

## Finding hydro solutions

The summer drought hit farmers hard and that will impact the whole economy. University of Waikato Earth and Ocean Scientist Associate Professor Earl Bardsley says we could better prepare for extreme weather events if we improved storage and distribution of water.

With support from Meridian Energy and the Ministry of Business, Innovation and Employment, one of Dr Bardsley's doctoral students, Varvara Vetrova, is trying to find out the degree to which dry periods in the southern hydro-lakes region can be forecast in advance.

"We're looking at large-scale factors like El Nino and water temperature and pressure variations over the Pacific Ocean," says Dr Bardsley.

"If we can work out how different wind patterns and ocean circulation influence rainfall, we will be able to develop statistical models to predict river inflows to the main hydro-storage lakes in the Waitaki hydro-scheme. We're also studying historical data to run a series of analytical tests over different seasons. Then we'll measure results against existing data in the region."

Another of Dr Bardsley's students is studying ways to store water so river flows can be more consistent season by season. Mohammed Majeed's thesis is simulating the operation of



**WATER WORK:** Associate Professor Earl Bardsley and his PhD students, Mohammed Majeed and Varvara Vetrova, are looking at ways to improve the storage and distribution of water.

a still hypothetical pumped storage scheme in the sparsely-populated Onslow basin near Roxburgh, which could more than double the national hydro storage capacity.

"The idea is that instead of holding back the summer flows in the hydro lakes, the water is released at almost the same rate as it flows in from rivers," says Dr Bardsley.

"That summer river water would be available for irrigation downstream, with the extra summer power generated then used to pump water up from the Clutha River, during high flows, to the Onslow basin. In winter, the water would run back down through the pumps in reverse to generate 1000 MW of electricity."

## From the Vice-Chancellor

The University of Waikato has been a strategic partner of the National Agricultural Fieldays for seven years and once again we welcome this important opportunity to showcase the innovative work we are doing in the agricultural sector to the community, the region and the nation.



**PROFESSOR ROY CRAWFORD**

No other tertiary organisation is as in-tune with the agricultural community and working as hard to provide solutions to the serious issues facing farming in the coming years. Our world-class researchers are among the best in their fields and we lead the way in important agricultural areas such as agribusiness, land ownership, environmental impacts, climate change and soil remediation.

Our staff are recognised internationally for their work and our students provide strong links to the wider agricultural sector in the Waikato.

I hope you enjoy learning how our researchers and students are adding value to land-based industries; we look forward to seeing you at our Fieldays stand.

## Swamp kauri gives up its climate secrets

Swamp kauri from Northland is helping University of Waikato scientists compile a reliable timeline of changes in climate going back millennia.

The kauri – extracted from Northland swamps – is analysed at the University's carbon dating laboratory to determine the amount of Carbon 14 in the atmosphere over the tree's lifespan.

Associate Professor Alan Hogg says the research – being carried out at Waikato University in conjunction with several overseas universities – is providing an indication of the environmental conditions experienced by the trees.

Because kauri can live for 2000 years, they are unique in providing accurate evidence over long periods. The trees have been growing in Northland for more than 60,000 years and provide one of the world's foremost archives of swamp wood. "We can get a picture of what the climate was like 30-40,000 years ago when the world was quite different from today," Dr Hogg says.

The swamp kauri is dug up and cut into slabs, which can then be sent to scientists around the world for analysis. Dr Hogg analyses the amount of Carbon 14 in the samples, which reflect

atmospheric levels at the time of growth. The amount varies in the tree rings because of two influences that have changed our climate in the past – output from the sun and the amount of carbon stored in the Earth's various carbon reservoirs, such as oceans, soil and vegetation.

"The carbon dating work we do is part of a jigsaw with lots of different pieces - this is one small part. When you put all the parts together you get a clear picture of past climates, including rainfall and temperature. You can then understand the natural cycles of climate change, which in turn helps to understand human-induced impacts upon it."

The focus of the research is currently the Younger Dryas period, from about 13,000 to 11,000 years ago, when parts of the northern hemisphere experienced a sudden and dramatic lowering of temperatures. "It's an important period," Dr Hogg says.

"In Iceland, over a 10-year period, the annual temperature dropped 7 degrees celsius. That's very significant and no one knows what mechanism can cause temperatures to change by this amount and this rapidly."



**KAURI SECRETS:** Waikato University researchers stand on an unearthed piece of Northland swamp kauri.

## A bioplastic fantastic

*Any source of plastic that doesn't rely on petroleum but works as well or better has got to be good.*

At the University of Waikato, chemical and biological engineer Dr Johan Verbeek has been leading a project that takes red meat industry by-products and transforms them into useful and non-polluting plastics. The result is Novatein, bioplastic granules that can be modified and optimised to suit a chosen product's attributes.

"For me, the most gratifying thing is being able to use low-value sustainable materials to create a high-value product that breaks down without polluting the environment," says Dr Verbeek. "Novatein granules can be made inexpensively and reformulated depending on the desired properties of the end product."

"We've run a number of product manufacturing trials including weedmat pegs, pots and measuring spoons, and it's even possible for Novatein to be blended with conventional plastics to reduce the petroleum load."

WaikatoLink, the technology transfer office of the University of Waikato, has

been involved with the Novatein project since 2007. WaikatoLink CEO Duncan Mackintosh says convincing the plastics industry and potential technology investors that Novatein has a commercial application has been challenging, particularly in the current economic climate.

"But the many years of hard graft by the research team and investment by the University and WaikatoLink has paid off with the announcement of investment by Wallace Corporation."

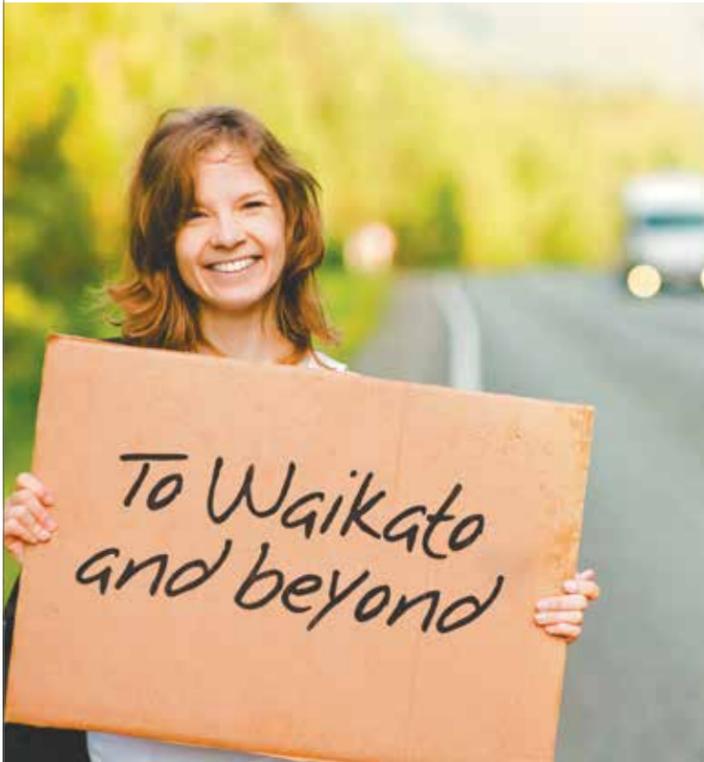
WaikatoLink and the Wallace Corporation have formed Aduro Biopolymers to continue the development of Novatein, aiming to develop and market a range of materials and biopolymers for use in the manufacturing sector.

The Wallace Corporation is by volume New Zealand's largest service rendering business, and Sir James Wallace has joined the Aduro board alongside Wallace CEO Graham Shortland.



**BIOPLASTIC:** Dr Johan Verbeek from the University of Waikato has led a project that turns meat industry by-products into bioplastic.

## agricultural FOR PEOPLE WHO REALLY WANT TO GO PLACES



**IT'S NOT TOO LATE TO START STUDYING IN 2013.  
B SEMESTER AT THE UNIVERSITY OF WAIKATO STARTS JULY.**

Whether you want to begin postgraduate study, start an undergraduate degree or continue working towards a degree you started last year or five years ago, there are plenty of opportunities right on your doorstep.

All of our faculties have papers and programmes that can be started this year, putting you on a path to an internationally-recognised degree at a university rated among the top 2% in the world.

At Waikato University excellence in teaching is driven by our world-changing research and supported by some of the most advanced facilities and equipment in the world. Our postgraduate and higher degree students benefit from academic challenge, professional support and research opportunities that equip them to take on the world – as academics, researchers and business leaders.

### AGRIBUSINESS AT WAIKATO

Agribusiness is one of New Zealand's primary export money earners, so there are clear advantages to studying it at the country's leading business school (Triple Crown accreditation puts the Waikato Management School in the top one per cent of the world's business schools). Learn business practice from the best and gain real-world practical experience in the heart of the agricultural sector.

If science is more your focus, there are many undergraduate and postgraduate options leading to a career in the agricultural sector. We're offering School of Science Masters Research Scholarships eligible to those who enrol for the first time in a Master of Science in B Semester 2013.

Seize the moment. For more information contact us today or drop into the Student Centre on campus – open weekdays until 6pm.

There's no stopping you  
*E kore e taea te aukati i a koe*



THE UNIVERSITY OF  
**WAIKATO**  
Te Whare Wānanga o Waikato

## Fulbright Scholar to take denitrification lessons home

*David Zweig, 22, from Fayetteville, Arkansas could have chosen any country in the world to study in.*

New Zealand ended up getting the nod from the 2013 Fulbright Scholar not because of our landscape, environment or even our relationship with Hobbits. "I don't speak a second language so that cut my choices down," he says.

David is spending 2013 at the University of Waikato studying in the Faculty of Science and Engineering under Professor Louis Schipper.

He is researching the effect of temperature on the efficiency of denitrification bioreactors for agricultural effluent, which is essentially looking at biological methods to decrease the amount of nitrogen entering waterways from farm run-off.

"It's a big issue for New Zealand and the US," David says.

"A lot of nitrogen ends up in waterways and that can cause algal blooms. This project looks at denitrification beds."

The beds help convert the nitrogen into a harmless gas which is released into the atmosphere, rather than into waterways.

David has been in Hamilton since the start of the year and says he's been doing plenty of reading to get up to speed with the work he'll be doing, which includes regular field trips to denitrification beds around the region.

He says it was a long process to get accepted into the Fulbright programme and finally begin his studies. "I spoke to lecturers at the University of Georgia and they had contacts down here and that's how I got in contact with Professor Schipper and that was great.



FULBRIGHT: David Zweig is in New Zealand working at the University of Waikato looking at denitrification beds.

"I had to submit a study proposal and went to an interview. I submitted my application in October 2011 and found out I'd been accepted in May 2012 and now I'm finally here. My family are very proud of me."

His work at the University of Waikato will go towards a Post-graduate Certificate in Earth Sciences but he thinks his future lies in business applications using his science knowledge. "I'm not cut out to be a lab guy but my background in science should help my entrepreneurial side too," he says.

Fulbright New Zealand was established in 1948 to promote mutual understanding through educational and cultural exchanges between New Zealand and the United States.

Fulbright New Zealand offers more than 70 exchange awards each year – half to students and half to scholars – and more than 1600 New Zealanders and 1300 Americans have benefited from a Fulbright award. The programme is mainly funded by the US and New Zealand governments.

## The secrets of honey

University of Waikato PhD student Megan Grainger spends all week in a chemistry lab testing honey samples; commercial product and artificial honey she makes herself. Her aim is to better understand how the dihydroxyacetone (found in flowers) converts to methylglyoxal (bioactive) in mānuka honey. Methylglyoxal (MGO) is the major contributor to antibacterial honey.

"We know that honey undergoes substantial change once it leaves the hive, but for beekeepers we need more detail," says Megan. "Not every honey is the same; we need to understand how time and temperature affect conversion in different honeys and how long the MGO remains before it starts 'falling off'."

The higher the antibacterial activity, the better the price for the beekeeper. "At the moment beekeepers have to pay for regular testing, but if we can come up with a model that will provide accurate information, tell them categorically that their honey will be right at specific time, then they would not have to test their samples as often."

Megan is the recipient of a Claude McCarthy Fellowship which will assist with travel to the University of Montana to work more closely with her external supervisor, University of Montana Professor Emeritus Richard Field – a physical chemist who specialises in nonlinear dynamics. Megan is also the recipient of a Shirtcliffe Fellowship, which aims to assist students of outstanding ability and character who are graduates of a New Zealand university, in the continuation of their doctoral studies.



MĀNUKA: Doctoral student Megan Grainger is looking at the antibacterial properties of honey.

## Impact is no laughing matter

A University of Waikato researcher is studying the impact of nitrous oxide, or laughing gas, on climate change.

Dr Joseph Lane, a computational chemist, believes nitrous oxide has serious consequences when emitted into the atmosphere, and says the gas is now the largest contributor to the ozone hole.

Dr Lane has a \$345,000 Marsden Fast-Start grant to develop a theoretical model that will ascertain how nitrous oxide is broken down in the atmosphere. He'll then use the model to predict the amount of nitrous oxide being released to the atmosphere.

The main contributors of nitrous oxide emissions are agricultural soils, says Dr Lane. "People tend to focus on carbon dioxide emissions when they are thinking about climate change but the reality is that for an agricultural country like New Zealand, methane and nitrous oxide emissions are much more important. We need to be leading the way in terms climate change research for agricultural emissions."

Previous research on nitrous oxide had looked at the gas only as individual molecules, whereas Dr Lane's research will look at nitrous oxide complexes. These complexes were thought

to be formed in the low temperatures of the upper atmosphere and could change our understanding of how the gas affects the atmosphere.

"It may be that nitrous oxide has a shorter lifetime in the atmosphere than previously thought or that we're emitting much more nitrous oxide than we presently think," says Dr Lane.

His work will take three years and include more than a million hours of computer simulations, using the University and National eScience Infrastructure supercomputers.

Dr Lane says the research will lead to a better understanding of important atmospheric matters such as the ozone hole and climate change. "This could lead to changes in land use, particularly in relation to intensification of farming."



DR JOSEPH LANE

## Mapping a future for the region

University of Waikato geographers are pioneering the use of image analysis software to identify indigenous vegetation and wetlands throughout the region.

Dr Lars Brabyn, a senior lecturer in geography at the University of Waikato, is working with the Waikato Regional Council on a project to map the native bush and swamps throughout the region. They are aiming to use image analysis software to do the mapping from high resolution satellite photographs, rather than the painstaking process of a person mapping each image individually.

It would save both time and money to have the images analysed by computer.

Dr Brabyn says the work is aimed at providing the best information possible on land cover throughout the region.

"The regional council is working with farmers and they need good information," he says.

"It's about producing quality information so good decisions can be made."

The highly detailed information would also be helpful for landowners, Dr Brabyn says.

"They can work out where the indigenous vegetation is and what should be protected, what areas should be fenced."

The regional council collects digital images of the region every five years and Dr Brabyn says improving technology meant more detailed analysis was possible than in the past.

The latest digital images not only capture the visible light bands, red, green and blue, but also non-visible wavelengths, which Dr Brabyn says helps to better identify different types of ground cover.

"What makes it more powerful than normal is using the near infra-red band, which can't be seen with the naked eye, but helps us identify vegetation accurately.

"We're training the computer to identify different types of vegetation."

The images, which are sharp enough to identify individual sheep on farms, can be classified to clearly identify different features of the landscape, including pine plantations, indigenous forests, buildings, pasture and roads.



**IMAGE ANALYSIS:** Software can now identify indigenous vegetation and wetlands throughout the region.

## Global careers – spoilt for choice

University of Waikato Professor of Agribusiness Jacqueline Rowarth says there's huge scope for people looking for rewarding international careers in agriculture and agribusiness – and she's urging school leavers to not just think 'down on the farm'.

Professor Rowarth will be speaking about global careers at the Fieldays Forum on Friday June 14 at Mystery Creek and says Fieldays is the perfect place to "look around" for careers.



**GLOBAL FUTURE:** Professor Jacqueline Rowarth urges people to think agriculture and agribusiness careers.

"Fieldays is where we see innovative agriculture and agribusiness at its best. Consider what the people manning the stands are doing and what it took in terms of education to get there. Certainly there are science and engineering degrees, but there is also food technology, management and business, marketing, public relations, design, agriculture, horticulture and much more to consider - all focussed on New Zealand's greatest industry – primary production."

Knowing about agriculture is a global passport to a career that makes a difference because people want sustainable food production, says Professor Rowarth. "New Zealand shows leadership in developing the science and technology that supports production growth while minimising impact on the environment."

She says another reason to consider a career in agriculture or its associated fields is the good salaries being offered. "The money's good, compared with many other industries, largely because there's a shortage of suitably qualified people in the agriculture-related sectors."

Professor Rowarth says the dairy industry has reported that it needs 1000 tertiary educated people a year to fill growth projections (and replace retiring staff); Australia has calculated that there are six jobs for every graduate; Britain has agriculture in the top five of the 'high employment' degrees.

"So I'm saying look around and see where you can add value, find out where your skills can make a difference, and if it's something you're interested in, then go for it; you'll develop a great career."

## News in brief

### *Agribusiness students at the University of Waikato spent much of their summer break undertaking research.*

Alana Scott and Thomas Macdonald wanted to find out how companies successfully entered the global market. They interviewed industry leaders and analysed the different business strategies companies used. "It is very easy to read success stories," says Jacqueline Rowarth, Professor of Agribusiness and supervisor of the students' research, "but behind every successful business, blood, sweat and tears are apparent. By seeking out the back-stories, the research has shown what works, what doesn't and where the future might lie."

### **Investigating co-operative expansion**

Thomas Macdonald, pictured below, investigated co-operative expansions. "Fonterra's strategy is well-known and involves suppliers in New Zealand that are members of the co-operative, suppliers in Australia that aren't, and factories and cows in China. It also owns over 99% of Soprole in Chile. In contrast, the Dairy Goat Co-operative has fewer members, is returning 1.5-3 times as much per unit of production as Fonterra, and is building supply by increasing shareholders and sourcing product from overseas."

A third model has been used by Ravensdown Fertiliser Co-operative. "They established co-operatives in Australia on a minimal risk basis, but now the large global fertiliser companies are challenging the co-operative position by undercutting. I'm watching developments."



### **Different firms, different strategies**

Alana Scott examined the strategies of three different milk companies. "Moving product overseas is relatively easy," she said, "but achieving the 'added-value' is difficult. Some companies appear to think they are achieving it, but when I look at the returns, the farmers aren't benefiting."

"Milk powder is still the biggest revenue stream for Fonterra, and it is treated as a commodity through the Global Dairy Trade auction," says Alana.

"Tatua does a completely different and valuable job – but comparing the two companies, even though they are both co-operatives, is simplistic. New Zealand needs them both," she says.

"Synlait does things differently again. It's a private company and the major traveller and marketer is Dr John Penno, the CEO. The added-value component is still being developed, and with considerable overseas funding, questions are already being asked about returns to New Zealand."