Landcare Research
Manaaki Whenua

DISCOVERY

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Precision Irrigation – Reducing Our Water Footprint

Cissy Pan

Science is leading the way to more efficient water use

Much has been said about carbon footprints and food miles but is it possible that the concept of water footprints could be the next big test for our agricultural and export industries?

Landcare Research scientist Carolyn Hedley is undertaking research into improved use of irrigation systems with a goal of helping to reduce our water footprint – the total amount of all forms of freshwater use that contribute to the production of goods and services. For example, about 900 litres of water goes into producing 1 kg of grain while 1000 litres of water is used to prepare a litre of milk. A proportion of this water is contributed as irrigation and therefore improving the efficiency of our irrigation systems will reduce our overall water footprint.

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Reputations – Hard Won, Easily Lost

Three recent events will leave an indelible mark on New Zealand's future: the passing of the Emissions Trading Scheme (ETS) legislation; the failure of the American-based Lehman's Bank as well as wider financial turmoil; and the unfortunate saga of toxic Chinese dairy products.

All three directly relate to sustainability. The ETS seeks to mitigate the adverse environmental effects of rising CO_2 concentration in the Earth's atmosphere by enabling carbon to be priced through a market mechanism; the failure in the banking system highlights the importance of appropriate 'checks and balances' through regulation and discipline in capital markets (which is true also for natural resources); and the food-safety scare highlights the utmost importance of credence in supply chains that touch human lives.

All three illustrate the importance of managing capital – whether it be financial, institutional or natural – with integrity and from an intergenerational perspective. And, they vividly highlight the importance of an organisation's brand. Trust breached is extremely difficult and costly to rebuild.

In providing a 'social licence to operate' the New Zealand public entrusts stewardship of much of our terrestrial ecosystems to the care of private property owners, their money to financial institutions, and their safety to manufacturing firms and retailers. These recent events have reminded us that it does not take much to shake public confidence in an organisation – a run on funds can send a finance company to bankruptcy almost overnight; a food scare dries up product sales almost instantly; and persistent breeches of environmental regulations undermine the public's confidence that landowners will act responsibly in the context of 'light' regulations (relative to the EU for example).

These events are timely for Landcare Research because we have been thinking about our reputation and brand. Our latest customer survey revealed that we are well-regarded and respected as a provider of high quality research that makes a difference. However, it also showed we can improve our reputation by building deeper, longer-term partnerships with our key clients. This fits neatly with the work we have recently undertaken with our staff and stakeholders to update our organisational values. To ensure these are meaningful, memorable and motivating we have settled on three: collaboration, clarity and curiosity. Each relates in some way to relationships and the way we work – collaboration requires team work, trust, some 'give and take'; curiosity takes you beyond current knowledge to find new and better ways to manage natural capital and continuously improve as an organisation; and clarity brings sharp definition to the part we play and where we can make the largest impact.

While reputations can be lost through a single event, they take persistent, consistent effort to build over the long-run. It's not surprising then that more than two-thirds of the world's top 100 brands have been around for more than 50 years. So, we at Landcare Research are on a journey to build on our already good name; we value your feedback and support on how we can do this better.

Warren Parker
Chief Executive
Landcare Research

Brief
Russian Prime Minister Vladimir Putin photographed attaching a tracking collar on a tranquilised Siberian tiger. The high-tech device was carefully crafted by the team at Sirtrack, a Landcare Research subsidiary which recently won the Emergent Exporter of The Year at the Hawke's Bay Export Awards.

Moa Research Takes Big Step Forward

The lives of New Zealand's ancient moa are about to be further unravelled, thanks to the financial assistance of a Marsden grant.

Landcare Research scientists Dr Jamie Wood and Dr Janet Wilmshurst, along with Professor Alan Cooper and Trevor Worthy at the University of Adelaide, aim to learn more about diets of moa and other large extinct birds and the effect their snacking had on our ecology.

In a land without large mammals, moa were the largest herbivores in New Zealand until their extinction about 600 years ago. Browsing by birds that weighed up to 240 kg undoubtedly had a significant influence on the ecosystems they inhabited; however, their diets are poorly known.

Examining the contents of moa coprolites (fossilised faeces) is one way to learn more about what they ate, but so far, only five have been investigated. The diets of several other extinct birds also remain unknown, even though these, too, are likely to have had a major impact on the vegetation in their habitats.

Overall, the 3-year study will dramatically improve reconstructions of ancient New Zealand and provide a comparison of the impacts of moa and introduced mammals.

Dr Wood, a promising young scientist surrounded by a very experienced team of colleagues, will examine a large collection of 1500 coprolites from rock shelters across southern New Zealand. This collection includes large coprolites attributed to moa, and many smaller ones whose species of origin are currently unknown.

Dr Wood will extract and analyse DNA to determine which bird species deposited each coprolite. The preserved dung will then be examined for seeds and leaf fragments to see what plants the birds ate. A surprising amount of detail can be gained from this type of analysis, including diet data according to species, ecological zone, sex, and even season. This project will provide an unparalleled view of the interactions between lost birds and the plants they ate.

The team will also study soil from relatively unmodified forests across New Zealand, to examine how forest understorey composition has changed over the last 1000 years (with moa; without large herbivores; and with introduced herbivores).

Total funding: $768,000 over 3 years.

The Marsden Fund supports research excellence in science, technology, engineering and maths, social sciences and the humanities. The Fund's objectives are to:

- Undertake investigator-driven research
- Enhance the research knowledge base in New Zealand
- Contribute to the global advancement of knowledge
- Broaden and deepen the research skill base in New Zealand

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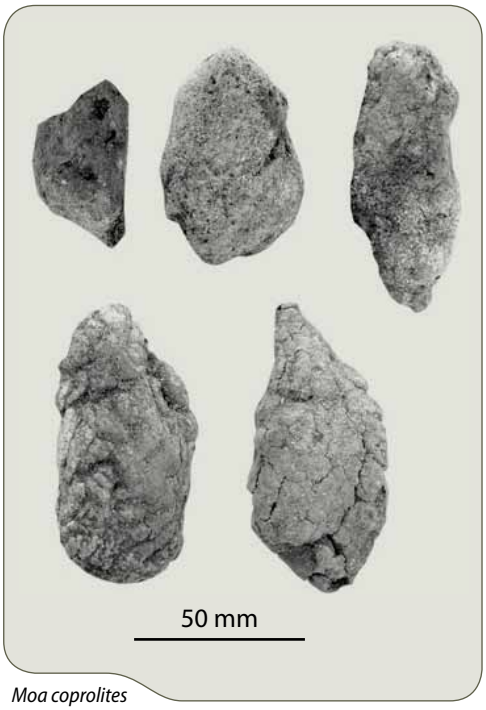
Jamie Woods

A Moa coprolite collection site



Moa coprolites

Precision Irrigation – Reducing Our Water Footprint

(continued from Page1)

Carolyn Hedley

In New Zealand the amount of irrigated land has been increasing by 60% every decade since the 1960s, supporting our increasing agricultural productivity. However, in recent times issues surrounding water abstraction and water quality have become intense and the challenge here, as well as overseas, will be food produced with greater energy and water efficiency.

Irrigation systems vary significantly in efficiency. Some, such as traditional border-dyke flood irrigation systems, tend to be less efficient than a well-maintained centre-pivot system, which is expected to have an application efficiency of at least 80%.

However, having a highly efficient irrigation system is only halfway to efficient irrigation, Ms Hedley says. It is also essential to know how much and how frequently to schedule irrigation and that depends on crop demand and soil supply. Different soils have varying abilities to supply water to plants, and where variable soils exist under one irrigation system then a variable-rate irrigation system is best. Prototype systems for variable-rate irrigation have been developed, but the soil-related decision support systems have not.

'Our current research uses an electromagnetic induction (EM) sensor and GPS to map soil variability and define management zones. The plant-available water-holding capacity of each management zone is estimated and related to soil EM, allowing us to produce an available water holding capacity map.
'Soil moisture information, monitored by sensors installed in each zone, is logged hourly and wirelessly transmitted to the farm office. The available water holding capacity map and soil moisture logging provide the information required for improved irrigation scheduling.'

An aim of this research, which is in collaboration with the New Zealand Centre for Precision Agriculture, is to add a daily time step to the available water holding capacity map so zones that require irrigation can be better identified.

'Variable-rate irrigation means that rather than applying a blanket rate of irrigation, the amount applied can be tailored across the field as different soil zones reach their irrigation trigger point. This improves water use and reduces pumping costs while maintaining maximum crop yield,' Ms Hedley says.

A prototype variable-rate centre-pivot irrigation system is currently being developed by WMC Technology so that it can upload the soil-water-status data to software that automatically controls the sprinklers.

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Cissy Pan

Herbarium Birthday

Landcare Research's Allan Herbarium is the biggest herbarium in New Zealand and its function is to collect and record flora and to make the information available to researchers, regional and national authorities, and the public.

Two-thirds of the specimens are of indigenous plants with the remainder divided between naturalised, cultivated, and foreign specimens. However, in New Zealand introduced species now outnumber indigenous species, with garden escapees being the greatest source of new weeds.

The herbarium also preserves records of plants that once occurred in habitats since destroyed by European land use.

Current staff were recently joined by former employees to celebrate the herbarium's 80th birthday and to look forward to an equally exciting future.

The herbarium was first established in Palmerston North in 1928 when H. H. Allan was appointed systematic botanist to the Plant Research Station, part of the newly formed DSIR. At this time Dr Allan donated his private herbarium of 3,000 specimens and this formed the nucleus of what has grown to be a collection of more than 600,000 specimens (with 5,000–8,000 specimens added annually).

In 1936 the herbarium became the 'Botany Section' of the Plant Research Bureau of DSIR; in 1937 the herbarium and staff relocated to Wellington; and in 1938 the Botany Section became Botany Division of DSIR. Over the next few years the herbarium and staff occupied three locations in Wellington, with continued problems of inadequate office and laboratory space and a need for suitable facilities for the herbarium.

In 1954 the herbarium was moved to Christchurch, and then finally to a purpose-built facility at Lincoln in 1960, which was extended in 1981 and again in 1988 to accommodate increasing numbers of specimens.

Where it all began, Palmerston North, 1928

The DSIR went through further restructurings, with Botany Division and the herbarium being absorbed into DSIR Land Resources until eventually DSIR was reconstituted into Crown Research Institutes and custodianship of the plant collection transferred to Landcare Research in 1992.

In 2001, it was named the Allan Herbarium in acknowledgement of H. H. Allan as founder of the herbarium and for his many contributions to New Zealand botany.

The oldest samples are the 91 duplicate specimens collected by Banks and Solander during Captain Cook´s first voyage to New Zealand in 1769–1770.

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Herbarium at Lincoln under construction 1959

New Carbon Footprinting Tool

A world-class carbon footprinting programme has been launched by the same organisation behind the award winning carboNZero$^{Cert\ TM}$ programme.

The new Certified Emissions Measurement and Reduction Scheme – CEMARS (pronounced *See Mars*) – focuses solely on the measurement and management of an organisation's carbon footprint or greenhouse gas emissions profile.

Westpac Banking Corporation is the first company to register and work towards CEMARS certification for its entire New Zealand operations.

Mike Tournier, Business Manager for Landcare Research's carboNZero programme, says CEMARS gives large-carbon-emitting companies the framework to measure and manage their carbon footprint and make a legitimate carbon claim.

'With the passing of the Emissions Trading Scheme (ETS) there will be a legal requirement for large carbon emitters to measure their impact on the environment and take steps to actively reduce their carbon emissions within a defined time frame to avoid heavy financial penalties,' he says.

'Smart companies will be aware of the pending regulation and how it is likely to affect their business and will be taking active steps now to get their "house in order".'

The voluntary sector may also stand to benefit from the launch of CEMARS.

CEMARS provides a market opportunity for those companies that may not be able to participate in carboNZero because it is either too onerous (i.e. the purchase of carbon credits is beyond economic viability) or brand positioning is such that they are not seeking to claim carbon-neutrality.

Business NZ Chief Executive Phil O'Reilly welcomes the announcement.

'As we move to a carbon-efficient economy, it's important that businesses have the right tools and robust certification processes to identify the opportunities to reduce their emissions. 'Landcare Research is to be congratulated for taking the initiative.'

The programme is working towards accreditation by the Joint Accreditation System of Australia and New Zealand (JAS-ANZ). CEMARS will be globally recognised as the most credible carbon footprinting tool available on the market to date.

In fact, Landcare Research's partner in the UK, Achilles Information, has signed up to roll out CEMARS to 32,000 clients across 24 countries.

The JAS-ANZ accreditation body is recognised across 50 major economies, including the European Union, and is a founding member of the International Accreditation Forum (IAF).

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May Chang (L) and Kathryn Hailes with CEMARS advertising material

Potential New Biocontrol

Scientists are seeking farmer feedback as they investigate the feasibility of importing a new biocontrol agent for a farming by-product that constantly causes a stink.

Landcare Research scientists Shaun Forgie and Hugh Gourlay plan to import and eventually release pastoral dung beetles onto New Zealand sheep, dairy and cattle farms.

To do this they're hoping to form a farmer-led community group based in Rodney District to apply for funding for the project. Similar groups have been highly successful in establishing biocontrols in other parts of New Zealand.

'Dung beetles search out fresh animal dung, which they then bury in tunnels and burrows beneath the soil surface. Adult beetles feed on this buried dung and lay eggs in it while all the time getting rid of dung sitting on top of the ground,' Mr Gourlay says.

'As the eggs hatch the emerging grubs feed on the dung, breaking it down and turning it into a sawdust-like material that adds to the fertility and structure of the soil.'

Although dung decomposes naturally, the large amounts dropped under intensive farming can lead to environmental problems such as leaching into waterways and reduced pasture production due to accumulated fouled forage.

Dr Forgie says, over and above the services provided by earthworms, dung beetles have many potential environmental and economic benefits, including:

- Improved soil health and reduced runoff, increased aeration and water penetration
- Reduced nitrous oxide emissions
- Greater pasture productivity. Stock will not graze around dung pats, reducing pasture productivity. Dung burial by the beetle enhances grass growth, reducing reliance on fertiliser inputs
- Reduced fly pests and human disease
- Reduced infection by parasitic worms of livestock – dung burial removes the infective stages of these parasites

New Zealand lacks native pastoral dung-burying beetles. A tropical species, Copris insertus, was introduced in 1956 but only established at Whangarei, probably due to poor climate matching. Two accidentally introduced Australian Onthophagus species are widespread, but have little impact, presumably because populations fail to reach sufficient densities, they are too small, and poorly adapted to feed on pastoral dung.

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Shaun Forgie talks with farmers about the possible introduction of the dung beetle (R)

Annual Report Highlights Strong International Presence

Landcare Research achieved a high positive impact and generated a lot of value for the New Zealand economy and environment over the past year, says Chief Executive Warren Parker.

Dr Parker made the comments following publication of Landcare Research's 2008 Annual Report, which shows high demand for the company's science skills and services supporting sustainable development.

Science highlights for the 2007/08 reporting period showed the diversity of work Landcare Research undertakes. These included research into bovine Tb control that showed effective possum control could be possible with an 80% reduction in the quantity of 1080 used and research supporting the expansion of the network of biodiversity sanctuaries to more than 50 projects totalling some 37,000 hectares of reserve land across New Zealand. The work highlighted includes new understanding about the dispersal of giant weta and the behaviour of rats getting into pest-free enclosures.

And, in a world first, Landcare Research scientists combined with Scottish counterparts to demonstrate and measure respiration rates between soil and roots in an undisturbed forest, which has led to increased knowledge about levels of carbon dioxide being returned to the atmosphere.

Dr Parker says these are just a few examples of Landcare Research scientists undertaking interesting and innovative research that benefits every New Zealander.

The Annual Report shows revenue increased 6.5% to $56.2 million with a net surplus after tax of $632,000. It also highlights a number of increasingly successful commercial activities.

When Russian Prime Minister Vladimir Putin was recently photographed attaching a tracking collar on a tranquilised Siberian tiger, few people would have known that the high-tech device had been carefully crafted in a small purpose-built factory in Hawke's Bay.

Sirtrack has, since its inception in 1986, manufactured wildlife tracking equipment for research on more than 550 species of wildlife, ranging from insects to elephants, in 75 countries around the world, from the Arctic Circle to the Florida Everglades.

Sales have more than doubled in the last four years from $2.2 million to $4.8 million and are expected to double again in the next 5 years. As an export-driven business Sirtrack is delivering strong results for the New Zealand economy.

Landcare Research also launched EcoGene, a new DNA-based diagnostics service for biosecurity and biodiversity, developed in response to increasing demands for DNA tests to be carried out quickly for clients to support species identification, mammal pest monitoring, genotyping and disease screening.

Similarly, the carboNZero programme continues to grow and develop. In March the internationally recognised greenhouse gas scheme launched a new Certified Emissions Measurement and Reduction Scheme – CEMARS – that focuses solely on the measurement and management of an organisation's carbon footprint or greenhouse gas emissions profile. CEMARS gives large-carbon-emitting companies the framework to measure and manage their carbon footprint and make a legitimate carbon claim. It has been launched through Landcare Research's partner in the UK, Achilles Information, and this month the scheme was introduced to New Zealand.

Dr Parker says the examples highlight the many ways Landcare Research is creating value for New Zealand and in sustainability initiatives around the world.

An online version of the annual report is available at http://www.landcareresearch.co.nz/publications/reports.asp

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