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Abstract

This project was undertaken because a critical shortage of the skills required by our livestock industries in the new trading world is looming. The loss of trained livestock health specialists, together with the loss of government employed district veterinary officers and epidemiologists, has dramatically weakened the national defences against disease incursions and other threats to product integrity and market access. This MLA project has led to immediate benefits for industry, and many of these will endure into the long term: undergraduate veterinary students better equipped to enter rural veterinary practice; graduates working in animal health can now learn skills in epidemiology and public health for immediate application; a steady stream of young post graduates is becoming available to fill retirement positions; young post doctoral fellows and PhD research students have greater opportunity to work on real world problems and provide service longer term to the livestock sector, and; significant critical mass now exists to conduct research on priority livestock health issues. The beneficiaries of this MLA project are livestock producers, processors and associated interests throughout Australia. The benefits of this project are long term as it has already and will continue to enhance human capacity. This will accrue benefits for future livestock producers.

Executive Summary

Australia derives a large income by being a major player in international trade in livestock and livestock products. In 1999, the gross value of livestock production was $13.4bn of which $11.5bn came from exports. The Australian economy, and the rural sector in particular, has a major dependence on maintaining this trade. Our long-standing position as a trader has been based on efficient production, marketing, quality assurance and access to major markets in the developed world. Most of these markets have a favourable status for the major epidemic diseases of livestock and, compared to many competitors, Australia enjoys privileged access due to the historical absence of important livestock diseases.

This project was undertaken because a critical shortage of the skills required by our livestock industries in the new trading world is looming. In the 1980s, State government funding of postgraduate training underpinned the development of new livestock disease specialists, but this has now ceased completely. In addition, opportunities for new specialists to gain on-the-job experience in livestock diseases have diminished dramatically with the large scale reduction of State government veterinary laboratory and field extension services; NSW has closed 2 of 5 veterinary diagnostic laboratories, Victoria 2 of 5 and South Australia closed one laboratory after the conclusion of the BTEC program and has outsourced the management of the second laboratory, while Queensland has reduced the services of 2 of 5 laboratories. In addition, Victoria and NSW have introduced fee for service livestock submissions, resulting in a substantial reduction in material sent for examination. The loss of trained livestock health specialists, together with the loss of government employed district veterinary officers and epidemiologists, has dramatically weakened the national defences against disease incursions.

During this project a new unit in Farm Animal and Veterinary Public Health was established in the Faculty of Veterinary Science at the University of Sydney. A Chair in Farm Animal Health, Professor Richard Whittington, was appointed to co-ordinate and manage the Unit and take responsibility for research, training, and advisory services. An assistant, Ms Marion Saddington, was appointed to support the research and development of the unit. A comprehensive research program in epidemiology and pathobiology was established and is ongoing. Research and training programs in epidemiology, disease surveillance and food safety were developed and delivered to postgraduate and undergraduate students through the Unit. A new degree program in Veterinary Public Health Management was established and currently has 49 students. Undergraduate teaching activities were enhanced. Ties were established with senior academics at the University of California Davis (Professor Ian Gardner), University of Colorado (Professor Mo Salman) and Michigan State University (Professor Ed Mather), and with the University of Glasgow (Professor Stuart Reid) to enable future development of joint teaching and research programs in epidemiology and public health. Professors Gardner, Mather and Reid have visited Sydney and Dr Toribio has visited Michigan State. A viable business entity was developed which is financially self-supporting through provision of research capability, post-graduate courses and consultancies. The Farm Animal Health and Veterinary Public Health group within the Faculty of Veterinary Science consists of university and industry funded staff and both are required to perform its essential functions. Financial sustainability depends on a flow of funds from external sources, including student fee income for post graduate course work programs, and consultancy and research program income. At the time of writing there is a steady stream of new research program income attributable to the initiative and expertise of academic staff, and post graduate student numbers are rising, suggesting sustainability. However, support from industry will need to be sustained to tackle the increasing number of issues related to animal health, food safety and public health. Staff from the unit are active in the research community and also in industry groups and the media, ensuring wide communication of research results. Staff from the unit work together with MLA and other stakeholders in the livestock sector to promote the benefits of the research programs. An example is the large role taken by staff of the unit in development of the OJD Harvest Year for MLA.

This MLA project has led to immediate benefits for industry, and many of these will endure into the long term:

- undergraduate veterinary students better equipped to enter rural veterinary practice
- graduates working in animal health now have a flexible post graduate coursework program to learn skills in epidemiology and public health for immediate application
- leadership and project management are now key elements in post graduate veterinary education so that the process of change can be smoothed
- local and international networks of Sydney postgraduates have been established for informal exchange of information – an immediate benefit in risk assessment for Australia
- a steady stream of young post graduates is becoming available to fill retirement positions
- young post doctoral fellows and PhD research students have greater opportunity to work on real world problems and provide service longer term to the livestock sector
- significant critical mass now exists to conduct research on priority livestock health issues

The beneficiaries of this MLA project are livestock producers, processors and associated interests throughout Australia. It should be noted that the benefits of this project are long term as it has already and will continue to enhance human capacity. This will accrue benefits for future livestock producers.

Recommendations from this project include the need to recognise the central role played by MLA in initiating the project through promotional materials prepared for the post graduate training program and in research reports prepared annually by the Faculty of Veterinary Science.

An important recommendation relates to identification of other training gaps, particularly in food safety and anatomical pathology. There is need for a detailed and focussed program as anatomical pathology is dying out as a discipline in Australia and yet it underpins differential diagnosis of most diseases as well as meat inspection. It is very difficult to identify training opportunities for young veterinarians in anatomical pathology or any of the related laboratory-based disciplines. Consequently it is recommended that MLA seek industry support for investment in training and research in food safety (in the context of veterinary public health) and anatomical pathology and related fields.

Finally, support from industry for research programs related to livestock health will need to be sustained to tackle the increasing number of issues related to animal health, food safety and public health, and to ensure human capacity in the future. Young researchers need to be retained in the service of the livestock sector to replace older researchers who will soon retire from the workforce. It is recommended that MLA explore options for identification and maintenance of livestock health research teams within Australia, because these will be needed to meet future challenges.

Contents

1 Background

Australia has enjoyed ready access to overseas markets for its livestock and livestock products as a consequence, in part, of freedom from important epidemic diseases of livestock and its ability to demonstrate its status in this regard. However, our favoured trading status cannot be taken for granted and it is likely to be subject to considerable challenges in the next 10 to 20 years.

Australia derives a large income by being a major player in international trade in livestock and livestock products. In 1999, the gross value of livestock production was $13.4bn of which $11.5bn came from exports. The Australian economy, and the rural sector in particular, has a major dependence on maintaining this trade. Our long-standing position as a trader has been based on efficient production, marketing, quality assurance and access to major markets in the developed world. Most of these markets themselves have a favourable status for the major epidemic diseases of livestock and, compared to many competitors, Australia enjoys privileged access due to the historical absence of important diseases.

The perceived or real presence in Australia of an exotic disease closes our access to foreign markets, and sometimes endemic diseases can have impact in this regard. In the past, live sheep exports to Saudi Arabia have been stopped by inadequate management of scabby mouth and the impact of finding bluetongue virus 25 years ago was costly to redress. Similarly, chemical residues in livestock products have seriously disrupted exports. Should Foot and Mouth Disease (FMD) occur in this country, ABARE has estimated that market closures will reduce average broad-acre farm income by $30,000 in the first year.

The long term impacts of these diseases and residues have been redressed to some extent by undertaking surveillance and epidemiological studies and demonstrating to customers that the risk can be dramatically reduced by sound risk management procedures based on the knowledge gained from these studies.

Maintenance of Australia's favoured trading position cannot be taken for granted. In the past decade we have been increasingly asked to defend our import restrictions and demonstrate our animal health status (eg transmissible spongiform encephalopathies) and the capacity of our animal health services. We have also had to deal successfully with "new" infections like Hendra virus and bat lyssavirus.

In a world that is slowly dismantling tariffs and subsidies to protect markets, our pest and disease status for agricultural products is going to come under greater scrutiny. We are also going to be forced by international agreements such as the Sanitary and Phytosanitary Agreeement to import animal products from sources that we have traditionally avoided because of perceived disease threats. Both of these factors will increase our need for epidemiological skills and improved competence in surveillance, risk assessment and risk management. The reputation and credibility of our animal health services will be a major factor in underpinning our position, as it will be in assuring the safety of our products to domestic consumers. As Office International des Epizooties President, Dr Romano Marabelli, recently observed, governments and consumers will seek advice on traditional animal health and welfare issues from others if animal health services and professionals are not able to provide it.

A sound understanding of our animal health situation, underpinned by solid data analysis and information that we can use to develop international protocols and our own import/export agreements, is becoming critical to maintaining and enhancing our trading position. In turn, the profitability of our livestock production, processing and marketing sectors depend on this. We must also maintain a capacity to identify, investigate and efficiently control exotic and emerging diseases that could otherwise severely affect production and marketing of our animal products or potentially human health.

The low numbers of appropriately trained veterinarians is a consequence, in part, of a failure of young veterinarians to find employment opportunities in the livestock industries during the past 10 to 20 years. For example, in 2001 at AAHL in Geelong, all four senior veterinary specialists were in their 50s and 60s; there was one specialist in her 40s and none younger. The same situation exists across Australia. In 1997/98 there were 74 livestock disease specialists in Australia representing all scientific disciplines. Their average age was 46 years and few young veterinarians were entering the system.

A critical shortage of the skills required by our livestock industries in the new trading world is looming. State government funding of postgraduate training underpinned the development of new livestock disease specialists into the 1980s, but has now ceased completely. In addition, opportunities for new specialists to gain on the job experience in livestock disease have diminished dramatically with the large scale reduction of State government veterinary laboratory services; NSW has closed 2 of 5 veterinary diagnostic laboratories, Victoria 2 of 5 and South Australia closed one laboratory after the conclusion of the BTEC program and has outsourced the management of the second laboratory, while Queensland has reduced the services of 2 of 5 laboratories. In addition, Victoria and NSW have introduced fee for service livestock submissions, resulting in a substantial reduction in material sent for examination. More qualified and experienced veterinary pathologists now work for private veterinary laboratories than for government, and these laboratories concentrate heavily on companion animal work. Where they are contracted to livestock work by government it is within strictly delineated boundaries (eg serological testing), with few or no post mortems included. In the past, regional diagnostic laboratories have been the home of the best trained livestock health specialists and have formed a key element in the national disease surveillance system. The loss of these people, together with the loss of government employed district veterinary officers and epidemiologists, has dramatically weakened the national defences against disease incursions.

There is a clear need for well trained personnel to take up key positions in a network of animal health service providers for the livestock industries. There will be fewer positions funded in the future than in the past, as a consequence of fundamental changes in the industries and in Government relationships with the agricultural industries. So, while fewer positions will exist, they must be filled with people with appropriate skills. The challenge for the future is to be smarter, more efficient and innovative in achieving the outcomes needed, but with fewer resources.

The University of Sydney's Veterinary Faculty was acutely aware of the challenge and was keen to contribute to addressing the needs presented by Australia's trading relationships. The Faculty is proud of the excellent contributions that its graduates have made, and continue to make, to the livestock industries and their health status. However it is also well aware that these graduates are aging and that comparatively few new graduates are developing skills and careers in livestock health research and management.

The following report outlines a strategy developed by the University to address priority research issues and to develop a research training capacity to meet the longer-term demands of Australia's livestock industries for technical skills to maintain the country's favourable animal health status and trading reputation. It is recognized that many of the changes which have occurred in the servicing livestock health needs are irreversible. Government is not going to return to its previous role of training and employing experts in large numbers. Nor will grazing industries support veterinary practitioners as it could do thirty or more years ago. It is clear, however, that the leaders of these industries recognize that they need appropriately trained individuals with skills in epidemiology and other key disciplines to fill defined and essential roles.

The Faculty sought the financial support of Meat & Livestock Australia (MLA) to create a research and training centre within the Faculty of Veterinary Science to provide research into OJD, extension of research findings and training in epidemiology. The centre would become self-supporting through research funding, provision of training, and sponsorship from corporate and private sources. It would be staffed by people with existing appointments, with anticipated new appointments

supported by the University, and with appointments supported for the first three years by MLA. This group will use funding from existing projects and projects developed by seeking further competitive grants to make additional appointments of post-doctoral scientists and students completing PhDs and Masters degrees. Key focus areas would be research into the epidemiology of OJD, post-graduate training of epidemiologists and the provision of knowledge and advice to the industry at all levels from producers to peak industry bodies. In the medium to long term, the centre would develop a broader focus on production animal health issues and post-graduate training.

2 Project Objectives

1. Develop and support research capabilities in epidemiology and pathobiology.
2. Develop and deliver research and training programs in epidemiology, disease surveillance and food safety, to postgraduate and undergraduate students, through the Unit;
3. Appoint a Chair in Farm Animal Health, who will co-ordinate and manage the Unit, responsible for research, training, and advisory services;
4. Appoint a research assistant to support the research and development of the Unit;
5. Establish ties with universities in the United Kingdom and North America with the view to developing joint teaching programs and research collaborations for the benefit of Australian industry;
6. Develop a viable business entity unit which will, after three years, be financially self-supporting through provision of research capability, post-graduate courses and consultancies;
7. Communicate research results widely (subject to interested parties' intellectual property rights); and
8. Work with industry to communicate the benefits of the research programs to industry and the wider community.

3 Methodology

The University of Sydney appointed a Chair of Farm Animal Health in 2002 to enable the development of the new unit. The Faculty of Veterinary Science then undertook detailed assessment of stakeholder need and sought partnerships with the Department of Agriculture Fisheries and Forestry, the Vincent Fairfax Family Foundation and the McGarvie Smith Trust to obtain the additional funding required to develop a world-class training and research unit and to provide student scholarships. Industry and government research grants were sought to tackle specific industry problems. Infrastructure support funds were sought from the University of Sydney to refurbish laboratories for the pathobiology program.

4 Results and Discussion

4.1 Post graduate coursework training

The impetus for establishment of a new postgraduate program in the Faculty of Veterinary Science at the University of Sydney was recognition of the changing landscape in relation to the needs of the veterinary profession, industry and animal health professionals wishing to pursue postgraduate education. The identified trends were:

- Critical lack of veterinary expertise in livestock medicine and production particularly in the disciplines of epidemiology and pathology, (Rose, 2000) with a substantial percentage of veterinarians working in this sector approaching retirement age
- Change in the services required by the livestock industries with increasing emphasis on issues such as market assurance, product integrity, sound government policy, economic assessment, risk analysis, environmental management and public health
- Increased demand for postgraduate education opportunities within Australia suitable for working professionals.

In addition extensive consultation with key stakeholders identified a consistent demand for animal health professionals with technical skills able to work effectively in multidisciplinary teams and manage projects ranging from emergency response to large-scale research programs. This requirement for effective application of technical and managerial skills in an age of increasingly complex animal and human health issues was strongly supported subsequently by expert opinion (Heuston, 2003).

In response, the Faculty of Veterinary Science launched an innovative postgraduate program in Veterinary Public Health Management (VPHMgt) in February 2003. The vision of this program is to produce leaders in veterinary public health. The VPHMgt program, consisting of three articulated award courses at Graduate Certificate, Graduate Diploma and Masters levels, ensures that graduates are equipped with technical and managerial skills that enable them to manage complex issues in the national and international animal health arena.

Development

With support from financial and in-kind contributors, Veterinary Public Health Management was an approximately $0.6M development project over 4 years with a projected operating income of approximately $300,000 in the fifth year. Meat & Livestock Australia contributed $100,000 directly to the program over 2 years as well as 50% salary and operating for a new Chair in Farm Animal Health over 3 years. The Vincent Fairfax family Foundation supported development through contribution of $520,000 over 4 years and The Commonwealth Department of Agriculture, Fisheries & Forestry (DAFF) has provided in-kind contribution in the development of two units of study by 4 members of staff in 2004. DAFF also funds two student scholarships per year and the McGarvie Smith Institute fund one student scholarship per year. Depending on the assumptions, VPHMgt has required an external investment of approximately $1M. In addition the University of Sydney made in kind contributions through the Information Technology Educational Ventures unit and the Institute of Teaching and Learning during the development phase.

Partnership with the Australian Graduate School of Management (AGSM) has enabled the Faculty to draw on material from the AGSM Executive MBA and to utilise 2 adjunct faculty from the AGSM to ensure effective leadership training.

Development of the VPHMgt program has included:

- Consultation and collaboration with representatives of the livestock industries, the veterinary profession and government and academic personnel;
- Development of graduate attributes, curriculum, documentation, quality systems, assessment policy and program infrastructure;
- Authorship, academic review and instructional design of 18 new units of study over 2002-2005;
- Training of new facilitators in online teaching and learning;
- Preparation of guidelines, supervision and support schemes for Masters research projects;
- Development of systems for ongoing professional development in online teaching and learning for facilitators;
- Marketing the new program to both employers and potential students;
- Supporting high quality education for a relatively small number of new students during the development period.

Over 2003- 2005, high quality, external unit of study facilitators were recruited to teach alongside academic staff. The quality of each unit of study was ensured through academic review by a prominent leader in a relevant field, as well as by instructional design consultation throughout the development process and for first-time teaching of each unit.

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Educational Model
Veterinary Public Health Management is a distance education program with short 3-5 day residential sessions. The program is designed to deliver high quality education to students who are working full time and are able to apply their learning in real time.

The model allocates equal credit points to technical and managerial learning in the first year of the program, demonstrating the importance of skill development in both areas. Managerial capabilities are a central, unique attribute of our graduates and core units in leadership and project management feature in each award course. The leadership units, purpose designed from existing course materials used in the Executive Masters of Business Administration degree program to identify linkages between veterinary contexts and organisational behaviour, management and leadership perspectives, are taught by staff of the Australian Graduate School of Management (AGSM) via residential workshops and online. The project management unit, also taught via a residential workshop and online class with emphasis on veterinary applications, was modelled on units in the highly successful online Master of Project Management offered through the Department of Civil Engineering at the University of Sydney.

VPHMgt, student learning is developed through interaction, engagement with one another and with authentic learning activities. In this sense, students engage in situated learning, characterised by the use of new knowledge in a real-life context, including: authentic activities, access to expert modelling of process, multiple perspectives and actively collaborating to construct knowledge (Herrington & Oliver 1995).

This is achieved in VPHMgt by providing students with access to:
- a wide range of externally contracted facilitators – suitably qualified experts working in the area in which they teach;
- online spaces for discussion in every unit of study, in which students participate in a range of activities that scaffold their social and learning interactions;
- clear expectations and processes including; provision of clear, relevant learning outcomes, clear assessment expectations, rapid feedback on work, quality teaching materials; learning and assessment tasks that reflect the activities they will complete in the workplace;

- a requirement to work together – a challenging experience that can involve several time zones, cultural backgrounds, work and study habits, learning styles, disciplinary backgrounds and software expertise.

Riel & Polin (2004) have suggested that this collaborative process is enhanced when students identify as a member of a group and understand their role within that group. Providing early opportunities for face-to-face interaction and socialisation assists and accelerates the development of this process online (Schrumm, 2002). VPHMgt has developed short residential sessions to achieve this.

Face to face study at short residential sessions enables deep, experiential learning in management/leadership and also provides valuable opportunities for networking and socialising amongst fellow students, external industry experts and Faculty staff.

To aid student progression through the award courses, students can choose to complete a degree in the minimum time required (for example, 2 years for the Masters) or to stagger unit enrolment in line with work and personal commitments. Non-award enrolment in individual units is also encouraged for professionals who need to gain skills in a particular area but do not wish to complete a full degree.

Orientation and support for these students is given high priority in the program. Induction sessions are conducted at residential workshops as well as collaborative and enjoyable orientation activities online. These are specifically designed to ensure students are supplied with the key skills necessary for postgraduate distance study (Bozarth et al., 2000). These include skills in time management and technology, ensuring students have clear expectations about the program, know how to manage group work and are clear about what to do if they need help.

The program's viability is dependent on its ability to attract and retain students. Significantly for the program's sustainability, student support is identified as a cause for the impressively high level of student retention achieved to date. The cost of sustaining this quality service and support for learners is documented, understood and explicitly acknowledged in the program budget.

Critical success factors of the program were: industry involvement in scoping the program; information technology and library infrastructure; funds; adequate time for program development; educational design for online delivery; a quality assurance plan for all aspects of the program to ensure high quality student service; preparation of students and teachers for online teaching and learning; and high quality facilitators.

Progress to Date

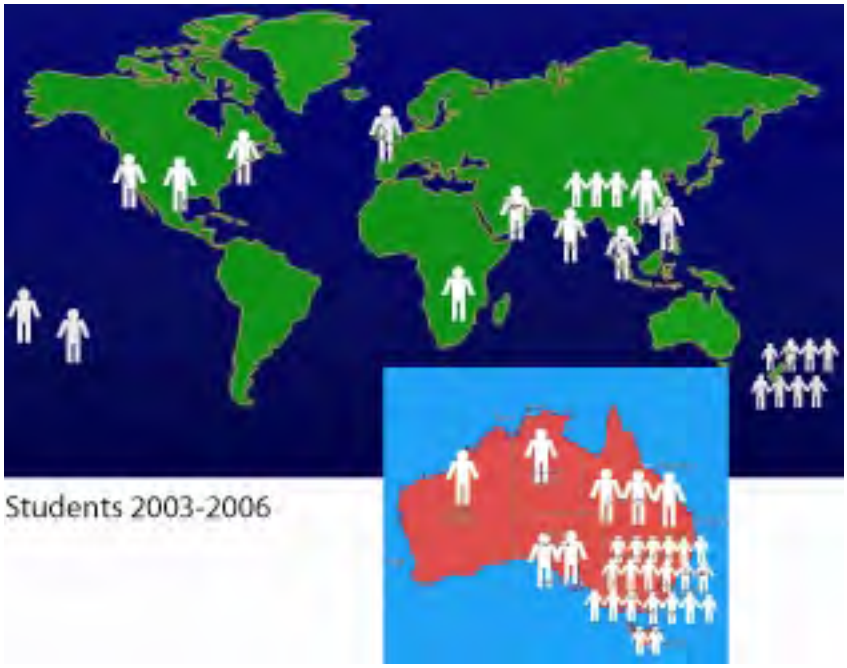
Enrolment

64 Students have been enrolled in the VPHMgt program over the period 2003-2005. 9 have graduated (8 MVPHMgt, 1 GradDipVPHMgt) and 6 have completed non-award requirements.

Table 1: VPHMgt enrolments as at 26 July 2005

	2003	2004	2005
International Offshore	1	7	7
Local Offshore	0	6	10
Local – Regional Australia	14	12	28
Local – Metropolitan Australia	3	8	4
Graduated	0	9	0
Completed requirements (non-award)	0	2	4
Deferred	1	1	2
Withdrawn	1	0	0
Total Students	18	33	49

International and local offshore students are located in countries such as New Zealand, China, French Polynesia, Hong Kong, Swaziland, Thailand and the United States. Local students are based in areas such as such as Orange, Katherine, Moe, Bordertown, Broome, Bendigo, Goulburn, Benalla and Scone.



Units of Study

- Veterinary Epidemiology 1
- Veterinary Epidemiology 2
- Animal Health Economics
- Animal Health Policy Development
- Data Analysis for Policy Development
- Animal Health Data Management
- Hazards to Human & Animal Health
- Leadership 1
- Leadership 2
- Leadership 3
- Project Management 1
- Project Management 2
- Aquatic Animal Epidemiology
- Wildlife Epidemiology
- Food Safety
- Surveillance, Preparedness and Response
- Risk Analysis
- Diagnostic Tests

In addition, a Biostatistics Refresher Course, facilitated by Peter Thomson, is run each January.

Student Feedback
Feedback from students has been collected through Residential Evaluation Surveys and Student Support & Administration Surveys. Each unit of study is evaluated annually using the USE. Informal and ongoing feedback is collected via anonymous discussion topics in every online discussion board and through invitations to provide feedback by email by student support staff once per semester. Feedback collected from students has been very positive on all aspects of the program using all instruments. Student evaluation of Residential sessions in VPHMgt has had consistently high levels of satisfaction across both learning and as an enjoyable and well-organised experience. USE results and student support feedback has been similarly positive (see Tables 2 & 3).

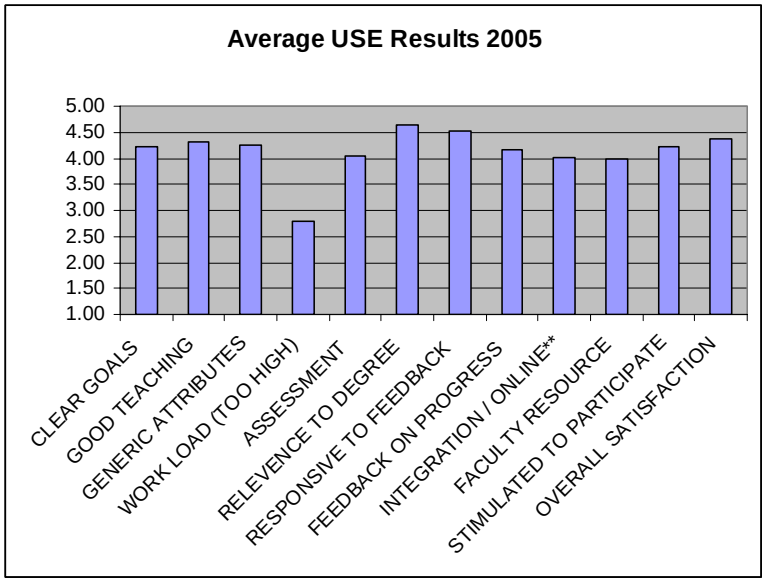


Table 2: Overall Satisfaction ratings, USE 2003 – 2005

Unit of Study	**Overall Satisfaction (out of 5)**		
	2003	**2004**	**2005**
Leadership 1 & 2	4.75	5	4.22
Leadership 3		3.89	4.06
Vet Epidemiology 1	4.1	4	4.22
Vet Epidemiology 2		4.45	4.27
Project Management	4.17	4	4.67
Hazards to Human & Animal Health	4.25	4	4.05
Animal Health Economics	4	4.4	4.29
Animal Health Policy Development	4.14	4.4	4.33
Data Analysis for Policy Making		4.29	4.36
Wildlife Epidemiology			4.35
Risk Analysis		3.5	3.5
Aquatic Animal Epidemiology		4	
Surveillance, Preparedness & Response		3.25	4.25
Animal Health Data Management		3.4	4.32
Food Safety		4.5	5
Average	4.24	4.08	4.28

Table 3: Student support and administration survey results, 2005

Question		Mean (out of 5)
1	Enquiries were dealt with quickly and staff were knowledgeable and helpful	4.80
2	I understood everything I needed to do to apply for Admission to the program	4.60
3	I received timely notification that the Faculty had received my application	4.60
4	I was happy with the admissions process	4.70
5	I understood everything I needed to do to enrol in the program	4.60
6	I was happy with the enrolment process	4.50
7	My options and methods for payment of fees were clear	4.00
8	The system for paying fees was satisfactory	3.60
9	Sufficient information was supplied at the start of the course	4.60
10	The residentials were well organised and enjoyable	4.70
11	I had no difficulty accessing and working in the online classroom	4.20
12	I understood how and when to access my assessment results	4.20
13	Responses from staff to questions/enquiries was timely	4.40
14	Resolution of issues was timely	4.40
15	Staff were friendly and helpful	4.90
16	I was always told what I needed to do and when I needed to do it	4.50
17	The quality of course materials was high	4.40
18	The functionality of online programs was satisfactory	4.50
19	The online programs were easy to use	4.50
20	The layout of objects on the screens of online classes was satisfactory	4.30
21	I feel a strong sense of community with other VPHMgt students	4.40
22	I feel a strong sense of community with VPHMgt staff	4.70
23	I feel supported within the VPHMgt program	4.60
24	I feel a part of the activities in the Faculty of Veterinary Science	2.90
25	I feel a sense of belonging within the University of Sydney	3.10
26	The ambience of the program stimulates my study and my work	4.40
27	Overall I was satisfied with the quality of administration and support services	4.78
	Average	**4.37**

Table 4: USE Results, Semester 1, 2005

Semester 1, 2005			Q1	2	3	4	5	6	7	8	9	10		12		
CODE	SUBJECT	COORDINATOR	CLEAR GOALS	GOOD TEACHING	GENERIC ATTRIBUTES	WORK LOAD (TOO HIGH)	ASSESSMENT	RELEVENCE TO DEGREE	RESPONSIVE TO FEEDBACK	FEEDBACK ON PROGRESS	INTEGRATION / ONLINE**	FACULTY RESOURCE	STIMULATED TO PARTICIPATE	OVERALL SATISFACTION	Avge (exc workload)	% Response
VETS7001	Leadership 1	Wendy Grusin	4.08	4.46	4.15	2.77	4	4.46	4.38	4.23	3.69	4.08	4.46	4.38	4.22	52
VETS7003	Leadership 3	Loretta O'Donnell	3.88	3.5	3.75	2.75	4.25	4.25	4.63	4.5	3.38	4.25	4	4.29	4.06	73
VETS7004	Veterinary Epidemiology 1	Nick Malikides	4.11	4.44	4.22	2.89	3.78	4.89	4.78	4.11	4	3.78	4	4.33	4.22	50
VETS7005	Veterinary Epidemiology 2	Jenny-Ann Toribio	4.43	4.29	4.29	2.29	4	4.86	4.57	4.29	4	3.57	4.29	4.43	4.27	58
VETS7008	Hazards to Human and Animal Health	Stephen Page and Robert Dixon	4	4	3.83	3	3.83	4.67	4.33	4.17	3.5	3.83	4.17	4.17	4.05	40
VETS7011	Data Analysis for Policy Making	Evan Sergrant	4.33	4.67	4.33	3	4	5	4.33	4.33	4.33	4	4	4.67	4.36	25
VETS7012	Wildlife Epidemiology	Hume Field	3.8	4.2	5	3.2	4.25	5	4.6	4	4.4	4	4.2	4.4	4.35	83
VETS7016	Animal Health Data Management	Evan Sergeant	4	4	4	3.5	4.5	5	4.5	5	4.5	3.5	4	4.5	4.32	50

Finances

The VPHMgt project has completed development of 18 units of study, to budget and delivered training to 60 postgraduate students in Australia and internationally.

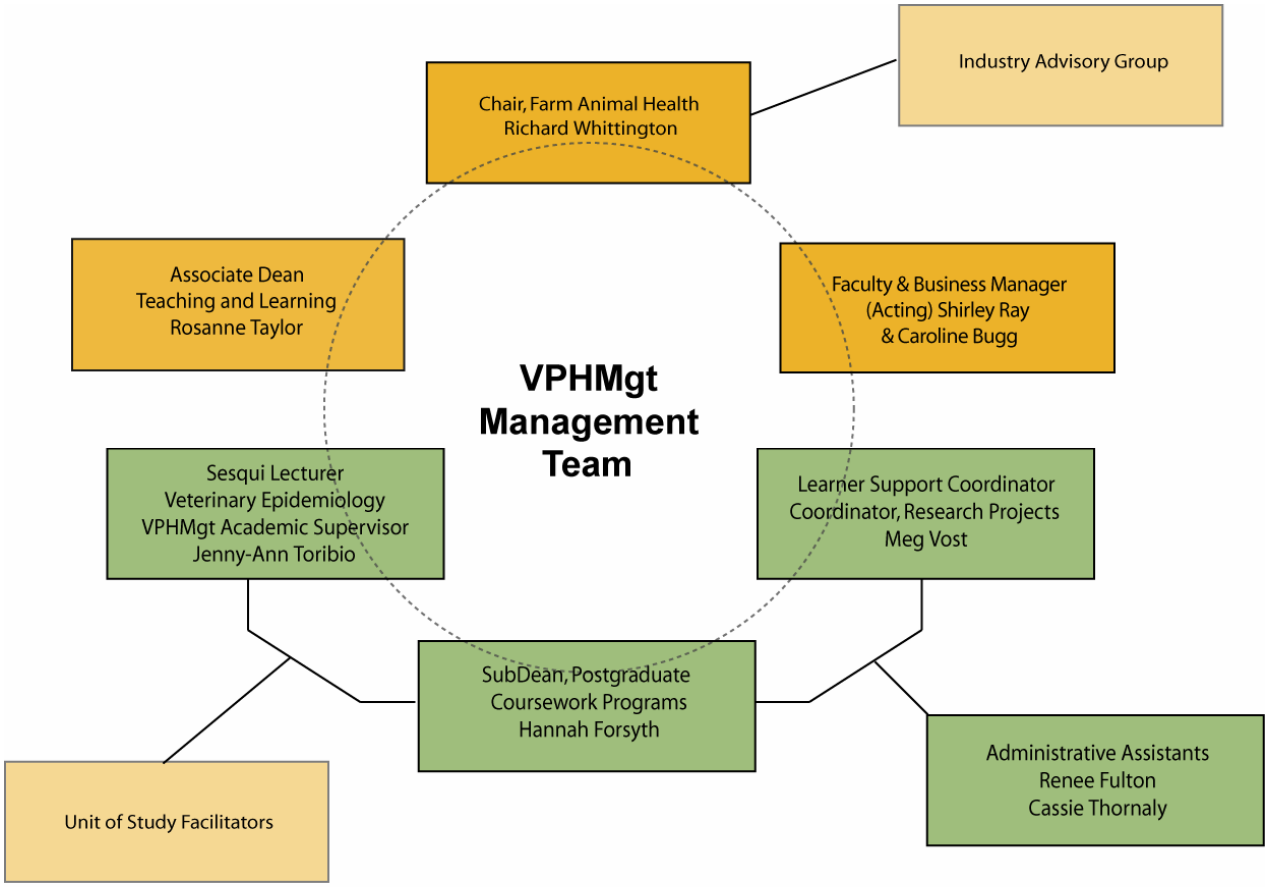
Income received included support from Vincent Fairfax Family Foundation, Meat and Livestock Australia, and student fee income. Income supported all salaries, contractors, student and administration costs associated with development and administration of the program.

Development costs as a percentage of total expenditure reached a peak in 2004 and are reducing in the project's final year, 2005. Student and administration costs have increased annually due to increased student numbers.

Student fees have increased from 22% of total income in 2003 to 57% in 2005. Student fee income is projected to increase to $306,597.60 in 2006, enabling the program to be fully self-funding as the project becomes an operational unit.

Governance

The VPHMgt program is managed by a Management Team, which reports to both the Learning & Teaching Committee and the Postgraduate Education & Research Training Committee.



4.2 Undergraduate training

Undergraduate students in the Bachelor of Veterinary Science degree have always received tuition in pathobiology and epidemiology. However, the establishment of the new unit by MLA has enabled significant change:

- Insertion in the curriculum in all years of a greater range of course materials related to the livestock sector, presented by academics with active involvement in the industries. The courses in which this has occurred include: VETS2013 Principles of Disease, VETS3011 Veterinary Pathology, VETS3040 Veterinary Microbiology; VETS3038 Animal Disease.
- Complete reformatting of: VETS4224 Ruminant Health and Production, combining sheep and cattle health into one course with emphasis on farming systems and whole of herd/flock approaches; and VETS4223 Pig Health and Production and VETS4221 Bird Health and Production to reintroduce poultry health to the curriculum and to emphasise trade access and productivity issues.
- in the final year unit of study VETS5338, active mentoring of students in work experience with private and government veterinarians who service the livestock sector
- Introduction of OLIVER, an on-line image collections related to livestock health
- Introduction of on-line case scenarios in livestock health
- Updating of curriculum content with the information available from current research trials to ensure that graduates are equipped with the latest information. The University of Sydney actively encourages research-led teaching.
- A review of course content in epidemiology, food safety and veterinary public health in the VETS3025 unit of study. More details of this are provided below because it is central to our graduates being able to effectively support the livestock sector.

Review of course content in epidemiology, food safety and veterinary public health

Veterinary Public Health (VETS3035) is specifically taught in Year 3 of the veterinary curriculum where it is juxtaposed between the preclinical units of study (Years 1 and 2) and the clinical courses (Years 4 and 5). In addition, within 12 months of the end of this course students begin their clinical rotations in their final year. Students have core information presented in microbiology, parasitology and pathology to integrate with topics in epidemiology, food safety and zoonoses, which can then be further expanded in their later clinical years, specifically in cattle, sheep, pig and poultry health and production courses. Development of a Public Health theme in this way allows students to expand their views of their professional role outside the narrow confines of clinical medicine and surgery. The nature of the new curriculum means that VPH (VETS3025) is considered as a vertically integrated component of the whole course.

Curriculum Audit

A curriculum audit of VPH across the undergraduate degree was conducted where specific learning objectives were matched against the Royal College of Veterinary Surgeons Policy Document of October 2001, which matches EU requirements. Topics were listed in three broad areas; Principles and Concepts of Veterinary Public Health, Population Medicine and Food Science. This audit showed that important themes in VPH are vertically integrated through the five years of the course.

Review of Veterinary Public Health

In 2004 the approach to teaching VPH (VETS3025) within the Faculty of Veterinary Science at the University of Sydney was reviewed. It was decided that the three disciplines of epidemiology, food

safety and zoonoses would be taught as an integrated whole so that students see the linkages across these three subject areas and can develop a holistic approach to solving problems within VPH. It was clear from previous unit of study evaluations by students that these linkages were not being made. It requires a paradigm shift by students to see that VPH provides a skills and knowledge base that allows them to solve problems occurring in a range of employment settings such as clinical practice, government service, food industries, research and human public health.

Veterinary Public Health Graduate Attributes and Learning Outcomes
The veterinary curriculum is structured to ensure our graduates meet a series of predetermined Graduate Attributes. At the end of the Unit of Study graduates will:

1. understand the role of veterinarians in maintaining human and animal health through identifying specific components of human-animal interactions
2. be able to outline the corresponding responsibility and inputs by the profession to these components
3. understand the key concepts from the interrelated disciplines of veterinary epidemiology, zoonotic disease and food safety by applying them to:
    - the investigation of health, production and performance problems in production animals
    - make clinical decisions in companion and production animal practice
4. recognise the economically or socially important zoonotic diseases in Australia overseas and be able to give accurate advice to clients regarding the source, transmission, diagnosis, treatment and control of these diseases
5. provide accurate advice on the control and prevention of foodborne diseases and residues associated with animal products
6. consider some of the social, legal and economic implications of pet/animal ownership in Australia
7. critically evaluate the research literature

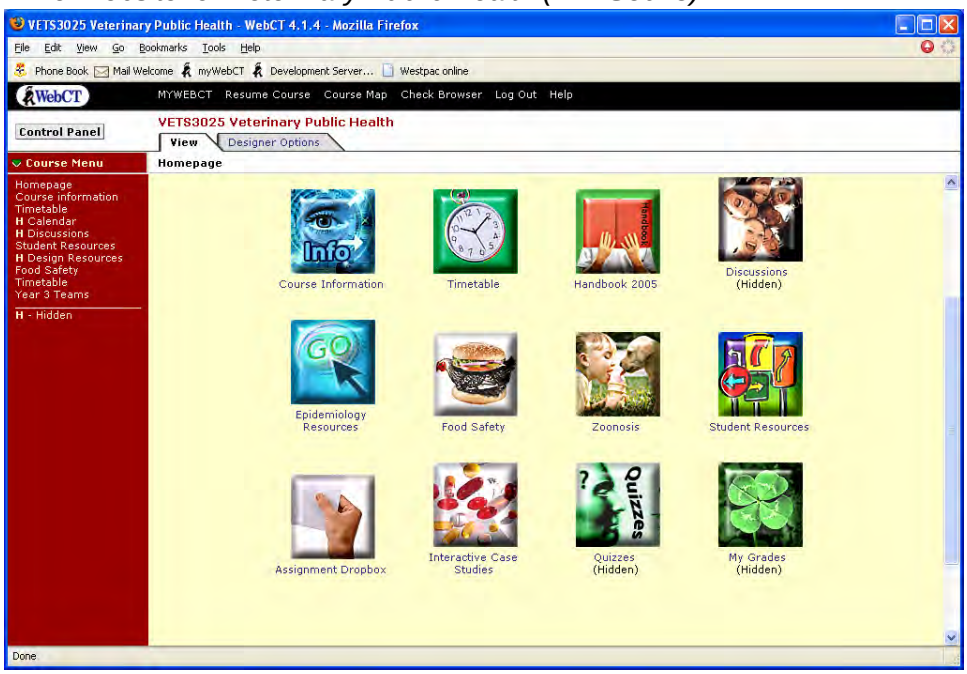
Veterinary Public Health is introduced to students using a case study of BSE and vCJD as this topic allows integration of material in the three major themes of epidemiology, zoonoses and food safety. By the time the specific lectures in Food Safety are delivered the students have had a strong introduction to general and specific epidemiological principles and have had most lectures in zoonotic diseases, including lectures on the organisms involved in gastroenteric disease. This progression in the structure of the VPH course allows application of earlier principles to be applied to specific topics in Food Safety.

In addition to lectures from specialist staff within the Faculty of Veterinary Science, students are presented lectures by external specialists recognised nationally and internationally in epidemiology, herd medicine and production, food safety, food microbiology and chemical residues. The inclusion of these external experts reinforces the global view of the role of the profession not only in animal health but also the important role of veterinarians in the maintenance of human health.

Material within this Unit of Study (VETS3025) is delivered by a variety of methods including lectures, small group workshops, an excursion, individual and group projects, and on-line activities. Emphasis in all these learning activities is placed on student participation, so that they actively engage with the information presented. In addition, problem solving skills are emphasised and enhanced, specifically whilst working in small group and with on-line projects. An important assessable component of the course is a visit to food processing plants.

The Unit of Study is supported by an **on-line website** (Figure 1) that provides learning activities, resource materials including lecture presentations, and an assignment drop box, which enables students to receive on-line feedback on submitted tasks. Students can access this site on or off campus.

Figure 1: On-line Website for Veterinary Public Health (VETS3025)



Additional on-line resources are provided through the **Veterinary Education Information Network (VEIN)** (Figure 2). This information portal provides a range of general resources, relevant organisations and access to appropriate databases.

Figure 2: Page in the Information Portal, VEIN, for Public Health and Zoonoses

In addition to specific assessment tasks in VETS3025, the key concepts of VPH are also assessed in other Units of Study such as Veterinary Microbiology, Veterinary Parasitology, Animal Disease, Ruminant Health and Production, Pig Health and Production and Bird Health and Production. A number of tasks including case reports, reflective journals, seminars to livestock producers etc are major forms of assessment in Year 5 Units of Study including Preparation for Veterinary Practice, Mixed Rural Practice and Rural Public Practice.

Practical teaching of veterinary public health at the University of Sydney
The Faculty has developed an integrated view of practical training in VPH in concert with the new curriculum and aligned with our Graduate Attributes. More specifically, the student abattoir experience encompasses a number of practical components within different Units of Study predominantly in Year 3, and acts to reinforce the important principles that are intrinsic to the public health role of the Veterinary Profession.

Several decades ago the Faculty of Veterinary Science at the University of Sydney timetabled 5 days of compulsory abattoir visit into the extramural component of the curriculum. However, by 2000 the formal abattoir extramural program had been abandoned because of the failure to provide an appropriate, relevant, high quality learning experience that achieved required outcomes, the failure of some students and abattoirs to comply with the requirements and the increased pressure on students to have paid employment in non-semester time. A review identified a number of constraints to reinstating this program: the need for pedagogically sound activities that had been missing from the previous student abattoir experiences; the need to provide this abattoir experience during semester time; the requirement for abattoir locations to be close to Sydney as the visits are conducted during semester; the lack of suitable abattoirs within 3 hours of Sydney. These are the only abattoirs that have a supervising veterinarian. The closest non-export abattoir is still over 90 minutes away and does not have a veterinarian. The Faculty developed a different approach to provide for a meaningful abattoir experience and exposure of students to important concepts in food hygiene and safety. It represents a holistic approach to VPH in general, and Food Safety in particular.

The following Table identifies the range of activities that have direct application to the Abattoir Experience and the time given each activity. Italicised activities are to be instituted in 2006.

The Abattoir Experience and Veterinary Public Health

Activity	# days
Current food processing plant visits – VETS3025	0.5
Case-based assignment related to visit – VETS3025	0.5
Abattoir specimens (AQIS) – VETS3011 Pathology prac #1 *Histopathological review – VETS3011 Pathology prac #2* *Assessment task – VETS3011*	0.75
Abortion case – examination of foetal specimens – Animal Diseases VETS3038	0.25
Examination of abattoir specimens for hydatid lesions – Animal Disease VETS3038 case	0.5
Antibiotic resistance and pigs – Animal Disease case VETS3038	0.5
Sudden Death and Emergence Animal Disease Preparedness – Animal Disease case	1.0
Smallgoods microbiology prac – VETS3025	0.5
Virtual abattoir group tutorial using Squizbiz with AQIS – VETS3025	0.5
Rural public practice – VETS5349	26
Elective rotation in Veterinary Public Health with emphasis on Inspection – AQIS veterinarians	26

Summary
The change to the new curriculum with a focus on teaching and learning principles that promote deep and life-long learning has been coupled with integration of material across the curriculum. As a consequence, students gain a real understanding of the professional role of veterinarians in public health. However, the Faculty was advised by the Royal College of Veterinary Surgeons in October 2006 that abattoir experience will need to be reintroduced into the curriculum to meet RCVS and therefore EU guidelines for accreditation. **This will require an urgent response and the Faculty is working with AQIS and industry to address this need.**

4.3 Research

The creation of the new unit has enabled the development of a world class research program to benefit the livestock sector. A comprehensive report is provided as Appendix 1 but the highlights are:

- five young post doctoral fellow employed and engaged to solve problems for the livestock sector
- twelve future researchers in training at PhD , Masters and Hons degree levels
- scientific publications, industry reports and consultancies
- industry workshops
- media activity and newsletters promoting the new initiatives
- an investment by the University of Sydney of $2.1M in 2003 in state of the art laboratories and postgraduate office accommodation at Camden for research in infectious diseases, proteomics and genomics
- research projects funded by MLA, AWI, ACIAR, FRDC, DAFF and other agencies
- greater credibility of primary production issues in general and the livestock sector in particular within the University and within the Faculty, enabling on-going activity and future investment in personnel and infrastructure

5 Success in Achieving Objectives

5.1 Develop and support research capabilities in epidemiology and pathobiology.

A comprehensive research program in epidemiology and pathobiology was established and is ongoing. Details are provided in Appendix 1.

5.2 Develop and deliver research and training programs in epidemiology, disease surveillance and food safety, to postgraduate and undergraduate students, through the Unit;

Research and training programs in epidemiology, disease surveillance and food safety were developed and delivered to postgraduate and undergraduate students through the Unit. A new degree program in Veterinary Public Health Management was established and undergraduate teaching activities were enhanced. A need remains to enhance undergraduate teaching in public health to meet the requirements of the EU.

5.3 Appoint a Chair in Farm Animal Health, who will co-ordinate and manage the Unit, responsible for research, training, and advisory services;

A Chair in Farm Animal Health, Professor Richard Whittington, was appointed to co-ordinate and manage the Unit and take responsibility for research, training, and advisory services.

5.4 Appoint a research assistant to support the research and development of the Unit;

An assistant, Ms Marion Saddington, was appointed to support the research and development of the unit.

5.5 Establish ties with universities in the United Kingdom and North America with the view to developing joint teaching programs and research collaborations for the benefit of Australian industry;

Ties have been established with senior academics at the University of California Davis (Professor Ian Gardner), University of Colorado (Professor Mo Salman) and Michigan State University (Professor Ed Mather), and with the University of Glasgow (Professor Stuart Reid) to enable future development of joint teaching and research programs in epidemiology and public health. Professors Gardner, Mather and Reid have visited Sydney and Dr Toribio has visited Michigan State.

5.6 Develop a viable business entity unit which will, after three years, be financially self-supporting through provision of research capability, post-graduate courses and consultancies;

The Farm Animal Health and Veterinary Public Health group within the Faculty of Veterinary Science consists of university and industry funded staff and both are required to perform its essential

functions. Financial sustainability depends on a flow of funds from external sources, either student fee income for post graduate course work programs, or consultancy and research program income. At the time of writing there is a steady stream of new research program income attributable to the initiative and expertise of academic staff, and post graduate student numbers are stable, suggesting sustainability. However, additional support from industry will be required to tackle the increasing number of issues related to food safety and public health.

5.7 Communicate research results widely (subject to interested parties' intellectual property rights);

Staff from the unit are active in the research community and also in industry groups and the media, ensuring wide communication of research results.

5.8 Work with industry to communicate the benefits of the research programs to industry and the wider community.

Staff from the unit work together with MLA and other stakeholders in the livestock sector to promote the benefits of the research programs. An example is the large role taken by staff of the unit in development of the OJD Harvest Year for MLA.

Further detail on these objectives is contained within the report in Appendix 1.

6 Impact on Meat and Livestock Industry

Safeguarding Australia's unique animal health status is a national priority because it has direct economic benefits. The Productivity commission estimated that a single 12 month outbreak of foot and mouth disease would cost up to $13 billion. Economic benefits accruing to the absence of problems with product integrity have also been noted. For example, there has been a sustained increase in the price of Australian cattle since 1996 from 157 to 385 cents per Kg dressed weight due largely to effective maintenance of Australia's animal health and chemical residue status. This has been of enormous social and economic benefit to rural communities. Dealing with these issues requires their early detection, accurate differential diagnosis, effective response, and seamless communication with trading partners at technical and political levels throughout the incident. Veterinarians are ideally placed to fulfil many of these roles, but only if adequately trained.

This MLA project has led to immediate benefits for industry, and many of these will endure into the long term:

- undergraduate veterinary students better equipped to enter rural veterinary practice
- graduates working in animal health now have a flexible post graduate coursework program to learn skills in epidemiology and public health for immediate application
- leadership and project management are now key elements in post graduate veterinary education so that the process of change can be smooth and efficient
- local and international networks of Sydney postgraduates have been established for informal exchange of information – an immediate benefit in risk assessment for Australia
- a steady stream of young post graduates is becoming available to fill retirement positions
- young post doctoral fellows and PhD research students have greater opportunity to work on real world problems and provide service longer term to the livestock sector
- significant critical mass now exists to conduct research on priority livestock health issues

7 Conclusions and Recommendations

7.1 Conclusions

An epidemiology and pathobiology training and research unit has been established in the Faculty of Veterinary Science at The University of Sydney for the benefit of the livestock sector. Attention has been focussed on the importance of the livestock industries and the role of veterinarians in maintenance of food safety and public health. Significant support now exists within the University of Sydney for the activity of the new unit. Many challenges remain, not the least of which is changing international regulations and trends related to product integrity and risk assessment and the flow on effects into accreditation of veterinary schools and veterinarians.

7.2 Recommendations

7.2.1 Promotional material on the epidemiology and pathobiology training

A brochure outlining the Masters in Veterinary Public Health Management degree program was prepared in 2003 but now needs revising in the light of new units of study and linkages between institutions, while continuing to acknowledge the original sources of funding. It is recommended that MLA agree to the on-going use of its logo on promotional material from the program in recognition of the central role of MLA in program initiation.

7.2.2 Report on research in the epidemiology and pathobiology training and research unit

It is recommended that a booklet or online .pdf with content similar to that presented in Appendix 1 be produced and updated annually to showcase the spectrum of activity within the unit. It is recommended also that MLA agree to the on-going use of its logo in this booklet in recognition of the central role of MLA in establishing the unit and funding many of the specific research projects within it.

7.2.3 Changes in training and research in veterinary public health, food safety and pathobiology

Creation of the new unit has addressed one of several critical needs in training and research related to the livestock sector. However, there remain many issues. In the author's opinion two of the most pressing relate to food safety and anatomical pathology. The new Veterinary Public Health Management degree program includes a unit of study on food safety at introductory level. There is need for a much more detailed and focussed program. Anatomical pathology is dying out as a discipline in Australia and yet it underpins differential diagnosis of most diseases as well as meat inspection. It is very difficult to identify training opportunities for young veterinarians in it or any of the related laboratory-based disciplines. It is recommended that MLA seek industry support for investment in training and research in food safety (in the context of veterinary public health) and anatomical pathology and related fields.

7.2.4 Maintenance of research teams

Support from industry for research programs related to livestock health will need to be sustained to tackle the increasing number of issues related to animal health, food safety and public health, and to ensure human capacity in the future. Research into OJD and internal parasitism are current examples where funding from industry has led to teams of young researchers being created to address an industry problem. These teams need to be nourished in order to retain the young researchers in the service of the livestock sector to replace older researchers who will soon retire from the workforce. It is recommended that MLA explore options for identification and maintenance of livestock health research teams within Australia.

8 Appendices

8.1 Appendix 1

Farm Animal and Veterinary Public Health: research and post graduate 2002-2005. Faculty of Veterinary Science, The University of Sydney. December 2005.

Research and Postgraduate

Farm Animal and Veterinary Public Health

2002 - 2005

Faculty of Veterinary Science

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FACULTY REPORT

FARM ANIMAL and VETERINARY PUBLIC HEALTH

Introduction

I would like to present this report on research and post graduate activity in Farm Animal and Veterinary Public Health on behalf of the Faculty of Veterinary Science, and commend the commitment and activity of the large group of people who have contributed so much during the period 2002-2005.

Farm Animal and Veterinary Public Health encompasses both teaching and research, and links these to provide the greatest possible benefit for the community. The undergraduate teaching outcomes are to be covered in a separate report from the Teaching and Learning Committee, and this report focuses on the achievements in research, post graduate coursework and post graduate research.

Academics and support staff in Farm Animal and Veterinary Public Health form a critical mass and are able to provide service to the community across many species, industries and scientific disciplines. We work extensively with collaborators from other institutions and the private sector both in Australia and overseas. We have a large network of contacts in government, academia and business and strive to ensure that our work is relevant and meets current and future community need.

In this report we provide a brief biography for each member of academic staff, and a project outline for their research projects. Most have been funded through external competitive research grants, which illustrates the calibre of the projects. We place high value on our post graduate students as they will be future leaders, and a summary of each of their projects is also included. Overall, there have been many scientific publications and conference proceedings from our work, a further measure of success, and these are listed in the report.

Farm Animal and Veterinary Public Health includes the traditional disciplines of veterinary medicine, epidemiology, state veterinary medicine, infectious diseases and public health. Each of the traditional and some emerging farm animal species and industries is also included: sheep, cattle, other ruminants, pigs, chickens and aquatic animals. To cover so much the Faculty has made significant investments in staff and because of its commitment to the production animal industries it will continue to play a key leadership role in ensuring animal health professionals have the skills needed to support and strengthen Australia's livestock industries.

In 2001 the Faculty identified an expanding range of opportunities available for veterinary graduates of the 21st century. Nowhere was this more evident than in the area of farm animal and public health. For a two year period from 2000, the Faculty moved strategically to rebuild its core teaching and research expertise in this area and received strong industry support for this. With funding from Meat and Livestock Australia a Chair in Farm Animal Health was created. This Chair is a key investment for the Faculty and its industry partner, providing the leadership needed to push forward major research programs and stimulate the interest of undergraduate students in production animal veterinary science and public health. A factor increasingly recognised as important by the international and Australian communities is understanding of the key issues in farm animal health and food safety. The Faculty is about to begin a vital new partnership with industry to establish a Chair in Veterinary Public Health and Food Safety. Building capacity in these fields is critical for the long-term viability of the farm animal sector.

A selection of significant achievements is outlined here and more details can be found in the report.

Veterinary Public Health Management Program

By 2005 the Faculty had 49 postgraduate students in a new program designed to equip animal health professionals to be future leaders with technical and other skills needed to support the livestock sector. Leadership and project management are key components of the program which also covers epidemiology, food safety, risk analysis, surveillance and much more. Most of the students are from Australia, but there are also international students who enrich the program and extend the network of animal health professionals for the benefit of our industries. A unique feature of the program is its on-line classroom that enables students from remote areas to participate, and short residential workshops ensure that an academic community is established and students participate in a traditional face-to-face environment for key units of study in leadership and project management. Feedback from both students and employers has been very encouraging, and we are confident that the community is receiving long term benefits from the program.

Investment in infrastructure

The University of Sydney has made a strategic investment of $2.1M to renovate the JL Shute Building at Camden to accommodate the new farm animal and veterinary public health team together with researchers in technologies that underpin animal health and production. State of the art laboratories, including biosecurity laboratories for study of infectious diseases and molecular biology facilities were opened in October 2003. Technology available includes flow cytometry, SELDI mass spectrometry, other proteomics technologies, quantitative real time PCR, laser capture microdissection, and more.

Major research program in Johne's Disease

In the most concerted effort yet to come to grips with a complex and frustrating disease, the Faculty has joined with Meat and Livestock Australia (MLA) to undertake intensive research into Ovine Johne's Disease (OJD), a devastating and ultimately fatal disease of sheep already entrenched in south eastern Australia. MLA has provided a $3.2 million grant, funded by the sheep industry, to support research focused on the early diagnosis of infection. This complemented a series of large and small grants to enable a comprehensive on-farm and laboratory-based research program. As this is such a complex and difficult disease, quarantine restrictions have failed to halt the spread of disease, the sheep industry has been polarised in its views on control options and the newly released vaccine does not fully prevent infection. Johne's Disease exists worldwide and many countries live with the disease. Efforts are being made in Australia to control the disease long term, but the lack of basic knowledge about the disease is hindering the design of improved tests, treatment and vaccines. The MLA grant has enabled a team of four leading post doctoral scientists and additional research students to be established to study the basics of Johne's infection. The latest genomics and proteomics technology will be applied to the problem, and over three years it is hoped that discoveries will be made leading to tests capable of detecting the infection before it has had a chance to spread.

Aquatic Animal Health

There is a national goal for Australia to increase aquaculture production three fold to $2.5 billion by 2010. Leadership in teaching and research in aquatic animal health is on the Faculty's agenda with a proposal for a vertically integrated program of study to become part of the animal health and production curriculum. Aquatic animal epidemiology is included as a unit of study in the Veterinary Public Health Management post graduate program and aquatic disease research was made available for the first time in 2004 to students in the BSc(vet) program, a one year full-time research stream within the BVSc curriculum. The Faculty is well-connected to the aquatic animal industries through national and international research projects, participation in the National Aquatic Animal Health Technical Working Group which advises government and the Fisheries Research and Development Corporation Scientific Advisory Committee. The Faculty also has an internationally-recognised role in epidemiology and diagnosis of one of the internationally notifiable viral diseases of finfish, epizootic haematopoietic necrosis virus (EHNV). The Faculty and the Australian Animal Health Laboratory host the Office International des Epizooties (OIE) Reference Laboratory for EHNV which provides research and a diagnostic referral service to the Australian industry, and ensures international diagnostic capabilities by providing technical advice, protocols and immunological and molecular biological reagents to laboratories worldwide. This supports international trade in aquatic animal products.

Diseases such as EHNV present real challenges to both commercial fisheries and to the management of ecosystems worldwide. The Faculty has the opportunity to make an increasing contribution to an often over-looked discipline within veterinary science.

Australian Biosecurity Cooperative Research Centre

The Faculty of Veterinary Science is a supporting partner in the Australian Biosecurity CRC, which will provide solutions to the growing number of issues in emerging infectious diseases of animals and man. The AB-CRC is a truly collaborative venture with enormous potential. The outcomes of the education and training program will be a large number of trained researchers and a new set of training opportunities in epidemiology, risk analysis, emergency response and other disciplines that underpin biosecurity.

Interdisciplinary Network in Public Health

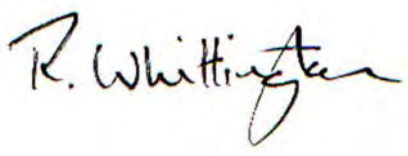
We commenced a new alliance in 2004 to address public health issues from both veterinary and human disciplines. Interdisciplinary Network in Public Health (INPH) grew out of the realisation that the Faculty of Veterinary Science and the School of Public Health in the Faculty of Medicine needed to build linkages, especially in the area of emerging infectious diseases. The Veterinary Public Health Management postgraduate program provided the initial impetus through a joint project with a medical Honours student to develop on-line zoonoses fact sheets appropriate for both medical and veterinary practitioners. Members of the INPH are now drawn from the Faculty of Veterinary Science, the School of Public Health, the National Centre for Immunisation Research, Westmead Hospital, Discipline of Medicine, Department of Infectious Disease, Northern Rivers University Department of Rural Health, and the Australian Centre for Agricultural Health and Safety. The primary concern is to develop core links in research, teaching and community related issues with a focus on infectious diseases and public health. The INPH is an evolving venture and represents an exciting step forward in the development of important and lasting partnerships between veterinary science, medicine and public health, disciplines that traditionally have remained separate.

Gut Immunobiology Research Team

Academic staff from the parasitology and Johne's disease research groups have formed a gut immunobiology team to advance studies on intractable problems facing the sheep industry – gastrointestinal nematodes, which have developed resistance to common anthelmintics, and paratuberculosis. There are many parallels at immunological and pathophysiological levels. The gut immunobiology group is able to pool ideas, equipment, technology and physical resources to maximise the possibilities of finding solutions to these problems.

Pig Health

The pig health group led by Dr Trish Holyoake was recognised in 2005 with the award of a prestigious Australian Research Council Linkage Grant to evaluate vaccination against *Lawsonia intracellularis*, an important intestinal pathogen. Tackling this intractable problem is made possible by the unique partnership with industry (Boehringer Ingelheim and NSW DPI) and the diverse skills in the Faculty in pig husbandry, epidemiology, gut immunobiology and infectious diseases.



Professor Richard Whittington
Chair Farm Animal Health
December 2005

TECHNICAL WORKSHOPS

FOCUS ON FOOD SAFETY
23rd August, 2004, University of Sydney

More than 50 delegates from 25 organisations attended a Faculty workshop on Food Safety and Farmed Animals held on 23rd August 2004, convened by Professor Richard Whittington. The seminar was a tangible demonstration of the Faculty's commitment to producing graduates and researchers able to meet the needs of Australia's future production animal industries. Australia's red meat industries alone could lose $AUD billions per annum in the event of a crisis in consumer confidence, and in the last ten years worldwide, human disease, sometimes in outbreak form, causing death due to exposure to animals or consumption of animal products has been observed. Examples include BSE or mad cow disease (bovine spongiform encephalopathy), Nipah virus in pigs, *E. coli* O157 in ground meat and hepatis A virus in oysters.

Keynote speaker was **Professor Will Hueston**, Director, Centre for Animal Health and Food Safety, College of Veterinary Medicine, University of Minnesota. Other internationally-recognised experts included **Professor Ian Gardner**, Professor of Epidemiology, Department of Medicine and Epidemiology, University of California, Davis, **Dr Bob Biddle**, Australian Deputy Chief Veterinary Officer, Department of Agriculture, Fisheries and Forestry Australia, Canberra and **Mr Ian Jenson**, Food Safety Program Manager, Meat & Livestock Australia.

Professor Ian Gardner (eft), Professor Will Hueston (centre) and Dr Jenny-Ann Toribio

The workshop provided the Faculty with a clear message that it has a significant impact in ensuring the well-being of the community through the role of veterinarians in food safety. The workshop was sponsored by the Australian Government Department of Agriculture, Fisheries and Forestry, Meat and Livestock Australia, Rabo Bank, Australian Meat Industry Council, Australian Biosecurity CRC and the Faculty's Veterinary Public Health Management Program.

ACHIEVING SUSTAINABLE RESEARCH DEVELOPMENT & EXTENSION OUTCOMES WORKSHOP: IDENTIFYING, UNDERSTANDING AND ASSESSING METHODS"
1st September 2004, University of Sydney

An interactive workshop, attended by 20 participants from 6 organisations, designed to identify, understand and assess specific methods that enhance the achievement and sustainability of research, development and extension outcomes in agriculture was hosted in the Faculty by Dr Jenny-Ann Toribio. Presenters included Dr Alberto Taveros, Dr Agnes Taveros, Dr Fe Gabunada and Mrs Elenita Espinosa, Leyte State University, Richard Clark, Queensland DPI, Dr Fay Rola-Rubzen, Curtin University.

The workshop was based on presentations from researchers involved in the Leyte Livestock Improvement Program (LLIP). This is an ACIAR-funded program working with smallholder farmers in the Philippines to improve and innovate their pig and chicken production systems, in order to increase their outcomes in profit, environment and efficiency. The workshop presentations focused on three aspects of the LLIP work: the methods used; results achieved; and the contribution of methods to sustaining outcomes after project completion. Throughout the workshop time was allocated for participants to question the methods presented, offer suggestions for improvement and evaluate their potential application in other agricultural research settings.

Hosting of this workshop by Farm Animal Health demonstrated the interest in and ability of our group to contribute in innovative and applied ways to research, development and extension that will achieve sustained outcomes for livestock enterprises in developing countries.

AQUACULTURE IN THE UNIVERSITY OF SYDNEY WORKSHOP
12th August, 2005, University of Sydney

The College of Science and Technology hosted a strategic planning workshop organised by Professor Richard Whittington with representatives from NSW Department of Primary Industries, the School of Aquaculture University of Tasmania and the Department of Agriculture Fisheries and Forestry. Guest speakers Dr Geoff Allan and Dr Barbara Nowak outlined the state of development of the aquaculture sector in Australia and internationally and outlined opportunities in teaching and research. Activities and capacity at the University of Sydney were presented by academic staff from The Faculties of Veterinary Science, Agriculture Food and Natural Resources and the Schools of Biomedical Sciences and Biological Sciences. The outcomes of the workshop included a commitment to work with other organisations to develop complementary streams in undergraduate teaching for markets in Australia and overseas and collaborative research. Pathways of study will be developed at the University of Sydney to cater for students with an interest in aquaculture and fisheries.

MLA OJD HARVEST YEAR CONFERENCE
8th – 9th December, 2005, Adelaide

The Faculty assisted Meat and Livestock Australia (MLA) in the planning of the MLA OJD Harvest Year Conference, Adelaide December 8-9 2005. The organising committee met at Camden on many occasions to create a major event with industry to showcase the outcomes of the 1998 – 2004 national research program. The Faculty's post doctoral researchers, post graduate students and academics were prominent among the many scientific and industry presenters at this meeting.

Producers from each of the states enthusiastically supported the opportunity to discuss the latest technological developments with senior scientists, young researchers and representatives of government agencies.

VISITING ACADEMICS

2003

Dr Edward Mather
Michigan State University

Dr Edward Mather, Deputy Director of the National Food Safety and Toxiocology Center at Michigan State University (MSU), visited the Faculty in February 2003. Dr Mather was a special international guest at the first residential for the postgraduate coursework Veterinary Public Health Management program at the invitation of then Dean Professor Reuben Rose. Dr Mather, as Program Director of the on-line Professional Master of Science in Food Safety (ProMS) Program at MSU, had experience to share in the establishment of on-line training programs. He provided an inspirational speech at the inaugural annual dinner, sharing his insights on food safety and public health issues in the USA. In addition he attended the residential teaching sessions and offered comment on suitability of the structure and content for Masters students. Dr Jenny-Ann Toribio later visited MSU and further joint activity in the discipline is planned.

2004

Professor Ian Gardner
University of California, Davis

Professor Ian Gardner, Professor of Epidemiology, Department of Medicine and Epidemiology, University of California, Davis, received a prestigious New South Wales Residency Expatriate Scientists Awards and visited the Faculty of Veterinary Science for three months in 2004.

This program is a joint initiative of three partners: the University of Sydney, CSIRO and the NSW Department of Education and Training. The selection process was based on the academic quality, the relevance and potential benefit of the applicant's collaborative research proposal for the University of Sydney and/or CSIRO and the ability of the applicant to communicate effectively especially with high school students.

Professor Gardner made a tremendous impact in his tour of NSW high schools to promote science, and in the Faculty where he presented numerous seminars, and undergraduate lectures. Research outcomes included proposals for joint projects in Johne's disease, and links between the two universities in Veterinary Public Health.

2005 - 2006

Dr ChuanQing Wang
Henan Agricultural University, Zhengzhou

Dr ChuanQing WANG is Professor of Infectious Diseases and Head of the Department of Veterinary Science Agricultural University, Zhengzhou. His research interests are in the rapid diagnosis and prevention of animal infectious diseases and recently has had projects in immunology and virology in pigs and poultry. He gained his BSc in Animal Medicine Science in 1982 from Henan Agricultural University and his PhD in 1998 from Nanjing Agricultural University.

Dr Wang's visit is funded by the Chinese Government and he will join the Farm Animal Health group at Camden to work in aquatic animal virology. This is a field of growing importance internationally and Dr Wang will assist in an ARC Linkage project that aims to control nodavirus infection in barramundi aquaculture.

POSTGRADUATE COURSEWORK

VETERINARY PUBLIC HEALTH MANAGEMENT

The foot and mouth disease outbreak in the United Kingdom in 2001, together with the bovine spongiform encephalopathy food safety crisis highlighted the need to have systems in place for both surveillance and effective training of veterinarians at post graduate level. To ensure we have the skills needed in the veterinary profession and in response to this urgent need for trained veterinarians to service national and regional livestock industries, the Faculty developed a postgraduate training program in epidemiology and veterinary public health. The project, which is supported by Meat and Livestock Australia, the Vincent Fairfax Family Foundation, the McGarvie Smith Trust and the Australian Government Department of Agriculture, Fisheries and Forestry has received widespread support from industry, government, community organisations and the University.

The program has two major objectives. The first is to develop veterinarians with technical expertise in veterinary epidemiology, food safety, zoonotic diseases, animal health economics, disease control, and animal health policy development. The second is to provide skills focused on teamwork, team leadership and project management. There are recognised needs for veterinarians in animal health industries to work in multidisciplinary teams, and to manage research and policy processes.

The postgraduate program has three articulated award courses at the Graduate Certificate, Graduate Diploma and Masters levels and is offered by a combination of distance education units of study and short, intensive residential units. Distance education units provide an appropriate learning environment for busy professionals, with small group interaction via a web-based classroom.

Throughout 2003 and 2004, experienced, external unit of study facilitators were recruited and taught alongside academic staff from the Faculty of Veterinary Science. Eight new units of study were developed in 2004 to complement those developed in 2002-2003.

There were 49 students enrolled in VPHMgt units in 2005. The first student, George Hughes, graduated in December 2004 and others graduated in April 2005 having completed a masters thesis in 2004.

The quality of each unit of study was ensured by academic review by a prominent leader in the relevant field as well as by instructional design consultation throughout the development process and for first-time delivery of each unit. Quality assurance systems for all areas of the new program were developed, implemented and are measured against standards.

The high priority given to student support was enhanced in 2004 and 2005 with the development of new and robust systems for admissions, enrolment and induction that are seamless for postgraduate distance students. Student feedback on support in the program, which is assessed each year with a student support and administration survey, is very positive.

Support from key sponsors has been critical to program development –approximately $650,000 for the period 2002 – 2005. This has enabled:

- Consultation and collaboration with representatives of the livestock industries, the veterinary profession and government and academic personnel
- Development of graduate attributes, curriculum, documentation, quality systems, assessment policy and program infrastructure
- Authorship, academic review and instructional design of 18 new units of study over 2002-2005
- Training of new facilitators in online teaching and learning
- Preparation of guidelines, supervision and support schemes for Masters research projects
- Development of systems for ongoing professional development in online teaching and learning for facilitators
- Marketing the new program to both employers and potential students
- Supporting high quality education for a relatively small number of new students during the development period

Units of study now available include:

- Veterinary Epidemiology 1
- Veterinary Epidemiology 2
- Animal Health Economics
- Data Analysis for Policy Development
- Animal Health Data Management
- Hazards to Human & Animal Health
- Leadership 1
- Leadership 2
- Leadership 3
- Project Management
- Aquatic Animal Epidemiology
- Food Safety
- Surveillance, Preparedness and Response
- Risk Analysis

Hannah Forsyth, Meg Vost and Renee Fulton

The VPHMgt development project has progressed according to plan, with the successful development and delivery of 16 units of study to date, within budget. Projections for 2005 and 2006 indicate that the program will be fully self-funding from 2006.

VPHMgt is coordinated through the tireless efforts of Hannah Forsyth with assistance from Meg Vost and Renee Fulton. A management team is led by Professor Richard Whittington, academic leadership is provided by Dr Jenny-Ann Toribio and an industry advisory group ensures community linkage.

National & International Facilitators

Dr Sam Beckett	Australian Government Department of Agriculture, Fisheries and Forestry
Dr Peter Black	Australian Government Department of Agriculture, Fisheries and Forestry
Dr Tracey Bradley	Victorian Department of Primary Industries
Dr Angus Cameron	AusVet Animal Health Services
Dr Robert Dixon	University of Sydney
Dr Kevin Doyle	Australian Veterinary Association
Dr Hume Field	Jeppesen Field P/L
Professor Ian Gardner	University of California, Davis
Dr Graeme Garner	Australian Government Department of Agriculture, Fisheries and Forestry
Ms Wendy Grusin	Australian Graduate School of Management
Dr Henk Hogeveen	Wageningen University, The Netherlands
Dr Jenny Hutchison	Australian Government Department of Agriculture, Fisheries and Forestry
Professor Ali Jafa'ari	University of Sydney
Dr David Jordan	New South Wales Department of Primary Industries
Ms Ruth Laxton	Education Design Consultant, RL Learning Designs
Dr Nick Malikides	Australian Biosecurity CRC/University of Sydney
Dr Simon More	University College Dublin
Dr Monique Mourits	Wageningen University, The Netherlands
Dr Mike Nunn	Australian Government Department of Agriculture, Fisheries and Forestry
Ms Loretta O'Donnell	Australian Graduate School of Management
Dr Stephen Page	Advanced Veterinary Therapeutics
Dr Edmund Peeler	Centre for Environment Fisheries & Aquaculture Science, UK
Dr Dick Roe	Veterinary Consultant
Professor Reuben Rose	Meat and Livestock Australia
Professor Mo Salman	Animal Population Health Institute, Colorado State University
Dr Gerdien Van Schaik	Universidad Austral de Chile
Dr Evan Sergeant	AusVet Animal Health Services
Dr Sophie St-Hilaire	Centre for Environment Fisheries & Aquaculture Science, UK
Dr Peter Thomson	University of Sydney
Mr Gary Timm	Project Management Consultant
Assoc Prof Meg Thorburn	University of Guelph
Dr Jenny-Ann Toribio	University of Sydney
Dr Jonothan Webber	Veterinary Consultant
Prof Richard Whittington	University of Sydney, Chair, VPHMgt Program
Dr Marion Wooldridge	Centre for Epidemiology and Risk Analysis,VLA, UK

RESEARCH PROJECTS UNDER MANAGEMENT

Title	**An epidemiology and pathobiology, training and research unit at the University of Sydney (AHW.007)**
Farm Animal Health Staff	Professor Richard Whittington Dr Jenny-Ann Toribio Dr Nick Malikides Ms Hannah Forsyth Mrs Anna Waldron Ms Marion Saddington
National Collaborators	Australian Biosecurity CRC
International collaborators	Professor Ian Gardner, University of California Davis
Summary	In 1999 the gross value of Australian livestock production was $13.4bn of which $11.5bn came from exports. The Australian economy and the rural sector depend on this trade, which is based on efficient production, marketing, quality assurance and access to major markets in the developed world. Most of these markets have a favourable status for the major epidemic diseases of livestock. Compared to many competitors, Australia enjoys privileged access due to the historical absence of important livestock diseases. This project was undertaken because a critical shortage of the skills required by the livestock industries is looming. The loss of animal health laboratories, trained livestock health specialists, together with the loss of government employed district veterinary officers and epidemiologists, has dramatically weakened the national defences against disease incursions, threats to product integrity and market access. The aim of this project was to establish a new teaching and research unit in the Faculty of Veterinary Science. Research and training programs in epidemiology, disease surveillance, pathobiology and food safety were developed and delivered to postgraduate and undergraduate students. A new post graduate degree program in Veterinary Public Health Management commenced. Ties were established with overseas universities to enable future development of joint teaching and research programs. Staff from the unit are active in the research community, in industry groups and the media, ensuring wide communication of research results. Staff work together with stakeholders in the livestock sector to promote the benefits of the research programs. This MLA project has led to immediate benefits for industry, and many of these will endure into the long term: undergraduate veterinary students are better equipped to enter rural veterinary practice; graduates working in animal health now have a flexible post graduate coursework program to learn skills in epidemiology and public health for immediate application; a steady stream of young post graduates is becoming available to fill retirement positions; young post doctoral fellows and PhD research students have greater opportunity to work on real world problems and provide service longer term to the livestock sector; significant critical mass now exists to conduct research on priority livestock health issues.
Source of Funding	Meat and Livestock Australia Limited
Project timeframe	February 2002 – January 2006

Title	**Exposure Factors – OJD Infection & Clinical Disease (OJD.002)**
Farm Animal Health Staff	Professor Richard Whittington Dr Om Dhungyel Ms Anna Waldron
PhD Students	Ms Helen McGregor Mr Sanjeev Gumber
National collaborators	Professor Kym Abbott, Charles Sturt University Novartis Australia Ltd Merial Australia Pty Ltd

Summary

The aim of this project was to demonstrate whether pastures of low infectivity can be prepared and effectively used to reduce the level of OJD infection, potential production losses and mortalities from OJD in adult sheep in endemically infected flocks.

Sheep were exposed to different levels of *M ptb*, from birth to weaning and/or from weaning onwards. The different levels of exposure were high (H), medium (M) and low (L) with the level of exposure in the H groups about 10 times higher than in the M groups. The L groups were not deliberately exposed to *M ptb* but accidental contamination at very low levels did occur. The experiment was replicated.

The study demonstrated that careful management of young sheep can reduce the level of OJD in the flock and reduce the death rate. Steps taken to limit the degree of exposure of pre-weaned lambs to infection from pastures will lead to reduced rates of severe infection in those sheep in later years. Continuous exposure to OJD bacteria throughout early life results in higher infection rates than exposure which is limited to either the pre-weaning or the post-weaning period alone. A critical factor in management is to provide 'low risk' pastures to young sheep at weaning to give them a break from exposure to infection which occurs in the lambing paddocks.

Producers who successfully limit the infection will find themselves in an improved position. Additionally, by using the library of samples collected during the experiment, many more insights will be gained into the epidemiology of OJD, including the relationship between age at first exposure and the time before excretion of the organism, seroconversion, sub-clinical disease effects, clinical disease and death. These insights may allow the development of additional management options and systems which restrict the impact of OJD in flocks and will also improve the overall understanding of the pathogenesis of the disease, interpretation of existing and new diagnostic tests and the value of emerging research tools.

Source of Funding	Meat and Livestock Australia
Project timeframe	September 1999 – December 2004

Title	**Effects of whole-flock vaccination for OJD (OJD.015)**
Farm Animal Health Staff	Associate Professor Peter Windsor Professor Richard Whittington Dr Om Dhungyel
PhD Student	Ms Helen McGregor

Summary

Vaccination with Gudair ® vaccine in OJD infected flocks has commenced in Australia. To date, use of vaccine has been recommended to be limited to lambs in an attempt to protect sheep before OJD pathology becomes advanced. As vaccination is considered by many graziers to be their best option for reducing losses and managing the disease, careful documentation of the effects of vaccination in a high prevalence infected flock and in older sheep will enhance knowledge and understanding of the benefits of the whole-flock vaccination strategy.

The proprietors of a farm reported a very high mortality believed to be due to OJD. Early estimates suggested that 25% of the flock had died in 1999. A preliminary investigation by The University of Sydney supported the owner's initial suspicion, with post mortem findings suggesting an annual mortality rate of 18.1% (+/- 12%). Vaccination of all sheep was favoured as the quickest way to reduce the OJD-contamination of pastures, the incidence of OJD and the death rate due to OJD.

The study concluded that vaccination combined with management changes led to a significant decline in the risk of OJD mortality and effective control of OJD in a heavily infected flock. Findings also suggested that vaccination may be beneficial in sheep as old as 8 months, even when exposed to a heavily contaminated environment since lambing.

This information will have immediate application to a large number of affected producers in NSW who have chosen or are considering vaccination as their major or initial method of OJD control.

This study provided the first estimate of flock mortality due to OJD based on objective data and was central to explaining the economic impact of OJD in high prevalence flocks. This information assisted development of rational control programmes.

Source of Funding	Meat and Livestock Australia
Project timeframe	September 2000 – June 2004

Title	**A study of the biological and economic impacts of OJD in affected sheep flocks in NSW (OJD.023)**
Farm Animal Health Staff	Dr Jenny-Ann Toribio Associate Professor Peter Windsor
PhD Student	Mr Russell Bush

Summary

Anecdotal reports of the extent of mortality due to ovine Johne's disease ranged from less than 1% to over 20% of adult sheep per year, but there were no objective data. This aim of this study was to estimate the annual mortality rate due to OJD on twelve affected sheep flocks in four different regions of NSW using the methods developed in project OJD.015.

OJD mortality estimates were derived from farm records (livestock inventories) and quarterly farm visits (necropsy inspections). A most likely cause of death was determined for 362 sheep on the basis of findings related to the environment, clinical signs, gross pathology and histopathology. OJD was most likely to have contributed to the death of 250 of these sheep. OJD mortality increased from 1 year of age (10.4%) to peak at 4 years of age (35.6%) and was very similar between wethers (49.6%) and breeding ewes (50.4%).

On the 12 farms, the average OJD mortality rate based on inventory records was 6.2% (range 2.1% to 17.5%), more than twice that considered acceptable (from all causes) in sheep flocks in southern Australia. The OJD prevalence in 2-year old sheep based on pooled faecal culture ranged from 0.7% to > 23% on the 12 farms and was found to be associated with OJD mortality rate.

The average decrease in gross margin due to a farm being infected with OJD was 6.4% (range 2.2% to 15.4%) and the average estimated cost of OJD losses on the 12 farms over the 12- month study period was $64,100 ($15,569 to $154,083). The average estimated cost of annual OJD losses/DSE was $7.68 ($0.84 to $20.51) while annual OJD losses/ha were $65.92 ($6.75 to $244.80).

This study provided the first objective data on the true impact of OJD and the findings are generally applicable to sheep flocks in southern Australia. Industry groups claiming that OJD does not present a threat on-farm can now be provided with accurate figures on direct losses attributable to OJD within the endemic area of NSW. There was a wide range of impacts, with some very high mortality rates. The data can be used to justify vaccination programs, other control options and the general concept of disease control and prevention.

The challenge for industry is to use the scientific findings from this study and other recent research to prepare education and extension material to address issues of misinformation about OJD and to develop cost effective strategies for the future control and management of OJD.

Source of Funding	Meat and Livestock Australia
Project timeframe	September 2001 – October 2005

Title	**Epidemiology of ovine Johne's disease – pasture contamination level, age susceptibility and diagnostic tests (OJD.028)**
Farm Animal Health Staff	Professor Richard Whittington Dr Om Dhungyel Mrs Anna Waldron Ms Natalie Schiller Ms Angela Reeves
PhD Students	Ms Helen McGregor Mr Sanjeev Gumber
National collaborators	Australian Animal Health Laboratory, CSIRO

Summary

The aim of this project was to determine whether pasture contamination rates and the age of sheep when they are first exposed to infection influence the occurrence of ovine Johne's disease. The outcomes were targeted to improve understanding of the development of OJD and will facilitate development of control strategies based on pasture management.

The principle conclusions from this study were that post weaning lambs were highly susceptible to infection with *M. paratuberculosis* and if exposed to high levels of contamination a proportion will develop severe infection leading to clinical disease and death. Hoggets and adult ewes are less likely than lambs to develop clinical disease after exposure to *M. paratuberculosis.* Nevertheless, even adult ewes may become infected and later act as a source for transmission of the disease. Lateral spread of OJD is a serious threat; it is not necessary for infected sheep to be present in a paddock for transmission of infection to occur if infected sheep are present in neighbouring paddocks. Conventional wire strand fences do not prevent spread of infection. For diagnosis on a flock basis, pooled faecal culture is more effective than the agar gel immunodiffusion assay for detection of the infection at relatively early stages in young sheep. Pooled faecal culture detected infection in sheep only 6 months after first exposure to contaminated pasture, when they were 11 months of age.

Samples were stored from sheep in this project for later research, for example in project OJD.031. In addition, blood samples were provided regularly to CSIRO for validation of the gamma-interferon assay for diagnosis of OJD.

The results of this study will have immediate impact on the management and control of OJD as they provide objective data to support and extend current recommendations for livestock grazing management.

Source of Funding	Meat and Livestock Australia Limited
Project timeframe	November 2001 – June 2005

Title	**Pathogenisis of OJD Strategic Research for Diagnosis and Prevention (OJD.031)**
Farm Animal Health Staff	Professor Richard Whittington Dr Kate Bosward Dr Lyrissa Di Fiore Dr Doug Begg Dr Reena Mehta Ms Natalie Schiller Dr David Emery Dr Kumi de Silva Dr Deborah Taylor Ms Nicole Carter Mrs Anna Waldron Ms Angela Reeves
PhD Students	Ms Sally Browne Mr Sanjeev Gumber Mr Ian Marsh Ms Kate Goldsmith Ms Ling Zhong
National collaborators	NSW Department of Primary Industries, Elizabeth Macarthur Agricultural Institute

Summary

Ovine Johne's disease is a chronic and intractable problem. Spread of the disease has continued despite stringent regulatory measures, and in the absence of compensation for affected producers has led to severe division within the industry. Vaccination and risk-based trading have been accepted as an interim approach to limit further spread of the disease.

There is clearly an urgent need for better diagnostic tests. The main requirement is for a test that can detect infection in young sheep before the onset of faecal shedding. The test needs to be sensitive, specific, accurate, cost effective and able to distinguish an active infection from one that has died out. New automated technology platforms will be needed if tests are to have wide application in the sheep industries.

None of the work on OJD to date has included basic research. However, the need for this has been recognised and these are opportunities to take advantage of new technologies. Consequently the aims of this program are to research fundamental aspects of OJD including host-pathogen interactions at the cellular level. Protemics, genomics and advanced immunology techniques will be applied to *in vivo* and *in vitro* models to study the early stages of infection and contrast these with events later in the disease process. The aim is to discover new pathways for disease development and expression that can be exploited later for development of diagnostics, vaccines and chemotherapeutics.

Source of Funding	Meat and Livestock Australia
Project timeframe	September 2002 – December 2007

Title	**Changes in within-flock prevalence of *Mycobacterium paratuberculosis* shedding following vaccination with Gudair in high and low prevalence flocks (OJD.033)**
Farm Animal Health Staff	Associate Professor Peter Windsor Professor Richard Whittington
National collaborators	Dr Jeff Eppleston, Central Tablelands Rural Lands Protection Board Dr Evan Sergeant, AusVet Animal Health Services

Summary

The purpose of the project is to validate the widespread use of Gudair® vaccine for the reduction of bacterial shedding in medium/high prevalence flocks and the prevention of increased shedding in low prevalence flocks. The major outcome from the project will be to allow producers to predict the infectivity of flocks over time following the commencement of a vaccination program.

There is much producer interest, both at an individual and industry level, in the use of Gudair® vaccine to control the impact of OJD in flocks varying in disease prevalence from very low to very high. This project will observe changes over time in the prevalence of mycobacterial shedding following the commencement of a Gudair® vaccination program in flocks varying in initial OJD prevalence. Up to four flocks, each with high, medium or low OJD prevalence at the commencement of a vaccination program will be sampled over a six-year period to estimate changes in the prevalence of shedding as the proportion of vaccinates in the flock increases.

The relevant industry questions being addressed in this project are as follows:

- how long will it take for a vaccination program to reduce mycobacterial shedding to a level where safe trade in low risk sheep can occur?
- can the disease be eradicated by long term vaccination?
- how effective will vaccination be in low prevalence flocks in the control zone?
- will vaccination prevent the increase in losses commonly seen in long term infected flocks?
- can healthy sheep be vaccinated on arrival at an infected property so that infection and shedding is prevented?

Source of Funding	Meat and Livestock Australia
Project timeframe	January 2003 – March 2008

Title	**Identification of risk factors for OJD-infection level in sheep flocks (OJD.038)**
Farm Animal Health Staff	Dr Jenny-Ann Toribio Professor Richard Whittington
PhD Student	Mr Navneet Dhand
National collaborators	Dr Jeff Eppleston, Central Tablelands Rural Lands Protection Board Dr Evan Sergeant, AusVet Animal Health Services

Summary

The level of clinical disease experienced due to ovine Johne's disease (OJD) appears to vary considerably between infected sheep flocks in Australia, even for flocks in the same locality that appear to have similar characteristics. This has led to considerable speculation about the potential importance of flock management, soil type, pH and micro-nutrients. Sound understanding about factors that influence disease expression will lead to management recommendations that improve on-farm disease control.

The aim of this project was to identify risk factors for OJD expression in infected flocks and improve the understanding of the epidemiology of the infection. The project consisted of a cross-sectional study on 92 infected properties located in New South Wales, Victoria, Tasmania and Western Australia. The information obtained from each included the OJD prevalence in specific groups of adult sheep measured using pooled faecal culture, details of farm and flock management and soil analyses from paddocks on which the sheep sampled had grazed.

A total of 31 significant farm/flock/management and soil variables were found. Some were likely to be a consequence of OJD infection, but the remainder appeared to be potential risk factors for the severity of the disease. There was a strong relationship between the PFC results and the duration of flock infection, the level of OJD mortality, dam stocking rates, as well as a relation with parent soil type. There was also a consistent but statistically non-significant trend for lower OJD levels in 4-year olds compared to 3-year olds, which may be due to deaths of affected sheep from 2 to 3 years of age. Wethers had significantly higher OJD levels than ewes, which strongly supports the anecdotal observation of higher losses in wether mobs. Higher OJD prevalence was linked to measures correlated with soil fertility including cation exchange capacity, phosphorus buffer index and organic matter content of soil.

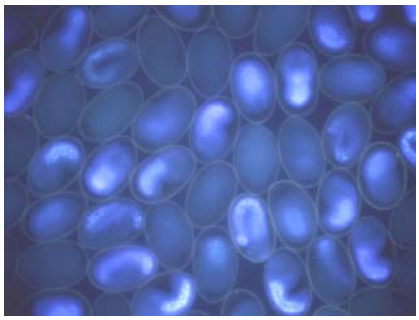
Successful completion of this project enables the development of additional recommendations for on-farm control measures for OJD to support vaccination, and may help clarify the ecological niche of *M. paratuberculosis*, the potential for disease spread into areas not currently affected and the likely level of disease that would be experienced in these areas.

Source of Funding	Meat and Livestock Australia
Project timeframe	January 2004 – June 2005

Title	**Enabling technologies of RNAi and cell culture for internal parasites of sheep (AHW.032)**
Farm Animal Health Staff	Professor Nick Sangster
Postdoctoral Fellow	Dr Michelle Power
Technical Officer	Ms Krishanthi Gunarathnam

Summary

Research into the biology of sheep nematode parasites suffers from the lack of molecular techniques to study gene function and cell biology. Techniques such as RNA interference and cell culture have potential to improve our understanding of parasites and to identify novel control targets.



Nematode eggs

RNAi is a technique of gene silencing where individual genes can be switched off and the effects observed. If the affected worms are affected (for example, are paralysed) the gene product may be a good candidate as a control target. Cell culture allows the study of isolated worm components. Given that it is difficult to cultivate these parasites *in vitro*, cell culture could open up approaches to studying cell biology that are currently unavailable.

In this project we have developed phenotyping tools that will be used to measure RNAi effects and have commenced the gene knockout experiments. These are currently available in the free-living stages of the parasite, but the ultimate aim is to develop the technique for parasites in sheep. Cells recovered from worms have been grown in culture. These will be used to study defined cell types and as a platform for RNAi. They offer several potential advantages as it may be easier to deliver RNA to these cells and their responses will be simpler to interpret than responses in sheep.

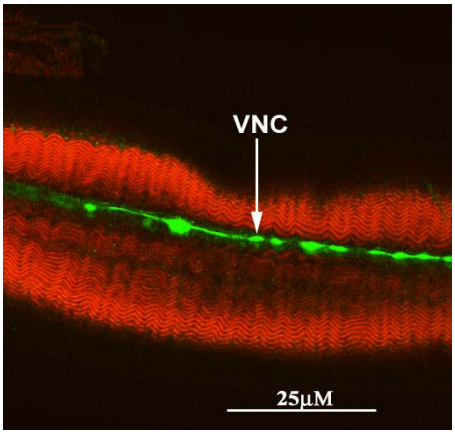
The aim is to develop tools for further research. This project falls into a multi-institutional research program with the aim of discovering targets for improved parasite control.

Source of Funding	Meat and Livestock Australia Australian Wool Innovation
Project timeframe	February 2004 – February 2006

Title	**Neuromuscular physiology of nematode parasites of sheep**
Farm Animal Health Staff	Professor Nick Sangster
International collaborators	Dr Janina Demeler Dr Arbeit Fellow (University of Hannover)

Summary

The neuromuscular physiology of nematodes is a rich source of potential parasite control targets. Nerves and muscle are also the site of the action of a range of current anthelmintic drugs. This project has two parts, one to explore the neuromuscular basis of ivermectin resistance with a view to developing resistance detection assays and the second is to discover novel neuropeptides and their receptors which may be useful targets for parasite control.



Several assays are used in the laboratory to measure: muscle contraction (using a force transducer), development, motility, migration and electrical responses in the pharynx of worms. The laboratory is equipped with electrophysiology gear that can be used to measure a range of electrical responses, including patch clamp and voltage clamp.

Several assays are used in the laboratory to measure: muscle contraction (using a force transducer), development, motility, migration and electrical responses in the pharynx of worms. The laboratory is equipped with electrophysiology gear that can be used to measure a range of electrical responses, including patch clamp and voltage clamp.

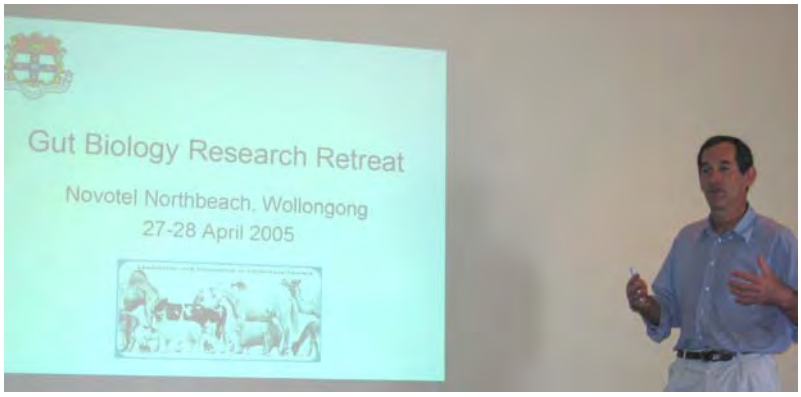
The project aimed to understand the pharmacology of avermectin/ivermectin resistance in sheep nematodes. This information will help develop tools for molecular diagnosis in the future. The work showed that:

- drug action and resistance occurred at two distinct sites, pharynx and body muscle of worms
- the two major drug classes act in similar ways but their receptor populations are not identical in distribution in the worms or and the three species of parasites
- resistance is most likely due to different mechanisms in the different species and even isolates of the same species. A single test for resistance is not likely to be found

Janina Demeler who carried out this work was awarded her Dr Arbeit at the Tierartzliche Hochschule Hannover and the prize for the best thesis in 2005.

Source of Funding	Australian Research Council Pfizer Australia
Project timeframe	August 2003 – August 2005

Title	**Analysis of critical genes in the sheep/*Haemonchus* relationship**
Farm Animal Health Staff	Professor Nicholas Sangster Associate Professor David Emery Dr Tony Rowe
National Collaborators	The SGP includes scientists from: CSIRO Livestock Industries, University of Melbourne and the University of Sydney
Summary	This project dovetails in with our existing project on the sheep/ *Haemonchus* relationship. The emphasis in this new project is to add value by carrying out DNA microarray experiments to identify sets of sheep genes which are up or down regulated during critical events in establishing immunity to *Haemonchus*. Further work to validate these genes will be performed using quantitative PCR and immunocytochemistry. The aim is to identify genes which may act as future markers for selection of sheep able to mount effective immune responses to worms.
Source of Funding	Meat and Livestock Australia Australian Wool Innovation
Project timespan	May 2004 – April 2007
Linked Project	**Characterisation of critical genes in the sheep/*Haemonchus* relationship**
Source of Funding	Meat and Livestock Australia and Australian Wool Innovation within the Sheep Genomics Project (SGP)
Project timeframe	November 2005 – July 2007



Title	**Eradicating footrot by specific vaccination (EC511)**
Farm Animal Health Staff	Professor Richard Whittington Dr Om Dhungyel Ms Angela Reeves
National Collaborators	Emeritus Professor John Egerton Dr Jeff Eppleston, Central Tablelands Rural Lands Protection Board Dr John Seaman, NSW Department of Primary Industries Dr Alison Lee, Department of Primary Industries, Victoria Dr Neil Buchanan, Department of Primary Industries and Resources, South Australia Dr Mick Middleton and Dr Cameron Bell, Tasmanian Department of Primary Industries, Water and Environment

Summary

Footrot is caused by the bacterium *Dichelobacter nodosus*, a parasite of the feet. This bacterium is unable to survive off the foot for more than one week. Eradication of footrot is therefore possible if all sheep with footrot are removed from a flock. Current techniques to achieve this are labour intensive, expensive and often take several years to achieve eradication. Vaccination is an alternative approach.

Current footrot vaccines contain ten strains of bacteria to provide coverage of the major *D. nodosus* serogroups. These vaccines offer only temporary (12 weeks) protection against footrot, so they are used in control campaigns, rather than for eradication. It has been demonstrated that eradication of footrot using vaccines is possible if the vaccines only target one or two groups of the bacterium at a time because immunity is long-lasting. This project will evaluate this approach under Australian conditions.

Objectives of the project:

1. Produce specific footrot vaccines for local (Australian) strains of the footrot bacterium.
2. Evaluate the use of these targeted footrot vaccines using one or two different antigens per vaccination in the eradication of virulent footrot in Australian sheep.
3. Demonstrate the use of these vaccines to remove virulent footrot on 12 commercial farms across areas of high footrot prevalence in southeast Australia.
4. Evaluate the minimum interval between vaccination with different vaccines to deliver an accelerated eradication program (less than twelve months between different vaccines).
5. Enable application for a minor use permit from the Australian Pesticides and Veterinary Medicines Authority (APVMA) to allow the use of these vaccines on farm and also aid transfer of the vaccine to commercial production facilities.

Source of Funding: Australian Wool Innovation

Project timeframe July 2005 - June 2010

Title	**The role of *Dichelobacter nodosus* genes in pathogenesis of footrot in sheep**
Farm Animal Health Staff	Professor Richard Whittington Dr Om Dhungyel Mr Craig Kristo
National Collaborators	Dr Leslie Reddacliff, NSW Department of Primary Industries, Elizabeth Macarthur Agricultural Institute Professor Julian Rood*, Monash University

Summary

Ovine footrot is a highly infectious bacterial disease that is of major ongoing concern to the Australian wool industry, causing significant economic losses as a result of its effect on wool production, farm management, animal welfare and the cost of control and treatment programs. The causative bacterium is *Dichelobacter nodosus*.

The overall objective of this research is to develop improved methods for the control and treatment of ovine footrot. The specific research aims are:

1. To identify *D. nodosus* genes that are differentially expressed in the virulent footrot lesion.
2. To determine the role of differentially expressed genes in the disease process.
3. To determine the value of whole genome based microarrays for the epidemiological analysis and diagnosis of field isolates of *D. nodosus*.
4. To identify surface or secreted *D. nodosus* antigens that induce the production of bactericidal antibodies in sheep.
5. To determine the vaccine potential of *D. nodosus* antigens that are either essential for the disease process or induce the production of bactericidal antibodies.

The successful completion of the project should lead to the subsequent commercial development of a protective footrot vaccine, with significant cost savings to wool producers and the Australian wool industry. It will also lead to a greater understanding of the epidemiology of footrot infections and may result in the development of improved methods for the laboratory diagnosis of ovine footrot.

This research program represents the pre-commercialisation phase of the development of a new generation of footrot vaccines. The successful identification of candidate antigens that can be used to develop a protective footrot vaccine will be subject to the uncertainty of dealing with a variable biological system.

Source of Funding:	Australian Research Council, Centre for Structural and Functional Microbial Genomics
Project timeframe	February 2005 – December 2010

* Principal investigator

Title	**Lameness is sheep and other ruminants in Bhutan** **National survey of the prevalence of footrot and development of specific footrot vaccine for Bhutan**
Farm Animal Health Staff	Emeritus Professor John Egerton Dr Om Dhungyel
MVSc student:	Mr Ratna Bahadur Gurung
International Collaborators	Department of Livestock Services, Royal Government of Bhutan

Summary

The first cases of footrot in Bhutan were reported in the flock at the National Sheep Breeding Centre (NSBC) in Bumthang in 1990. This Centre supplies breeding animals to village flocks throughout Bhutan. Despite the presence of footrot at the Centre the distribution of sheep continued. In 1998 The Royal Government of Bhutan and the Australian Centre for International Agricultural Research began a joint project in footrot research. This was aimed initially at identifying the strains of *Dichelobacter nodosus* responsible for the disease at NSBC. Forty isolates were cultured from cases in that flock. All isolates were identified antigenically as belonging to serogroup B. Vaccine was prepared from these isolates and shown in a controlled trial to accelerate cure of cases and to prevent infection at a time when the disease spread in unvaccinated animals. The same vaccine was used to treat all sheep at NSBC for two successive years. After the first year no further cases of footrot were seen at NSBC despite of close surveillance for two years after the cessation of vaccination.

Cases of footrot had been reported in village flocks soon after the disease was diagnosed at NSBC. In order to establish the distribution and prevalence of footrot in Bhutan, a national survey was designed and implemented. This survey revealed that footrot was present in nine of 13 districts surveyed, but that with the exception of one district, Bumthang, the prevalence of disease was lower than expected. There was an association between the receipt of animals from NSBC and the presence of footrot.

During the survey 234 isolates of *D. nodosus* were cultured from affected sheep in all districts where it occurred. Once again all isolates tested proved to be of serogroup B. When examined with a series of tests they were found to be phenotypically indistinguishable from one another. Genotypically there were minor variations in OMP gene patterns among the isolates. The conclusion was reached that all the isolates studied from Bhutan were essentially the same and were probably all derived from the same source. The presence of a single strain is most unusual in other sheep producing countries.

The presence of only one strain of *D. nodosus* in Bhutan suggests that it could be eliminated from village sheep by using specific vaccine for two years as was done at NSBC.

The experience in Bhutan with footrot reinforces the necessity to ensure the health of animals imported into a country and in those distributed from its animal breeding centres.

Source of Funding	Australian Centre for International Agricultural Research Royal Government of Bhutan
Project timeframe	June 1999 – July 2002

Title	**Management of footrot in small ruminants in the hill districts of Nepal and Control of footrot in small ruminants in Nepal – vaccination and serosurveillance.**
Farm Animal Health Staff:	Emeritus Professor John Egerton Dr Om Dhungyel Professor Richard Whittington
PhD Student:	Dr Shiva Chandra Ghimire
International collaborators	Overseas Development Administration, Government of U K Lumle Agricultural Research Centre, Royal Government of Nepal.

Summary

Footrot was introduced into the migratory flocks of Siklis village of Kaski district in Nepal during the 1960s with imported sheep from New Zealand and formally reported by Lumle Agriculture Centre (LAC) in 1971. Control measures were initiated during 1975 with the assistance of the United Nation's Development Programme (UNDP) and LAC. However, by that time the disease had spread to the flocks of the adjoining districts of Lamjung and Manang. The UNDP programme terminated in 1977 and the sole responsibility footrot eradication was handed over to LAC. The footrot eradication programme continued in the conventional manner with the organization of campaigns to carry out foot trimming, foot bathing and removal of non-responding animals. However, despite the apparent recovery of animals at the beginning of each monsoon season, many became re-infected during their annual migration to alpine pasture. Hence, although the problem was contained, disease eradication remained unachievable.

Emeritus Professor John Egerton with shepherd, Nepal

A footrot management project funded by ACIAR was developed. During this initial project the disease epidemiology was investigated and the strains of *Dichelobacter nodosus* involved in the disease in Nepal were identified. Specific vaccines were developed based on the two infecting serotypes and these vaccines were used in a controlled field trial which was done in association with the LAC normal programme. The results indicated that flocks treated with specific vaccine had less footrot than others treated with conventional vaccines or controls. All previously vaccinated flocks were treated with the specific vaccine and within 2 years there was no evidence of virulent footrot in the population of sheep and goats in the study area.

The present project provided evidence that virulent footrot has been eradicated from the flocks of Kaski, Lamjung and Manang districts where the disease had persisted for nearly 30 years.

The second part of the project aimed at surveillance for virulent footrot in the endemic area and in surrounding non endemic areas using clinical examination, microbial culture and ELISA serology. It confirmed that virulent footrot had been eradicated from the study area in Nepal. It was shown also that benign footrot persisted in the flocks and occurred in other flocks remote from the project area, and established the existence of some other important diseases in the migratory small ruminant population.

The development of an anamnestic diagnostic test which can be used for the retrospective assessment of the life experience of sheep and goats with respect to infection with virulent organisms was another achievement. This could provide a basis for field testing and certification for the freedom from virulent footrot.

Source of Funding:	Australian Centre for International Agricultural Research (ACIAR) Overseas Development Administration, UK Royal Government of Nepal
Project timeframe	July 1993 – June 1999

Title	**Revisting the Mulesing Operation (EC830)**
Farm Animal Health Staff	Dr Katrina Bosward- Professor Paul Canfield Associate Professor Geraldine Hunt
PhD Students	Mr Craig Macpherson Ms Michelle Lepherd

Summary

Mulesing was introduced to the Australian sheep industry by J.H.W. Mules in 1931 as a measure for the prevention of blowfly strike in sheep, and in particular, the Merino. The wrinkliness and wooliness of the Merino sheep breech makes it highly susceptible to urine and faecal staining, leading to a high risk of blowfly strike. Mulesing involves the removal of skin from around the breech and tail to decrease wrinkles and increase the size of the bare area around the perineum. The result is a significant reduction in staining, with the area drier and less attractive to blowflies.

Mulesing prevents debilitating illness and death due to blowfly strike. However, it is acknowledged that sheep suffer short term stress and pain as the operation is performed without analgesia or anaesthesia. The Australian sheep industry is trying to find effective humane alternatives to this procedure and as part of a nationwide effort, the Faculty team is studying the conformation of the breech, examining the skin and assessing the best patterns for applying chemical or other non-surgical alternatives to mulesing.

The project will apply specialist surgical skills and evaluate the skin resection pattern used in the mulesing operation. Wound healing will be examined, focusing on the microscopic, ultrastructural and molecular changes that occur. The project will focus on characterising features that are present in the normal breech skin of sheep and comparing how these change with wound healing after the mulesing operation compared to the healing that occurs with the use of chemicals or other mulesing alternatives. The systemic inflammatory response incited by surgical mulesing and its alternatives will be examined by measuring a range of haematological and biochemical parameters.

This project is one of a suite of AWI projects aimed at assisting Australian wool growers to find an alternative to mulesing as a preventative measure for flystrike. The primary objectives are to put the mules operation on an evidence-based, scientific and quantitative footing as a foundation for investigating, devising and comparing alternative procedures.

Source of Funding Australian Wool Innovation

Title	**Biotechnology and epidemiology to control nodavirus in barramundi aquaculture**
Farm Animal Health Staff	Professor Richard Whittington
National Collaborators	Mr Glenn Schipp, Darwin Aquaculture Centre Mr Craig Foster, Marine Harvest Ltd Ms Lorna Melville and Dr John Humphrey, Berrimah Veterinary Laboratory

Summary

Production of farmed barramundi has increased by more than 1200% in the Northern Territory since 2001 but is threatened by nodavirus infection.

To achieve growth targets for barramundi aquaculture in northern Australia the University of Sydney and the three industry partners will collaborate to:

1. Control nodavirus infection
2. Develop new technologies to detect nodavirus using immunoassay and surface enhanced laser desorption ionisation mass spectrometry (SELDI)
3. Develop an integrated disease control strategy based on epidemiological survey data, and ensure that it is practical and able to be widely adopted.

Control of nodavirus infection is required also to meet the national goal to boost aquaculture production to $2.5 billion by 2010. This project meets two designated national research priorities: frontier technologies for building and transforming Australian industries and protecting Australia from invasive diseases and pests. It will develop biotechnological and epidemiological tools to control nodavirus, improve biosecurity of finfish in the wild and on farms in Northern Territory, Queensland, Victoria, New South Wales, South Australian and underpin growth of the barramundi aquaculture industry in regional areas. The benefit will be increased employment and investment with economic and social returns. This project has support from all States and Territories.

Source of Funding:	Australian Research Council Linkage Grant
Project timeframe	January 2006 – December 2009

Title	**Development of diagnostic and reference reagents for epizootic haematopoietic necrosis virus of finfish (FRDC 2003/621)**
Farm Animal Health Staff	Professor Richard Whittington Ms Kylie Deece
National collaborators	Australian Animal Health Laboratory, CSIRO


Photograph courtesy of Kristen Clarke

Summary

The quantity and value of aquaculture production will increase relative to wild harvest fisheries globally and as a consequence the international community is taking great interest in disease threats to finfish aquaculture. Epizootic haematopoietic necrosis (EHN) is one of the viral diseases of fish listed by the Office International des Epizooties (OIE) and occurs in parts of Australia. Due to the extreme virulence of the causative agent EHN virus (EHNV), its restricted geographic range and limited opportunities for study outside Australia, this country hosts the OIE Reference Laboratory for EHNV, based jointly at the University of Sydney Faculty of Veterinary Science and CSIRO Australian Animal Health Laboratory. In addition to providing research and diagnostic referral services to the Australian industry, the reference laboratory provides technical advice, protocols and reagents to laboratories throughout the world, thereby ensuring international diagnostic capability. This is required under international guidelines in trade in aquatic animal products, administered by the OIE. The OIE Reference Laboratory for EHNV represents an important contribution by Australia to the international community.

EHNV reference laboratory functions were identified as one of a number of high priority issues for funding under the Federal Government's "Building a National Approach to Animal and Plant Health" program. The OIE Reference Laboratory for EHNV has provided reagents, protocols and diagnostic referral services to fish health laboratories in Australia and other countries for more than 10 years. Research on protocols for improved viral detection and differentiation from related viruses has been ongoing, and has been published in high quality journals. However, many of the original reagents were prepared in 1989-1992 and stocks of quality-controlled batches were almost exhausted. Furthermore, new protocols had recently been developed using modern tools of molecular biology but standardized DNA reagents were not available. The aim of this project was therefore to provide quality-controlled viral, tissue, antibody and DNA reagents and protocols to detect EHNV and to differentiate it from related viruses including BIV. A further aim was to develop and assess new storage conditions, guidelines for reconstitution and shelf life for these reagents.

Reagents and protocols for the detection of EHNV using the latest technology in ELISA, immunohistochemistry and molecular biology have been prepared, evaluated at an independent laboratory and are now available to laboratories in Australia and internationally. EHNV is a very serious pathogen. Consequently the reagents have been prepared using a new approach which will facilitate easy shipment in a stable form with no biosecurity risk. This is important in the current era of bioterrorism.

Source of Funding	Fisheries Research and Development Corporation
Project timeframe	March 2003 – August 2004

Title	**Pilchard herpesvirus infection in wild pilchards (FRDC 2002/044)**
Farm Animal Health Staff	Professor Richard Whittington
National collaborators	Dr Brian Jones*, Fisheries Department Western Australia Ms Melanie Crockford CSIRO Australian Animal Health Laboratory *Principal investigator

Summary

In 1995 and 1998 there were major epizootics in pilchards which spread from South Australia around the southern coastline of Australia until the entire geographic range of pilchards in Australian waters was affected. A herpesvirus was identified as the cause. There was a loss of 60% of pilchard biomass, devastation of the pilchard fishery and secondary effects on piscivorous birds such as penguins which failed to breed. The Joint Pilchard Scientific Working Group (JPSWG) was established under the Consultative Committee on Exotic Animal Diseases. The working group set priorities and coordinated research on the virus. Development of molecular diagnostic techniques was given highest priority as these will enable epidemiological studies to determine whether the virus is dormant in the pilchard population and whether or not it is coming in to the country through imported pilchard bait.

Photograph courtesy of Dr Brian Jones

The aim of this study is to validate molecular diagnostic tests for pilchard herpesvirus and to put them to use in elucidating the biology of the virus, including a survey of wild pilchards. Sequencing of the viral genome will continue, in order to design more specific tools and also to compare the virus obtained in 1995 with that collected in 1998. Objectives include:

- To improve the polymerase chain reaction and in situ hybridization diagnostic assays which are based on limited sequence data by generation of further viral genome sequence data from the available stocks of virus
- To independently establish the sensitivity and specificity of the diagnostic assays at other laboratories
- To investigate basic aspects of the virus and the disease: tissue distribution of virus in infected fish, and the correlation between disease in fish and the presence of virus
- To survey wild pilchard populations to determine whether the virus is still currently detectable and causing disease
- To compare the herpesvirus strains from 1995 and 1998, and to compare, at the molecular level, this herpesvirus and this disease with two other similar herpesvirus fish diseases which have been reported elsewhere in the world

Source of Funding	Fisheries Research and Development Corporation
Project timeframe	December 2002 – December 2005

Title	**Aquatic Animal Health Subprogram: Current and future needs for aquatic animal health training and for systems for merit-based accreditation and competency assessments (FRDC 2005/641)**
Farm Animal Health Staff	Professor Richard Whittington Mr Matt Landos
National collaborators	Dr Brian Jones*, Fisheries Department Western Australia *Principal investigator

Summary

Aquatic animal health service providers have expressed concern that there is a shortfall of aquatic animal health professionals to support Australia's aquaculture industries. Despite this need, most current Australian education systems/institutions do not adequately cover aquatic animal health. For example, there is a need for research and training in subjects such as invertebrate immunology, identification of nutritional disorders, water quality issues, taxonomy of pathogens, development and implementation of modern diagnostic methods and development of vaccines. As an example of this wider educational approach, the University of Tasmania currently provides a training course in histopathology of aquatic animals that is targeted at, and in part run by, non-veterinarians. There is also a need for continuing education. Identifying accreditation mechanisms to ensure competency in professionals providing aquatic animal health services to the aquaculture sector is another requirement for the industry.

The aim of this project is to evaluate and clearly define current and future needs for aquatic animal health training and for systems for merit-based accreditation and competency assessment. Stakeholder consultations will define current and future needs for aquatic animal health support among Australia's aquaculture industries, both established and emerging. The needs identified will determine the training that is required to provide those services. However, consultations will also take into account issues such as succession planning, merit-based accreditation of experts, and competency assessment, as well as the reluctance of institutions to provide training for what may be perceived to be a very small and specialised market. After the consultations, an issues paper will be prepared that identifies the problems and solutions, for formal submission to the Aquatic Animal Health Committee (AAHC).

Source of Funding	Fisheries Research and Development Corporation
Project timeframe	April 2005 – June 2006

Title	**Aquatic Animal Health Subprogram: Establishment of a national aquatic animal health diagnostic network (FRDC 2005/621)**
Farm Animal Health Staff	Professor Richard Whittington Mr Matthew Landos
National collaborators	Dr Brian Jones, Fisheries Department Western Australia Dr Mark Crane Australian Animal Health Laboratory, CSIRO

Summary

The lack of many serious diseases is one of Australian aquaculture's prime competitive advantages to meet future global demand for seafood. Maintenance of this high health status through initiatives which reduce the risk of disease incursions and facilitate early detection and response to emerging disease problems is seen as critical to continuing industry expansion. The range of commercially significant aquatic animal species, and their diseases, is increasing steadily. Due to limited resources it is clear that diagnostic laboratories cannot develop proficiency in the diagnosis of all significant diseases. As a consequence, expertise in specific diseases has developed in different laboratories throughout the country. To take advantage of this development, to ensure that expertise in different diseases is available Australia-wide, and to create a consistent system of aquatic animal disease diagnosis and reporting, it is proposed that a national network of laboratories should be established for the diagnosis and monitoring of aquatic animal diseases. This needs to be underpinned by a formal quality assurance program. Through a consultation process, uniform data standards and reporting formats need to be developed and adopted by all jurisdictions. Standard diagnostic tests and operating procedures also need to be developed and subsequently adopted by laboratories within the network.

This project is concerned with the establishment of the network and commencement of activities, including proficiency tests ("ring tests") designed to assist laboratories in further developing their diagnostic capabilities and/or to allow demonstration that performance of a particular test is at a nationally accepted standard, using Australian and New Zealand Standard Diagnostic Procedures (ANZSDPs). In this way the confidence of stakeholders in the quality of the diagnostic service is increased.

Specific objectives include to:

- Make recommendations on the structure and function of the network of receival and reference laboratories
- Establish a laboratory network for aquatic animal disease diagnosis
- Facilitate transfer of knowledge and technology in aquatic animal diagnostics
- Develop a model for national laboratory proficiency (ring) testing as a mechanism to enhance the proficiency of the diagnostic network.

Source of Funding	Fisheries Research and Development Corporation
Project timeframe	June 2005 – June 2006

Title	***Dam* mutants of Salmonella *typhimurium* as modified live vaccines in calves**
Farm Animal Health Staff	Associate Professor John House
National Collaborators	Dr Keith Walker and Dr Michael Hornitzky NSW Department of Primary Industries, Elizabeth Macarthur Agricultural Institute
International Collaborators	Dr Michael Mahan and Mr Doug Heihoff University of California, Santa Barbara
BSc (Hons) Student	Ms Jenny Mohler

Summary

Salmonellae are important pathogens of animals and man. They can cause food poisoning in humans upon consumption of contaminated meat and animal products. This proposal is based on our previous discovery that *Salmonella typhimurium* containing mutations in the *dam* gene that prevent DNA adenine methylase (*dam*) expression are avirulent yet confer protective immunity as modified live vaccines in murine, avian, and calf models of typhoid fever. One of the principal challenges to the development of commercial livestock vaccines is that multiple *Salmonella* strains are often endemic on farms, and traditional vaccines normally elicit protection against a single strain. We have recently shown that *dam* mutant *Salmonella* confer cross-protective immunity to multiple *Salmonella* strains when used as modified live vaccines in murine and avian models of typhoid fever.

Specific aims include to:

- determine if *Salmonella dam* mutant vaccines can confer cross-protective immunity against multiple *Salmonella* isolates in calves. A principal concern with all modified live vaccines is safety.
- introduce additional attenuating mutations (e.g., *aroA*) to reduce the virulence capacity of the *Salmonella dam*$^-$ vaccine without compromising efficacy in calves.
- determine if *Salmonella dam*$^-$ vaccines can be used as a platform for delivering passenger antigens to elicit protection against the cognate pathogen. We have chosen the Enterotoxogenic *E. coli* (ETEC) K99 fimbriae as a model passenger antigen since ETEC strains that express K99 fimbriae account for nearly all cases of ETEC infection in newborn calves and K99 fimbriae are a known immunogen that confers protective immunity against clinically relevant ETEC infections in calves and other species. The K99 fimbriae antigen from ETEC clinical isolates will be expressed in *dam*$^-$ *Salmonella*. Vaccine efficacy will be assessed by elicitation of protective immunity against ETEC diarrheal disease in calves via passive colostral transfer of protective antibodies from vaccinated cows.
- develop safe and effective vaccines against *Salmonella* infection of cattle, and to demonstrate that this vaccine platform may be used to express cognate antigens from other pathogens thereby promoting the health and productivity of livestock, reducing *Salmonella* contamination of livestock, livestock-derived food products, and enhancing food safety.

Funding	United States Department of Agriculture
Project timeframe	Continuing

Title	**Bovine Pink Eye**
Farm Animal Health Staff	Associate Professor John House
National Collaborators	25 Veterinary Practices from around Australia
International Collaborators	Dr John Angelos University of California, Davis
Masters Student	Mr Craig McConnell

Summary

Infectious bovine keratoconjunctivitis (IBK) is considered the most common ocular disease of cattle throughout the world. IBK is important both in terms of animal welfare and as a cause of lost production.

Despite the susceptibility of the causative bacterium, *Moraxella bovis*, to a large number of antimicrobial compounds the treatment of affected cattle has many disadvantages and the prevention of IBK is therefore preferable. *M. bovis* virulence factors including the production of leukotoxin, protease, and β-hemolysin along with the presence of fimbriae on the bacterial cell surface that play a role in adherence. *M. bovis* fimbrial proteins act as immunogens and vaccination with isolated fimbriae stimulates bovine anti-fimbrial antibodies. However, strains of *M. bovis* are known to differ in their fimbrial antigens, with two types of fimbriae identified along with at least seven distinct serogroups of fimbriated *M. bovis*. Efficacious application of fimbrial based IBK vaccines requires production of a polyvalent vaccine targeting specific regional isolates.

The aims of this project are:

- to conduct a survey of *Moraxella bovis* strains in Australia to determine the prevalence of different serotypes across the country
- to determine which virulence attributes are common to most isolates
- to design a pink eye vaccine applicable to prevention of bovine infectious keratoconjunctivitis in Australia.

Funding	Schering Plough Animal Health
Project timeframe	Due for completion - January 2006

Title	**Prevention and Treatment of Environmental Mastitis**
Farm Animal Health Staff:	Associate Professor John House
Masters Student	Ms Lucy Shum

Summary

The prevalence of contagious mastitis in dairy cattle has dropped over the last 20 years. Environmental mastitis subsequently accounts for the largest proportion of intramammary infections and the associated losses in production. Surveys of mastitis conducted in Australia have reported that *Streptococcus uberis* is the most frequent environmental mastitis pathogen and suggest that coliform mastitis is relatively infrequent in Australian dairy cattle. These prevalence surveys have been conducted in Victoria and reflect the prevalence of disease in pasture fed dairy cattle.

Over the last 10 years there has been a steady and continuing trend toward intensification of the dairy industry with more farms providing supplementary feeding and some farms feeding total mixed rations similar to dairy production systems in Europe and the United States. Working with intensive dairy production systems in NSW we have observed a higher incidence of coliform mastitis than reported in Victorian surveys.

The objective of this study is to determine the prevalence of different mastitis pathogens on intensive dairies in NSW and to investigate the interaction between diet and environment on the major groups (coliforms and streptococci) of environmental pathogens.

Funding	Pfizer Animal Health
Project timeframe	January 2004 – December 2006

Title	**Reducing antibiotic usage in pig herds:controlling *Lawsonia intracellularis* by vaccination, housing and hygiene**
Farm Animal Health Staff	Dr Trish Holyoake Associate Professor David Emery
National Collaborators	Dr Alison Collins, Elizabeth Macarthur Agricultural Institute, NSW Department of Primary Industries Boehringer Ingelheim Pty Ltd, Australia
PhD Students	To be appointed
Summary	Proliferative enteritis (PE) is a major disease in the global pig industry. It is caused by *Lawsonia intracellularis* and is currently prevented by feeding pigs antibiotics. The project will provide two scientists (APAIs) with training in epidemiology and immunology applicable to livestock industries and biosecurity. The ultimate aim of the project is to reduce antibiotic use on pig farms to make the pork industry in Australia more globally competitive, and to benefit human health by reducing the risk of amplifying strains of antibiotic-resistant bacteria. There are three complementary streams of the research plan. The first stream will provide essential research to maximise the adoption of a commercial vaccine (Enterisol® Ileitis, Boehringer Ingelheim) as an alternative to antibiotics to control PE. Experiments will be undertaken to improve the efficacy of Enterisol® to control PE under Australian pig management systems and to induce immunity to Australian field isolates of *Lawsonia intracellularis* (LI). In particular, we will: • measure the protective efficacy and the immune response of vaccinated pigs against Australian LI isolates; • increase the ability of the vaccine strain of LI to induce an effective immune response in vaccinated pigs by modifying its administration (extending the "antibiotic-free" window); • identify the antibiotics that do not interfere with the vaccine strain of LI's ability to infect pigs, hence allowing producers to continue to medicate in the face of concurrent disease while they vaccinate against LI; • establish the feasibility of vaccinating pre-weaning as an alternative to post-weaning as a way of avoiding the inherent post-weaning problems of concurrent medication and ease of administering vaccine through bulk water-delivery systems; • elucidate immune "markers" of protection to provide the commercial partner, veterinarians and pig producers world-wide with an objective measure of vaccine efficacy. The second stream will compare the infection dynamics of LI in pigs reared in "traditional" concrete-based housing and in increasingly popular, welfare-friendly, bedded housing, so management strategies can be developed to control PE in these systems, as an adjunct to vaccination. The third stream will provide accurate and definitive data on the impact of PE on the pig industry in Australia, including the seroprevalence of LI infection on farms in Australia, the cost of antibiotics used to control PE and direct measures of the effect of LI infection on pigs' carcass composition using a CT scanner. This data will provide accurate information on the impact of LI infection on the use of antibiotics and the profitability of the Australian pig industry and so supply the rationale to vaccinate and/or modify management to reduce antibiotic use.
Source of Funding:	Australian Research Council Linkage Grant
Project timeframe	February 2006 – December 2008

Title	**Peri-urban and remote regional surveillance for biosecurity within the pig industry in eastern Australia**
Farm Animal Health Staff	Dr Trish Holyoake Dr Jenny-Ann Toribio Dr Fortune Sithole
PhD Student	Mrs Nicole Schembri
National Collaborators	Department of Agriculture, Fisheries and Forestry NSW Department of Primary Industries Victorian Department of Primary Industries Queensland Department of Primary Industries WA Department of Agriculture Rural Lands Protection Boards of NSW QAF Meat Industries Australian Pork Ltd

Summary

Preliminary studies have found disturbing gaps in our ability to identify and monitor pig health in a significant sector of the pig-rearing community in Australia – the small-scale pig producers in peri-urban and regional areas. Currently pigs raised in small-scale enterprises pose a high risk to Australia's animal health industries due to our lack of knowledge about their movements, health and management practices implemented in these herds.

In this project we will develop systems to minimise the risk of exotic disease occurring in Australia by targeting this sub-population of the pig-rearing community. In particular work will focus on:

- Identification of the locations and practices of peri-urban pig producers
- Improved methods for tracking pig movements
- Mechanisms for health surveillance
- Improved extension in relation to disease detection and swill feeding

Funding	Australian Biosecurity Cooperative Research Centre for Emerging Infectious Disease
Project timeframe	February 2005 – February 2008

Title	**Specialised management of gilts and their progeny**
Farm Animal Health Staff	Dr Trish Holyoake
National Collaborators	QAF Meat Industries
PhD Student	Ms Yvette Miller

Summary

This project seeks to address two problems. The first is the broad issue of a shortage of veterinarians with pig-specialist skills in Australia. There are few veterinarians entering the industry, despite many opportunities available to them working with commercial farms, educational institutions, pharmaceutical companies and regulatory organisations.

The second problem this project seeks to address is the relatively poor health and performance of gilt progeny relative to sow progeny. Gilts are completely different animals than mature sows and can act as a health destabilising factor in herds. Overseas, producers are segregating gilt progeny and sow progeny to:

1. stabilise PRRS in the progeny, to the extent that PRRS does not occur clinically in the mature sow herd; and
2. manage Mycoplasma pneumonia.

On farms that segregate progeny, vaccines are only used in gilt progeny. Segregation has resulted in a 3 fold decrease in pneumonic lung lesions at processing in P2 progeny (35% incidence of lesions in P1 progeny vs 12% in the progeny of mature sows). On farms where only sow progeny are housed, nursery drug costs are less than half that of gilts ($1.85US/pig vs $0.72US/pig).

The proposed project seeks to:

1. provide extensive training for a post-graduate veterinarian in pig health and production to provide for succession in the Australian pig industry
2. improve the pre-weaning growth performance of gilt progeny using supplemental milk
3. identify risk factors that explain why gilt progeny perform poorly, relative to sow progeny
4. develop management strategies to control the risk factors and hence improve their performance

Funding	Australian Pork Ltd QAF Meat Industries
Project timeframe	February 2005 – January 2008

Title	**Building capacity to model emerging disease threats in the intensive livestock industries**
Farm Animal Health Staff	Dr Jenny-Ann Toribio
PhD student	Mr Sam Hamilton
National Collaborators	Dr Graeme Garner and Dr Mike Nunn Department of Agriculture, Fisheries and Forestry
Summary	Emerging infectious diseases have the potential to cause significant impacts on animal health, public health, the economy and/or the environment. A good understanding of the epidemiology and likely spread of these diseases, should they be introduced to Australia, is a necessary component of effective preparedness and response planning. At present there is a shortage of people in Australia with skills to undertake comprehensive epidemiological modelling of animal and human diseases. This project offers the opportunity to develop advanced skills in disease modelling through the development of a stochastic spatial simulation model for a disease of concern to the Australian intensive livestock industries. Diseases that pose a serious threat include Newcastle disease and highly pathogenic avian influenza for the poultry industry and classical swine fever for the pig industry. Disease modelling, by evaluating the behaviour of an exotic disease under Australian conditions and the effect of alternate control strategies, is recognised as an important tool to support Australia's preparedness for a disease incursion. This project, working with government and industry, will develop a new model of the spread of highly pathogenic avian influenza within the Australian intensive livestock population to address issues associated with assessing the extent, impact and control of disease outbreaks. This model will be used to enhance national disease planning and will provide technical underpinning for Australia's outbreak management policies.
Funding	Australian Biosecurity Cooperative Research Centre for Emerging Infectious Disease
Project timeframe	February 2005 – February 2008

Title	**Enhancing the contribution of livestock within smallholder mixed farming systems in the Philippines** **- The Leyte Livestock Improvement Program (LLIP)**
Farm Animal Health Staff	Dr Jenny-Ann Toribio
National collaborators	Dr Richard Clark – Project leader - Queensland DPI Dr Fay Rola-Rubzen – Curtin University Dr Bob Pym – University of Queensland
International collaborators	Dr Alberto Taveros – Project Leader Dr Agnes Taveros Dr Eugene Lañada Dr Fe Gabunada Leyte State University

Summary:

Livestock are an important contributor to the social and economic wellbeing of resource-poor smallholder families in low-income countries. They provide tangible household benefits as a ready source of income, as well as benefits that are less tangible including the generation of employment, and the supply of inputs and services for crop production. Work from Africa suggests that livestock of all types on average make up 70% of farm investment and 40% of farm-generated income to smallholder families.

To date, most of the research and development work with smallholder farmers and their livestock in low-income countries has been conducted using traditional scientific methods. These methods have a strong focus of output-production such as the identification of new or improved knowledge or the development of a tangible solution to an identified problem. This is generally followed by a relatively linear sequence of problem identification, resolution and communication, and involved smallholder farmers as participants rather than partners in the research process. This project represents a substantial shift from traditional methodologies. Rather than focusing on the production of outputs, we are specifically seeking to build the capacity of farmers to improve the management, profitability and long-term sustainability of their livestock production systems through continuous improvement in their creativity, decisions, processes, practices and performance. Our work is focused on chicken and pig production systems, which play a key role in household income and nutrition for smallholder families in the Philippines.

LLIP Mission

'Enhancing the wellbeing of smallholder families in western Leyte by increasing the capacity of farmers to continuously improve their pig and chicken production systems to achieve an average of 5% improvements in profit (gross margin), environment (specific KPIs), and energy efficiency (specific KPIs), this year and in the future'.

LLIP Objectives

1. To increase the capacity of participating producers to improve the management, profitability and long-term sustainability of their livestock systems through continuous improvement in their creativity, decisions, processes, practices and performance
2. To improve the contribution of livestock, in a measurable and sustainable way, to the social and economic wellbeing of smallholder families in western Leyte.

Source of Funding	Australian Centre for International Agricultural Research (ACIAR)
Project timeframe	February 2000 – December 2005

Title	**Advanced surveillance systems - electronic data collection and decision support**
Farm Animal Health Staff	Dr Jenny-Ann Toribio Dr Peter Thomson
National Collaborators	Dr Angus Cameron and Dr Chris Baldock (deceased) AusVet Animal Health Services
PhD Student	Mr Richard Shephard

Summary

Under-reporting of disease events in farm animals has been identified in numerous studies and is a significant gap in Australia's national surveillance processes in that it becomes difficult to generate information to support claims of freedom from disease and reduces our capacity for early detection of emerging disease problems. The main sources of animal health surveillance information are veterinary laboratories, but these sources have been declining and represent only a small proportion of animal disease events and provide virtually no information on the health status of livestock in the remote pastoral regions of northern Australia which are the main supply areas of our beef exports. This project is a collaboration between researchers and industry to develop tools that assist with the collection of animal disease information using electronic systems based on a pilot project involving beef producers in northern Queensland. The outcome will assist producers and disease managers in collecting and analysing information on disease in Australian livestock and providing evidence for regional freedom from disease.

Electronic data capture can be achieved either by using a web-based data submission system (providing real-time access to a centralised database and allowing instant analysis), or by the use of hand held computing devices. In this current project both systems will be developed in a staged fashion. A web-based system will be followed by a hand-held device for data entry. A central component of each system is the Bovine Syndromic Surveillance System (BOSSS) a tool to assist farmers identify disease problems. This artificial intelligence system controls flow of information about individual diseases, disease investigation and control based on examination of reported signs, and will promote the capture of negative sign data (ie signs that are definitely not present). It provides producers with information about the most likely diseases that can explain reported signs and undertakes a differential examination of these listed signs by questioning the user about the presence (or absence) of key differential signs. The data are entered into a syndromic database that includes negative signs and has enhanced ability to differentiate disease and investigate potential exotic disease events.

This project will result in:

- An internet-based animal health information system enabling data entry, data analysis and reporting as a syndrome surveillance system for use by producers in remote areas.
- User-friendly computer-assisted diagnostic aids to help producers in remote areas.
- Software to be used on hand held devices which permits data entry and access to computer-assisted diagnostic aids in the field.
- Software and simple methods to transfer data from hand held devices to a centralised database for more sophisticated analysis of aggregated data as part of Australia's overall disease surveillance system for cattle.

Source of Funding	Australian Biosecurity Cooperative Research Centre for Emerging Infectious Disease
Project timeframe	February 2004 – March 2007

Title	**Investigations of Borna Disease Virus in Australia**
Farm Animal Health Staff	Associate Professor Jennie Hodgson
National collaborators	Dr Robert Flower* Ms Sandra Kamieh North Shore Hospital *Principal investigator

Summary

Borna disease virus (BDV) is a neurotropic RNA virus that can cause clinical disease in humans, horses, cats and sheep. Reports of its presence in Australia have been made, but have been unsubstantiated. These reports required verification with regard to human and animal health in this country as well as implications for export of animals from Australia.

The aim of this study is to investigate in various species whether BDV could be detected in Australia, by use of various serological and molecular techniques. Specific objectives include:

- Investigate and determine the prevalence of BDV in horses and cats using serological and molecular techniques.
- Investigate whether BDV or a BDV-like agent can be detected in the human population and if so, to determine the prevalence of BDV infection in humans, primarily blood donors, pregnant women, long-term multiply transfused haematology and depressed patients.
- Investigate whether BDV is associated with altered cytokine production in depressed patients, as opposed to a control population.
- Use definitive confirmatory serological tests for the detection of BDV.
- Obtain sequence data of isolates of BDV in Australia and compare to existing sequences of BDV for evidence of variation.

Source of Funding	Rural Industries Research and Development Corporation
Project timeframe	February 2003 – January 2006

Title	**Interdisciplinary Network in Public Health**
Farm Animal Health Staff	Ms Meg Vost Dr Nicholas Malikides
National collaborators	Australian Biosecurity Cooperative Research Centre for Emerging Infectious Disease
International collaborators	Centres for Disease Control and Prevention

Summary

The clear and strong parallels between human and animal health have been recognised for millennia. Recent collaborative endeavours in developing and industrialised countries between the World Health Organisation, Food and Agriculture Organisation of the United Nations, and the Office International des Epizooties have redefined the role of veterinary public health and have involved veterinarians and other health professionals and scientists in a broad range of government and non-government sectors. However, in Australia, few lasting and significant collaborations have been formed between veterinary and medical science, and education, training and research activities in animal and human health have remained only tenuously linked.

In 2004, the veterinary, medical, and public health schools of the University of Sydney and public health institutions within Sydney and New South Wales formed a working group, the Interdisciplinary Network in Public Health (INPH). The INPH now has an expanding group of representatives from the University of Sydney, Westmead Hospital and the Public Health units in Lismore, Broken Hill, and Moree. Meeting every four months by teleconference, the INPH aims to create key partnerships between multiple health disciplines, including epidemiology, environmental and occupational health, clinical veterinary and human medicine and public health, pathology, wildlife and agricultural science, and to enhance, and capitalise on members' areas of expertise in teaching, research and community service.

Joint projects in infectious diseases of public health importance, seminars given by experts in emerging infectious diseases and development of a unique animal and human based zoonoses fact sheet website were the major tasks of the INPH for 2004-2005. Through conferences related to communicable diseases, and through major government, industry, university and international organisations such as the Australian Biosecurity Cooperative Research Centre for Emerging Infectious Disease and the Centres for Disease Control and Prevention, we aim to enhance these and other similar initiatives while promoting the need for ongoing interdisciplinary animal and human health collaboration.

Source of Funding	Multi-institutional
Project timeframe	February 2004 – ongoing

MASTERS OF VETERINARY PUBLIC HEALTH MANAGEMENT
RESEARCH THESES

2004

Comparison of Rose Bengal Plate Agglutination Test and Allergic Skin Test in detection of *Brucella suis* in adult pigs in commercial farms in French Polynesia

Ms Valerie Antras
Supervisor: Dr Jenny-Ann Toribio

Porcine brucellosis is a zoonotic disease listed by the OIE that impacts the health and productivity of pigs in infected countries. The disease is caused by *Brucella suis* and is responsible for abortion in infected sows and an abortion epidemic in newly infected pig herds. *B. suis* biovar 1 is present throughout the whole pacific region whereas biovar 2 is dominant in Europe and biovars 1 and 3 in North and South America. Following a survey conducted in 1998, the 23 commerical pig herds of French Polynesia have been monitored for brucellosis and six identified as infected. The problem of availability of diagnostic tools and lack of knowledge about test characteristics was recognized during this period of surveillance. This study was designed to generate the data regarding sensitivity (Se)and specificity (Sp) of the Rose Bengal Agglutination and Allergic Skin tests. Among 23 farms, three infected and three uninfected enterprises were selected purposively. 142 adult animals were recruited in infected farms where the disease is endemic and 226 in uninfected farms as a reference population. In absence of a gold standard method for identifying infected animals, "TAGS", a model based on maximum likelihood estimates was used to compare the results of parallel testing in the infected population and the reference uninfected population, and generate the test characteristics estimates with 95% confidence intervals: Rose Bengal Agglutination Test Se = 66.67% [0.5986 ; 0.7695] and Sp = 1[1 ; 1]; Allergic Skin Test Se = 57.45% [0.5062 ; 0.6744] and Sp = 99.12% [0.9779 ; 1]; combination of both tests in parallel Se = 85.52% [0.7937 ; 0.9105] and Sp = 99.12% [0.9779 ; 1].
These characteristics will be used for the design of surveillance programs and elaboration of control strategies. The insufficient sensitivity will rule out a test and slaughter strategy. Research in future should address the characteristics of the test in replacement gilts and in the non-commercial herd which constitutes both a very different population and a threat for human health.

Maternal vaccination strategies as an aid to the control of Glassers disease in weaner pigs

Ms Katherine Clift
Supervisor: Dr Trish Holyoake

The efficacy of maternal vaccination on the performance (growth rate, mortality rate and treatment rate) of four to ten-week-old weaner pigs was assessed using a commercial vaccine (Fort Dodge HPS) and an autogenous vaccine for *Haemophilus parasuis*. The trial was stratified by sow parity and weaner gender. Maternal vaccination did not significantly affect any of the measured variables. There were no significant differences detected between the progeny of vaccinated dams and the control progeny. Sow progeny performed significantly better than gilt progeny in all of the assessed variables. There were no consistent differences in the performance (weight gain, mortality and treatment rate) of entire male and female weaner pigs.

Assessment of the level of microbiological contamination of mutton carcasses produced for the United States and non-United States markets using generic *Escherichia coli, Salmonella* and total viable count results

Mr Anand Deo
Supervisor: Dr Jabbar Hashim Tarish

The objective of the ESAM program is to ensure microbiological consistency of meat produced at all export abattoirs through national benchmarking and prescribed testing criteria. The aim of this project was to assess the level of mutton carcass contamination/hygiene, at Australian meat export plants supplying US and non-US markets. The data were compared with results from the previous Australian studies. ESAM data were used from seven plants within each cohort to assess the level of *E. coli*, *Salmonella* and total viable count (TVC) contamination. Pooled variance *t* test analysis for differences in the two means (of positive samples) for *E. coli* did not show any statistically significant difference between the US and non-US cohorts, but the mean TVC results showed the non-US cohort to be significantly higher ($P < 0.05$) than the US cohort. Trend analysis of data from 1994 to 2003 showed that the microbiological status of Australian mutton has improved significantly with negative linear trend lines seen in all 3 categories (*Salmonella*, *E. coli* & TVC). This study (2003) showed that for the tests conducted, the microbiological contamination of Australian mutton was low, however, significant differences were seen between different export plants. Given the high level of non-compliance testing ratios for *Salmonella* and *E. coli*, it would be prudent to reassess the enforcement of the ESAM program. The microbiological contamination of Australian mutton was low (within the set performance standards) demonstrating AQIS standards to be effective in meeting objectives. The high quality of Australian mutton appears to meet the standards and requirements of our overseas trading partners. On non-US plants the TVC results were significantly higher. However, since testing is not compulsory, it would be necessary to conduct further studies to confirm these results.

Distribution of bovine Johne's diseease in the Casino Rural Lands Protection Board

Mr Paul Freeman
Supervisor: Dr David Jordan

This study describes aspects of the epidemiology of bovine paratuberculosis, which is caused by *Mycobacterium paratuberculosis (Map)*, in cattle herds in the Casino RLPB, a subtropical area in NSW in the period 1971 to 2004. A general literature review of bovine paratuberculosis was undertaken, initially at the global level, and then progressively focused at the national, state, and finally the subtropical level in order to identify possible influences on the disease patterns in the study area. Of 78 herds (44 beef, 34 dairy) in the Casino RLPB with a history of *Map* infection it was found that 56.4% (70.5, beef; 32.4 dairy) have eradicated *Map* infection. Following the introduction of infection, an average of 6.9 years was required to diagnose the presence of *Map* and an average of 4.4 years to eradicate the organism. Disease investigations accounted for 73% of *Map* herd detections with the remainder resulting from surveys, accreditation tests and tracings. In those herds where transmission to homebred animals had occurred, detection of *Map* and eradication took about 5 times longer than herds where transmission was not observed. In 72 herds an introduced animal was the source of infection. Two herds contracted the infection due to sharing of yards and the source of infection was not determined in 4 herds. For beef herds with *Map*, 92.8% of infected introductions were sourced locally while for dairy herds 34.5% introduced infected animals were from Victoria. Two herds introduced infection from BJD protected zones in NSW. Straying, contaminated feed or effluent were not identified as sources of infection suggesting the risk posed to neighbours by infected herds is low. The time taken to detect and eradicate *Map* infection was shorter in recent years and the influences of technical, social, political and economic factors on these trends were discussed with an emphasis on their impact in a subtropical region.

Risk-based determination of animal disease priorities for the national animal health system

Ms Peta Hitchens
Supervisor: Dr Robert Keogh

This dissertation details development of a risk-based animal disease prioritisation model that aims to address one aspect of a critical success factor identified at Animal Health Australia's National Animal Health Consultative Group meeting in Spetember 2003. Prior to work reported here, there has been no consistent means of prioritising emerging, exotic or endemic animal disease risks for the purposes of assessing the feasibility of implementing an animal disease management program. The first stage of the study was to conduct a Delphi survey of Animal Health Australia's Members to determine the criteria they perceive as important when prioritising animal disease programs. The second stage was to analyse the survey responses by identifying those criteria most important to form the basis of the model. The primary criteria identified for inclusion in the model were epidemiology, likelihood of achieving program outcomes, nature of contribution, public health and social impact, economic impact, stakeholder commitment and cost benefit analysis. It is intended that the model will be perceived as a fair, transparent and consistent approach for determining priorities and risk ratings for animal diseases and their management programs. Refinement of the model and risk assessment process will be necessary to achieve stakeholder acceptance.

The effect of exposure of lambs to pasture contaminated with varying levels of *Mycobacterium avium* subsp *paratuberculosis* on the development of ovine Johne's disease in Australia

Ms Jane Littlejohn
Supervisor: Dr Jenny-Ann Toribio

Grazing strategies are promoted as disease management tools for ovine Johne's Disease (OJD). The effect on OJD development in 528 lambs in the Southern Highlands of NSW, of grazing pasture with high, medium and low levels of contamination with *Mycobacterium avium* subsp. *paratuberculosis*, both before and after weaning, was studied by multiple linear and logistic regression. Test parameters compared were PCR/REA, histopathology (including the Perez lesion score) and gross lesion assessment used to diagnose OJD. The association between grazing strategies and the OJD rate, mortality rate, body weight, wool weight and estimated age at death was not conclusive. Perez type 3B and 3a lesions predicted reduced body weights by 3.6 and 3.53 kg respectively. Conversely lesion types 3c, 1 and 2 predicted body weights 5, 4 and 1.9 kg higher, respectively. Sheep with lesion type 3b died an average of 6 months earlier than sheep with other lesion types. Using the Perez score which includes lesions without acid fast bacteria as a positive diagnosis, increased the sensitivity in this study group to 52.22% but decreased specificity to 97.54%. The study suggested that the lesion type might be able to be used as a flock indicator of potential losses from mortality and reduced body weight.

Descriptive analysis of 32 ovine Johne's disease infected flock profiles performed between 2000 and 2004 in NSW, Australia

Ms Luzia Rast
Supervisor: Dr Barbara Maloney

OJD was first detected in Australia in 1980 in the central tablelands of NSW. Since then it has gradually spread. Local, regional and, since 1998, national control programs were initially underpinned by quarantine on individual (suspect or infected) properties. Movement restrictions were later removed as it was realized that a better understanding was needed on how OJD established in a flock, how disease spread over time and if certain management practices could prevent disease progressing throughout a flock. To achieve this, a procedure called 'infected flock profiling' (IFP) was implemented in 32 infected flocks in NSW between 2000 and 2004. The aim was to develop specific property disease control programs. This study compared and analysed the 32 flock profiles with an aim to identify common risk factors that contributed to different disease patterns. There were large variations in available data quality and quantity from individual flock profiles. The main reason for limited data from IFPs were: 1. lack of resources to implement a management structure that ensured a consistent approach to IFPs including monitoring and evaluating progress and collation of results; 2. no predetermined clear criteria and objectives for IFPs; 3. insufficient consideration of impending national program changes, leading to a time period of only 2-3 years for IFPs, too short for a disease that spreads very slowly. Recommendations to address these shortcomings were made.

West Nile virus surveillance in wild birds in Australia

Mr Rob Williams
Supervisor: Dr Peter Black

West Nile Virus (WNV) is a virus of public health significance that does not occur in Australia. It is unclear how WNV would behave in Australia, given the different ecological factors that exist when compared with other countries. The purpose of this project was to identify elements of a surveillance system involving wild birds to detect an incursion of WNV into Australia. The project was primarily a literature review of WNV surveillance in other countries, especially North America and Europe. Key conclusions were that a WNV surveillance system should complement existing systems that are monitoring other flaviviruses and a cost-benefit analysis would assist its establishment. Other key conclusions included: the potential epidemiological behaviour of WNV, especially virulent strains, and its interaction with Kunjun virus in wildlife is a key area for consideration for future preparedness work; the ability to differentiate between Kunjun virus and WNV using serology is an urgent priority for Australia; and surveillance in wild birds should be geographically targeted to reflect the highest risk areas for an incursion, such as urban areas around major international airports. Finally any surveillance system established should be cost effective and measured against performance criteria to assess its capabilities.

A cross sectional study of canine leptospirosis in mainland Australia

Mr Raphael Zwijnenberg
Supervisor: Dr Jenny-Ann Toribio

Leptospirosis is of significant public health concern. A cross sectional study of canine leptospirosis was conducted in animal welfare populations of dogs with the objectives to determine the prevalence in the state of Queensland and the detection of disease presence in all other states and territories except for Tasmania and the ACT. In Queensland, the sample size was calculated using the standard formula to estimate proportions. For the other states and territories, sample sizes were determined according to Freecalc software in Survey Toolbox (Cameron, 2004). In Queensland, a seroprevalence of 2.4% was measured with a 96% level of confidence, while in all other states and territories except for South Australia the disease was detected with a higher prevalence than the originally estimated 0.5%. The highest prevalence in the sampled populations was found in NSW (3.2%). Significant associations were demonstrated between a relatively young age group (1 - <3 years) and seroprevalence as well as dogs located in NSW and seroprevalence. These findings demonstrate that leptospirosis in Australia is more prevalent than generally thought by veterinarians. Veterinarians in Australia should consider the significance of these findings and disease prevention by measures including more efficient rodent control and vaccination. These findings confirm under-diagnosing and under reporting of this zoonotic disease in Australia.

2005

A critical review on the role of chrytid fungus in causing global amphibian decline

Mr Wing Ka Au
Supervisor: Professor Richard Whittington

The main task of the project was to critically review the epidemiological evidence based on literatures for the involvement of the chrytrid fungus in global amphibian decline. The recent decline appearing simultaneously in various continents has raised the alarm of the breaking down of environmental shield and may also threaten the survival of other species including food animals and humans. Understanding the cause is important because early preventative measures can be taken to secure the environmental protection in which veterinary public health is closely associated. It is important to find out what has and what has not been done and whether the conclusions are valid so that a series of recommendations for future work to look for the real cause can be concluded from the review.

The caprine brucellosis situation in Swaziland - a review of previous studies, clinical and laboratory records

Mr Roland Xolani Dlamini
Supervisor: Dr Nick Malikides

Swaziland experienced its first ever outbreak of *Brucella melitensis* infection in goats in 1995. Brucellosis is a disease of serious public health importance and causes Malta fever in humans. To date there have been three independent prevalence studies in: 1995, 1999 and 2003, and no specific intervention. This project was a retrospective desktop study to review the results from the sero-prevalence studies, clinical and laboratory records to predict the most likely present brucellosis situation in small ruminants and suggest reasonable control/eradication measures. The objectives were: to critically evaluate previous sero-prevalence studies, paying particular attention to sampling methodologies and analysis; to collect, compile and analyze anecdotal evidence of small ruminant brucellosis from clinical and laboratory records; to

predict the most likely brucellosis situation in small ruminants; and, to propose cost effective control/eradication strategies.

Contrary to expectations, the prevalence of brucellosis rose briefly following its introduction and thereafter decreased sharply. Based on prevalence, the 1999 survey divided the country into three zones: Endemic zone; Propagation front; and, Free zone.

In 2003 no such pattern of prevalence was found. At this time there were very few positive flocks even in the previously endemic zone. What is interesting is that both studies used a two-stage cluster sampling method; dip tanks were primary sampling units and flocks were secondary sampling units. Also no evidence could be found that *B. melitensis* Rev 1 vaccine had been used at any time in the country. South Africa, which experienced a similar outbreak at the same time, found that the disease spread slowly in local goats even though the conditions were ideal for rapid spread and this could not be explained (Emslie et al 2002). There was no correlation between abortion storms and melitensis sero-positivity.

An analysis of the effects of an intensive spay/neuter program on classical animal control activities and the stray pet animal population

Mr Allan Drusys
Supervisor: Dr Janet Foley

The negative impacts of stray animals in the United States, as elsewhere, are manifold and significant. Not only do stray dogs and cats pose the greatest risks for the introduction and dissemination of terrestrial rabies virus into the urban environment, they represent an ever present threat to public health as carriers of other zoonotic diseases. Furthermore, the negative environmental impacts of feral cats through wildlife predation can not be understated. The traditional approach to stray pet management, consisting primarily of a trap, impound and euthanize policy, has not provided a long term, cost-effective mechanism to reduce the stray population. The recent popularity of trap/neuter/release (TNR) strategies involving feral cats were successful on a limited scale but did little to address the concerns of wildlife predation.

An animal control management software application, Chameleon®, and a spay/neuter program were developed at one of the largest animal control agencies in the U.S. with the aim of making policy and management decisions factually based and justifiable in the emotional atmosphere of the animal welfare and public policy arena. The dataset of impound and outcome cases from 2000 to the present was extracted from Chameleon® through a combination of Excel® and Crystal Reports® applications. Program activities increased by 15% during the period. The numbers of live and dead pets decreased, while the opossum numbers remained stable over the same period. Using this dataset, a comparison to the human demographic profile needs to be drawn to provide insights into the significance of the analysis.

A model for foot and mouth disease in the Kimberley pastoral region

Mr Ben Madin
Supervisor: Dr Graeme Garner

Foot and Mouth Disease (FMD) is one of the biggest risks for the Australian livestock industry. Effectively managing an outbreak is critical to governments, industry and the community. During the 2002 Fire and Emergency Services Authority exercise in the Kimberley region it became apparent that resources were going to become exhausted very quickly in a large outbreak, and effective management of resources is essential. Department of Agriculture, Fisheries and Forestry (DAFF) has developed a sophisticated simulation model for studying potential spread and control of FMD. 'AusSpread' integrates Monte-Carlo modelling with spatial analysis tools, to provide spatial representations of outbreak scenarios. It is designed to use readily available data sources – and being regionally-based, data has to be collected for relevant regions under study.

The aim of this project was to collect data to develop a region-specific FMD model for the Kimberley, and required the collection of data on topography, cadastral information (property boundaries), animal numbers, and methods of spread - especially animal movements. In the Kimberley nearly all between-property animal movements are by road train, so collection of data on movements and for what purpose allowed model parameters to be developed. Sampling was by a modified stratified procedure, using shires as the first level, to ensure that the variation across the region and by season was accounted for to some extent, then judgment sampling based on who is likely to bother filling in a survey. The project provided a useful background for planning for future exercises – particularly as it is likely that the model could realistically use the same parameters in regions across Northern Australia.

Article I. Biosecurity Risk Profile of foot and mouth disease spread through New Zealand livestock saleyards

Ms Andrea Murray
Supervisor : Dr Robert Sanson

At livestock saleyards, animals, people and vehicles from various source farms congregate before dispersal to various destination farms. The effects of infected animals moving through livestock saleyards were illustrated in the United Kingdom and Dutch foot and mouth disease (FMD) outbreaks of 2001 (Gibbens et al. 2001, Bouma et al. 2003). This project will determine catchment and dispersion parameters, and parameters for the mixing or splitting of lines through sales, for selected saleyards. The outcomes will be a better understanding of risks associated with saleyards and the determination of parameters to be used in models of the spread of FMD. The strengths of the proposed project are the support of government and industry (all major stakeholders), better understanding of the role of livestock saleyards in the spread of FMD and other contagious diseases, and determination of parameters to assist in modelling spread. The weaknesses are that the livestock saleyards and associated industries are in a constant state of change in terms of number of saleyards and stock and station companies servicing them, causing parameters of catchment and dispersion to fluctuate, and dependence on data provided by a third party (a stock and station company).

Epidemiology and control of bovine Johne's disease in a beef cattle herd

Ms Catherine Taragel
Supervisor: Dr Evan Sergeant

The prevalence of bovine Johne's disease (BJD) in beef cattle within Australia is low compared to dairy cattle and there is less known about the epidemiology of the disease. Information on the effectiveness of a control program within a beef herd will assist in the development of policy in this area. Similarly, information concerning the dam in transmission of the disease in this more extensively managed environment (compared to dairy) will assist with risk assessment and policy making in BJD control in beef cattle herds.

A database will be developed in epi-info to store data and assist in its management and analysis.

An assessment will be made of the true prevalence and distribution of BJD over time in an extensively grazed beef cattle herd undergoing a test and cull program in a temperate environment. This may help in determining what impact this has had on the herd and whether eradication or control of the disease is feasible or practical. The presence of dam, calf and age data may enable analysis to be undertaken to assess the importance of the dam in disease transmission in an extensively grazed beef herd and also any impact of age of dam when detected to determine which of her calves to cull.

BACHELOR OF SCIENCE (VET) RESEARCH THESES

Molecular epidemiology of iridovirus infection in Murray cod and ornamental fish

Mr Jeffrey Go
Research support: The Faculty of Veterinary Science
Supervisor: Professor RJ Whittington

H.R. Canne Prize for Excellence in the BSc(Vet)

Professor Beryl Hesketh, Pro Vice Chancellor, College of Sciences and Technology and Professor Leo Jeffcott, Dean, Faculty of Veterinary Science presenting Jeff Go with the award

In 2003 an outbreak of iridoviral disease in Murray cod (*Maccullochella peeli peeli*) in an aquaculture facility in Victoria, Australia resulted in 90% losses. Viral inclusions in affected tissues did not stain in an immunoperoxidase test for epizootic haematopoietic necrosis virus infection, the only systemic iridoviral disease of fish known to occur naturally in Australia. A molecular epidemiological approach was undertaken to determine the relationship between this new virus and other iridoviruses. DNA was extracted from formalin-fixed paraffin-embedded tissues of affected Murray cod, and primers were designed to amplify DNA from the major capsid protein, ATPase, and RNA polymerase genes, as well as the CY15 and IRB6 amplicons. There was extremely high nucleotide sequence homology between the Murray cod iridovirus (MCIV) and tropiviruses, particularly infectious spleen and kidney necrosis virus (ISKNV) (≥ 99.9 % identity) and dwarf gourami iridovirus (DGIV) (≥ 99.6 % identity). MCIV was distinct from Red Sea Bream Iridovirus (RSIV), with about 95% homology. MCIV, DGIV and MCIV therefore are strains of the one species of tropivirus, suggesting a common geographic origin, and the entry of MCIV into Australia through trade in ornamental fish. This was confirmed in a survey of routine mortalities in gouramis from pet shops in Sydney. PCR positive gouramis were found in two of four pet shops. Organ filtrates from affected gouramis were injected intraperitoneally into Murray cod juveniles; 29 of 30 died within 28 days with PCR results and microscopic lesions typical of iridoviral infection. Cohabitation of Murray cod with live gouramis led to transmission of the virus through water, with death of 11 of 30 Murray cod. These findings were communicated to relevant government authorities, leading to a review of import policy for freshwater ornamental fish.

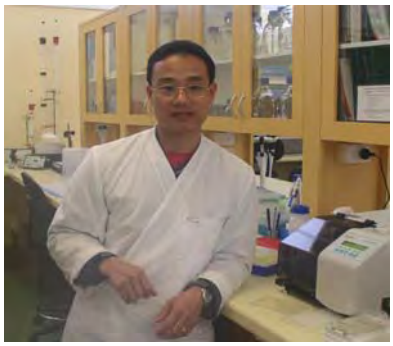
Studies in anaesthesia of Koi carp

Ms Bronwyn Clayton
Research support: The Faculty of Veterinary Science
Supervisor: Associate Professor Garry Cross

Koi carp are an important species in high value added ornamental aquaculture and are a useful model species for physiological studies applicable to other farmed fish. Clinical procedures are frequently required in finfish but current literature fails to provide a comprehensive guide to anaesthetic agents. Benzocaine, clove oil, Aqui-S ® and alphaxalone were evaluated in this study. Benzocaine was found to be the most effective agent when tested at various temperatures. A dose of 75 ppm induced stage A4 anaesthesia in all subjects within 8 minutes, with recovery to stage R4 occurring in all subjects within 20 minutes of removal from the exposure bath. Significant disadvantages were seen with the other agents. Increasing doses of agents generally resulted in faster induction times with longer recovery times. Recommendations for further research include studies on maintenance of anaesthesia for lengthy procedures, and the analgesic properties of anaesthetic agents given the increasing importance of animal welfare.

MASTERS OF VETERINARY SCIENCE RESEARCH STUDENTS

A comparative study of the sensitivity of antigen capture ELISA and PCR to detect epizootic haematopoietic necrosis virus in spiked tissue homogenates of rainbow trout



Mr Tho Nguyen Dang
Research support: University of Sydney International Postgraduate Research Scholarship.
Supervisors: Dr RJ Dixon, Professor RJ Whittington

Epizootic haematopoietic necrosis virus (EHNV) can cause high mortality (100%) in redfin perch and mild morbidity and mortality in rainbow trout. The Fish Diseases Commission of the Office International des Epizooties (OIE) has recommended that an antigen capture ELISA be the standard diagnostic test for EHNV infection. As PCR is routine in many diagnostic laboratories, this study was initiated to determine whether PCR would be more sensitive than the ELISA, subsequently reducing false negative results in virus testing. The results showed that the PCR had increased sensitivity compared to the ELISA in detecting EHNV. The practical implications of these results were addressed. Additional data were obtained through transmission experiments in redfin perch on the host-pathogen relationship. Pre-existing antibody mediated immunity was demonstrated in redfin perch that were refractory to infection with an isolate of EHNV shown previously to be highly virulent for this species.

A National Survey of Bovine Infectious Bovine Keratoconjunctivitis and characterization of virulence attributes.

Mr Craig McConnell
Research Support: Schering Plough Animal Health
Supervisor: Associate Professor JK House

Infectious bovine keratoconjunctivitis (IBK) is considered the most common ocular disease of cattle throughout the world. Despite the susceptibility of the causative bacterium, *Moraxella bovis*, to a large number of antimicrobial compounds the treatment of affected cattle has many disadvantages and the prevention of IBK is therefore preferable. IBK pathogenesis is linked to two *M bovis* virulence factors; namely, surface-associated pili and a haemolytic exotoxin (cytolysin) with corneotoxic properties. Pili have been shown to be antigenic and immunogenic and have been recommended as either cellular or acellular vaccine components. Efficacious application of pili based IBK vaccines requires production of a polyvalent vaccine targeting specific regional isolates. Cytotoxicity is mediated by the *M bovis* calcium-dependent cytolysin which is a β-haemolytic, leukotoxic pore-forming protein (MbxA protein) that belongs to the repeats in the structural toxin (RTX) family of pore-forming toxins and is encoded by the gene *mbxA*. The objective of this project is to evaluate pili serologic cross-reactivity, assess for the presence of RTX operons, and to measure antimicrobial susceptibility of *Moraxella* strains isolated from Australian IBK outbreaks.

Efficacy of DNA Adenine Methylase Salmonella Vaccines Against Heterologous Challenge in Holstein-Friesian Bull Calves

Ms Virginia (Jennie) Mohler
Research Support: United States Department of Agriculture
Supervisors: Associate Professor John House, Dr. Keith Walker, and Dr. Michael Hornitzky

This is a Bachelor of Science (Veterinary)/PhD project. Salmonella are important pathogens of livestock and humans. Increasing antibiotic resistance in food producing species; concerns about antibiotic residues; stock losses; and residual poor growth rates indicate that vaccination would be more economically effective. Traditional salmonella vaccines elicit protection against a single strain of Salmonella. In intensive animal agriculture multiple Salmonella serovars are endemic. A major challenge in the development of a commercial Salmonella vaccine is to find a product that provides sustained cross-protective immunity.

Salmonella *Typhimurium* containing a deletion of the gene required for DNA adenine methylation (DAM) are avirulent yet confer protective immunity as modified live vaccines in murine, avian and bovine models of salmonellosis. *DAM* controls several important and diverse biological processes including DNA replication, methyl-directed mismatch repair, transposition, and the expression of pili required for colonization of host tissues. Experiments conducted in mice and poultry have demonstrated the capacity of *DAM* attenuated *S. typhimurium* to induce protection against heterologous salmonella challenge. Results from current research in calves indicates that protective efficacy of DAM vaccines against subacute heterologous infection with Salmonella *Dublin*.

Dietary and management impacts on the prevalence of environmental mastitis pathogens.

Ms Lucy Shum
Research Support: Pfizer Animal Health
Supervisor: Associate Professor JK House

There has been a significant decline in the incidence of contagious mastitis due to improvements in milking management in the dairy industry. Intra-mammary infections are now caused predominantly by environmental pathogens, particularly environmental *Streptococci spp.*, coliforms, and environmental S*taphylococci spp.*. Australian mastitis surveys conducted on pasture based dairies in Victoria report *Streptococcus uberis* to be the most common environmental mastitis pathogen with few cases of coliform mastitis. In contrast coliform mastitis is reported to be common in Europe and North America. According to the results of mastitis cultures conducted at the UVCC coliform mastitis is more frequent in this region than reports from Victoria. The dairy industry in NSW reflects a diversity of management systems ranging from pasture based to intensive freestall production systems. The objective of this study is to determine the prevalence of mastitis pathogens in NSW dairy farms and to investigate the interactions between diet and environment on the incidence of environmental mastitis pathogens.

PHD RESEARCH STUDENTS

A study of the biological and financial impact of OJD in affected sheep flocks in NSW


Photograph: Kristen Clarke

Mr Russell Bush
Research support: Meat and Livestock Australia.
Supervisors: Dr JA Toribio, Dr P Windsor, Dr S Webster

Debate continues regarding the impact on infected farms of Ovine Johne's disease (OJD), a chronic enteric disease of sheep caused by the bacterium *Mycobacterium paratuberculosis*. Accurate estimation of annual mortality rates and the proportion attributable to OJD could provide an insight into the financial significance of this disease. The study quantified OJD mortalities in 12 flocks across four districts of south-eastern NSW, confirming considerable mortality rates (average 6.2%, range 2.1 to 17.5%) contributed to significant financial loss during the 12-month study period. Industry groups can now be provided with accurate figures on direct OJD losses within the endemic area of NSW. The data can be used to justify vaccination programs, and contribute to the development of cost effective strategies for future control and management. Further work on economic modelling will lead to tools being made available to farmers to enable them to optimise disease control programs.

Remote area syndrome surveillance systems for cattle

Mr Richard Shephard
Research support: Meat and Livestock Australia,
Australian Biosecurity CRC
Supervisors: Dr JA Toribio, Dr Peter Thomson,
Dr Angus Cameron, AusVet Animal Health Services

Remote extensive cattle grazing regions of Australia are characterised by large herds, long distances between properties and communities, little requirement for veterinary input, sparse veterinary services and inadequate surveillance coverage. This project investigates the potential for syndromic disease information to be captured by lay observers using the disease diagnostic program BOVID, analysed to compare prevalence of symptoms across regions and time periods, and used to determine the relative likelihood of individual disease occurrence. Changes in relative frequencies result in a 'trigger', notifying local government veterinary authorities that a given disease syndrome has emerged or changed in frequency, potentially leading to targeted surveillance efforts being focused towards investigation of the syndrome.

Identification of risk factors for OJD infection-level in sheep flocks

Mr Navneet Kumar Dhand
Research support: University of Sydney International Postgraduate Research Scholarship, Meat and Livestock Australia.
Supervisors: Dr JA Toribio, Professor R Whittington

This project is designed to identify risk factors for the expression of Ovine Johne's Disease (OJD) in 100 infected flocks through a cross sectional study of 3-4 year old sheep. OJD prevalence estimates will be based on pooled faecal culture. Information about OJD flock history, flock management practices and management of the 3-4 year old cohort will be collected by personal interviews. In addition, soil samples will be collected from the properties for analysis. Statistically significant associations between potential risk factors and OJD infection-level will be identified. The study is particularly focused on identifying risk factors that can be manipulated by farmers to improve on-farm control of OJD.

In vitro survival and dormancy of *Mycobacterium paratuberculosis*

Mr Sanjeev Gumber
Research support: University of Sydney International Postgraduate Research Scholarship, Meat and Livestock Australia.
Supervisors: Professor R Whittington, Dr D Taylor

Mycobacterium paratuberculosis causes Johne's disease, an economically significant problem in ruminants in most countries. This organism survives for long periods on pasture and soil, and as the infection is acquired by ingestion, control is difficult. This in-vitro study monitored the survival of the organism (sheep strain) following exposure to different time and temperature combinations. It showed that temperature flux has a more detrimental effect on the survival of *M. paratuberculosis* than peak temperature. Dormancy was also observed in these experiments. Further work will lead to characterisation of gene and protein expression in the organism during growth and induction of dormancy in experimental models. This knowledge will inform our understanding about the survival of the organism in the environment and also in the host during the development of OJD.

Ovine Johne's disease – investigating mortality rates, disease transmission and control

Ms Helen McGregor
Research support: Meat and Livestock Australia, NSW Stud Merino Breeders Association, CSL and proprietors of the study properties
Supervisors: Associate Professor P Windsor, Professor R Whittington

OJD infection in Australian sheep flocks continues to cause significant losses due to mortality but losses in the sub-clinical phase of the disease have not been widely investigated under Australian conditions. Estimate to be made in this study of sub-clinical losses include reduction in wool growth and retardation in growth rates and their relationship with the development of clinical disease. This may provide insight into disease pathogenesis. Obtaining an accurate estimate of crude mortality rates and mortality risk in a flock and the proportion of the mortality attributable to OJD will establish the cost of the disease. Determining the contribution of pasture contamination rates and age of sheep, when first exposed to the disease, to incidence of disease in a flock, mortality rate attributable to OJD, the incubation period and the timing of diagnosis will lead to greater understanding of possible strategies for control and monitoring of diseased flocks. Documentation of the effects of whole flock vaccination on faecal excretion rates and mortalities in a high prevalence infected flock will enhance the knowledge and understanding of the benefits of a whole flock vaccination strategy including effects on adult excretion and cyclical pasture contamination.

Comparison of the S and C strains of *Mycobacterium paratuberculosis* at genome and proteome levels

Mr Ian Marsh
Research support: Meat and Livestock Australia, NSW Department of Primary Industries
Supervisor: Professor R Whittington

Johne's disease (JD), a chronic and incurable disease affecting many ruminant species, is caused by *Mycobacterium avium* subsp. *paratuberculosis* (*M. a. paratuberculosis*). *M. a. paratuberculosis* strains can be divided into two groups known as sheep and cattle strains. The host range for the cattle strain is quite broad but the sheep strain primarily affects sheep. S and C strains have different cultural requirements. Little is known about the differences between S and C strains with respect to mechanisms of host specificity and pathogenicity. A greater understanding of these characteristics at the genome level would greatly assist in the control and management of JD both in Australia and abroad. In this study the genomes of S and C strains were compared using representational difference analysis, genome microarray and proteomic techniques. The differences observed thus far are greater than wre previously suspected from existing restriction fragment length polymorphism analysis data, include major genetic deletions, and may be related to phenotype.

Genomic and phenotypic comparison of isolates of *Mycobacterium sp.* that contain IS*900*–like elements

Mr Martin McLoon
Research support: Meat and Livestock Australia, NSW Department of Primary Industries
Supervisor: Professor R Whittington

Ovine Johne's disease (OJD) is an important economic concern of Australian agriculture. The early diagnosis and implementation of control measures on properties with infected stock is the most effective way in preventing further spread of the disease. Presently a diagnosis of OJD relies on culture of the causal agent, *Mycobacterium paratuberculosis*, highlighting a mycobactin dependent phenotype in conjunction with PCR for the insertion sequence IS*900*. Detection of IS*900* is included as a confirmatory test, and in some cases, the sole test because it has been shown to be unique to *M. paratuberculosis*. However, environmental mycobacterial isolates have been discovered which cause a cross reaction in the PCR for IS*900* creating a false positive result and indicating the existence of IS*900-like* insertion sequences. To prevent false positive results a post PCR test was developed. To ensure the validity of this IS*900* PCR-REA there is a need to characterise the mycobacterial isolates that possess an IS*900-like* insertion sequence at both a phenotypic and genotypic level, as well as the individual IS*900-like* insertion sequences. This analysis will allow a better understanding of the threat they pose to OJD diagnosis and their taxonomic position within the *Mycobacterium* genus.

Apoptosis in sheep with *Mycobacterium paratuberculosis* infection

Ms Sally Browne
Research support: Meat and Livestock Australia
Supervisors: Dr K de Silva, Associate Professor D Emery

Johne's disease is a chronic wasting condition of ruminants caused by *Mycobacterium avium* subsp. *paratuberculosis* (Mptb). Clinical disease is seen only in adult animals. More knowledge regarding the pathogenesis of this disease, including apoptotic responses during the course of infection, is needed to allow advances towards management and control of Johne's disease. The aim of this project is to develop assays for detection of apoptosis in sheep then define apoptotic responses in sheep with OJD. In initial experiments, Merino sheep aged 7 months were orally dosed with the organism and samples were taken of many tissues. At this very early stage in the development of Johne's disease, there were no significant differences in the percentage of caspase positive cells when lymph node cells were incubated in the presence of medium alone or *Mptb* antigen. However, at day 6 with *Mptb* antigen, cells from gut lymph nodes in animals exposed to the highest dosage tended to have a higher percentage of caspase positive cells than the medium controls. Cells from peripheral lymph nodes incubated with *Mptb* for 6 days had higher apoptotic activity than the medium only controls, regardless of exposure to *Mptb*. These results suggest that detecting apoptosis in response to Mptb antigen *in vitro* in lymph node cells may be useful in identifying animals exposed to *Mptb*. Further studies are being carried out at later time points in the disease.

Aspects of the pathogenesis of *Mycobacterium paratuberculosis* infection in sheep

Ms Kate Goldsmith
Research support: Meat and Livestock Australia
Supervisors: Professor R Whittington, Dr D Begg, Dr K Bosward

Johne's disease is characterised by a lengthy incubation period, measured in years. It is well known that cows with severe infections commonly shed the causative organism, *Mycobacterium paratuberculosis,* into their milk, and may also infect their unborn calf *in utero*. The organism can be isolated from extra-intestinal sites in such cases. There is a smaller body of evidence for this in sheep, but infection of tissues outside the gut is recognised in advanced cases in rams and ewes. The means by which the organism reaches sites outside the gut is uncertain, but may involve transfer via blood. The aim of this project is to identify extra-intestinal transfer of the organism during experimental and natural Johne's disease infections in sheep.

Genetic and proteomic differentiation of stages of *Mycobacterium paratuberculosis* infection

Ms Ling Zhong
Research support: Meat and Livestock Australia
Supervisors: Professor R Whittington, Dr D Taylor, Dr L Di Fiore

Johne's disease is a chronic disease affecting ruminants and other hosts. It is caused by *Mycobacterium paratuberculosis*. The events leading to clinical disease are complex and poorly understood but obvious signs of disease are seen only in adult animals. The genome sequence of the causative organism was recently published and this has triggered a dramatic interest in genomics and proteomics to elucidate mechanisms of disease. During this study a range of genomic and proteomic techniques will be applied to study the early stages of infection of sheep with this organism, and to contrast findings with those occurring later in the disease process. This information will be used to design improved diagnostic tests and disease control strategies.

Modelling the emergence of avaian influenza in the Australian poultry industry

Mr Sam Hamilton
Research support: Australian Biosecurity CRC for Emerging Infectious Disease,
Department of Agriculture, Fisheries and Forestry
Supervisors: Dr Jenny-Ann Toribio, Dr Graeme Garner

Highly pathogenic avian influenza (HPAI) poses a serious threat to the Australian poultry industry and potentially also to public health in this country given recent occurrence of human deaths in south-east Asia. Disease modelling, by evaluating the behaviour of this disease under Australian conditions and the effect of alternate control strategies, is recognised as an important tool to support Australia's preparedness for an incursion of this disease in our poultry population. This project, working with government and industry, will develop a new model of the spread of HPAI within the Australian intensive poultry population to address issues associated with assessing the extent, impact and control of disease outbreaks. This model will be used to enhance national disease planning and will provide technical underpinning for Australia's outbreak management policy in the event of an outbreak of HPAI.

Peri-urban regional surveillance for biosecurity for pigs in eastern Australia

Mrs Nicole Schembri
Research scholarship: Australian Biosecurity CRC
Supervisors: Dr Trish Holyoake, Dr Jenny-Ann Toribio

Photograph: Kristen Clarke

Exotic diseases such as foot and mouth disease may enter Australia through anthropogenic means, most likely closely associated with large urban centres. Pigs in peri-urban settings may be the initial focus of a disease outbreak. This project involves reviewing current pig keeping legislation, educating producers about awareness of abnormal behaviours and clinical signs of disease, reviewing current extension materials and methods, as well as possible alternative animal identification technologies. The information obtained will be used to locate peri-urban pig producers, identify and track pig movements, and improve producer awareness of disease.

The sheep/ *Haemonchus contortus* relationship

Ms Kate McMaster
Research support: Meat and Livestock Australia.
Supervisors: Associate Professor N Sangster, Dr K Bosward

Haemonchus contortus is one of the most economically important parasites in the Australian sheep industry. In recent years resistance to parasitic drugs has forced both sheep producers and researchers to look for alternative means of parasite control. A better understanding of the host parasite relationship is an essential step in discovering improved control measures. The balance of the host parasite relationship shifts depending on the status of the host, for example age or reproductive status, and how the parasite responds. Studying the development of the protective immune response of the sheep when infected with *Haemonchus* will enable a better understanding of the host-parasite relationship and should provide the means to measure the development and mechanisms of immunity and resilience to infection. This will indicate whether we can predict or modulate the response towards protection or test the host's "resistance status" for selection purposes. It is hoped that this investigation will provide producers with another tool to manage parasitic infections without resorting to anthelmintic treatment.

FARM ANIMAL HEALTH STAFF

Dr Douglas Begg
Dr Katrina Bosward
Dr Kumudika De Silva
Dr Om Dhungyel
Dr Lyrissa Di Fiore
Dr Robert Dixon
Associate Professor David Emery
Ms Hannah Forsyth
Dr Peter Groves
Associate Professor Jennie Hodgson
Dr Trish Holyoake
Associate Professor John House
Mr Matt Landos
Dr Nicholas Malikides (Resigned July 2005
Dr Michelle Power
Dr Tony Rowe
Professor Nick Sangster
Dr Fortune Sithole
Dr Deborah Taylor
Dr Jenny-Ann Toribio
Ms Meg Vost
Professor Richard Whittington
Associate Professor Peter Windsor

EMERITUS PROFESSOR
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Mr Nobel Toribio
Mr Bruce Tye
Mr Matt van Dijk
Mrs Anna Waldron

SUPPORT STAFF
Mrs Pabitra Dhungyel
Mrs Geetanjali Dhand
Ms Marion Saddington

Dr Douglas Begg
Post-Doctoral Research Fellow

Qualifications

1996	BSc
1997	Diploma for Graduates
2000	MSc
2005	PhD

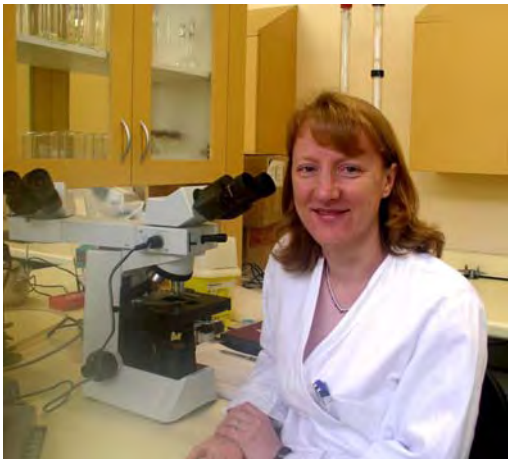
Career History

1993 – 2004	University of Otago
2005 - present	University of Sydney

Research Interests

After completing his BSc majoring in Zoology, Doug went on to do a Diploma for Graduates with a major in Microbiology. From 1998 - 2000 Doug completed his MSc in the Disease Research Laboratory at the University of Otago, New Zealand. His thesis examined the effect that different experimental housing conditions and environmental enrichment had on stress and immune responses of brush tail possums. Staying within the Disease Research Laboratory, for his PhD studies, Doug went on to look at experimental infection models for *Mycobacterium paratuberculosis* which causes Johne's disease in sheep. The immune responses from infected, diseased and vaccinated animals were examined. Doug joined the Farm Animal Health Group in 2005 and is continuing to studying the pathogenesis of Johne's disease in sheep.

Dr Katrina Bosward
Lecturer in Pathbiology



Qualifications:

1990	BSc (Vet)
1991	BVSc
1995	PhD

Career History:

1991 – 1995	Veterinary practice
1995 – present	The University of Sydney

Research Interests:

Following the completion of a BSc(Vet) in 1990 and BVSc in 1991 at the University of Sydney, Katrina worked in mixed and small animal veterinary practice. Katrina returned to the University of Sydney in 1995 to undertake a PhD in collaboration with CSIRO Animal Production entitled "Eosinophils and Interleukin 5 in Sheep". On completion of her PhD, Katrina commenced training in Clinical and Anatomical Veterinary Pathology at the University Veterinary Centre, Camden earning a Graduate Diploma in Clinical Studies. She has been employed as Lecturer in Veterinary Pathology in the Faculty of Veterinary Science, University of Sydney since 2002 where she is a member of the Farm Animal Health group working on the Pathogenesis of Ovine Johnes Disease in sheep. Other research interests include wound healing in mulesed sheep; snake envenomation in dogs; feline chronic renal disease; and immunohistochemical studies of tumours in cats and dogs.

Dr Kumudika De Silva
Research Fellow

Qualifications:
1992 BAppSc (Hons)
2000 PhD

Career History:
1993 University of Kelaniya, Sri Lanka
2000 Loyola University Medical Centre,Chicago
2002 - present The University of Sydney

Research Interests:
Kumi completed a Bachelor of Applied Science degree (Hons. Class I) at the University of Canberra, where she studied the oxidation of low density lipoproteins for her Honours project. She then worked for two years as a lecturer in Biochemistry at the Faculty of Medicine, University of Kelaniya, Sri Lanka.

Kumi returned to Australia to undertake doctoral studies at the John Curtin School of Medical Research, Australian National University, Canberra. During her PhD she studied the adhesion and migration of subsets of human mononuclear cells in response to native and minimally oxidised forms of low density lipoprotein. After completing her PhD, Kumi worked as a postdoctoral research fellow at the Burns and Shock Trauma Institute, Loyola University Medical Center, Chicago, USA. Here she studied the effects of prostaglandin E_2 on IL-6 receptor expression and signal transduction pathways. She found that PGE_2 was able to arrest cell proliferation in an *in vitro* model by down-regulating expression of the IL-6 receptor as well as subsequent signal transduction and identified cell surface receptors used by PGE_2. This work provides an explanation for the granulocytopenia seen in thermal injury and sepsis. Kumi was also involved in studies investigating the response of bone marrow stem cells to injury in a murine model.

Kumi joined the Farm Animal Health Group in 2002 to study the pathogenesis of *Mycobacterium paratuberculosis* infection, the cause of Johne's disease, in sheep.

Dr Om Dhungyel
Research Fellow

Photograph: Kristen Clarke

Qualifications:
1984 BVSc&AH
1992 MSc
2001 PhD

Career History:
1984 – 1989 Veterinary Officer, Bhutan
1992 – present The University of Sydney

Professional Distinctions:
1990 FAO Scholarship

Research interests:
After completion of an undergraduate degree in Veterinary Science from the Kerala Agricultural University, India in 1984, Om worked as a Regional and Zonal Veterinary Officer in his home country Bhutan for 5 years. In 1990 he was awarded an FAO scholarship to undertake a Masters of Science in Animal Breeding and Genetics at the University of Sydney. On completion of his MSc in 1992 Om worked on an ACIAR funded project on footrot in sheep and goats in Nepal. He successfully made a recombinant DNA footrot vaccine which was used to control and eradicate endemic footrot in that country. He has also worked on a similar project in Bhutan and other footrot projects and research collaborations in India, China and Malaysia. He has been a key member of the research team looking at molecular pathogenesis of footrot working in collaboration with Monash University and NSW Department of Primary Industries. Om is also worked on Ovine Johne's Disease, but returned to research on vaccines for ovine footrot in 2005 in a new project funded by Australian Wool Innovations.

Dr Lyrissa Di Fiore
Post-Doctoral Fellow

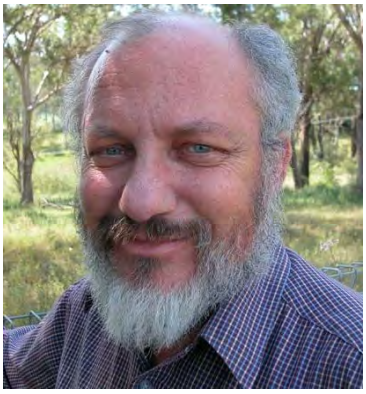
Qualifications:
1998 BBSc (Hons) Biochemistry
2004 PhD

Career History:
2003 - 2004 Prince Henry's Institute of Medical Research
2004 – present The University of Sydney

Research interests:
Lyrissa completed a Bachelor of Biological Science with Honours in Biochemistry at La Trobe University in 1998. She then went on to complete a PhD in Molecular Biology through Monash University and Prince Henry's Institute of Medical Research. She examined gene expression in the adapting small bowel. She completed her PhD in March 2004 and is now working as a postdoctoral research fellow with the Farm Animal Health Group.

The aim of her current research is to investigate genes/processes involved in regulating the interaction between *Mycobacterium paratuberculosis* and the host in Ovine Johne's Disease (OJD). She has always had an interest in molecular biology, medical research and biotechnology and is interested in opportunities to apply new tools in the fields of genomics and proteomics.

Dr Robert Dixon
Senior Lecturer in Veterinary Clinical Sciences
Sub Dean for Animal Welfare
(a)



Academic Qualifications:
1973 BSc(Vet)(Hons)
1974 BVSc (Hons)
1982 PhD

Career History:
1974 - 1975 Australian Department of Agriculture
1975 - 1977 The University of Sydney
1978 - 1982 Massey University New Zealand
1982 - 1983 Ministry of Agriculture and Fisheries, New Zealand
1983 - present The University of Sydney

Research interests:
Robert graduated with a BSc(Vet) degree in 1973 in which he studied the emerging field of retroviruses, before completing his BVSc degree in 1974. He worked in the Australian Department of Agriculture in the current equivalent of the Australian Quarantine Inspection Service. He then took a clinical appointment back at the University of Sydney Rural Veterinary Centre at Camden as a Clinical Pathologist. In 1977, he was appointed Cancer Research Fellow at the Faculty of Veterinary Science, Massey University, New Zealand, to further pursue his research love of retroviruses. In 1980 he was appointed Junior Lecturer in Clinical Microbiology before he received his PhD in 1982 for examining ovine lymphoma for retroviruses. He then moved to the New Zealand Ministry of Agriculture and Fisheries Laboratory Service as Veterinary Investigation Officer before taking up an academic appointment at the University of Sydney in 1983.

Robert has had extensive teaching experience with interests in animal virology, immunology and toxicology and animal welfare. His research career has involved a range of viruses of animal and human health importance. These include animal retroviruses, human and animal hepadnaviruses, human and animal pestiviruses, orbiviruses, circoviruses and picornaviruses. Robert has researched the application of novel genetically engineered vaccines. He has also worked on production animal toxicology research programs. He is currently in collaboration with the Faculty of Medicine developing disinfection models for human immunodeficiency virus. As Subdean for Animal Welfare in the Faculty Robert is developing new research projects in animal welfare, a key issue for the future of production animals. He is also collaborating in a multi-agency program to reduce transmission of diseases from animal to humans in indigenous communities in northern Australia.

Associate Professor David Emery
Associate Professor in Veterinary Parasitology

Academic Qualifications

1973	BSc(Vet) (Hons)
1974	BVSc (Hons 1)
1978	PhD

Career History

1978 – 1981	ILRAD, Kenya
1981 – 1984	CSIRO Animal Health
1985 – 1986	ILRAD, Kenya
1984 – 2001	CSIRO Animal Health and Production
2001 – 2002	Department of Agriculture, Fisheries and Forestry, Animal Biosecurity
2002 – present	The University of Sydney

Research Interests:
David graduated from The University of Sydney and has devoted 25 years to ruminant mucosal immunity, disease pathogenesis and vaccination for exotic and endemic infectious diseases and gastrointestinal nematodes, with several periods in Africa. He defined cell-mediated cytotoxicity for protective immunity against *Theileria parva* (East Coast fever), determed protective epitopes on *Dichelobacter nodosus* pili (ovine footrot) and characterised leucocidins of *Fusobacterium necrophorum* (foot abscess). He led the first project team developing recombinant vaccines for worm parasites of sheep, produced and trialled several protective antigens and identified allergic (Th2) responses as the protective mechanism in natural infections. David also has experience with biosecurity, import/export quarantine, animal health policy formulation, negotiation and operations. At Biosecurity Australia, David developed import risk analyses for importation of wool and fibres as well as zoo *Bovidae* and was responsible for trade negotiations for market access of live ruminants exported from Australia to northern Asia.

David's current research interests are mucosal immunobiology of infectious and parasitic disease. He was appointed in 2004 to lead the "Host Resistance to Internal Parasites" subprogram in the Sheep Genomics Program, funded by Meat and Livestock Australia and Australian Wool Innovation. In this consultancy role, he coordinates research projects involving discovery and characterisation of genes responsible for worm resistance in sheep, develops research initiatives, reports and interfaces directly with senior staff in rural industry research and producer bodies.

Ms Hannah Forsyth
Sub Dean, Postgraduate Coursework

Qualifications:

1998	BA(Hons)
2005	MA

Career History:

1998	Sydney College of Divinity
1998 – present	University of Sydney

Description:
Hannah's educational background is in archaeology and history and she retains an interest in urban history and culture. She has completed short courses in higher education, online teaching and management and plans to continue formal education in eLearning.

Hannah has either worked, studied or both at the University of Sydney since 1993 and has been with the Faculty of Veterinary Science since 1998, with a break when her son was born. In that time, Hannah worked in administration, strategic projects, policy development, stakeholder surveys and curriculum review.

In 2003 Hannah was appointed to manage the postgraduate program in Veterinary Public Health Management and developed an interest in moderating online classrooms, conducting student group work and assessment by distance and the tools and support that are needed by adult distance learners who are also working full-time. Hannah was appointed as the Sub Dean for Post Graduate Coursework in 2005 and now also manages the new Master of Animal Science and the Master of Veterinary Studies degrees in the Faculty.

Dr Peter Groves
Senior Lecturer in Poultry Health

Qualifications:

1977	BVSc (Hons)
1991	MACVSc (Epidemiology)
2000	PhD

Career History:

1977 – 1979	Veterinary practice (small animals, horses)
1980 – 1981	Pfizer Agricare
1981 – 1985	Elanco Products Company
1985 – 1987	Ingham's Enterprises
1987 – 2003	Baiada Poultry Pty Ltd
2003 – present	Zootechny Pty Ltd

Professional Distinctions:
President Australian Veterinary Poultry Association 1994; president-elect 2005.
Director, Board Member and member of the Research and Development Committee of the Australian Poultry CRC (2003 - present)

Research Interests:
After graduation from the University of Sydney Peter worked in small animal and equine veterinary practice before joining Pfizer Agricare as a Veterinary Research Officer. Peter continued to work in the commercial environment with poultry research, veterinary and technical services managerial roles with Elanco Products, Ingham's Enterprises and Baiada Poultry. Currently Peter is Director of Zootechny Pty Ltd and consultant in poultry health. Peter completed his PhD at the University of Sydney in 2000 with a project on the epidemiology of the broiler ascites syndrome.

Peter's research interests include epidemiological approaches to poultry disease management, with particular interests in broiler ascites syndrome, coccidiosis, Mareks' disease and Salmonella. Peter is currently part of a Poultry CRC research team studying Marek's Disease in broilers. This project has lead to a better understanding of MD virus epidemiology and has introduced a real time PCR test to detect MDV in poultry dust. Peter is currently pursuing studies on the effects of an inactivated tri-valent salmonella vaccine in broiler breeders aimed at decreasing the overall prevalence of Salmonella on poultry meat.

Associate Professor Jennie Hodgson
Associate Professor and Chair Learning and Teaching Committee

Qualifications:

1982	BVSc (Hons)
1983	DipVetPath
1990	PhD
2002	GradDipEdStud (Higher Education)

Career History:

1983	University of Sydney
1984-1991	Washington State University
1991-present	University of Sydney

Research Interests:
After graduation Jennie pursued her interest in veterinary pathology and microbiology through an internship program at the University of Sydney. She then pursued her husband to the United States and Washington State University. There she completed a PhD, under the supervision of one of the world's leading researcher's in veterinary immunology and worked for a short period of time on Faculty teaching veterinary microbiology. She returned to Australia in 1991 to take up a position as Laboratory Director at the University Veterinary Clinic Camden – the University's large animal clinical facility. Needing a new challenge in 2001, she returned her attentions to veterinary microbiology and is now a senior academic in veterinary microbiology on the main campus.

Jennie's research interests include microbiology (including zoonotic diseases), immunology (allergies) and clinical pathology. A significant component of her research is focused on equine respiratory disease, but she also has programs investigating vaccine development for infectious bovine keratoconjunctivitis in cattle, investigations of Borna disease in Australia (a zoonotic disease involving humans, horses, cats and sheep) and antimicrobial resistance patterns in bacterial isolates obtained from animals.

Dr Trish Holyoake
Senior Lecturer, Intensive Animal Industries

Qualifications:

1987	BVSc
1992	PhD

Career History:

1988 – 1989	Veterinary Practice
1989 - 1993	University of Melbourne
1993 – 1994	University of Minnesota, USA
1994 - 1997	University of Melbourne/Victorian Dept of Ag
1997-2004	QAF Meat Industries
2004 - present	The University of Sydney

Professional Distinctions:
President of the Australian Association of Pig Veterinarians 2004.

Research Interests:
Trish discovered her passion for pigs after graduating from the University of Melbourne in 1988. Originally from Adelaide, Trish spent her first year in practice with small animals but after 12 months moved to Bendigo to start a PhD in the "Epidemiology of proliferative enteritis in pigs". In 1993, upon completion of her PhD, she conducted post-doctoral work with the Swine Medicine Group at the University of Minneosta, USA. After returning to Australia in 1994, she spent four years working partly for the University of Melbourne as course-coordinator-Pig Health and Production, and partly for the Victorian Department of Agriculture as Pig Specialist Veterinarian. From there she was seconded to QAF Meat Industries. QAF is the largest pig producer in Australasia, producing about 1 million pigs each year. She took up the position of Senior Lecturer Intensive Animal Industries with the University of Sydney in 2004.

Trish's current research interests include biosecurity for the Australian pork industry, improving the performance of gilts and their progeny, epidemiology and immunology of *Lawsonia intracellularis* infections in pigs, reducing pregnancy loss during seasonal infertility, disease diagnosis on smallholder pig farms in Vietnam, and the impact of air quality on the health of people and pigs.

Associate Professor John House
Associate Professor in Bovine Health and Production

Qualifications:

1984	BSc
1986	BVMS (Hons)
1994	Dip ACVIM
1997	PhD

Career History:

1987 - 1989	Veterinary practice
1989 - 2002	University of California, Davis
2002 – present	University of Sydney

Professional Distinctions:
1994 Ray Bankowski Memorial Scholarship, graduate research award
1995 Jastro Shields Research Scholarship

Research Interests:
John completed his BVSc degree at Murdoch University, Western Australia in 1986 and after two years in private practice relocated to the University of California, Davis, where he held positions of Resident, Large Animal Medicine, Lecturer and finally, Clinical Associate Professor. He was appointed as Associate Professor in Bovine Health and Production at the University of Sydney in 2002.

John's research efforts have focused on disease control and enhancing farm productivity through the conduct of epidemiological studies and the development of diagnostic tests and vaccines. Much of this work has been directed at prevention of salmonellosis in intensive ruminant production systems. Current projects include the evaluation of DNA adenine methylase attenuated salmonella vaccines in cattle, a national survey of bovine pink eye in Australia looking at the types and virulence attributes of isolates from around the country, epidemiological studies of environmental mastitis pathogens on NSW dairy farms, and a study evaluating different approaches to assisted reproduction in dairy cattle.

Mr Matt Landos
Research Associate

Qualifications:

1995	BVSc (Hons)
2002	MACVSc (Aquatic)

Career History:

1995	Veterinary Practice
2000	NSW Department of Primary Industries
2005 - present	The University of Sydney

Research Interests:
Matt worked in mixed private veterinary practice in northern NSW and the United Kingdom for five years after graduating from The University of Sydney in 1995. He worked on herd health programs for dairy farms and some companion animals. He took up a position with NSW Fisheries within the Aquatic Animal Health Unit where he was involved in providing extension support to the growing aquaculture industry in NSW, policy advice to Fisheries Management and running a diagnostic laboratory for fish diseases. He undertook a five year research project to determine the best practice for health management of intensive pond-based silver perch aquaculture which involved intensive investigation of a new mass mortality event termed winter disease. Matt also delivered a range of fish health workshops to industry and government research staff and more recently has been involved with the barramundi recirculation aquaculture industry trying to define causes and identify mitigation measures for disease-related losses in fingerlings and grow-out fish.

Matt joined the Farm Animal Health Group in 2005 as a Research Associate to complete project work on two FRDC projects to scope the future national need for aquatic animal health education and a national aquatic animal diagnostic network with proficiency and accreditation standards. He also delivers lectures and practical classes in aquatic animal health.

Dr Nicholas Malikides
Research Fellow

Qualifications:

1988	BVSc
1993	DVCS
1997	MVCS
2000	FACVSc (Equine Medicine)
2003	PhD

Career History:

1988 - 1992	Veterinary Practice
1998 - 1999	University of Glasgow
1992 – 2005	The University of Sydney

Research interests:
Nick graduated from the University of Sydney in 1988 and, after four years in mixed practice in Australia and the UK, returned to undertake specialty training in equine medicine as an intern, resident and registrar at the Sydney University Veterinary Centre, Camden. During this time he completed a Masters in Veterinary Clinical Studies, and spent a year as Lecturer in Equine Clinical Studies at the University of Glasgow. In 2003, he completed his PhD on the epidemiology of inflammatory airway disease in young Thoroughbred racehorses. Nick was appointed as the Australian Biosecurity Cooperative Research Centre's Research Fellow in 2004.

Nick has a broad interest in the application of the principles of epidemiology, evidence-based medicine and biostatistics, with particular focus on study design, emerging infectious disease epidemiology, clinical and environmental epidemiology, multilevel modelling and risk analysis.

Dr Michelle Power
Research Fellow

Qualifications:
1996 BSc
2002 PhD

Career History:
1991 - 1997 CSIRO Division of Animal Health
1998 - 2003 Macquarie University
2004 - present The University of Sydney

Research Interests:
After graduation from Macquarie University Michelle worked within CSIRO Division of Animal Health for six years in the area of anthelminitic resistance in sheep with emphasis on screening natural products for novel anthelmintics. Her focus was on the development of colorimetric bioassays for high throughput screening of microbial extracts, and to streamline methods for isolation of target organisms and extraction of their secondary metabolites. It was during this time that Michelle became interested in protozoan parasites when working on the development of anti-protozoals for *Giardia* and *Trichomonas*. In early 1998 Michelle joined the water research group at Macquarie University where she began working with *Cryptosporidium*. This led to PhD research at Macquarie investigating the occurrence of cryptosporidia in native animals inhabiting the Sydney water catchment. After completion of her thesis she remained employed at Macquarie University continuing her research with emphasis on characteristion of *Cryptosporidium* sporozoite surface antigens. Michelle also worked on phenotypic and genotypic charcterisation of *E. coli* from a range of hosts and blooms in Warragamba Dam using genomics and proteomics during this period.

Michelle joined the Farm Animal Health group in January 2004 to investigate the use of molecular techniques for the identification of novel anthelmintic targets. A major focus is the development RNA interference for different life cycle stages of parasitic nematodes. Michelle's other research interests include protozoan parasite biology, development of molecular diagnostic techniques, the impact of humans on animal disease, zoonoses, the evolution, adaptation and host-relationships of parasites/pathogens and the host potential of Australian wildlife as vectors for pathogens that pose a biosecurity threat to Australia.

Dr Tony Rowe
Post-Doctoral Fellow

Qualifications:
1994 BVSc (Hons)
2001 PhD

Career History:
1995 - 1996 Veterinary practice
1996 – 2001 Westmead Hospital
2001 - 2002 Prince of Wales Hospital
2002 - 2004 The Children's Hospital Westmead
2004 - present The University of Sydney

Research Interests:
After graduation Tony spent several years in mixed dairy practice, and later in a leading Animal Emergency Centre in Sydney and as a locum in mixed practice in England. Tony then completed a PhD on gene transfer to the immune system as a collaborative project between the Faculty of Veterinary Science and the Institute for Immunology and Allergy Research at Westmead Hospital. He moved to the Prince of Wales Hospital, Department of Cardiovascular Genetics in 2001 to study the role of antioxidants in the pathogenesis of atherosclerosis and then to the Oncology Research Unit at the Children's Hospital at Westmead to work on the role of human D52 protein in a transgenic mouse model of breast cancer.

Tony's research interests in immunology, immunotherapy, molecular biology and the pathogenesis of disease are diverse and include mouse models of central immune tolerance, gene function in vascular disease and mouse models of carcinogenesis. Tony joined the Farm Animal Health group in 2004 to study the immune response of sheep to *Haemonchus*.

Professor Nick Sangster
Professor of Veterinary Parasitology

Qualifications:
1978 BSc (Vet) (Hons)
1979 BVSc (Hons)
1984 PhD

Career History:
1984 - 1986 University of Toronto, Canada
1986 - present The University of Sydney

Research Interests:
Nick is a career researcher and teacher in parasitology. He has worked in Australia, the USA and other countries since graduation from the University of Sydney in 1979.

Nicks major research interests are the study of the mode of action of anthelmintics and mechanisms of drug resistance. Anthelmintic resistance is a major problem in several animal industries and the fundamental work on sheep nematodes done by Nick and a range of other Australians lead the world in this field. Nick has used a variety of *in vivo* and *in vitro* techniques to explore anthelmintic resistance. These include bioassays for resistance, physiological assays on worms and molecular investigations of resistance. These techniques have also been applied to the study of novel drug targets in worms of sheep. New projects include studies of host-parasite relationships and enabling technologies for sheep nematodes. Nick was a key member of the team that successfully secured funding for the ARC/NH&MRC Network in Parasitology which started in 2005. Nick is also the current Editor-in-Chief of the International Journal for Parasitology.

Dr Fortune Sithole
Post-Doctoral Fellow

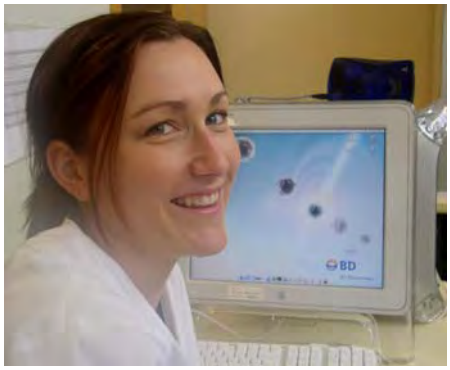
Qualifications
1997 BVSc (Hons 1)
2002 MSc
2005 PhD

Career History:
1998 - 2000 University of Zimbabwe
2000 - 2002 University of Utrecht
2002 – 2005 University of Prince Edward Island
2005 – present University of Sydney

Research Interests:
Fortune obtained his BVSc at the University of Zimbabwe in 1997. He then undertook a residency at this university involving clinical treatment of both companion and food animals and the task of establishing a swine herd health service to provide regular herd health visits to pig farms and consultancy services to the national pig industry. Fortune commenced postgraduate study in 2000 and completed a Masters in Veterinary Epidemiology and Animal Health Economics at the University of Utrecht in The Netherlands, undertaking a project titled “Evaluation of diagnostic tests for porcine proliferative enteropathy in the absence of a gold standard test”. He then completed a PhD in Veterinary Epidemiology at the University of Prince Edward Island in Canada with a thesis on the immunologic monitoring and treatment of gastro-intestinal parasites in dairy cattle.

Fortune joined the Farm Animal Health group in 2005 as a Post-Doctoral Fellow, an AB CRC-funded project on peri-urban pig surveillance. He is applying his knowledge of a range of pig production systems, from smallholder to commercial, and his epidemiological expertise.

Dr Deborah Taylor
Research Fellow



Qualifications:

1996	BSc (Hons)
1997	MSc (Hons)
2001	PhD

Career History:

2001 - 2003	The University of Sussex
2004 - present	The University of Sydney

Research Interests:
Following a Bachelor of Science (Hons) in Biomedical Sciences from Liverpool John Moores University (1996) and a Master of Science (Hons) in Molecular Genetics from The University of Leicester (1997), Deborah completed a PhD in Biochemistry in 2001 at the University of Sussex in the UK, working on the role of SUMO-1 homologues in the DNA damage checkpoints of *Schizosaccharomyces pombe*. In 2001 Deborah began a Post-Doctoral Research Fellowship at the University of Sussex, working on the analysis of differential gene expression in *Streptococcus uberis*, a cause of bovine mastitis, by representational difference analysis of cDNA. The objective was to identify potential virulence determinants in clinical isolates of streptococci that showed modified expression under infection-mimicking conditions.

Deborah has been a Research Fellow with the Farm Animal Health group of the Faculty of Veterinary Science since January 2004. Her work involves analysis of differential gene expression during the host/pathogen interaction in ovine Johne's disease using DD-PCR, microarrays, QPCR and SELDI proteomic technology.

Dr Jenny-Ann Toribio
Lecturer in Epidemiology
Academic Supervisor - Veterinary Public Health Management Program

Qualifications

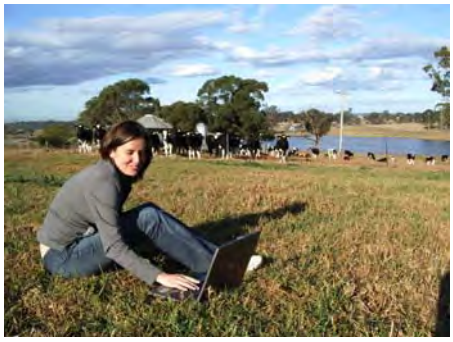
1989	BVSc (Hons 1)
2000	PhD
2003	Graduate Certificate in Higher Education

Research Interests:
Jenny-Ann completed a BVSc at the University of Queensland in 1989 and worked predominately in companion animal practice including 2 years with the RSPCA in New South Wales. In 1994 she commenced a PhD at the University of Queensland on smallholder pig systems in the Philippines – a project funded by the Australian Centre for International Agricultural Research (ACIAR). On completion she provided input as a consultant to two ACIAR projects in the Philippines prior to commencing her appointment at the University of Sydney.

Jenny-Ann's research interests are varied and currently include the epidemiology of ovine Johne's disease, surveillance systems for the extensive beef industry and for peri-urban pig producers in Australia, and the improvement of smallholder pig systems in the Philippines. Jenny-Ann has considerable experience working in south-east Asia and has on-going involvement in an ACIAR-funded project on smallholder livestock systems in the Philippines.

Jenny-Ann has had a key role in the establishment of a new postgraduate coursework program in Veterinary Public Health Management. This program delivers technical and managerial units via an online classroom and short residentials. Her research interests now extend to innovative approaches to training in veterinary epidemiology.

Ms Meg Vost
Learner Support and Research Projects Coordinator
Veterinary Public Health Management Program



Qualifications:

1997	BA
2004	MIPH

Career History:

1998	Tony Stone Images, London
1998 – 1999	University of London, Faculty of Medicine
1999	Refugee Legal Centre, London
2000 – present	University of Sydney
2005	Part-time Volunteer, AUSTCARE

Description:
After graduating with a BA in human geography from the University of Wollongong, Meg travelled to London, where she worked at the University of London and for the Refugee Legal Centre. She started working at the University of Sydney in the Centre for English Teaching in 2000 and moved to the Faculty of Veterinary Science in 2001. Meg is passionate about social and public health issues and undertook a Master of International Public Health in 2002. After graduation, Meg commenced in a volunteer position at AUSTCARE (Australians Caring for Refugees) and in 2005 began to work for the Veterinary Public Health Management program.

Meg coordinates student recruitment and support as well as marketing and student orientation in the Veterinary Public Health Management program. She coordinates research projects for Master of Veterinary Public Health Management students and acts as the primary contact for student advice on research, and unit of study selection for career progression. Meg is progressively moving into new areas as she learns more about the program.

Professor Richard Whittington
Chair Farm Animal Health and Veterinary Public Health Management

Qualifications:

1980	BVSc (Hons 1, University Medal)
1987	MACVSc
1994	PhD

Career History:

1980 - 1983	Veterinary practice
1984 - 2002	NSW Agriculture
2002 - present	The University of Sydney

Professional Distinctions:
Ian Clunies Ross Award 2002, Australian College of Veterinary Scientists for contributions to veterinary research
Specialist registration in Veterinary Pathobiology

Research Interests:
After a promising career as gardener and bar attendant, Richard graduated with a BVSc from The University of Sydney and spent several years in small and mixed animal practice on the NSW south coast and in the United Kingdom before undergoing training with NSW Agriculture in Veterinary Pathology. Following 5 years as a diagnostic pathologist Richard commenced full time research at the Veterinary Research Station, Glenfield and Elizabeth Macarthur Agricultural Institute, working mainly in microbiology, virology and immunology of economically significant diseases of sheep and fish, and completed a PhD on the immunology of *Dichelobacter nodosus* infection in sheep at the University of Sydney.

Richard currently leads research on the pathobiology of *Mycobacterium paratuberculosis*, the cause of Johne's disease in ruminants, and also works on infectious diseases of finfish and wildlife including the platypus. Studies involve functional analysis and molecular studies of viruses and bacteria, immune responses and pathology in individual animals and animal populations. Better understanding of host-pathogen interactions will lead to development of improved diagnostic tests, vaccines and other disease control strategies. This research is conducted at Camden in newly built infectious diseases laboratories and involves a large and dynamic group of young scientists, post graduate students and support staff. Richard teaches in veterinary public health, microbiology, pathology and ruminant and aquatic animal health, and Chairs the new post graduate coursework program in Veterinary Public Health Management.

Associate Professor Peter Windsor
Associate Professor of Sheep Health and Production

Qualifications:

1977	BVSc(Hons)
1988	PhD
2005	Grad Cert Higher Ed

Career History:

1977 – 1980	NSW Department of Agriculture
1980 – 1981	Cornell University
1981 – 1982	San Diego Zoo
1983 – 1998	NSW Department of Agriculture
1998 – 1999	FAO, Philippines
1999 – 2002	NSW Agriculture
2002 – present	The University of Sydney

Professional Distinctions:
1980 - Australian-American Educational Foundation Fulbright Overseas Study Award
Specialist registration in Veterinarian in Pathobiology

Research interests:
Peter graduated with a BVSc from the University of Sydney in 1977, commencing his career with NSW Agriculture. An early interest in diagnostic pathology led to a Fulbright Award to undertake Residencies in Pathology at Cornell University and the San Diego Zoo, with return to the Veterinary Research Station at Glenfield, NSW in 1983. Peter completed his PhD on neuropathology in 1987, identifying new inherited disorders in livestock including citrullinaemia of Holstein-Friesians and maple syrup urine disease and myoclonus of Herefords, disorders exploited as animal models of human inborn errors of metabolism. Peter was Officer in Charge of the Regional Veterinary Laboratory at Glenfield then Elizabeth Macarthur Agricultural Institute in 1990. Peter then transferred to the Grafton Agricultural Research Station, managing animal health surveillance, regulatory and extension programs for the NSW north-coast region. He commenced research on bovine abortion, resulting in isolation of *Neospora caninum* and development of an Australian serological test. In 1998, Peter undertook a 19-month appointment to the FMD eradication program with the FAO in Naga City in the Philippines. He returned to NSW Agriculture at Goulburn in 2000, transferring to EMAI in 2001 to manage ovine Johne's disease vaccination research leading to registration of Gudair vaccine.

Peter's current research interests are diverse and span applied field-based research, ovine Johne's disease and reproductive disorders, as well as neurological and genetic diseases in ruminants.

Craig Kristo

Photograph: Kristen Clarke

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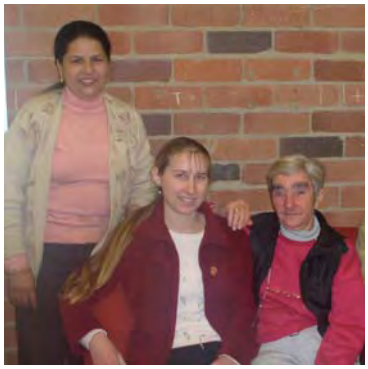
Anna Waldron and Angela Reeves

Nicole Carter

Matt Van Dijk



Pabitra Dhungyel, Natalie schiller and Eileen Risby

Nobel Toribio

Reena Mehta

Natalie Schiller

2005

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von Samson-Himmelstjerna G, Harder A, **Sangster NC**, Coles GC. (2005) Efficacy of the two cyclooctadepsipeptides PF1022A and emodepside against anthelminti- resistant nematodes in sheep and cattle. *Parasitology* 130, 343-347

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McGregor H Nov 2004 – Skipton and Munro districts Producer groups Victoria - invited speaker - Grazing management for OJD control" & "The role of vaccine in infected flocks

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