



ANNUAL REPORT



ARC/NHMRC RESEARCH NETWORK FOR
PARASITOLOGY



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

2009 HAS BEEN AN EXCEPTIONALLY EXCITING YEAR FOR THE ARC/NHMRC RESEARCH NETWORK FOR PARASITOLOGY, DESPITE THE FACT THAT IT REPRESENTS THE LAST YEAR WITH ARC AND NHMRC FUNDING.

The excitement stems from the 2 year commitment by the Australian Society for Parasitology (ASP) to continue to fund the Network to allow the successful initiatives established over the last 5 years – most particularly the Research Exchange, Training and Travel Scheme and the Outreach Activities – to continue. This funding is also providing the leverage to begin looking for more extensive support to try to develop an “Australian College of Parasitology” over the next decade. If successful, this development will reinforce and extend the ground gained improving the graduate experience and career development opportunities for young parasitologists achieved over the last 5 years.

Following on the heels of the ASP announcement of funding for the Network, came the announcement from the NHMRC that Geoff McFadden, Kevin Saliba and a team of more than 30 other world-leading malaria researchers had been successful in their bid to secure NHMRC funding to allow them to form “OzEMalaR”, a formal link to “EviMalaR”, the new EU FP7 Network of Excellence in malaria research. This was a very gratifying end result of the signing of a Memorandum of Understanding between the ARC/NHMRC Research Network for Parasitology and BioMalPar (the previous iteration of EviMalaR) in February 2008 at the Molecular Approaches to Malaria Conference in Lorne, Australia.

Research from previous Researcher Exchange, Training and Travel Awards – more than 70% of which have gone directly to young researchers – continued to bear fruit in 2009, with 31 quality research papers being published in internationally recognised, peer-reviewed journals. More broadly, parasitology research in Australia continued to flourish in 2009, with over

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340 research papers published, many millions of dollars worth of grants awarded, and some very high honours coming the way of several Network Participants.

2009 saw the continuation of two initiatives specifically for early career researchers and students, namely, a workshop to enable postdoctoral researchers and students to discuss their career options 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 2009.

The Network also continued its support of an outstanding annual conference. The annual joint conference with the Australian Society for Parasitology in Sydney was superb, attracting 240 delegates and including a programme of presentations by national and international speakers that make it equal to the very best international conferences. Thus, the very strong attendance patterns evident in previous meetings – effectively double the typical numbers attending previous national parasitology conferences – was continued in 2009.

Parasites in Focus continued to travel the country, being exhibited in Perth, Darwin, Sydney and Wollongong in 2009, this year equipped with three totally interactive exhibits as well as the 26 spectacular photos and images, which were featured in *Cosmos* in 2009. A series of other public outreach and education events were staged by the Network throughout 2009, most especially to school groups. All of these activities will continue in 2010.

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 2009: 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 and Wendy Relf, who put tremendous time, effort and imagination into Network outreach events; Wendy Relf and Lisa Jones, who coordinate the annual conference; and, most especially, Lisa Jones, who publishes the Network Newsletter and generally ensures the Network operates at the very highest levels of professionalism.

Professor Nick Smith

Convenor, ARC/NHMRC Research Network for Parasitology



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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 2009, 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 2009 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 (QLD Museum), Dr Jody Zawadzki (Department of Primary Industries, Victoria), Dr Malcolm Jones (Queensland Institute of Medical Research). The Committee met in July 2009 and corresponded, as a Committee, regularly by email.

The Management Committee also received input from an Advisory Committee, though this committee was not formally assembled in 2009:

- Professor Graham Mitchell, AO (for services to science, especially immunoparasitology), recognised as one of Australia's leading biological scientists and consultants;
- Professor John Horton; Vice-President of the Royal

Summary cont.

- 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);
- Professor Artur Scherf, Director of BioMalPar, an EU FP6 Network of Excellence.

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 2009 was \$1,712,024.

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 2009, 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

Work continued in 2009 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. PARA-SITE resource will be incorporated as part of "Parasites in Focus" interactive exhibition in 2010.

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 University of Sydney, New South Wales - from July 12 to 15, 2009. 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 2009 conference saw the continuation of the "Elsevier Lectures", including the "International Journal for Parasitology Lecture" and the

Progress on Initiatives cont.

"Trends in Parasitology Lecture", delivered by Professors John Boothroyd (Stanford University, USA) and Alan Sher (National Institutes of Health, USA), respectively. Sponsors for the conference included the International Journal for Parasitology, Elsevier, The Queensland Institute of Medical Research (QIMR), Meat and Livestock Australia, Australian Wool Innovation, The Institute for the Biotechnology of Infectious Disease (IBID), Schering-Plough Pty Limited, Intervet and Coopers, New England Biolabs, Novartis Animal Health, Virbac Animal Health and Trends in Parasitology.



Alan Sher (NIH) with IBID, UTS researchers (moving clockwise from Alan), Alana Zakrzewski, Marilyn Katrib, Louise Harkness, Rowan Ikin, Mike Lees, Philippa Sharman and Kate Miller during the 2009 ASP & Network Conference

The conference covered a wide variety of parasitology research, reflecting the diversity and multidisciplinary nature of Network Participants. The meeting was opened by ASP President Peter Holdsworth, AM, and was attended by 240 delegates. It included participants from 33 out of the Network's Participating Organisations. Well over 50% (131) of attendees were early career researchers or students and there were 24 international delegates. Plenary and Symposium Lectures were delivered by:

The Elsevier Lectures - Host Cell Modulation

- John Boothroyd (Stanford University, USA) - The Trends in Parasitology Lecture

- Alan Sher (NIH, USA) - The International Journal for Parasitology Lecture

Human Helminthiases

- David Dunne (University of Cambridge, UK)
- Tom Nutman (NIH, USA)
- David Rollinson (The Natural History Museum, UK)
- Don McManus (QIMR)
- Sripa Banchob (Khon Kaen University, Thailand)

Malaria Vaccine: Fact or Fantasy?

- Richard Carter (University of Edinburgh, UK)
- Denise Doolan (QIMR)
- Michael Good (QIMR)
- Louis Schofield (WEHI)

Population Genetics and Epidemiology of Livestock Parasites

- Una Ryan (Murdoch University)
- Aaron Jex (University of Melbourne)
- Ala Lew (QLD DPI)

Immunopathology

- Chris Engwerda (QIMR)
- Georges Grau (University of Sydney)
- Nick Hunt (University of Sydney)

Parasites and Environmental Health

- Nigel Beebe (University of QLD)
- Lydden Polley (University of Saskatchewan, Canada)
- Bart Currie (Menzies School of Health Research)

Ectoparasites and Resistance

- Greg Harper (CSIRO)
- Gary Levot (NSW DPI)
- Brian Horton and Barry Hosking (Tasmanian DPI and Novartis Animal Health)

Bancroft Mackerras Award Oration

- Brendan Crabb (Burnet Institute)

Australian Society for Parasitology Presidential Address

- Peter Holdsworth AM

Progress on Initiatives cont.

Researcher Exchange, Training and Travel Awards

In 2009, the Network funded only two new Researcher Exchange, Training and Travel Awards. Awardees were:

Sejal Gohil (Monash University) for the Molecular Parasitology Training Course at Woods Hole (U.S.A.)

Natalie Spillman (The Australian National University) for the Molecular Parasitology Training Course at Woods Hole (U.S.A.)

However, Researcher Exchanges awarded in 2008, continued throughout 2009 and, as in previous years, generated fantastic outcomes and opportunities for Australia's parasitology researchers. The Case Study and stories that follow, showcase just a few examples...

CASE STUDY 1:

Patrick Driguez is a PhD Student from the Molecular Parasitology Laboratory, Division of Infectious Diseases, Queensland Institute of Medical Research and The University of Queensland. Patrick won a Network Researcher Exchange, Training and Travel Award in 2008 to visit Prof. Phil Felgner at University of California: Irvine, as part of a collaborative effort investigating helminth biology.

Patrick's Network Travel Award involved a collaboration between the McManus (Molecular Parasitology), Loukas (Helminth Biology), Doolan (Molecular Vaccinology) laboratories, QIMR with Prof Phil Felgner at the Protein Microarray Laboratory, University of California: Irvine (UCI) to produce the first reverse vaccinology protein microarray for *Schistosoma japonicum* and *Schistosoma mansoni*. This is also the first application of this technology to a metazoan parasite. This method is anticipated to become a standard parasitological technique and will be of value to the parasitology community at large.

Patrick tell us about your research?

"My PhD research is on vaccine discovery for Asian

schistosomes using protein microarray technology."

"The main purpose of this exchange was the manufacture of the first schistosome protein microarray at the Protein Microarray laboratory at the University of California, Irvine. It's the first use of a reverse vaccinology/immunomics protein microarray for investigating a metazoan parasite. Through this collaboration, the development of the protein microarray and the associated skills and methods, we hope to make significant progress in the design of a schistosome vaccine, further understanding of the host/parasite interaction and make a valuable contribution to scientific knowledge," said Patrick

Patrick tell us about the technique you used?

"From the schistosome genome, known immunogens and potentially immunogenic proteins are selected. These genes are amplified and cloned. The resultant plasmids are used in a cell-free expression to produce recombinant proteins. These individual proteins are then spotted onto microarray slides."

"This protein microarray was completed successfully. Fifty glass microscope slides with 16 pads per slide were printed in February 2009. A second batch of 50 will be made at a later date. On each pad is a microarray with 289 proteins; 172 *Schistosoma japonicum* and 50 *Schistosoma mansoni* cell-free proteins were printed on the array as well as 48 recombinant protein spots and 19 controls."

"Antibodies from infected animals/humans and resistant sera are captured by the microarray proteins and then marked with labelled secondary antibodies. A laser scanner will resolve each protein spot and measure fluorescent and you can tell how reactive each protein is in sera (like a Western). Through this approach, new vaccine candidate molecules and biomarkers can be identified and then characterised".

Patrick says, "The first results from the microarray are very encouraging. The protein expression tags are present and >90% of the spots are full length proteins. Compared to naïve mouse and human sera, the microarrays are reactive to infected/exposed sera. Infected/exposed sera are reactive

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against known antigens and also some unknown proteins. We will further characterise the immune response of animal models and endemic populations in our future work."

"The manufactured microarray will be probed at QIMR with field-collected human sera from putatively resistant and infected individuals as well as the "semi-permissive" rat and radiation-attenuated larvae vaccinated pig animal models. The most promising antigens are expected to be surface or secreted proteins strongly recognised by the resistant sera types compared to control and infected sera. The antigens discovered using this high throughput screen will be expressed recombinantly and tested for vaccine efficacy. Furthermore, the combined *S. japonicum* and *S. mansoni* array may enable the discovery of cross-protective antigens."

"In addition to vaccine discovery we will also elucidate some of the mechanisms in the complex parasite/host interaction and may discover biomarkers of disease severity/susceptibility", says Patrick.

"The advantage of this technique is that it is very efficient – you get most of what you want, most targets expressed at the other end, but you lose some tertiary structure (protein folding) and might lose some epitopes – there are no guarantees." "But", Patrick said, "there is no ideal expression system."

Patrick said he wants to try to look at two different antibody classes per pad. He said, "Usually you look at one antibody class per pad. It is natural for someone infected with schistosomiasis to get high titres of IgE. I'd like to also look at IgG subclasses as some show protection."

Patrick, can this technique be used in Australia?

Patrick said that he "has the knowledge now for this technique and potential to pursue this and develop the technology in Australia. Also, the technique can be used in many other fields."

In addition to the scientific results gained via this exchange, the techniques and skills learnt through this high throughput screening and antigen discovery technology will be important to schistosome research, and other parasites and

the diseases they cause and may inform vaccine research in parasitology as a whole.

Patrick how does your research relate to human disease?

Patrick said, "Now we can compare people in endemic areas, who have had no treatment against schistosome, and are resistant to schistosome antigens (i.e. they are naturally resistant), and people infected previously but who are not resistant and this should give us an indication of which proteins are important for resistance to schistosomiasis."

Patrick said, "Magda Ellis from our lab and her collaborators have been studying two groups of people in China; one who show strong resistance to schistosome infection despite being constantly exposed and another group who are highly susceptible to schistosomiasis, more prone to being infected and show acute disease."

Patrick said, "It is very exciting news that the genomes for both schistosomes have recently been published, and that these two parasites are closely related. If you pick a protein from one the other has a very similar set of proteins. If you use sera from Chinese people, anticipate to see some of the same proteins from *S. mansoni* light up – so, then we need to look at the protein in *S. japonicum*; that might lead to a crossprotective vaccine or an antigen that may protect against both species."

Patrick, what were the outcomes of your Network Travel Award?

This project has brought together three laboratories within the QIMR. The Loukas, McManus and Doolan laboratories, all members of the ARC/NHMRC Research Network for Parasitology, initially collaborated on this project and have submitted a grant, which is currently being reviewed.

Patrick says, "A review paper will soon be submitted by these collaborators and we anticipate further papers as the microarrays are fully utilised."

Progress on Initiatives cont.

This Researcher Exchange award allowed Patrick to work at Phil Felgner's Protein Microarray laboratory, UCI for three months. During this time as a member of the lab Patrick developed a strong working relationship with Dr Felgner and the members of his lab, contributed to lab meetings and presented his work and the work of his Australian labs on two separate occasions. Patrick said, "This created a lot of interest in schistosomiasis research within the Felgner lab and our labs are currently investigating collaborations on co-infection studies. In addition to the protein microarrays, new technologies being trialled at the Felgner lab may be introduced into the collaborating laboratories at the QIMR in the near future".

Patrick says he is really enjoying his PhD, and found that his Network Travel Award was a fantastic experience, he says he felt inspired and enjoyed living in Orange County, California and working with other scientists at the University of Irvine.

Patrick is now busy finishing his PhD and we hope to hear more about his research in the future.



Patrick Driguez and Don McManus

"WHAT HAPPENED NEXT?" – STORIES FROM OUR 2005, 2006, 2007, 2008 AND 2009 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 6 past recipients of our Award funds. In **2008**, the Network funded **28** applications for assistance from its Researcher Exchange, Training and Travel Award funds (**80%** directly benefited research students or early career researchers). With the scheme winding down in 2009, the management committee made a decision to award the remaining budget allocated to Travel Awards at the end of 2008 so that Travel Awardees had an opportunity to complete their awards in the final year of the Network and to claim their grant money. However, in **2009** the Network funded **2** applications for assistance from its Researcher Exchange, Training and Travel Award funds (**100%** directly benefited research students to enable them to attend the Molecular Parasitology Training Course at Woods Hole, USA.) Each year we continue to see very positive outcomes from our Researcher Exchange, Training and Travel Award Programme. The following stories are from our **2005 – 2009 Network Researcher Exchange, Training and Travel Award recipients.**

In the 2008 annual report for the ARC/NHMRC Research Network for Parasitology, we featured stories on **Mieke Burger** and **Mark Robinson** - 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 **Rama Jayaraj, Kate Hutson, Leann Robinson, Annette Dougall, Patrick Driguez, Stephanie Godfrey, Liting Lim, Nick Sangster, Colin Sutherland and Rogan Lee,**

Progress on Initiatives cont.

Ashlie Hartigan, Philippe Boeuf, Natalie Spillman and Mai Tran.

Mieke Burger (The University of Queensland) 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. In 2010 Mieke published a paper in the journal, *Parasitology*, as a direct result of this travel award.

Dr Mark W. Robinson (University of Technology, Sydney), 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 has continued his success through this Travel Award and in 2009 had a series of publications in *Veterinary Parasitology*, *J. Biol. Chem.*, *Trends in Parasitology*, *Biochemistry*, *PLoS Neglected Tropical Diseases*, *Parasite Immunology*, *Philosophical Transactions of the Royal Society B*, *Molecular and Cellular Proteomics*, *Cellular Microbiology* and *Journal of Infectious Diseases: Drug Targets*.

Kate Hutson (The University of Adelaide) won a Researcher Exchange, Training and Travel Award in 2007 to visit the University of Valencia and the British National History Museum to carry out collaborative research on marine parasites and as a result of this exchange in 2009 Kate had a publication in *Aquaculture*.

Rama Jayarai (Menzies School of Health Research, NT) won a Researcher Exchange, Training and Travel Award in 2008 to attend a workshop on "Materials and Methods for Lateral Flow Applications", San Diego, USA and University of California, San Francisco, California, USA. Rama found the training content of the workshop was extremely informative. The workshop sessions ranged from the requirements of Lateral Flow Test to Developing Biosensors and Biochip tests. In this BioDot workshop, they had interesting sessions that explained the most commonly used tests for detecting sensitivity to antibodies, emerging

multiplex assays and new lateral flow technology. They also introduced the dual path platform, the use of nanometer paramagnetic microspheres in immuno assays and discussed the clinical usefulness and practicality of the various rapid diagnostic procedures. BioDot also arranged the four manufacturing practicals: Dispensing lateral flow rapid tests; Processing lateral flow; Dispensing Biosensors; and Biochip rapid tests.



The In Line Web Handling System RR4500 with antibody dispensing module, dip tank, dry tower and enclosed take up module (right) were displayed during practical session. The BioDot workshop was a mixture of lectures and laboratory sessions where scientists reviewed the entire process of lateral flow applications.



Diagnostic components for Rapid tests: membranes; colloidal gold conjugate solutions; and packaging materials, were displayed during practical session

Progress on Initiatives cont.

development trends in Rama said, "This workshop saved me a great deal of time identifying, locating, and gathering information about the lateral flow assay format, detection format, detection limit and assay speed. It allowed me to source necessary materials such as nitrocellulose membrane, conjugate pad, adsorbent pad and colloidal gold conjugate for a rapid assay in an immediately usable format. Most importantly, these techniques and experiences will aid in our project which aims to develop a rapid diagnostic test for scabies. One aspect that did take my attention was just how many excellent Australian scientists were present. Fortunately, I met an Australian Scientist, Lech Wieczorek, from Integrated Nano-Science, CSIRO Molecular Health Technologies. It may be possible for the scabies team to make a future collaboration between the Menzies and CSIRO on this project."



Rama Jayarai standing adjacent to the Golden Gate Bridge, San Francisco

Rama's second stop was to visit the laboratory of Professor James McKerrow at the Sandler Center for Basic Research in Parasitic Diseases which is located at Byers Hall at the Mission Bay campus of the University of California, San Francisco. Rama said, "Apart from being a five star laboratory, the research and facilities were quite eye opening. I was particularly interested in talking with Prof. James McKerrow and his team of researchers about the snail culture of trematodes (*Schistosoma*), clinical screening

of parasites, and the study of parasite proteases and protease inhibitors. In addition, I gave a presentation about our current scabies research for members of Prof. James McKerrow's laboratory."

Leanne Robinson (Walter and Eliza Hall Institute of Medical Research) won a Researcher Exchange, Training and Travel Award in 2007 to attend the annual Epidemiology and Control of Infectious Diseases Training Course at St Marys Hospital, London.

Leanne reports three publications made possible by the skills gained while attending this course in *Clin Infect Dis.*, *PLoS One*, and *Infect Immun*.

Leanne gave three presentations on her Travel Award; Walter & Eliza Hall Institute Seminar 2008 Doctoral presentation, Molecular Approaches to Malaria (MAM), Lorne, Australia 2008 and American Society of Tropical Medicine & Hygiene Meeting, Philadelphia 2007.

Leanne has completed her PhD and is currently employed as study coordinator and team leader – Malaria Immunology/ Microscopy PNGIMR – in Madang. She said, "I'm currently a post-doctoral fellow with the Vector Borne Diseases Unit at The Papua New Guinea Institute of Medical Research (PNGIMR) in Madang, PNG. I coordinate several field teams, as well as the Malaria Immunology and Microscopy groups within the Unit. I conduct regular training sessions with members of these groups, particularly with Honours and Masters students regarding the principles of Infectious Disease Epidemiology and Modelling."

Leanne reports that she is currently coordinating a "Treatment to Re-infection" study in children aged 5-10 years of age in the Albinama region of East Sepik Province, PNG. This study is a collaboration between the Papua New Guinea Institute of Medical Research (PNGIMR), The Walter & Eliza Hall Institute of Medical Research (WEHI) and the Centre de Recerca en Salut Internacional de Barcelona (CRESIB). Leanne said that this project has drawn upon many of the skills she acquired during the course.

Leanne also said, "This course also allowed me to establish a solid network of highly qualified experts and colleagues in this field, as well as many good friends."

Progress on Initiatives cont.

Annette Dougall (Menzies School of Health Research, NT) won a Researcher Exchange, Training and Travel Award in 2007 to visit Dr Bruce Alexander, Liverpool School of Tropical Medicine and *Leishmania* field site in Teresina, Brazil to carry out research, receive training and form collaborations as part of Annette's PhD 'Australian *Leishmania* lifecycle Investigation'.

There is one publication in preparation from the Travel Award Exchange in the University of Piaui in Teresina, Brazil and another article in *Epidemiology and Infection* which is indirectly a result of this collaboration.

Experiments infecting *Lutzomyia longipalpis* with Australian *Leishmania* were conducted whilst Annette was at the Liverpool School of Tropical Medicine. These experiments were repeated as a result of ongoing collaborations with Professor Paul Bates now located at Lancaster University and the results have been presented in oral presentations at Menzies School of Health Research and at the Australian Biosecurity for emerging infectious diseases annual workshop, Darwin, May 2009.

Annette was also reported on the local news in Teresina, Piaui, Brazil.

As a result of her travel award, Annette has collaborations with Professor Paul Bates at Lancaster University and Bruce Alexander from Xeroshield Ltd, Roslin BioCentre. They are currently submitting grants to continue research on the Australian *Leishmania* vector. And the following grant was also funded last year (Bruce Alexander is collaborator on this project);

2009-2010: Wildlife And Exotic Disease Preparedness Program project grant; Field Surveillance and monitoring *Leishmania* transmission by the blood-sucking midge *Forcipomyia* subgenera, *Lasiohelea* in the Northern Territory.

Patrick Driguez (Queensland Institute of Medical Research) won a Researcher Exchange, Training and Travel Award in 2008 (see *Case Study 1*). A year after his exchange Patrick talks about the outcomes and outputs that he has achieved. "Through the travel grant I was able to learn new methods, skills and knowledge that I have been able to share with my

lab and our collaborating labs. Also the experience has made me a more confident and competent scientist." Patrick said.

Patrick said, "The travel grant has helped us greatly in applying for more grants. We were awarded an \$80,000 Australian Centre for Vaccine Design (ACVD) for a collaborative program between QIMR and the Emory Vaccine Centre. Alex Loukas (with Don McManus, me and Denise Doolan as Associate Investigators) has also used the protein chip as a central component for a NHMRC grant awarded last year. We have also commenced a collaboration with Els Meeusen, University of Monash, with experimental rat schistosomiasis using our protein microarray. There has been some media coverage associated with some of the grants that were awarded and, in 2009, publication in *Parasites & Vectors*."

Stephanie Godfrey (Flinders University) won a Researcher Exchange, Training and Travel Award in 2007 for a Researcher Exchange to visit Prof Krause at University of Leeds and Dr James at University of Bath. As a result of research conducted during her travel award, Stephanie and colleagues published an article in *Behavioral Ecology and Sociobiology* in 2009.

Stephanie presented at the International Congress of Ecology, Brisbane, Australia in 2009; at the International Society for Behavioral Ecology Biennial Congress, Ithaca, NY, USA in 2008; and at the Australian Society of Herpetologists Conference, Albany, WA in 2007.

In 2008, Stephanie attended a workshop at the University of Tasmania with Prof. Hamish McCallum and his research group on the use of social networks in understanding parasite transmission in wildlife populations; and Stephanie shared what she learned from her exchange with this research group. Following her exchange Stephanie also presented a talk to her research group at Flinders University, describing what she learned, and how it could be applied to other research in our lab. In 2009, Stephanie discussed these methods with other researchers (Dr Molly Whalen & Dr Duncan Mackay) at Flinders University working on pollination in plant networks, and shared what she had learned from her exchange.

Progress on Initiatives cont.

Liting Lim (The University of Melbourne) won a Researcher Exchange, Training and Travel Award in 2008 to visit 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.

Through this Travel Award, Liting was able to meet collaborators and look at their experimental set-ups for transporter assays. Liting was interested to characterize the function of two plant-like transporters of the relict plastid (also known as the 'apicoplast') in the malaria parasite and so approached Andreas and Marc, the experts in characterizing plant chloroplast transporters. From the start of the collaboration, they had tremendous difficulty in getting the malaria genes to express using various expression systems, including those of yeast and bacteria. Liting reports that in 2009, they decided to marry a relatively novel cell-free translation system with the standard transporter assay. Liting spent two months in the Weber lab expressing proteins of interest with the cell-free expression system and reconstituting the proteins into liposomes for subsequent activity assays. Under Marc's supervision, Liting conducted the experiments in characterizing the two apicoplast transporters. The two transporters are the first apicoplast transporters ever analysed at the molecular level. Their substrate profiles validated a previously proposed model of how the apicoplast fuels itself in the absence of the ability to photosynthesize and demonstrated the metabolic nexus between the organelle, the parasite's cytosol and the host cell. The results are now published in *FEBS Letters* (*FEBS Lett.* 2010 Feb 5;584(3):549-54).

In 2009, Liting presented this work at the Molecular Parasitology Meeting in Woods Hole, MA and the Malaria in Melbourne conference at The Walter and Eliza Hall Institute for Medical Research.

Nick Sangster won a Researcher Exchange, Training and Travel Award whilst he was working at University of Sydney in 2006 for Researcher Exchanges to WEHI, CSIRO and to Sanger Centre Glasgow, UK. In 2009, two publications in *Veterinary Parasitology* resulted from work done during this exchange.

Rogan Lee (Westmead Hospital) won a Researcher Exchange, Training and Travel Award in 2007 to fund a visit by **Dr Colin Sutherland** from London School of Hygiene and Tropical Medicine (LSHTM) to visit the Parasitology Laboratory at Institute of Clinical Pathology and Medical Research, Westmead, QIMR and Menzies School of Health Research, Darwin.

The Travel Award supported Dr Colin Sutherland visit to Rogan's laboratory (ICPMR, Westmead Hospital) and Professor Warwick Britton at the University of Sydney. Colin presented at the 2007 ASP & ARC/NHMRC Research Network for Parasitology Annual Conference in Canberra and also presented his research data to QIMR, Menzies School of Health Research, Darwin and the Sydney Branch of the ASM.

New molecular skills were shared with Dr Sutherland during his visit. A follow up visit to his lab at the London School of Hygiene and Tropical Medicine (LSHTM) was planned so that Rogan could develop more molecular skills analysing genetic diversity of parasites with specific emphasis on human malaria species. This work can then be applied to regional malaria to monitor shifts in parasite genetics as a result of human movement, anti-malarial medication and climate change.

Rogan says, "An improved specificity of diagnosis for malaria patients with *Plasmodium ovale* was an outcome as a result of this Travel Award."

Colin Sutherland also wrote to express his thanks for the Network Travel Award and to tell us about a very welcome concrete outcome from this Network Researcher Exchange in 2007.

Colin writes, "One of the main ideas I sought to explore on the trip in 2007 was that the human malaria parasite *Plasmodium ovale*, found worldwide but at low to very low prevalence, comprised two related species - an African one, and a SE Asian one. I began pilot work and primer design etc in Rogan Lee's lab in Westmead and, ever since, Rogan has been in contact with me as the project took off back in London. Eventually a large collaboration across many institutions pooled bits of data to tease out an interesting story."

Progress on Initiatives cont.

"We have now had a major article published in 2009 in *The Journal of Infectious Diseases*:

Sutherland CJ, Tanomsing N, Nolder D, Oguike M, Jennison C, Pukrittayakamee S, Dolecek C, Hien T T, do Rosário VE, Arez AP, Pinto J, Michon P, Escalante AA, Nosten F, Burke M, Lee R, Blaze M, Otto TD, Barnwell JW, Pain A, Williams J, White NJ, Day NPJ, Snounou G, Lockhart PJ, Chiodini PL, Imwong M, Polley SD (2010) Two Nonrecombining Sympatric Forms of the Human Malaria Parasite *Plasmodium ovale* Occur Globally. *The Journal of Infectious Diseases* 201: 1544–1550

"In this publication we demonstrate that *Plasmodium ovale* is two species (i.e. we were right) but that these two species are sympatric in both Africa and Asia (i.e. we were also wrong!). Thus, there are now six confirmed malaria species that routinely infect humans (including the zoonotic *P. knowlesi*). We have proposed the following names for the new species: *Plasmodium ovale curtisi* (after Christopher Curtis) and *Plasmodium ovale wallikeri* (after David Walliker)," he writes.

Colin further writes, "A further happy spin-off of this work is that myself, Network member Alyssa Barry (Burnet Institute) and collaborators Abdoulaye Djimde (Mali) and Mallika Imwong (Bangkok) have submitted a Wellcome Trust project proposal to continue this work. This all goes to demonstrate the importance of the international exchanges your Network has been promoting and supporting."

Ashlie Hartigan (University of Sydney) won a Researcher Exchange, Training and Travel Award in 2008 to visit the laboratories of Prof. Dykova and Dr Fiala, Institute of Parasitology, Czech Republic, for training in protist biology and taxonomy.

In April 2009, Ashlie visited the Czech Republic's Academy of Sciences Institute of Parasitology for 5 weeks. Ashlie learnt valuable research skills and techniques that have aided her PhD work and will further her career. Ashlie's project on the effects of a myxozoan parasite on Australian frog species was in need of expert techniques and her training at the Czech Institute taught her more about parasitology, electron microscopy and molecular characterisation. This stay also helped Ashlie build a collaborative network of

myxozoan researchers; the international cooperation that was established during and after her trip has culminated in a poster presentation, an international conference presentation and numerous grant applications. Some of the transmission electron microscopy work was completed during her visit and was presented as a poster at the ASP & ARC/NHMRC Network for Parasitology 2009 conference. Furthering this collaboration, Czech and Australian researchers worked on an abstract submission that was accepted for an oral presentation at the international European Association for Fish Pathologists conference in Prague (September 2009). Their work has also been presented to the Department of Environment and Conservation (June 2009), the Wildlife Health and Conservation Conference (August 2009) and the University of Sydney Postgraduate Conference in November 2009. Ashlie reports that her Travel Award has enabled her to provide technical advice to other laboratory members in numerous parasitology related projects. Two new honours students have since joined their laboratory in 2010 with this Travel Award project's results and the international scope of its implications. Ashlie said, "This Travel Award has benefited my career development immensely. With the contacts made in that funded travel exchange I have presented at international conferences, expanded my profile as a young researcher and was offered the opportunity to return in 2010 to the Czech republic as a funded researcher. I feel this opportunity advanced my skills for my PhD work as well as provided me with career options in the parasitology field."

Following on from her Travel Award in 2008, Ashlie successfully applied for a Network Travel Award in 2010 and was awarded the prestigious JD Smyth Postgraduate Travel Award for a Researcher Exchange to The Academy of Sciences, Institute of Parasitology in Ceske Budejovice, Czech Republic for her research into the lifecycles and biology of myxozoan parasites that threaten frog species.

Philippe Boeuf (University of Melbourne) won a Researcher Exchange, Training and Travel Award in 2007 to visit the laboratory of Prof. Colin Sibley and Dr Jocelyn Glazier at St Mary's Hospital, Manchester University.

Since his Travel Award, Philippe has presented at Laboratory meetings, program grant seminars and Rotary D9810

Progress on Initiatives cont.

Conference 2010. Philippe said, "The audience of non-researchers were potentially interested in supporting malaria research in neighbouring countries such as PNG." Amongst his research group, Philippe has taught one RA and one PhD student how to make vesicles from the microvillous membrane of the placenta, taught one PhD student how to measure amino acid transport across the placenta using these vesicles and taught all three how to check the quality (integrity and purity) of these vesicles.

An outcome of his Travel Award is the initiation of a project, "Use of placental vesicles as adhesion matrix for malaria parasites". Philippe also won an Early Career Researcher Grant from the University of Melbourne (about \$25,000 for 2009). Philippe also said he has made new collaborations with Dr Eric Hanssen from LaTrobe Uni, Prof. Lars Hviid and A/Prof. Ali Salanti from University of Copenhagen and used placental vesicles to develop a new malaria parasite adhesion assay that is under consideration by a Patent Office (Melbourne Ventures) as a result of his Network Travel Award.

Natalie Spillman (Australian National University) won a Researcher Exchange, Training and Travel Award in 2008 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.

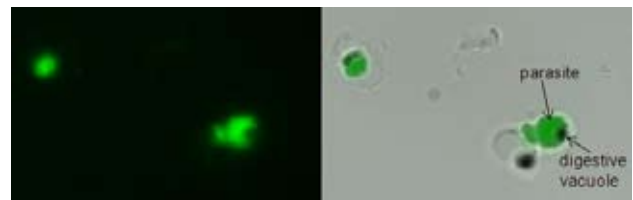
"My PhD project in the laboratory of Prof. Kieran Kirk at the ANU is focussed on the regulation of cations (particularly H^+ and Na^+) in the malaria parasite (*Plasmodium falciparum*). I am interested in both the mature intraerythrocytic (trophozoite) form and the invasive (merozoite) forms of the parasite.

"The trophozoite form of the parasite maintains a low intracellular $[Na^+]$ of ~ 10 mM despite a high extracellular $[Na^+]$ (~ 130 mM) in the erythrocyte host cytosol. The resulting electrochemical gradient is crucial for the survival of the parasite, energising the uptake of essential nutrients, such as inorganic phosphate, via Na^+ -coupled symport processes. As part of my PhD studies, I am focusing on how the parasite maintains such a low intracellular $[Na^+]$.

"During my Network-funded exchange, I worked with

Dr Nick Klonis at La Trobe University. I learnt to use flow cytometry and fluorescence microscopy to carry out single cell analyses of pH and $[Na^+]$ using ion-sensitive dyes. In particular, I've been using a Na^+ -sensitive, fluorescent dye called SBFI. Using an epi-fluorescence microscope at LTU, I took some photos to demonstrate that the dye appears localised to the parasite cytosol, and not the digestive vacuole. The left panel (see images below) is the fluorescence image and the right panel is the fluorescence image superimposed on a bright field image.

"I presented this work, along with some of my other findings at the Woods Hole Biology of Parasitism course that I attended with the support of another Network Travel grant. I highly recommend this course - I learnt lots of new techniques and ideas that I am now implementing in my current studies. The experience of studying overseas was also very rewarding and lots of fun!"



Natalie Spillman during her 2008 Researcher Exchange, Training and Travel Award

Progress on Initiatives cont.

Mai Tran won a Researcher Exchange, Training and Travel Award in 2006 to visit the Biomedical Research Institute, (NIAID/NIH) in Rockville, USA and the University of Pennsylvania and was featured in our 2007 Network Annual Report. In 2009 Mai and her colleagues had a publication in *PLoS Pathogens*, which was a result of her Network Travel Award.

Early Career Researcher Initiatives

ARC/NHMRC Research Network for Parasitology Early Career Researcher Award for the best presentation:

In 2009 two Network participants won the Network Early Career Researcher Award:

Kate Hutson, The University of Adelaide, School Earth and Environmental Science for her poster presentation entitled "Parasite assemblages as indicators of population structure of southern garfish (*Hyporhamphus melanochir*)"

Magda Ellis, from the Queensland Institute of Medical Research for her contributed paper entitled "The effect of SNP variants located downstream from IL-5 on gene transcription and translation and their role in infection with *Schistosoma japonicum*."

Both will now be speakers at the International Congress of Parasitological Associations in 2010.

ARC/NHMRC Research Network for Parasitology Student and Early Career Researcher Workshop

The Network organised and sponsored **Student and Early Career Researcher Workshop** was held on Monday 13 July 2009, 7:00-9:00am. This year's workshop comprised of three main sessions where Early Career Researchers (ECRs) discussed their experiences; Senior Researchers and ECRs then joined attendees for an over-breakfast discussion.

Session 1 - A panel of early career researchers and an experienced examiner shared their knowledge and answer questions on the '**PhD experience**':

- Stuart Ralph (The University of Melbourne)
- Magda Ellis (QIMR)

- Kate Hutson (The University of Adelaide)
- Una Ryan (Murdoch University)

Session 2 – Career Options

A panel of early to mid-career scientists from Institutes and Industry shared their stories on different career paths post PhD, shed light on the importance of track records and gave tips for building CVs:

- Jake Baum (WEHI)
- Graham Robertson (Concord Hospital)
- David Witcombe (Wyeth Australia)
- Tiggy Grillo (Australian Wildlife Health Network)

Session 3 – Mentorship

The importance of mentoring: Alex Maier (La Trobe), a young scientist and his mentor, Kieran Kirk (ANU), talked about their experience with the Network Mentoring Scheme.

The Network's **Early Career Researcher and Student Workshops** aim to enable postdoctoral researchers and students to speak to prominent parasitologists about their career and to meet like-minded peers. They aim 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. 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 70 research students and early career researchers from institutions within the ARC/NHMRC Research Network for Parasitology.

Progress on Initiatives cont.

Student and Early Career Researcher Workshop feedback

There were over 70 participants who attended the student breakfast workshop at this year's conference. We surveyed the 70 participants and 10 speakers who attended the student and early career workshop at this year's conference and 30 (43%) responded to give feedback about this event; 18 identified as students, 6 identified as early career researchers and 4 were speakers at the event, 1 was an observer.

Almost all respondents to this section agreed or strongly agreed that the speakers were inspirational and interesting to listen to (87.5%); that "this event enabled me to meet other early career researchers and discuss our science careers and research" (81%); and "Overall, I found the whole experience of attending the early career and student workshop valuable" (77%). Most (61%) agreed or strongly agreed that the event gave them the "opportunity to discuss my future career."

Following the 2008 ECR and student event feedback from participants was a need for "having separate PhD student and ECR sessions" so this year the committee of ECRs and students who organised the 2009 event directed it at PhD students. There were three main sessions where Early Career Researchers discussed their career experiences:

- Session 1 - A panel of early career researchers shared knowledge and answered questions on the 'PhD experience'
- Session 2 - A panel of early to mid-career scientists from different Institutes and Industry shared their stories on different career paths post PhD, shed light on the importance of track records and gave tips for building CVs
- Session 3 - "The importance of mentoring" A young scientist and their mentor talked about their experience with the Network Mentoring Scheme.

There were 29 comments from respondents with comments and suggestions for running this type of event for early career researchers and students. Most thought the event was "very well organised", and gave the following comments;

- "Good choice of topics, but not enough time for discussion",
- "Very worthwhile and it was very beneficial to hear the experiences of others",
- "Was very well done, interesting speakers giving useful information for aspiring scientists. Trivia was exciting at the end, and provided a good way to meet new people" and
- "I found it really inspirational and great to receive advice, especially as a lot of speakers had similar advice."

Some suggestions included;

- "Session on career alternatives went particularly well - would be a useful, longer session for consideration in the future as it stimulated quite a bit of discussion and interest. The speakers chosen were excellent" and
- "Include a person who is non-native English speaker, student or postdoctoral researcher, it would be great to discuss about the experience to live in a different country speaking other language."

The workshop also promoted the third 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 cont.

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 and the development of national and international collaborative research through the Network Researcher Exchange, Training and Travel Awards are summarised above.

Publications

ARC/NHMRC Research Network for Parasitology Participants published 343 articles in journals or books during 2009. 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.

NETWORK PARTICIPANTS REPORTED 60 SEMINARS, POSTERS AND PRESENTATIONS AND 31 PUBLICATIONS IN 2009/2010 ARISING DIRECTLY FROM WORK CARRIED OUT UNDER NETWORK RESEARCHER EXCHANGE, TRAINING AND TRAVEL AWARDS.

The publications were:

Belli SI, Ferguson DJP, Katrib M, Slapetova I, Mai K, Slapeta J, Flowers SA, Miska KB, Tomley FM, Shirley MW, Wallach MG, Smith NC (2009) Conservation of proteins involved in oocyst wall formation in *Eimeria maxima*, *Eimeria tenella* and *Eimeria acervulina*. *International Journal for Parasitology* 39: 1063-1070

Bolas-Fernández F, Dea-Ayuela MA, Connolly B, Robinson MW (2009) Micro-environmental conditions modulate protein secretion and infectivity of the *Trichinella spiralis* L1 larva. *Veterinary Parasitology* 159 (3-4), 236-239

Burger MAA, Adlard RD (2010) Four new species of *Kudoa* Meglitsch 1947 (Myxosporaea: Multivalvulida) from Australia with recommendations for species descriptions in the Kudoidae. *Parasitology* 137: 793-814

Catalano SR, Hutson KS (2010) Harmful parasitic crustaceans infecting wild arripids: a potential threat to southern Australian finfish aquaculture. *Aquaculture* 303: 101-104

Cwiklinski K, Meskill D, Robinson MW, Pozio E, Appleton JA, Connolly B (2009) Cloning and analysis of a *Trichinella pseudospiralis* muscle larva secreted serine protease gene. *Veterinary Parasitology* 159: 268-271

D'Ombra MC, Robinson LJ, Stanisic DI, Taraika J, Bernard N, Michon P, Mueller I, Schofield L (2008) Association of early interferon-gamma production with immunity to clinical malaria: a longitudinal study among Papua New Guinean children. *Clin Infect Dis*. 47: 1380-7

Dalton JP, Brindley PJ, Donnelly S, Robinson MW (2009) The enigmatic asparaginyl endopeptidase of helminth parasites. *Trends in Parasitology* 25: 59-61

Donnelly S, O'Neill SM, Stack CM, Robinson MW, Turnbull L, Whitchurch C, Dalton JP (2010) Helminth Cysteine Proteases Inhibit TRIF-dependent Activation of Macrophages via Degradation of TLR3. *J. Biol. Chem.* 285: 3383-3392

Dougall A, Shilton C, et al. (2009) New reports of Australian cutaneous leishmaniasis in Northern Australian macropods. *Epidemiology and Infection* 137: 1516-20

Driguez P, Doolan D, Loukas A, Felgner P, McManus DP (2010) Schistosomiasis vaccine discovery using immunomics. *Parasites & Vectors* 3:4

Achievements and Outputs cont.

Godfrey SS, Bull CM, James R, Murray K (2009) Network structure and parasite transmission in a group-living lizard, the gidgee skink (*Egernia stokesii*). *Behavioral Ecology and Sociobiology* 63:1045-1056

Jamieson SE, Peixoto-Rangel AL, de Roubaix L-A, Hargrave AC, Boulter NR, E. Miller N, Fuller SJ, Wiley JS, Mui EJ, Castellucci L, Boyer K, Guerra Peixe R, Kirisits MJ, de Souza Elias L, Coyne JJ, Correa-Oliveira R, Sautter M, Smith NC, Lees MP, Swisher CN, Heydemann P, Noble AG, Patel D, Bardo D, Burrows D, McLone D, Roizen N, Withers S, Bahia-Oliveira LMG, McLeod R, Blackwell JM (2010) Evidence for associations between the purinergic receptor P2X₇ (*P2RX7*) and toxoplasmosis. *Genes and Immunity* (in press, accepted February 12, 2010)

Lees MP, Fuller SJ, McLeod R, Boulter NR, Miller CM, Zakrzewski AM, Mui EJ, Witola WH, Coyne JJ, Hargrave AC, Jamieson SE, Blackwell JM, Wiley JS, Smith NC (2010) P2X₇ receptor-mediated killing of an intracellular parasite, *Toxoplasma gondii*, by human and murine macrophages. *Journal of Immunology* (in press, accepted March, 2010)

Lim L, Linka M, Mullin KA, Weber APM, McFadden GI (2010) The carbon and energy sources of the non-photosynthetic plastid in the malaria parasite. *FEBS Lett.* 584: 549-54

Lin E, Kiniboro B, Gray L, Dobbie S, Robinson L, Laumaea A, Schöpflin S, Stanistic D, Betuela I, Blood-Zikursh M, Siba P, Felger I, Schofield L, Zimmerman P, Mueller I (2010) Differential patterns of infection and disease with *Plasmodium falciparum* and *Plasmodium vivax* in young Papua New Guinean children. *PLoS One* 5: e9047

Mai K, Sharman PA, Walker RA, Katrib M, DeSouza D, McConville MJ, Wallach MG, Belli SI, Ferguson DJP, Smith NC (2009) Oocyst wall formation and composition in coccidian parasites. *Memorias do Instituto Oswaldo Cruz* 10: 281-289

Maric S, Donnelly S, Robinson MW, Stack CM, Trenholme KR, Gardiner DL, Dalton JP, Lowther J (2009) The M17 leucine aminopeptidase of the malaria parasite *Plasmodium falciparum*: the importance of active site metal ions in the binding of substrates and inhibitors. *Biochemistry* 48: 5435-5439

Parameswaran N, O'Handley RM, Grigg ME, Fenwick SG, Thompson RC (2009) Seroprevalence of *Toxoplasma gondii*

in wild kangaroos using an ELISA. *Parasitol Int.* 58: 161-5

Parameswaran N, O'Handley RM, Grigg ME, Wayne A, Thompson RC (2009) Vertical transmission of *Toxoplasma gondii* in Australian marsupials. *Parasitology* 136: 939-44

Parameswaran N, Thompson RCA, Sundar N, Pan S, Johnson M, Smith NC, Grigg ME (2010) Nonarchetypal Type II-like and atypical strains of *Toxoplasma gondii* infecting marsupials of Australia. *International Journal for Parasitology* (in press, accepted February 15, 2010)

Pinlaor P, Kaewpitoon N, Laha T, Sripa B, Kaewkes S, Morales ME, Mann VH, Parriott SK, Suttiprapa S, Robinson MW, To J, Dalton JP, Loukas A, Brindley PJ (2009) Cathepsin F cysteine protease of the human liver fluke, *Opisthorchis viverrini*. *PLoS Neglected Tropical Diseases* 3: e398

Robinson LJ, D'Ombra MC, Stanistic DI, Taraika J, Bernard N, Richards JS, Beeson JG, Tavul L, Michon P, Mueller I, Schofield L (2009) Cellular tumor necrosis factor, gamma interferon, and interleukin-6 responses as correlates of immunity and risk of clinical *Plasmodium falciparum* malaria in children from Papua New Guinea. *Infect Immun.* 77: 3033-43

Robinson MW, Hutchinson AT, Dalton JP, Donnelly S (2010) Peroxiredoxin: a central player in immune modulation. *Parasite Immunology* 32: 305-313

Robinson MW, Dalton JP (2009) Zoonotic helminth infections with particular emphasis on fasciolosis and other trematodiasis. *Philosophical Transactions of the Royal Society B* 364, 2763-2776

Robinson MW, Menon R, Donnelly SM, Dalton JP, Ranganathan S (2009) An integrated transcriptomic and proteomic analysis of the secretome of the helminth pathogen, *Fasciola hepatica*: proteins associated with invasion and infection of the mammalian host. *Molecular and Cellular Proteomics* 8: 1891-1907

Rowe A, Gondro C, Emery D, Sangster N (2008) Genomic analysis of *Haemonchus contortus* infection in sheep: abomasal fistulation and two *Haemonchus* strains do not substantially confound host gene expression in microarrays *Veterinary Parasitology* 154: 71-81

Achievements and Outputs cont.

Rowe A, Gondro C, Emery D, Sangster N (2009) Sequential microarray to identify timing of molecular responses to *Haemonchus contortus* infection in sheep. *Veterinary Parasitology* 161: 76-87

Sripa J, Laha T, To J, Brindley PJ, Sripa B, Kaewkes S, Dalton JP, Robinson MW (2010) Secreted cysteine proteases of the carcinogenic liver fluke, *Opisthorchis viverrini*: regulation of cathepsin F activation by autocatalysis and trans-processing by cathepsin B. *Cellular Microbiology* 12: 781-795

Sutherland CJ, Tanomsing N, Nolder D, Oguike M, Jennison C, Pukrittayakamee S, Dolecek C, Hien T T, do Rosário VE, Arez AP, Pinto J, Michon P, Escalante AA, Nosten F, Burke M, Lee R, Blaze M, Otto TD, Barnwell JW, Pain A, Williams J, White NJ, Day NPJ, Snounou G, Lockhart PJ, Chiodini PL, Imwong M, Polley SD (2010) Two Nonrecombining Sympatric Forms of the Human Malaria Parasite *Plasmodium ovale* Occur Globally. *The Journal of Infectious Diseases* 201: 1544–1550

Tran MH, Freitas TC, Cooper L, Gaze S, Gatton ML, et al. (2010) Suppression of mRNAs Encoding Tegument Tetraspanins from *Schistosoma mansoni* Results in Impaired Tegument Turnover. *PLoS Pathog* 6: e1000840

Trenholme KR, Brown CL, Skinner-Adams TS, Stack C, Lowther J, To J, Robinson MW, Donnelly SM, Dalton JP, Gardiner DL (2010) Aminopeptidases of Malaria Parasites: New Targets for Chemotherapy. *Journal of Infectious Diseases: Drug Targets* 10: 217-225

Grants

Research grants awarded to Network Participants in 2009 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 2009 ARC and NHMRC grant rounds, securing over \$18 million in grants, fellowships and major equipment. NHMRC and ARC Fellowship winners deserve particular mention: Michael Good, Stuart Ralph, Aaron Jex, James Beeson, Adele Lehane, Matthew Dixon, Lev Kats, Kathy Andrews, Yuesheng Li and Chris Peacock.

Additionally, Network Participants attracted more than \$5.9 million grants from other national and international sources such as Griffith University, Queensland-US Vaccine Technology Alliance (ACVD and EVC), Research Council of Norway, CTCBIO, Water Corporation of Western Australia, ABRS/Creeps, NIH/NIAID (USA), Smart Futures Fund National and International Research Alliances Program (AUSTRALIA), Ministerio de Educación y Ciencia, SPAIN, Northern Territory Government Department of Agriculture, Fisheries and Foresteries, Wildlife Exotic Disease Preparedness Program, Australia-India Strategic Research Fund (AISRF), Fluorescence Applications in Biotechnology and Life Sciences (FABLS), ANZ Trustees Program: Medical Research and Technology in Victoria; Buckland Foundation Grant, Australian Biological Resources Study, BHP Billiton, The Great Barrier Reef Foundation, the Australian Institute of Marine Science, Alfred P. Sloan Foundation, The Hugh D. T. Williamson Foundation Grants; ANZ Charitable Trusts; Medical Research and Technology in Victoria, Mosquito and Arbovirus Research Committee, Inc., The Broad Foundation, MMV, UBS Optimus Foundation, Switzerland, Grains Research and Development Corporation, Griffith Medical Research College Collaborative Grant Scheme, The Dr William Richards Awards in Veterinary Pathology, University of Sydney, Margot Roslyn Flood Bequest, Faculty of Veterinary Science, University of Sydney, Malaria in Pregnancy Consortium, Pfizer Inc Investigator Initiated Research, Bill and Melinda Gates Foundation Grand Challenges Exploration Initiative.

Internationalisation of Research

HOW THE RESEARCH NETWORK HAS FACILITATED THE INTERNATIONALISATION OF RESEARCH AND INTERNATIONAL LINKAGES — LINKS TO INTERNATIONAL NETWORKS.

At the **“Molecular Approaches to Malaria”** meeting in Lorne, Victoria, in early February, 2008, Professor Smith, representing the Network, and Professor Artur Scherf, the Director of BioMalPar, signed a formal Memorandum of Understanding between the Network and the EU Network of Excellence for the Biology and Pathology of Malaria (*BioMalPar*) to facilitate and enhance future interactions and

Internationalisation of Research cont.

explore co-funding opportunities. The MoU formalised the excellent relationship that already exists between the two Networks.

As a result, the Australian malaria research community were included 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*.

On 25 February 2010 The NHMRC - European Union (EU) Collaborative Research Grants scheme supporting Australian participation in leading international collaborative research under FP7 were announced. One of these was awarded to **Geoff McFadden** (The University of Melbourne), **Kevin Saliba** (Australian National University) and colleagues who were successful in their project grant application for **Australia - Europe Malaria Research Cooperation - OzEMalaR** and were awarded \$830,000 over 5 years.

Malaria is a global problem with no single solution. A large, but sometimes disjointed, research community is addressing the problem, but more collaboration is vital. OzEMalaR will link 34 Australian labs with 47 European, African & Indian malaria researchers. Funding will enable exchange of modern technologies by supporting early career researchers (PhD and postdocs) from Australia to work and be trained in top European labs. European trainees will work and be trained by Australian malariologists using reciprocal EU support.

Geoff said, "I anticipate that we will be able to fund collaborative exchanges of Australian malaria research laboratory members into EviMalaR laboratories shortly. The process will work in a very similar manner to the research exchanges funded by the ARC/NHMRC Research Network for Parasitology."



Heidleburg, Germany is the location of the annual EVIMalaR conference. Photograph courtesy Alex Maier (La Trobe University), who attended as the 2008 Network ECR Awardee.

Significant Contributions

There were several highlights for the Network in 2009, including the continuing excellent registration at the Joint Conference of the ARC/NHMRC Research Network for Parasitology and ASP 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 2009, especially in the form of publications in peer-reviewed international journals (detailed above).

There were also several major personal and research achievements in 2009, that deserve particular mention here.

Professor Michael Good, Director of the Queensland Institute of Medical Research (QIMR) was awarded the 2009 CSIRO Eureka Prize for Leadership in Science.

The Eureka Prize for Leadership in Science is awarded to an Australian individual who has demonstrated an outstanding role and impact in science.

Significant Contributions cont.

"It is an honour to have been recognised with such a prestigious award and I am humbled to join the list of distinguished winners - leaders who have helped shape and inspire research in Australia. I would like to thank CSIRO and the Australian Museum for supporting these annual awards and congratulate the other prize winners," said Michael.

The Eureka Prize for Leadership in Science is awarded to an Australian individual who has demonstrated an outstanding role and impact in science and was presented to Professor Michael Good on Tuesday night in Sydney. Michael is pictured here with his Eureka Prize standing with Nick Smith from the ARC/NHMRC Research Network for Parasitology. Nick nominated Michael for this highly prestigious award on behalf of the Network.

Nick said, "Michael is an inspired choice as the 2009 winner of the Eureka Prize for Leadership in Science. In many ways, he embodies what it means to be scientific leader - through his own internationally renowned parasitology research, his leadership of Australia's largest medical research institute and his national influence as the inaugural Director of the Vaccine Cooperative Research Centre (Vaccine CRC), President of the Association of Australian Medical Research Institutes, Chair of the Council of the National Health and Medical Research Council (NHMRC) and Chair of the Health Stream of the Prime Minister's National 2020 Summit, to name a few. And, of course, his wonderful support for the Network for Parasitology. What I particularly admire is his belief in collaborative scientific endeavour and an ability to inspire the collaborative spirit of others".

Michael has been Director of QIMR since 2000 and in that time has led the institute to become one of Australia's biggest and most successful. Beginning his career as a medical doctor, Professor Good decided to move into medical research. He completed his doctorate at the Walter and Eliza Hall Institute of Medical Research under the supervision of Sir Gustav Nossal and dedicated his research career to combating some of the world's great killers.

After 25 years of dedicated research into malaria, Michael is now performing pre-clinical studies into the development of a whole of parasite malaria vaccine. His world leading research has also led to the development of a trial vaccine for Streptococcus A - the cause of rheumatic fever which is

responsible for over 500,000 deaths every year with a high impact among Indigenous Australians. In 1996, Michael became a member of the Board of the Co-operative Research Centre for Aboriginal Health. He later established the Indigenous Health Research Program at QIMR.

He has nurtured many of the next generation of scientific leaders and researchers and represented the science community at a number of influential forums such as the National 2020 Summit as well as being President of the Association of Australian Medical Research Institutes from 2002-2004, and chair of the National Health and Medical Research Council.

In 2008 Michael was awarded an Officer of the Order of Australia (AO) 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.

The Eureka Awards were presented in at the Royal Hall of Industries in Sydney on August 18, 2009. Michael was also awarded an **Australian Fellowship** commencing in 2010 at Griffith University, for his clinical medicine and science research into cellular immunology, and vaccine development.



Network participants congratulate Michael Good (centre) for his 2009 Eureka prize for Leadership in Science.

Significant Contributions cont.



Brendan Crabb awarded the 2009 Bancroft-Mackerras Medal by the Australian Society for Parasitology

Professor Brendan Crabb, Director of the Burnet Institute, who was awarded Australia's most prestigious award for parasitological research, the Bancroft-Mackerras Medal by the Australian Society for Parasitology. Brendan, Tania de Koning-Ward and their research teams and collaborators have identified a critical vulnerability in the life cycle of malaria that offers hope for the development of new treatment options for this devastating disease. They have published their discovery identifying a molecular machine used by the malaria parasite to export its protein, in the prestigious international journal, *Nature*. "A newly discovered protein export machine in malaria parasites" *Nature*, Vol 459, 945-950, 19 June 2009

The malaria parasite grows inside red blood cells but, being essentially a sack of haemoglobin, the red blood cell is not actually a great place to live. To survive, the malaria parasite, *Plasmodium falciparum*, has to move hundreds of proteins out of itself and to the outside of the red blood cell. While these proteins have many different functions that are crucial to the parasite, they all share one common feature - they must all pass through the same pore in a membrane that surround the parasite. Brendan and his colleagues at Deakin University and the Walter and Eliza Hall Institute of Medical Research, have discovered the identity of this protein pore.

Brendan says that, "Protein export machines are of great interest in biology but because of the enormous scale of the malaria problem this one also has practical health value.

Therapies that block this pore interfere with many different crucial processes in the one hit and in that sense it is an Achilles heel of the malaria parasite."

Dr Rowena Martin is a NHMRC Australian Biomedical Fellow in the Research School of Biology, at The Australian National University and at the School of Botany, University of Melbourne. Here, she speaks to Lisa Jones about a paper, published recently in *Science*, "Chloroquine Transport via the Malaria Parasite's Chloroquine Resistance Transporter" by Rowena E. Martin, Rosa V. Marchetti, Anna I. Cowan, Susan M. Howitt, Stefan Bröer, Kiaran Kirk, 25 September 2009, Vol 325, *Science*.

Rowena said, "Chloroquine was an important tool in the battle against malaria. The drug was developed in the 1930's but it wasn't until the mid-1940's that it was introduced as the frontline anti-malarial for both the treatment and prevention of the disease. There was massive worldwide (and at times uncontrolled) usage of chloroquine – the Brazilian government even added it to table salt in 1961! Despite this, resistance to the drug was relatively slow to develop and was first reported in the early 1960's. By the 1990s, however, resistant strains had spread throughout endemic regions, severely reducing the effectiveness of chloroquine."

Rowena's group is looking at the molecular mechanism of resistance in the malaria parasite *Plasmodium falciparum*. "The malaria parasite infects the red blood cell and takes up human haemoglobin into its vacuole, where it chops up haemoglobin into peptides and/or amino acids, which it can use; but the by-product is haem, which is very toxic. To combat this, the parasite incorporates haem into an inert crystal. Chloroquine is a very effective anti-malarial because it interferes with the formation of this crystal, so there are high enough levels of haem to kill the parasites," Rowena said.

What is your group working on now?

"We are focussing on the chloroquine resistance transporter – or 'PfCRT' - located on the vacuole of the malaria parasite; mutations in this protein confer chloroquine resistance. However, there has been a lot of debate and controversy over how the protein achieves this," Rowena said.

Rowena's group has succeeded in expressing PfCRT in

Significant Contributions cont.

oocytes from the frog, *Xenopus laevis*, and using this system, they have shown that the resistant form of the protein has the ability to transport chloroquine out of the digestive vacuole, whereas the sensitive form does not. Achieving expression was not straightforward; Rowena used a codon-harmonised form of the gene, and removed a number of protein targeting motifs that she suspected would cause PfCRT to be retained within the oocyte. Rowena and her PhD student, Rosa Marchetti, showed that without these changes, chloroquine transport activity could not be detected in oocytes expressing the resistant form of PfCRT, nor was the protein expressed at significant levels in the plasma membrane of the oocyte. Armed with this novel expression system, Rowena and colleagues went on to demonstrate that transport of chloroquine via mutant PfCRT is inhibited by verapamil, a drug long-recognised for its ability to reverse chloroquine resistance *in vitro*.

"One of the exciting things about the PfCRT oocyte system is that it allows us to examine interactions between the protein and different drugs", says Rowena. "Identifying novel chloroquine-like drugs that don't interact with mutant PfCRT and are, therefore, not substrates of the transporter, would be a step in the right direction in the search for a potent new quinoline antimalarial," she said.

Not surprisingly, a number of groups have sent novel resistance-reversers and chloroquine-like molecules to Rowena's group for them to test in the PfCRT oocyte system. Rowena said, "Collaborating with these groups, each of which has substantial expertise in studying and/or synthesising novel antimalarial compounds, is very helpful for our research."

How long have you been interested in this area of research Rowena?

Rowena began working on PfCRT during her PhD, when she performed a detailed bioinformatic analysis of the protein (published in 2004). It was over the course of this work that she began formulating the hypothesis that codon-harmonisation and (the removal of) targeting motifs may play important roles in the successful expression of PfCRT in a heterologous system. In 2005, she set about testing these ideas as a postdoc in the laboratory of Kieran Kirk and, after obtaining promising preliminary results, Rowena secured NH&MRC funding to pursue her ideas. Rowena's work is now split between the ANU and University of Melbourne.

Rowena tell us about your research work in Melbourne.

Rowena explained, "The work I am carrying out in collaboration with Geoff McFadden and colleagues at the University of Melbourne investigates whether knocking out the targeting motifs in PfCRT alters its location in the parasite. We plan to use immunofluorescence in conjunction with microscopy to determine the location of the modified protein; does it still traffic to the digestive vacuole or is it instead at the plasma membrane or even somewhere else in the cell?"

How will this research help people with malaria?

Rowena said, "The PfCRT oocyte system provides us with an opportunity to understand interactions between PfCRT and the quinoline class of antimalarials as well as compounds that reverse chloroquine resistance. By doing so, it has the potential to facilitate the rational design of novel chloroquine-like drugs that bypass the resistance mechanism, and/or clinically effective resistance-reversers."



Rowena Martin, NHMRC Australian Biomedical Fellow in the Research School of Biology, at The Australian National University and at the School of Botany, University of Melbourne.

Significant Contributions cont.

Peter Holdsworth was made a Member of the Order of Australia for "service to the animal health industry, particularly as a contributor to the development of international standards for the veterinary pharmaceutical sector."

Aaron Jex (University of Melbourne) was awarded the WAAVP Peter Nansen Young Scientist Award. The award has been established in memory of late Professor Peter Nansen, to reward innovative and outstanding work by promising young professionals in the field of Veterinary Parasitology.

Andy Thompson (Murdoch University) was recently elected as a Fellow of the Linnean Society of London, the world's oldest active biological society, founded in 1788.

Geoff McFadden (School of Botany, University of Melbourne) was awarded the 2009 Ramaciotti Medal for Excellence in Biomedical Research. The Medal recognises Geoff's work in developing new ways to combat one of the world's major health problems, malaria. Through their research, Geoff and his colleagues have been able to identify a whole series of biochemical pathways in the malaria parasite that do unique things and make unique products for the parasite that are excellent drug targets.

Alan Cowman (Walter and Eliza Hall Institute of Medical Research) was awarded the 2010 Howard Taylor Ricketts Award by the University of Chicago. The award recognises outstanding accomplishment in the field of medical sciences. "It was a very nice surprise and a great honour to join a list that includes such stellar scientists," Alan said. Alan's research has led to better understanding of how the malaria parasite evades the human immune system as well as anti-malarial drugs. It has also revealed much about how the malaria parasite invades and remodels the human red blood cell. Collectively, this knowledge is being used to identify vaccine and drug candidates against malaria.

Walter and Eliza Hall Institute researchers have identified a key protein used by the malaria parasite to transform human red blood cells, ensuring the parasite's survival. Their discovery means researchers have a clear target against which to develop a new class of anti-malarial drugs that

destroy the parasite.

Alan Cowman, head of the institute's Infection and Immunity division, said the parasite, *Plasmodium falciparum*, remodels the red blood cells by exporting hundreds of so-called 'effector' proteins into the cytoplasm of the red blood cell. "These are key virulence proteins that allow the parasite to survive in the human and hide from the human immune system," Professor Cowman said. "There has to be a mechanism that allows these effector proteins to be exported but until now we haven't known what it is."

Alan, **Justin Boddey, Tony Hodder, Svenja Gunther, and Andrew Pearce** from the WEHI, in collaboration with **Richard Simpson, Heather Patsiouras and Eugene Kapp** of the Ludwig Institute for Cancer Research, **Brendan Crabb and Paul Gilson** at the Burnet Institute and **Tania de Koning-Ward** at Deakin University, have identified a protein called Plasmepsin V as being essential for effector proteins to be exported into the red blood cell. Their research was published on 4 February 2010 in the international journal, *Nature*.

Alan said experimentation had shown that the action of Plasmepsin V on the effector proteins was the first step in priming the proteins to be exported beyond the parasite's membrane into the red blood cell cytoplasm. "Plasmepsin V is responsible for determining that all the hundreds of effector proteins are exported. If we could find drugs to block Plasmepsin V the malaria parasite would die," he said.

Alan said because Plasmepsin V was a protease it was an attractive drug target. "Drugs that target proteases have been very effective in combating HIV so, by analogy, drugs that impede the function of Plasmepsin V should also show promise," he said.

Significant Contributions cont.

Associate Professor Stephen Barker and Dr Renfu Shao (The University of Queensland) had their collaborative research (with Professor Ewen Kirkness from the J. Craig Venter Centre, Rockville, MD.) on lice published online in a special issue of *Genome Research* to mark the 200th anniversary of the birth of Charles Darwin on February 12, 2009. (www.genome.org, Shao et al. *Genome Res.* doi:10.1101/gr.083188.108). The paper was highlighted in *Nature* (<http://www.nature.com/nature/journal/v458/n7238/full/458552b.html>)

Steve, says that "Lice are a challenge for parents of primary-school aged children all around the world, including Australia."

"Lice are a nuisance familiar to parents and children around the world and, in developing regions, some lice can be vectors for serious diseases such as epidemic typhus. Yet, for all the trouble this pest causes, new research is indicating that the louse may actually be quite unique in the animal world; but it will be of little comfort to parents that head lice have the most highly evolved mitochondrial chromosomes of all multi-celled animals," said Stephen.

"Almost all multi-celled animals, including humans, have one large mitochondrial chromosome, but lice have more than twelve mini-chromosomes," Stephen said. "What's more, parts of these mini-chromosomes join to one another for a while only to split again later - this is extraordinary."

"These mini-chromosomes seem to sit at the summit of mitochondrial chromosome evolution," his colleague, Dr Renfu Shao said. "So the mitochondrial chromosomes of lice, in this sense, are extreme genomes," Renfu said. "The lice that infect the nearest living relatives of humans, the chimpanzee, also have these extreme genomes," he said. "While multiple mitochondrial minichromosomes have been previously described in plants and protists, this is the first report of an animal adopting a highly fragmented mtDNA structure," Renfu said.

Stephen said, "We are examining the implications of the work for knowledge of the biology of lice. Efforts are underway to sequence the genome of the human body louse, *Pediculus humanus*, which will lead to new strategies for treatment and prevention of infestation."

The body louse mitochondrial genome story also appeared in Science News. (http://www.sciencenews.org/view/generic/id/42342/title/Louse-y_genome_surprise)



Pediculus capitis are parasitic lice that are often found in our hair. They live, eat blood, sleep, and lay their eggs close to our scalp so the heat from our head allows the egg to hatch in about a week. They live for just over a month. Images courtesy of Cath Covacin, Stephen Barker and Rick Webb, The University of QLD (Australia).

Media and Outreach

IN 2009, OUR NETWORK MEMBERS ENGAGED IN NUMEROUS OUTREACH ACTIVITIES THAT HIGHLIGHTED THEIR RESEARCH.

The audience was widespread, ranging from radio listeners, film documentary buffs, 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.

Outreach Presentations and Activities

Network Participants were again involved in many outreach presentations and activities across Australia during 2009. 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.

Media and Outreach cont.

Utilising these opportunities to showcase the hard work of Australian parasitologists is a perfect way to engage a curious public.

Workshops and Exhibitions

Network staff, Lisa Jones and Wendy Relf ran **parasitology workshops** at **University of Technology, Sydney**, for visiting **high school students** in May, September and November 2009. 150 high school students experienced what it is like to be a parasitologist first-hand. During the "Parasitology workshop" students performed a DNA extraction on a "faecal" sample (actually chicken liver), checked out parasites under the microscope and "pinned the parasite on Polly". Each year the Museum of Human Disease at University of NSW coordinates and hosts a **Teachers Professional Development Day** for high school teachers of Senior Biology. In July 2009 **Kate Miller**, a scientist from University of Technology, Sydney presented '**Revenge of the Bodysnatchers**' as part of this programme to high school teachers from across New South Wales. This was a great opportunity to provide teachers with information about research developments and concepts in parasitology which can then be used to engage and educate their students. Some teachers came along to the Network public event "Itchies and Scratchies" held shortly after the development day (and detailed below).

'Parasites in Focus' hands-on exhibition

In 2009 the Network and the Australian Society for Parasitology, Inc., expanded 'Parasites in Focus' photographic exhibition to include three hands-on interactive exhibits: **parasite game show "Who's my host?"** this exhibit has six animals sitting around a screen where the game show host invites "celebrity" parasites and the visitor has to select the correct host for each parasite. The other two exhibits allow visitors to explore lots of different parasites found in Australia and around the world using **"The microscopic world of parasites"**, 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, and **"Bring your own parasite"**

where visitors use a real medium-powered light microscope to examine parasites embedded in resin, eg "roundworm". Accompanying the exhibits are twenty-six superb colour photographic prints showing the amazing microscopic world of the parasite including up close images of head lice, ticks, fleas, fish parasites, tapeworms and organisms that cause malaria.

In 2009 'Parasites in Focus' exhibition travelled and was on display in three states, moving from Perth to Sydney, then Darwin and finally Wollongong.

Following a highly successful run at **Perth Zoo in Western Australia** for over 10 months, 'Parasites in Focus' travelled to **Sydney** where more than 240 ASP & ARC/NHMRC Research Network for Parasitology conference delegates and their families and friends enjoyed the exhibition over the four-day event at **The University of Sydney**.

'Parasites in Focus' exhibition then travelled to **Darwin** to the **Northern Territory Library** where it was on display during the Darwin Festival for three months from late July until early September 2009. Some comments from visitors who experienced the exhibition were:

- Thanks, you provide about parasites knowledge for me.
- Would not think a lot of bugs would be so interesting.
- Thanks for the new knowledge.
- Very interesting
- Humans are the real problem!
- Kool
- Fascinating and informative.
- Interesting and important. Compliments a great library!
- Fascinating, thanks!
- Very interesting and set out great.
- Very well presented and interesting.
- Very impressive.
- Nice.
- Great resources.
- Fantastic
- Well done!
- An enjoyable time
- Feeling itchy? Yeah! But interesting.

Media and Outreach cont.

- Very interesting, well presented.
- Creepy.
- Scary and distressing.
- Awesome,
- Excellent
- Good
- Most interesting and informative.
- Thank you – horrid but interesting.
- Such detail – quite amazing!
- Off to the chemist for me!

Finally, 'Parasites in Focus' exhibition was on display at the **Wollongong Science Centre** from November 2009 for 3 months and had over 15,000 visitors, mostly school children, their teachers and family groups, during that time.



Visitors to Wollongong Science Centre explore parasite game show "Who's my host?", part of 'Parasites in Focus'

"Itchies and Scratchies" public event

In 2009 the Network organised and ran a highly entertaining quiz show, *"Itchies and Scratchies"*, in the Holme Building and Footbridge Theatre at The University of Sydney 5:30 – 10:00pm, Sunday, July 12, 2009.

"Itchies and Scratchies" entertained parasitologists attending the annual ASP & Network Conference, their families and friends and members of the general public as two teams of parasitologists battle it out to uncover the

strange, unusual and not-so-secret life of parasites. This free event was open and promoted to all conference delegates, their family members and the general public and attracted over 250 guests.

We surveyed visitors who experienced 'Parasites in Focus' at The University of Sydney and/or "Itchies and Scratchies" to find out what they thought of these outreach activities and some of their responses are listed below:

- Love the photos - they are excellent, enjoyed what I saw of Parasites in Focus - like the touch screen exhibit.
- Excellent!!
- Photos looked almost unreal, very impressive. It worries me what may be lurking out there!
- Enjoyed the photos.
- I thought that the photographic display was excellent would like to see more images added to the collection.
- I thought the photographic display was good. I enjoyed the Parasites in Focus exhibition, but did not partake in all of the exhibits in display.
- I absolutely loved the pics and found them fascinating, especially with the writings with them. I enjoyed the exhibits.



"Parasites in Focus" exhibition at Wollongong Science Centre.

Media and Outreach cont.

- Beautiful photos. The Parasites in Focus exhibit was interesting and fun.
- Thank you so much for your invitation and organising events like this.
- They are very pretty and attractive.
- Very good. Good interesting photos
- The interactive one was good.
- Very good. It was nice to see beautifully taken pictures and the colours would attract any audience.
- Impressive. Nice to have spectacular pictures on the walls.
- Fun.
- I liked the "Parasites in Focus" posters.
- Outstanding pictures.
- The parasite pictures were nice.
- "Parasites in Focus" display was excellent.
- Photographs were impressive in their detail and, in some instances, aesthetically pleasing.
- It worked well.
- Very rewarding in terms of knowledge enhancement. Thank you.
- It was good.
- It was fun.
- Some quirky parasite facts.
- I enjoyed the clips from the documentary as I'd missed it when it was on telly and it's prompted me to try and obtain a copy.
- The textbook singing was good.
- It revised my knowledge of parasitology.
- Good idea; worked well.
- Great concept, well done on limited budget.



Lisa Jones, Kate Miller and Wendy Relf deliver Network outreach programmes throughout the year

Outreach Presentations and Activities

In total Network Participants were involved in over 49 outreach presentations and activities across Australia during 2009. 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. Outreach activities by Network participants are listed below:

Mike Bull gave talks to The University of the Third Age The SA Herpetology Group and The Field Naturalists Society

Kathy Andrews gave a talk for QIMR Public Seminar/Forum "Mosquito and man: an unhealthy relationship" entitled: "Drugs against malaria"

Christian Engwerda was a participant in the Spotighting Careers in Indigenous Health and Science Programme at QIMR, October, 2009. Chris also designed and supervised science projects for year 6 and 7 students and gave a

Media and Outreach cont.

presentation to Prep students at New Farm State School, Brisbane, Australia, September, 2009.

Michael Good was very involved in Outreach activities in 2009 including:

- '2020 Australia: priorities for prevention in chronic disease in Queensland', Co-chair, 2020 Queensland Forum on Health (Springfield), 26 March
- Welcome and Overview, Public Forum - Mosquito and Man: an unhealthy relationship, QIMR, 27 April
- Welcome and Overview, Griffith Medical Research College 2009 Retreat, South Brisbane, 28 April
- Welcome Address, High School Students Lecture Series, QIMR, 29 April
- 'The promises and challenges in developing new vaccines, with a focus on diseases of the developing world', invited Lecturer, Public Lecture - World Day of Immunology 2009, ANU, Canberra, 29 April
- NHMRC Career Development Workshop, Canberra, 9 July
- Presentation on promises of stem cell research, Order of Malta, Brisbane, 18 July
- Prevention and early intervention approaches to tackle chronic diseases", Address to Social Development Committee Inquiry into Chronic Diseases, Parliament House, Brisbane, 4 August
- 'Vaccines for the developing world -status of rheumatic fever', Invited speaker for the Barbara Ell Seminar Series, Victor Chang Cardiac Research Institute, Sydney, 7 August
- 'Recent developments in QIMR Research', Kowloon Rotary Club, Hong Kong, 7 October
- 'Progress on the NPC Immunotherapy Study', Dynasty Club, Hong Kong, 9 October
- 'Developing vaccines for the world's poorest', Warren Jones Oration, Fremantle Hospital Medical Research Foundation, Perth, 30 October
- 'The importance of clinical leadership in improving health care', invited speaker, NHMRC NICS Implementation Fellows Graduation, Brisbane, 24 November
- 'Contributions of women to the research efforts and support of research at QIMR', invited speaker,

International Women's Day Luncheon Hosted by the Queensland Police Service, Brisbane, 9 March

- Progress with malaria vaccines. Are we learning from history?', invited Keynote speaker, NIAID Workshop: Immunology of Malaria, Bethesda, Washington, USA, 16-17 March

Alan Lybery gave presentations to Brunswick River Action Group on introduced parasites of freshwater fishes and to the Department of Water, Department of Fisheries, Department of Environment and Conservation on freshwater fish parasites.

Jenefer Blackwell was yarning with Martu people of Wiluna about ear health and metabolic diseases in Aboriginal communities. She also was engaged with children of Karalundi Aboriginal Education Centre (Meekatharra, WA) on risk factors for runny ear and metabolic diseases.

Barbara Nowak gave numerous presentations to salmon industry in Tasmania and Southern bluefin Tuna industry in South Australia, and presentations to Intervet Schering Plough UK June 2009 and to the salmon industry from Scotland, Norway and Ireland, Scotland, February 2009

Katja Fischer ran a Workshop for Indigenous High school students 'Spotlighting Careers in Science and Indigenous Health', August 2009

Dave Kemp gave two presentations to the Rotary Club Australia.

Leslie Chisholm in her capacity as Collection Manager of the Australian Helminthological Collection attended a South Australian Museum Road Show to Millicent and Mount Gambier, South Australia, 2 – 4 December, 2009.

David Blair co-organised and participated in a workshop on necropsy techniques for sea turtles, University of Queensland, 20 Feb 2009. This was in association with the 29th Symposium on Sea Turtle Biology and Conservation, 17-19 Feb 2009 in Brisbane

Deborah Holt participated in Science Week 2009 interactive presentations, CSIRO campus, Berrimah, NT. CSIROs Cutting Edge Lecture Series 2009, Charles Darwin

Media and Outreach cont.

University.

Jake Baum was a speaker at High Resolves Initiative Summit 2009 a not-for-profit, non-religious educational program that seeks to motivate high school students to view themselves as purposeful global citizens and to acquire the skills they will need to lead their community. He was a speaker at Youth ANZAAS (Australian & New Zealand Association for the Advancement of Science) Forum promoting science research to Year 10-12 students. July 2009. Jake was also internationally selected by WHO/Gates Foundation to join the Young Investigator Group of MalERA, a global initiative tasked with identifying barriers to moving research into action towards malaria eradication. Boston, USA. October 8th-9th 2009.

Robert Adlard participated in ScienceWeek 2009: Parasitology on the floor; public gallery interaction with school groups and general public, display and research at the Queensland Museum SouthBank, Brisbane.

Robin Anders gave a talk on malaria to Ivanhoe Grammar School Year 9 Outreach Program, 3 August, 2009.

Brian Kay carried out a "Temporary Advisor" task in 2009 for WPRO and he and his WHO colleagues continued to carry out a Year 4 Program Evaluation meeting in Ho Chi Minh City during July 2009 and several dengue risk workshops.

In June 2009, **Professor Brian Kay** acted as Expert Panel Chair to present a national evaluation of the problem of emerging infectious diseases in Australia and regionally. This was presented to the Prime Minister of Australia and the PM's Science, Engineering and Innovation panel.

During the year, **Drs L Hugo, J Jeffery and T Hurst** gave lectures and participated in two secondary schools visitation programs involving 900 students.

Dr T Hurst continued to act as the Mosquito and Arbovirus Research Committee, Inc. scientist servicing needs of Local Government practitioners, and attended and spoke at 3 MARC, Inc meetings also attended by Dr P Ryan and Prof B Kay (as President).

Vern Bowles gave a presentation to Grade 4 school girls at Korowa Girls School in Melbourne around parasites and head lice.

Brendan Crabb was a board member, Gene Technology Access Centre, which has been heavily involved in the Outreach associated with the upcoming ICOPA XII meeting in August 2010.

David Jenkins presented at the Livestock Health and Pest Authority Annual regional Animal Health meeting (Goulburn) on intestinal worms of public health and financial importance in rural domestic dogs.

Media Reports

In total, 37 stories promoting the ARC/NHMRC Research Network for Parasitology participants were reported in the media in 2009. In addition to radio and TV interviews and newspaper articles, some of our Network scientists have been featured in documentaries and film.

Cosmos, Australia's #1 Science Magazine, issue 29 Oct/Nov 2009 (<http://www.cosmosmagazine.com>) features six images from our "Parasites in Focus" exhibition. Network Malaria researchers, **Michael Good** (QIMR), **Rowena Martin and Kieran Kirk** (Australian National University), **Alan Cowman** (Walter and Eliza Hall Institute), **Robin Anders** (La Trobe University) and visiting ASP lecturer **Richard Carter** (University of Edinburgh) featured in *The Weekend Australian* (26-27 September 2009) in an interview by Helen Francombe. Read the full news story online <http://www.theaustralian.news.com.au/story/0,25197,26119541-23289,00.html>

Rowena Martin and Kieran Kirk, Australian National University, published their paper "Chloroquine Transport via the Malaria Parasite's Chloroquine Resistance Transporter" Rowena E. Martin, Rosa V. Marchetti, Anna I. Cowan, Susan M. Howitt, Stefan Bröer, Kieran Kirk, 25 September 2009, Vol 325, Science. An interview with **Rowena** by Wendy Zukerman appeared in *The Australian, Higher Education* October 7, 2009 "Biologist probes parasite's progress". Read

Media and Outreach cont.

The Australian news story online <http://www.theaustralian.news.com.au/story/0,25197,26173986-12332,00.html>

Rowena Martin additionally featured in the following media stories and her research is highlighted above as one of our "Researcher news" profiles:

- Malaria drugs may get new lease of life, *ABC online*.
- ANU study may lead to new malaria drug, the *Canberra Times*.
- Malaria drug to make a comeback?, the *Australasian Science Magazine*.
- Ground shifts in malaria fight, *The Australian*.

Annette Dougall was reported on the local news in Teresina, Piaui, Brazil during her Network Researcher Exchange Travel Award.

Mike Bull appeared on Channel 7 News.

Leann Tilley made several media appearances:

- La Trobe Bulletin, Apr 2009. "Beautiful on the inside."
- Interview with Robin Williams, *ABC Science Show*. **Leann Tilley / Andrew Peele** (Coherent x-ray science; malaria).
- *The Economist*. Nov 2009 (Graham O'Neill), "Blood wars" (Malaria research in Australia).
- Comment on Kelly/Hinrichs et al publication *Nature* (2009) for *The Oregonian* Discovery of dual function acridones as a new antimalarial chemotype. http://www.oregonlive.com/news/index.ssf/2009/04/portland_scientists_report_maj.html
- Video on La Trobe University's seven research strengths, titled 'Infinite Possibilities Through Research' (Nov 09). The research video on 'Molecular Sciences' features interviews with **Professor Nick Hoogenraad, Professor David Vaux, Professor Leann Tilley**.

Nigel Beebe was interviewed on *ABC radio* April 2009 after his PLoS NTD publication on climate change and dengue.

Alexandra Grutter and her research team featured in the

following media stories:

- *New York Times*. Remarkable creatures: For fish in coral reefs, it's useful to be smart. **Sean B. Carroll**. Oct 20, 2009 http://www.nytimes.com/2009/10/20/science/20creature.html?_r=1
- *The Sydney Morning Herald*. Colourful way to fish for clients. **Debora Smith** 23/09/09. <http://www.smh.com.au/environment/colourful-way-to-fish-for-clients-20090822-eued.html>
- *National Geographic News*. Cleaner Fish Wear "Uniforms" to Advertise, Avoid Danger. **Christine Dell'Amore**, 20/08/09 <http://news.nationalgeographic.com/news/2009/08/090820-cleaner-fish.html>
- *Australasian Science*. Cleaner fish uniforms stand out. August 2009. **Stephen Lutz**.
- *Thaindian News*. Cleaner fish wear 'uniforms' to signal their professions to clients 21/08/09. http://www.thaindian.com/newsportal/health/cleaner-fish-wear-uniforms-to-signal-their-professions-to-clients_100235665.html
- *Physorg.com*. New research decodes the secret language of the sea. 09/07/09 <http://www.physorg.com/news166346318.html>.

Ian Whittington and his research team featured in the following media stories:

- **Hutson K.S. & Hutson G.D.** 2009. In search of Charles Darwin. Selected readings from Geoffrey Hutson's Diary. The South Australian Museum & The Royal Society of South Australia, 12 March 2009.
- **Kate Hutson** 2009. How to be a parasitologist. Junior Field Naturalists Society, Adelaide, 28 May, 2009.
- **Hutson K.S. & Hutson G.D.** 2009. In search of Charles Darwin. More selected readings from Geoffrey Hutson's Diary. The South Australian Museum & The Royal Society of South Australia, 12 November 2009.

Brown Besier (2009) Scour management. Proceedings (online) *Agribusiness Update* Perth (July 2009).

Jan Slapeta and his research team featured in the following media stories:

Media and Outreach cont.

- **Hartigan. A, Rose. K, Slapeta. J**, Myxozoan Parasites in the Green and Golden Bell Frog, Australian Registry of Wildlife Health (Jan 2009), Taronga Zoo.
- **Hartigan. A, Rose. K, Slapeta. J** (2009) Myxozoan Parasites and Endangered Australian Frog species Dept. Environment and Climate Change, Hurstville, 25/6/09.

Brendan Crabb featured in the following media stories:

- Radio National PM & 774 ABC, Nature article A newly discovered protein export machine in malaria parasites.
- ABC "Can We Help" Program 14/08/09.
- Channel 9 news "One Man Epic" Tom Smithergale's walk across Antarctica - Nov 2009.

David Jenkins featured in the film documentary "Bite Me" with Dr Mike Leahy (Episode 5) "Outback" 947 mins) 2009; Natural History New Zealand Ltd, New Zealand.

David Jenkins also featured in the following media stories

- Radio interview with a reporter from *Triple J* (wild dogs/hydatids).
- Radio interview with Tim Holt ABC South coast (wild dogs/hydatids).
- ACT Government media officer (intestinal parasites in dogs in municipal dog pounds, risks and solutions).

Michelle Power, parasitologist at Macquarie University featured in the *Sydney Morning Herald* online news 30/03/09 in a report by Richard Macey: "Genetic testing has revealed that Sydney's recent *Cryptosporidium* outbreak in swimming pools may have stemmed from a single infected person." "We have analysed about 250 samples from the current outbreak, and they are all the same strain of *Cryptosporidium hominis*," Michelle said. "If it had originated from different sources we would have expected to see multiple strains. When sporadic cases, reported over the past 12 months, were analysed they identified 24 strains, involving both the human and animal species," Michelle reported. For the full story in the *Sydney Morning Herald* online news click on the following link <http://www.smh.com.au/national/crypto-clue-one-person-to-blame-for-outbreak-20090330-9h2q.html>

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.

The contribution of ARC/NHMRC Research Network for Parasitology Network to Australia's fundamental, strategic and applied research effort is evident in the quantity and quality of publications listed in Appendix 1 for the research priorities identified at the point of origin of the Network to address Australia's National Research Priorities. With regard the Network more directly, 2009 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 131 early career parasitology researchers. Both these strategies are now paying off with young researchers publishing their research undertaken on Network funding 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 2010

Future Planning

In July 2009, the Australian Society for Parasitology Inc., in the absence of continuing ARC and NHMRC funding for Research Networks, took the momentous decision to take over funding of the Research Network for Parasitology for, at least, the next 2 years. Network staff will be retained and, in addition to managing and administering Network Researcher Exchange Travel Award Scheme, JD Smyth grants, ASP Student Travel Awards and the ASP Invited Lectureship Grants, and raising the awareness of Australian parasitology with the general public through the development of outreach initiatives, the Network will be able to further the strategic development of Australian parasitology research, with particular emphasis on the development of an "Australian College of Parasitology". This decision has also prompted a major Strategic Planning exercise by the Society, with the College representing a major new initiative in its future.

Below is an outline describing the possible strategic development the Research Network for Parasitology into the "Australian College of Parasitology" and answers to the following questions:

- [1] What will the Australian College of Parasitology do?
- [2] Who does the Australian College of Parasitology serve?
- [3] How can the Australian College of Parasitology excel?

What will the Australian College of Parasitology do?

The mission of the Australian College of Parasitology is to:

- focus and enhance Australia's 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 College will achieve this through fostering and financing collaborative Australian parasitology research by:

- promoting national and international research collaborations to maximise access to key infrastructure, equipment, expertise and supervision and to encourage the growth of new relationships;
- enhancing communication within the Australian parasitology research community via production of newsletters, annual reports and the organisation of conferences, workshops and other events;
- promoting Australian parasitology research to the general public through outreach activities and public events;
- providing mentoring, training and grant writing support for young investigators;
- creating research leadership and management opportunities for young investigators; and

Who does the Australian College of Parasitology serve?

The vision for the Australian College of Parasitology is to create a world-class centre for Australian parasitology researchers to celebrate and promote Australian parasitology, to support collaborative research – both within Australia and internationally – and enhance parasitology career opportunities for Australian researchers.

The Australian College of Parasitology will exist for all Australian parasitology researchers.

How can the Australian College of Parasitology excel?

Goals and Objectives

Short-term goals and objectives (within 2 years)

The Australian College of Parasitology will promote the research careers of College alumni members and provide opportunities for further career development and research collaborations by:

- enhancing communication and foster collaboration by maintaining a website that provides information on Australia's parasitology research effort, producing newsletters and annual reports, and by organizing conferences, workshops and other

Activities and Strategies cont.

events that promote Australia's parasitology research (including raising of external sponsorship for these events);

- fostering and financing 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;
- providing mentoring, training and grant writing support for young investigators.

Medium-term goals and objectives (within 5 years)

The Australian College of Parasitology will:

- seek and establish cash and in-kind funding to ensure the long-term future and development of the Australian College of Parasitology;
- create a postdoctoral fellowship scheme with clear cross-institutional, co-supervisory arrangements;
- maintain current international collaborations and develop more links with international researchers to aid the future of Australian Parasitology research;
- promote multi-disciplinary research collaborations that result in promotion and funding of Australian Parasitology research.

Long-term goals (within 10 years)

The Australian College of Parasitology will:

- 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
- develop an intensive, month-long, postgraduate course in parasitology to be held annually or biannually and mirror the highly esteemed "Biology of Parasitism" course, which is run each year at Woods Hole (USA).

How will the Australian College of Parasitology achieve these goals and objectives?

- The college will be made up of numerous Participating Organisations (universities, research institutes and the ASP), contributing cash and in-kind funding – all funds are held and administered centrally.
- College-funded staff will include a Director, Communications Coordinator and Administration Officer.
- Communication will be via a website, bimonthly newsletters, annual report, annual conferences and Council Meetings of the ASP.

Budget (5 years)

The following is a possible 5 year funding scenario. An "ideal" situation is presented but it should be clearly noted that the scope, and therefore the budget, of the Australian College of Parasitology can be varied considerably by, for example, reducing the ambitions for the number of Researcher Exchange Awards, Postdoctoral Fellowships, Tenure Track positions and Training Course positions available.

Income

A combination of Australian federal and state government funding, co-investment by participating organisations (ie, universities and research institutes), sponsorship by industry and philanthropic partners, and public donations will be necessary to finance the Australian College of Parasitology.

Activities and Strategies cont.

Expenditure

Salaries (Fulltime Director, Communications and Strategic Development Coordinator, Admin. Officer)	\$1,900,000
Researcher Exchange, Training and Travel Awards (30 per year @ ~\$20,000 each)	\$3,000,000
Annual Intensive Parasite Biology Training Course	\$500,000
Postdoctoral Fellowship Scheme (five new 3 year Fellowships – including salary and operating costs – to be awarded in each of years 1, 2 and 3 of the College)	\$6,000,000
Tenure Track Scheme (three new 3 year salaries to be offered in each of years 1, 2 and 3 of the College)	\$3,240,000
Conferences and workshops (to be self-sustaining events run on a cost-recovery plus externally-sponsored basis but organised by School staff)	nil
Outreach and Office Costs	\$200,000
Committee Meetings	\$100,000
TOTAL	\$14,940,000

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.

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

As described above, the Australian Society for Parasitology Inc., now funds the Research Network for Parasitology with a view to developing an Australian College of Parasitology, with ambitious plans for supporting Australian parasitological research.

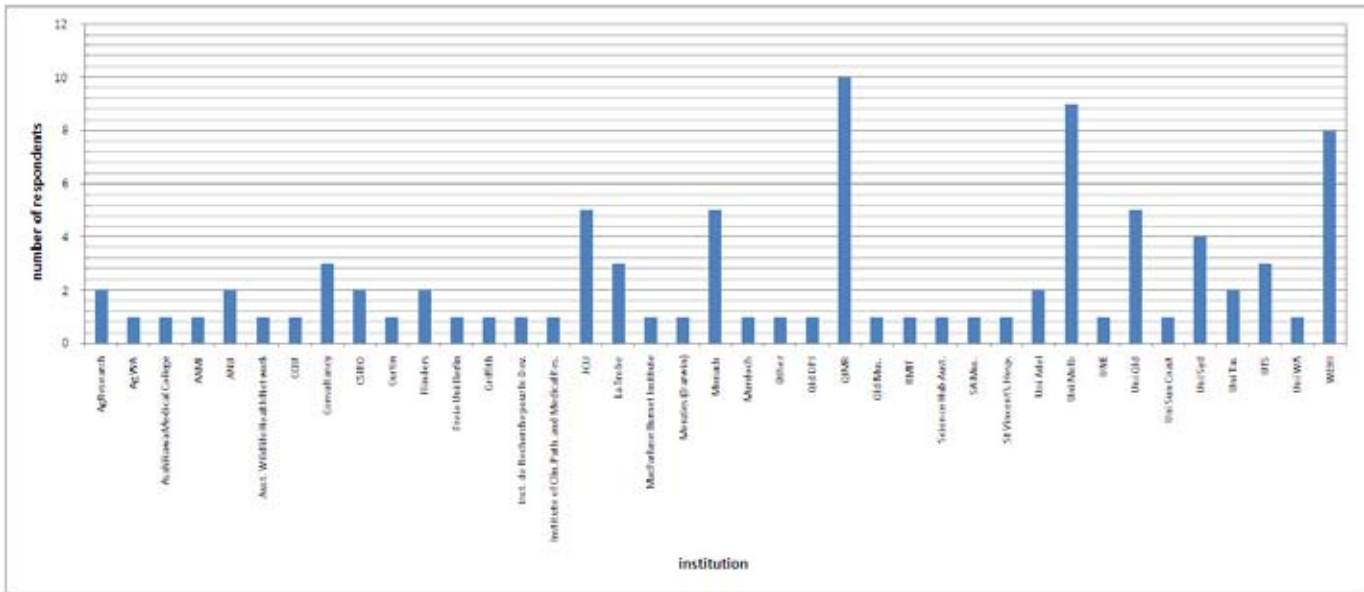
2009 ARC/NHMRC Research Network for Parasitology Annual Survey

Participant Information

This survey was made available to the Network participants to complete online. Responses were monitored over four weeks and a total of 90 Network participants responded. Respondents were self-selected.

Survey respondents represented 41 different institutions with the highest number being based at QIMR 11%, The University of Melbourne 10%, Walter and Eliza Hall Institute of Medical Research 9%, and James Cook University, Monash University and University of Queensland each 6% (Figure 1).

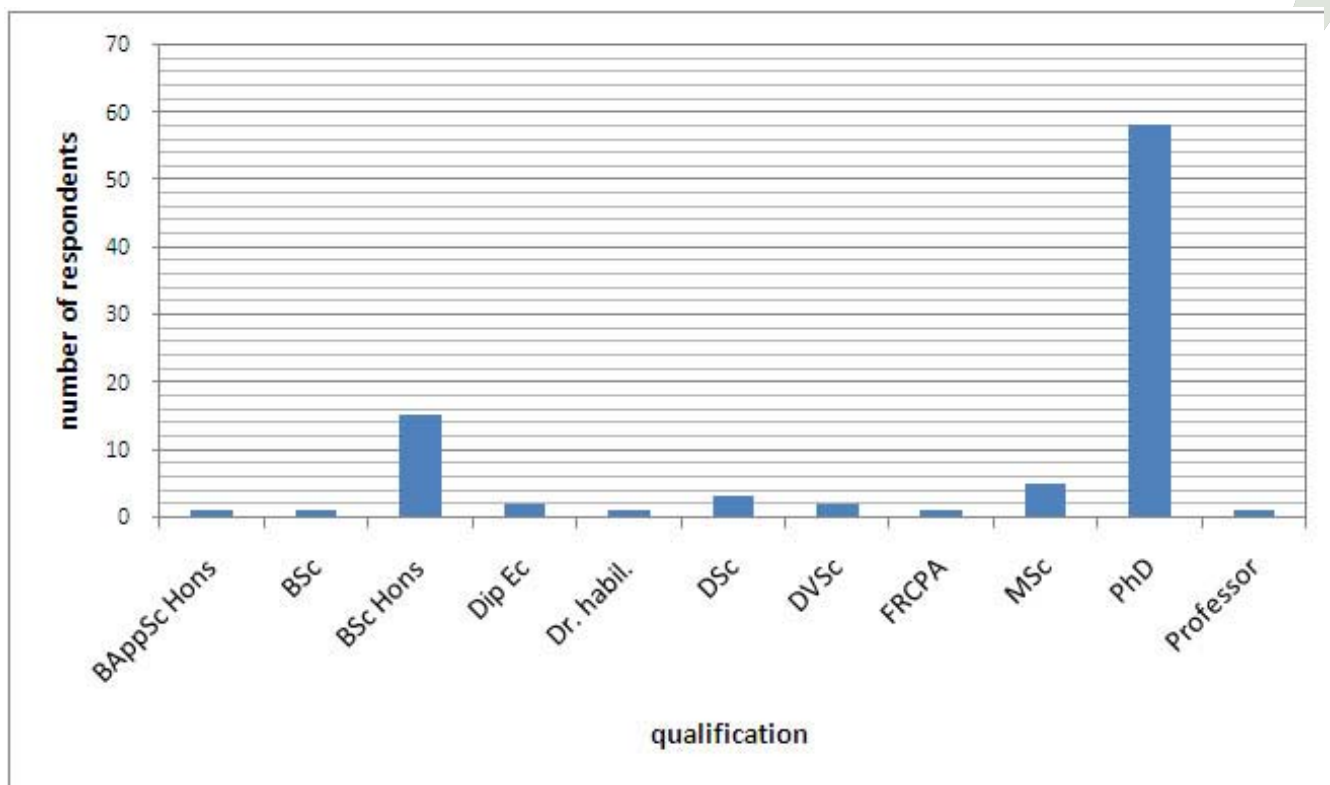
Figure 1: Network survey for 2009 – respondents by institution (n=90)



Annual Survey cont.

When asked about their highest qualification the majority of survey respondents reported having a PhD (64%) or BSc Hons (17%) (Figure 2)

Figure 2: Network survey for 2009 – highest qualification of respondents (n=90)

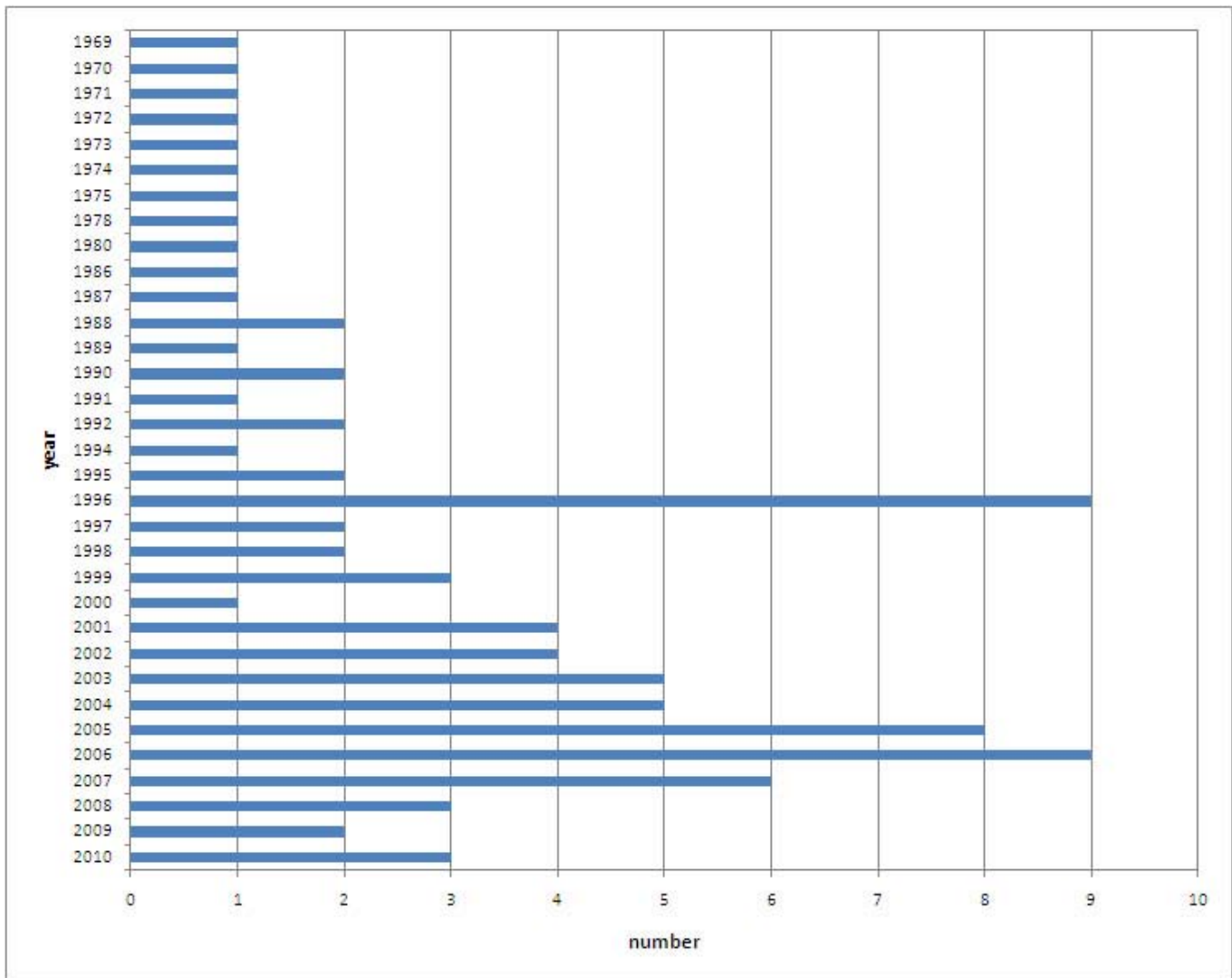


The responses to “year gained highest qualification” spanned 41 years with the most recent being gained in 2010 and the earliest in 1969, the majority were gained between 1996 and 2010 (Figure 3). Of the 88 survey respondents, 35 were identified as early career researchers (10 years or less since gaining 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 55 years (Figure 4). Both male and female respondents were fairly evenly represented, with more males (57%) than females (43%) (Figure 5).

Annual Survey cont.

Figure 3: Network survey for 2009 – respondents by year of their highest qualification (n=88)



Annual Survey cont.

Figure 4: Network survey for 2009 – respondents by age range (n=89)

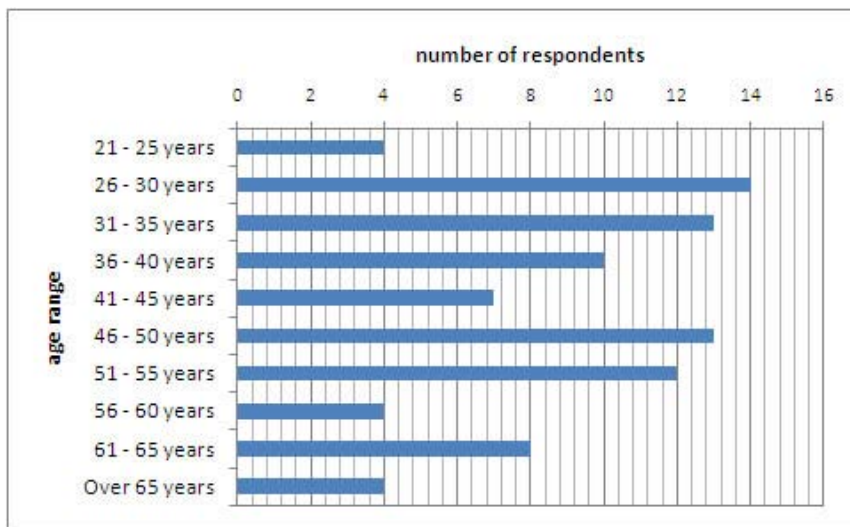
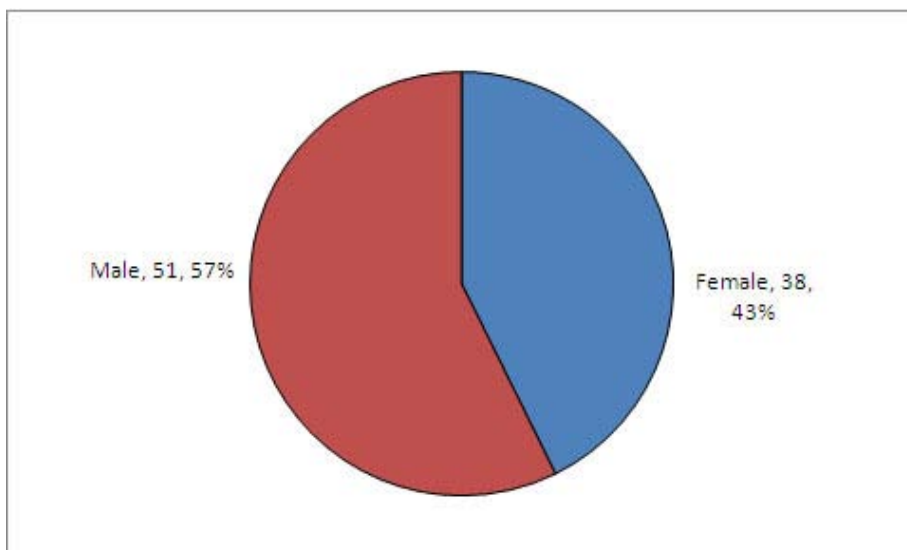


Figure 5: Network survey for 2009 – respondents by gender (n=89)

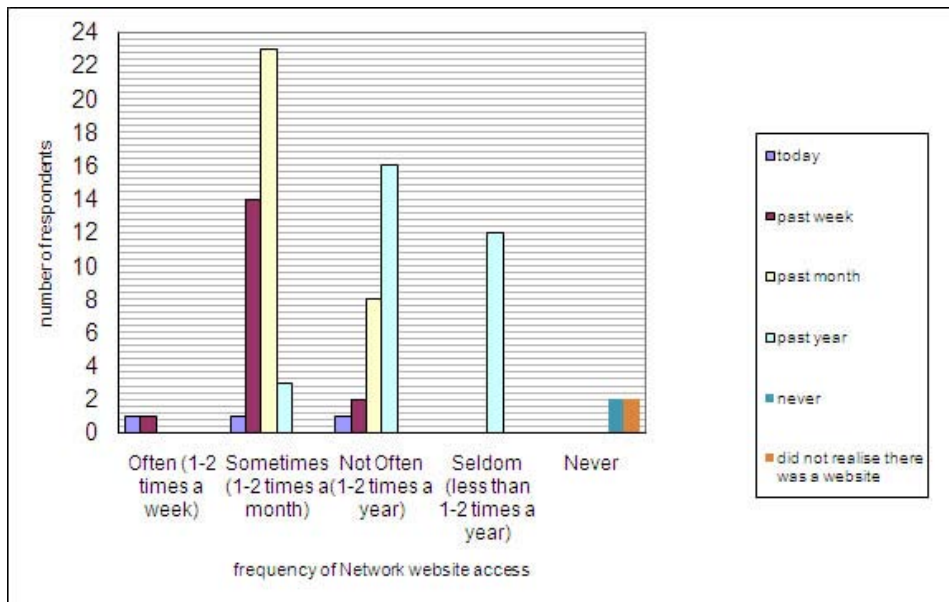


Annual Survey cont.

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 2009 – respondents who accessed the Network website sometime in the past year by frequency of access (n=86)



Annual Survey cont.

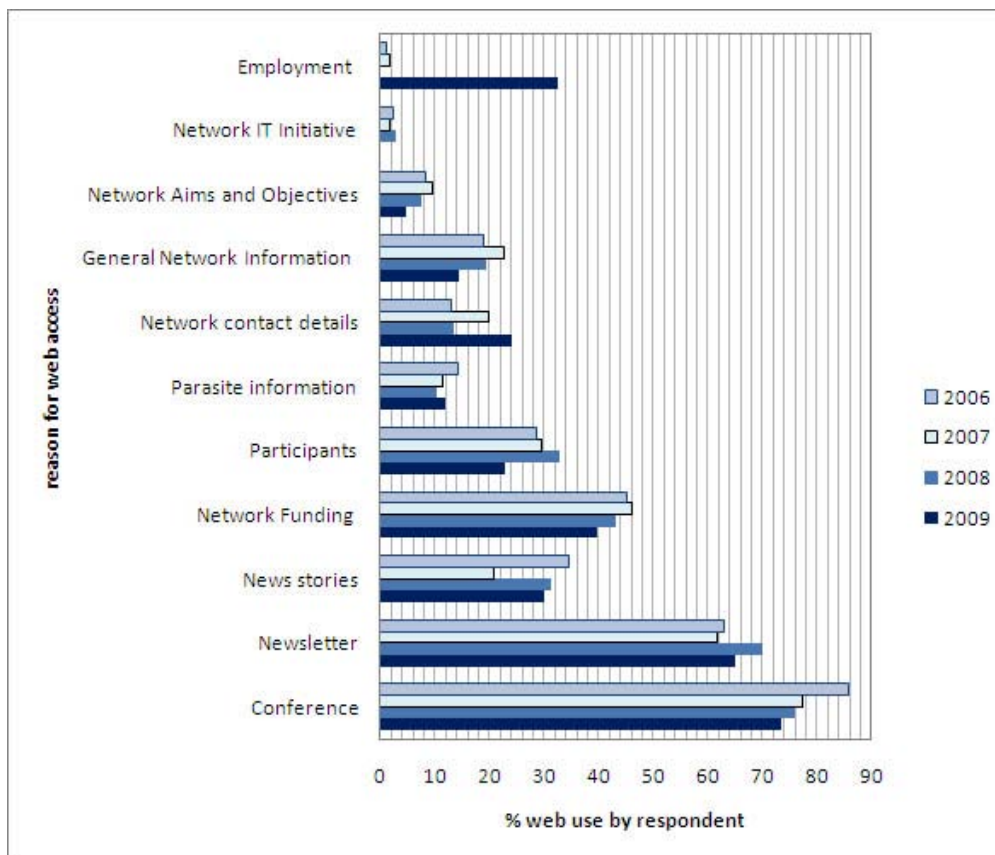
Participant Information

Network Survey respondents who had accessed the website (n=86) reportedly did so for:

- obtaining conference information (73%);
- reading the Network Newsletter (65%);
- finding out about Network Funding available for participants (40%); or
- finding out information about job opportunities or studentships (33%).

Figure 7 shows a complete list of reasons for accessing the Network website and a comparison between Network survey for 2006, 2007, 2008 and 2009 shows very similar results. In 2009 there was a marked increase in the number of people accessing the website to look at job vacancies and PhD opportunities (respondents were able to select more than one option and list others).

Figure 7: Network survey for 2009 – website access by respondents, comparison between 2006(n=84), 2007(n=115), 2008(n=66) and 2009 (n=83)



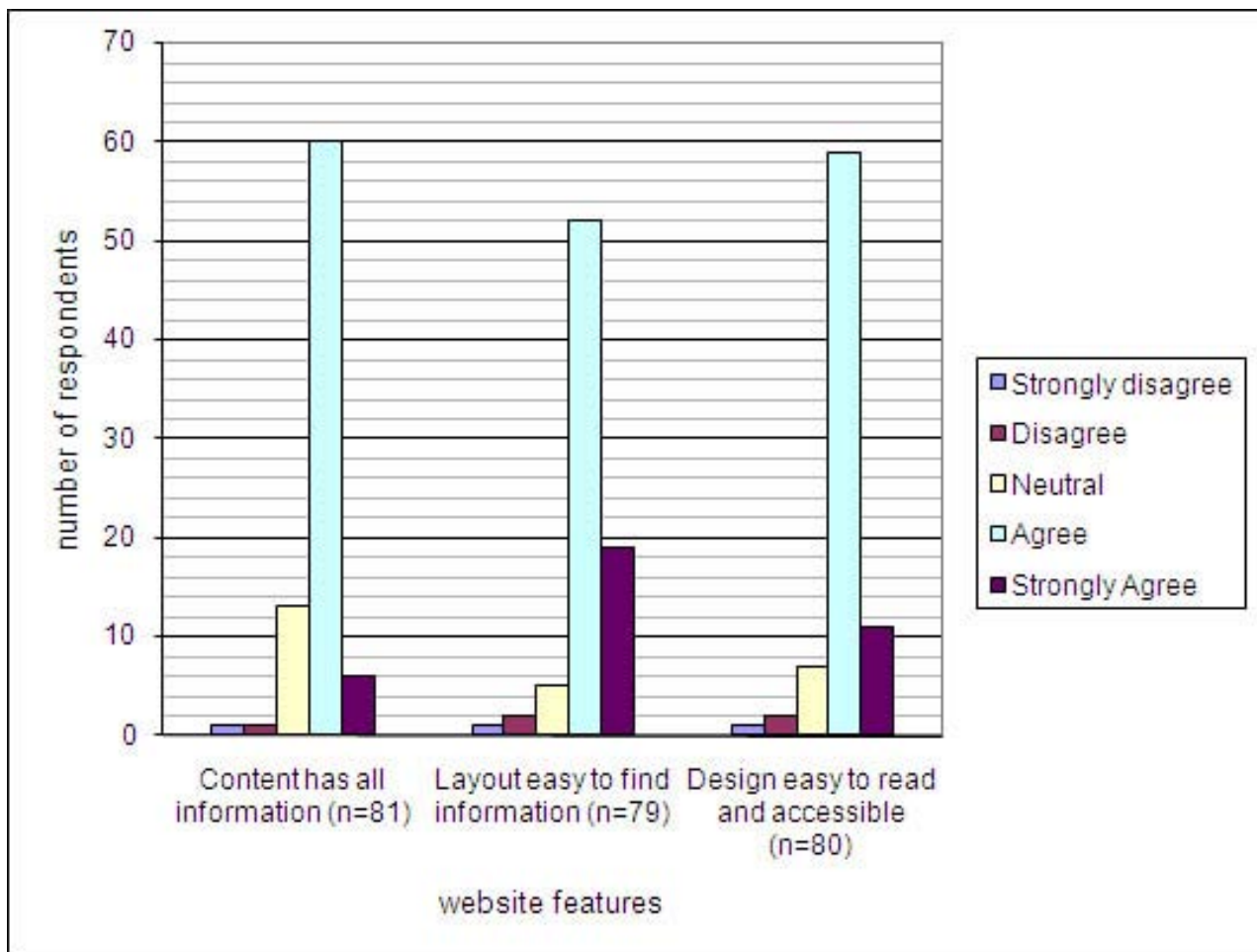
Annual Survey cont.

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. (81 Responses)
2. The layout of the website enabled me to find the information I was looking for easily. (79 Responses)
3. The website design means that information is accessible and easy to read. (80 Responses)

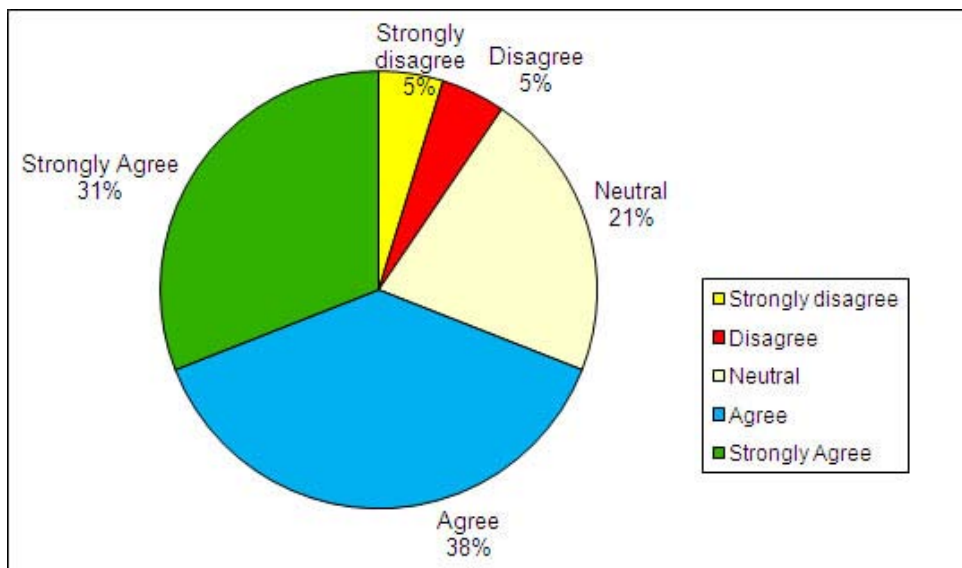
Figure 8 shows that a majority of respondents either agreed or strongly agreed with each statement.

Figure 8: Network survey for 2009 – respondents comment on website content, layout and design



Annual Survey cont.

Figure 9: Network survey for 2009 – respondents and their agreement with the statement that being a Network Participant is beneficial for their career (n=84)



Overall view of the Network

When asked about being part of the ARC/NHMRC Research Network for Parasitology, 69% either agreed or strongly agreed with the statement that being a part of the Network was beneficial for their career, while 21% were neutral, and only 9% disagreed or strongly disagreed. (Figure 9)

Network Survey Respondents were asked, "As the Network moves into the future and takes on a new function within the ASP, what changes would you like to see made to the activities Network?" and suggestions for additional activities/schemes that the Network should be involved with. Forty six respondents gave suggestions and comments, an overwhelming majority were positive and constructive comments and suggestions, which include the following:

- Continued focus on Students and early career scientists
- I'm happy with how the Network works, there were a few projects which didn't seem to be that beneficial, but that happens everywhere. I think it's

good that ASP membership is now required from people applying for funding

- Primarily none. Try to maintain all of the previous momentum and initiatives but on the tighter budget!
- The education and marketing arm of the ASP
- Ensuring greater linkages between universities, government agencies and other agencies involved in parasite research.
- Expansion of funding possibilities to include support for research as well s travel costs for researcher exchanges. Ultimately, it would be great if the Network could also provide support, on a competitive basis, for fellowships for early career researchers. An advanced training course in parasitology would also be a great new initiative.
- I use the network as a source of information about what other people are doing, it is not essential to my work, but it helps keep me in context.

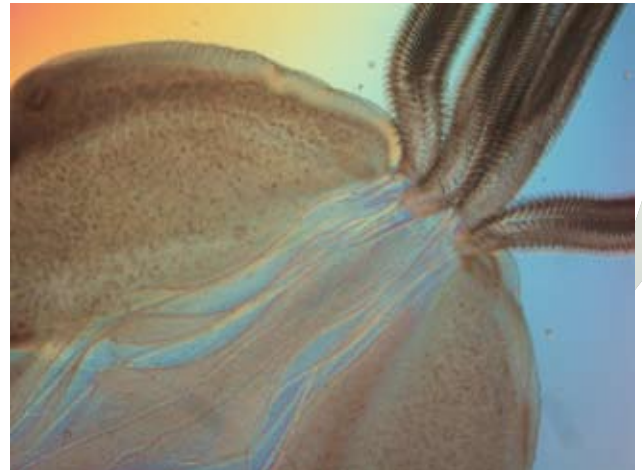
Annual Survey cont.

- Include more of medical (human) parasitology
- I feel that competitive award of small, seed grants (i.e. up to about \$30,000) would be very beneficial for early career researchers and researchers stepping into the parasitology field. This would aid development of projects to a level suitable for applying for major from e.g. NHMRC and ARC.
- It would be nice to facilitate regional catch up "meetings" ie. researchers in Brisbane (for example) area have a meeting about current work/ possible equipment sharing/how they can work together.
- That the proactive work the Network undertook in communicating parasitology research activities to both Australian scientists and the general public is continued.
- Develop a stronger clinical focus
- I think the Network activities have been totally appropriate and are only constrained by funding
- One or two day workshops held during the year.
- As per survey regarding ASP's future distributed last year, communication is important - frequency, content and medium perhaps should be considered. The mentoring scheme is a great initiative and should be retained.
- Needs to engage more with end-users, stakeholders
- Mentoring
- Funding for the mentorship program. More workshops/mentoring of ECRs
- The Mentoring program I think is very good
- If possible, augment number of grants to students for research travel and exchange as well as increase research funds for researches aimed of helping developing Asian countries. Also if possible, extend travel research grants/trainings for parasitologists in developing Asian countries. Thank you!
- I'm not sure if it is feasible, but perhaps promoting any relevant seminars/visiting speakers in parasitology in each city (Melbourne for me).
- Workshops on latest techniques/ issues just before the start of ASP Annual conference
- Travel funding and research funding
- Let's see some fundamental parasitology supported. Parasitology in Australia is at a critical stage. The ASP, by pulling in 'high end' parasitologists like malaria people, is causing some disenchantment among the ranks. This scenario has caused major ructions in similar societies elsewhere. Let's hope it doesn't do similar here.
- Early career support and mentorship
- Financial support for young scientists, travel grants and high profile international speakers at the conference
- More workshops like training are necessary for students.
- The activity I would like to see is the network winding itself up.
- Travel grants, PhD prizes or scholarships
- Outreach activities, conference expertise, web maintenance
- Support for visiting scientists and support for local scientists to visit other overseas institutions. We are isolated and a small discipline to manage alone and need a global perspective to survive.
- Student initiatives, Fact Sheets on Current research and parasites, collaboration between human health and veterinary health researchers.
- Researcher exchanges and mentoring schemes. And, of course, the continuation of the high quality conference we've grown used to under the Network.
- Support for students. Support for travel exchange, overseas collaborations etc.
- Peer review of grants before submission, mentoring

Annual Survey cont.

program

- Early career/student workshops
- Retain the Executive Officer paid position - mandatory to move initiatives forward. Retain or grow funding for lab exchange and conferences. Retain and expand links with other appropriate networks particularly overseas.
- More funding opportunities for senior post-docs.
- It's recently come to attention that one of the Queensland universities has begun an online course for entomology. Parasitology training in Australia is in decline. We should investigate whether an online course could also be established for parasitology and have it accredited for academic recognition as part of a post-grad diploma or undergraduate major
- Conferences funding for student travel grants
- Mentoring scheme and travel awards
- Funding, awards, mentorship, career development schemes, conferences (local and focused) to complement the general annual one.
- I think the travel award scheme is very valuable, and unique - and I think it would be of great benefit if this can be continued.
- Networking between different groups
- Workshops for students/early career researchers



Head of a trypanorhynch tapeworm, complete with tentacles. This parasite was found on a serranid fish on the Great Barrier Reef. Image courtesy of Rob Adlard, QLD Museum (Australia).

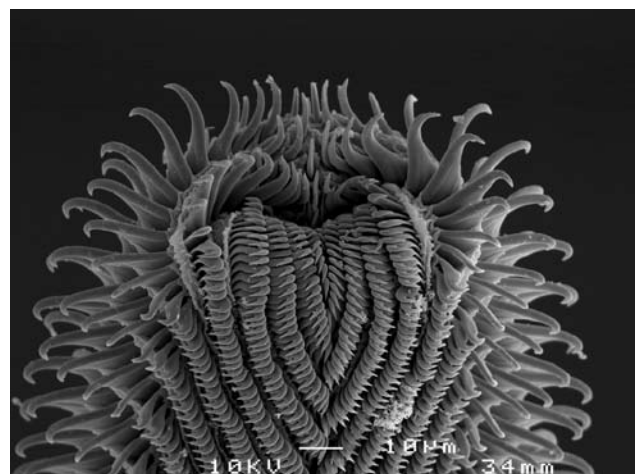


Image shows the tip of a tentacle of the parasite, Pseudotobothrium dipsacum. The spiny tentacles are used to attach to its host. Image courtesy of Bronwen Cribb, Centre for Microscopy & Microanalysis, University of Queensland & Ian Whittington, Monogenean Research Laboratory, SA Museum, Adelaide (Australia).

Statistical Snapshot 2009

- 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 388 of these Participants in 2009 and they were all fully eligible to benefit from the Network's co-sponsorship of an annual scientific research conference with the ASP and enjoy access to Network programmes and initiatives.
 - 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 323 such associates (additional to the Participants) receiving the Network Newsletter in 2009.
- Number of ECRs funded to do various activities;
 - 131 ECRs (including research students) were effectively given funding assistance to attend the Joint Conference of the ARC/NHMRC Research Network for Parasitology and ASP (The University of Sydney, NSW, July 2009) via the Network's subsidisation of this event.
 - 2 ECRs (including research students) were awarded Network Researcher Exchange, Training and Travel awards in 2009, representing 100% of all successful applications for funding.
- Number of workshops, conferences or seminars conducted;
 - One conference – the Joint Conference of the ARC/NHMRC Research Network for Parasitology & the ASP (University of Sydney, NSW, July 2009), attended by 240 researchers.
- 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 4 participants to attend international workshops and funded, or co-funded with the ASP, Elsevier, *Trends in Parasitology* and *The International Journal for Parasitology*, 8 international visitors to Australia (as invited lecturers to the Network Conference).
 - In total, 40 international visitors spent time in Australian parasitology groups during 2007 – they came from the UK (8), the USA (13), Switzerland (3), Iran (2), China, Israel, Thailand, Malaysia, Papua New Guinea, Spain, New Zealand, Malawi, Brazil, Italy, South Africa (all 1 each).
 - International conference attendances 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);
 - There were 37 reports in the media involving Network scientists in 2009 and more than 49 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;
 - 343 printed publications in total with 31 directly resulting from Researcher Exchange, Training and Travel Awards.
- Number of universities receiving funding;
 - Network Participants from 33 Participating Organisations were effectively funded to attend the Annual Conference of the ASP and the ARC/NHMRC Research Network for

Statistical Snapshot 2009 cont.

- Parasitology via the subsidisation of this event by the Network.
- Network Participants from 2 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>



'Parasites in Focus' exhibition



'Parasites in Focus' exhibition with virtual microscope "The microscopic world of parasites".

Register of Network Participants

NAME	INSTITUTION	ROLE IN NETWORK
A Auliff	Australian Army Malaria Institute, Qld	Student Participant
J Baker	Australian Army Malaria Institute, Qld	Student Participant
M Chavchich	Australian Army Malaria Institute, Qld	Participant - Postdoctoral Researcher
N Chen	Australian Army Malaria Institute, Qld	Participant - Postdoctoral Researcher
Q Cheng	Australian Army Malaria Institute, Qld	Participant - Senior Researcher
R Cooper	Australian Army Malaria Institute, Qld	Participant - Senior Researcher
M Edstein	Australian Army Malaria Institute, Qld	Participant - Senior Researcher
D Krause	Australian Army Malaria Institute, Qld/QIMR	Participant - Postdoctoral Researcher
D Shanks	Australian Army Malaria Institute, Qld	Participant - Senior Researcher
N Waters	Australian Army Malaria Institute, Qld	Participant - Senior Researcher
A Al'anazi	Charles Sturt University, Wagga Wagga Campus, NSW	Student Participant
M Ayton	Charles Sturt University, Wagga Wagga Campus, NSW	Participant
D Jenkins	Charles Sturt University, Wagga Wagga Campus, NSW	Participant - Senior Researcher
NC Sangster	Charles Sturt University, Wagga Wagga Campus, NSW	Participant - Senior Researcher
T Spithill	Charles Sturt University, Wagga Wagga Campus, NSW	Participant - Senior Researcher
J Wright	Charles Sturt University, Wagga Wagga Campus, NSW	Participant - Postdoctoral Researcher
RB Besier	Department of Agriculture Western Australia	Participant - Senior Researcher
S Binos	Department of Primary Industries, Victoria	Participant - Postdoctoral Researcher
J Zawadzki	Department of Primary Industries, Victoria	Participant - Senior Researcher, Management Committee Member
M Bull	Flinders University of South Australia	Participant - Senior Researcher
M Oorebeek	Flinders University of South Australia	Student Participant
S Godfrey	Flinders University of South Australia	Student Participant
D Blair	James Cook University, Qld	Participant - Senior Researcher
P Fromm	James Cook University, QLD	Student Participant
H Korner	James Cook University, QLD	Participant - Senior Researcher
W Melrose	James Cook University, Qld	Participant - Senior Researcher

Register of Network Participants cont.

NAME	INSTITUTION	ROLE IN NETWORK
L Skerratt	James Cook University, Qld	Participant - Postdoctoral Researcher
R Speare	James Cook University, Qld	Participant - Senior Researcher
L van Bonnel	James Cook University, Qld	Student Participant
T Abu-Bakar	La Trobe University Vic	Student Participant
C Adda	La Trobe University Vic	Participant - Postdoctoral Researcher
R Anders	La Trobe University Vic	Participant - Senior Researcher
J Casey	La Trobe University Vic	Participant - Postdoctoral Researcher
A Coley	La Trobe University Vic	Student Participant
M Dixon	La Trobe University Vic	Participant - Postdoctoral Researcher
M Foley	La Trobe University Vic	Participant - Senior Researcher
K Harris	La Trobe University Vic	Student Participant
N Klonis	La Trobe University Vic	Participant - Postdoctoral Researcher
P McMillan	La Trobe University Vic	Participant - Postdoctoral Researcher
A Maier	La Trobe University Vic	Participant - Postdoctoral Researcher
J Schloegel	La Trobe University Vic	Student Participant
L Tilley	La Trobe University Vic	Participant - Senior Researcher
J Burgess	La Trobe University Vic	Student Participant
S Cotton	La Trobe University Vic	Student Participant
M Crespo	La Trobe University Vic	Student Participant
S Deed	La Trobe University Vic	Student Participant
Y Fu	La Trobe University Vic	Student Participant
E Hanssen	La Trobe University Vic	Participant - Postdoctoral Researcher
R Masciantonio	La Trobe University Vic	Student Participant
P Mehrpouian	La Trobe University Vic	Participant - Postdoctoral Researcher
K Munro	La Trobe University Vic	Student Participant
V Murphy	La Trobe University Vic	Student Participant

Register of Network Participants cont.

NAME	INSTITUTION	ROLE IN NETWORK
K Parisi	La Trobe University Vic	Student Participant
M Sandeman	La Trobe University Vic	Participant - Senior Researcher
H Schwartz	La Trobe University Vic	Student Participant
J Yeoman	La Trobe University Vic	Student Participant
K Vingas	La Trobe University Vic	Student Participant
A Barry	MacFarlane Burnet Institute, Vic	Participant - Senior Researcher
B Crabb	MacFarlane Burnet Institute, Vic	Participant - Senior Researcher
P Gilson	MacFarlane Burnet Institute, Vic	Participant - Senior Researcher
K Leykauf	MacFarlane Burnet Institute, Vic	Participant - Postdoctoral Researcher
A Luga	MacFarlane Burnet Institute, Vic	Student Participant
J Reeder	MacFarlane Burnet Institute, Vic	Participant - Senior Researcher
L Scultz	MacFarlane Burnet Institute, Vic	Participant
M Power	Macquarie University, NSW	Participant - Postdoctoral Researcher
L Waldron	Macquarie University, NSW	Participant
N Anstey	Menzies School of Health Research, NT	Participant - Senior Researcher
B Currie	Menzies School of Health Research, NT	Participant - Senior Researcher
C Darcy	Menzies School of Health Research, NT	Student Participant
A Dougall	Menzies School of Health Research, NT	Student Participant
D Holt	Menzies School of Health Research, NT	Participant - Postdoctoral Researcher
R Jayaraj	Menzies School of Health Research, NT	Participant - Postdoctoral Researcher
W Mahmood	Menzies School of Health Research, NT	Student Participant
K Mounsey	Menzies School of Health Research, NT	Participant - Postdoctoral Researcher
K Piera	Menzies School of Health Research, NT	Participant
R Price	Menzies School of Health Research, NT	Participant - Senior Researcher
R Ramamoorthi	Menzies School of Health Research, NT	Participant
L Viberg	Menzies School of Health Research, NT	Participant

Register of Network Participants cont.

NAME	INSTITUTION	ROLE IN NETWORK
S Walton	Menzies School of Health Research, NT	Participant - Senior Researcher, Management Committee Member
T Woodberry	Menzies School of Health Research, NT	Participant - Postdoctoral Researcher
C Black	Monash University, Vic	Participant - Postdoctoral Researcher
S Charman	Monash University, Vic	Participant - Senior Researcher
W Charman	Monash University, Vic	Participant - Senior Researcher
B Cooke	Monash University, Vic	Participant - Senior Researcher
R Coppel	Monash University, Vic	Participant - Senior Researcher
S Gohil	Monash University, Vic	Student Participant
H McWilliam	Monash University, Vic	Student Participant
E Meeusen	Monash University, Vic	Participant - Senior Researcher
D Piedrafita	Monash University, Vic	Participant - Postdoctoral Researcher
M Plebanski	Monash University, Vic	Participant - Senior Researcher
S Prickett	Monash University, Vic	Participant - Postdoctoral Researcher
N Proellocks	Monash University, Vic	Student Participant
K Waller	Monash University, Vic	Participant - Postdoctoral Researcher
T Armstrong	Murdoch University, WA	Student Participant
A Ash	Murdoch University, WA	Student Participant
S Averis	Murdoch University, WA	Student Participant
H Borowski	Murdoch University, WA	Student Participant
A Boxell	Murdoch University, WA	Student Participant
H Burmej	Murdoch University, WA	Student Participant
J Conlan	Murdoch University, WA	Student Participant
C Covacin	Murdoch University, WA	Participant - Researcher
A Dargantes	Murdoch University, WA	Student Participant
A Elliot	Murdoch University, WA	Participant - Researcher
W Hon	Murdoch University, WA	Student Participant

Register of Network Participants cont.

NAME	INSTITUTION	ROLE IN NETWORK
P Irwin	Murdoch University, WA	Participant - Senior Researcher
M Kerfoot	Murdoch University, WA	Participant
S Kurscheid	Murdoch University, WA & QLD DPI&F	Student Participant
A Khong	Murdoch University, WA	Participant
A Lymberry	Murdoch University, WA	Participant - Senior Researcher
L McInnes	Murdoch University, WA	Student Participant
A Mikosza	Murdoch University, WA	Participant - Senior Researcher
Z Njiru	Murdoch University, WA	Student Participant
R O'Handley	Murdoch University, WA	Participant - Senior Researcher
C Palmer	Murdoch University, WA	Student Participant
S Pan	Murdoch University, WA	Student Participant
U Parkar	Murdoch University, WA	Student Participant
LNT Phong	Murdoch University, WA	Student Participant
B Ralston	Murdoch University, WA	Student Participant
S Reid	Murdoch University, WA	Participant - Senior Researcher
A Smith	Murdoch University, WA	Participant - Senior Researcher
R Steuart	Murdoch University, WA	Student Participant
R Thompson	Murdoch University, WA	Participant - Senior Researcher, Management Committee Member
N Parameswaran	Murdoch University, WA	Student Participant
U Ryan	Murdoch University, WA	Participant - Senior Researcher, Management Committee Member
C Wielinga	Murdoch University, WA	Student Participant
D Zienkiewicz	Murdoch University, WA	Student Participant
J Blackwell	Telethon Institute of Child Health Research, WA	Participant - Senior Researcher
S Jamieson	Telethon Institute of Child Health Research, WA	Participant - Postdoctoral Researcher
C Peacock	Telethon Institute of Child Health Research, WA	Participant - Senior Researcher

Register of Network Participants cont.

NAME	INSTITUTION	ROLE IN NETWORK
A Bruyeres	Queensland Department of Primary Industries & Fisheries	Participant - Researcher
L Jackson	Queensland Department of Primary Industries & Fisheries	Participant - Senior Researcher
P James	Queensland Department of Primary Industries & Fisheries	Participant
S Jarrett	Queensland Department of Primary Industries & Fisheries	Participant - Researcher
W Jorgensen	Queensland Department of Primary Industries & Fisheries	Participant - Senior Researcher
A Lew	Queensland Department of Primary Industries & Fisheries	Participant - Senior Researcher
C Minchin	Queensland Department of Primary Industries & Fisheries	Participant - Researcher
J Morgan	Queensland Department of Primary Industries & Fisheries	Participant - Senior Researcher
M Rodriguez Valle	Queensland Department of Primary Industries & Fisheries	Participant - Senior Researcher
B Wlodek	Queensland Department of Primary Industries & Fisheries	Student Participant
F Amante	Queensland Institute of Medical Research	Participant - Postdoctoral Researcher
K Andrews	Queensland Institute of Medical Research	Participant - Senior Researcher
S Apte	Queensland Institute of Medical Research	Participant - Postdoctoral Researcher
S Beckham	Queensland Institute of Medical Research	Participant - Postdoctoral Researcher
K Buttigieg	Queensland Institute of Medical Research	Participant
A Burgess	Queensland Institute of Medical Research	Student Participant
F Caldas Cardoso	Queensland Institute of Medical Research	Student Participant
K Clark	Queensland Institute of Medical Research	Student Participant
B Datu	Queensland Institute of Medical Research	Student Participant
T Don	Queensland Institute of Medical Research	Student Participant
D Doolan	Queensland Institute of Medical Research	Participant - Senior Researcher
P Driguez	Queensland Institute of Medical Research	Student Participant
L Dunn	Queensland Institute of Medical Research	Participant - Postdoctoral Researcher
R Dunne	Queensland Institute of Medical Research	Student Participant
C Engwerda	Queensland Institute of Medical Research	Participant - Senior Researcher
K Fischer	Queensland Institute of Medical Research	Participant - Postdoctoral Researcher

Register of Network Participants cont.

NAME	INSTITUTION	ROLE IN NETWORK
D Gardiner	Queensland Institute of Medical Research	Participant - Senior Researcher
G Gobert	Queensland Institute of Medical Research	Participant - Postdoctoral Researcher
M Good	Queensland Institute of Medical Research	Participant - Senior Researcher
P Groves	Queensland Institute of Medical Research	Participant
A Haque	Queensland Institute of Medical Research	Participant - Postdoctoral Researcher
M Gatton	Queensland Institute of Medical Research	Participant - Postdoctoral Researcher
A Glanfield	Queensland Institute of Medical Research	Student Participant
A Haque	Queensland Institute of Medical Research	Participant - Postdoctoral Researcher
L Hugo	Queensland Institute of Medical Research	Participant - Postdoctoral Researcher
T Hurst	Queensland Institute of Medical Research	Participant - Postdoctoral Researcher
J Jeffery	Queensland Institute of Medical Research	Participant - Postdoctoral Researcher
M Jones	Queensland Institute of Medical Research	Participant - Senior Researcher, Management Committee Member
B Kay	Queensland Institute of Medical Research	Participant - Senior Researcher
D Kemp	Queensland Institute of Medical Research	Participant - Senior Researcher
S Kopp	Queensland Institute of Medical Research	Student Participant
K Krauer	Queensland Institute of Medical Research	Student Participant
A Loukas	Queensland Institute of Medical Research	Participant - Senior Researcher, Deputy Convenor, Management Committee Member
J McCarthy	Queensland Institute of Medical Research	Participant - Senior Researcher
D McManus	Queensland Institute of Medical Research	Participant - Senior Researcher
J Mulvenna	Queensland Institute of Medical Research	Participant - Postdoctoral Researcher
C Pasay	Queensland Institute of Medical Research	Participant - Postdoctoral Researcher
M Pearson	Queensland Institute of Medical Research	Participant - Postdoctoral Researcher
A Pinzon-Charry	Queensland Institute of Medical Research	Participant - Postdoctoral Researcher
N Ranjit	Queensland Institute of Medical Research	Student Participant

Register of Network Participants cont.

NAME	INSTITUTION	ROLE IN NETWORK
L Randall	Queensland Institute of Medical Research	Student Participant
A Redmond	Queensland Institute of Medical Research	Student Participant
P Ryan	Queensland Institute of Medical Research	Participant - Postdoctoral Researcher
T Skinner-Adams	Queensland Institute of Medical Research	Participant - Postdoctoral Researcher
M Smout	Queensland Institute of Medical Research	Student Participant
A Stanley	Queensland Institute of Medical Research	Participant - Postdoctoral Researcher
M Tran	Queensland Institute of Medical Research	Student Participant
T Tran	Queensland Institute of Medical Research	Student Participant
K Trenholme	Queensland Institute of Medical Research	Participant - Senior Researcher
A Trieu	Queensland Institute of Medical Research	Participant - Postdoctoral Researcher
P Upcroft	Queensland Institute of Medical Research	Participant - Senior Researcher
J Upcroft	Queensland Institute of Medical Research	Participant - Senior Researcher
C Willis	Queensland Institute of Medical Research	Student Participant
H You	Queensland Institute of Medical Research	Student Participant
W Zhang	Queensland Institute of Medical Research	Participant - Postdoctoral Researcher
L Zhang	Queensland Institute of Medical Research	Participant - Postdoctoral Researcher
R Adlard	Queensland Museum	Participant - Senior Researcher, Mangement Committee Member
L Warner	South Australia Museum	Participant - Senior Researcher
I Whittington	South Australia Museum	Participant - Senior Researcher
RJW Allen	The Australian National University, ACT	Participant - Postdoctoral Researcher
L Alleva	The Australian National University, ACT	Participant - Postdoctoral Researcher
C Behm	The Australian National University, ACT	Participant - Senior Researcher
XWA Chan	The Australian National University, ACT	Student Participant
S Cobold	The Australian National University, ACT	Student Participant
T Dolstra	The Australian National University, ACT	Student Participant

Register of Network Participants cont.

NAME	INSTITUTION	ROLE IN NETWORK
KJ Easton	The Australian National University, ACT	Student Participant
J-A Fritz	The Australian National University, ACT	Participant - Postdoctoral Researcher
S Hassan	The Australian National University, ACT	Student Participant
S Hetherington	The Australian National University, ACT	Student Participant
K Kirk	The Australian National University, ACT	Participant - Senior Researcher
R Kumarisinghe	The Australian National University, ACT	Student Participant
A Knight	The Australian National University, ACT	Student Participant
A Lehane	The Australian National University, ACT	Student Participant
R Marchetti	The Australian National University, ACT	Student Participant
R Martin	The Australian National University, ACT	Participant - Postdoctoral Researcher
C Paeper	The Australian National University, ACT	Participant - Postdoctoral Researcher
K Saliba	The Australian National University, ACT	Participant - Senior Researcher, Management Committee Member
C Spry	The Australian National University, ACT	Student Participant
N Spillman	The Australian National University, ACT	Student Participant
R Summers	The Australian National University, ACT	Student Participant
N Ramanayake	The Australian National University, ACT	Student Participant
D van Schalkwyk	The Australian National University, ACT	Participant - Postdoctoral Researcher
R Visser	The Australian National University, ACT	Student Participant
H Weaver	The Australian National University, ACT	Student Participant
L Wilson	The Australian National University, ACT	Student Participant
S-Y Yeo	The Australian National University, ACT	Student Participant
L Chisholm	The University of Adelaide, SA	Participant - Postdoctoral Researcher
L Dent	The University of Adelaide, SA	Participant - Senior Researcher
V Glennon	The University of Adelaide, SA	Student Participant
K Hutson	The University of Adelaide, SA	Participant - Postdoctoral Researcher

Register of Network Participants cont.

NAME	INSTITUTION	ROLE IN NETWORK
A Mooney	The University of Adelaide, SA	Student Participant
E Perkins	The University of Adelaide, SA	Student Participant
D Schmarr	The University of Adelaide, SA	Student Participant
R Williams	The University of Adelaide, SA	Student Participant
P Boeuf	The University of Melbourne, Vic	Participant - Postdoctoral Researcher
N Bott	The University of Melbourne, Vic	Participant - Postdoctoral Researcher
I Beveridge	The University of Melbourne, Vic	Participant - Senior Researcher
J Blaszkak	The University of Melbourne, Vic	Student Participant
V Bowles	The University of Melbourne, Vic	Participant - Senior Researcher
G Brown	The University of Melbourne, Vic	Participant - Senior Researcher
C Cantacessi	The University of Melbourne, Vic	Participant - Senior Researcher
A Colebrook- Robinson	The University of Melbourne, Vic	Student Participant
M deVeer	The University of Melbourne, Vic	Participant - Postdoctoral Researcher
M Duffy	The University of Melbourne, Vic	Participant - Postdoctoral Researcher
R Gasser	The University of Melbourne, Vic	Participant - Senior Researcher
D Goodman	The University of Melbourne, Vic	Participant - Postdoctoral Researcher
G van Dooran	The University of Melbourne, Vic	Student Participant
M Hu	The University of Melbourne, Vic	Participant - Postdoctoral Researcher
A Jabbar	The University of Melbourne, Vic	Student Participant
A Jex	The University of Melbourne, Vic	Participant - Postdoctoral Researcher
M Kalanon	The University of Melbourne, Vic	Student Participant
B Kalinna	The University of Melbourne, Vic	Participant - Senior Researcher
J Lackenby	The University of Melbourne, Vic	Student Participant
M Lightowlers	The University of Melbourne, Vic	Participant - Senior Researcher
L Lim	The University of Melbourne, Vic	Participant - Researcher

Register of Network Participants cont.

NAME	INSTITUTION	ROLE IN NETWORK
E Mann	The University of Melbourne, Vic	Student Participant
M McConville	The University of Melbourne, Vic	Participant - Senior Researcher
G McFadden	The University of Melbourne, Vic	Participant - Senior Researcher, Management Committee Member
S Middleton	The University of Melbourne, Vic	Participant - Postdoctoral Researcher
V Mollard	The University of Melbourne, Vic	Student Participant
A Mount	The University of Melbourne, Vic	Student Participant
R Opperman	The University of Melbourne, Vic	Student Participant
M Pellegrino	The University of Melbourne, Vic	Student Participant
S Ralph	The University of Melbourne, Vic	Participant - Senior Researcher
A Read	The University of Melbourne, Vic	Student Participant
N Robinson	The University of Melbourne, Vic	Student Participant
S Rogerson	The University of Melbourne, Vic	Participant - Senior Researcher
S Shamsi	The University of Melbourne, Vic	Participant - Postdoctoral Researcher
R Smith	The University of Melbourne, Vic	Student Participant
L Stimmler	The University of Melbourne, Vic	Student Participant
J Tonkin	The University of Melbourne, Vic	Student Participant
W Stanley	University of Western Australia	Participant - Postdoctoral Researcher
S Shamsi	The University of Melbourne, Vic	Student Participant
J Shaw	The University of Melbourne, Vic	Participant - Postdoctoral Researcher
A Umbers	The University of Melbourne, Vic	Student Participant
N Ashbolt	University of New South Wales	Participant - Senior Researcher
N Beebe	The University of Queensland	Participant - Senior Researcher
M Burger	The University of Queensland	Student Participant
P O'Donoghue	The University of Queensland	Participant - Senior Researcher
R Traub	The University of Queensland	Participant - Postdoctoral Researcher

Register of Network Participants cont.

NAME	INSTITUTION	ROLE IN NETWORK
S Barker	The University of Queensland	Participant - Senior Researcher
K Cheney	The University of Queensland	Participant - Postdoctoral Researcher
G Clague	The University of Queensland	Student Participant
F Cortesi	The University of Queensland	Student Participant
A Crean	The University of Queensland	Student Participant
T Cribb	The University of Queensland	Participant - Senior Researcher
L Curtis	The University of Queensland	Student Participant
M Eckes	The University of Queensland	Student Participant
P Ebert	The University of Queensland	Participant - Senior Researcher
A Grutter	The University of Queensland	Participant - Senior Researcher
N Gunter	The University of Queensland	Student Participant
C June	The University of Queensland	Student Participant
A Murrell	The University of Queensland	Participant - Postdoctoral Researcher
A Noel	The University of Queensland	Student Participant
E Piper	The University of Queensland & QDPI&F	Student Participant
M Rix	The University of Queensland	Student Participant
J Rothwell	The University of Queensland	Participant - Senior Researcher
R Shao	The University of Queensland	Participant - Postdoctoral Researcher
R Smith	The University of Queensland	Student Participant
D Sun	The University of Queensland	Student Participant
P Waldie	The University of Queensland	Student Participant
H Ball	The University of Sydney, NSW	Participant - Postdoctoral Researcher
D Emery	The University of Sydney, NSW	Participant - Senior Researcher
G Grau	The University of Sydney, NSW	Participant - Senior Researcher
A Hartigan	The University of Sydney, NSW	Student Participant

Register of Network Participants cont.

NAME	INSTITUTION	ROLE IN NETWORK
N Hunt	The University of Sydney, NSW	Participant - Senior Researcher
R Jambou	The University of Sydney, NSW	Participant - Postdoctoral Researcher
LT Khaw	The University of Sydney, NSW	Student Participant
J King	The University of Sydney, NSW	Student Participant
A Mitchell	The University of Sydney, NSW	Participant - Postdoctoral Researcher
J Slapeta	The University of Sydney, NSW	Participant - Postdoctoral Researcher
P Windsor	The University of Sydney, NSW	Participant - Senior Researcher
M Adams	The University of Tasmania	Participant - Postdoctoral Researcher
H Aiken	The University of Tasmania	Student Participant
M Andrews	The University of Tasmania	Student Participant
J Covello	The University of Tasmania	Student Participant
P Crosbie	The University of Tasmania	Participant - Postdoctoral Researcher
R Florent	The University of Tasmania	Student Participant
R Gurney	The University of Tasmania	Student Participant
C Hayward	The University of Tasmania	Participant - Postdoctoral Researcher
R Morrison	The University of Tasmania	Participant - Postdoctoral Researcher
B Nowak	The University of Tasmania	Participant - Senior Researcher
M Powell	The University of Tasmania	Participant - Postdoctoral Researcher
S Roberts	The University of Tasmania	Student Participant
E Sridevi	The University of Tasmania	Student Participant
N Young	The University of Tasmania	Student Participant
S Foote	Menzies Institute, The University of Tasmania, Tas	Participant - Senior Researcher
S Al-Qassab	University of Technology, Sydney	Student Participant
J Dalton	University of Technology, Sydney	Participant - Senior Researcher
M Davey	University of Technology, Sydney	Participant - Senior Researcher
S Donnelly	University of Technology, Sydney	Participant - Postdoctoral Researcher

Register of Network Participants cont.

NAME	INSTITUTION	ROLE IN NETWORK
J Ellis	University of Technology, Sydney	Participant - Senior Researcher
S Flowers	University of Technology, Sydney	Student Participant
S Hemmerter	University of Technology, Sydney	Student Participant
A Hudson	University of Technology, Sydney	Student Participant
R Ikin	University of Technology, Sydney	Student Participant
C James	University of Technology, Sydney	Student Participant
M Johnson	University of Technology, Sydney	Participant - Postdoctoral Researcher
M Katrib	University of Technology, Sydney	Participant - Postdoctoral Researcher
M Lees	University of Technology, Sydney	Student Participant
C Miller	University of Technology, Sydney	Participant - Postdoctoral Researcher
M Robinson	University of Technology, Sydney	Participant - Postdoctoral Researcher
P Sharman	University of Technology, Sydney	Student Participant
N Smith	University of Technology, Sydney	Participant - Senior Researcher, Convenor
R Walker	University of Technology, Sydney	Student Participant
M Wallach	University of Technology, Sydney	Participant - Senior Researcher
A Zakrzewski	University of Technology, Sydney	Student Participant
A Achtman	Walter and Eliza Hall Institute of Medical Research	Participant - Postdoctoral Researcher
J Babon	Walter and Eliza Hall Institute of Medical Research	Participant - Postdoctoral Researcher
J Baum	Walter and Eliza Hall Institute of Medical Research	Participant - Postdoctoral Researcher
J Beeson	Walter and Eliza Hall Institute of Medical Research	Participant - Senior Researcher
J Boddey	Walter and Eliza Hall Institute of Medical Research	Participant - Postdoctoral Researcher
M Boyle	Walter and Eliza Hall Institute of Medical Research	Student Participant
T Carvalho	Walter and Eliza Hall Institute of Medical Research	Participant - Postdoctoral Researcher
J Chan	Walter and Eliza Hall Institute of Medical Research	Student Participant
L Chen	Walter and Eliza Hall Institute of Medical Research	Participant - Postdoctoral Researcher
A Cowman	Walter and Eliza Hall Institute of Medical Research	Participant - Senior Researcher

Register of Network Participants cont.

NAME	INSTITUTION	ROLE IN NETWORK
Z Feng	Walter and Eliza Hall Institute of Medical Research	Participant - Postdoctoral Researcher
F Fowkes	Walter and Eliza Hall Institute of Medical Research	Participant - Postdoctoral Researcher
S Gunther	Walter and Eliza Hall Institute of Medical Research	Participant - Postdoctoral Researcher
E Handman	Walter and Eliza Hall Institute of Medical Research	Participant - Senior Researcher
D Hansen	Walter and Eliza Hall Institute of Medical Research	Participant - Postdoctoral Researcher
J Healer	Walter and Eliza Hall Institute of Medical Research	Participant - Postdoctoral Researcher
T Hodder	Walter and Eliza Hall Institute of Medical Research	Participant - Senior Researcher
M Hommel	Walter and Eliza Hall Institute of Medical Research	Participant - Postdoctoral Researcher
J Judd-Mole	Walter and Eliza Hall Institute of Medical Research	Student Participant
L Kedzierski	Walter and Eliza Hall Institute of Medical Research	Participant - Postdoctoral Researcher
C MacRaid	Walter and Eliza Hall Institute of Medical Research	Participant - Postdoctoral Researcher
R Mazhari	Walter and Eliza Hall Institute of Medical Research	Participant - Postdoctoral Researcher
T Nebl	Walter and Eliza Hall Institute of Medical Research	Participant - Postdoctoral Researcher
C Nie	Walter and Eliza Hall Institute of Medical Research	Student Participant
R Norton	Walter and Eliza Hall Institute of Medical Research	Participant - Senior Researcher
A Pearce	Walter and Eliza Hall Institute of Medical Research	Participant - Postdoctoral Researcher
S Pilat	Walter and Eliza Hall Institute of Medical Research	Participant - Postdoctoral Researcher
L Reiling	Walter and Eliza Hall Institute of Medical Research	Participant - Postdoctoral Researcher
D Richard	Walter and Eliza Hall Institute of Medical Research	Participant - Postdoctoral Researcher
J Richards	Walter and Eliza Hall Institute of Medical Research	Participant - Postdoctoral Researcher
D Riglar	Walter and Eliza Hall Institute of Medical Research	Student Participant
L Robinson	Walter and Eliza Hall Institute of Medical Research	Participant - Postdoctoral Researcher
M Rug	Walter and Eliza Hall Institute of Medical Research	Participant - Postdoctoral Researcher
L Schofield	Walter and Eliza Hall Institute of Medical Research	Participant - Senior Researcher
D Stanisc	Walter and Eliza Hall Institute of Medical Research	Participant - Postdoctoral Researcher
W-H Tham	Walter and Eliza Hall Institute of Medical Research	Participant - Postdoctoral Researcher

Register of Network Participants cont.

NAME	INSTITUTION	ROLE IN NETWORK
C Tonkin	Walter and Eliza Hall Institute of Medical Research	Participant - Postdoctoral Researcher
T Triglia	Walter and Eliza Hall Institute of Medical Research	Student Participant
A Uboldi	Walter and Eliza Hall Institute of Medical Research	Participant - Postdoctoral Researcher
J Volz	Walter and Eliza Hall Institute of Medical Research	Participant - Postdoctoral Researcher
D Wilson	Walter and Eliza Hall Institute of Medical Research	Student Participant
S Yao	Walter and Eliza Hall Institute of Medical Research	Participant - Postdoctoral Researcher

Appendix 1

PUBLICATIONS BY PARTICIPANTS OF THE ARC/NHMRC RESEARCH NETWORK FOR PARASITOLOGY IN 2009

Publications by Participants of the ARC/NHMRC Research Network for Parasitology in 2009

[1] AN ENVIRONMENTALLY SUSTAINABLE AUSTRALIA

Aken'Ova TO, Cribb, TH, Bray, RA (2009) Seven species of *Pseudopecoeloides Yamaguti*, 1940 (Digenea, Opecoelidae) from temperate marine fishes of Australia, including five new species. *Zookeys* 5: 1-32

Austen J, Jefferies R, Friend T, Adams P, Ryan U, Reid SA (2009) Morphological and molecular characterisation of *Trypanosoma copemani* n.sp. (Trypanosomatidae) isolated from Gilbert's potoroo (*Potorous gilbertii*) and quokka (*Setonix brachyurus*). *Parasitology* 136: 783-92

Averis S, Thompson RCA, Lymbery AJ, Wayne AF, Morris KD, Smith A (2009) The diversity, distribution and host-parasite associations of trypanosomes in Western Australian wildlife. *Parasitology* 136: 1269-1279

Barton DP, Beaufrère C, Justine J-L, Whittington ID (2009) Polyopisthocotylean monogeneans from carangid fishes off Queensland, Australia and New Caledonia, with a description of *Heteromicrocotyloides megaspinosus* sp. nov. *Acta Parasitologica* 54: 205-217

Beveridge I (2009) A re-description of *Progamotaenia ewersi* (Schmidt, 1975) (Cestoda: Anoplocephalidae) from wallabies and kangaroos (Macropodidae), with the description of a new species, *P. ualabati* n. sp. *Transactions of the Royal Society of South Australia* 133: 1-17

Beveridge I and Durette-Desset M-C (2009) A new species of the nematode genus *Copemania* (Nematoda: Trichostrongylida), parasitic in the western quoll, *Dasyurus geoffroyi* and short-nosed bandicoot, *Isodon obesulus* from south-western Western Australia. *Records of the Western Australian Museum* 25: 345-349

Beveridge I, Shamsi S (2009) Revision of the *Progamotaenia festiva* species complex (Cestoda: Anoplocephalidae) from Australasian marsupials, with the resurrection of *P. fellicola* (Nybelin, 1917) comb. nov. *Zootaxa* 1990: 1-29

Boehm AB, Ashbolt NJ, Colford JM Jr, Dunbar LE, Fleming LE, Gold MA, Hansel JA, Hunter PR, Ichida AM, McGee CD, Soller JA, Weisberg SB (2009) A sea change ahead for recreational water quality criteria. *J Water Health* 7: 9-20

Bott N J, Cribb TH (2009) Prosorhynchine trematodes (Digenea: Bucephalidae) from epinephelins (Perciformes: Serranidae) on the Great Barrier Reef, Australia. *Systematic Parasitology* 72: 57-69

Bray RA, Cribb TH, Justine JL (2009) New observations on the genus *Hypocreadium* Ozaki, 1936 (Digenea: Lepocreadiidae) in the Indo-West Pacific region, including the description of one new species. *Zootaxa* 2110: 22-40

Bray RA, Justine JL, Cribb TH (2009) *Cableia balistidicola* n. sp (Digenea, Monorchiiidae) from Pacific Ocean balistids (Tetraodontiformes) and new reports of *Cableia pudica* Bray, Cribb and Barker, 1996 in temperate Australian monacanthids. *Parasitology International* 58: 341-345

Bray RA, Waeschenbach A, Cribb TH, Weedall GD, Dyal P, Littlewood DTJ (2009) The phylogeny of the Lepocreadioidea (Platyhelminthes, Digenea) inferred from nuclear and mitochondrial genes: Implications for their systematics and evolution. *Acta Parasitologica* 54: 310-329

Calver M, Lymbery A, McComb J, Bamford M (Editors) *Environmental Biology*. Cambridge University Press. 2009

Campbell RA, Beveridge I (2009) *Oncomegas aetobatidis* sp. Nov. (Cestoda: Trypanorhyncha), a re-description of *O. australiensis* Toth, Campbell & Schmidt, 1992 and new records of trypanorhynch cestodes from Australian elasmobranch fishes. *Transactions of the Royal Society of South Australia* 133: 18-029

Cheney KL, Grutter AS, Blomberg SP, Marshall NJ (2009) Blue and yellow signal cleaning behaviour in coral reef fishes. *Current Biology* 19: 1283-1287

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- Chilton NB, Bull CM, Andrews RH (2009) Unique biological rhythm in the reproductive behaviour of female ticks of reptiles. *Parasitology* 136: 77-84
- Chilton NB, Huby-Chilton F, Johnson PM, Beveridge I, Gasser RB (2009) Genetic variation within species of the nematode genus *Cloacina* (Strongyloidea: Cloacininae) parasitic in the stomachs of rock wallabies, *Petrogale* spp. (Marsupialia: Macropodidae) in Queensland. *Australian Journal of Zoology* 57: 1-10
- Chilton NB, Huby-Chilton F, Smales LR, Gasser RB, Beveridge I (2009) Genetic divergence between island and continental populations of the parasitic nematode *Labiosimplex australis* in Australia. *Parasitology Research* 104: 229-236
- Chisholm LA, Whittington ID (2009) *Dendromonocotyle urogymni* sp. nov. (Monogenea, Monocotylidae) from *Urogymnus asperrimus* (Elasmobranchii, Dasyatidae) off eastern Australia. *Acta Parasitologica* 54: 113-118
- Chisholm LA, Whittington ID (2009) *Malalophus jensenae* n.g., n. sp. (Monogenea: Monocotylidae) from the gills of *Aetomylaeus vespertilio* (Myliobatidae) off northern Australia. *Systematic Parasitology* 73: 81-86
- Coetzee M L, Smit N J, Grutter AS, Davies AJ (2009) *Gnathia trimaculata* n. sp. (Crustacea: Isopoda: Gnathiidae), an ectoparasite found parasitising requiem sharks from Lizard Island, Great Barrier Reef, Australia. *Systematic Parasitology* 72: 97-112
- Cutmore SC, Bennett MB, Cribb TH (2009) *Paraorygmatobothrium taylora* n.sp. (Tetraphyllidea: Phyllobothriidae) from the Australian weasel shark *Hemigaleus australiensis* White, Last & Campagno (Carcharhiniformes: Hemigaleidae). *Systematic Parasitology* 74: 49-58
- Davies CM, Roser DJ, Feitz AJ, Ashbolt NJ (2009) Solar radiation disinfection of drinking water at temperate latitudes: inactivation rates for an optimised reactor configuration. *Water Res.* 43: 643-52
- Dougall A, Shilton C, Low Choy J, Alexander B, Walton S (2009) New reports of Australian cutaneous leishmaniasis in Northern Australian macropods. *Epidemiology and Infection* 137: 1516-152
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- Godfrey SS, Bull CM, James R, Murray K (2009) Network structure and parasite transmission in a group living lizard, *Egernia stokesii*. *Behavioural Ecology and Sociobiology* 63: 1045-1056
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- Hassan M, Jones B, Lymbery AJ (2009) A new species of *Dermoergasilus* Ho & Do, 1982 (Copepoda: Ergasilidae) from freshwater fishes in the south-west of Western Australia. *Systematic Parasitology* 74: 143-148
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- Minardi D, Paladini G, Whittington ID, Fioravanti ML (2008) Studio tassonomico di monogenei Capsalidae, parassiti di teleostei ed elasmobranchi in cattività. [=Taxonomic study on Capsalidae (Monogenea), parasites of teleosts and elasmobranchs held in captivity]. *Ittiopatologia* 5: 171-178
- Modrý D, Petrzeková KJ, Pomajbíková K, Tokiwa T, Krížek J, Imai S, Vallo P, Profousová I, Šlapeta J (2009) The occurrence and ape-to-ape transmission of the entodiniomorphid ciliate *Troglodytella abressarti* in captive gorillas. *Journal of Eukaryotic Microbiology* 56: 83–87
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[2] PROMOTING AND MAINTAINING GOOD HEALTH

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Appendix 1 cont.

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Appendix 1 cont.

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Giardia species in pre-weaned sheep in Australia. *Veterinary Parasitology* 61: 19-24

Appendix 2

RESEARCH GRANTS AWARDED TO ARC/NHMRC RESEARCH NETWORK FOR PARASITOLOGY PARTICIPANTS IN 2009

Fellowship and Grant Winners

NHMRC Australia Fellowship

Prof **Michael Good** (Griffith University)
*Australian Fellowship for clinical medicine and science
research into cellular immunology, and vaccine development.*

NHMRC Career Development Awards and Fellowships

Stuart Ralph (University of Melbourne)

Aaron Jex (University of Melbourne)

James G Beeson (WEHI)

NHMRC Training (Postdoctoral) Fellowships

Adele Lehane (Australian National University)

Matthew Dixon (La Trobe University)

Lev Kats (Monash University)

NHMRC Project Grants

Kevin Saliba, Kieran Kirk, Alex Maier, Leann Tilley (ANU and
LaTrobe University)
The Na⁺/H⁺ exchanger and H⁺-pumping pyrophosphatases

of the malaria parasite

Ross Andrews, Rick Speare, Jonathan Carapetis, James
McCarthy, Allen Cheng, Theresa Kearns, Eddie Mulholland,
Deborah Holt, Peter Markey (MSHR)
*Impact of an ivermectin mass drug administration program
against endemic scabies and strongyloidiasis*

Nicholas Anstey, Tsin Yeo, Stephen Duffull, Daniel Lampah,
Enny Kenangalem (MSHR)
*Endothelial dysfunction as a therapeutic target in severe
malaria*

Katja Fischer (QIMR)
Functional analysis of novel scabies mite serpins

Michelle Gatton, Qin Cheng, Richard Price (QIMR)
*Development and application of theoretical models of
Plasmodium transmission to guide malaria elimination efforts*

Christian Engwerda, Paul Kaye (QIMR)
*Tissue specific antigen presenting cell functions during
infection*

Alex Loukas, Jeffrey Bethony (QIMR)
*Apical membrane proteins as targets for a schistosomiasis
vaccine*

Alex Loukas, Banchob Sripa, Jason Mulvenna, Mal Jones
(QIMR)
*Interactions between excretory/secretory proteins of the
carcinogenic liver fluke and host cells*

Don McManus, Gail Williams, Yuesheng Li, Jiagang Guo,
Allen Ross, Donald Harn Jnr, (QIMR)
*Impact of the Three Gorges Dam on transmission and future
control of human schistosomiasis in China*

Jason Mulvenna (QIMR)
*Unravelling the tetraspanin web in the schistosome
tegument*

Ashrafal Haque (QIMR)
*IL-2/anti-IL-2 complexes in immunity to blood stage malaria
infection and prevention of cerebral immunopathology*

Appendix 2 cont.

Simon Foote and colleagues (Menziés Research Institute)
ENU mutagenesis to identify targets for host-directed therapy against malaria

Leann Tilley, Eric Hanssen, Don Gardiner (La Trobe University and QIMR)
Trafficking of the major virulence protein to the host cell surface in malaria parasite infected erythrocytes

Brendan Crabb, Paul Gilson, Kerstin Leykauf (Macfarlane Burnet Institute for Medical Research and Public Health)
Signalling during red blood cell invasion by Plasmodium falciparum

Brian Cooke, Artur Scherf (Monash University and Pasteur Institute)
Exported malaria kinases and red blood cell remodeling

Brian Cooke, Mohandas Narla (Monash University)
SBP1 and altered structure and function of malaria-infected red blood cells

Marshall Lightowlers (University of Melbourne)
Immunological prevention of cysticercosis and hydatid disease

Stephen Rogerson, Anthony Jaworowski, Kevin Kain (University of Melbourne)
Phagocytic clearance and immune activation in malaria

Stuart Ralph (University of Melbourne)
Cytosolic and organellar tRNA synthetases in Plasmodium falciparum

Jake Baum, Stuart Ralph (WEHI and University of Melbourne)
Dissecting the molecular basis of the malaria parasite-erythrocyte tight junction complex

Jake Baum, Geoff McFadden (WEHI and University of Melbourne)
Investigating cytoskeletal dynamics across the lifecycle of the malaria parasite

Ray Norton, Robin Anders (WEHI and LaTrobe University)
Structure and interactions of a disordered malaria surface

protein: implications for antigenicity

Tim Davis, Ivo Mueller, Harin Karunajeewa, Peter Siba, Kevin Batty, Tim St Pierre (UWA)
Novel artemisinin-based combination therapies for children exposed to high transmission of multiple Plasmodium species

Chris Peacock (UWA)
Comparative analysis of human and kangaroo Leishmania: defining human pathogenicity genes

Malcolm McConville and SJ Williams (University of Melbourne)
Polysaccharide biosynthesis as a new drug target in Leishmania parasites

Stuart Ralph (University of Melbourne)
Understanding protein translation in the malaria parasite

James Beeson and Stephen Rogerson (WEHI and University of Melbourne)
Defining the targets and function of antibodies that protect against malaria in pregnancy

NHMRC PROGRAM

Alan Cowman, Brendan Crabb, Terence Speed, Geoff McFadden, Louis Schofield, James Beeson (WEHI, Burnet, and University of Melbourne)
Interaction of malaria parasites with the host: disease, pathogenesis and control

NHMRC Equipment Grant

Leann Tilley, M. Ryan, Nick Klonis (La Trobe)
Automated Stage Fluorescence Microscope for Quantitative Cellular Imaging

Appendix 2 cont.

NHMRC: European Union Collaboration Research Program

Geoff McFadden (The University of Melbourne), Kevin Saliba (Australian National University) and colleagues who were successful in their project grant application for *Australia – Europe Malaria Research Cooperation – OzEMaR*.

Stuart Ralph (University of Melbourne)
Targeting Protein Synthesis in the Apicoplast and Cytoplasm of Plasmodium

ARC Future Fellowships in Parasitology

Stuart Ralph (The University of Melbourne)
Transfer ribonucleic acid (tRNA) synthetases as drug targets in Plasmodium falciparum

James Beeson (Walter and Eliza Hall Institute of Medical Research)
Identifying the major targets of protective antibodies against malaria

Kathy Andrews (Griffith University and QLD Institute of Medical Research)
New drugs for malaria that target histone deacetylases

Yuesheng Li (QLD Institute of Medical Research)
Development of new interventions and treatment for schistosomiasis morbidity control

Chris Peacock (The University of WA)
Genomic and molecular characterisation of a novel Australian leishmania pathogen.

ARC Discovery

Andrew Thompson and colleagues (Murdoch University)
Functional proteomics of Giardia

Robin Gasser, Aaron Jex, David Littlewood (University of Melbourne)
Mitogenomics using a massively parallel reactor platform from barcoding to diagnostic tools for pathogens of major socioeconomic importance

Robin Gasser, Andreas Hofmann, Alex Loukas, Paul Sternberg (University of Melbourne and QIMR)
Elucidating structure and function of activation associated secreted proteins (ASPs) in blood feeding hookworms – toward new methods of control

Alex Maier and colleagues (La Trobe University)
Biogenesis of red blood cell membrane modifications by the malaria parasite Plasmodium falciparum

Grant Hose, John Ellis and colleagues (Macquarie University and IBID, UTS)
Testing the biodiversity function paradigm for the provision of clean water in aquifers

Brian Cooke and colleagues (Monash University)
Structural and functional alteration of red blood cells by Babesia parasites

Robin Gasser, Paul Sternberg, Alex Loukas (University of Melbourne and QIMR)
Elucidating a key developmental switch in Haemonchus contortus using a massively parallel picolitre reactor sequencing coupled genomic and bioinformatic platform

Ross Waller, Geoff McFadden (University of Melbourne)
Investigations of Australian Hematodinium species (sp.): a dinoflagellate parasite damaging major crustacean fisheries in

Appendix 2 cont.

Australia and worldwide

Malcolm McConville and colleagues (University of Melbourne)
Mannosyl transfer processes in Leishmania and mycobacteria

Malcolm Jones, Geoff Gobert (University of Queensland)
Discovery of pathways to embryogenesis in pathogenic flatworm parasites using microdissection and transcriptomic technologies

Mike Bull (Flinders University)
Behavioural syndromes and social networks in sleepy lizards

ARC Linkage Projects

Terry Spithill, Nick Sangster, Tiggy Grillo and Glenn Anderson (CSU Wagga Wagga and Virbac)
Liver fluke: improving disease control through understanding of parasite diversity, drug resistance and better diagnosis.

ARC Linkage Infrastructure, Equipment and Facilities

Roland Stocker, Nicholas Hunt, Rebecca Mason, Paul Witting, Basil Roufogalis, Peter Lay, Michael Davies, Ian Dawes, Grant Drummond, Carolyn Geczy, Levon Khachigian, Philip Hogg, Martin Lackmann, Tony Tiganis, Shane Thomas, Kevin Croft, Nicholas King, Leann Tilley, David James (University of Sydney, UNSW, The University of Melbourne, Monash, UWA, La Trobe)
Oxidative stress bioanalytical facility

Other Grants

Kathy Andrews (Griffith University), Griffith University Research Grant
Investigation of a non-histone target of malaria deacetylase proteins

Christian Engwerda and B. Pulendran (QIMR & EVC), Queensland-US Vaccine Technology Alliance-A collaborative program between ACVD and EVC
Identifying Molecular Signatures for a Safe and Effective Malaria Vaccine

Alexandra Grutter, Robert Lester, Lesley Warner, Armand Kuris (University of Queensland, SA Museum, UCSB), UQ External Support Enabling Grant
Do parasites affect settlement processes in larval fish?

Trond Amundson, Elisabet Forsgren, Alexandra Grutter, Justin Marshall, Ian Owens, Ivar Folstad (Norwegian University of Science and Technology, University of Queensland, Imperial College, London, University of Tromsø), Research Council of Norway
Coral reef coloration: Sexual selection, diversification, and speciation

Alan Lymbery (Murdoch University), CTCBIO
The efficacy of Bacillus polyfermenticus KJS-2 in protecting against bacterial infections in barramundi Lates calcarifer

Alan Lymbery (Murdoch University), Water Corporation of Western Australia
Aquatic fauna survey: Mitchell/Hay and Quickup/Denmark Rivers

Robert Adlard, Thomas Cribb, Ian Beveridge (Queensland Museum, University of Melbourne, University of Melbourne), ABRIS/Creefs
Biodiversity and genetic relatedness of internal parasites of coral reef fishes

Denise Doolan (QIMR), NIH/NIAID 1R01AI082597 (USA) Subaward to A Sette, La Jolla Institute of Allergy and Immunology, San Diego
Proteome-wide cellular immunity approach to Plasmodium falciparum antigen identification

Denise Doolan (QIMR) Smart Futures Fund National and International Research Alliances Program (AUSTRALIA)
Exploring novel vaccine technologies through Queensland-US alliance

Appendix 2 cont.

Gonzalez, David Piedrafita, Els Meeusen, Molina, Rodriguez, Hernandez (Monash University), Ministerio de Educación y Ciencia, SPAIN, National Grant
In vivo depletion of T cells and eosinophilia and its effects on the resistance of the Canaria Hair Breed sheep against Haemonchus contortus

Alberto Pinzon-Charry, Michael Good, Alberto Moreno (QIMR, EVC), Queensland-US Vaccine Technology Alliance-A collaborative program between ACVD and EVC
Immunization of non-human primates with low doses of whole parasite to elicit protection against blood-stage malaria

Dr Karrie Rose (Taronga Conservation Society Australia), Dr Deborah Holt, Annette Dougall, Dr Shelley Walton, (Menzies School of Health Research) Dr Lorna Melville, Dr Cathy Shilton (Berrimah Veterinary Laboratories, Northern Territory Government Department of Resources), Mr Peter Whelan, Ms Nina Kurucz (Medical Entomology, Northern Territory Government Department of Health and Families, Department of Agriculture, Fisheries and Foresteries, Wildlife Exotic Disease Preparedness Program)
Field surveillance of Lasiohelea and wildlife surveillance for natural Leishmania infection

James Beeson, Alan Cowman, Jake Baum (WEHI) and C. Chitnis (ICGEB-India), Australia-India Strategic Research Fund (AISRF) Project Grant (BF030062)
Development of blood-stage vaccines for Plasmodium falciparum based on the EBA and PfrRH proteins

Jake Baum (WEHI) Fluorescence Applications in Biotechnology and Life Sciences (FABLS) Project Grant
Imaging actin dynamics in the malaria parasite

Jake Baum (WEHI), ANZ Trustees Program: Medical Research and Technology in Victoria; Buckland Foundation Grant (CT9989)
Developing new drugs to target the malaria parasite invasion motor
Robert Adlard (Queensland Museum), ABRS Creefs grant funded by the Australian Biological Resources Study and BHP Billiton in partnership with The Great Barrier Reef Foundation, the Australian Institute of Marine Science, and

the Alfred P. Sloan Foundation.
Biodiversity and genetic relatedness of internal parasites of coral reef fishes

Alex Maier (La Trobe), The Hugh D. T. Williamson Foundation Grants; ANZ Charitable Trusts; Medical Research and Technology in Victoria; Equipment grant
Responses to heat shock in the malaria parasite Plasmodium falciparum

Brian Kay, Peter Ryan (QIMR) Mosquito and Arbovirus Research Committee, Inc.
Local government mosquito control and arbovirus research

John Croese, James McCarthy, Alex Loukas, Bob Anderson, Graham MacDonald (James Cook University, QIMR), The Broad Foundation
Inoculating Coeliac Disease patients with the human hookworm Necator americanus: a small study evaluating immunity and gluten-sensitivity

James McCarthy (QIMR), MMV
Towards a Clinical Trial of experimental antimalarials using blood stage challenge

B Striepen (University of Georgia) and Malcolm McConville (University of Melbourne), NIH RO1 grant (R01 AI084415-01) bridging grant
Genetic dissection of parasite metabolism

Don McManus (QIMR) UBS Optimus Foundation, Switzerland
Impact of educational videotapes on soil transmitted helminth risk behaviour

Don McManus (QIMR) Queensland-US Vaccine Technology Alliance
Identification of Novel Schistosome Vaccine Candidates Using an Immunomics Protein Microarray

Una Ryan (Murdoch University) and Paul Monis (University of South Australia) LP100100160
Innovative approaches to managing and understanding taste and odour in drinking water systems

Carolyn Behm (Australian National University) Grains

Appendix 2 cont.

Research and Development Corporation ANU00006
Exploring a model system to develop controls for plant parasitic nematodes

Don Gardiner, Tina Skinner-Adams, M Williams (QIMR)
Griffith Medical Research College Collaborative Grant Scheme
Delocalised Lipophilic Cationic Anti-Malarial Conjugates

Jan Slapeta (University of Sydney), The Dr William Richards Awards in Veterinary Pathology, University of Sydney
Transmission electron microscopy and fluorescence in-situ hybridisation to define the extend of myxosporidiosis in the declining Green and GoldenBell Frog populations in Sydney

Jan Slapeta (University of Sydney), Margot Roslyn Flood Bequest, Faculty of Veterinary Science, University of Sydney
Do we really need to worry about trichomonads in dogs and cats?

Stephen Rogerson (University of Melbourne) Malaria in Pregnancy Consortium
Evaluating the causes of neonatal and infant illness and perinatal death in Papua New Guinea

Stephen Rogerson (University of Melbourne) Pfizer Inc Investigator Initiated Research
Intermittent preventive treatment with azithromycin-containing regimens for the prevention of malarial infections and anaemia and the control of sexually transmitted infections in pregnant women in Papua New Guinea

G Gilson, Brendan Crabb, Tonia de Koning-Ward, I Street, Alan Cowman (WEHI and Burnet Institute) Bill and Melinda Gates Foundation Grand Challenges Exploration Initiative: Grant Number OPPI006873
A novel virulence-associated malaria drug target