



DISCOVERY

August 2007 ISSUE 17

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ISSN 1175-7329

Viva la collaboration

'Collaborate or die!' was the catch-cry of management guru Dr Tom Peters as business entered the new millennium – a call contradicting the competition and contestability of 1980s economic thinking. Peters perhaps saw the wider impacts of globalisation earlier than most, and the consequent expansion of huge multi-nationals, increased travel and communication, and much greater mobility of top talent.

Partnerships provide access to specialists and information networks, licensing arrangements, and more flexible cost structures. Through collaborations smaller entities can 'punch above their weight' and increase their speed to innovate and adapt.

For Landcare Research effective partnering nationally and internationally is a strategic imperative. New Zealand generates less than 1% of world science. We can only seriously lead in specific niches. Landcare Research strives to be a partner of choice with Government agencies, business and other leading research organisations, extending our core strengths of research, innovation and future-thinking.

Partnerships influence how Landcare Research conducts its science. The ability to partner and collaborate requires shared purpose, mutual commitment and excellent communication. Partnerships require adaptability and new ways of working. Researchers in our Collaborative Learning group are helping us gain a formal understanding of how science partnerships work: how partners build knowledge, develop common frames for research and communication, and recognise the scope and limitations of the partnership.



After more than a decade of high contestability, attention to science investment supporting partnerships and relationships with end-users is welcome. Accordingly we strongly support the move towards negotiated funding and the Foundation for Research, Science and Technology's Outcome-based Investment (OBI) funding for successful science teams.

In this edition of *Discovery* we showcase examples of our partnerships in both the public and private sectors. Some are mature, as in our deer research in the Kaweka Ranges with the Department of Conservation (page 7). Others are at an early stage, such as helping Hawke's Bay business leaders to make the region carbon neutral (page 2) and our work with Southland Ngāi Tahu rūnanga (page 5). We also profile an innovative new project with Ngāi Tahu, Environment Canterbury and Hurunui District Council among others looking at Canterbury's water resource allocation woes (page 4); and partnerships with other Crown Research Institutes: NIWA (page 3) and GNS (page 6).

We are persuaded that more benefit to New Zealand can be achieved through collaborative pathways than by excessive reliance on contestability for relatively short-term projects.

Warren Parker
Chief Executive
Landcare Research





Hawke's Bay positive about carbon neutrality

Landcare Research is helping to 'neutralise' the Hawke's Bay, with a plan to snare a marketing advantage for the region.

Local leaders want Hawke's Bay to become carbon neutral. Landcare Research scientists are preparing a greenhouse gas (GHG) 'balance' showing the region's carbon status. They are also providing a toolkit for the region's major export industry – the wine industry – to become carbon neutral. Then they will draw up an action plan for helping the whole region to do the same.

The project is Hawke's Bay's response to the export threat of 'food miles' and the premiums offered by major UK supermarkets Sainsbury's and Tesco for sustainably produced products.

If carbon neutrality results in product price increases of just 1% for the region's horticultural exports, it will bring an extra \$23 million to the region's coffers per year.

The move to carbon neutrality is being spearheaded by Hawke's Bay Incorporated, the region's economic development, tourism and marketing organisation. Its efforts are backed by the Hawke's Bay

Regional Council, the Hastings District Council, and wine industry players.

Landcare Research senior economist Dr Suzie Greenhalgh is leading the research team working with Hawke's Bay Inc.

'Our regional GHG balance will look at key sectors including energy, waste, agriculture, forestry and industry,' Suzie says. 'There'll be presentations and workshops on carbon neutrality and improving GHG efficiency.'

'Our GHG toolkit for wineries to reduce their emissions will be an abridged version of "Greening the Screen", our step-by-step environmental toolkit for the screen production industry. It will also draw on techniques we developed for the New Zealand Wine Company to certify Grove Mill and Sanctuary - the world's first carbonZero^{Cert}™ certified wines.'

'We are doing case studies on four wineries, and talking with the wider industry to ensure these are representative. The work will be highly applicable to other wineries within Hawke's Bay and throughout New Zealand.'

'Also, if the Hawke's Bay is able to say their wines are carbon neutral across the board, that would be a far larger drawcard than saying any one wine is.'

The last step will be an 'action plan' for the region as a whole, summarising some options for the region to pursue to address climate change

and move towards becoming carbon neutral, if it is not already. The plan will also recommend the best ways to reduce emissions if needed.

Hawke's Bay Incorporated's Chief Executive Tom Hamilton met with the head of brand policy and sustainability and product developers and technologists of leading UK supermarkets in January to discuss the Hawke's Bay's position.

'The executives were pleased with the performance of the Grove Mill and Sanctuary wines. So they said to me, "how about if a whole region's products became carbon neutral?"'

'The Hawke's Bay needs to go down this route because it's competing with high volumes from markets such as Chile and South Africa. If we are carbon neutral we can set a premium price, and keep step with competitors producing goods sustainably.'

'European importers want to know four things. They want to know our products are safe to consume, ethically produced, sustainably produced, and carbon neutral. It's not a marketing ploy, and it's not something that's just going to go away.'

'New Zealand exporters have tended to deny the importance of being carbon neutral. That's why we're working with Landcare Research to achieve this goal.'

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No laughing matter: research clears the air on nitrous oxide

In what is believed to be the first project of its type in the world, Landcare Research and NIWA, with help from Agriculture and Agri-Food Canada, are using a dual approach to measure the potent greenhouse gas nitrous oxide. This is helping researchers to know where to focus mitigation efforts, and whether these efforts are effective.

Nitrous oxide (N₂O), also known as laughing gas, is 310 times more potent than carbon dioxide. It is generated from surplus nitrogen in soils, contributed mainly from grazing animal urine and nitrogen fertilisers. New Zealand's nitrous oxide emissions have increased by about 25% since 1990, so measuring and understanding variance in these emissions are increasingly important.

Landcare Research and NIWA are using a unique 'top down, bottom up' system to measure nitrous oxide outputs on dairy farms around the country (dairy farms produce more nitrous oxide than sheep farms). Landcare Research scientists

are focusing on the 'bottom up' – using chambers placed on the ground to trap and measure emissions from soil. This method works well at a small scale and is useful in analysing processes related to emissions.

NIWA brings expertise in 'top down' measurements – a 'micro-meteorological' approach, where nitrous oxide is measured in atmospheric gas samples at various heights, using a newly developed, customised laser. This method can be applied to a wider scale. The Canadian government department Agriculture and Agri-Food Canada is helping translate the top-down measurements.

Landcare Research scientist Dr Surinder Saggar says knowing this will help in planning mitigation options. He also says that using the two systems at once not only helps researchers compare the accuracy of the methods, but also helps transcend the limitations of each.

'The bottom-up approach requires a large number of chambers to cover a wide area and get a representative estimate. The top-down approach is also limited – for example, it doesn't work for hill country.

'The processes behind nitrous oxide emissions are complex. Irrigation or rain after grazing or fertiliser application can trigger bursts of nitrous oxide emissions. We need to know more about what percentage of nitrogen input into the soil comes out as nitrous oxide. Then we can know more about the impact of variables such as soil moisture, soil type, different grazing

regimes and climatic conditions like temperature and rainfall.

'We can also find out how effective the nitrification inhibitors on the market are proving to be, and where to focus the mitigation strategies.'

NIWA scientist Dr Mike Harvey says the collaboration has been very productive. 'By working together we are all better able to push ahead with the technology and get the most out of the research.'



Mike Harvey

'Bottom up' measurements: Tony Bromley (NIWA) and Jagrati Singh (Landcare Research) help to collect gas samples from chambers.



Surinder Saggar

'Top down' measurements: air is sucked from two heights at high velocity and piped to a laser detector.

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The project team, from left: Mike Kotkamp (NIWA), Elizabeth Pattey (Canada), Ross Martin (NIWA), Surinder Saggar, Rowena Moss (NIWA), Mike Harvey, Jagrati Singh (Landcare Research), and Tony Bromley (NIWA).

Water in Canterbury: Old problems, new solutions

New research on Canterbury's water woes has far-reaching aims: to improve cooperation on water management, and bridge rifts over managing water.

The Foundation for Research, Science and Technology has awarded \$1.8 million in funding over 4 years for a Landcare Research-led project called 'Old problems, new solutions'.

New Zealanders' livelihoods and well-being depends on sustainable use and management of water. Allocation of water resources in New Zealand is undertaken on a 'first-come, first-served' basis. However, this approach was developed in conditions of relative abundance.

Now there is conflict over the allocation of water, and councils find it hard to reconcile individual needs and views and find solutions acceptable to their communities. These issues are always harder when there is scientific uncertainty involved and the individual stakes are very high.

The project looks for new ways of dealing with contentious resource allocation

issues, with an initial focus on Canterbury's water supply worries. Participants include **Te Rūnanga o Ngāi Tahu, Environment Canterbury, Hurunui District Council, Enterprise North Canterbury and Christchurch City Council.**

Landcare Research scientist Dr Bob Frame says traditionally discussion on these resources has been based on multiple single perspectives, which causes confusion and conflict. 'Landcare Research is leading efforts to understand multiple stakeholder perspectives.

'Policy makers have to face complex and difficult questions, for which they need appropriate support. How are they to integrate what hydrologists tell them, for example, with what lawyers, economists and community groups tell them?

'In our project all these perspectives are included, and therefore the science will be much more useable for policy makers.'

Bob says researchers are tackling water supply as a timely case study. 'However, our broad aim is to develop an interdisciplinary approach that we can use for other New Zealand natural resources under stress.'

through viticulture, tourism and increased employment. But this growth is dependent on water.

'The collaboration will bring key stakeholder groups together. It will enhance everyone's understanding of the complex issues surrounding sustainable management of a precious resource.

'It will help council's planning, and will help council support businesses and communities in their own development and planning.'

Te Rūnanga o Ngāi Tahu is leading a segment of the research that focuses on the relevance of traditional Māori knowledge and values. Brett Ellison (Ngāi Tahu) will be studying this.

'I'll be researching the extent to which Māori views and Ngāi Tahu views in particular are heard at a policy level. Māori believe their spiritual and cultural values for water can play an important role in the wider discussion about sustainable water management', Brett says.

'The multi-disciplinary nature of the project will allow a frank and open discussion about these resources, and will encourage communities to work together.'

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Hurunui District Council Chief Executive Paddy Clifford says the project has important implications for his drought-prone district.

'The Hurunui district has the third highest economic growth in the country



Geoff Leeming (flickr.com)

Researchers and tangata whenua investigate river's ills

Landcare Research and Southland Ngāi Tahu representatives are using Western science and Māori monitoring methods to investigate the health of a river and its fish. The results will help the formation of a management plan for part of the river.

The Mataura River is a lifeline to several hapū, and contains prized fish such as kanakana (lampreys), tuna (eels), and toitoi (bullies). Originating in the mountains of Central Otago and flowing past Gore and Mataura townships to Toetoes Bay, its upper reaches are relatively pristine. But tangata whenua are worried about multiple stressors on the river. Research will focus on discharges from the freezing works, fibreboard factory, milk plant and sewage treatment plants that line the middle and lower stretches of the river; and also on stormwater and agricultural runoff.

In collaboration with Te Ao Mārama, a resource management company that looks after the interests of the four Southland rūnanga, researchers from Landcare Research, Ngāi Tahu and HortResearch are studying various sites from the river's source to the sea. Three sites are within a 10-kilometre stretch that receives industrial discharge. The Ministry of Fisheries designated this stretch as New Zealand's first freshwater mātaihai (fishing reserve) under the care of the local Hokonui Rūnanga.

Ngāi Tahu researcher Craig Pauling is using Ngāi Tahu-specific techniques to provide information on the present state of the river. This involves interviews, visual observations and cultural indices, such as the degree of cultural significance of a site.

Meanwhile, HortResearch and Landcare Research scientists will be measuring for the presence of chemical residues in kanakana and tuna caught from the river. Other tuna will be captured from tributaries feeding into the Mataura, and placed in clean water to 'flush out' any contaminants. They will then be placed in cages in the Mataura for 3 to 4 weeks, and analysed for chemical residues.

Landcare Research scientist Dr Jamie Ataria (Rongomaiwahine, Ngāti Kahungunu, Ngāti Tuwharetoa) says the partnerships formed during the project are aiding the research.

'The project had humble beginnings, and the huge amount of donated time, equipment and facilities will help our research to help tangata whenua.'

Rewi Anglem (Ngāi Tahu) is kaiwhakahaere (administrator, manager) for the Hokonui Rūnanga, and is working closely with the researchers. Rewi says although it is early days, he is optimistic about the project's impacts.

'I see it as very positive. It will help tangata whenua formulate a management plan for the mātaihai. We want the river back to the state it was in pre-1870, before humans introduced pollutants.'

Rodney Trainor (Ngāi Tahu) is a technical advisor for the project. Rodney describes the study area as 'one of the worst stretches of river in New Zealand,



■ *Going with the flow: Members of the research team Grant Northcott (HortResearch), Rodney Trainor (tangata whenua) and Louis Tremblay (Landcare Research) discuss their work at a study site on the Mataura River. The Mataura freezing works, which discharges wastewater into the river, is on the opposite bank.*

with almost every possible source of discharge going into it.'

'We eat the fish, but is that safe or not? We've never really known, but we'll start to get a picture after the first sampling is done.'

'The project will have huge advantages for Ngāi Tahu. As well as helping us put our plans in place, it will give us concrete findings to take to our local councils, who will be working in conjunction with us.'

This research is funded by Ngā Pae o Te Māramatanga.

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XN Solutions – excelling in removing nitrogen

A joint initiative is using small agents – woodchips and microbes – to help councils and industry tackle one of our biggest pollution problems.

Increased rural production in the last few decades has seen dramatic increases in nitrogen input into our environment, but there has been little corresponding effort to develop mitigation tools to manage environmental effects.

Even small amounts of nitrogen escaping into waterways can have adverse effects, and Lakes Taupo and Rotorua are dramatic examples. Current treatments generally struggle to remove all nitrogen from wastewaters.

XN Solutions is a joint initiative between GNS, Landcare Research and the University of Waikato. After assessing the waste problem, XN Solutions design and construct denitrification beds. Nitrified water is passed through carbon-based

material (mainly sawdust) and microbes reduce the nitrate to nitrogen gas.

The lifespan of a denitrification bed is about 10 years, and little maintenance is needed.

Project manager Graeme Anderson describes the system as ‘bolt-on’ technology to complement standard systems wherever there is a particular problem with nitrates and minimal budget to alleviate the problem.

A pilot plant is being used in the recent municipal wastewater treatment installation in Taupo’s satellite subdivision of Kinloch, and is showing almost complete removal of nitrogen from wastewater, despite large variations in volumes treated. The Taupo District Council has reproduced the design in the new wastewater treatment plant at Motutere.

XN Solutions is also designing beds for the Thames Coromandel District Council,

to complement wastewater treatment upgrades planned for Whangamata.

Hydroponic greenhouses and dairying operations can also benefit from this relatively simple technology.

‘We are working with New Zealand Hothouses’ large-scale Bombay and Karaka sites, treating waste hydroponic solutions,’ Graeme says.

Taupo District Council engineer Colin Light says the carbon beds show promise for the small communities springing up around Taupo.

‘During the establishment of the first one at Kinloch, we made several adjustments to the engineering and chip size, but we established a design that finally proved to be very effective. It’s quite an achievement to be on the catchment on the lake edge and to be able to say you can remove all the nitrogen.

‘The beds are quite cheap, and if they last 5 to 10 years, they will be very useful.’

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■ Twin denitrification beds near new suburban development at Kinloch. This photo was taken in 2003 when the beds were first installed.

Deer study finds way through forest

The findings of a major report on the consequences of deer control on native mountain beech may help forests recover from natural disturbance, and also help the Department of Conservation and hunters pave a way forward.

Sika deer, which are popular with hunters, make up about 90% of the hunting stock of the Kaweka Ranges, inland between Napier and Taupo. But the Landcare Research report demonstrates that mountain beech seedling growth and mortality are affected both directly and indirectly by deer browsing.

Landcare Research was contracted by DOC to help estimate the impact of deer control options on mountain beech in Kaweka Forest Park. Storms and insect attacks have damaged mountain beech trees, and parts of the forest were opened up and have not been regenerating well.

The project is believed to be the most intensive of its kind ever carried out in New Zealand. Data used in the final report were meticulously collected by DOC staff over 7 years, and analysed and interpreted by a Landcare Research team: Drs Rob Allen, Sarah Richardson and Wendy Ruscoe, and Dr Richard Duncan of Lincoln University.

Wendy Ruscoe says about 16% of the mountain beech forest is in an open canopy state (the norm in New Zealand beech forest is 8%). Only about 5% of the beech forest has enough saplings above deer browse height to allow future canopy formation.

'Saplings need to be taller than about 1.35 metres so deer can't chomp the tops off

them, and stunt them into bonsai trees,' Wendy says.

The research team used statistical and predictive modelling to analyse the effects of deer control options on the forest in an open canopy state. Mountain beech recovered most quickly when deer were fenced out entirely; most slowly under recreational hunting alone; and in between with aerial hunting.

'If deer are fenced out of the forest, the percentage of damaged open forest will on average drop to 8% in 100 years. Under aerial shooting, it will stay relatively constant at about 15%. With recreational shooting alone, our best models show this figure could be 25% in 100 years.

'So although 16% open canopy may not sound like much now, as mature trees die, and if nothing is done to control deer, the consequences could be severe. 'As well as the obvious impacts on beech forest and native biodiversity, an increase in open forest will encourage weeds, and will lead to a reduction in carbon storage.'

DOC has the dual goals of protecting the forest and providing a quality experience for hunters. DOC's Hawke's Bay Area Manager Ken Hunt says the research is widely recognised as one of the longest, most intensively researched deer control projects ever.

'Landcare Research's analyses of our raw data are an important source of information on which to base the ongoing discussions DOC has with hunter liaison groups.

'The fact that DOC and hunters can find common ground in Landcare Research's work speaks volumes for the careful and rigorous way the analyses were prepared and presented.'

The full report, *Consequences of deer control for Kaweka mountain beech forest dynamics*, is available online:

<http://www.doc.govt.nz/templates/MultiPageDocumentTOC.aspx?id=42618>



'Bonsai beech' – beech trees stunted by deer browsing. Some of these are up to 50 years old.



Landcare Research's Dr Rob Allen inspects a regenerating sapling inside a deer enclosure.

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'Broadband on steroids' is fast track to collaboration

Landcare Research has teamed up with GNS Science to ride the information superhighway.

Landcare Research is one of the 18 New Zealand academic and research institutes to use KAREN, the Kiwi Advanced Research and Education Network. KAREN provides high-capacity, ultra-high-speed connectivity between these institutes and with others around the world.

KAREN has made it possible for the two Crown Research Institutes to combine their huge spatial datasets on New Zealand and its living environment. Landcare Research has information describing the natural landscape and the top few metres of soil. GNS has data from deeper underground describing the behaviour of our land mass and its surrounding continental shelf, and information on natural hazards.

Landcare Research scientist Robert Gibb says bringing the information together has multiple benefits for each CRI and their customers.

'KAREN is broadband on steroids,' says Robert. 'By collaborating on this project, we are jointly embarking on a technological learning path, and will benefit from each other's different experiences and perspectives as we implement the new technology.'

Robert says KAREN is paving the way towards managing the computing architecture for the next generation of landscape models and the massive amounts of data available. 'The World Wide Web and web browsers gave impetus to the current centralisation of computing resources and shared data.

'In our use of Google, instead of the Yellow Pages, TradeMe instead of classified ads or Google Earth instead of an atlas, we have subconsciously changed to using national or even global shared datasets and distributed computing systems instead of local desktop or bookshelf datasets.

The KAREN network is over a thousand times faster than broadband Internet, and will dramatically change the way

environmental scientists think about using their computers.

'So just as broadband allows people to share digital holiday photographs with friends, KAREN will make it possible for environmental scientists to share and combine huge amounts of each other's data. Over the next 18 months, we'll be designing and building the infrastructure for this to happen.'

Robert says KAREN will enable new collaboration both overseas, where such high-speed networks have existed for some years, and elsewhere within New Zealand as government departments, regional and district councils start to connect to the Government's own version of the same high-speed network technology.

This project was funded by Research and Education Advanced Network New Zealand (REANNZ).

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Views of the Motueka Hills, produced by combining three national data sources: a mosaic of satellite images, a digital elevation model and a land use model. KAREN makes it easier for researchers to share large datasets.



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Editor: Tom Fraser
Layout: Cissy Pan
Thanks to: Christine Bezar

Published by: Manaaki Whenua - Landcare Research
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This newsletter is printed with vegetable inks on Ambassador 9 Lives Recycled Satin 150 gsm

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