# Allan Wilson Centre for Molecular Ecology and Evolution

Annual Report

six month period to December 2005

# CONTACT US

Allan Wilson Centre for Molecular Ecology and Evolution

Massey University

Private Bag 11-222

Palmerston North

New Zealand

Phone: +64 6 350 5448

Fax: +64 6 350 5626

Email: AWC@massey.ac.nz

*Courier Address*

Level 5

Science Tower D

Riddet Road

Massey University

Palmerston North

This report is also available in downloadable form from our website at:

http://awcmee.massey.ac.nz

# CONTENTS

# STAFF

*Principal Investigators*

David Penny – Massey University - Palmerston North, Distinguished Professor and Co-Director (Research)

Mike Hendy – Massey University - Palmerston North, Professor and Co-Director (Executive)

Charles Daugherty – Victoria University of Wellington, Professor

David Lambert – Massey University - Albany, Distinguished Professor

Peter Lockhart – Massey University – Palmerston North, Associate Professor

Lisa Matisoo-Smith – University of Auckland, Dr

Mike Steel – University of Canterbury, Professor

*Associate Investigators*

Craig Millar – University of Auckland, Dr

Allen Rodrigo – University of Auckland, Professor

Hamish Spencer – University of Otago, Professor

*Post-doctoral and Research Fellows*

David Chapple – Victoria University of Wellington

Lesley Collins – Massey University

Dee Denver – Massey University, Albany

Andrew Dodd – Massey University, Albany

Kirsten Donald – University of Otago

Stephane Guidon – University of Auckland

Jennie Hay – Massey University, Albany

Barbara Holland – Massey University

Leon Huynen – Massey University, Albany

Martyn Kennedy – University of Otago

Kim McBreen – Massey University

Heidi Meudt – Massey University

Hilary Miller – Victoria University of Wellington

Mary Morgan-Richards – Massey University

Nicky Nelson – Victoria University of Wellington

Mark Stevens – Massey University

Rick Stoffels – University of Otago

Siva Swaminathan – Massey University, Albany

Bhalchandra Thatte – Massey University

Steve Trewick – Massey University

Michael Woodhams – Massey University

*Support Staff*[1]

Warwick Allen – Scientific Programmer – Massey University

Jennifer Anderson – Technician, Massey University, Albany

Lorraine Berry – DNA Sequencer Technician, Massey University

Charlie Gao – DNA Sequencer Technician, Massey University, Albany

Abby Harrison – Laboratory Manager, Fiji School of Medicine

Corina Jordan – Part-time Technician, Massey University

Olga Kardailsky – part-time Research Assistant, Massey University

Sue Keall – Administration and Research Assistant, Victoria University of Wellington

Tania King – Technician, University of Otago

Trish McLenachan – Laboratory Manager, Massey University

Sara Mirmoeini – Technician, Massey University, Albany

Dietrich Radel – Technical Assistant, Canterbury University

Judith Robins – Research Manager, University of Auckland

Karen Sinclair – Administrative Assistant, Massey University

Tim White – Scientific Programmer, Massey University

Joy Wood – Secretary, Massey University

Susan Wright – Executive Officer, Massey University

*Students*

Oliver Berry – PhD, Massey University, Albany

Barbara Binney – MSc, Massey University, Albany

Richard Carter – MSc, Massey University

Sylvia Chen - MSc, Massey University

Andrew Clarke – PhD, Massey University

Greg Ewing – PhD, University of Auckland

Ravikumar Gaddam – PhD, Massey University

Gillian Gibb – PhD, Massey University

Stephanie Godfrey – PhD, Flinders University/Victoria University of Wellington

Julia Goldberg – PhD, Massey University

Matt Goode – PhD, University of Auckland

Kelly Hare – PhD, Victoria University of Wellington

Klaas Hartmann – PhD, Canterbury University

Jessica Haywood – PhD, University of Auckland

Simon Hills – PhD, Massey University

Joanne Hoare – PhD, Victoria University of Wellington

Peter Humpfries – MSc, Canterbury University

Michael Knapp – PhD, Massey University

Hayley Lawrence – PhD, Massey University, Albany

Carlos Lehnebach – PhD, Massey University

Libby Liggins – MSc, Victoria University

Angela McGaughran – PhD, Massey University

Katie McKenzie – MSc, Victoria University

Jennifer Moore – PhD, Victoria University

David Philips – MSc, Canterbury University

Melanie Pierson – PhD, Canterbury University

Mort Piripi – MSc, Massey University

Renae Pratt – PhD, Massey University

Kristina Ramstad – PhD, University of Montana/Victoria University of Wellington

Anna Santure – PhD, University of Otago

Klaus Schliep – PhD, Massey University

Lara Shepherd – PhD, Massey University, Albany

Kerryn Slack – PhD, Massey University

Bastiaan Star – PhD, University of Otago

Alice Storey – PhD, University of Auckland

Meredith Trotter – PhD, University of Otago

David Waugh – PhD, Massey University, Albany

David Welch – PhD, University of Auckland

Tim White – PhD, Massey University

*Royal Society of New Zealand Teaching Fellows*

Bernard Beckett – Massey University

Rachel Heeney – Massey University, Albany

*Affiliate Member*

Charles Semple – Canterbury University, Dr

## CHAIRMAN'S REPORT

The Allan Wilson Centre was established in 2002, as part of the New Zealand Government's Centres of Research Excellence initiative. The Centre is based on collaboration between research teams, across four research themes, located at five university sites throughout the country, and headquartered with the main host institution at Massey University's Palmerston North campus. The Governance Board thanks each of the partner institutions and the host, Massey University, for their accommodation and support of the Centre.

Initial funding provided for establishment and operation until 2008. While no ongoing funding is promised, members of the Board have ensured that the Centre is planning for its sustainability, and is well positioned with a strong future research strategy, to take advantage of funding opportunities.

The Governance Board has therefore concentrated on three aspects of the Centre: sustainability, benchmarking against the pre-eminent comparable national and international research organisations for the quantity and quality of its outputs, and the development of research themes which are relevant to the Nation's interests and that will build on the teams' research strengths and fare well in the competition for national resources .

While it is difficult to single out a single research project or publication, one example of the level of international and public interest in the research themes of the Centre is a paper *Shepherd, L.D., Millar, C.D. Ballard, G. Ainley, D.G., Wilson, P.R., Haynes, G.D., Baroni, C. & Lambert D.M. (2005). Microevolution and mega-icebergs in the Antarctic. Proceedings of the National Academy of Sciences USA 102: 16717-16722* which recorded for the first time, micro-evolutionary change in a natural population over a geological time period. The authors identified mutational processes responsible for micro-evolutionary changes. The publication stimulated extensive discussion and was widely reported in the popular press.

An initiative, which will serve all of New Zealand, and change the way in which samples are collected, stored and accessed, is the New Zealand Frozen Tissue Collection. This collaboration between the Centre, the Department of Conservation, and Te Papa will focus on specimens of restricted populations of flora and fauna collected under permit from the Department of Conservation.

One research theme is the evolution and migration of people, flora and fauna across the Pacific, which has lead to the Centre forging strong links with institutions in the South Pacific region. This vital link will encourage knowledge transfer to institutions like the University of the South Pacific in Fiji. This is enhancing regional capacity in molecular systematics and affording opportunities to emerging scientists in Fiji and the Pacific. This relationship is strengthened as we jointly apply for funds and collaborate on research of mutual interest.

The Governance Board has been pleased to see the commitment of the Centre's Directors and senior researchers to encouraging young scientists and post-graduate students, and to communicating the work of the Centre to schools, iwi and the broader community, and thereby fostering public understanding of this complex but very significant field.

The Board congratulates David Penny, Director, Research and Mike Hendy, Executive Director for their outstanding leadership of the Centre. It has an international reputation and is truly fulfilling the original goals of the Centres of Research Excellence initiative. Prof Penny was awarded a Distinguished Professorship by Massey University during the year.

Finally, I and the Governance Board members would like to acknowledge the leadership of Sir Neil Waters, first Chairman of the Governance Board, who, in his two years in this role, set an excellent precedent in guiding the establishment and repute of the Centre.

Dr Seddon Bennington
*Chair of the Governance Board*

## REPORT OF THE AWC SCIENTIFIC ADVISORY PANEL

Independent reviews have proved to be a useful source of performance appraisal and strategic input for the AWC. During the period the AWC was assessed by Dr John Jungck of Beloit College. Excerpts from his Report:

“The Allan Wilson Centre (AWC) builds on an extraordinary legacy of excellence. The staff and students of the AWC have been extraordinarily productive. They have solved major scientific problems, developed new theoretically informed methodologies that have become widely used, and had an enormous impact on New Zealand’s environment and understanding of its rich natural heritage. The AWC addresses problems that face New Zealand and its rich cultural, biological, geological, and economic heritage. Numerous investigators have received awards for their outstanding achievements. The Centre has attracted students from over ten countries who in turn have published co-authored papers with investigators, shared their work in annual meetings of Centre researchers and presented at international scientific meetings. Most importantly, the AWC is engaging post-graduate students and their mentors in a quality educational experience”.

Dr Jungck identified opportunities for the Centre being:

- The preparation of a new generation of world certified taxonomists including the educating of those not seeking a career as a researcher
- Increased opportunities for synergistic collaboration through more frequent interaction and collaboration between staff and students at the sites of the AWC
- The development of a second tier of infrastructure by providing greater opportunities for those in this category.

Challenges mentioned included education and outreach becoming less parochial and more inclusive of diversity. The AWC’s computational infrastructure was considered particularly the securing of greater bandwidth for computations and the preparation of a strategic plan identifying computational infrastructural needs for the next five years.

# EXECUTIVE DIRECTOR'S REPORT

July 2004 marked the half-way point for the projected CoRE funding for the Allan Wilson Centre. The funding for year four and beyond had initially been subject to a major review by the Tertiary Education Commission (TEC), however due to the tight time-frame, our year four funding was granted. The TEC review (undertaken in April 2005) led to a very favourable report and provided a confirmation of continued funding for the Allan Wilson Centre to June 2008.

It is my expectation that we will shortly have the opportunity to bid for another round of CoRE funding, and with that expectation the Investigators are currently undertaking a longer term planning exercise to extend the Centre's programme into the next six years. Accompanying this is the need to plan transitional activities such as succession and recruitment. We have already seen an increasing demand to recognize new high caliber researchers as affiliates to the Centre, together with the observation that many of our current doctoral students and our post-doctoral fellows have an ambition to continue to actively research in their fields and see the Centre as an attractive prospect.

We also received a very useful visit from our Scientific Advisory Panelist, Professor John Jungck (a summary of his report is provided elsewhere). As well as having discussions with most of our researchers, John delivered the third of our three Allan Wilson Centre Lectures, to audiences in each of the five cities of the Centre These followed the lectures delivered by Allen Rodrigo (Auckland) and myself in September and October. My own experience gave me an awareness of the enjoyment in engaging in this outreach to the public of New Zealand.

The CoRE experiment has been breaking new ground, and the inter-relationships between the parties have taken time to develop. I believe the experiment has been highly successful in providing a vehicle for world-class inter-disciplinary and inter-institutional research to be undertaken in New Zealand.

In conclusion I wish to acknowledge the valuable contribution made by the founding chair of our Governance Board, Sir Neil Waters. Sir Neil has taken a strong personal interest in the activities of the Allan Wilson Centre, has assisted us in working through a number of difficult issues, and has crafted the Governance Board to be an effective body giving guidance to the Directors. Thank you Sir Neil for your very valuable assistance.

Mike Hendy
*Executive Director*

*Koil Island Village – Trapping Sites*
*(Project 3)*

## RESEARCH DIRECTOR'S REPORT

We are now well into our fourth year of funding and thus it is appropriate to consider briefly our early achievements before focusing on what we need to aim for in the second half of our initial six-year period. It is sufficient to state that we have built up a strong group of researchers, and that we are one of the largest Centres of Research Excellence in terms of numbers of researchers – graduate students, post docs, Research Fellows and Investigators- even though we are not the largest in terms of funding. Our publication profile in top international journals has been outstanding, and it would be hard for any comparable institute in the world to match the numbers and diversity of investigators who have publications in high impact journals such as Nature, Science, various Nature Reviews and Trends journals, the Proceedings of the National Academy of Science, Genome Research and others. All this is backed up by a solid publication record in journals appropriate for the discipline. One of our tasks is to demonstrate that New Zealand researchers can operate at the top world level.

Thus at the level of graduate students to investigators, publications, and research relevant to our biota, we are doing extremely well. Can we be satisfied? The question is obviously intended to be answered in the negative. There are so many new opportunities on the short-term horizon that we must be alert to continuous change both in question and in technology available. A Centre of Research Excellence must always be thinking about future directions and opportunities. 'Whole genomes' is perhaps too obvious an example; it is now frequently said at meetings that the first thing to get done if working on the conservation of a group is to sequence its genome. Yes, that will be possible soon, and we must be prepared for these new developments. However, it is also increasingly recognized that the genome sequence itself is only the start of a study. We need information on how changes at the DNA level affect gene expression, cellular functioning, and through to the levels of tissues, organs, and organisms and their behaviour. Micro-array and gene expression data is a good start in understanding these complexities and we are beginning with an ideal system of New Zealand plants that are close relatives of the model plant *Arabidopsis*.

There are major problems with phylogenetic analysis on deeper level phylogeny that even whole genomes are not resolving the deeper level phylogenies of multicellular animals. That problem is perhaps at a intermediate level, because there are much deeper phylogeny issues beyond multicellular animals. Indeed, it is realistic to say that deep phylogeny is in complete disarray. Yes, within the Centre we have a good theoretical understanding of the issues that lead to the problems and we must continue to get more of our knowledge into practice.

At the other end of the spectrum, there are exciting opportunities for short term studies of genealogies, populations and very closely related species. There will almost certainly be a burst of reconstructing genealogies, and from that level into many rate measurements using a variety of calibration points, both within New Zealand and in the South Pacific. Everybody has their own list of opportunities. Most times we will not be able to implement them on our own; we will need skills and ideas from other groups within the AWC and elsewhere.

David Penny
*Research Director*

*Herman Mandu, a colleague from the Papua New Guinea National Museum. talking with children on Koil Island (Project 3)*

# RESEARCH PROGRAMME OVERVIEW

The research goal of the AWC is to combine fundamental biological questions, molecular (DNA sequence) data, and mathematics, in order to understand important processes that helped shape present day plants and animals, especially those of New Zealand. On a world scale, our combination of biologists and mathematicians is probably unique, and therefore we aim for research that is at the very best world standard. For convenience, we divide our research into four projects.

Under Rates and Modes of Evolution in Project 1 we test whether measuring rates of DNA sequence change at different times gives the expected acceleration of evolution at shorter times. A related sub-project seeks to understand how changes in the secondary and tertiary structure of proteins affects rates of evolution. Furthermore, we are testing the extent to which the measurable processes of microevolution (as measured in this Project) are sufficient for long term evolution.

Our second Project on Biodiversity is very broad and particularly focuses on New Zealand biota. We have an excellent opportunity to identify dispersal methods that have helped establish the main groups. We have unique animals from which we can learn about probable past events. The (geologically) recent uplift that gave the Southern Alps is a unique opportunity to study recent speciation as new niches become available, and in one case is challenging long held paradigms about the nature of species themselves.

Our Project 3 is on the peopling of the Pacific, identifying their origins and those of their plants and animals. Given the relatively recent date of initial occupation, and the rich archaeological record, the Pacific Islands are arguably the best place in the world to understand the processes involved in human settlement and to assess their impacts on relatively “pristine” island environments.

Finally, Project 4 on new ecological and evolutionary models uses the power of mathematics, together with a strong interaction with biologists, to develop and implement testable models for ecology and evolution. These range from short-term effects such as viral evolution, to very distant events such as optimal conditions for the origin of life. Another sub-project develops better ways for detecting hybridization from sequence data, a topic much neglected by other groups as being far too hard. Project 4 gives us a major competitive advantage with respect to other groups in the world, but needs the strong input from biologists in order to be effective.

In summary, the AWC strives to be at the forefront of Molecular Ecology and Evolution, and we believe we have the ability to maintain ourselves there.

Staff and students of the Allan Wilson Centre.
*Photograph taken at the 2005 Annual AWC Meeting held at Victoria University of Wellington*

# RESEARCH HIGHLIGHTS

**Project One**

**Rates and Modes of Evolution**

*Project coordinated by Prof David Lambert*

*Researchers* *David Lambert, Craig Millar, Peter Lockhart, David Penny, Dee Denver, Andrew Dodd, Jennie Hay, Leon Huynen, Jennifer Anderson, Sara Mirmoeini, Barbara Binney, Lara Shepherd, Oliver Berry, Mary Morgan-Richards, Steve Trewick, Mark Stevens, Gillian Gibb, Renae Pratt, Julia Goldberg, Kerryn Slack, Rebecca Heeney.*


One of the highlights of the period has been the publication and reaction to the paper by Shepherd et al., entitled "Microevolution and mega-icebergs in the Antarctic" which appeared in the Proceedings of the National Academy of Sciences USA. This paper recorded, for the first time, micro-evolutionary changes in a natural population over a geological time period. In addition, the authors were able to identify the mutational processes responsible for the micro-evolutionary change detected. This paper was ranked 5$^{th}$ in the journals most read papers for November 2005 and was featured on the cover of this prestigious journal. The publication stimulated extensive discussion on science website (see Knowledge Transfer section) and was widely reported in the popular press.

Major advances in other areas include the being able to develop multiplex PCR methods and thereby sequence 37 complete mitochondrial genomes of Adélie penguins, up to 44,000 years old. This will now enable a major advance in the estimation of evolutionary rates, particularly of complete mitochondrial genomes.

Two areas of high points have been

1. Events preceding the Cretaceous/Tertiary (K/T) boundary, and the reasons for the decline and eventual extinction of both pterosaurs and dinosaurs.

2. The question of what is being measured by 'rate' estimates within populations a compared with distantly diverged organisms.

The first question requires firstly on an accurate phylogenetic tree, onto which rate and time estimates can be made from the molecular clock assumption. Here very good progress has been made with mammals, and especially birds. Work includes an integration of the oldest reported penguin fossils, new mitochondrial genomes, phylogenetic trees, date estimates, fossil footprints, and an analysis of diversity of pterosaurs through time. Such an integrated approach has given a detailed picture of the expansion of modern birds, and decline of earlier flying groups, well before the impact that marks the end of the Cretaceous.

We have worked for a few years trying to identify a shorter term and longer term rate for RNA viruses. Hepatitis B is particularly useful because we have a longer rate from archaeological dates as early Polynesians moved into the South Pacific. For a shorter term rate we have blood samples taken from the same individuals 14 years apart. The longer term rates are quite well established, using complete viral genomes. However, we will need new technology to get enough of the diversity for populations within individuals.

There has been little progress in recent years in improving the reliability of phylogenetic reconstruction for anciently diverged organisms, or even in answering the question "how much historical information is retained in sequence data?" A paper (Lockhart & Steel, 2005) provides a theoretical framework for understanding the evolutionary properties of protein sequences, and how these properties may mislead efforts to reconstruct history.

Lockhart et al, 2005, provides the strongest empirical evidence to date of the asymmetric nature of sequence evolution. In this paper the relationship between evolutionary properties of data and the effect that such model misspecification has to mislead tree building is discussed.

**Project Two**

**Biodiversity**

*Project coordinated by Prof Charles Daugherty*

*Researchers* *Charles Daugherty, David Lambert, Peter Lockhart, Hamish Spencer, Craig Millar, David Chapple, Kirsten Donald, Nicky Nelson, Kim McBreen, Martyn Kennedy, Sue Keall, Trish McLenachan, Hilary Miller, Olga Kardialsky, Julie Allsop, Angelique Aschrafi, Hayley Lawrence, Corina Jordan, Ravikumar Gaddam, Kelly Hare, Joanne Hoare, Michael Knapp, Carlos Lehnebach, Libby Liggins, Katie McKenzie, Hilary Miller, Jennifer Moore, Mort Piripi, Tania King, Kristina Ramstad, Richard Carter, Stephanie Godfrey, Angela McGaughran*

*MHC and reproductive ecology of tuatara*

Methods have been developed to measure class I MHC variation, and work has begun to measure variation in island populations of tuatara. Preliminary data indicate that the large Stephens Island population has high levels of variation, while variation in the Brothers Island population is significantly reduced.

Lab work was conducted to extract DNA from tuatara blood samples previously collected from Stephens Island. These individuals will be genotyped (using microsatellite loci) to gain a better understanding of population structure and dispersal patterns on the island. Field work was conducted to radio track female tuatara (that were observed mating in March 2005) to their nests. From these nests, three clutches of eggs were removed and taken for incubation. They will ultimately be used for paternity analyses that will help us better understand the mating system of these reptiles.

*What are the biological effects of global warming?*

A third tuatara nesting season has been monitored on Stephens Island adding to data on nest characteristics and female nesting behaviour which will be analysed to determine the impacts of global warming on sex ratios.

Translocating tuatara to the mainland: Tuatara, reptiles that outlived the dinosaurs, were returned to the New Zealand mainland for the first time in over 200 years in December 2005. The translocation of 70 adults from Stephens Island into Karori Wildlife Sanctuary represents a turning of the tide for tuatara conservation - they are finally being restored to areas in the largest part of their former range from which they were exterminated by introduced mammals. The translocation was managed by staff of the AWC at Victoria University of Wellington, in collaboration with the Karori Wildlife Sanctuary, the Department of Conservation, and the local tribe from the source area for the tuatara, Ngati Koata. The translocated tuatara are being monitored to investigate development of territories in new locations, and impacts on tuatara of low levels of mice reinvasion, a problem affecting fenced mainland islands. Parasite loads, condition, growth and territory size of individuals will be investigated. In addition, information is being gathered on territory establishment by tuatara on Stephens Island in the plots from which the translocated animals were removed.

Mainland islands are important areas for future conservation of tuatara in the face of global warming. They offer a greater variety of nesting habitat for a species that has its sex, and hence sex ratios of populations, influenced by environmental temperatures. Increasing global temperatures may mean that more tuatara hatchlings are male, threatening population persistence, according to results from research on the largest population of tuatara (Stephens Island), but more variable nesting habitat and a greater latitudinal range of populations may allow tuatara more choice over nesting sites and hence production of both sexes. Tuatara have survived climatic upheavals in the past, but human influences have restricted their distribution, narrowing their options for responses to the changing environment. Research into nesting ecology, sex determination and translocation techniques now allows us the chance to, in part, reverse the consequences of our past actions.

Parasitology of tuatara: This project investigates the host-parasite ecology of tuatara on Stephens Island, and how a territorial population's structure affects parasite transmission. Samples collected were processed to measure blood parasite loads and preliminary data analyses were conducted to examine seasonal and demographic patterns of infection. Field data were collected and preliminary tick micro habitat choice experiments were conducted during a one month visit to Stephens Island.

Nest site choice of tuatara: Since tuatara have temperature-dependent sex determination, it is possible that an increase in temperature resulting from global warming could lead to highly male-biased sex ratios in wild populations. However, tuatara have survived through periods of climate change in the past, suggesting that they have some mechanism to compensate for the effect of temperature changes on offspring sex ratio. Experiments will be conducted to determine what cues females use when choosing a nest site and assess whether these cues can be used to attract nesting females and thereby lead to establishment of a new nesting rookery. Understanding why females choose certain nest sites will allow researchers to predict the potential effects of global warming on tuatara populations, the success of established nesting rookeries, and the likelihood of new sites being used as rookeries. Additionally, knowledge of the microhabitat features and environmental cues used by females when choosing a nest site will ensure that suitable nesting habitat is made available to populations of re-introduced tuatara.

*Why are NZ lizards rare on the mainland?*

A suite of introduced mammalian predators have wreaked havoc with New Zealand lizard assemblages on the mainland: many lizard populations have become extinct with the new form of predation, and the future of others that remain sympatric with mammals seems uncertain. Our research into causes for rarity of lizards now coexisting with mammals is well underway. Laboratory-based work into the olfactory ability of NZ lizards to detect and behaviourally respond to native and introduced predators is now complete and being analysed. Field work involving a radio telemetric study of Duvaucel's gecko behaviours in the presence and absence of kiore (introduced rats) is now complete. While NZ lizards do not display an olfactory ability to detect introduced predators, behaviour of lizards in sympatry with mammals is markedly different to that of lizards that remain under a natural predation regime. Furthermore, while introduced mammals are known to affect lizard population structure, it also seems that they affect plastic behaviours such as micro- and macro-habitat use and retreat site selection, as evidenced by a dramatic behavioural shift in a Duvaucel's gecko population just 6 months after mammal eradication.

*Skink phylogeny*

This research project aims to examine the origin and evolution of the New Zealand skink fauna. A molecular phylogeny is almost completed for all species in the New Zealand skink radiation based on mitochondrial and nuclear DNA sequences. Parallel morphological work is also being completed to describe several new skink species in New Zealand. The phylogeography of the New Zealand common skink (*Oligosoma* *nigriplantare polychroma*), including the Chatham Islands subspecies (*O. n. nigriplantare*) is being examined. Preliminary evidence indicates that the Chatham Islands subspecies is genetically divergent from the mainland common skink. However, relatively little genetic divergence was found between islands within the Chathams group. The phylogeography and taxonomy of the spotted skink (*O. infrapunctatum*) is also being investigated. Genetic data from three mitochondrial genes have so far uncovered deep genetic divergences within the group and show a unique biogeographic pattern which will be used to test hypotheses about the influence of historical processes in New Zealand on the evolution of its fauna. The phylogeography of McCann's skink (*O. maccanni*) and the brown skink (*O. zelandicum*) have been examined. McCann's skink was found to exhibit strong phylogeographic structuring that may be attributable to mountain building events since the Pliocene and/or Pleistocene glaciation. In contrast, the brown skink displayed relatively little genetic structuring across its distribution.

*Katie McKenzie showing Helen Clarke a tuatara at Karori Wildlife Sanctuary after the translocation. Katie McKenzie is a Masters of Science student supervised by Dr Nicky Nelson, Prof Charles Daugherty is on the far right.*

*The Royal Society of New Zealand Tuatara project, in collaboration with the AWC*

*Traditional ecological knowledge of tuatara*

Maori traditional ecological knowledge (TEK) of tuatara was recorded through semi-directed interviews of kaumatua (elders) of Te Atiawa and Ngati Koata iwi in early 2004. These iwi are the kaitiaki, or guardians, of North Brother and Stephens Islands, some of the few remaining islands that tuatara still inhabit today. Interview records have been analysed for ecological and cultural content. Results are summarised in a final report entitled: *Species and cultural conservation in New Zealand: Māori traditional ecological knowledge of tuatara.* Final iwi approval for public dissemination of the report is expected.

*Conservation genetics of the Chatham Island Taiko*

We are isolating microsatellite DNA loci by the construction of a genomic library of the endangered Taiko. During the period work has progressed on the library phase of the project. Participation in a field trip to the Chatham Islands assisted in obtaining seven more Taiko blood samples, which were then DNA sexed, genotyped and sequenced. Consequently, we now have samples from the entire known living population. Hence we will be able to directly measure (as opposed to estimate) allele frequencies in this species. Methods for sequencing two regions of the mitochondria have been developed and sequencing is almost completed for all adult Taiko samples and some chicks. Results show more genetic variation than expected. For the first time, ancient DNA has been successfully extracted and amplified from sub-fossil Taiko bones. Results so far show haplotypes not seen in the contemporary population.

*The Royal Society of New Zealand Tuatara project,*
*in collaboration with the AWC*

## Project Three

## Human settlement of Aotearoa/New Zealand

*Project coordinated by Dr Lisa Matisoo-Smith*

*Researchers* *Lisa Matisoo-Smith, David Penny, Judith Robins, Simon Hills, Abby Harrison, Melanie Pierson, Andrew Clarke, Alice Storey*

The general objective of Project 3 is to better understand the timing and process of prehistoric human migration and the effects of humans on Pacific island environments. We investigate the trail of human settlements in the Pacific through fully integrated DNA studies of not only humans but their commensal and domesticated plants and animals. Analyses of modern human genetic variation focusing on mtDNA, Y-chromosome and Hepatitis B variants across and among Pacific populations provide vital evidence of human adaptation and evolution in the unique Pacific environments, in addition to contributing to issues of health and wellbeing of Pacific peoples. Both the commensal approach we employ and the methods of analysis we are developing and using are innovative and multidisciplinary – bringing together fields as diverse as anthropology, mathematics, botany, zoology and bioinformatics all investigating questions from a molecular perspective. Our research is also multicultural in that we work closely with *iwi* and other indigenous populations in the Pacific.

*Analyses of human genetic variation in the Pacific – mtDNA, Y-chromosome and hepatitis B studies*

This topic is being addressed with a number of different datasets including analyses of complete mitochondrial genomes of Pacific populations and comparisons with other populations in the wider region (eg Taiwan). We have applied new methods of analysis (the MinMax squeeze) to this dataset in order to better understand the various possible scenarios of population migration and interaction. Research collaborations between the AWC, Cambridge University and medical workers in Papua New Guinea and the Fiji School of Medicine are addressing not only evolutionary questions (what Y chromosome variation can tell us about population origins and histories), but also have significant medical contributions, for example understanding the transmission and evolution of Hepatitis B. Ancient DNA analyses of Pacific populations, most importantly the DNA of the Lapita skeletons recently recovered from Vanuatu, allow us to identify the mitochondrial haplotypes of the first Lapita colonists to settle Remote Oceania. These ancient skeletal samples have recently been obtained and early results are promising regarding the preservation of mtDNA in the remains.

*Commensal approach to tracking human migrations*

Human migrations are tracked through the analyses of genetic variation in animals (rats, pigs, dogs and chickens) and plants (sweet potato and bottle gourd) that were transported by Pacific peoples as they settled the region. Philippine samples of *Rattus exulans* were obtained from the Field Museum in Chicago and mtDNA analyses of those are complete. Collections of *Rattus* species from New Guinea are underway with samples being collected on Koil Island, off the coast of Wewak. Contacted researchers from the CSIRO in Canberra have agreed to provide additional samples and are interested in establishing a joint project on genetic variation in *Rattus rattus*. Additional *Rattus* species have been requested from an will be provided by the South Australian Museum. We have addressed the (mis)identification of a sample as *Sus bucculentus* – a species thought to be extinct. Collection and DNA extraction from archaeological chicken bone from across the Pacific and from Asia and South America is underway. The plant side of the commensal project is productive with both the primary phases of the sweet potato and bottle gourd research complete. This primary phase has highlighted several potentially exciting areas for future research.

*Human impacts and Pacific biodiversity*

Fieldwork in New Guinea has resulted in new research relationships being established with AWC and the National Museum of Papua New Guinea. This is a multidisciplinary project which, in addition to collecting key samples from the New Guinea region, also provides training in the development and application of new methods of analyses incorporating molecular, population genetic, chronometric, and archaeological data.

All of the planned research for Year 4 is progressing well, however, two areas which were dependent on obtaining additional external funding will not proceed: investigation of paper mulberry as a commensal marker and DNA barcoding and conservation biology in the Pacific.

**Project Four**

**New Ecological and Evolutionary Models**

*Project coordinated by Prof Mike Steel*

*Researchers* *Mike Steel, Mike Hendy, Allen Rodrigo, David Penny, Charles Semple, Barbara Holland, Hamish Spencer, Rick Stoffels, Tim White, Lesley Collins, Bhalchandra Thatte, Stephane Guidon, Michael Woodhams, David Bryant, Greg Ewing, Matt Goode, Klaas Hertmann, Peter Humpfries, James Matheson, David Philips, Sylvia Chen, Klaus Schliep, Bastiaan Star, Jessica Hayward, David Welch, Anna Santure, Meredith Trotter, Bastiaan Starr*

Considerable progress was made on algorithms for optimizing phylogenetic diversity, and solving cases of the `Noah's Ark problem'. Further work is also underway with probability theorists on quantifying phylogenetic signal, and on understanding processes that mislead phylogenetic inference.

Research into the analysis of serially sampled data within a subdivided population when some demes are not sampled is nearing completion as is work on the molecular epidemiology of Feline Immunodeficiency Virus. Research on codon models for serially sampled data has also progressed.

A previous AWC sabbatical visitor, Professor Jotun Hein from Oxford University, helped in the development of a new theory aimed at reconstructing pedigrees from genomic data.

# RESEARCH EXCELLENCE

### *Multidisciplinary research programme*

The overarching science goal of the Centre is to give an unprecedented understanding of New Zealand's biota, its past and its future. The Centre is multidisciplinary in that it comprises world-class evolutionary biologists, mathematicians, and ecologists working together to unlock secrets of our plants, animals, and microbes. How did they get here? How fast does evolution happen? What underlying genetic and ecological processes explain the evolution of our biota? How might these processes affect us in the future?

Whilst the biogeography of New Zealand is unique, it provides models for investigating general processes that underpin the nature of complex biological systems, biodiversity and ecosystems. An innovative series of research projects range from molecular rates of evolution, biodiversity, through to molecular anthropology and mathematical models.

Prof Hamish Spencer was appointed an investigator in another CoRE, the National Centre for Growth and Development, bringing his expertise in evolutionary explanations and theory into medical research. He was also appointed an Honorary Research Fellow at the Liggins Institute, University of Auckland.

### *Innovative approach to research*

Jo Hoare (Project 2) is one of the first to use small transmitter technology on NZ lizards to build a comprehensive study addressing the question of impacts of introduced rodents on behavioural ecology of cryptic geckos.

Dr Hilary Miller (Project 2) has developed a new method of DNA sampling for tuatara, which will improve the ability of researchers to undertake large-scale population genetics studies on reptiles. This method uses cloacal or buccal (cheek) swabs and is much less invasive than traditional methods such as blood sampling and toe clipping. (Ref: Miller (2006) Cloacal and buccal swabs are a reliable source of DNA for microsatellite genotyping of reptiles.

### *High research capability*

Professors David Penny and David Lambert were promoted to Distinguished Professors at Massey University.

Dr Hamish Spencer was appointed to a Personal Chair at the University of Otago.

A postdoctoral Fellow, Dr Dee Denver was appointed to a faculty position at Oregon State University.

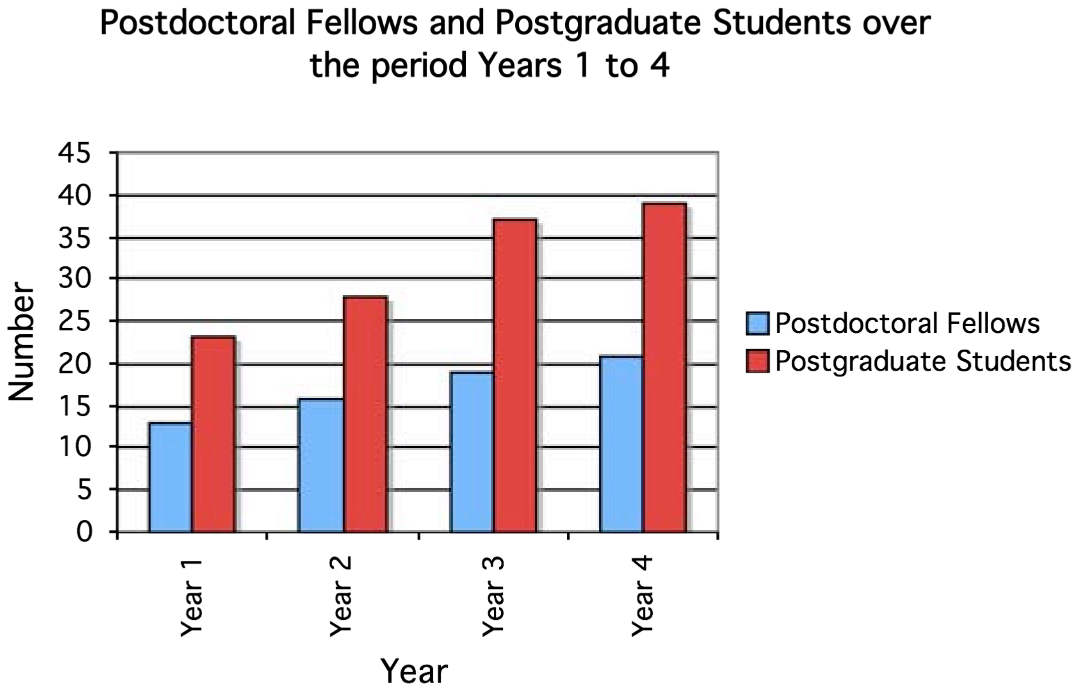
Affiliates appointed to the Centre during the period were

- Dr Nicky Nelson – Victoria University of Wellington
- Dr Anne La Flamme – Victoria University of Wellington
- Dr Peter Ritchie – Victoria University of Wellington
- Dr David Bryant – University of Auckland
- Dr Alexei Drummond – University of Auckland.

## KNOWLEDGE TRANSFER

***Postgraduate and Postdoctoral Training***

The CoREs have a strong role in the training of postgraduate students and in exposing students to career opportunities. The number of students trained in the AWC has grown over the life of the Centre and this number is predicted to continue to grow.




The AWC hosts a number of research students enrolled at various overseas universities, who come to the Centre for some of their research work, staying with the Centre for up to one year. Comments received indicate that the students value their time at the AWC; the access to facilities, expertise, ability to attend top conferences. The ease with which AWC students secure postings in top international laboratories is a further indication of the high calibre of AWC students and their training. In some instances our students travel overseas to undertake some of the postgraduate research, traveling to work with acknowledged experts in their field.

Students chosen to enter the AWC postgraduate programme have strong all-round skills. Students are encouraged to consider more than their immediate research training but also their future within the scientific community and to identify additional skills which will assist them to reach their potential.

### *Academic Publication*

Over the six month period which this report covers 24 papers were published in international, refereed journals by Centre staff and students.

Donald, K.M., Kennedy, M. & Spencer, H.G. (2005). Cladogenesis as the result of long-distance rafting events in South Pacific topshells (Gastropoda, Trochidae). Evol 59:1701-1711. This paper was listed by the Faculty of 1000, a post-publication evaluation assessment considering recommendations of over 1000 leading scientists, in its rankings. This paper was also chosen as the front cover story for this issue of Evolution.

Shepherd, L.D., Millar, C.D., Ballard, G., Ainley, D.G., Wilson, P.R., Haynes, G.D., Baroni, C. & Lambert, D.M. Microevolution and mega-icebergs in the Antarctic. PNAS 2005 102: 16717-16722. This papers was ranked 5$^{th}$ in a list of the journal's most read papers in 2005, with the paper also featuring on the front cover of the issue of the journal.

The 2005 December issue of the Marsden Fund "Marsden Fund Update" featured the research of David Penny in an article titled "How does evolution work?" The research of David Lambert into rates of evolution was also highlighted.

### *Conferences/Workshops*

During the period of this Report 20 presentations were given by AWC staff and students.

The AWC has been successful in attracting international conferences to New Zealand, with the international Evolution meeting coming to our shores in 2007. Furthermore a number of Workshops are being organized in international venues following the securing of funds by AWC investigators.

### *Collaborative research arrangements*

The AWC investigators have a large number of collaborations both within and outside of New Zealand. These collaborations are strengthened through the hosting of sabbatical visitors within the Centre and the reciprocal arrangements made for the hosting and training of students associated with the Centre and the collaborator. On many occasions this collaboration is strengthened further when a graduate is placed within the laboratory of the collaborator for their postdoctoral period.

During the period of this report the Centre hosted sabbatical visitors Dr Keith Crandall of the Department of Integrative Biology, Brigham Young University, Utah and A/Prof Andrew Young of the Department of Biochemistry and Molecular Biology at Dalhousie University, Canada.

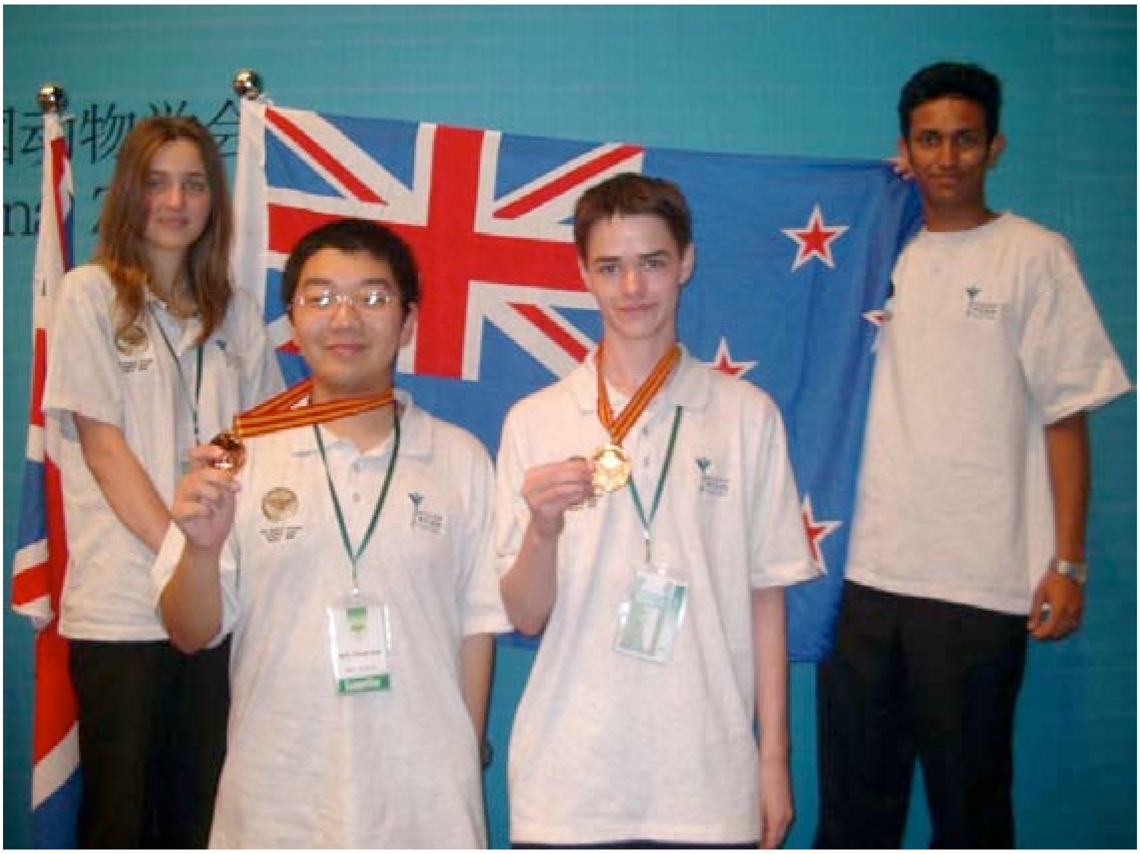
### *Profile of the Allan Wilson Centre*

It is vital that the Centre maintain a high profile throughout the world and this is achieved through a number of means. Those in the Centre who present their work at conferences are required to introduce the Centre during their first few slides. The Centre has a number of initiatives to raise its profile continually; these include a semi-annual newsletter sent to all New Zealand secondary schools and the sponsoring of stationery at international conferences.

The research undertaken in the Centre continues to attract media interest with work on the release of tuatara in the Karori Wildlife Sanctuary and shifting icebergs and penguin evolution being of prime interest.

During the period the Centre assisted with the training and sponsoring of secondary school students chosen to represent New Zealand at the International Biology Olympiad held in China.

The “Tuatara: a taonga for the people of New Zealand” project attracted high local media interest – 19 newspaper articles and 3 radio interviews reported the programme’s activities in centres around New Zealand in 2005.



*New Zealand secondary school students won two bronze medals at the International Biology Olympiad held in China*

*International Connections*

International connections are vital for the success of the AWC research programme as we seek to understand important biological processes. Relationships with tertiary institutions in the South Pacific, especially the University of the South Pacific in Fiji, have strengthened as we develop and are awarded joint grant applications for the development of a capacity in molecular systematics in Fiji. The relationship will progress further as investigators in the AWC co-supervise PhD students based in Fiji. This relationship will:

- Encourage knowledge transfer from New Zealand to Fiji;
- Allow the establishment of in-region capacity in molecular systematics by the support of outstanding emerging young Fijian scientists;
- The promotion of understanding within the national and international community of the importance of Fijian and Pacific biota.

During this period new international collaborations have been established.

- Between the AWC and the National Museum of New Guinea.

- Dr Michael Hoefreiter, Max Planck Institute for Evolutionary Anthropology, Leipzig, Germany.
- Dr Hilary Miller and Prof Scott Edwards, Department of Organismic and Evolutionary Biology, Harvard University, USA (tuatara genomics).
- Dr Nicky Nelson, and Profs Scott Mills and Winsor Lowe of University of Montana. (modelling future viability of tuatara populations).
- Dr Nicky Nelson and Drs Arthur Georges and Sean Doody of University of Canberra (nesting ecology of reptiles).
- Timothy Dorn and Thomas LoFaro, Department of Mathematics and Computer Science, Gustavus Adolphus College, Saint Peter, USA
- Tom Eichhorst, Rio Rancho, New Mexico, USA.

Tim Heupink from the Department of Biotechnology, Van Hall Institute in Leeuwarden from The Netherlands worked in the AWC on a 6-month undergraduate internship with Project 1 He has now moved to Beth Shapiro's ancient DNA group at Oxford University.

Manuel Irimia of the Universidad Complutense de Madrid is undertaking a one year research project associated with Project 2.

Project 4 hosted six international exchange students from Dresden University for a six month period.

***Relationships with end-users***

Relationships with the Department of Conservation (DoC) have been strengthened: Data collected by DoC staff in the 1980s on lizard populations at Pukerua Bay initiated a concerted effort to monitor the site, particularly out of concern for the last mainland population of a large, endangered, nocturnal skink (*Cyclodina whitakeri*). A pitfall trapping programme at the site has resulted in comprehensive data which can be examined in light of lizard community changes at a mainland site exposed to mammalian predators, and can act as a case study for mainland lizard populations in general. A further collaboration with DoC is analysing the data and recommending management solutions for such ecologically important mainland sites.

A collaboration between DoC, the Karori Wildlife Sanctuary and Ngati Koata iwi on the first translocation of tuatara to a mainland site, is building on an existing long-standing relationship involving research and conservation activities.

## THE INTERNATIONAL BIOLOGY OLYMPIAD

The Allan Wilson Centre recognises the importance of developing an interest in biology right from the school years and for this reason was actively involved in the 2005 International Biology Olympiad. The Centre assisted by sponsoring the travel of qualifying students to attend a Workshop over the school break in Auckland, and in the training of the students over that period. The Centre also made sure that the members of the New Zealand team were instantly recognisable by printing T-shirts and polo shirts for those chosen to travel to China and represent New Zealand.

In 2005 New Zealand entered its first-ever team in the International Biology Olympiad (IBO) competitions, held this year in Beijing, China. The IBO is a competition for secondary school students, which tests students' skill in tackling biological problems and dealing with biological experiments.

This involves a week-long program of intense scientific competition. Competitors sit six hours of practical based laboratory exams on one day followed by another six hours of theory exams on a second day. As you can imagine, this is an extremely stressful event, and so team selectors must look not only for students with the necessary academic qualifications and skills, but also for those with the personal qualities that allow them to perform under pressure. Not only are the students working in a pressure-cooker environment. Two adults from each country travel with their teams – one a theory and one a practical examiner. Before the students sit the exams, the examiners themselves are sequestered for many hours at a time, determining the fairness and validity of each and every question. This sometimes takes until 4am on the day of the exam, after which the team of examiners then meets to review the students' answers and performance. The accompanying adults are definitely not along for the ride!

Obviously we need to ensure that the best possible team was chosen to represent New Zealand in the IBO. This is done through the NZ International Biology Olympiad (NZIBO), which in 2004-05 consisted of 3 phases:

1. Over 70 top students, from all over New Zealand, entered a national exam, held last October. The top 30 students had their achievement recognised with bronze medalist certificates.
2. We then ran ten theory tutorials from December 2004 – March 2005. These tutorials were designed to begin to bring the students up to speed with the level of knowledge that would be expected of them in the Olympiad itself. The tutorials were followed in March 2005 by an IBO theory exam.

   The top 13 students (silver medalists) were determined on the basis of this exam, and went forward to the practical training camp held – in Auckland and Hamilton – in April 2005.
3. At the practical camp the students learned a wide range of laboratory techniques and practical skills, in preparation for the practical exams. They were assessed on their ability as well as how they performed under pressure. The final New Zealand International Biology Olympiad team (gold medalists), selected at the end of this camp, were Eric Liu, Cameron Cole, Chinthaka Samaranayake and Kate Duggan. They traveled to Beijing with 2 teachers (Max Thompson & Angela Sharples), who represented New Zealand on the IBO examination jury panel.

   Angela's diary of the trip makes it clear that both students and examiners were under huge pressure to perform – but they also found time for water fights, shopping trips, and a tour of the Great Wall. Not only was the trip a wonderful experience for all concerned, but – on our first attempt in this highly competitive international event – the team brought home two bronze medals! Congratulations to Cameron and Eric on this achievement, and to Chintaka and Kate, who missed out on the medal placings by just a single mark.

   China was the top-ranked country overall, with NZ in the middle of the International ranking. This is a great result for a first attempt, especially when you consider that we only had a few months to prepare our students! We've learned a great deal from the experiences of the team, and from Angela and Max in their capacity as examiners, and this will all go towards improving and enhancing our preparations for the 2006 event.

   Jules Robson

   *Biology Educators Association NZ (BEANZ)*

### *Public Outreach*

The Centre is committed to outreach and dissemination of research results to the general public.

On a collecting tour of New Guinea Dr Lisa Matisoo-Smith gave 3 lectures to the non-scientific community in the Wewak region high schools on “Commensal animals and plants and their use in the tracing of human settlement patterns”, and on DNA in general. On 21st July the Australian Broadcasting Corporation (ABC) “Catalyst” programme, a general science documentary series, aired throughout Australia featured a 30 minute segment on the kiore research of Dr Matisoo-Smith and the collaborative relationship with Ngatiwai, *kaitiaki* of the kiore.

“Tuatara: a taonga for the people of New Zealand”, a joint project between Victoria University of Wellington, Te Atiawa iwi, The Allan Wilson Centre, and the San Diego Zoo was successfully completed in December. A Powerpoint presentation conveyed how science and technology play an essential role in supporting the conservation of native biodiversity. Approximately 3500 members of the New Zealand public participated in the programme that visited schools in Wellington, New Plymouth, Whakatane, Whangarei, Greymouth, Picton and Blenheim. The project has enabled iwi presenters to develop knowledge and skills that will assist them in developing further conservation education outreach programmes within their own rohe. Iwi presenters in the programme have been positive role models in demonstrating to other young Māori the value of science and further education.

Sue Keall was selected to receive a General Staff Award for Excellence for 2005 at Victoria University of Wellington, in recognition of her outstanding contribution and leadership in this project.

In November the popular journal “New Scientist” featured Prof Lambert’s paper on the microevolution of Adelie penguins in their research news and discovery section. This research was also picked up in six local and international publications as well as on a number of science-related websites.

Staff of the AWC based at the University of Canterbury were featured in a TV series "Cyberworld", episode 12, which highlighted latest research in DNA being undertaken at Canterbury.

The AWC hosted the second "Allan Wilson Centre Lecture Series". For the first time the series was presented at a number of sites across New Zealand i.e. Auckland, Palmerston North, Wellington, Christchurch and Dunedin. Presenters in this series were:

- Prof Allen Rodrigo from the University of Auckland, "Tending Darwin's Garden: growing evolutionary trees with genes on"
- Prof Mike Hendy from Massey University, Palmerston North, "Figuring evolution: the kiwi connection"
- Prof John Jungck of Beloit College, Wisconsin, USA, "Biological patterns through the eyes of artists, biologists and mathematicians".


*Maori feather cloak – an object of investigation in Project One*

# CONTRIBUTION TO NATIONAL GOALS

Of the National Goals relevant at the time of CoRE selection, some are more relevant to the AWC than others and focus on our unique vision and activities.

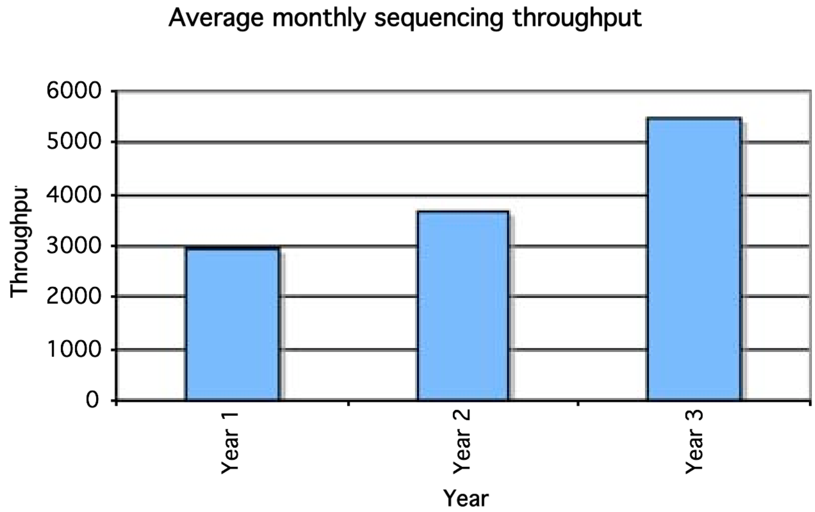
***Innovation***

Barcoding is still a novel innovation for the identification of species. Prof Lambert is a member of an international collaborative effort, the Consortium for the Barcoding of Life, with his brief being to barcode the birds of Australasia and Antarctica.

***Economic Development***

A recent report titled "The Economic Impact of CRC's in Australia: Delivering Benefits for Australia" found that the average time between the formation of a CRC and the commencement of economic impacts was nine years. The AWC is in its fourth year of operation.

The AWC Genome Facility is New Zealand's leader in commercial DNA Sequencing and Genotyping. Over the period there has been a 63% increase in the number of sequences and genotypes processed by the facility.




***Social Development***

"Tuatara: a taonga for the people of New Zealand", a joint project between Victoria University of Wellington, Te Atiawa iwi, The Allan Wilson Centre, and the San Diego

Zoo has enabled iwi presenters to develop knowledge and skills that will assist them in developing further conservation education outreach programmes within their own rohe. Iwi presenters in the programme have been positive role models in demonstrating to other young Māori the value of science and further education.

The Centre was awarded funding from the Royal Society of New Zealand for Teacher Fellowships to fund research undertaken by Ms Rachel Heeney (Epsom Girls' Grammar School) and Mr Bernard Beckett (Onslow College).

***Environmental sustainability***

The barcoding initiative of which the Allan Wilson Centre is an active participant could help in the development of methods and procedures for biosecurity.

***Fulfilling the obligations of the Treaty of Waitangi***

- The Centre awarded its first PhD Scholarship targeted to Maori students to Ms Gillian Gibb.
- A joint project with the Te Atiawa iwi has developed knowledge and skills in iwi to assist them to further conservation and education outreach programmes in their rohe. Iwi presenters in the programme have been positive role models in demonstrating to other young Māori the value of science and further education.
- Work with Rangi Te Kanawa, Ranui Ngarimu from the New Zealand Maori Weavers Association *Te Roopu Raranga Whatu o Aotearoa* and Hokimate Harwood from Te Papa to develop a programme for the identification of the origin of feathers in cloaks and kete.
- A key point in the Australian Catalyst TV programme which was associated with Project Three was the importance of relationships between iwi (in this case Ngatiwai) and science researchers and the benefits of those relationships to both parties.

# PUBLICATIONS

Total number of publications for the period: 24

Chan, C., Ballantyne, K.N., Lambert, D.M. and Chambers, G.K. 2005. Characterization of variable microsatellite loci in Forbes' parakeet (*Cyanoramphus forbesi*) and their use in other parrots. *Conservation Genetics* 6: 651-654.

Chapple, D.G. (2005). Life history and reproductive ecology of White's skink, *Egernia whitii*. *Australian Journal of Zoology* 53: 353-360.

Donald, K.M., Kennedy, M. & Spencer, H.G. (2005). Cladpogeneis as the result of long-distance rafting events in South Pacific topshells (Gastropoda, Trochidae). *Evol* 59:1701-1711.

Donald, K.M., Kennedy, M. & Spencer, H.G. (2005a). The phylogeny and taxonomy of austral; monodontine topshells (Mollusca: Gastropoda: Trochidae), inferred from DNA sequences. *Mol Phylo* & Evol 37:474-483.

Erickson, D. L., Smith, B. D., Clarke, A. C., Sandweiss, D. H., Tuross, N. (2005). An Asian origin for a 10,000-year-old domesticated plant in the Americas. *Proceedings of the National Academy of Science, USA* **102**(51): 18315-18320.

Gartrell, B. and Hare, K.M. (2005). Mycotic dermatitis with digital gangrene and osteomyelitis, and protozoal intestinal parasitism in Marlborough green geckos (*Naultinus manukanus*). *New Zealand Veterinary Journal 53(5):* 363-367.

Gluckman, P.D., Hanson, M.A., & Spencer, H.G. (2005). Predictive adaptive responses and human evolution. *Trends in Ecol & Evol* 20:527-533.

Hare, K.M. and Cree, A. (2005). Natural history of *Hoplodactylus stephensi* (Reptilia: Gekkonidae) on Stephens Island, Cook Strait, New Zealand. *New Zealand Journal of Ecology 29(1):* 137-142.

Hare, K.M., Miller, J.H., Clark, A.G., and Daugherty, C.H. (2005). Muscle lactate dehydrogenase is not cold-adapted in nocturnal lizards from cool-temperate habitats. *Comparative Biochemistry and Physiology, Part B 142*(4): 438-444.

M.D. Hendy, M.D. (2005). Hadamard Conjugation: An analytic tool for phylogenetics, chapter 6, pp 143-177, Mathematics of Evolution and Phylogeny, ed. O. Gascuel,

Holland, B. R., F. Delsuc, and V. Moulton. 2005. Visualizing conflicting evolutionary hypotheses in large collections of trees: Using consensus networks to study the origins of Placentals and Hexapods. *Syst. Biol*. 54: 66-76.

Kennedy, M., Holland, B.R, Gray, R.D. & Spencer, H.G. (2005). Untangling long branches: Identifying conflicting phylogenetic signals using spectral analysis, neigbor-net, and consensus networks. *Syst Biol* 54:620-633.

Lambert, D.M. 2005. Ancient DNA from the 'Southern End of the World'. 60th Cawthron Lecture, Cawthron Institute, Nelson.

Lockhart, PJ, Novis, P, Milligan, BG, Riden, J, Rambaut, A 7 Larkum, AWD. 2005 Heterotachy and Tree Building: A Case Study with Plastids and Eubacteria *Mol Biol Evol* 23, 40-45.

Lockhart, P & Steel, M. (2005). A tale of two processes. *Syst Biol* 54:1-4.

Matisoo-Smith, E, K Roberts, N Welikala, G Tannock, P Chester, D Feek and J Flenley , 2005. DNA and pollen from the same Lake Core from New Zealand. Pp. 15-28 In C.M. Stevenson, J. M. Ramírez Aliaga, F. J. Morin, and N. Barbacci (eds) *The Reñaca Papers. VI International Conference on*

*Easter Island and the Pacific/VI Congreso internacional sobre Rapa Nui y el Pacífico.* The Easter Island Foundation, Los Osos. ISBN 1-880636-08-5

Miller, H.C., Belov, K. and Daugherty, C.H. (2005). Characterisation of MHC class II genes from an ancient reptile lineage, *Sphenodon* (tuatara). *Immunogenetics* 57: 883-891.

Penny, D. (2005). Biology and 'physics envy'. *EMBO Reports* 6:511.

Penny, D. (2005). An interpretive review of the origin of life research. *Biol & Phil* 20:633-671.

Perrie, L.R., Shepherd. L.D. & Brownsey, P.J. (2005). *Asplenium xlucrosum nothosp*. Nov.: a sterile hybrid widely and erroneously cultivated as "Aspelium bulbiferum". *Plant Syst Evol* 250:243-257.

Shepherd, L.D. and Lambert, D.M. (2005). Mutational drive in penguin microsatellite DNA. *Journal of Heredity* 96(5): 566-571.

Shepherd, L.D., Millar, C.D. Ballard, G. Ainley, D.G., Wilson, P.R., Haynes, G.D., Baroni, C. & Lambert D.M. (2005). Microevolution and mega-icebergs in the Antarctic. *Proceedings of the National Academy of Sciences USA* 102: 16717-16722.

Spencer, H.G. & Feldman, M.W. (2005). Adaptive dynamics, game theory and evolutionary population genetics. *J Evol Biol* 18:1191-1193.

Winsor, L & Stevens, M. (2005). Terrestrial flatworms (Platyhelminthes: Tricladida, Terricola) from sub-Antactic Macquarie Island. *Kanunnah* 17-32.

*The Royal Society of New Zealand Tuatara project, in collaboration with the AWC*

# PRESENTATIONS

Total number of presentations for the period: 20

Chapple, D.G. Phylogeography of the marbled skink (*Cyclodina oliveri*) complex. *Annual General Meeting of the Society for Research on Amphibians and Reptiles in New Zealand (SRARNZ)*, 14 February 2006, Wellington.

Chapple, D.G. Origins and evolution of New Zealand skinks. *Annual Meeting of the Allan Wilson Centre for Molecular Ecology and Evolution,* 11-12 October 2005, Victoria University of Wellington, New Zealand.

Greaves, S., Chapple, D.G., Ritchie, P.A., Daugherty, C.H. and Gleeson, D.M. Phylogeography of the speckled skink (*Oligosoma infrapunctatum*). *8$^{th}$ Annual New Zealand Molecular Ecology Meeting*, 2-4 December 2005, Wainui, Canterbury, New Zealand.

Hare, K.M. Daily metabolic rhythms of lizards: integrating physiology, phylogeny and ecology. 2005. Biology Department, Massey University, Palmerston North, NZ.

Hare, K.M., Pledger, S., Thompson, M.B., Miller, J.H., and Daugherty, C.H. 2005. Low cost of locomotion in lizards that are active at low temperatures. *22nd Annual Meeting of the Australian and New Zealand Society for Comparative Physiology and Biochemistry*, December 2005, Dunedin, New Zealand.

Hoare, J.M., Nelson, N.J. and C.H. Daugherty (2005). Microhabitat use by sympatric native geckos, *Hoplodactylus duvaucelii*, and kiore, *Rattus exulans*, in New Zealand. *Joint conference of the New Zealand Ecological Society and New Zealand Freshwater Sciences Society*, 28 August – 1 September 2005, Nelson, New Zealand

Lambert, D.M. Invited Plenary Speaker at Joint Symposium between Peking University and Massey University, Beijing, October 26-27, 2005.

Lambert, D.M. Invited Plenary Speaker at All Birds Barcoding *Initiative Meeting, Harvard University, "Barcoding the Birds of Australasia and Antarctica"* September, 13-15, 2005.

Lambert, D.M. "DNA Barcoding Ancient Life" Invited Plenary Speaker at *All Birds Barcoding Initiative Meeting*, Harvard University, September, 13-15, 2005.

Lambert, D.M. "DNA to Diversity" . *Inaugural Professorial Speaker at Massey University,* Albany, October 19, 2005.

Liggins, L., Chapple, D.G., Ritchie, P.A., and Daugherty, C.H. Phylogeography of the Chatham Islands skink (*Oligosoma nigriplantare nigriplantare*). *8$^{th}$ Annual New Zealand Molecular Ecology Meeting*, 2-4 December 2005, Wainui, Canterbury, New Zealand.

Matisoo-Smith, E., "The Lapita people: An ancient DNA perspective" Paper presented at the *Lapita '05 Oceanic Explorations' conference*, August 2005, Nuku'alofa, Tonga.

Matisoo-Smith, E. "Who let the dogs out? Assessing the evidence of prehistoric animal introductions in the Pacific. Paper presented at the *Australasian Archaeometry Conference*, December 2005, Canberra, Australia.

Moore, J.A., Nelson, N.J., and Daugherty, C.H. Are tuatara polygynous? Investigating the mating system of an endangered reptile. *Animal Behavior Society Conference*, 6 August 2005, Salt Lake City, Utah, USA.

Moore, J.A, Nelson, N.J., and Daugherty, C.H. What affects the fitness of tuatara? *Annual Meeting of the Allan Wilson Centre* *for Molecular Ecology and Evolution,* 11-12 October 2005, Victoria University of Wellington, New Zealand.

Nelson, N.J., Pledger, S., Thompson, M.B., Keall, S.N., and Daugherty, C.H. (Invited speaker). Conservation-biased research on a New Zealand treasure, the tuatara. *University of Montana Biological Station*, 28 June, 2005, Missoula, Montana, USA

Penny, D. Mammal/bird/dinosaur/ pterosaur interactions in the late Cretaceous. *Zoology Department, Cambridge University,* 12 September 2005.

Penny, D. Gene evolution from very short to very long time scales. *Symposium Evolution and Development: from molecules to organisms,* CRONA Auditorium, 15-17 September 2005.

Spencer, H.G. Host specificity and molecular phylogeny of parasites infecting New Zealand and Australian topshells. *Department of Biology, Villanova University, Pennsylvania*. October 2005.

Spencer, H.G. Topshells and Trematodes in Tandem: Co-evolution and Dispersal in the Pacific Ocean. *Department of Marine Science, University of Otago*. August 2005.

*Local field assistants, Koil Island (Project 3)*

# ADDITIONAL FUNDING SECURED DURING PERIOD

Total additional funds secured during the period: $2,779,825

Godfrey, S.S. Holsworth Wildlife Research Fund. AUS$4,000 annually for three years.

Liggins, L. Victoria University of Wellington Postgraduate Scholarship for Masters. MSc Part 2 fees waiver plus $15,000 stipend.

Liggins, L. Miss E.L. Hellaby Indigenous Grasslands Research Trust Scholarship. $7,825. NZ Common skink phylogeny.

Liggins, L. Helen Stewart Royle Scholarship, Victoria University of Wellington. $2,000. NZ Common skink phylogeny.

Liggins, L. Stocker Scholarship, Royal Forest and Bird Protection Society Inc. $1,000. NZ Common skink phylogeny.

Liggins, L. Tongariro Natural History Society Memorial Award. $1,000. NZ Common skink phylogeny.

Liggins, L. Sigma Xi Grant in Aid of Research. US$569. Travel expenses and field work.

Liggins, L. Enderby Trust Scholarship. Funded expedition to the Sub Antarctic Islands of New Zealand and Australia.

Lockhart, P.J. Using New Zealand *Pachycladon* to understand adaptive plant radiations. Marsden Fund $822,000 over three years.

E. Matisoo-Smith (PI), H. Ross, J. Robins, M. Hendy and G. Summerhayes, $683,000 (3 years) from the Marsden Fund for “The Rat’s Tale: Tracking Lapita peoples through phylogenetic analysis of Pacific rats”

Millar, C.M. University of Auckland Research Fund $10,000. DNA Barcoding the birds of New Zealand.

Millar, C.M. Vice-Chancellor's University Development Fund, $79,800. DNA Barcoding the birds of New Zealand and Antarctica.

Miller, H.C. FRST NZ Science and Technology Postdoctoral Fellowship. $217,500.

Miller, K. Victoria University of Wellington PhD Scholarship. $25,000 annually for three years. Implications of founder selection on population success after reptile reintroductions.

Moore, J.A. NZ International Doctoral Research Scholarship. $40,000 annually 2006-08.

Nelson, N.J. Offield Fund, Zoological Society of San Diego. US$5,000. Tuatara translocation to the mainland.

Spencer, H. $ 710,000 (3 years) from the Marsden Fund for “Modelling the evolutionary genetics of parental effects”.

Starr, B. PhD Scholarship awarded by the University of Otago. $75,000 over three years.

# OVERSEAS VISITORS

*The following scientists visited the Centre during the period under consideration*

Dr Benny Chor
Tel Aviv University
Israel

Dr Sean Doody
University of Canberra
Australia.

Dr. Bob Gervasi
President
Institute for Study Abroad
Butler University
USA.

Dr Katherina Huber
University of East Anglia
UK

Prof John Jungck
Beloit College
Wisconsin
USA

Dr. Winsor Lowe
University of Montana
USA.

Dr. James Martin,
Curator of Vertebrate Paleontology
Museum of Geology; Professor,
Geology and Geological Engineering
Dept.
South Dakota School of Mines and
Technology
USA.

Prof. Scott Mills
University of Montana
USA.

Dr Vincent Moulton
University of East Anglia
UK

Jeanine Refsnider
Fulbright Scholar
USA.

Dr Vaughan Symonds
Florida Museum of Natural History
Florida
USA

Dr Jennifer Tate
Florida Museum of Natural History
Florida
USA

# FINANCIAL REPORT for the period ended 31 December 2006.

## Statement of Accounting Policies

### Entity Reporting

This financial report is for the Allan Wilson Centre for Molecular Ecology and Evolution (AWC), a Centre of Research Excellence, established pursuant to a contract dated 1 July 2002 with the Royal Society of New Zealand (which was subsequently replaced by the Tertiary Education Commission) and hosted within Massey University. The AWC is managed as a research centre within Massey University and has its own Board of Governance.

The financial report has been extracted from the books and records of Massey University. The financial statements have been prepared in the New Zealand currency.

### Reporting Period

The AWC was formally established on 1 July 2002 with the financial year being the twelve month period 1 July to 30 June of each year. This financial statement is for the six months 1 July 2005 to 31 December 2005. The figures given alongside are for the twelve month periods ending June 2005, June 2004 and June 2003 respectively.

### Capital Assets

According to contractual obligations, the AWC has acquired substantial capital assets that are listed on the host asset register. In a number of cases these assets are housed at a partner institution. An operating cost for the Centre, described as "Equipment Depreciation" in the Statement of Income and Expenditure, are funds required to maintain the value of capital items. These funds are held in a "Depreciation Reserve".

### Goods and Services Tax (GST)

The financial report has been prepared so that all components are stated exclusive of GST.

## Statement of Financial Performance

### for the six month period 1 July 2005 to 31 December 2005

| | July 05 to Dec 05<br>$ | July 04 to June 05<br>$ | July 03 to June 04<br>$ | July 02 to June 03<br>$ |
|---|---|---|---|---|
| Operating Income | | | | |
| Tertiary Education Commission Grant | 1,053,333 | 2,106,666 | 2,017,777 | 1,982,222 |
| Balance brought forward | 91,494 | 173,147 | 108,460 | 0 |
| Total Operating Income | 1,144,827 | 2,279,813 | 2,126,237 | 1,982,222 |
| | | | | |
| Expenditure | | | | |
| Research projects | | | | |
| Salary and salary related costs | 357,095 | 687,144 | 667,642 | 648,523 |
| Overheads | 304,204 | 584,072 | 567,496 | 551,245 |
| Consumables | 92,387 | 205,993 | 212,969 | 244,447 |
| Postgraduate student stipends and fees | 168,030 | 314,947 | 206,849 | 107,669 |
| Equipment Depreciation | 84,250 | 168,500 | 101,172 | 163,107 |
| Travel | 29,889 | 68,169 | 73,009 | 64,723 |
| Total research projects | | 2,028,825 | 1,829,137 | 1,779,714 |
| | | | | |
| Fiji initiatives | 0 | 0 | 12,087 | 14,483 |
| Directorate and Administration | 78,614 | 157,123 | 105,071 | 71,018 |
| Hospitality | 8,784 | 2,371 | 6,796 | 8,547 |
| Total operating expenditure | 1,133,680 | 2,188,319 | 1,953,091 | 1,873,762 |
| | | | | |
| Total operating income less expenditure | 20,782 | 91,494 | 173,147 | 108,460 |

## DIRECTORY

*Management Office*
Science Tower D. level 5
Massey University
Private Bag 11-222
Palmerston North
New Zealand
Tel: +64 6 350 5448
Fax: +64 6 350 5626

*Host Institution*
Massey University
Private Bag 11-222
Palmerston North
New Zealand

*Solicitors*
Park and Associates
Wellington

*Partner Institutions*

The University of Otago
P O Box 56
Dunedin
New Zealand

The University of Auckland
Private Bag 92019
Auckland
New Zealand

Victoria University of Wellington
P O Box 600
Wellington
New Zealand

Canterbury University
Private Bag 4800
Christchurch
New Zealand