with a BSc in marine biology from the University of New Brunswick and a DVM from the University of Prince Edward Island. Andrew 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.

### **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 Whakararae 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 mātou nei roopu rangahau pūtaiao Māori e kiia nei ko Te Kūwaha. Nō reira tēnā koutou katoa.

### **David Wratt**

#### **Chief Scientist, Climate**

David has a PhD in atmospheric physics from the University of Canterbury. He has worked in the USA, Australia, and New Zealand on climate and meteorology. He is a Companion of the Royal Society of New Zealand, Chair of the Royal Society's New Zealand Climate Committee, and a member of the Bureau of the Intergovernmental Panel on Climate Change.

### **John McKoy**

#### **Chief Scientist, Fisheries**

John is a marine zoologist with a PhD from Victoria University of Wellington. He has worked in fisheries research in New Zealand since 1973, in MAF, MAF Fisheries, and, since 1995, NIWA. He has experience in crustacean and molluscan aquaculture, fisheries biology, and resource management in New Zealand, Australia, the Middle East, and the Pacific.

### **Murray Poulter**

#### **Chief Scientist, Atmosphere, Natural Hazards, & Energy**

Murray has a PhD in physics from the University of Canterbury 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.

### **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, water plants, and wetlands. 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.

### **Fred Smits**

#### **General Manager, Vessel Operations**

Fred is a geotechnical engineer with a ME from the University of Auckland, as well as two engineering degrees from the Netherlands. He has worked in many countries as a contracts' manager for major onshore and offshore civil engineering projects. Fred joined NIWA in 1994 and has been in charge of NIWA's research vessels, *Tangaroa* and *Kaharoa*, since 2004.

### **Douglas Ramsay**

#### **Manager, Pacific Rim**

Doug has degrees in Civil and Water Engineering, an MBA, is a Chartered Engineer and Fellow of the Royal Geographical Society, and joined NIWA in 2003. Doug coordinates NIWA's international commercial work focusing on the Pacific and Asia regions as well as coastal consultancy work in NIWA's Hamilton office.

### **Nicholas Bain**

#### **Manager, Commercialisation**

Nicholas holds an LLB and an MBA. Prior to joining NIWA in 2004 to establish and manage its commercialisation activities, he had an international career in law and investment banking as well as a three-year stint as an advisor in the Department of the Prime Minister and Cabinet.

# OUR PEOPLE

## Operations Management Team

David Roper, Charles Pearson, Graham Fenwick, Julie Hall, Michael Stobart, Terry Hume, Andrew Laing, Ken Grange, Ken Becker



### **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 29 years, specialising in environmental impact assessment and resource management with NIWA and then ECNZ (later Mighty River Power), before returning to NIWA as Operations Manager in 2002.

### **Charles Pearson, Christchurch & Lauder**

Charles is a hydrologist with 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 an executive member of NZ's Hydrological and Meteorological Societies and is the World Meteorological Organization's Hydrological Adviser for its Asia-Pacific region.

### **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.

### **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 as a scientist with DSIR and then NIWA working in both marine and freshwater research, specialising in phytoplankton and microbial food web studies. Julie is the Chair of the Integrated Marine Biogeochemistry and Ecosystems Research (IMBER) international oceanographic research project. Julie joined the Operations Management Team in July 2008.

### **Michael Stobart, Bream Bay**

Michael has an MSc in ichthyology and fisheries science from Rhodes University in South Africa. He joined the NIWA Operations Management Team in 2007 after gaining 15 years' management and sales experience in commercial aquaculture and agriculture in both Zimbabwe and New Zealand.

### **Terry Hume, Hamilton Assistant RM**

Terry is a marine geologist/coastal oceanographer with a PhD in earth sciences from the University of Waikato. He holds an Hon Assoc. Professorship at the University of Auckland and an Hon Lectureship at the University of Waikato. He has more than 30 years' experience in environmental research and consulting for government departments, local authorities, and private companies.

### **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, in Wellington, before moving to Nelson as Operations Manager in 1994.

### **Ken Becker, Auckland**

Ken is a marine biologist with a BSc (Hons) from the University of Liverpool and a postgraduate diploma in Professional Ethics from the University of Auckland. He spent 24 years as a scientist and project manager with Auckland Regional Council, working on marine ecology and water resource management, before joining NIWA in 2005.

# DIRECTORY

## National Institute of Water & Atmospheric Research Ltd

### Directors

**Christopher Mace** (Chairman)  
(appointed 1 July 2009)

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**Jason Shoebridge** (appointed 1 July 2009)

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**Dr Graham Hill** (resigned 30 June 2009)

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This 'Year in Review' is a companion volume to NIWA's official Annual Report 2009. That report, including full financials and other statutory reporting, is available online at [www.niwa.co.nz/pubs/ar](http://www.niwa.co.nz/pubs/ar) or request a hard copy through [scicomm@niwa.co.nz](mailto:scicomm@niwa.co.nz)

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A photograph of a lush, mossy forest stream. The water flows over large, moss-covered rocks. The surrounding vegetation is dense, featuring many ferns and other green plants. The scene is captured in a natural, slightly overcast light, emphasizing the vibrant greens of the forest.

National Institute of Water & Atmospheric Research Ltd

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