2006 ANNUAL REPORT

ARC/NHMRC RESEARCH NETWORK FOR
PARASITOLOGY

Introduction

Professor Nick Smith, Convenor,
ARC/NHMRC Research Network for Parasitology.

2008 has been an outstanding year for the ARC/NHMRC Research Network for Parasitology, once again especially for our early career researchers.

The Network awarded 34 Researcher Exchange, Training and Travel Awards, with 79% of these going to young researchers to expand their horizons and skills in collaborating laboratories both within Australia and internationally. Furthermore, research from previous Researcher Exchange, Training and Travel Awards continued to bear fruit in 2008, with quality research papers being published in internationally recognised, peer-reviewed journals, and the development and award of grants to several of the young beneficiaries of Network Awards.

More broadly, parasitology research in Australia continued to flourish in 2007, with over 370 research papers published and over $25 million in grants awarded to Network Participants and some very high honours coming the way of several Network Participants.

2008 saw the continuation of two initiatives specifically for early career researchers and students, namely, a workshop to enable postdoctoral researchers and students to speak to prominent parasitologists about their career and to meet like-minded peers, and the Network's Mentoring Scheme, whereby early career researchers are given the opportunity to arrange mentoring partnerships with senior parasitology researchers to discuss their personal career aspirations and development and seek advice on annual and longer-term goals and career planning. Several young parasitologists benefitted from this scheme in 2008.

The Network also continued its support of conferences.

The annual joint conference with the Australian Society for Parasitology in Glenelg was an outstanding event, attracting 220 delegates and including some superb presentations by national and international invited speakers. Thus, the very strong attendance patterns evident in previous meetings - effectively double the typical numbers attending previous national parasitology conferences – was continued in 2008. The Network also supported the "Molecular Approaches to Malaria" in Lorne, Victoria, in early February, 2008, attracting over 400 malariologists from around the world, "The Imaging Infectious Diseases Workshop", a joint WEHI and Institut Pasteur event, held at WEHI, Thursday 31st January & Friday 1st February 2008, attracting over 60 researchers, and Australian Health and Medical Research conference at the Brisbane Convention Centre, November 16 – 21, 2008.

"Parasites in Focus" continued to travel the country, being exhibited in Adelaide, Sydney and Perth in 2008. A series of other public outreach and education events were staged by the Network throughout 2008, most especially to school groups. All of these activities will continue in 2009 and, additionally, stage one of Intimate Aliens, a travelling, hands-on exhibition about parasites, will be launched in 2009/2010.

2009 will be a year for planning the future after the ARC and NHMRC funding ends. These plans are presented in some detail inside this annual report and point to a very exciting future for Australian Parasitology research – we have a unique opportunity to grasp the benefits gained for our discipline via the ARC/NHMRC Research Network for Parasitology and build them to even greater heights.

The success of the Network is due to the energy, time and commitment of every participant but several deserve special thanks for their efforts in 2008: the management and advisory committee members (Alex Loukas, Una Ryan, Andrew Thompson, Shelley Walton, Geoff McFadden, Kevin Saliba, Malcolm Jones, Rob Adlard, Jody Zawadzki, Chris Bryant, Graham Mitchell, John Horton and Artur Scherf), who work tirelessly and altruistically to ensure the success of the various Network schemes and initiatives; Lisa Jones, Kate Miller, Wendy Relf and Sheila Donnelly, who put tremendous time, effort and imagination into Network outreach events; and Wendy Relf and Lisa Jones, who coordinate the annual conference, publish the Network Newsletter and ensure the Network operates at the highest levels of professionalism.

Professor Nick Smith

Convenor, ARC/NHMRC Research Network for Parasitology

Australian Government

Australian Research Council

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Australian Government

National Health and Medical Research Council

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Summary of Goals and Objectives

A SUMMARY OF THE OVERALL GOALS AND OBJECTIVES, PROGRAMS AND RESEARCH PRIORITIES AND ANY CHANGES TO THESE THAT MAY HAVE OCCURRED DURING THE PAST YEAR

Objectives

The mission of the ARC/NHMRC Research Network for Parasitology (as stated in the application for funding) is to:

- focus and enhance Australia's fundamental, strategic and applied parasitology research capabilities to understand parasitism, parasite biology and parasitic disease; and
- to use that understanding to discover and develop sustainable control strategies to improve and maintain the health and well-being of humans and animals.

The Network aims to:

- create a website that will foster national and international collaborations by providing access to databases on parasites, parasite genomes, bioinformatics analysis tools, parasitology research resources and protocols, parasitology researchers – this will prevent duplication of research and promote the adoption of uniform protocols, which will fast track Australia's research effort;
- organise and fund conferences, workshops and meetings for scientists, industry representatives, end-users (e.g. farmers, veterinarians, wildlife experts), government representatives and community groups, including participation by international experts;
- foster and finance exchange of staff between national and international research institutions to maximise access to key infrastructure, equipment, expertise and supervision and to encourage the growth of new collaborative relationships;
- provide mentoring, training and grant writing support for young investigators;
- create research leadership and management opportunities for young investigators; and
- actively search for world-class recruits to enhance Australia's parasitology research effort.

Research Priorities

At a series of national workshops held on December 17-18, 2003 and February 17, 2004, the following research priorities were developed for the ARC/NHMRC Research Network for Parasitology:

[1] AN ENVIRONMENTALLY SUSTAINABLE AUSTRALIA.
By assessing the susceptibility to, and monitoring the prevalence of, parasitic disease in wildlife the Network will generate new information that will assist in the management of terrestrial and marine ecosystems. The specific objectives of the Network are to enhance and focus Australia's parasitology research effort in order to:

- assess parasite diversity in Australian fauna; and
- ensure the sustainability of wildlife and ecosystem health.

[2] PROMOTING AND MAINTAINING GOOD HEALTH.
The young and the elderly are the most susceptible to parasitic diseases, both in the developed and the developing world. To address this, the Network will focus on the development of new vaccines and treatments for local and global populations and the creation of new technologies to monitor and prevent contamination of waterways with infectious stages of zoonotic parasites (a key source of disease). The specific objectives of the Network are to enhance and focus Australia's parasitology research effort to:

- better understand host-parasite relationships; and
- discover and develop sustainable parasite control strategies.

[3] FRONTIER TECHNOLOGIES.
A central goal of the Network is the development of new molecular tools and information resources. This includes

Summary *cont.*

the development of new databases and data management systems to enable the Network's researchers to harness the vast quantity of information being generated by a growing number of genome sequencing projects. Developing new bioinformatic tools will create unprecedented opportunities to identify new vulnerabilities/targets for control in parasites. The specific objectives of the Network are to enhance and focus Australia's parasitology research effort to:

- discover and develop molecular and bioinformatics tools for studying parasite biology; and
- discover and develop anti-parasite vaccines and therapies.

[4] SAFEGUARDING AUSTRALIA.
The Network will lead to the development of new technologies (e.g. sophisticated biosensors) to aid in the surveillance of our border areas and neighbours for exotic, emerging and re-emerging parasitic diseases. Thus, the specific objectives of the Network are to enhance and focus Australia's parasitology research effort to:

- better understand the epidemiology and transmission dynamics of parasites; and
- discover and develop better surveillance systems.

There have been no significant changes to the overall goals, objectives, programs or research priorities of the Network. The adjustments and reorientations of budget allocations reported in the 2005 Annual Report, in light of the granting of $300,000 per annum from the ARC and NHMRC versus the requested ~$500,000 per annum, remain in operation. However, the Management Committee agreed in 2006 to welcome three new Participating Organisations to the Network, namely, Macquarie University, Charles Sturt University and the South Australian Research and Development Institute (SARDI).

Governance

The Network is managed by a Management Committee comprised of the Network Convenor, the President or Vice President of the Australian Society for Parasitology, plus, in 2008, eight others. The following considerations, as well as gender balance, are priorities in selection of the Management Committee: (i) at least two members must be Young Investigators; (ii) the composition of the Management Committee represents different disciplinary groups within the Network; and (iii) the composition also includes geographical representation in its makeup but as a secondary factor. The quorum for decision-making is five members. The responsibilities of the Management Committee include, but are not be limited to: creating a vision and strategic plan for the Network; identifying research priorities for the Network; providing advice on budgeting and planning (including making funding decisions, e.g. for award of laboratory exchanges, workshops, grant writing "retreats"); ensuring effective communication, both internally and externally, including coordination of the preparation of reports and newsletters, and the organisation of workshops and conferences; and planning the Network's educational activities.

The 2008 Management Committee was: Prof. Nick Smith (Convenor, University of Technology, Sydney); Dr Shelley Walton (President, Australian Society for Parasitology); Dr Alex Loukas (Deputy Convenor, Queensland Institute of Medical Research); Prof. Geoff McFadden (University of Melbourne); A/Prof. Una Ryan (Murdoch University); Prof. Andrew Thompson (Murdoch University), Dr Kevin Saliba (Australian National University), Dr Rob Adlard (Queensland Museum), Dr Jody Zawadzki (Department of Primary Industries, Victoria), Dr Malcolm Jones (Queensland Institute of Medical Research). The Committee met in July 2008 and corresponded, as a Committee, regularly by email.

The Management Committee also received input from an Advisory Committee, the following of whom met jointly with the Management Committee in July, 2008:

- Professor Graham Mitchell, AO (for services to science,

Summary *cont.*

especially immunoparasitology), recognised as one of Australia's leading biological scientists and consultants.

- Professor John Horton; Vice-President of the Royal Society for Tropical Medicine and Hygiene;
- Professor Chris Bryant, AM (for achievement in parasitology and science communication), past Dean of Science at the ANU and founder of the Centre for the Public Awareness of Science (CPAS).

Additional funding

In-kind contributions for Academic Time Contributions have been estimated using a conservative calculation that estimates Management Committee member's commitment to Network activities as 10% of their time and for other participants at Level A academic and above as 5%. Thus, for most participants, in-kind contributions are based on 5% of their salary (including on-costs) with the addition of a value calculated by multiplying 5% of salary by 1.25 to provide an estimate of the value of facilities available to Network participants. In addition, 50% of the Convenor's salary is contributed by the University of Technology, Sydney, and is included as an in-kind contribution. The total estimated value of in-kind contributions by Participating Organisations to the Network in 2008 was $1,646,177.

Cash commitments to the Network were made by the Australian Society for Parasitology Inc., the University of Technology, Sydney, the Queensland Institute of Medical Research, Monash University, Murdoch University, LaTrobe University, The University of Queensland, The Australian National University, The University of Sydney, the Walter and Eliza Hall Institute of Medical Research and the South Australian Museum.

Progress on Initiatives

The extent to which the objectives of the Research Network and the Approved Proposal have been met

Website and Newsletter

The Network website was totally overhauled in 2007, producing a more attractive, functional, user-friendly and informative resource for Australia's parasitology community; in 2008, its content was updated appropriately. The website is at www.parasite.org.au/arcnet. The Network Newsletter was published, on average, every 2 months, keeping Network Participants up-to-date on developments and opportunities afforded by the Network and achievements of its participants.

Information Technology Initiative

The Network maintained an IT team with staff at the Victorian Bioinformatics Consortium (Monash University). Additionally, in 2008, funding was again provided to the The University of Queensland (specifically Professor Peter O'Donoghue and Ms Lynn Prior) to continue development on an Australian parasite research and education web resource. The IT team is led by Professor Ross Coppel of Monash University. In 2008, having successfully developed and deployed a suite of collaborative, communication and bioinformatic tools in previous years (see 2007 Annual Report for details), the IT Initiative focused on eight collaborative projects, building on the expertise developed over the previous 3 years:

- A parasite nematode isolate database (in collaboration with Dr Peter Hunt at the CSIRO);
- A nematode mitochondrial DNA pipeline and database (in collaboration with Prof. Robin Gasser at the University of Melbourne);
- An *Haemonchus contortus* mass spectrometry, EST library and genome database (in collaboration with Dr Michael de Veer at Monash University);
- A *Fasciola hepatica* EST database (in collaboration with

Progress on Initiatives *cont.*

Dr Janelle Wright at Charles Sturt University);

- A *Cryptosporidium* genome analysis project (in collaboration with Prof. Robin Gasser at the University of Melbourne);
- A project to analyse the major surface antigen genes of the malaria parasite (in collaboration with Dr Alyssa Barry at the Burnet Institute);
- Annotation of the *Babesia bigemina* genome (in collaboration with Assoc. Prof. Brian Cooke at Monash University);
- Development of software to combine data sources and predictions related to the *Plasmodium falciparum* proteome to provide a shortlist of vaccine candidates.

Work continued in 2008 on the Australian Parasite Research and Education Resource at The University of Queensland, led by Professor Peter O'Donoghue. The resource will be a web-based interactive site with illustrated keys to helminth, protozoan and arthropod parasites of Australian hosts relevant to undergraduate students, postgraduate students, teachers and researchers in biology, medical and veterinary sciences. The Network is co-sponsoring this initiative with the Australian Society for Parasitology Inc. It is anticipated that the site will be active for testing and feedback from the Network and ASP Management Committee and Council, respectively, by mid-2009 and ready for full release before the end of the year.

Scientific Conferences and Workshops

The ARC/NHMRC Research Network for Parasitology co-hosted a scientific meeting with the Australian Society for Parasitology Inc. - held at the Stamford Grand Hotel, Glenelg, South Australia - from July 6 to 9, 2008. The Network underwrote funding for the conference in order to keep registration fees for delegates to a minimum and thereby ensure access to as many delegates – especially early career researchers and students – as possible. The Network also coordinated the raising of sponsorship for the conference to further defray costs and ensure the attendance of top quality international invited speakers,

The 2008 conference saw the continuation of the "Elsevier Lectures", including the "International Journal for Parasitology Lecture" and the "Trends in Parasitology Lecture", delivered by Professors Geoff McFadden (University of Melbourne) and David Ferguson (Oxford University, UK), respectively. Sponsors for the conference included Ancare Australia, Schering-Plough Australia (part of the Intervet group), Elsevier, The International Journal for Parasitology, Trends in Parasitology, Meat and Livestock Australia, Australian Wool Innovation, Bio-Rad, Bayer, New England BioLabs and Bioaustralis.

Brendan Crabb and Geoff McFadden during the International Journal for Parasitology Lecture at the 2008 ASP & Network Conference

The conference covered a wide variety of parasitology research, reflecting the diversity and multidisciplinarity of Network Participants. The meeting was opened by Professor Chris West (Director of Adelaide and Monarto Zoos) and was attended by 220 delegates. It included participants from 23 out of the Network's Participating Organisations. Over 55% (113) of attendees were early career researchers or students and there were 25 international delegates.

Progress on Initiatives *cont.*

Plenary and Symposium Lectures were delivered by:

THE ELSEVIER LECTURES - APICOMPLEXAN ORGANELLE BIOLOGY

- David Ferguson (Oxford University, UK) – The Trends in Parasitology Lecture
- Geoff McFadden (University of Melbourne) – The International Journal for Parasitology Lecture

HOST-PARASITE INTERACTIONS

- Charles Nunn (Max Planck Institute, Germany, and University of California, Berkeley, USA)
- Jennie Blackwell (Cambridge University, UK)
- Peter Hudson (Pennsylvania State University, USA)
- Hamish McCallum (University of Tasmania)
- Rick Speare (James Cooke University)

PARASITE PROTEASES

- Ben Dunn (University of Florida, USA)
- John Dalton (Institute for the Biotechnology of Infectious Diseases, University of Technology, Sydney)
- Katja Fischer (Queensland Institute of Medical Research)

PLANT PARASITIC NEMATODES

- David Bird (North Carolina State University, USA)
- Gregor Yeates (Landcare Research, New Zealand)
- Mike Hodda (CSIRO Entomology, Canberra)

PARASITES AND THE AQUACULTURE INDUSTRY

- Andy Shin (University of Stirling, UK)
- Mehdi Doroudi (SARDI Aquatic Sciences, Adelaide)
- David Raftos (Macquarie University)

STATE-OF-THE-ART TECHNOLOGIES: PROTEOMICS

- Jonathan Wastling (University of Liverpool, UK)
- Alan Wilson (University of York, UK)
- Ben Herbert (University of Technology, Sydney)

SUSTAINABLE WORM CONTROL IN GRAZING LIVESTOCK

- Brown Besier (Department of Agriculture and Food, WA)
- Nick Sangster (Charles Sturt University)
- Ian Sutherland (The Hopkirk Institute, New Zealand)

BANCROFT MACKERRAS AWARD ORATION

- Kiaran Kirk (The Australian National University)

AUSTRALIAN SOCIETY FOR PARASITOLOGY PRESIDENTIAL ADDRESS

Shelley Walton (Menzies School of Health Research, NT)

Kate Hudson and Ian Whittington at the 2008 ASP & Network Annual Conference.

Progress on Initiatives *cont.*

The Network also sponsored, through its Researcher Exchange, Training and Travel Awards Scheme, two other conferences and workshops in 2008:

"Molecular Approaches to Malaria" in Lorne, Victoria, in early February, 2008, was an outstanding success, attracting over 400 malariologists from around the world (http://www.mamconferences.org). Congratulations to Brian Cooke, Brendan Crabb, Alan Cowman, Maureen Grant and Marian Cravino for organising an outstanding meeting.

The meeting also saw the signing of a Memorandum of Understanding between the Network and the EU Network of Excellence for the Biology and Pathology of Malaria (BioMalPar). The MoU formalises the excellent relationship that already exists between the two Networks.

Artur Scherf (Director, BioMalPar) and Nick Smith (Convenor, ARC/ NHMRC Research Network for Parasitology) sign the MoU between the two Networks, overseen by Hannu Lang, representing the EU.

"The Imaging Infectious Diseases Workshop", a joint WEHI and Institut Pasteur event, was held at WEHI in January, 2008, with the assistance of the Network, in collaboration with the FABLS Network. See: http://www.wehi.edu.au/WEHI_Groups/indexworkgroups.php?id=124

Lucky participants reported very enthusiastically about the value of the workshop and our thanks and congratulations go to Emanuela Handman for her splendid efforts in bring this meeting to fruition. It seems likely that a series of very fruitful collaborations and breakthroughs will result from this workshop in the not-to-distant future.

The Network also co-sponsored symposia at the **Australian Health and Medical Research conference** at the Brisbane Convention Centre, November 16 – 21, 2008. See: http://www.ahmrcongress.org.au

The invited speakers sponsored by the ASP and the Network were:

- Charles King (The Center for Global Health and Diseases, Case Western Reserve University, USA)
- Giovanna Raso (Queensland Institute of Medical Research)
- Ian Riley (The University of Queensland)
- Scott O'Neill (The University of Queensland)
- Malcolm McConville (The University of Melbourne)
- Andreas Hofmann (Griffith University)
- Tina Skinner-Adams (Queensland Institute of Medical Research)

Wendy Relf and Nick Smith at the 2008 ASP & Network Annual Conference

Progress on Initiatives *cont.*

Researcher Exchange, Training and Travel Awards

In 2008, the Network funded the following applications for assistance from its Researcher Exchange, Training and Travel Award funds (27 of the 34 awards directly benefited research students or early career researchers). We have highlighted two case studies in this section, featuring *Toxoplasma* researchers and also an interview (in the "What Happened Next" section) with another group of researchers from La Trobe University who work on malaria. Awardees were:

- **Dr Kathy Andrews** from the Queensland Institute for Medical Research (QIMR) to fund Dr Geoff Dow (Walter Reid Army Institute of Research WRAIR; Silver Spring, MD, USA) to spend a week at QIMR to write a joint grant proposal to the Medicines for Malaria Venture.
- **Ms Hayley Schwarz** from La Trobe University for a Researcher Exchange for travel to the Menzies School of Health Research, Darwin to collaborate with Deborah Holt and Shelley Walton on the molecular analysis of iron-binding proteins of *Sarcoptes scabiei*.
- **Dr Geoff Gobert** from the Queensland Institute for Medical Research for a Researcher Exchange to travel to Shanghai and the National Institute of Parasitic Diseases, and the Hunan Research Institute of Parasitic Diseases Yueyang, China, for collaborative work on helminth infections.
- **Dr Alex Loukas** from the Queensland Institute for a Researcher Exchange for a visit from Dr Jeffrey Bethony from George Washington University, Washington DC to visit network laboratories in Brisbane and Sydney, collaborating on hookworm vaccine research.
- **Mieke Burger** from The University of Queensland for a Researcher Exchange to visit the laboratory of Dr Michael Kent, Oregon State University, USA.
- **Magda Ellis** from the Queensland Institute of Medical Research to fund a Researcher Exchange to Yueyang and Nanchang to conduct research on immunological and genetic aspects of schistosomiasis in China.
- **Prof. Leann Tilley** from La Trobe University for a Researcher Exchange for the visit of Shelia Akinyi from the laboratory of Assoc. Prof. Mary Galinski, Emory University, Atlanta, USA. (See *Case Study 3*).
- **Phillip Fromm** from James Cook University, for a Researcher Exchange for a four week visit to the laboratory of Prof Christian Bogdan, Institute of Medical Microbiology, Immunology and Hygiene, Freidrich-Alexander University, Erlangen, Germany to learn methods to measure antileishmanial activities of macrophages to *Leishmania major*.
- **Cath Covacin** from The University of Queensland for a Researcher Exchange to visit labs of Claudio Bandi, Milan Italy and Prof Serap Aksoy, Yale University, USA.
- **Suzannah Hetherington** from The Australian National University, to fund a Researcher Exchange with the INSERM in Strasbourg, France, to perform a series of experiment on *Caenorhabditis elegans* under the supervision of Prof. Michel Labouesse.
- **Michael Lees** from the University of Technology, Sydney, NSW for a Researcher Exchange to visit Prof. Rima McLeod's lab at the University of Chicago Illinois, USA, to collaborate on a project investigating early immune responses to *Toxoplasma*.
- **Alex Umbers** from The University of Melbourne for a Researcher Exchange to visit Dr Julie Moore's laboratory at the Centre for Tropical and Emerging Diseases, Georgia, for a Human Placental Workshop for training in the isolation of fresh placental primary syncytiotrophoblasts.
- **Prof. Nick Smith** from the University of Technology, Sydney, NSW and **Prof. Andrew Thompson** from Murdoch University for a Researcher Exchange for the visit of Dr Michael Grigg from the National Institutes of Health, USA, for collaborative work on *Toxoplasma* strain characterisation. (See *Case Study 1*).

Progress on Initiatives *cont.*

- **Ming Kalanon** from The University of Melbourne, to attend the Biology of Parasitism Course at the Marine Biology Laboratory in Woods Hole, USA.
- **Dr Alan Dargantes** from Murdoch University for a Researcher Exchange to visit Dr David Piedrafita at Monash University to enhance his skills in molecular diagnosis of parasites and to attend a workshop on diagnostics at CSIRO AAHL (Geelong).
- **Dr Shelley Walton** from Menzies School of Health Research (Darwin), to fund a three day retreat to bring together national collaborators involved in a coordinated program of scabies research.
- **Prof. Leann Tilley** from La Trobe University for a Grant Writing Retreat with **Prof. Kiaran Kirk** from The Australian National University. (See *Case Study 3*).
- **Dr Fernanda Caldas Cardoso** from the Queensland Institute of Medical Research for a Researcher Exchange to visit Prof. Edgar Cavalho and Dr Jeff Bethony in Brazil, to collaborate on hookworm research in the field.
- **Dr Malcolm Jones** from the Queensland Institute for Medical Research for a retreat to launch a project for estimating the economic burden of parasites in Australia.
- **Patrick Driguez** from the Queensland Institute of Medical Research for a Researcher Exchange to visit Prof. Phil Felgner in California, as part of a collaborative effort investigating helminth biology.
- **Elizabeth Perkins** from The University of Adelaide for a Researcher Exchange to visit Prof. Jean-Lou Justine in New Caledonia. (See *Case Study 2*).
- **Dr Corinna Paeper** from The Australian National University to attend courses at Wageningen University on Nematology.
- **Dr Eric Hanssen** from La Trobe University for a Researcher Exchange visit by Prof. Hans-Peter Beck from the Swiss Tropical Institute. (See *Case Study 3*).
- **Tamsin Barnes** from the The University of Queensland for a Researcher Exchange to visit to Dr Patrick Giraudoux at the University de-Francke Comt, France and Dr Paul Torgorson, at Ross University, St Kitts, West Indies.
- **Haylee Weaver** from The Australian National University for a Researcher Exchange to visit the laboratories of Prof. Scott Gardener and Dr Augistine Jimenez-Ruiz at the University of Nebraska, USA.
- **Dr Liting Lim** from The University of Melbourne for a Researcher Exchange visit to the laboratories of Dr Robert Menard, Pasteur Institute, Paris, Dr Dominique Soldati at the University of Geneva for a COST Apicomplexan Biology Training Workshop, and Dr Andreas Weber at the Heinrich-Heine University, Dusseldorf, to enhance knowledge of *Plasmodium* transporters.
- **Prof. Terry Spithill** from Charles Sturt University, Wagga Wagga, NSW for a retreat to explore potential collaborative research opportunities on helminth vaccines, at Monash University on 15 December, 2008.
- **Dr Jake Baum** from the Walter Eliza Hall Institute for a Researcher Exchange, co-funded with the Fluorescent Applications Network, to visit the laboratory of Prof. Robert Sinden, Imperial College, London UK, to develop microscopy tools for live imaging of the malaria parasite insect-stage.
- **Natalie Spillman** from the Australian National University for a Researcher Exchange to visit the laboratory of Dr Nick Klonis, Department of Biochemistry at La Trobe University to initiate collaboration between the La Trobe and ANU malaria groups to measure ion fluxes in single malaria-infected cells.
- **Dr Kathy Andrews** the Queensland Institute of Medical Research for a Researcher Exchange to visit the laboratory of A/Prof. Zbynek Bozdech, Nanyang Technological University, Singapore to investigate synthetic HDAC inhibitors as potential antimalarials.

Progress on Initiatives *cont.*

- **Adbul Jabbar** from The University of Melbourne for a Researcher Exchange to visit Zdzislaw Swiderski and Daniel Mlococki at Warsaw Medical University to study syncytial structures in tapeworm oncospheres.
- **Rama Jayarai** from Menzies School of Health Research, NT to attend a workshop on "Materials and Methods for Lateral Flow Applications", San Diego, USA.
- **Ashlie Hartigan** from The University of Sydney for a Researcher Exchange to visit the laboratories of Prof. Dykova and Dr Fiala, Institute of Parasitology, Czech Republic, for training in protist biology and taxonomy.
- **Dr Janelle Wright** from Charles Sturt University for a Researcher Exchange to visit Prof. Alan Wilson at the University of York for training and collaboration in helminth proteomics.

CASE STUDY 1:

Toxoplasma gondii, is a protozoan parasite, discovered 100 years ago by an Italian physician in Brazil and by two French researchers in Tunisia. Research on *Toxoplasma* has been going on for over a century. There was a burst of activity in Australian research on this fascinating parasite as a result of a Network-funded visit by Dr Mike Grigg from the National Institutes of Health in the USA. Mike Grigg is from the Molecular Parasitology Unit in the National Institute of Allergy and Infectious Diseases, National Institutes of Health. Mike is Chief Investigator in the Laboratory of Parasitic Diseases and, in October 2008, travelled to Australia to visit Professor Andy Thompson's laboratory at Murdoch University and Professor Nick Smith's lab at IBID, University of Technology, Sydney as part of a Network Researcher Exchange, Training and Travel Award. Here, Mike talks to Lisa Jones about his research.

Mike, how did you become interested in studying Toxoplasma?

"I've worked on a lot of other parasitic systems but none so easy to work with as *Toxoplasma*, because we can manipulate both the parasite and the host to study pathogenesis of disease".

Mike and his team study the biology of *Toxoplasma* pathogenesis – Mike says, "We are parasite-centric in our approach and are interested in *Toxoplasma* at a population level. We aim to understand how much the parasite strain contributes to disease and how many strains there are. Our hypothesis is that the cat produces lots of *Toxoplasma gondii* strains that are: (1) asymptomatic, where the host is exposed and the disease is non-transmissible; (2) asymptomatic or symptomatic, where the disease is transmissible; and (3) lethal. We're looking at *Toxoplasma* disease outbreaks to find out which hosts are dying, which are chronically infected and which are exposed but don't produce a chronic infection… and why."

Is there much disease associated with *Toxoplasma*?

"Oh yes, there is widespread disease. Globally, 2 billion people are infected with *Toxoplasma* and whilst most don't have any disease – almost no symptoms at all – it is a real problem for people who become immunocompromised," Mike says, "and, of course, has serious repercussions for women who become infected for the first time whilst pregnant – they can lose their babies or their babies can be born with serious congenital problems, particularly neural developmental problems and sight problems. What is not commonly appreciated is that 2% of infected humans will get ocular toxoplasmosis, which can result in conditions like blinding chorioretinitis. One of the problems is that there is no universal treatment for ocular toxoplasmosis – clinicians are not clear about the best treatment options and sometimes the outcomes depends on which treatment you start with."

Mike says that his research team are most interested when *Toxoplasma* is producing an unusual response in their host – and they try to understand why it is different. "What's particularly fascinating," says Mike, "is that there are many different natural hosts and, when we do genetics on the parasites from out-of-the-ordinary hosts, we find unusual genotypes of the parasite associated with disease. Naturally, the next important question is whether or not unusual strains of the parasite are also associated with human disease; information coming out of Brazil, and now other places, suggests that the answer to that question is yes."

How will that knowledge impact on treatment or prevention?

Mike says, "It is important to identify *Toxoplasma* infection diagnostically and to treat those strains that are dangerous and tailor medicine around the disease. In places like France, Belgium and South America they have screening programmes and can screen for a strain to identify those people that might need treatment. They can then treat prophylactically before the patient develops the disease and its complications."

"If we can identify specific strains associated with chorioretinitis then we can tailor the treatment to fit the disease. This is a whole new model for medicine that involves screening the host, identifying the parasite strain and then treating prophylactically. This model takes into account the disease-forming agent and the susceptibility of the patient."

Mike predicts that in the next decade eukaryotic pathogenesis will be the next big area to study. "These are complex, highly regulated genomes with an infinite number of possibilities to break past the host defences so they are much more complex," Mike says. "Right now there is a global epidemic of three strains of *Toxoplasma*; the cat produced them and is producing more strains all the time. It is only a matter of time before one or more new strains of *Toxoplasma* are produced. And the cat is critical," Mike warns.

"Since relatively little is known about eukaryotic pathogenic processes, as compared to the field of bacterial or viral pathogenesis, it is likely that entirely new mechanisms and principles of pathogenesis will emerge from our work," Mike says.

I've heard that *Toxoplasma gondii* is a food and water-borne parasite – what food and water sources should we be wary of?

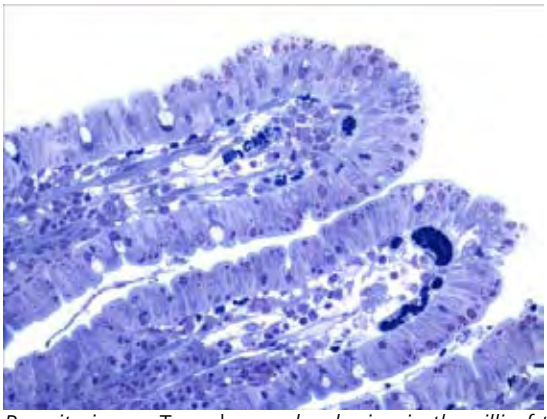
"Undercooked food, especially pig and sheep, unfiltered water (though it's important to remember that the parasites can survive chlorine too)."

Should more researchers be investigating *Toxoplasma*?

Mike is extremely enthusiastic about his research and thinks that we should have more scientists studying *Toxoplasma* to try and understand the sexual cycle better.

"It's a great time to be working on *Toxoplasma*. Today we have parasitologists mixing with specialist immunologists and veterinarians in an integrated approach to tracking new *Toxoplasma* strains and their zoonotic potential so that scientists can understand how new strains cause disease."

Mike says of the *Toxoplasma gondii* parasite, "If you can understand the basic biology you can find their Achilles heel but we need more basic research on the pathways important to *Toxoplasma* and, most importantly, we need to develop new drugs for treatment of the disease, as well as vaccine development".



Parasite image Toxoplasma *developing in the villi of the cat small intestine. Image copyright 2007 D J P Ferguson, University of Oxford, UK.*

Lisa Jones also spoke with Andy Thompson, Professor of Parasitology at Murdoch University, about the collaborative research on *Toxoplasma* with Mike Grigg.

Andy, Alan Lymbery, Andy Smith and their team have been investigating parasites of wildlife for many years. The Western Australia Department of Environment and Conservation has a very active research Division with numerous sampling sites for most of the threatened

Progress on Initiatives *cont.*

marsupials across the state and Andy's team have taken samples from the majority of native marsupials. Over recent years, Andy says, they have started to see *Toxoplasma* in many marsupial samples. Andy and his team want to characterise the parasite, genotype it, and find out if *Toxoplasma* in wildlife is clinically relevant. One of the problems of their sampling is that as soon as animals become moribund, whether due to *Toxoplasma* or another disease, they become prey for others so they see *Toxoplasma* in healthy animals but not necessarily clinical cases. The clinical cases written up about *Toxoplasma* have been principally animals in captivity. Currently Andy and his team are interested in *Toxoplasma* found in the Burrowing Bettong - "Woylie" - found in SW WA; *Toxoplasma* is evident in dying Betongs but not observed in healthy specimens.

Nevi Parameswaran has just completed her PhD with Andy and was investigating whether vertical transmission of *Toxoplasma* was occurring (i.e. from mother to their unborn baby); she visited Dr Mike Grigg's laboratory in U.S.A. to characterise some strains of *Toxoplasma*. Nevi found that within Bettongs and Kangaroos vertical transmission of *Toxoplasma* does occur.

Andy has a new PhD student, Shuting Pan, who will be investigating the molecular characterisation of wildlife hosts of *Toxoplasma* and part of Mike Grigg's visit was to help Shuting with this research.

The team have discovered novel strains of *Toxoplasma* not found elsewhere and their aim is to find out whether *Toxoplasma* was here before the feral cat (the presumed definitive host responsible for the spread of *Toxoplasma*); if it was here prior to the cat then how was it maintained and what, therefore, is the definitive host? Andy and his team will be looking at several hundred samples stored over the past 10 years to help them answer their research questions.

Why is it important to study *Toxoplasma* and what more can we learn?

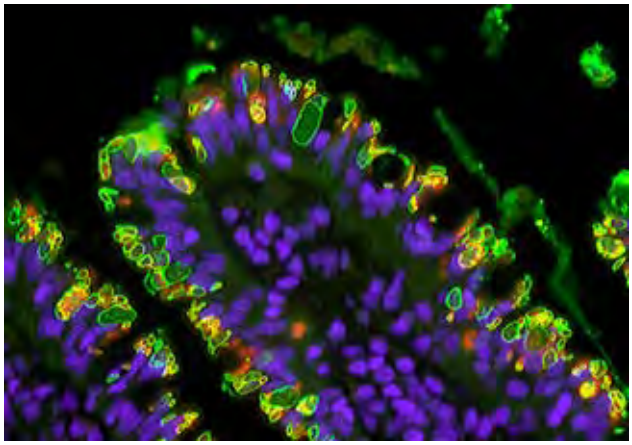
Andy says, "It is important to learn more about *Toxoplasma* because of anecdotal reports of its association with declining numbers of native fauna due to this parasite. We are looking at how variation in *Toxoplasma* strains relates to virulence of the parasite and by studying it we will have a better understanding of the biology of *Toxoplasma*."

Is one of your aims to control disease associated with *Toxoplasma*?

Andy says "yes" - they do aim to control *Toxoplasma* if they find that it is significant in causing clinical disease in marsupials. In that circumstance, they want to understand the stresses that give rise to the clinical disease so that they can limit *Toxoplasma* being clinically significant and better managed in wildlife.

What do you see as the future for drug discovery or vaccine development in relation to *Toxoplasma*?

"There are currently no reliable drugs or vaccines for wildlife affected by *Toxoplasma*," says Andy. "Furthermore, *Toxoplasma* can be better managed by understanding the clinical symptoms in animals. We need better drugs for humans, domestic animals and some livestock affected by *Toxoplasma* and this is an area we can investigate through the drug discovery work at Murdoch". Currently Andy is also looking at sleeping sickness, and has found good potential drug targets for *Toxoplasma* also.



Toxoplasma *parasite. Image copyright 2007 D J P Ferguson, University of Oxford, UK.*

Progress on Initiatives *cont.*

CASE STUDY 2:

Elizabeth Perkins is studying towards her PhD at The University of Adelaide and won a Network Researcher Exchange, Training and Travel Award in September 2008 for a Researcher Exchange to visit Professor Jean-Lou Justine in New Caledonia. Lizzie speaks to Lisa Jones about her research on marine parasites and her Network Travel award.

Lizzie, tell me about your area of research and what interests you about working in this area?

"I work on the molecular phylogenetics of Capsalidae, a monogenean ectoparasite attached to the outside of marine fish. These parasites occur in fish farms, public aquariums and most importantly they infect a huge range of marine fishes – mostly rays and sharks," Lizzie said.

Lizzie explains this parasite has an interesting evolutionary history and as part of her research she wants to produce a robust phylogenetic history of the parasite and look at how they have evolved as the fish they parasitise have evolved.

Lizzie says, "I find parasites fascinating and understudied in their phylogenetic and evolutionary history – there are so many interesting questions about the hosts and parasites."

How has the Network travel award helped your research develop?

"With my Network travel award I was able to visit the laboratory of Professor Jean-Lou Justine in Noumea, New Caledonia. New Caledonia is a French colony with Noumea being the capital. It is the third largest island in the South Pacific region and is surrounded by the world's largest lagoon and beautiful coral reefs. While this sounds like an ideal location for a tropical holiday I was there for anything but that! This was my last opportunity to collect monogenean parasites for the molecular phylogenetic work I have been doing during my PhD and I was determined to make the most of my last chance to flesh out my phylogenetic trees with as many monogenean taxa as possible. Through the work of Professor Justine, New Caledonia has been recognised as a region supporting a large diversity of monogeneans parasites allowing me to maximise the diversity and numbers represented in my analyses," Lizzie said.

Elizabeth Perkins catching fish to study parasites during her Researcher Exchange to visit the laboratory of Professor Jean-Lou Justine in Noumea, New Caledonia.

"The first few days generally began bright and early as we headed out fishing at around 7am for four days straight. Depending on just how windy it was, we managed to get out to a range of the beautiful reefs that surround New Caledonia and set about catching some fish. While there is nothing too fancy about the fishing, using hand lines and a bit of squid, it is very effective with a wide range of fish coming up. The locals definitely seemed to have the advantage in the fishing department but us Aussies rallied and managed to catch a few too (though I can't be sure of the final numbers, more sinkers may have been sacrificed in the process than fish caught!). I had gone to Noumea with a bit of a fish "wish" list and while you can never predict exactly what will take your bait, many of the exact fish species we were after did just that. Sometimes there seemed to be more excitement from the locals over the edible fish than the fish we wanted to dissect!" Lizzie said.

"Afternoons were occupied with fish dissecting and searching through fins, branchiostegal membranes, gills and skin scrapings for elusive worms. There were some fantastic finds with the branchiostegal membranes proving to be an excellent site for worms," Lizzie said.

"During the second week, in between boat trips, we began our mission to introduce Noumea to seine netting,

Aussie-style. This was all to the amusement of the New Caledonians as dragging a seine net is simply unheard of over there. They put out nets as stake nets and leave them over a tidal cycle, they never drag them, seine-style! Despite the somewhat sceptical looks and stifled giggles, we forged ahead and managed to snare a couple of Neotrygon kuhlii in less than ideal netting conditions. Fortunately they also had worms and the parasites we found were a new locality record." Lizzie said.

"In the final days we managed some more days out on the boat and with the assistance of some spear fishers got some fantastic fish to look through. In total we dissected 26 fish species for over a hundred vials of worms and fish tissue – a fantastic effort and some very useful additions to my work." Lizzie said.

"WHAT HAPPENED NEXT?" – STORIES FROM OUR 2005, 2006, 2007 AND 2008 NETWORK RESEARCHER EXCHANGE, TRAINING AND TRAVEL AWARD RECIPIENTS

In 2005, the Network funded 15 applications for assistance from its Researcher Exchange, Training and Travel Award funds (73% directly benefited research students or early career researchers). In 2006, the Network funded 23 applications for assistance from its Researcher Exchange, Training and Travel Award funds (73% directly benefited research students or early career researchers) and we followed the stories of 11 past recipients of our Award funds. In 2007, the Network funded 28 applications for assistance from its Researcher Exchange, Training and Travel Award funds (75% directly benefited research students or early career researchers) and we followed the stories of six past recipients of our Award funds. In 2008, the Network funded 28 applications for assistance from its Researcher Exchange, Training and Travel Award funds (79% directly benefited research students or early career researchers). Each year we continue to see very positive outcomes from our Researcher Exchange, Training and Travel Award Programme. The following stories from our 2005 – 2008 Network Researcher Exchange, Training and Travel Award recipients include further updates from six past Award recipients as well as "What happened next" stories from an additional 19 of our Award recipients.

In the 2007 annual report for the ARC/NHMRC Research Network for Parasitology, we featured stories on **Mieke Burger, Mark Robinson, Matthew Dixon, Una Ryan,** and **Jake Baum**. These researchers have made more progress on their work done with the help of their Network Travel Award and are featured below, along with some more recent recipients of Network support, including **Alyson Auliff, Fiona McCallum, Barbara Nowak, Michelle Power, Malcolm Jones** and **Bong Sze How, Cielo Pasay, Kathy Andrews** and **Leann Tilley**.

Mieke Burger won two Network Researcher Exchange, Training and Travel Awards over the course of her PhD degree at the The University of Queensland; first to attend the Fish Histopathology Workshop at the University of Tasmania, Launceston from 11-14th December 2006; and, second, to visit a myxozoan-focussed lab at Oregon State University, Corvallis from 4-8th August 2008.

"The visit to Tasmania provided me with skills for the interpretation of histopathology which is a recurring aspect of my PhD project. Therefore, the training and experience I received from the workshop were invaluable during the preparation of manuscripts for publication and oral presentation," Mieke says.

"The lab stay in Oregon was useful for extending the relationship of myxosporean parasite research between my lab group and that in Oregon. I spent time with many different researchers assisting them with their research. I learnt much about aspects of myxosporean research that was beyond the scope of my own research, for example, life-cycle studies and characterisation of alternate stages of myxosporeans derived from annelid worms. These specific skills I acquired while in Oregon will be particularly valuable for my continuing research and the formal discussions I had with members of the lab on the biology, phylogenetic relationships and systematics of myxosporean parasites was highly beneficial for all." Mieke says. Mieke's Award has already resulted in a publication describing wildlife reservoirs

Progress on Initiatives *cont.*

of commercial fish parasites, in *Journal of Fish Diseases* in 2008.

Dr Mark W. Robinson, Wains International Fellow and UTS Chancellors Fellow, was part of a Network Researcher Exchange, Training and Travel Award for a Researcher Exchange to travel to IBID, UTS from the University of Aberdeen, UK in 2007. Mark reports that as part of this Researcher Exchange he has helped to advance the use of proteomic techniques for the study of parasite protein expression (in particular secretory proteins that function at the host-pathogen interface) at UTS. Mark has successfully integrated his research programme with ongoing work within IBID and notes that his proteomics/bio-informatics skills have been of considerable use for mapping substrate cleavage sites of helminth pathogen secretory proteases. Mark has also passed on skills in bio-informatics to several honours students, research assistants and postgraduate students during his Researcher Exchange. This has resulted in a series of publications in 2008 in *Trends in Biochemical Sciences, Molecular and Cellular Proteomics* and the *Journal of Biological Chemistry*. Mark also reports that the work led to the award of a grant from the JCRF Islet Transplantation Program in Australia for "Exploiting parasite-derived immunomodulatory molecules to prevent rejection of transplanted islets".

Matthew Dixon, PhD student, Queensland Institute of Medical Research won a Network Researcher Exchange, Training and Travel Award in 2006 for a Researcher Exchange to Dr Joanne Thompson's laboratory at the Institute of Immunology and Infection Research, University of Edinburgh, to learn transfections in the rodent malaria's *Plasmodium berghei* and *P. chabaudi* and apply this to the study of commitment to gametocytogenesis in *Plasmodium*. Matthew published some of the work arising from his Award in *Trends in Parasitology* in 2008, with the article being featured on the cover of the journal.

A/Prof. Una Ryan, Murdoch University, won a Network Researcher Exchange, Training and Travel Award in 2007 for a Researcher Exchange to Dr Caccio, Department of Infectious Parasitic and Immunomediated Diseases, Italy for "Development and evaluation of a diagnostic assay for *Cryptosporidium* and *Giardia*."

Una writes "*Cryptosporidium* and *Giardia* are two of the most important parasitic causes of diarrhoea worldwide. Accurate diagnosis is essential for control, however current diagnostic methods lack sensitivity and specificity".

During her Researcher Exchange Una was able to beta-test her lab's *Cryptosporidium/Giardia* DNA diagnostic test to ensure that the test can detect parasites from many different geographical locations. Una was also able to evaluate new primers for *Giardia* epidemiology in the laboratory and initiated collaborative research on understanding the epidemiology and species structure of *Giardia*. Two publications resulted in 2008, one in *Molecular and Biochemical Parasitology* and another as a book chapter in *Molecular Detection of Foodborne Pathogens*.

Jake Baum, Walter and Eliza Hall Institute, won a Network Researcher Exchange, Training and Travel Award in 2006 for a Researcher Exchange to research malaria actin in the Pollard laboratory at Yale University, U.S.A.

Jake reports that a solid collaborative relationship is now well-established with Prof. Tom Pollard of Yale University to pursue actin regulation in the malaria parasite and that Jake was given an opportunity to start his own lab at WEHI focussing on actin regulation as a result of the work facilitated by his Network Travel Award. Jake was selected by the NHMRC to attend the *Federation of Australian Scientific and Technological Societies, Science Meets Parliament* meeting. He had a formal meeting with Harry Jenkins MP (Speaker of the House) to promote malaria research. Jake published a paper in *Cell Hosts and Microbes* in 2008, as a direct result of the collaborative work undertaken for his award and was an invited speaker at the 4th Annual BioMalPar Conference in Heidelberg, Germany, and at the Joint Pasteur Institute-WEHI Imaging Infectious Diseases Workshop, Melbourne, Australia.

Alyson Auliff won a Network Researcher Exchange, Training and Travel Award for a researcher exchange to study at the University of Notre Dame in Professor John

Progress on Initiatives *cont.*

Adams laboratory from 27th October - 12th December 2006. The purpose of Alyson's visit was to develop new skills that would allow her to transfect *Plasmodium vivax dhfr* genes into *P. falciparum* using the *piggybac* system.

Alyson says, "Since my 2006 visit to the University of Notre Dame I have been establishing the *piggybac* transfection technology at the Australian Army Malaria Institute (AMI). In 2008 I presented some of my *piggybac* results on a poster at the Molecular Approaches to Malaria 2008 conference. I also recently received a fellowship to continue my *piggybac* research with Professor John Adams at the University of South Florida (USF), USA. My research at USF will hopefully result in further publications and seminar presentations of the *piggybac* system, as well as completing my doctorate."

Fiona McCallum won a Network Researcher Exchange, Training and Travel Award for a laboratory exchange with the Kenya Medical Research Institute, (KEMRI) in Kilifi, coastal Kenya in September, 2007.

Fiona says, "Our lab has close collaborative association with KEMRI, Kilifi, and I have used serum samples and clinical data from Kilifi cohorts during my PhD studies to investigate the acquisition of functional antibodies that inhibit *Plasmodium falciparum* growth and replication. I have recently published a paper in *PLoS ONE*, which compares and contrasts the acquisition profiles of growth inhibitory and ELISA antibodies of residents in this area."

Fiona McCallum during her Network Researcher Exchange in Kilifi, Kenya.

Barbara Nowak, from The University of Tasmania, won a Network Researcher Exchange, Training and Travel Award in 2006 for Prof. Iva Dyková to visit Barbara's laboratory to do research on *Neoparamoeba spp.* and run a short training workshop. This led to an excellent collaboration that has resulted in publications in *Diseases of Aquatic Organisms* and the *Journal of Fish Diseases* in 2008. It has also resulted in an FRDC grant (2008/218) *Extension funding application: AGD vaccine phase III* and a *Seafood CRC PhD scholarship*: Using mucosal antibody response to recombinant *Neoparamoeba perurans* attachment proteins to design an experimental vaccine for amoebic gill disease.

Michelle Power, Macquarie University, won a Network Researcher Exchange, Training and Travel Award in 2007 for a one-month Researcher Exchange to visit the Laboratories of Dr Donald Duszynski at the SouthWest Museum of Biology and Assoc. Prof. Rob Miller at the University of New Mexico, both in Albuquerque, USA to learn methodology for describing new *Eimeria* species, obtain samples of *Eimeria* from North and South American marsupials, to isolate and extract DNA from these samples and ship back to Australia and to establish a collaboration to investigate co-evolution of *Eimeria* and marsupials. Michelle has recruited undergrad, Samantha Emery, through internships program to work on research project directly linked to this Award. Samantha now works on the project and intends to pursue parasitology in postgraduate studies after completion of her undergrad program in 2009. As a result of her Award, Michelle secured an Academy of Science grant to visit John Barta (University of Guelph) and Rob Miller (University of New Mexico) to further strengthen and expand the project on host-parasite relationships of parasitic protozoa.

Bong Sze How (PhD student) of Murdoch University, won a Network Researcher Exchange, Training and Travel Award in 2005 for assistance to travel to the laboratory of Dr Mal Jones at Queensland Institute of Medical Research to determine the ultrastructural changes in mature and immature *Schistosoma* induced by triclabendazole. A paper in *PLoS Neglected Tropical Diseases* in 2008 is the result of their collaboration.

Progress on Initiatives *cont.*

Dr Kathy Andrews from the Queensland Institute for Medical Research (QIMR) won two Network Researcher Exchange, Training and Travel Awards in 2008. First for a Grant Writing Retreat to fund Dr Geoff Dow (Walter Reid Army Institute of Research WRAIR; Silver Spring, MD, USA) to spend a week at QIMR to write a joint grant proposal to the Medicines for Malaria Venture. Second a Researcher Exchange to visit the laboratory of A/Prof. Zbynek Bozdech, Nanyang Technological University, Singapore to investigate synthetic HDAC inhibitors as potential antimalarials. As a result, a paper was published in *Antimicrobial Agents and Chemotherapy* in 2008.

Celio Pasay, Queensland Institute of Medical Research, won a Network Researcher Exchange, Training and Travel Award in 2007 to travel to Wright University, Ohio, USA, to study drug resistance in scabies mites. Ceilo writes, "My three-week Researcher Exchange to Wright University served as a spin-off to my work on investigating metabolic basis of drug resistance in scabies mites. The initial bioassays on permethrin resistant mites maintained in the laboratory of our collaborators showed the effect of insecticide synergists in reversing resistance to the acaricide and validated multiple mechanisms of permethrin resistance in scabies mites." This work was published in 2008 in *PLoS Neglected Tropical Diseases* and led to the award of an NHMRC Project Grant on *Diagnostics for drug resistance in scabies* for James McCarthy, Shelley Walton, Ceilo Pasay and Deborah Holt.

Prof. Leann Tilley, La Trobe University, has been a part of six Network Researcher Exchange, Training and Travel Awards and a strong supporter of the funding scheme since the Network began in 2005:

Paula Hawthorne (PhD student) of the Queensland Institute of Medical Research, won a Network Researcher Exchange, Training and Travel Award in 2005 to travel to Leann's laboratory at LaTrobe University to investigate the function of three malaria parasite proteins for her PhD.

In 2006 Leann's lab won a Network Researcher Exchange, Training and Travel Award jointly with **Nick Smith** (UTS) and **Andrew Thompson** (Murdoch University) for a Researcher Exchange for **Professor David Ferguson**, Oxford University to visit Australia to continue collaborative research with Leann's lab on the morphology of the malaria parasite, *P. falciparum*, Nick Smith's lab on the morphology of *Eimeria spp.* and *Toxoplasma gondii* and new collaborations with Andrew Thompson's lab on the morphology of developmental stages of *Cryptosporidium* and *Blastocystis*.

Leann's lab won two more Network Researcher Exchange, Training and Travel Awards in 2007. The first for a Researcher Exchange by international student **Silvia Haase** from Dr Tim Gilberger's laboratory in the Bernhard Nocht Institute for Tropical Medicine, Hamburg, for collaborative research. The second was for a Researcher Exchange for **Leann Tilley, Eric Hannsen** and **Nick Klonis** to visit and use the unique x-ray and optical microscope facilities at the University of California.

In 2008, Leann's lab again won two Network Researcher Exchange, Training and Travel Awards. First for the visit of **Shelia Akinyi** from the laboratory of Assoc. Prof. Mary Galinski, Emory University, Atlanta, USA. The second was for a Grant Writing Retreat with **Prof. Kiaran Kirk** from The Australian National University. (Leann's laboratory is featured as Case Study 3 below). Outputs from these collaborations have been significant and include papers *Eukaryotic Cell, Molecular and Cellular Biology, Molecular Microbiology* (three times) and *Traffic*.

Sheila Akinyi and Eric Hannsen during a 2008 Network Researcher Exchange

Progress on Initiatives *cont.*

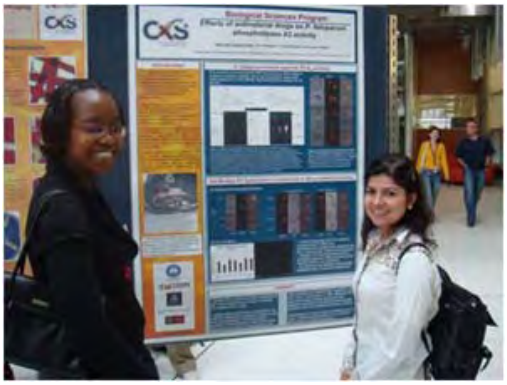
CASE STUDY 3:

Professor Leann Tilley's laboratory at La Trobe University undertakes research in the areas of cell biology and drug development. Her work has been particularly concentrated on studies of the malaria parasite. Leann was a founding member of the ARC/NHMRC Research Network for Parasitology and talks to Lisa Jones about her work.

Leann tell me about your research team at La Trobe University, the techniques you use in your research and why they are so important in parasitology research?

"My lab currently comprises 15 people, including 5 postgraduate students and 4 postdoctoral fellows. The lab members represent an impressive pool of talent with cutting edge skills in fluorescence microscopy and quantitative fluorescence imaging, electron and X-ray microscopy, including 3D reconstructions from electron tomography, and malaria parasite cell biology and genetics manipulation skills."

Leann's lab employs a range of quantitative imaging techniques to study molecular aspects of host-parasite interactions and to probe the functions of a range of parasite proteins. Members of her lab have extensive experience in using confocal microscopy and, more recently, electron microscopy. They have developed protocols for incorporating exogenous labels into parasite-infected erythrocytes and have used molecular biology protocols to produce transfectants expressing green fluorescent protein chimeras. The application of quantitative fluorescence-based techniques to studies of the malaria parasite has enabled the dissection of the ways in which the parasite modifies its erythrocytic host. In particular, it has been shown that the host cell membrane proteins undergo a dramatic molecular reorganisation that is likely to facilitate parasite survival. Her lab has also employed electron tomography to obtain 3-D information about the cellular architecture at very high resolution and to image parasite-derived structures within the host red blood cell.



Sheila Akinyi during her Network Researcher Exchange to the Tilley lab, La Trobe University

"We've been able to use fluorescent molecular "beacons" to monitor changes in cell function upon treatment of parasites with antimalarial drugs and electron microscopy to confirm the changes in digestive vacuole morphology that result from drug treatments," says Leann, "And these studies have shown that both quinoline and endoperoxide antimalarial's act at the level of the parasite's digestive vacuole; they appear to interact with the toxic by-products from the parasite digestion of hemoglobin."

Leann, what inspires you about your parasitology research?

"I am particularly interested in developing novel imaging technologies because of the marvellous cellular landscapes and molecular insights that are revealed when one has access to a new technique for probing parasite function. I believe that networking is very important. In modern laboratory science, no one can act alone. We all depend on a network of collaborations and interactions. I really enjoy bringing people together with different areas of expertise and interest."

Leann, you and your team have been active promoters and recipients of the ARC/NHMRC Research Network for Parasitology Travel Award Scheme. Tell us how these Travel Awards have helped your research progress.

Progress on Initiatives *cont.*

"The ARC/NHMRC Research Network for Parasitology Travel Award Scheme funds have allowed a number of research students, Paula Hawthorne (QIMR), Silvia Haase (Bernhard Nocht Institute for Tropical Medicine, Hamburg), Sheila Akinyi (Emory University, Atlanta, USA), to visit our laboratory to collaborate with us in the use of electron tomography and confocal microscopy to examine malaria parasites. They have used our expertise and high level facilities to image their samples, which have included novel GFP transfectant-infected *P. falciparum* and non-falciparum species. Professor David Ferguson (Oxford Uni) visited the lab to help us set up the electron microscopy facility.

We have also used Network Travel Award funds to visit X-ray and optical microscope facilities in the laboratories of Prof. John Sedat, Prof. Carolyn Larabell, Prof. Joe De Risi and Prof. Steve Lane in the USA. This gave us access to structured illumination microscopy and x-ray tomography facilities that are not available in Australia and a Network Researcher Exchange visit by Professor Kiaran Kirk (ANU) provided an opportunity to exchange ideas, find areas of common interest and synergy. This has led to a joint funding application."

It must be very exciting to have such a dynamic team of researchers and collaborators working with you, tell us what the future holds?

"We are very excited about the possibility that the novel imaging techniques that we are using will reveal the mechanism that this obligate intracellular parasite uses to export virulence proteins outside the boundaries of its own plasma membrane and to take up host cell haemoglobin for digestion. The molecular machinery and the mechanisms of transport involved in these unusual transport systems are not yet well understood but they appear to be different from those used in mammalian systems. My lab concentrates on increasing our molecular understanding of the parasite, which is still really very limited. In the longer term we hope that unravelling the molecular mechanisms will lead to novel antimalarial strategies. We also hope that the fluorescence technologies that we are developing might be useful for high throughput screening for antimalarial drugs or for new malaria diagnostics platforms."

Prof. Tilley's lab group on their Researcher Exchange to the University of California in 2008

Dr. Eric Hanssen was a recipient of a Network Travel Award for a Researcher Exchange to visit laboratories in the USA Eric, tell me about your area of research?

"I work on malaria - more precisely on the architecture of the exporting membrane system within the host erythrocyte."

How has the Network travel award helped your research develop?

"In 2009 our Network Travel Award will bring Esther Patchlatko to Australia, she's an expert in protein pull down and other biochemistry techniques while our lab has expertise in imaging, so that will be a nice exchange of techniques."

What do you see as the benefits of being part of the Network and what would you like to do in the future?

"Being part of a bigger picture; hearing about other research areas; being able to meet other scientists in the area; and the funding available for researchers who are part of the Network. In the future I would like to be a group leader with a focus on EM, or better still, the head of an EM facility with a research group."

Progress on Initiatives *cont.*

Early Career Researcher Initiatives

The Network organised and sponsored an Early Career Researcher and Student Workshop on Sunday 6 July, 2008 to enable postdoctoral researchers and students to speak to prominent parasitologists about their career and to meet like-minded peers. They learnt how some of Australia's highly successful parasitology researchers developed their career and arrived at the point they are today and had the opportunity to question these research leaders in a relaxed, informal setting.

The Early Career Researcher and Student Workshop was attended by 37 early career researchers (including research students) from 15 different institutions within the ARC/ NHMRC Research Network for Parasitology.

The aim of this event was to inspire young parasitologists to think about their own careers in parasitology and we hoped there would be opportunities for the young scientists to discuss their own careers with peers and mentors and network with other people in similar situations. This year's event ran for about five hours and included presentations and discussion by some leading Network researchers on topics such as: time and project management; mentoring and being mentored; getting published; establishing and increasing profile; setting up collaborations; getting funded. There were six speakers who were able to give an insight into their research careers and represented a broad range of experiences of scientists and research parasitologists:

- Nick Smith (Convenor, ARC/NHMRC Research Network for Parasitology);
- Alan Johnson (Research Management Services International)
- Margaret Clayton (Australian Research Council)
- Kiaran Kirk (ANU)
- Alex Loukas (QIMR)
- Una Ryan (Murdoch University)

We surveyed the 37 participants and five speakers who attended the student and early career workshop at this year's conference and 24 (57%) responded; 13 identified as students, 10 identified as early career researchers and three were speakers at the event. Two respondents would like to have attended but were not able to because of either other meetings or not realising it was on.

Almost all respondents to this section agreed or strongly agreed that the speakers were inspirational and interesting to listen to; that "this event enabled me to meet other early career researchers and discuss our science careers and research"; and "Overall, I found the whole experience of attending the early career and student workshop valuable". Most (75%) agreed or strongly agreed that the event gave them the "opportunity to discuss my future career."

There were 27 comments from respondents with suggestions for running this type of event for early career researchers and students and other comments. Many thought there was a need for "having separate PhD student and ECR sessions". Others suggested ideas for the workshop content; "media relations, bargaining contracts, cv presentation"; "Focus on getting grants and fellowships for young postdocs, and writing thesis, applying for postdocs and time management for students getting jobs and publications"; "practical aspects…thesis writing, conference presentation, advice on looking at other career options post-PhD"; "preparing for employment as an academic i.e. the interview seminar, other topic could be ideas on employment options".

Many commented they "found this event very valuable and was very glad I attended", they found "the topics covered very useful and the chance to meet fellow early career researchers and senior research scientists was very useful".

The workshop also promoted the second year of the Network's Mentoring Scheme, whereby early career researchers are encouraged to apply to the Network Convenor (Nick Smith), in strict confidence, for funding to participate in the Network Mentorship Scheme. The scheme allows young investigators to be paired with experienced, successful researchers to discuss, plan, prioritise and set targets for their career. Mentors discuss with the early

career researcher their personal career aspirations and development and the early career researcher can seek advice on annual and longer-term goals and career planning. Several young parasitologists have already taken advantage of this new scheme. Typically, the early career researcher will fly to the institute of a senior parasitologist and spend a day there. Arrangements for professional development and progress to be reviewed by the pair annually can also be arranged. Importantly, mentors need not be from an individual's home institution but can be drawn from across the Network. The scheme has proved very valuable for several young researchers and their mentors already.

Achievements and Outputs

THE ACHIEVEMENTS OF THE RESEARCH NETWORK, NETWORK PARTICIPANT CONTRIBUTIONS TO THE RESEARCH NETWORK AND OTHER OUTPUTS ACHIEVED RESULTING FROM THE USE OF THE FUNDS, INCLUDING ANY ADVANCES IN KNOWLEDGE, RELEVANT PUBLICATIONS, OR INTERNATIONAL COLLABORATION.

Progress on the Network IT Initiatives and the development of national and international collaborative research are summarised above

Publications

ARC/NHMRC Research Network for Parasitology Participants published over 370 articles in journals or books during 2008. These are listed in Appendix 1, at the end of this report, under the National Research Priority that best describes the major theme of each paper. By presenting this list of publications, the Network does not mean to claim undue credit for their production; rather, the list serves as a summary of the research activity of Network Participants, and as a benchmark for reporting and assessing the impact of the Network in subsequent years. The list is also a very useful reference source about and for Australia's parasitology research community. Publications arising specifically from Network Funding are listed separately below. In addition to the printed publications, Network Participants presented 428 papers at conferences or by invitation at institutions across Australia and around the world (including 57 invited lectures at institutions and 85 invited papers at conferences). A comprehensive listing of these presentations is not documented in this report.

NETWORK PARTICIPANTS REPORTED 34 SEMINARS AND POSTERS AND 22 PUBLICATIONS IN 2008 ARISING DIRECTLY FROM WORK CARRIED OUT UNDER NETWORK RESEARCHER EXCHANGE, TRAINING AND TRAVEL AWARDS.

The publications were:

Baum J., Tonkin C.J., Paul A., Smith B.J., Richard D., Pollard T.D., Cowman A.F. Formin regulation of actin polymerisation during malaria parasite invasion of the erythrocyte. *Cell Host and Microbe* 3:188-198.

Burger M., Barnes T., Adlard R. Wildlife as reservoirs for parasites infecting commercial species: host specificity and redescription of *Kudoa amamiensis* from teleost fish in Australia. *Journal of Fish Diseases* 31:835-844.

Caccio S., Ryan U. Molecular epidemiology of giardiasis. *Molecular and Biochemical Parasitology* 160:75-80.

Dixon M.W.A, Thompson J., Gardiner D.L, Trenholme K.R. Sex in *Plasmodium* – A sign of commitment. *Trends in Parasitology* 24:168-75.

Dow G.S., Chen Y., Andrews K.T., Caridha D., Gerena L., Gettayacamin M., Johnson J., Li Q., Melendez V., Obaldia N. 3rd, Tran T.N., Kozikowski A.P. Antimalarial activity of phenylthiazolyl-bearing hydroxamate-based

Achievements and Outputs *cont.*

histone deacetylase inhibitors. *Antimicrobial Agents and Chemotherapy* 52:3467-77

Fenner A.L., Bull C.M. The impact of nematode parasites on the behaviour of an Australian lizard, the gidgee skink *Egernia stokesii. Ecological Research* 23: 897-903

Fenner A.L., Warner L., Bull C.M. *Pharyngodon wandillahensis* n.sp. (Nematoda: Pharyngodonidae) from the endangered pygmy bluetongue lizard *Tiliqua adelaidensis* Peters, 1863 (Sauria: Scincidae), South Australia, Australia. *Comparative Parasitology* 75: 69-75

Godfrey S.S., Bull C.M., Nelson N.J. Seasonal and spatial dynamics of ectoparasite infestation of a threatened reptile, the tuatara (*Sphenodon punctatus*) (Reptilia: Sphenodontia). *Medical and Veterinary Entomology* 22: 374-385

Guzinski J., Saint K.M., Gardner M.G., Donnellan S.C., Bull C.M. Development of microsatellite markers and analysis of their inheritance in the Australian reptile tick, *Bothriocroton hydrosauri Molecular Ecology Resources* 8: 443-445

Hanssen, E., Hawthorne, P., Dixon, M., Trenholme, K., Spielmann, T., Gardiner, D.L., Tilley, L. Targeted mutagenesis of the ring exported protein-1 of *Plasmodium falciparum* disrupts the architecture of Maurer's cleft organelles. *Molecular Microbiology* 69: 938-953.

Hanssen, E., Sougrat, R., Frankland, S., Deed, S., Klonis, N., Lippincott-Schwartz, J. and Tilley, L. Electron tomography of the Maurer's cleft organelles of *Plasmodium falciparum*-infected erythrocytes reveals novel structural features. *Molecular Microbiology* 67 : 703-718

Jones M.K., Bong S.H., Green K.M., Holmes P., Duke M., Loukas A., McManus D.P. Correlative and dynamic imaging of the hatching biology of *Schistosoma japonicum* from eggs prepared by high pressure freezing. *PLoS Neglected Tropical Diseases* 2: e334.

Lowther J., Robinson M.W., Donnelly S.M., Xu W., Stack C.M., Matthews J.M., Dalton J.P. The importance of pH in regulating the function of *Fasciola hepatica* cathepsin L1 cysteine protease. *PLoS Neglected Tropical Diseases* 3: e369

McCallum F.J., Persson K.E., Mugyenyi C.K., Fowkes F.J., Simpson J.A., et al. Acquisition of growth-inhibitory antibodies against blood-stage *Plasmodium falciparum. PLoS ONE* 3: e3571

Robinson M.W., Dalton J.P., Donnelly S. Helminth pathogen cathepsin proteases: it's a family affair. *Trends in Biochemical Sciences* 33: 601-608.

Robinson M.W., Tort J.F., Wong E., Donnelly S.M., Lowther J., Xu W., Stack C.M., Padula M., Herbert B., Dalton, J.P. Proteomics and phylogenetic analysis of the cathepsin L protease family of the helminth pathogen, *Fasciola hepatica:* expansion of a repertoire of virulence-associated factors. *Molecular and Cellular Proteomics* 7:1111-1123.

Ryan U.M., Caccio S. Cryptosporidiosis. In: *Molecular detection of foodborne pathogens*. (ed, D. Liu). CABI publishing, Oxfordshire, UK. In press.

Spycher, C., Rug, M., Pachlatko, E., Hanssen, E., Ferguson, F., Cowman A.F., Tilley, L., Beck, H-P. The Maurer's cleft protein MAHRP1 is essential for trafficking of PfEMP1 to the surface of *Plasmodium falciparum*-infected erythrocytes. *Molecular Microbiology* 68: 1300-1314.

Stack C.M., Caffrey C.R., Donnelly S.M., Seshaadri A., Lowther J., Tort J.F., Collins P.R., Robinson M.W., Xu W., McKerrow J.H., Geiger S., Marion R., Brinen L.S., Dalton J.P. Structural and functional relationships in the virulence-associated cathepsin L proteases of the parasitic liver fluke, *Fasciola hepatica. Journal of Biological Chemistry* 283: 9896-9908.

Tilley L., Sougrat R. Lithgow T., Hanssen E. The twists and turns of Maurer's cleft trafficking in *Plasmodium falciparum*-infected erythrocytes. *Traffic* 9:187-97

Young N.D., Dyková I., Nowak B.F., Morrison R.N. Development of a diagnostic PCR to detect *Neoparamoeba perurans*, agent of amoebic gill disease (AGD). *Journal of Fish Diseases* 31: 285-295.

Young N.D., Dyková I., Snekvik K., Nowak B.F., Morrison R.N. *Neoparamoeba perurans* is a cosmopolitan aetiological agent of amoebic gill disease. *Diseases of Aquatic Organisms* 78: 217-223.

Achievements and Outputs *cont.*

Grants

Research grants awarded to Network Participants in 2008 are listed in Appendix 2 at the end of this report, as a benchmarking record, without claiming undue influence of the Network in the success of the applications. ARC/NHMRC Research Network Participants once again enjoyed great success in the 2008 ARC and NHMRC grant rounds, securing over $20 million in grants, fellowships and major equipment. And this in a year where many fine researchers were actually ineligible to apply because of their outstanding results over the past two years! NHMRC Fellowship winners deserve particular mention: Terry Speed, John Reeder; Brian Cooke; Chris Engwerda; Malcolm McConville; Ray Norton; Tim Davis; Chris Tonkin; Marthe D'Ombrain; Fiona Sansom; Rachel Lundie; Magda Ellis; Gabriela Ninigo; and Julie Wheway. Also, particularly noteworthy was the success of consortia to secure some very valuable infrastructure and equipment, particularly in the area of advanced microscopy - the University of Technology Sydney, LaTrobe University, Murdoch University and the Universities of Melbourne, Sydney and WA will all be enjoying some new state-of-the-art facilities.

Additionally, Network Participants attracted more than $5 million grants from other national and international sources such as the National Institutes of Health, USA, Medicines for Malaria Venture, Australian Biological Resources Study, Drugs for Neglected Diseases Initiative, World Health Organisation, Meat and Livestock Australia, the Fisheries Research and Development Corporation, CRC for Sheep Industry Innovation, the Rural Industries Research and Development Corporation, the Sandlar Foundation, the Seafood CRC, Consejaria de Education, Cultura y Deportes, Gobierno de Canarias (Spain), the Australian Academy of Science, ANZ Trustees, the Northern Territory Government, the Cattle Compensation Fund, the Juvenile Diabetes Foundation of Australia and GlaxoSmithKline

PhD student Mike Lees during his Researcher Exchange to the University of Chicago, U.S.A.

Internationalisation of Research

How the Research Network has facilitated the internationalisation of research and international linkages – links to international networks.

Aside from the Research Exchange, Training and Travel Fund awards (27 out of 34 of which involved international collaboration), and the financing of international invited guest speakers to the annual conference, The Network Management Committee has devoted substantial attention and effort into cementing international linkages with various significant EU, and North American parasitology networks:

- European Union COST Action 857 "Apicomplexan Biology in the Post-Genomic Era" (Chair: Dr Fiona Tomley, fiona.tomley@bbsrc.ac.uk);
- European Union Network of Excellence "BioMalPar – Biology and Pathology of Malaria" (Director: Prof. Artur Scherf, ascherf@pasteur.fr);
- European Union COST Action B22 "Drug Development for Parasitic Diseases" (Chair: Prof. Fred Opperdoes, opperdoes@trop.ucl.ac.be);
- The Quebec Centre for Host-Parasite Interactions (Canada) (Director: Prof. Terry Spithill, terry.spithill@mcgill.ca).

The ARC/NHMRC Research Network for Parasitology has in place agreements to:

[1] Establish an email list that includes all of the ARC/NHMRC Network participants and associates plus the Chairs/Directors of the various international networks. The Communications Coordinator of the ARC/NHMRC Network posts news concerning Network activities, success stories, job advertisements, conference notices, funding opportunities etc to the email list and the Chairs/Directors of the European and Canadian networks determine which items are relevant to their members and forwards these items to their membership as appropriate.

[2] Welcome delegates from the European and Canadian networks at the annual conference of the ARC/NHMRC Network with the same registration subsidy as members of the ARC/NHMRC Network.

[3] Award prizes to early career researchers (one or two each year) for the best presentations at the ARC/NHMRC Network annual conference. The prizes are funding for travel to attend the annual conference of the international network that is most relevant to that researcher. The international networks will guarantee a speaking slot for the prize winners – **Alex Maier (LaTrobe University)** and **Julie-Anne Fritz (ANU)** were the 2008 awardees and will represent the Network at the 2009 BioMalPar conference and the 2009 World Association for the Advancement of Veterinary Parasitology Conference, respectively.

[4] Invite the Chairs/Directors of the various international networks to sit on the Advisory Committee of the ARC/NHMRC Research Network for Parasitology, which meets annually.

Our sponsorship arrangement with Elsevier Publishing (including *Trends in Parasitology* and *The International Journal for Parasitology*) saw the continuation the "Elsevier Lectures" as a feature of the annual conference.

In 2008, Associate Professor Smith, representing the Network, and Professor Artur Scherf, the Director of BioMalPar, signed a formal Memorandum of Understanding between the two networks to facilitate and enhance future interactions and explore co-funding opportunities. As a result, the Australian malaria research community have been include on a European Union FP7 Network of Excellence application, along with the European malaria research community, to seek a second iteration of *BioMalPar*, to be known as *EVIMalaR - a European Virtual Institute for Malaria Research*. In association with this, Prof. Geoff McFadden and Dr Kevin Saliba from the Network Management Committee spearheaded an application to the NHMRC to assist Australian participation in this major international malaria research initiative.

Significant Contributions

There were several highlights for the Network in 2008, perhaps most notably the increasingly strong uptake of the opportunity to establish and strengthen collaborative research via the Network's Researcher Exchange, Training and Travel Fund, the continuing excellent registration at the Joint Conference of the ARC/NHMRC Research Network for Parasitology and ASP, the very successful staging of three other conferences (all described above) and a series of outstanding public awareness initiatives including the continuing success of "Parasites in Focus" (described below in Outreach Activities).

Most pleasingly, tangible outcomes from the Network's Researcher Exchange, Training and Travel Fund continued to emerge in 2008 in the form of publications in peer-reviewed international journals, conference presentations and successful research grants and fellowships (detailed above).

A major personal achievement in 2008, that deserves particular mention here, was **Professor Terry Speed (Walter and Eliza Hall Institute) being awarded an Australian Fellowship**. The highly prestigious Australian Fellowships were introduced by the NHMRC "to provide support for the most outstanding health and/or medical researchers [and] outstanding research teams…to undertake research that is of major importance in its field and of significant benefit to Australian health and medical research." The Fellowship will enable Terry's research team to intensify their efforts in defining the mechanisms of some of humanity's most deadly diseases.

Terry will apply his funding to, amongst other things, the continuing search for better understanding of malaria. Worldwide, this parasitic disease infects an astonishing 600,000,000 people – about 10% of humanity – and kills up to 3,000,000 people every year. The World Health Organisation (WHO) has stated that overcoming malaria would be one of the greatest single contributions to alleviating poverty in the developing world. Terry is Head of the Bioinformatics Division at WEHI, and describes his scientific discipline as being the point where mathematics meets biology. The recent achievements of the Bioinformatics Division include the identification of members of a class of genes involved in the transport of deadly malaria parasites to the red blood cells of the human host. The Fellowship will also allow Terry to conduct his research entirely within Australia; until now he has divided his research time between the Walter and Eliza Hall Institute in Melbourne and the University of California, Berkeley, in the United States.

Queensland Institute of Medical Research members also enjoyed enormous personal success in 2008. First, **Dave Kemp was awarded a Medal of the Order of Australia** on January 26, 2008 for *"service to medical research as a molecular biologist, particularly in the areas of tropical health and infectious diseases, through contributions to Indigenous health and to professional organisations"* and, then later in the year, **Michael Good was awarded Officer of the Order of Australia** on the 9th June 2008 for *"service to medical research, particularly in the fields of infectious disease immunology and vaccine technology, through leadership roles at the Queensland Institute of Medical Research and contributions to education."* And, third, **Kathy Andrews won an Australian Society for Medical Research Queensland Premiers Award for Medical Research (Senior Category)**.

Parasitologists at the Australian National University also received some thoroughly deserved recognition. **Adele Lehane, a PhD student was awarded the Australian Society for Biochemistry and Molecular Biology's (ASBMB) Mannatech Award in Modern Metabolic Biochemistry**. The Award is made for the most outstanding metabolic biochemistry publication (published in the preceding year) by a PhD student or researcher with no more than seven years post doctoral experience. The paper for which the award has been made is "Feedback inhibition of pantothenate kinase regulates pantothenol uptake by the malaria parasite" by Adele Lehane, Rosa Marchetti, Christina Spry, Don van Schalkwyk, Rongwei Teng, Kiaran Kirk and Kevin Saliba [*J.Biol. Chem*., 282, 25395-405]. **Adele Lehane was also awarded the ASBMB's President's Award Fellowship.** The ASBMB Fellowships are awarded to early career researchers

Significant Contributions *cont.*

in recognition of their outstanding work in an area of biochemistry or molecular biology. Adele's supervisor, **Kiaran Kirk, was awarded the ANU Vice-Chancellor's Award for Excellence in Research Supervision** and the Bancroft-Mackerras Medal by the **Australian Society for Parasitology** for Excellence in Parasitological Research. Kiaran received his Medal for his work on the biology of the malaria parasite.

Prof. Kiaran Kirk and Adele Lehane (ANU)

Other award winners in 2008 were: **David Blair (James Cook University)** and **Nick Smith (University of Technology, Sydney)**, **both made Fellows of the Australian Society for Parasitology** for their career achievements and service to the discipline of parasitology; **Ala Lew (QDPI&F) who won a Smart State Smart Women Award (Qld)** for Women in the Community/ Public Sector – Science; **Robin Gasser, of the University of Melbourne, who was made a 2008 Australian Fulbright Senior Scholar**; and **Emily Piper (DPI&F) was awarded the Early Career Scientist award by the Cooperative Research Centre's Association.**

There were a number of major research successes by Network Participants, which deserve to be highlighted. A particular feature of these success stories is the considerable international collaboration that characterises much of Australian parasitology research:

- Australia's research effort in marine parasitology, with particular regard to the cataloguing of the ecology and biodiversity of parasites of marine fish and shellfish, including their impact on Australia's aquaculture industry continued unabated – many new species of marine parasites were described during 2008 by researchers around the country and, additionally, Lexa Grutter and colleagues continued to uncover important evolutionary checks and balances amongst cleaner fish, their "clients" and their ectoparasites (*Nature* 455: 964-967);
- Australia's malaria researchers continued to lead the world, publishing cutting edge papers on the immunopathology of the disease, especially with regard to cerebral malaria (eg, Yeo et al., *PNAS*, Randall et al., *J. Immunol*; Penet *et al*., *PNAS*.; Yeo et al., *PNAS*) and on the molecular machinery that underpins the ability of *Plasmodium falciparum* to "stick" to host cells (Maier et al. *Cell*) – new drug treatment strategies may ultimately result;
- Australian pre-eminence in vaccine development for parasites was still in evidence in 2008 with numerous articles published on the developments and obstacles faced for vaccines as well as, most notably, a *PLoS ONE* article (Wallach *et al*.) describing the first successful commercial use of a subunit vaccine against a protozoan disease (poultry coccidiosis);
- Australian malaria researchers collaborated on major international collaborative efforts to sequence the genomes of *Plasmodium vivax* and *P. knowlesi*, published in *Nature* in 2008 (Pain *et al*., Carlton *et al*.) – these developments highlight the differential gene family expansion that characterises different malaria parasite species and may profoundly influence efforts to understand cell invasion and antigenic variation by these parasites;

Significant Contributions *cont.*

- The plastid of apicomplexan parasites came in for particular attention in 2008, with Australian researchers leading the way in dissecting the targeting sequences, showing that apicoplast transit peptides are governed by a remarkably simple set of parameters (Tonkin *et al.*, *PNAS*) plus the discovery – in Sydney Harbour – of a unique algal symbiont of coral, *Chromera*, that is a perfect model for studying the evolution of the plastid of apicomplexan parasites and may also be useful for drug testing because, unlike most parasites, it grows "like a weed" *in vitro* (Moore *et al*., *Nature*).

Media and Outreach

IN 2008, OUR NETWORK MEMBERS ENGAGED IN NUMEROUS OUTREACH ACTIVITIES THAT HIGHLIGHTED THEIR RESEARCH.

The audience was widespread, ranging from talk-back radio viewers, children's television, Rotarians, and rural communities. Our Network scientists recognise the important role they can play in communicating to the wider community with the aim to stimulate more interest in science and health.

Media Reports

In total, 46 stories promoting the ARC/NHMRC Research Network for Parasitology participants were reported in the media in 2008. In addition to radio and TV interviews and newspaper articles, some of our Network scientists have been featured in documentaries and film.

"Parasites in Focus" photography exhibition features in the weekend edition of the *Sydney Morning Herald* "What's on" section in August 2008.

Brown Besier featured on *ABC* radio (South Coast WA): interviews on: cattle worms (Aug 08); strategic sheep worm control (Aug 08); summer rains and sheep worms (Dec 08); Barbers Pole Worm risk in sheep (Dec 08).

A news article about **Kate Hutson's** research on parasites of recreational fish at The University of Adelaide appeared in the Adelaide *Advertiser*, August 9 2008.

David Jenkins contributed to the filming of a New Zealand *Discovery Chanel* programme about diseases that you can pick up travelling around the world; Dave talked about hydatids.

Mal Jones was interviewed on *ABC* 612 Brisbane, Mornings - 06/02/2008 - 10:43 AM with Madonna King about his talk at the Queensland Museum, called '*Parasites and People*' to complement the '*Parasites in Focus*' photography exhibition at the Museum.

Ala Lew featured in the following news stories:

- *WIN Channel 9* television interview – opening of Centre for Advanced Animal Science (September 2008)
- *Sunday Mail* (Qld) interview and newspaper article– as Smart State Smart Women finalist
- *South East Advertiser* (Brisbane) interview and Newspaper article – Smart State Smart Women Award winner
- Media releases associated with the tick vaccine research: *Qld Country Life, SectorWide, Fassifern Guardian, Qld Times, Toowoomba Chronicle, Brisbane City South News, North Queensland Register*.

Alex Maier was involved in media coverage on *ABC* Television ("News" and "Dateline"), and Radio and Print media in more than 15 countries.

Kate Miller and **Sheila Donnelly** (UTS) hosted a *"Totally Wild"* visit and filming.

Terry Spithill featured in an article about ARC funding in the Higher Education section of *The Australian*.

Leann Tilley:

- Made a comment on the National Innovation Statement which featured in *The Australian*, October 08, 2008.

Media and Outreach *cont.*

"Funding shortfall hampers research expertise" by Luke Slattery and Andrew Trounson.

- http://www.theaustralian.news.com.au/story/0,25197,24461707-12332,00.html
- Featured in *Swinburne Magazine*, May 2008 (Graham O'Neill) (report of interview with CXS members) "Disease arms-race looks to powerful new X-ray tools"
- Featured in *Australian Life Scientist*, May 2008 (Kate McDonald) in a report of an interview with CXS members: "Shining a Light on Membrane Proteins"

Ian Whittington:

- Gave an interview on *ABC* Local Radio (ABC 891) on the Bald Brothers Breakfast Show about stingrays in the Adelaide area, 21st February 2008.
- Publicised both the 2009 ASP & ARC/NHMRC Research Network for Parasitology Annual Conference and "Parasites in Focus" in the *Adelaide Advertiser*, June 19 2008.

Outreach Presentations and Activities

In total Network Participants were involved in over 42 outreach presentations and activities across Australia during 2008. Following a number of highly successful Outreach events in 2007, our Network scientists were delighted to participate in these events again in 2008 as well as involve new presentations. Public lectures and outreach activities help the ARC/NHMRC Research Network for Parasitology meet one of its aims in promoting Australia as a centre for parasitic research. Utilising these opportunities to showcase the hard work of Australian parasitologists is a perfect way to engage a curious public.

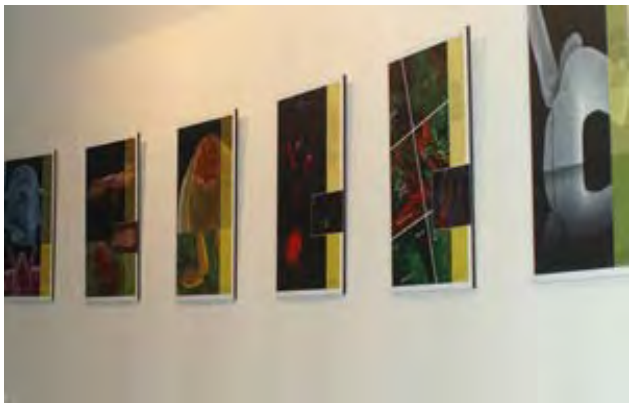
Workshops and Exhibitions

Network scientists have been busy running the very popular DNA workshop and parasitology talks for school students in 2008.

Early in the year **Dr Shelia Donnelly**, UTS gave her talk 'Revenge of the Body Snatchers' at Science in the Suburbs at Olympic Park, May 27th-28th 2008, coordinated by the Australian Museum.

Dr Kate Miller, and **Dr Wendy Relf**, UTS ran a DNA workshop for 40 Canley Vale High School Year 10 students June 11. They also ran a parasitology demonstration for school visit by St Anthony's, Picton Year 5, October 14, 2008 and a DNA workshop for Siemens Science Experience December 3, 2008 at UTS.

To celebrate National Science Week in August 2008, Network scientists were involved in the Australian Museum's Science in the City (6-8 August, 14-16 August), and the Ultimo Science Festival (22 August) coordinated by the Powerhouse Museum, University of Technology, Sydney, Ultimo TAFE and ABC. **Shelia Donnelly**, UTS gave the now famous presentation, 'Revenge of the Bodysnatchers' as part of Science in the City and for the Ultimo Science Festival, along with our fabulous "Parasites in Focus" exhibition of 26 amazing photographic images of parasites on display at the Muse Gallery, TAFE Ultimo College. More than 400 school students and general public were horrified and surprised to see gory photographic evidence as to how Helminths, or worms can devour and multiply in host tissue. Network scientists also staffed a hands-on parasite display with parasite specimens in resin and to look at under a microscope.



"Parasites in Focus" photography exhibition

Media and Outreach *cont.*

"Parasites in Focus" Photography Exhibition

This exhibition was a new initiative by the Network in 2007 developed by the Network, the Australian Society for Parasitology, Inc., Questacon and Department of Education, Science and Training. The photographic exhibition featured twenty-six superb colour photographic prints showing the amazing microscopic world of the parasite. It included up close images of head lice, ticks, fleas, fish parasites, tapeworms and organisms that cause malaria.

The "Parasites in Focus" exhibition followed the Annual ASP & ARC/NHMRC Research Network for Parasitology Conference held at Glenelg, and was on display from 4 June 2008 to 20 July 2008 at the **South Australian Museum**, North Terrace Adelaide.

The exhibition was part of the Ultimo Science Festival, and on display from 18 to 31 August 2008 at **The Muse Gallery**, Building C,TAFE Ultimo College, Cnr Mary Ann and Harris Street, Ultimo, Sydney. More than 400 students and general public visited the gallery to view the exhibition and Network scientists also staffed a hands-on parasite display and Sheila Donnelly presented her fantastic "Revenge of the Bodysnatchers" presentation.

"Parasites in Focus" then travelled west and has been on display since 10 September 2008 at **Perth Zoo**, 20 Labouchere Rd, South Perth, Western Australia where visitors are enjoying an extended season. The next two locations will be Sydney (in conjunction with the 2009 ARC/NHMRC Research Network for Parasitology Conference in Sydney) and then onto Darwin at the Northern Territory Library in August and September 2009.

"Intimate Aliens" *interactive exhibition*

Development has progressed very well in 2008. The Australian Society for Parasitology committed funds to develop an exhibition portfolio (download this portfolio from the Network website http://www.parasite.org.au/arcnet/events/intimate_aliens_portfolio.pdf) and three interactive exhibits due for completion in time for the ARC/NHMRC Research Network for Parasitology Conference in Sydney July 2009. The Exhibition Portfolio Intimate Aliens exhibition portfolio was sent out to potential sponsors in November 2008.

Pediculus humanus *the body or clothes louse image courtesy of Cath Covacin, Stephen Barker and Rick Webb, The University of Queensland.*

Stuart Kohlhagen from Questacon and Lisa Jones are developing three interactive exhibits to accompany the "Parasites in Focus" photography exhibition. These exhibits will be on display at the next ASP & Network Conference in July 2009 at The University of Sydney and are described below:

- A "virtual microscope" where visitors select a parasite type, eg "animal parasites", and select a parasite, eg "tapeworm", and then can use the virtual microscope to zoom in to different sections of the parasite.
- "Bring your own parasite" where visitors use a real medium-powered light microscope to examine parasites embedded in resin, eg "roundworm".
- "The farmyard scene" This has a range of animals sitting around a screen, eg pig, cow, chicken, dog, cat, rat, fox, kangaroo. Using a scanner, visitors can swipe each animal to discover what parasite inhabits each different animal. The screen will display information about the parasite and whether it can infect humans.

Media and Outreach *cont.*

Outreach activities by Network Participants

Robin Anders gave a talk to ANZAAS on the need for a malaria vaccine. 14 May, RMIT University, Melbourne.

Kathy Andrews gave an invited seminar to the Brisbane Probus Club

Alyssa Barry presented at the Monash University Tertiary Careers Evening (hosted by ASMR)

Jake Baum was an invited guest speaker at Glen Waverley Golf Club charity day to promote medical research and raise awareness about our work at the WEHI in February 2008.

Stephen Barker was part of the CSIRO Scientist in Schools Program and resident scientist at Durack State School. He works with the grade 7 science teachers each week for an hour.

Brown Besier presented at the Farmer field days: cattle worm control (Mt Barker, Sept 08); sheep worm control (Mt Barker, Sept 08); Sheep CRC parasite research (Katanning, Oct 08).

David Blair gave an "Inaugural lecture" -a public lecture presented at Rydges Convention Centre, in Townsville on December 2nd 2008. Title "Blood-flukes: catchy parasites here to stay".

Vern Bowles gave a BioGeelong seminar (Aug 2008).

Mike Bull gave presentations to SA Field naturalists April 2008 and Nature Foundation of SA Sept 2008.

Denise Doolan presented to Pfizer Australia, Sydney, NSW, Australia. 25 Nov 2008 Immuomics and malaria vaccine development.

Michael de Veer, participation in the CSIRO "Scientists in Schools" program with two schools.

Chris Engwerda:

- Participant in the Spotlighting Careers in Indigenous Health and Science Programme at QIMR, October, 2008.
- Design and supervision of science projects for year 6 and 7 students at New Farm State School, Brisbane, Australia, September, 2008.
- Scientific Presentation to Prep students at New Farm State School, Brisbane, Australia, December, 2008.

Simon Foote:

- Attended numerous state and federal government panel discussions on a range of topics from the commercialisation of intellectual property, genetic biobanks, genetic ethics etc.
- Addressed the genetics class at the Friends School in Hobart

Don Gardiner gave a talk to Year 2 Students at Fig Tree Pocket State School on "What does a Scientist do".

Michael Good:

- Invited speaker - Like Minds program, Queensland Academy for Science, Mathematics & Technology, Toowong, Brisbane, 21 May
- Welcome Address, High School Students Lecture Series, QIMR, 31 July
- Invited speaker – Queensland Academy for Health Sciences, Southport, Gold Coast, 1 August

Kate Hutson presented a talk to school children during National Science Week at the South Australian Museum during August 2008.

Mal Jones presented a talk at the Queensland Museum called 'Parasites and People' to complement the 'Parasites in Focus' photography exhibition at the Museum.

Members of **Brian Kay's** laboratory were involved in three outreach events in 2008:

- T Hurst, J Jeffery and L. Hugo, Presentations on mosquito biology at the QIMR high school lecture series, Brisbane, July
- T. Hurst, J Darbro and L. Hugo, Hosted high school student Thisun Piyasena for work experience, September.
- L Hugo, P Ryan, B Kay, Hosted QUT summer research scholar, Ben Rutherford, January

Geoff McFadden gave a Malaria presentation for the Science Issues Café on 4th August 2008.

Alex Maier ran a Guest Faculty Workshop: Molecular Methods in Malaria Research, International Centre for

Media and Outreach *cont.*

Genetic Engineering and Biotechnology, New Delhi, India

Elizabeth Perkins, Steve Donnellan, Leslie Chisholm & Ian Whittington presented "Phylogeny and radiation of flatworm ectoparasites (Platyhelminthes: Monogenea: Capsalidae) from marine fish using molecular genetic approaches." as an invited student presentation to the Royal Society of South Australia, August 12 2008.

Michelle Power gave a presentation "*Cryptosporidium*: An Australian perspective" to Microbiology Department, John Hunter Hospital.

Leann Tilley was part of the International Baccalaureate (Theory of Knowledge) Study Daze Program. La Trobe University, December 2008, "Cell & Molecular Biology of the Malaria Parasite: Microscopic views of life in a red blood cell".

Ian Whittington

- "My interesting work on fish parasites!" gave an invited presentation to the South Australian Wildlife Health Group at the Adelaide Zoo, Adelaide, South Australia, March 11 2008.
- Presented a talk about the value of museum collections to a National Postgraduate Training Workshop in Systematics (21-25 July 2008) on July 23 2008 at The University of Adelaide, sponsored by the Australian Biological Resources Study (ABRS), Environmental Futures Network, Research Network for Vegetation Function, the National Taxonomy Hub and the Australian Centre for Evolutionary Biology & Biodiversity.

Wendy Relf and Kate Miller during their outreach activity "Science in the Suburbs"

Contribution to the National Benefit

THE CONTRIBUTION OF ARC/NHMRC RESEARCH NETWORK FOR PARASITOLOGY TO AUSTRALIA'S FUNDAMENTAL, STRATEGIC AND APPLIED RESEARCH EFFORT IS EVIDENT IN THE QUANTITY AND QUALITY OF PUBLICATIONS LISTED IN APPENDIX 1.

2008 has been a year where national and international collaboration has been strongly fostered by the Network through its Researcher Exchange, Training and Travel Fund and through the continuation of formal links with international networks in Europe and North America. Additionally, the Network has created substantial training and networking opportunities for research students and early career researchers, again through the Researcher Exchange, Training and Travel Fund, but also via financial support for the Annual Conference of the ARC/NHMRC Research Network for Parasitology, which attracted nearly 130 early career parasitology researchers, and other Network-sponsored conferences held throughout the year (and described above). Both these strategies are now paying off with young researchers publishing their research and winning grants and fellowships, either as spin-offs of research undertaken under the Network Researcher Exchange, Training and Travel Award scheme or as a result of linkages forged at Network-sponsored events. Fostering the exposure, profile and opportunities of young researchers is seen as key to the future of parasitology research in Australia and is, therefore, a high priority for the Network.

Activities and Strategies for 2009

Early Career Researcher Initiatives

The Network will stage two workshops for early career researchers in conjunction with the 2009 annual conference in Sydney in July, 2009; one for postdoctoral researchers and one for research students.

The Network's Mentoring Scheme will continue in 2009. Under this scheme, early career researchers are given the opportunity to (confidentially, via the Network Convenor) arrange mentoring partnerships with senior parasitology researchers – not necessarily from their current host institution – to discuss their personal career aspirations and development and seek advice on annual and longer-term goals and career planning.

Communications Strategy

In 2009, the Network will continue to provide outreach activities as described above for 2008. The Network's photographic exhibition, "Parasites in Focus" will continue to tour the country with venues booked for Sydney and Darwin in 2009.

The Network will also continue to develop an interactive, hands-on, travelling exhibition about parasites and the importance of Australian parasitology research. Three interactive exhibits are currently being developed and will be on display at the 2009 Network and ASP Annual Conference with the official launch of these exhibits planned to coincide with Australia's hosting of the International Congress of Parasitological Associations, the major research conference for the discipline, to be held in Melbourne in 2010. The exhibition is being developed in collaboration with Questacon – the National Science Centre. Download the exhibition portfolio from the Network website (http://www.parasite.org.au/arcnet/events/intimate_aliens_portfolio.pdf)

Future Planning

The Future of the Network was a major topic for discussion by the Network Management and Advisory Committees at their meeting in July 2008 and concrete steps have been taken, and will continue to be taken in 2009, to secure a future for the Network beyond the term of the current ARC and NHMRC funding. Thus, as a result of the Memorandum of Understanding that was signed with the European Union FP6 Network Of Excellence for the Biology and Pathology of Malaria (BioMalPar) in February, 2008, Australia's malaria research community have been included in the FP7 application for continuation of this Network and have, accordingly, been eligible to apply for funding from the NHMRC to facilitate participation in the European Network (coordinated by Geoff McFadden and Kevin Saliba from the Network Management Committee). The funding will be to support exchanges of staff (especially postdoctoral researchers) and students between Europe and Australia. The application was submitted in December, 2008. Additionally, a proposal was lodged with the Australian Society for Parasitology Inc., at its Council meeting in January, 2009, to support a continuation of the Network for another five years. The mission of the second generation Network will be largely unchanged, that is to:

- focus and enhance Australia's fundamental, strategic and applied parasitology research capabilities to understand parasitism, parasite biology and parasitic disease; and
- to use that understanding to discover and develop sustainable control strategies to improve and maintain the health and well-being of humans and animals.

And the aims will be to:

- maintain a website that will foster national and international collaborations by providing access to databases on parasites, parasite genomes, bioinformatics analysis tools, parasitology research resources and protocols, parasitology researchers – this will prevent duplication of research and promote the adoption of uniform protocols, which will fast track Australia's research effort;
- organise conferences, workshops and meetings (including raising of external sponsorship for these events);
- foster and finance exchange of staff between national and international research institutions to maximise access to key infrastructure, equipment, expertise and supervision and to encourage the growth of new collaborative relationships;

Activities and Strategies *cont.*

- coordinate effective communication about parasitology and Australian parasitology research to the general community via organisation of outreach events and exhibits.

The Network is currently envisaged to continue to be made up of numerous Participating Organisations (universities, research institutes and professional bodies) contributing cash – all funds would be held and administered centrally. A Convenor, appointed by the ASP Council, would oversee operations of the Network, on a part-time basis as part of their negotiated duties in their home institution. This would be done in collaboration with Prof. Geoff McFadden, the nominated Chief Investigator for the Australian arm of the EU Malaria Network of Excellence. A fulltime Communications Coordinator would be required to manage communication, administration and outreach activities.

The governance model that has proved to be extremely efficient and appropriate for the current Network, will continue, i.e., a Management Committee of around ten, drawn from various disciplines and organisations of the network, plus an Advisory Committee that is largely international. Communication would be via a website, bimonthly newsletters, annual report, annual conferences and Council Meetings of the ASP.

The intent is that this second generation Network would give the parasitology research community time to raise its profile further and to develop a plan and funding strategy for an *Australian Graduate School for Parasitology*, to be implemented by 2015. The mission of the *Australian Graduate School for Parasitology* will be to foster collaborative research – both within Australia and internationally – and enhance parasitology career opportunities in order to:

- focus and enhance Australia's fundamental, strategic and applied parasitology research capabilities to understand parasitism, parasite biology and parasitic disease; and
- to use that understanding to discover and develop sustainable control strategies to improve and maintain the health and well-being of humans and animals.

The Graduate School aims to:

- maintain a website that will foster national and international collaborations by providing access to databases on parasites, parasite genomes, bioinformatics analysis tools, parasitology research resources and protocols, parasitology researchers – this will prevent duplication of research and promote the adoption of uniform protocols, which will fast track Australia's research effort;
- organise conferences, workshops and meetings (including raising of external sponsorship for these events);
- foster and finance exchange of staff and students between national and international research institutions to maximise access to key infrastructure, equipment, expertise and supervision and to encourage the growth of new collaborative relationships;
- provide mentoring, training and grant writing support for young investigators;
- create a postdoctoral fellowship scheme with clear cross-institutional, co-supervisory arrangements;
- create a "tenure-track" scheme wherein the Graduate School provides institutions with funding for excellent candidates for 3 years, after which the institution takes responsibility for financing a continuing position; and
- development of an intensive, month-long, postgraduate course in parasitology to be held annually or biannually and mirroring the highly esteemed *"Biology of Parasitism"* course, which is run each year at Woods Hole (USA).

How the Research Network has tackled or plans to tackle issues in a manner that may not otherwise have been achievable without the mechanism of a Research Network

The Network's Research Exchange, Training and Travel Fund creates opportunities for collaborative research that would otherwise not exist. This has proved particularly valuable for research students and early career researchers who have been granted the opportunity to work in different laboratories in Australia and overseas, gaining access

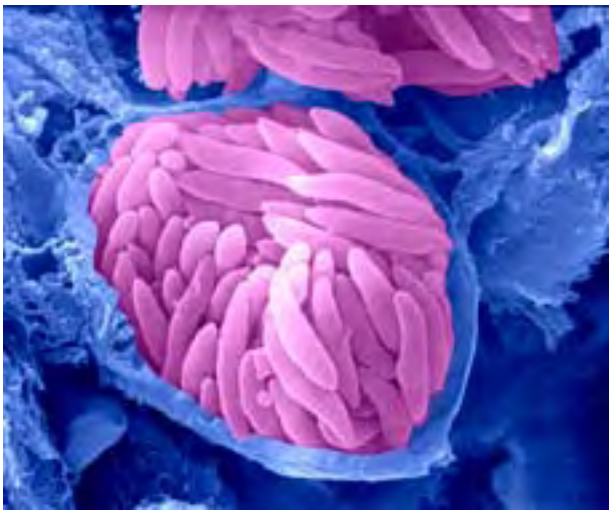
to specialised equipment and expertise and exposure to a wider variety of research cultures than would normally be possible. Additionally, the subsidisation of scientific meetings by the Network has brought more opportunities for young parasitology researchers to interact with their peers and senior researchers. If the hopes outlined above for a future iteration of the Network are realized, then these opportunities for collaborative research and career development will increase even further.

Career guidance opportunities for early career researchers has been enhanced by the introduction of the Network Mentoring Scheme at the Early Career Researcher Workshop in Canberra, in July, 2007. We anticipate growing uptake of the opportunities afforded by this initiative throughout 2009.

Increased public awareness about parasites and parasitology research has been a goal of the Australian parasitology community for many years but is being realised now on a larger scale, thanks to the Network grant. In particular, the ability to employ a professional science communicator – Lisa Jones – has facilitated interactions with the media and general public.

How the Research Network has increased or is planning to increase the scale and focus of research activities.

Aside from facilitating collaborative research via the Researcher Exchange, Training and Travel Fund, which has begun to bear fruit in the submission, and award, of new grant applications and the production of collaborative research papers, the Network Management Committee has discussed extensively and drawn up a list of international researchers that it wishes to target for recruitment back to Australia, especially – but not exclusively - via the Australia Fellowship, Federation Fellowship and/or Laureate Fellowship schemes. This list is discussed, and added to, by the Network Management and Advisory Committees, annually, and contact subsequently made with researchers to encourage and support the submission of applications. Similarly, the Management and Advisory Committees identify groups of researchers and areas of research focus that appear good candidates for development of larger scale, program-style or Centre or Excellence applications – the Researcher Exchange, Training and Travel Fund provides a mechanism for these groups to gain funding to bring people together to prepare large-scale grant applications.



Parasite image Eimeria tenella. *Image copyright 2007 D J P Ferguson, University of Oxford, UK.*

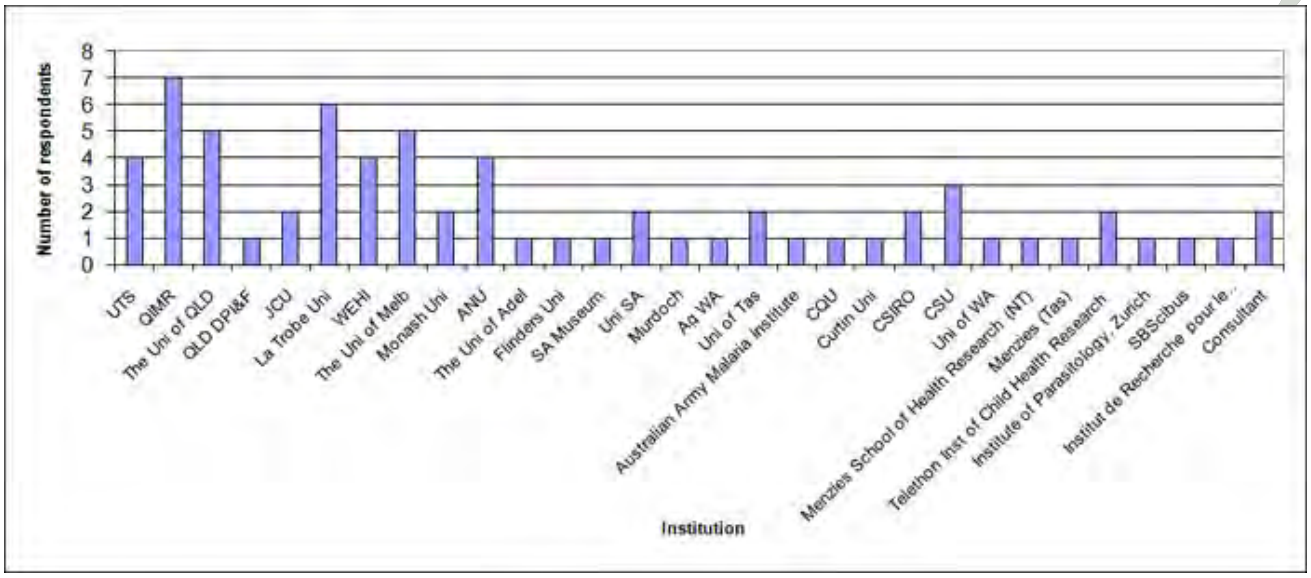
2008 ARC/NHMRC Research Network for Parasitology Annual Survey

Participant Information

This survey was made available to the Network participants to complete online. Responses were monitored over two weeks and a total of 67 Network participants responded. Respondents were self-selected.

Survey respondents represented 29 different institutions with the highest number being based at QIMR 10%, La Trobe University 9%, The University of Melbourne 7.5% WEHI, ANU and UTS each 6% (Figure 1). Five respondents indicated that they represented two different institutions.

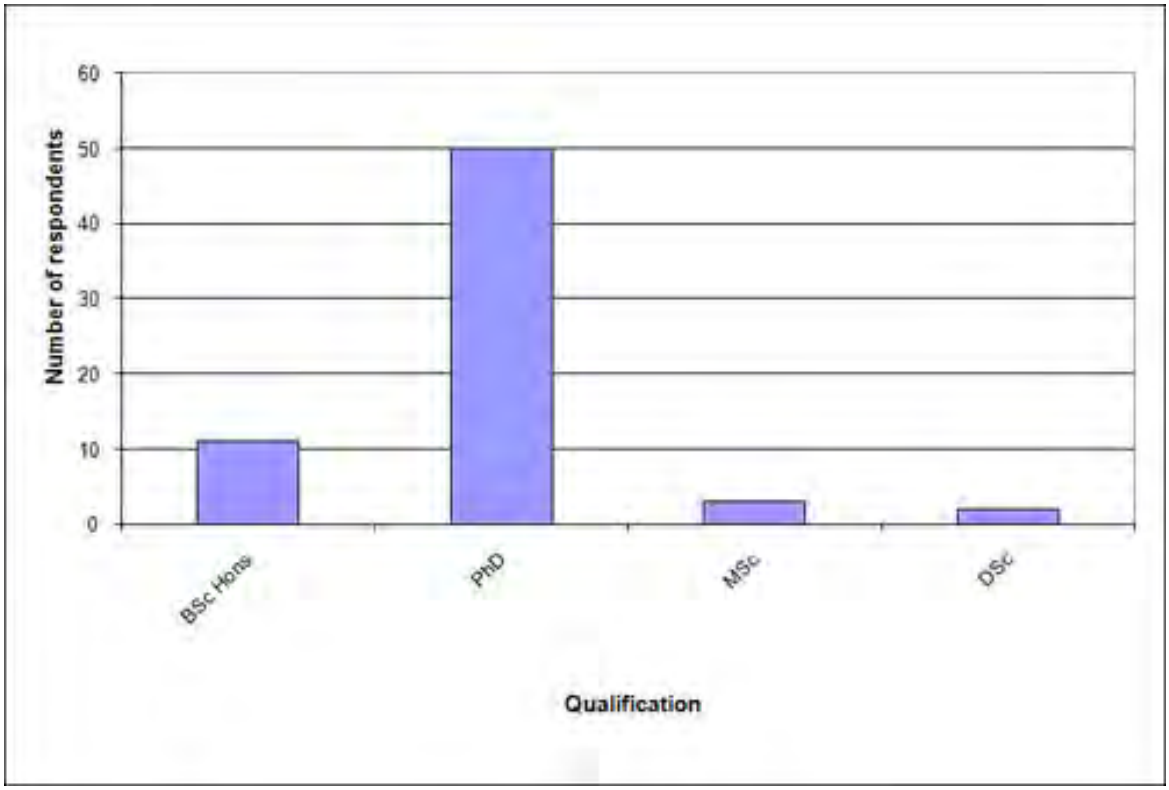
Figure 1: Network survey for 2008 – respondents by institution (n=67)



When asked about their highest qualification the majority of survey respondents reported having a PhD (76%) or BSc Hons (17%) (Figure 2)

Annual Survey *cont.*

Figure 2: Network survey for 2008 – highest qualification of respondents (n=66)



The responses to "year gained highest qualification" spanned 41 years with the most recent being gained in 2008 and the earliest in 1967, the majority were gained between 1994 and 2008 (Figure 3). Of the 67 survey respondents, 27 were identified as early career researchers (10 years or less since gaining their PhD, Doctorate, or Masters qualification).

Network Survey Respondents represented a good spread of ages ranging from 21 to over 65 years, with a majority of respondents aged between 26 and 50 years (Figure 4). Both male and female respondents were fairly evenly represented, with slightly more males (51%) than females (49%) (Figure 5).

Figure 3: Network survey for 2008 – respondents by year of their highest qualification (n=67)

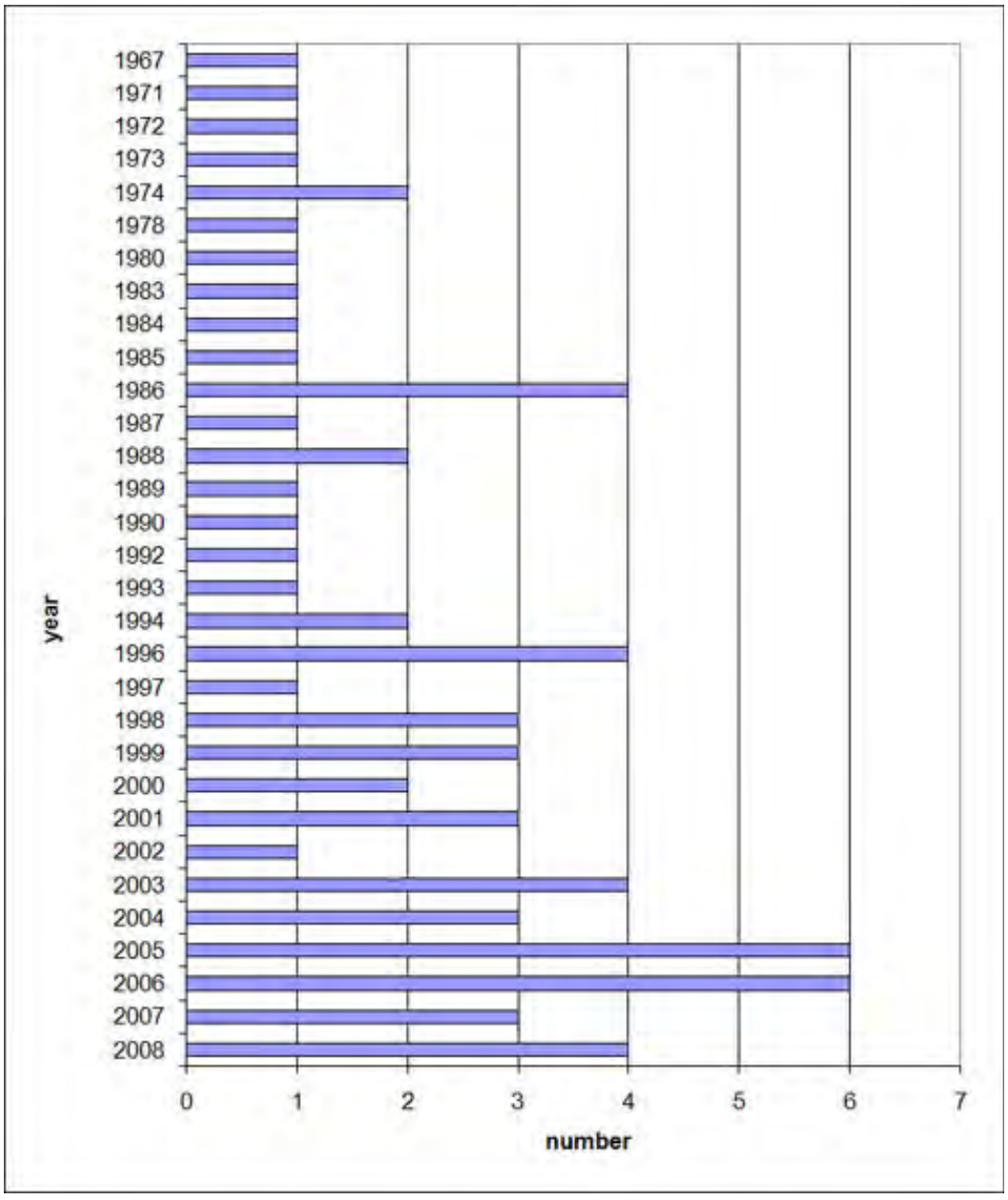


Figure 4: Network survey for 2008 – respondents by age range (n=67)

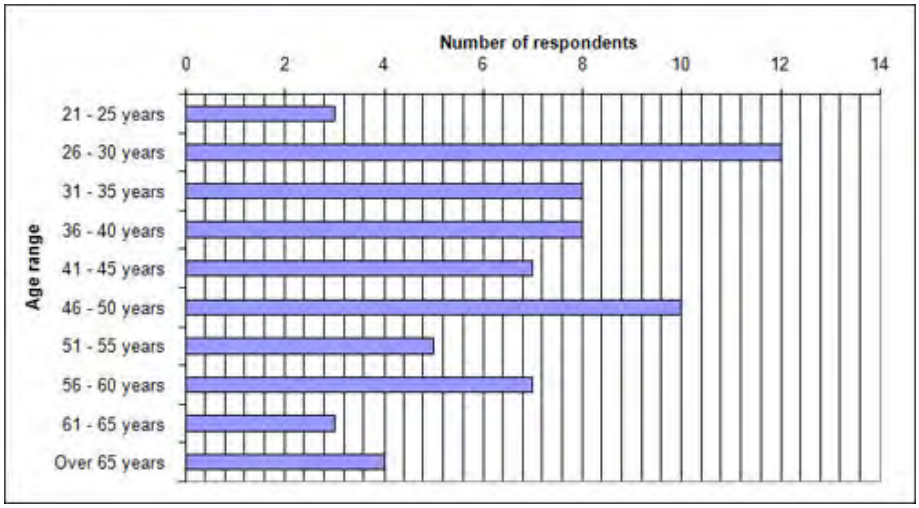
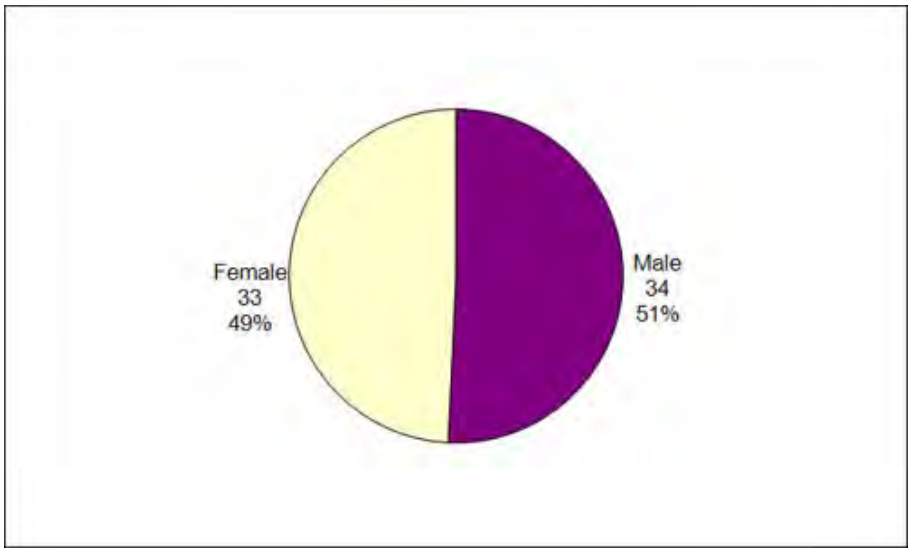


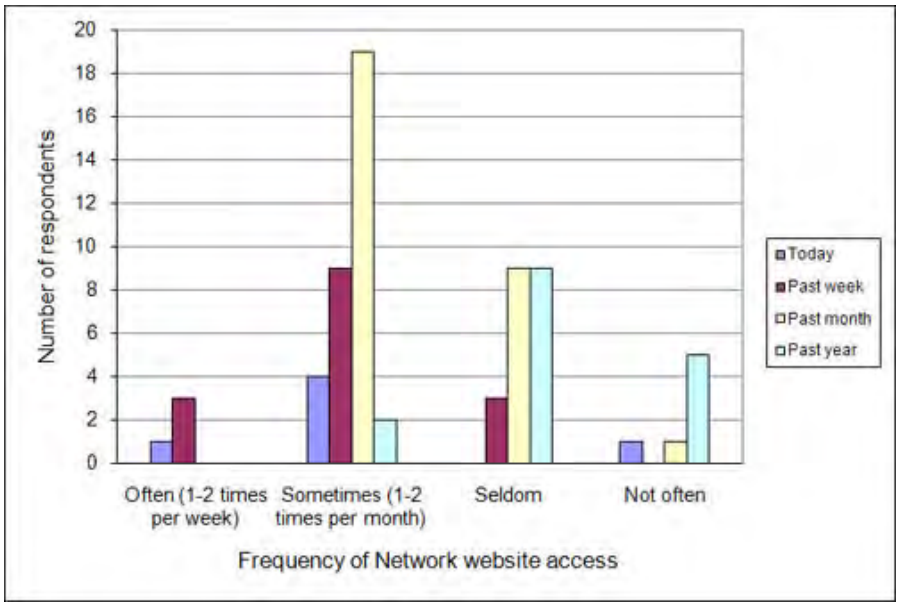
Figure 5: Network survey for 2008 – respondents by gender (n=67)



Network website

Most Survey Respondents had accessed the website sometime in the past year (n=67) and Figure 6 indicates frequency of access. Like previous years the frequency of accessing the Network website reflects when the Network Newsletter is circulated by email and is made available on the website (approximately monthly).

Figure 6: Network survey for 2008 – respondents who accessed the Network website sometime in the past year by frequency of access (n=66)



Annual Survey *cont.*

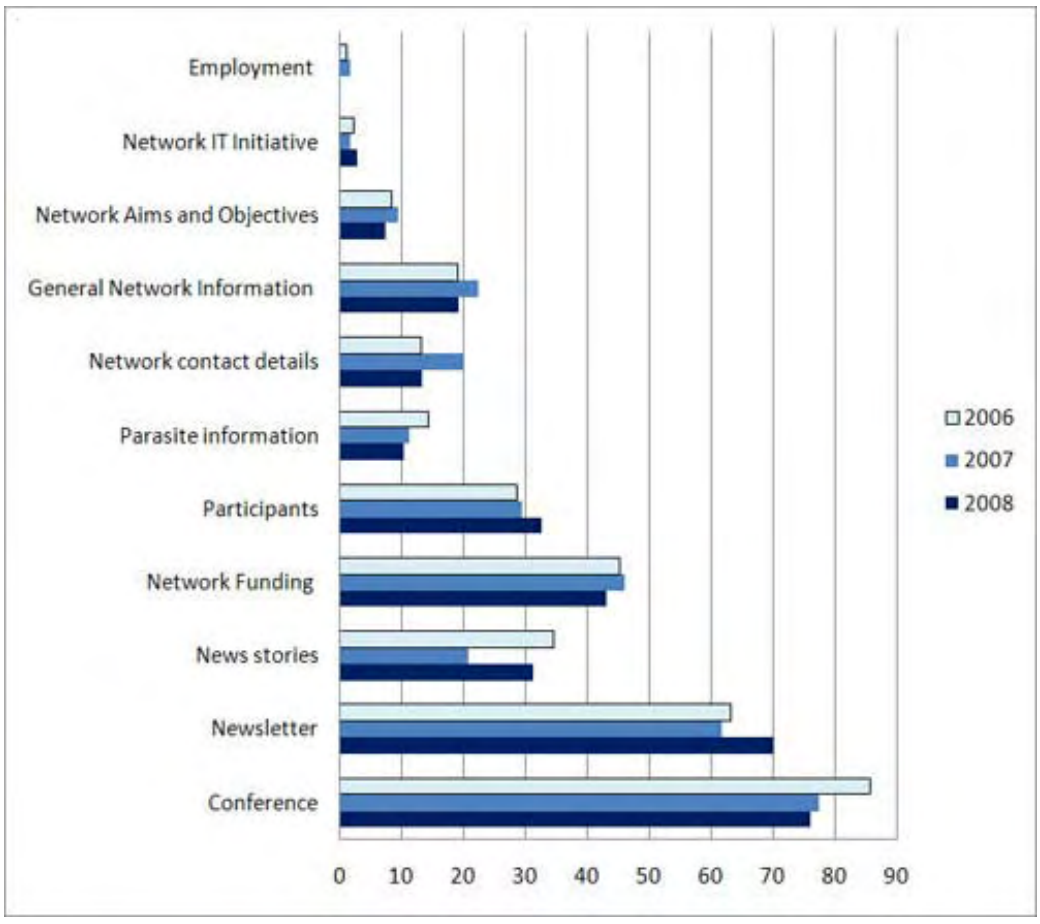
Participant Information

Network Survey respondents who had accessed the website (n=67) reportedly did so for:

- obtaining conference information (76%);
- reading the Network Newsletter (70%);
- finding out about Network Funding available for participants (43%); or
- finding out information about Network Participants (32%).

Figure 7 shows a complete list of reasons for accessing the Network website and a comparison between Network survey for 2006, 2007 and 2008 shows very similar results. (Respondents were able to select more than one option and list others.)

Figure 7: Network survey for 2008 – respondents by gender (n=67)



Annual Survey *cont.*

Network Survey Respondents were asked to rate (on a scale of 1 – 5) how strongly they agreed with the following statements:

1. The website content has all of the information I need. (65 Responses)
2. The layout of the website enabled me to find the information I was looking for easily. (66 Responses)
3. The website design means that information is accessible and easy to read. (65 Responses)

Figure 8 shows that a majority of respondents either agreed or strongly agreed with each statement.

Figure 8: Network survey for 2008 – respondents comment on website content, layout and design

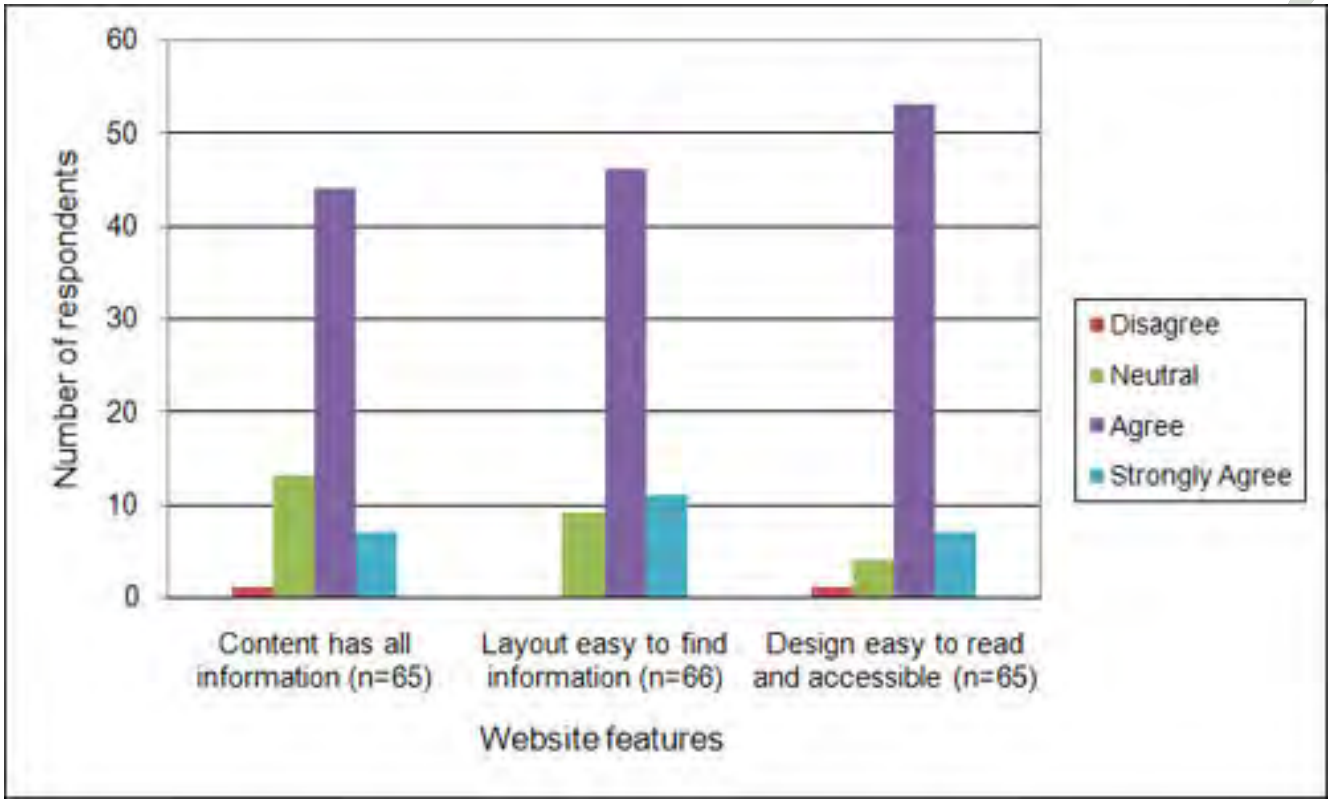
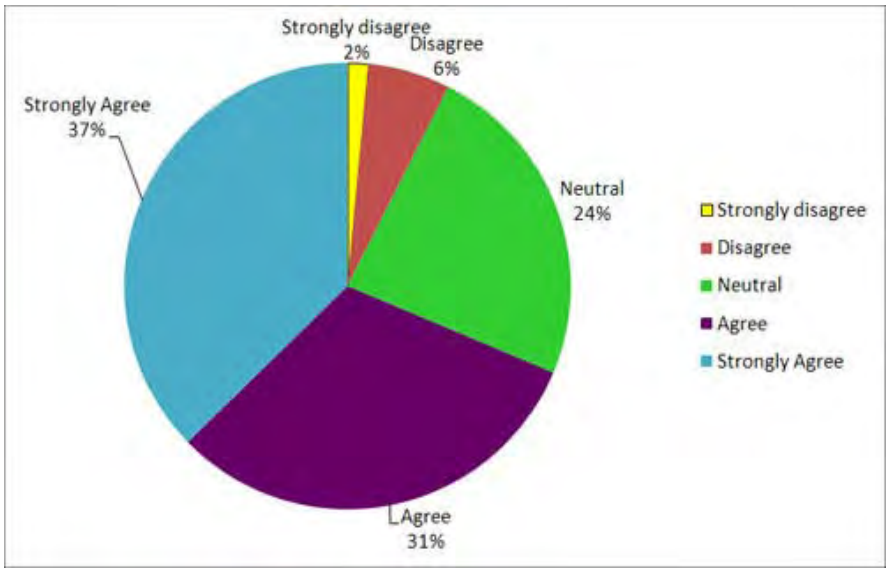


Figure 9: Network survey for 2008 – respondents and their agreement with the statement that being a Network Participant is beneficial for their career (n=67)



Overall view of the Network

When asked about being part of the ARC/NHMRC Research Network for Parasitology, 68% either agreed or strongly agreed with the statement that being a part of the Network was beneficial for their career, while 24% were neutral, and only 8% disagreed or strongly disagreed. (Figure 9)

Network Survey Respondents were asked about changes to the Network and suggestions for additional activities/schemes that the Network should be involved with. Seven respondents gave suggestions and comments, which include the following:

- "I would like to see it continue. It has really built up links between labs that would have been harder to establish before the start of the Researcher Exchange Scheme."
- "I think it should concentrate on what it is doing now as it is doing it successfully."
- "I would like to see the very successful outreach efforts of the Network expanded even further."
- "The ability to fund research and research salaries in addition to researcher exchange programmes to enhance career opportunities for early career researchers"
- "I feel that the Network would be well positioned to competitively distribute seed-funding for e.g. Early Career Researchers to initiate new parasitology research projects in their home institutes. Would be good if the NHMRC and ARC could make funds available to the Network for such a scheme."
- "It would be wonderful if the network could somehow include or have stronger links with the Papua New Guinea Institute

Annual Survey *cont.*

of Medical Research. The PNGIMR has units investigating *P. falciparum, P. vivax, Filariasis*. These units are largely composed of honours, masters and PhD students researchers here, in particular the PhD students, would greatly benefit from the availability of scholarships to come the annual network conference and interact with leading scientists in their field."

- "I recently attend a meeting organised via ASM (microbiology) involving a master class for parasitology. It was a great practical workshop (in hobart) for medical parasitologist and perhaps there could be…a practical forum for information regarding parasitological diagnostics & research"
- "Part of me is concerned that in funding this Network, less research funding has been available for Discovery-type projects in parasitology. However, that could also be a sign of the times."
- "PhD scholarships support for students from disadvantaged countries e.g. Iraq, Gaza, Zimbabwe; we should show support for students in countries that will benefit from better parasite control. We offer stipend support to a student registering with a Network member where the student commits to returning to home country….We use income from IJP to cover costs ; scholarship is named after eminent parasitologist such as Bruce Copeman who was dedicated to supporting foreign student training."

Pigeon louse Campanulotes bidentatus *image courtesy of Cath Covacin, Stephen Barker and Rick Webb, The University of Queensland.*

Statistical Snapshot 2008

- Number of (active) participants;
  - The Network defines a Participant as, most importantly, an active researcher (including postgraduate students) from a Participating Organisation, self-subscribed to the Network listserver and receiving the Network Newsletter. There were 378 of these Participants in 2008 and they were all fully eligible to apply for funding from the Network Researcher Exchange, Training and Travel Fund, benefit from the Network's co-sponsorship of an annual scientific research conference with the ASP and enjoy access to the Network IT Initiative's developments.
  - Additionally, the Network recognises Australian Society for Parasitology Incorporated (ASP) members as associates by virtue of the ASP's cash contribution to the Network. These associates receive the Network Newsletter, benefit from the Network's co-sponsorship (with the ASP) of an annual scientific research conference and enjoy access to the Network IT Initiative's developments. These associates are not eligible for support from the Network Researcher Exchange, Training and Travel Fund. There were 316 such associates (additional to the Participants) receiving the Network Newsletter in 2008.
- Number of ECRs funded to do various activities;
  - 113 ECRs (including research students) were effectively given funding assistance to attend the Joint Conference of the ARC/NHMRC Research Network for Parasitology and ASP (Glenelg, July, 2008) via the Network's subsidisation of this event.
  - 27 ECRs were awarded Network Researcher Exchange, Training and Travel awards in 2008, representing 79% of all successful applications for funding.
- Number of workshops, conferences or seminars conducted;
  - Four conferences – the **"Joint Conference of the ARC/NHMRC Research Network for Parasitology & the ASP"** (Glenelg, South Australia, July, 2007), attended by 220 researchers, the "**Molecular Approaches to Malaria**" in Lorne, Victoria, in early February, 2008, attracting over 400 malariologists from around the world (http://www.mamconferences.org), "**The Imaging Infectious Diseases Workshop**", a joint WEHI and Institut Pasteur event, held at WEHI, Thursday 31st January & Friday 1st February 2008, attracting over 60 researchers, and "**Australian Health and Medical Research conference"** at the Brisbane Convention Centre, November 16 – 21, 2008. See: http://www.ahmrcongress.org.au.
- Number of international visits, both by Network members in Australia to overseas destinations, international events, and short and long term visits by international researchers to Australia;
  - The Network funded 17 participants to spend time in international laboratories, five participants to attend international workshops and funded, or co-funded with the ASP, Elsevier, *Trends in Parasitology* and *The International Journal for Parasitology*, 14 international visitors to Australia (ten as invited lecturers to the Network Conference, four on Researcher Exchanges). An additional 15 international researchers attended the Network/ASP Annual Conference and over 250 international delegates attended the *Molecular Approaches to Malaria Conference* and *The Imaging Infectious Diseases Workshop*.
  - In total, 272 international visitors spent time in Australian during 2008, a number swelled over that seen in previous years by the staging of the Molecular Approaches to Malaria Conference – they came from the UK (63), the USA (59), Germany (24), Sweden (19), France (16), Switzerland (13), Kenya (6), Japan (6), South Africa (6), Thailand (5), Singapore (5), Spain (5), Portugal (5), Denmark (5), Malawi (4), Papua New Guinea (3), India (3), New

Statistical Snapshot 2008 *cont.*

Zealand (3), the Netherlands (3), Brazil (3), Italy (3), South Korea (3), Mali (2), Canada (2), Indonesia, Belgium, Peru, Israel, Panama and Ghana (all 1 each).

- O International conference attendances by Network Participants are not listed in this report as there are several hundred and this is considered routine for Australian researchers.

- Number of outreach activities including public lectures (or other forms of engagement with people outside the research community including schools, industry and government agencies);
  - O There were 46 reports in the media involving Network scientists in 2008 and more than 42 documented outreach activities where Network scientists presented to, or engaged with, the general public and/or specific community groups about their research work.
- Number of publications produced;
  - O Over 370 printed publications and 428 conference presentations and institutional seminars.
- Number of universities receiving funding;
  - O Network Participants from 23 Participating Organisations were effectively funded to attend the Annual Conference of the ASP and the ARC/NHMRC Research Network for Parasitology and other Symposia via the subsidisation of these events by the Network.
  - O Network Participants from 13 Participating Organisations received support from the Network Researcher Exchange, Training and Travel Fund.

The URL of the Research Network's web site
http://www.parasite.org.au/arcnet

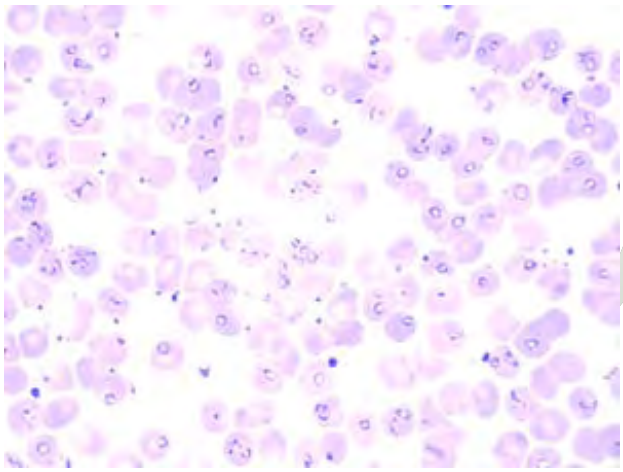


*Image of red blood cells infected with ring-stage malaria parasites (*Plasmodium falciparum*); courtesy of Dr Richard Allen (ANU).*

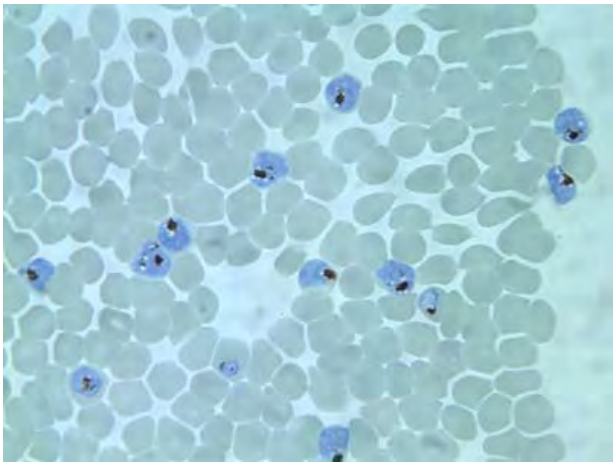


*Image of human red blood cells infected with trophozoite-stage malaria parasites (*Plasmodium falciparum*); courtesy of Dr Richard Allen (ANU).*