Landcare Research
Manaaki Whenua

DISCOVERY

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Kiore Provides New Insights Into Colonisation

Dr Janet Wilmshurst has used rat bones and gnawed seeds to date colonisation

Radiocarbon dating of Pacific rat (kiore) bones and rat-gnawed native seeds has provided compelling new evidence of the timing of New Zealand's colonisation.

The dating project, one of the largest studies of its kind, has shown that the country was not visited by humans over 2000 years ago, as some previous research suggests. The work has been published in the prestigious journal *Proceedings of the National Academy of Sciences* in the United States.

An international team of researchers, led by Dr Janet Wilmshurst of Landcare Research, spent 4 years on the project which shows conclusively that the earliest evidence for human colonisation is about AD1280-1300 and no earlier. Their results do not support previous radiocarbon dating of Pacific rat bones which implied a much earlier human contact about 200 BC, dates that have been hotly debated ever since they were published in *Nature* in 1996.

The ages are controversial because there is no supporting ecological or archaeological evidence for the presence of kiore or humans and the reliability of the bone dating has therefore been questioned. This is the first time that the actual sites involved in the original study have been re-excavated and analysed.

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With Challenges Come Opportunities

The food and energy crisis presents big challenges and opportunities for business and government locally and globally. The pressure on natural resources – land, water, air, biodiversity (our natural capital) – has never been greater yet, paradoxically, to generate more food and energy we are going to have to draw on our natural systems even more than in the past.

Clearly we need to do this in a manner that is much different to what we have become accustomed to. As someone quipped, 'The present system is perfectly designed to give the current results!' So we need big ideas, alongside the immediate and sensible things we can all do, to achieve more rapid change in our businesses, public policy and capability development. And, as we illustrate in this edition of Discovery, we need to develop an excellent understanding of the way ecosystems work and therefore how they are likely to respond to management and other interventions.

While the present scarcity of natural resources manifesting in higher food, electricity and fuel costs evokes strong emotions for many, the scientific evidence supporting the need for radical innovation in the way we do things is robust and compelling. Here at Landcare Research we are committed to fresh thinking to find new solutions in the way we manage and value natural capital, design and conduct business and support policy development. This demands transformative, not minor change. However, we are quickly learning, for example the emissions trading scheme (ETS) that the solutions to environmental problems frequently present tough political choices. While we would prefer to avoid these, the parlous state of some of our natural resources means inaction is not an option.

Transformative change also means we have to invest much more in research and development and in a manner that strengthens end-user connections. Since I last wrote there have been some significant financial initiatives to accelerate innovation in New Zealand including the Government-backed New Zealand Fast Forward scheme - a $700 million initiative to be matched by industry funding.

There was funding, for the first time, dedicated to national databases and collections - the 'backbone' of our science infrastructure (you can read more about the seven we are custodian for on our website). We welcome these steps but know that increased investment is but one precondition for rapid innovation. We will also need to work with others more effectively and be better connected to leading international research groups and end-users.

It is not surprising then that collaboration is a strong, consistent theme running through the initiatives to stimulate research and development.

Collaboration appears simple to achieve, but our experience shows it is in fact sometimes quite a challenge. After more than a decade of highly contested, often adversarial bidding for science funding where relationships have often been under valued and dented, we are rediscovering how to make collaboration really work. That means clarity of purpose, choice of best partners with shared values, investing time in building relationships, mutual respect, a willingness to 'give and take', and shared rewards and risks. We think this approach is especially important for New Zealand's small, geographically remote economy with modest, by world-leading standards, resources and capabilities, a predominance of small firms and fragmented local government.

Landcare Research is committed to using collaboration to hasten the innovation needed to achieve a sustainable New Zealand (and planet). As always, I welcome your feedback and thoughts.

Warren Parker
Chief Executive
Landcare Research

Helping Our Iconic Kiwi

Meet Heidi, a 4-day-old kiwi chick, plucked from a burrow in Te Urewera National Park in late May.

Removed because she was vulnerable to predation, Heidi is now safely housed at the Westshore Wildlife Reserve near Napier. There, she's putting on weight in preparation for relocation back into forest at Lake Waikaremoana in August.

She was discovered as staff from Sirtrack, a Landcare Research subsidiary, assisted in the annual 'kiwi call' census held at the lake.

Sirtrack is a sponsor of the Lake Waikaremoana Hapu Restoration Trust, which is working with DOC to restore the lakeside's brown kiwi population, estimated to have declined by 90% since 1920.

The annual census is used as a method of mapping the demographics and population density and trends of kiwi within New Zealand and Sirtrack account manager Phil Sargisson says it's also a great opportunity for the people who develop Sirtrack's world leading tracking technology to see how their equipment handles field conditions.

'It's great for the team to see what happens to our products once they're being used on animals in the field. The guys who make the products don't usually see what happens to them so it's an invaluable opportunity.'

Thanks to the combined results associated with the extensive trapping of predators, a predator fence, predator-free kiwi chick enclosure and the ongoing tracking and monitoring of resident kiwis, the researchers have found that kiwi numbers have stabilised and are now slowly on the increase.

The project was sparked in 1992 when Dr John McLennan of Landcare Research chose the area to test his theory that the main cause of kiwi death is predation: in particular, stoats killing chicks while they are still too small to defend themselves.

The theory was proven to be true and had a huge and immediate influence on the work being done to save kiwi all around New Zealand.

With equipment and services donated by Sirtrack, tangata whenua took over managing the predators on Puketukutuku Peninsula, while DOC focused on monitoring the kiwi population.

The main strategy has been to create a 'mainland island' on Maori land on the peninsula.

As for Heidi, Sirtrack staff say they'll adopt and sponsor her on an ongoing basis. That will ensure her development, relocation and ongoing survival is a little more certain.

Contact: **Mike Kelly**
Sirtrack Chief Executive
Havelock North
06-872-8250
kellym@sirtrack.com
www.sirtrack.com

Phil Sargisson

Heidi, soon to be re-released at Lake Waikaremoana

Kiore Provides New Insights Into Colonisation

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Dr Wilmshurst and her team of researchers re-excavated and redated bones from nearly all of the previously investigated sites and all of their new radiocarbon dates on kiore bones are no older than 1280. This is consistent with other evidence from the oldest dated archaeological sites, Māori whakapapa, widespread forest clearance by fire, and a decline in the population of marine and land-based fauna.

'As the Pacific rat (kiore) cannot swim very far, it can only have arrived in New Zealand with people on board their canoes, either as cargo or stowaways. Therefore, the earliest evidence of the Pacific rat in New Zealand must indicate the arrival of people,' Dr Wilmshurst says.

The dating of the rat bones was also supported by the dating of over a hundred woody seeds, many of which had distinctive tell-tale rat bite marks, preserved in peat and swamp sites from both the North and South Islands.

'These rat-gnawed seeds provide strong additional evidence for the arrival of rats, and therefore humans, and are an indirect way of testing the veracity of the dates we have done on rat bones,' says Dr Tom Higham, Deputy Director of the Oxford Radiocarbon Accelerator Unit at Oxford University.

Rats leave rows of narrow grooves or bite marks on woody seed cases when they gnaw open the seed, and these distinctive teeth marks can be seen with the naked eye.

'The width of the teeth marks left on the woody seeds exactly match those of a rat's two front teeth, and cannot be mistaken for any other seed predator. We have dated over 100 individual seeds, some rat-gnawed, others intact or bird-cracked, which show that rat-gnawed seeds only occur in both islands of New Zealand around the end of the 13th century', Dr Wilmshurst says.

Janet Wilmshurst

Rat gnawed matai nut

With over 165 dates from seeds and bones from a large number of sites, the evidence is overwhelming.

'It now seems certain that the first Māori settlers arrived in New Zealand sometime about 1280. The earliest dates for rat and human arrival are strikingly consistent with the oldest dates from archaeological sites, the first large clearances of forest by fire, and declines or extinctions of marine and land-based fauna. The consistent picture emerging now is that settlement was much later than the old rat bone dates led many people to believe,' says Professor Atholl Anderson, from the Australian National University.

The date for human and rat introduction has several important implications: Firstly, rat predation only began after 1280 which is a much shorter period than previously implied and makes the risk to currently declining populations of rat-sensitive species more pressing as they could be diminishing faster than previously assumed. Secondly, colonisation did not involve a protracted delay between initial discovery and subsequent colonisation, an idea implicit in earlier theories. The first people arriving in New Zealand from tropical east Polynesia initiated an immediate and rapid transformation.

'A precise date for the arrival of the rat helps us to fully understand both the history of human settlement and the past and present ecological impacts of kiore on native fauna and flora. It also allows the human settlement of New Zealand to be placed more accurately in the context of the broader settlement pattern of East Polynesia,' Dr Wilmshurst says.

Contact: **Dr Janet Wilmshurst**
Landcare Research, Lincoln
wilmshurstj@landcareresearch.co.nz

Janet Wilmshurst undertaking field work as part of the study

The Nation's Big Garden Bird Count

New Zealand's second nationwide garden bird survey is scheduled to take place between 12 and 20 July - just a month away.

Participants will spend one hour watching birds in their home gardens, local parks, or school grounds and record the highest number of individuals of each species seen at once.

Organiser Dr Eric Spurr says there had been a great deal of interest in the event, which fills several important roles.

'We want to encourage people to become interested in birds and the environment and we also want to look at trends in bird numbers over time. Likewise, we want to know if birds such as tui, bellbirds, grey warblers, and fantails are increasing or declining in our gardens and in our towns and cities.'

Just two native species, the silvereye and fantail, featured in the top 10 birds counted during last year's survey.

Dr Spurr says a total of 2064 survey forms were returned last year and in total 89 species were detected.

'The large number of species was surprising, but reflects the fact that home gardens ranged from truly urban to rural and seaside.'

The silvereye was the species recorded in greatest numbers during the survey with an average of 10.2 per garden while the fantail was the 9th most abundant species (0.86 per garden). Of the other native species, the tui was 11th, bellbird 15th, kereru 18th, and grey warbler 21st.

Dr Spurr says the overall results were similar to what he would have expected although there were some pleasant surprises including the presence of kaka in some gardens.

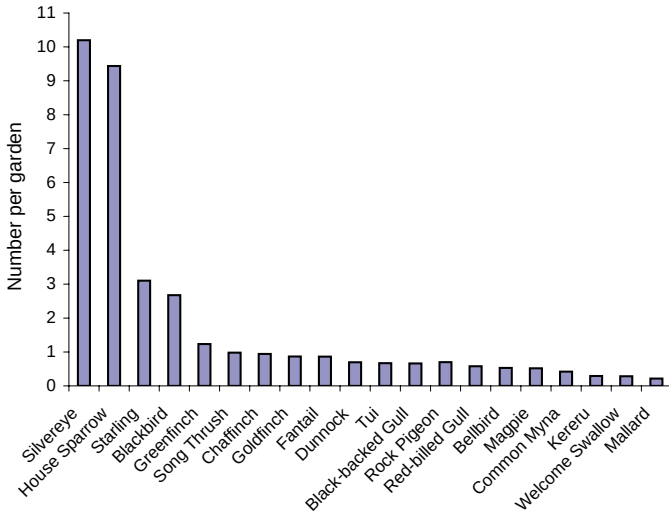
'One resident of Stewart Island feeds kaka and regularly has up to 24 in her garden. One day while working in her kitchen there was a sudden downpour outside, so she went to close the ranch sliders in her living room only to discover 17 kaka sitting on the floor and couch sheltering from the rain. Another time a kaka came inside at night and helped itself to nibbles laid out for dinner party guests.'

Dr Spurr says he was overwhelmed by the public response which included many letters, detailed notes on the birds visiting gardens, and photographs of birds at feeders, as well as recipes for bird food.

Top 10 species in New Zealand gardens 2007

1. Silvereye
2. House sparrow
3. Starling
4. Blackbird
5. Greenfinch
6. Song thrush
7. Chaffinch
8. Goldfinch
9. Fantail
10. Dunnock (Hedge sparrow)

Website:
http://www.landcareresearch.co.nz/research/biocons/gardenbird/



Average numbers of top 20 bird species detected at once in gardens

Contact: **Dr Eric Spurr**
Landcare Research, Lincoln
spurre@landcareresearch.co.nz

The silvereye – number 1

Foraging For Fungi

The discovery of a rare European mushroom on an Otago beach has excited mycologists but left them scratching their heads over just how it arrived in New Zealand.

The fungus – Hohenbuehelia culmicola – was discovered during the recent Fungal Foray and is so rare it's listed on European 'red data lists' of organisms under threat of extinction. They are reported to the International Union for the Conservation of Nature (IUCN) and countries have a legal responsibility to look after them. It was found clinging to marram grass – introduced from Europe over 100 years into New Zealand to stabilise sandy areas - nestled in the dunes on a beach near Dunedin, and Landcare Research scientist Dr Jerry Cooper says it was a remarkable find.

'What kind of luck do you need to bring over a population of marram grass that happens to have associated with it such a rare fungi in Europe?' he asks.

And, on closer inspection Dr Cooper discovered other unknown and equally intriguing fungi were also nestled nearby.
'So here in Otago we've got this sand-dune fungus community with some really bizarre things in it, including red data species, and probably other new species that have never been described anywhere in the world.

'There is also an irony in this find because marram grass is an invasive species and doing such a good job of stabilising dunes that they are disappearing – which threatens native species including the indigenous pingao grass', Dr Cooper says.

Jerry Cooper

Hohenbuchia culmicola

The finds were highlights of the 22nd annual New Zealand Fungal Foray, which is intended for both amateur and professional fungal enthusiasts (mycologists). Forty-five participants, including some who travelled from Sweden, the UK, Australia, and the United States, attended the week-long event that included collection sites in beech forest, mixed broadleaf/podocarp forest, manuka/kanuka stands and montane grassland.

Landcare Research scientist and member of the organising council Dr Peter Buchanan says 1 in 8 of New Zealand's most threatened organisms are fungi and the event was an opportunity to increase public understanding and appreciation of these often overlooked but incredibly numerous and ecologically important organisms.

Contact:

Dr Jerry Cooper
Landcare Research, Lincoln
cooperj@landcareresearch.co.nz

Dr Peter Buchanan
Landcare Research, Auckland
buchananp@landcareresearch.co.nz

Peter Buchanan

TVNZ cameraman Brent Walters takes a close interest in the Fungal Foray

Wildlife Forensics Go Commercial

Expertise in molecular diagnostics has taken a big step forward with Landcare Research launching a new business unit to undertake commercial work passing through its Ecological Genetics Laboratory (EGL).

As highlighted in *Discovery* last year, the development of DNA field tests – similar to what scientists use in human forensics - means Landcare Research scientists can establish what animal species was responsible for the killing of a native animal species. These include using feather fragments, eggshell remains, snagged hairs and even saliva remnants on a carcass of a dead animal. And, in some cases, the scientists can identify exactly which individual animal undertook the killing.

'EcoGene' has been created to provide DNA-based services for a range of ecological applications and was developed in response to increasing demands for DNA tests to be carried out quickly for clients.

Science Director Dr Dianne Gleeson says there is need for a service that is distinct from Landcare Research's general research and that can be responsive, cost-effective and still provide quality data.

'EcoGene will be Australasia's leading provider of DNA-based diagnostic services for biosecurity and biodiversity, and from our Auckland laboratory we will provide a cost effective and fast-turnaround service for species identification, mammal pest monitoring, genotyping and disease screening,' Dr Gleeson says.

The main provider of DNA services to the Centre for Conservation Medicine at Auckland Zoo, EcoGene also supports the Department of Conservation's centralised species recovery programmes.

To ensure a responsive service, EcoGene is separate from the laboratory's research arm – however, links are maintained for the development of new applications.

EcoGene at a glance

Services include 'wildlife forensics',vertebrate pest-monitoring using non-invasive DNA samples, conservation genetics, and disease diagnostics.

Species identification:
- Identification of invertebrate species from samples such as eggs, larvae and fragments using DNA barcoding methods
- Predator identification from saliva swabs, hair snags and scat samples
- Gut content analysis for identification of food items

Vertebratel pest monitoring
- Mark-recapture analysis
- Track movements of individual animals
- Detection of a pest from forensic samples
- Design and analysis of monitoring projects

Genotyping:
- Genotypes can be obtained from individuals where molecular markers are available or by development of species-specific markers
- Gender assignment in birds

Disease Screening
- Avian malaria
- Whataroa virus
- Murine typhus
- Chytrid fungus

Other services will be added as they are developed and will include pipeline projects such as hormone monitoring, assisted breeding, and genetic resource banking.

EcoGene
DNA-based diagnostics

Contact: **Frank Molinia**
Facility Manager
09 574 4225
ecogene@landcareresearch.co.nz
Web: www.ecogene.co.nz

Biocontrol Makes a Big Impact

A biocontrol agent first released a decade ago looks to be finally making significant headway against heather (Calluna vulgaris).

Researchers predict that if favourable conditions and exponential growth of heather beetle (Lochmaea suturalis) populations continue for three more years, then the entire heather infestation across Tongariro National Park could be badly damaged or killed.

Over the past decade Simon Fowler and Paul Peterson have been helping DOC and the New Zealand Army deal with a 50, 000ha heather infestation on the Central Plateau of the North Island. Heather is by far the worst weed in Tongariro National Park and displaces many native plants.

Heather was introduced from the UK where it is managed for grouse production on upland moors, as well as being valued for conservation. There, the heather beetle is seen as a pest.

Researchers suspect the combined effects of variable spring temperatures at high altitude, the small size of beetles and low nitrogen levels in the heather foliage have slowed the beetle's impact here. 'Where we have experimentally added fertiliser to sites generally the beetles do better.'

But, the scale with which the beetle can multiple and spread is remarkable, he adds.

'Eight years ago on the Scottish Borders there was a massive series of outbreaks that destroyed about 250,000 ha of heather.

"We've only got about 50,000ha to destroy in Tongariro National Park so one big outbreak could almost do the job.

Currently, there are two significant outbreaks of the beetle, each causing very impressive damage to areas of about 150 m^2.

'It's almost like you've been using the most selective herbicide in the world. The heather is all dead or very heavily damaged, and all other plant species are completely untouched.'

At both outbreak sites, the damaged area has increased exponentially over the past three years.

Contact: **Simon Fowler**
Landcare Research, Lincoln
fowlers@landcareresearch.co.nz

Green Projects Get Technological Boost

A new website utilises the technology available through Google Earth to show New Zealanders some of the important environmental initiatives being undertaken on their doorstep.

When internet users access the www.ourfuture.net.nz website they will be able to navigate across New Zealand and follow the icons to look at specific environmental projects in particular geographical areas.

The site also shows people places – including bush walkways – that they can visit and projects that they can be involved in.

Landcare Research has used Google mapping technology to develop the site, and has partnered with QEII National Trust, the Royal Forest and Bird Protection Society of New Zealand, and New Zealand Ecological Restoration Network (NZERN).

Landcare Research science general manager Dr Richard Gordon says the website is a simple hands-on tool that assists New Zealanders to take an interest in environmental research and to encourage them to participate in local projects. The goal is for www.ourfuture.net.nz to become the definitive guide to environmental initiatives in New Zealand.

Contact: **Tom Fraser**
Landcare Research, Lincoln
frasert@landcareresearch.co.nz

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Layout: Cissy Pan
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