

## MARK PAGEL ON THE EVOLUTION OF HUMAN LANGUAGES

The first of the Allan Wilson Centre's 2013 lecture series will be held in March. Eminent evolutionary biologist, Mark Pagel, is speaking on the evolution of human languages (all 7000 of them!) which both enable and limit communication between people.

Mark Pagel describes his work in evolutionary biology as 'attempts to rewind the clock of evolution to try to discover what the past was like, and how that past gave rise to the present.' He is an elected Fellow of the Royal Society of London and Professor of Evolutionary Biology at the University of Reading in the UK. Over the past three decades, his work on broad-ranging topics within the field of evolutionary biology has included the development of mathematical and statistical modeling techniques that have been widely used

for evolutionary reconstructions of the past, and influential studies of many issues in evolutionary theory such as speciation and adaptation.

He has a particular interest in the evolution of human cultures and languages, and explores this in his new book for general readers *Wired for Culture: Origins of the Human Social Mind*. In the book Pagel examines what it is that makes us human, and distinguishes us from all other living organisms - our cultural inheritance. He writes that our



*Eminent evolutionary biologist, Mark Pagel*

invention of culture, around the time of the first humans, 160–200,000 years ago, created an entirely new sphere of evolving entities. This second great system of inheritance that could transmit knowledge down through generations allowed humans to successfully colonise the globe, and resulted in today's incredible cultural diversity.



### Public Talks by Professor Mark Pagel, FRS

**Seats may be reserved, and tickets purchased (for Wellington and Auckland) at [www.royalsociety.org.nz/events](http://www.royalsociety.org.nz/events)**

- **Auckland:** Tuesday 12 March, 6pm, Auckland Museum Events Centre, \$15/\$10 for Royal Society and Auckland Museum Institute members, and students with ID
- **Hamilton:** Wednesday 13 March, 6.30pm, Gallagher Academy of Performing Arts, University of Waikato
- **Wellington:** Friday 15 March, 6pm, Embassy Theatre, Courtenay Place, \$15/\$10 for Royal Society members, and students with ID
- **Dunedin:** Monday 18 March, 6.30pm, St David's Lecture Theatre, University of Otago
- **Christchurch:** Wednesday 20 March, 6.30pm, Central Lecture Theatre 1., University of Canterbury

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## RAT ON THE RUN

We congratulate Allan Wilson Centre (AWC) affiliate, Dr James Russell, for winning the 2012 Prime Minister's MacDiarmid Emerging Scientist Prize. This prestigious prize for a scientist starting out in their career is one of five Prime Minister's Science Prizes introduced in 2009 to raise the profile and prestige of science in New Zealand. The prizes recognise and reward five individuals each year, including a science teacher and a secondary school student, for their outstanding work in science.

James went to Auckland Grammar School where biology was his worst subject, which he blames on a lack of ecology at the time. This didn't put him off further study, and he completed his PhD at The University of Auckland in 2007, and returned in 2010 as a lecturer in a shared appointment between the School of Biological Sciences and the Department of Statistics. James's PhD research focused on ways of stopping rats re-invading protected islands once pests had been eradicated. Methods devised by James included releasing and monitoring rats using tracking devices, and using genetic identification techniques to track the likely sources of trapped rats.

One of his experimental rat subjects made news around the world, proving just how evasive the animals can be. It avoided all intensive efforts to trap it, and James lost the signal from its radio collar. After swimming 400m to a neighboring island it was

finally caught after four months on the run. As James and co-authors put it in their *Nature* article, 'our findings confirm that eliminating a single invading rat is disproportionately difficult', and quite a different problem to the initial eradication of a population from an island. James's work gave him both a respect for rats, which he says are intelligent creatures that learn to avoid poison and traps, and a determination to outsmart them using all the scientific tools and analyses available.

The Department of Conservation (DOC) now uses the results of James's PhD research in their management plans for risk analyses of rat re-invasions of protected islands, and James is currently working on ways to extend the methods to mainland sanctuaries and larger predator-free areas across New Zealand. His knowledge and expertise is sought after internationally, as conservation organisations overseas face difficulties

dealing with rats and other mammalian pests. James's fieldwork has taken him to many fascinating and remote locations in the past few years, including the Faroe Islands, the Tibetan Plateau, the Antipodes Islands and Tetiaroa, the atoll north of Tahiti in French Polynesia that Marlon Brando found so beautiful in the 1960s he bought it.

James has also worked on Hauturu (Little Barrier Island) recently, as a member of the AWC's *Hidden Treasures* project team. His plans this year include spending time in France working on conservation projects, and working with DOC and philanthropist Gareth Morgan on the *Million Dollar Mouse* eradication project on the Antipodes Islands. A new Year 13 Biology textbook *Continuing Life Processes: Ecology and Evolution* by Heeney and Shepherd quotes James in its opening pages. He advises students to 'Do what you love', just as he is doing.

### Teaching suggestions

Predator eradication is a vital factor in conservation management in New Zealand.

- **DOC** has lots of information on rat eradication projects in NZ on their website
- **LEARNZ** is running several virtual field trips this year focusing on conservation issues
- **Curriculum links:** Nature of Science: Understanding about science (L1-8), Living World: Ecology (L4-8, particularly L6)



Dr James Russell – MacDiarmid Emerging Scientist 2012

# PESTS PRESENT NATIONAL SCIENCE CHALLENGE

A current television advertisement for the National Science Challenges quips, “Did you know New Zealand has a pest problem?” That New Zealanders might not know that we have a pest problem is to me staggering, and probably strikes to the heart of how disconnected science can be from the public.

What we, as scientists, take for granted as common knowledge is clearly not, as evidenced from a variety of discussions I have had about the TV adverts during the summer barbeque season. Various smart people, some also influential, have been apparently utterly unaware that New Zealand has a problem with mammalian pests, which makes me wonder what else we take for granted that they might not know.

New Zealand certainly does have a pest problem, with mammalian pests well known to most biologists for the past several decades to be a key contributor to the decline in a variety of our native species, most conspicuously our native birds. The key culprits are rats, stoats and possums, each of which play a part in making New Zealand that little bit less special. Over the course of 50 odd years the pest problem has been grappled with by a variety of agencies, with the Department of Conservation (DOC) and Animal Health Board leading the charge for the past couple of decades. Thanks to the work of many we can control and even eradicate many of these species at increasingly large scales, and the success of these programmes has seen a variety of “pest-free” sanctuaries formed, such as Kapiti Island and the Orokonui mainland sanctuary, where populations of our native species now have a realistic chance of recovery.

Pest control with current technologies over significant spatial scales is definitely possible, but it’s time-consuming and expensive. Thus if we want to reach a goal of

*The key culprits are rats, stoats and possums, each of which play a part in making New Zealand that little bit less special.*

a pest-free New Zealand by 2050 we either have to make this a priority and open up the national cheque book, or we need to come up with much smarter (read cheaper) ways to control our pest problem. Facing this challenge head-on, DOC recently convened a two-day Pest Summit (3-4 December 2012) to assemble about 50 of the best science and technical minds in the pest management and technology space in New Zealand, including myself and Professor Ian Jamieson from the AWC, to get their views on potential new ways to control or eradicate possums, stoats and rats.



Professor Neil Gemmell

The workshop came up with numerous ideas over the two-day meeting, which were then distilled down to three top contenders:

- customised biocontrol agents (e.g. various forms of persistent fertility control)
- novel surveillance devices (remote detection devices to improve the field detection and monitoring of pests, possibly in real time)
- pheromone-based super-lures which might enable better trapping and poisoning rates by attracting targets to baits, while repelling species we wish to save.

DOC proposes to workshop these top three ideas further to capitalise on whatever funding might emerge for a national science challenge focused on eradicating mammalian pests – watch this space.

*Neil Gemmell is an Allan Wilson Centre Principal Investigator, AgResearch Chair in Reproduction and Genomics, and Director of the Centre for Reproduction and Genomics at the University of Otago*



*One of our biggest pests, the rat*

## THE LONGEST JOURNEY – FROM AFRICA TO AOTEAROA

Congratulations are in order for Principal Investigator Professor Lisa Matisoo-Smith of the University of Otago, who has been awarded a coveted James Cook Fellowship. This prestigious award is presented to applicants at the pinnacle of their research careers, and relieves Fellows of their university administration and teaching duties for two years. The Fellowship will give Lisa time to concentrate on her research project *The longest journey - from Africa to Aotearoa*.



Professor Lisa Matisoo-Smith

Lisa's ambitious project aims to collect DNA samples from about 1000 New Zealanders, and use these to provide an overview of our genetic heritage. Volunteers will be recruited from throughout the country, and along with their DNA will provide details of their birthplace, parents' and grandparents' first language and ethnic self-identification.

In the lab, Lisa and colleagues will determine the haplotypes, or lineage families, that each individual's mtDNA and Y-chromosome markers

(in male subjects) belong to. Analyses on a nationwide level will provide a genetic picture of the many different migration pathways settlers took to arrive in New Zealand. The study may also pick up on features of the social history of New Zealand. For example, it will be interesting to see if the results show up regional differences in settlement histories - for example whether genetic traces of the Scottish settlers of Dunedin distinguish this region from others.

As well as being a part of the large study, volunteers will have the added

benefit of finding out their own personal haplotypes, linking them back through time to past ancestors and in the present to distant cousins. The documentary *Venus: A Quest*, described on page 8, presents a fascinating example of this, as the narrator, Kiwi Dylan Horrocks, explores his family connections to Jeremiah Horrocks, who made the first observations of a transit of Venus, and died in 1641.

Look out for news of Lisa's project in upcoming issues of Pheno.



## BEAUTI AND THE BEAST

Bayesian Evolutionary Analysis for Sampling Trees needs an acronym. BEAST is an open source software package widely used in the scientific community for evolutionary analyses. It has grown steadily both in functionality and popularity since the first version was released ten years ago by Allan Wilson Centre Principal Investigator Alexei Drummond, and colleague Professor Andrew Rambaut of the University of Edinburgh. Alexei and Andrew developed the programme while working together at the University of Oxford, building on Alexei's doctoral research in bioinformatics at The University of Auckland.

Recently Alexei and Andrew, with co-authors Dr Dong (Walter) Xie (AWC, University of Auckland) and Professor Mark Suchard (UCLA) announced the release of a new version of BEAST and its graphical interface BEAUti (Bayesian Evolutionary Analysis Utility), in the journal *Molecular Biology and Evolution*. In early versions, users needed to specify the settings for BEAST directly using an XML input format. The development of the BEAUti software improved the accessibility of BEAST to researchers, often evolutionary biologists without a background in computer science, providing a straightforward, intuitive interface for researchers.

BEAST can now be used for several different types of evolutionary analyses, including Bayesian phylogenetic inference, divergence time dating, and coalescent and phylogeographic analyses. A quick count online reveals that more than 1000 publications in 2012 referenced BEAST, demonstrating its importance in the evolutionary biology field. High-profile examples include papers in *Science* that examined the evolutionary history of fungi capable of breaking down wood, a major pool of organic carbon, and work by Dr Remco Bouckaert of The University of Auckland, with Alexei and colleagues, on the origins of the Indo-European language family.

# THE DIVERSE DNA INTERESTS OF CRAIG MILLAR – THE BIRDS AND THE BEES

Allan Wilson Centre (AWC) Principal Investigator, Dr Craig Millar of The University of Auckland, spent much of his summer this year in Antarctica, collecting samples for work on Adélie penguins. Craig and colleagues are searching in the Ross Sea region for old sub-fossil Adélie bones. These bones will be used to investigate how penguins have coped genetically with climate change from the peak of the last glacial period, 18,000 to 25,000 years ago, to the present day.

The project is a collaboration with former AWC member Professor David Lambert, now at Griffith University in Queensland, and builds on previous research on the Adélie penguins, whose cold and dry habitat provides near-perfect conditions for the preservation of DNA.

During the summer months millions of Adélie penguins nest in ice-free areas of the Antarctic coast. Many eggs and chicks are lost to predators, and adult mortality is also reasonably high. Eggshells, penguin and food remains, along with guano, build up over time without much decay, resulting in stratified layers. Just as archaeologists study areas of human occupation, the coastal Antarctic sites can be carefully excavated to reveal layers from which bones can be retrieved, and organic material dated, making the Adélie penguins an invaluable source of data for studies of DNA through time.

Previous work by Craig and David used the Adélie penguins to examine how quickly DNA sequences change as they are passed down from generation to generation, and found that these changes occur much more frequently than previously thought. Now Craig and colleagues plan to use next generation sequencing technologies to look for changes in the DNA during a major period of climate change, an approach that Craig says 'allows us to look at the past, but it also allows us to look forward and predict what might happen in the future'.

The Adélie project is one of several that Craig is working on at present. An ongoing project with colleagues, including AWC Associate Investigator

Dr Howard Ross, involves building up a comprehensive DNA-based identification system for the birds of New Zealand and the Antarctic. The DNA region targeted is a short sequence that is highly variable among bird species, and sequencing this piece gives an identifying DNA barcode for each species.

John Waugh, a recent AWC PhD graduate from Craig's lab, used these barcodes to identify species involved in birdstrikes - when birds and planes collide. Most birdstrikes occur near airports when planes are at low altitude, during take off or landing. The damage done to the bird can pose serious problems for identification - often just blood and feathers remain.

Craig is also involved in chronobiology research with colleagues from the Department of Anaesthesiology in the School of Medicine at The University of Auckland. Chronobiology is a field of biology that examines rhythms in living organisms and their adaptation to other solar-, tidal- and lunar-related rhythms. The research team has focused on the effects of anaesthetics on circadian rhythms, using the honey bee as a model species.

Despite the importance of anaesthetics in modern medicine, the mechanisms by which they work are still not clear. The effects resemble normal sleep, with some obvious differences - patients emerging from anaesthesia are often disoriented, and feel that time has not passed. Bees have extremely accurate circadian rhythms that have been long-studied, and well-characterised 'clock' genes that are remarkably similar to those in mammals. The levels of mRNA transcripts and protein



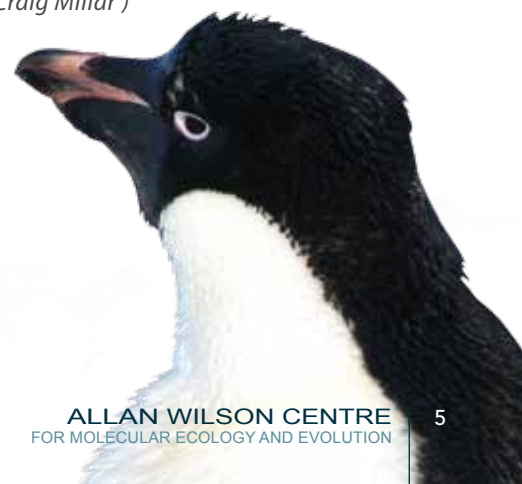
Dr Craig Millar

products from these clock genes fluctuate through the 24-hour day, driving the biochemical, physiological, and behavioral rhythms of night and day.

The study used a commonly administered anaesthetic - isoflurane - on bees. A series of experiments included tracking the flight paths of bees after treatment with isoflurane, and measuring levels of expression of mRNA from the clock genes before and after the isoflurane had been administered. The results showed that the anaesthetic had not only caused a delay in the time the bees left the hive to forage, it also affected their orientation behaviour, as bees use the Sun as a compass. In the laboratory, levels of expression of mRNA indicated that isoflurane affected the molecular clockwork in the brain, but that the effect of the general anaesthetic was time-dependent.

Craig's chronobiology research has been featured on the *Ever Wondered* series which ran on TV7, and is continuing with support from the Allan Wilson Centre.

See Craig describing his chronobiology research at the Science Learning Hub (<http://www.sciencelearn.org.nz/>, search 'Craig Millar')





## Tuatara Fly Home

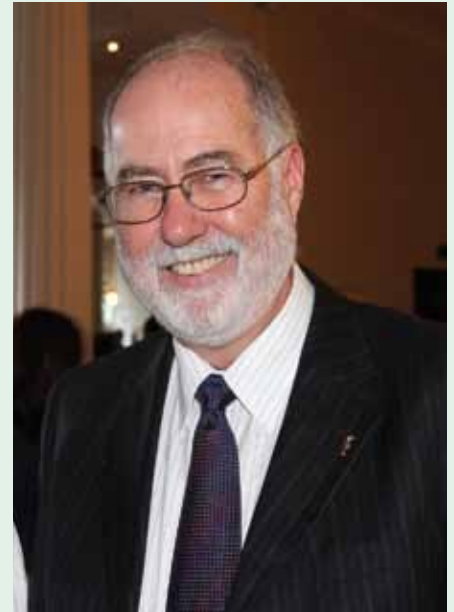
Dr Nicky Nelson of the School of Biological Sciences at Victoria University of Wellington has been a member of the Allan Wilson Centre (AWC) from its early beginnings, and became a principal investigator in 2010. Nicky has a strong commitment to conservation and the results of her studies have direct applications to conservation management.

The AWC has recently begun a large project to sequence the tuatara genome, one of several collaborative projects Nicky is involved with. New Zealand's unique reptile species - the tuatara - has been a research focus of much of Nicky's past and current work. In October 2012 Ngāti Kōata, the Department of Conservation (DOC) and Victoria University carried out a major relocation project involving five recipients and 220

adult tuatara, informed by the results of tuatara research by Nicky and colleagues.

Fossil evidence shows that tuatara were once widespread in New Zealand, but wild populations now survive only on about 30 offshore islands. Takapourewa (Stephens Island) in the Marlborough Sounds supports the largest population. The main aim of the relocation project was to establish populations of wild tuatara in new areas to restore former populations and to help the species survive as the climate changes. Tuatara are particularly vulnerable to climate change as the species is cold-adapted and has temperature-dependent sex determination - at warmer temperatures only males are produced, so sex ratios are predicted to become more male-biased as temperatures rise.

The relocation project was assisted by Air New Zealand. Tuatara captured on Takapourewa were transferred to Wellington by helicopter, then taken on commercial flights to Gisborne, Hamilton and Dunedin. The tuatara were housed in individual tubes and travelled inside the cabin accompanied by Ngāti Kōata representatives. They were delivered to the Orokonui Ecosanctuary near Dunedin, Whangaokeno Island, Cape Sanctuary in Hawke's Bay, Young Nick's Head Sanctuary near Gisborne and Maungatautari in Central Waikato. Nicky's research group will monitor the outcomes of the relocation project in collaboration with iwi and managers of the sites.



## Charles Daugherty up for Top Kiwi Honour

Emeritus investigator and former director of the Centre, Professor Charles Daugherty, came to New Zealand in 1982. He grew up in the American south, as his warm, relaxed accent still reveals. As if to earn his residency here, this young immigrant then spent much of the following three decades – his entire career in fact – involved with our oldest native resident, the tuatara, which he has now had the satisfaction of seeing re-established on many islands and mainland sites, including Zealandia.

In the last couple of years, he was thrust into the limelight as director of the Centre and when university colleague Sir Paul Callaghan became increasingly unwell. They were both Trustees of Zealandia, and Charles was Paul's understudy at the very last public talk he gave on the subject, in February 2012. On Paul's death in March 2012, Charles took over governance of the Transit of Venus Forum, which Paul had initiated and planned but never lived to see. The Allan Wilson Centre was a strong supporter of the Forum and associated initiatives.

The clear Forum consensus was for New Zealand to redefine GDP to take account of environmental costs and to underpin our economy and general well-being by returning our land, water and sea to good health - urgently. No-

## Teaching suggestions

- **Curriculum links:** Nature of Science: Understanding about science (L1-8), Living World: Ecology (L4-8), Evolution (L1-4,6,7)
- **Nicky and Sue Keall**, also of Victoria University, have developed a resource *Tuatara - New Zealand's Taonga*, for the *Starters and Strategies* magazine (June 2012). This is available on the AWC website.
- **Victoria University** has a small captive colony of tuatara on public display which are able to be used for advocacy, including presentations on tuatara research and conservation to schools and public groups. See our website for contact details.
- **TVNZ news** has a short piece on the translocation project featuring Nicky, see the link below or search 'tuatara relocated', on their website <http://tvnz.co.nz/national-news/over-200-tuatara-relocated-across-nz-5136424>

one wanted to talk about much else. Charles is now following through on this mandate by organizing a conference, together with the Department of Conservation, on the Economy and the Environment (Wellington, 9-10 July 2013), and by uniting fellow ecologists, others involved in restoration work and related business/economic interests, to give our "100% pure NZ" brand genuine standing. Sir Paul's final challenge to make New Zealand pest-free may be part of that drive.

Such national leadership by scientists like Sir Peter Gluckman and Sir Paul Callaghan is a new development in our society. New Zealanders place trust in their depth of knowledge and independence from commercial and political interests. Sir Paul was 2011 Kiwibank New Zealander of the Year. Charles is a semi-finalist for the 2013 honour. For him personally, this is a sign of acceptance as a fellow Kiwi – another long-time New Zealand resident Charles and the Allan Wilson Centre have played a role in conserving.

*Professor Charles Daugherty is a Fellow of the Royal Society of NZ, and in 2005 was awarded an ONZM for Services to Conservation and Biology. He joined the academic staff of Victoria University of Wellington (VUW) in 1982, and is now Assistant Vice Chancellor (Research). He is on the University Council, is a board member of the MacDiarmid Institute and Trustee of Zealandia.*



"Arnie" the Tuatara

## SO THIS IS WHAT SUCCESS LOOKS LIKE

Clive Anstey, a consultant to the Allan Wilson Centre on the Tolaga Bay/Uawanui sustainability project it supports, attended the November 2012 graduation of local students from the Eastern Institute of Technology horticultural course run in the Tolaga Bay Anglican Church Hall.



The graduates' delight in this achievement is obvious in these photos. The students supplemented their celebratory fare with a platter of produce from the garden they planted at the back of the Church. The Centre became connected with the Course through the sustainability project, which many of these now qualified people will be able to take part in at a higher level. The future is in their hands, along with a copy of the Uawanui Ruamatua Riverbank Restoration Guide published by AWC, which has practical advice on how to get started.

# VENUS: A QUEST

The power of DNA to establish human relationships and descent – not to mention culpability - has captured the public imagination as much if not more than any other scientific achievement.

Graphic novelist Dylan Horrocks, and his father Roger, an Emeritus Professor of the University of Auckland, had a burning question: are we related to the famous Jeremiah Horrocks, known as the father of British Astronomy, and the first man to anticipate and witness the Transit of Venus in 1639? Their families came from the same area in Lancashire. The rare



Graphic novelist Dylan Horrocks

*Venus: a Quest* was shown at several premiere events around New Zealand last November. This thought-provoking documentary includes interviews with local scientists such as Lisa Matisoo-

Smith, Kate McGrath, Charles Daugherty, and the late Sir Paul Callaghan. Overseas interviewees include the Astronomer-Royal Martin Lord Rees. Topics range from cutting-edge astronomy to nanotechnology to DNA discoveries. And there's also some memorable

*It was Allan Wilson himself who dealt some of the biggest surprises after Darwin when he concluded that humans split from chimpanzees as recently as 5-6 million years ago...*

occurrence of a Transit of Venus in June 2012 re-focused everyone's minds on the question.

The Allan Wilson Centre was the principal funder of a documentary by Shirley Horrocks, Roger's partner and a well-known film-maker, that set out to find the answer. Their quest provided a human interest story on which the Centre could hook information about the latest developments in DNA research and technology, which is transforming our view of ourselves, our history and our place in nature. It was Allan Wilson himself who dealt some of the biggest surprises after Darwin when he concluded that humans split from chimpanzees as recently as 5-6 million years ago, and that every person alive on Earth today descends from one woman who lived in Africa c150-200,000 years ago.

footage of the Transit of Venus celebration at Tolaga Bay and the Forum in Gisborne.

A thousand more New Zealanders may have some surprises in store for them when Lisa Matisoo-Smith analyses their DNA as part of her James Cook Fellowship investigation: *The Longest Journey - From Africa to Aotearoa*.

*Enquiries about viewing the documentary to Centre Administrator, Joy Wood at [j.r.wood@massey.ac.nz](mailto:j.r.wood@massey.ac.nz)*

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