Development of a Wildlife Health Centre

Proceedings of a Workshop

8-9th November 1999

Held at: **Division of Wildlife and Ecology**
CSIRO
Gungahlin
Canberra

Cover photograph courtesy of Ed Slater, CSIRO Wildlife and Ecology

CONTENTS

Workshop agenda

DAY 1
SETTING THE SCENE FOR A WILDLIFE HEALTH CENTRE

9.00 am	Opening Comments	**Gardner Murray**
	Key note address: Science and technology in Australia – The changing scene	**Graham Mitchell**
9.30 am	The significance of wildlife health to Australia Encompassing: • trade • agricultural industries • human health • biodiversity • national heritage and • tourism	**Tony Robinson**
	10.00 am Morning tea	
10.30 am	The impact of wildlife health Case studies would be selected to illustrate how diseases impact on: • trade • agriculture industries • human health • biodiversity • national heritage • tourism	
	Bat diseases	**Hume Field**
	Kangaroo Blindness	**Leslie Reddacliff**
	Hydatids	**David Jenkin**
	The feral pig - range of diseases	**Jim Hone**
	Amphibian die-off	**Rick Speare**
	Japanese encephalitis in Kangaroos	**Deborah Middleton**
	Avian influenza	**Christine McClintock**
	12.30 pm Lunch	
13.30 pm	Models of disease health centres:	
	• Canadian cooperative wildlife health centre	**Karrie Rose**
	• USA wildlife health system	**Pam Whiteley**

- NZ wildlife health system **Karrie Rose**
- other – eg Europe, India, Japan etc **Pam Whiteley**

14.00 pm Existing resources and wildlife health activities in Australia **Andrew Tribe**

This was an inter-active session to discuss existing wildlife health resources using hypothetical and real scenarios. The purpose was to draw out what is available and the potential to adapt existing resources to new functions.

The four being:

- Willis Island seabird die-off **Heather Gardner**
- Exotic/ Japanese encephalitis **Chris Bunn**
- Emerging/endemic eg Tammar Wallaby **Karrie Rose**
- Translocation **Karen Viggers**

- government departments
- research centres
- pathology registers
- population and disease surveillance and monitoring systems
- wildlife health care centres

15.00 pm Afternoon tea

15.30 pm Open forum for discussion **Gerry Maynes**

16.30 pm Summary **Chris Bunn**

17.00 pm Tour of Gunghalin – CSIRO

Evening Social / dinner at the Rex Hotel

DAY 2
FRAMEWORKING A WILDLIFE DISEASE CENTRE

8.30 am Review of day 1 and objectives of day 2 **Chris Bunn**

- aims and focus of a disease health centre
- highlight the need to obtain agreement in principle with the concept of a wildlife disease health centre

8.45 am Workshop Sessions **Ian Denney**

- structure and functions a National Wildlife Health Centre
- contribution by stakeholders towards development of a National Wildlife Health Centre
- business plans
- sustainability

10.30 am Morning Tea & Questions

11.00 am Workshop discussion and summaries **Ian Denney**

12.30 pm Lunch

13.00 pm Develop and seek agreement on an action plan **Ian Denney**

14.30 pm Summary of the outcomes of the Workshop **Ian Denney**

Executive summary

The need for a national approach to wildlife health has been identified by many over the years. Recently, this need has gained impetus due to the appearance of a series of diseases and mass mortalities in wild fauna, and emerging diseases in wildlife that affect humans and production animals. Through these events it has become apparent that a national, coordinated approach and an information centre for wildlife health would better enable us to identify and respond to these and other wildlife health issues.

At present, some aspects of wildlife health are picked up by disparate groups of federal and state government departments in agriculture, environment and health; researchers; conservation agencies and wildlife carers but the effort and communication is inefficient and essentially uncoordinated.

A workshop was held in November 1999 to consider how better to coordinate wildlife health issues through development of a national wildlife health centre/network. This was funded by the Wildlife Exotic Disease Preparedness Program (WEDPP), a program within the Department of Agriculture, Fisheries and Forestry Australia (AFFA).

Over 60 representatives from federal and state conservation, agriculture and health departments, universities, zoos, animal harvesting and hunting industries, diagnostic pathology services and others, attended the workshop. Information about existing national and regional wildlife health organisations including centres in the US, Canada, India, New Zealand, the European Union and France was discussed. Case studies were used to highlight recent significant wildlife diseases and to identify benefits and gaps in the existing 'systems'. All participants contributed to the workshops that developed the proposal for a Wildlife Health Centre/Network outlined below.

A Wildlife Health Centre/Network

Aim

To promote and facilitate collaborative links in the investigation and management of wildlife health in support of human and animal health, and biodiversity.

Objectives

- Establish and coordinate a network of wildlife health expertise and resources;
- Develop and operate a national database of wildlife health information;
- Identify wildlife health surveillance and research needs and priorities;
- Promote the development of regional and national wildlife health emergency preparedness and response strategies;
- Facilitate and monitor field investigations of disease incidents;
- Advance education and training in wildlife health;
- Provide information about wildlife health to the community; and

- Seek and secure resources to achieve the objectives listed above.

What can the centre / network provide?

- *New capability - something more than the individual parts that currently exist*

  A wide range of people and organisations are interested in the health and disease of wildlife. Participation and contribution to a network would strengthen links enabling sharing of information, and create synergy.

- *Provide monitoring/surveillance system*

  A network/centre would link the information gained from existing surveillance systems and as well collate information from research and field reports. These sources are not picked up adequately in the existing systems.

- *Rapid response across agencies and jurisdiction to emerging diseases or emergencies*

  A network linking agencies, jurisdictions at the coalface will enable rapid response and coordinated effort to disease or emergency issues. At present, knowledge of major wildlife health issues travels only via personal networks. Stronger networks are needed.

- *Identify gaps*

  Gaps exist between the current roles of many organisations. The gaps need to be identified and steps taken to correct any anomalies and deficiencies.

- *Coordinate research/identify priorities*

  Identify research priorities, facilitate wherever possible the gaining of research funds and promote research between relevant groups.

- *Professional advice*

  A centre would provide an avenue to the sources of specialised knowledge in monitoring and surveillance and for specific information on disease.

- *Cost-effective*

  A centre /network, as a central source of information, would reduce duplication and effort and thereby expedite the process of information gathering and communication.

Outcomes from the workshop

The workshop developed a basic framework for a centre/network. A steering committee was appointed to create a proposal to be put to funding bodies for resources needed. The following members were appointed to the steering committee:

• Chris Bunn	Agriculture Fisheries Forestry Australia
• Graham Eggleston	NSW Agriculture
• Tony English	University of Sydney/Australian Veterinary Assoc
• Heather Gardner	Australian Quarantine Inspection Service
• Gerry Maynes	Environment Australia
• Tony Robinson	CSIRO
• Karrie Rose	Zoological Parks Board of NSW
• Karen Viggers	Conservation Biology
• Pam Whiteley	Wildlife Disease Association

The steering group was asked to:

- Develop proceedings of the workshop
- Agree on broad objectives and activities of the centre/network
- Prepare a business plan
- Identify and define the role of a project officer
- Identify location(s) for the centre headquarters
- Prepare submissions for funding

It was envisaged that the first submission for funding would be for a project officer, initially as a secondment or on a temporary basis to initiate key/priority functions of the centre/network.

It was understood that the centre/network would not interfere with the roles of existing organisations – that is it would be designed to fill in the gaps, and facilitate cooperation and communication. The centre/network would commence by utilising and linking existing facilities, and hence would provide a national system.

The workshop was unresolved on whether the term centre/network should be used (or possibly another term). It was agreed at the meeting to accept the offer to use an existing website (Wild Health Australia, www.wha.org.au) and to establish regional groups based on representatives from each State. The following participants offered to be state or territory representatives:

Queensland	Hume Field and Geoff Lundie-Jenkins
NSW	Karrie Rose and Tony English
ACT	Karen Viggers and Will Andrew
Vic	Ian Temby and Dave Middleton
Tas	Philip Ladds and Mark Holdsworth
SA	Barbara St John and Sue Conaghty
WA	Cleve Main and Shane Raidel
Northern Territory	Derek Spielman

Acronyms

AAHC	Australian Animal Health Council
AAHL	Australian Animal Health Laboratory
AFFA	Agriculture Fisheries Forestry Australia
AI	Avian influenza
ANZFAS	Australia and New Zealand Federation of Animal Societies (now Animals - Australia
AQIS	Australian Quarantine Inspection Service
ARAZPA	Australasian Regional Aquaria and Zoological Parks Association
AVA	Australian Veterinary Association
CCEAD	Consultative Committee on Emergency Animal Disease
CCWHC	Canadian Co-operative Wildlife Health Centre
CNEVA	National Centre for Veterinary and Alimentary Studies
CITES	Commission for the International Trade in Endangered Species
CoB	Convention on Biodiversity
CDNANZ	Communicable Diseases Network of Australia and New Zealand
CRC	Cooperative Research Centre
CVO	Chief Veterinary Officer
DHAC	Department of Health and Aged Care
DoC	Department of Conservation, New Zealand
EA	Environment Australia
EBHS	European Brown Hare Syndrome
ENVL	National Veterinary School Lyons
EU	European Union
FAO	Food and Agriculture Organisation
FDC	Departmental Federation of Hunters
GATT	General Agreement on Trade and Tariffs
IPPC	International Plant Protection Convention
IWHC	Indian Wildlife Health Cooperative
JE	Japanese encephalitis
LVD	Department Veterinary Laboratory
MOU	Memorandum of understanding
NAHIS	National Animal Health Information Service
NAMP	National Arbovirus Monitoring Program
NAQS	Northern Australian Quarantine Service
NDV	Newcastle Disease Virus
NGO	Non government organisation
NHMRC	National Health and Medical Research Council
NWHC	National Wildlife Health Centre
NZWHC	New Zealand Wildlife Health Centre
OIE	Organisation International Epizooties
ONC	Office National de la Chasse
SAGIR	Surveillance of Wildlife Disease in France
SPS	Sanitary and Phytosanitary (Agreement)
USFWS	U.S. Fish and Wildlife Service
USNWHC	U.S. National Wildlife Health Centre
VetComm	Veterinary committee
VPS	Veterinary Pathology Services
WEDPP	Wildlife Exotic Disease Preparedness Program
WHO	World Health Organisation
WII	Wildlife Institute of India
WHIP	Wildlife Health Information Partnership
WIRES	Wildlife Information and Rescue Service
WTO	World Trade Organisation
WWF	World Wildlife Fund
ZPB	Zoological Parks Board of NSW

DAY 1: SETTING THE SCENE FOR A WILDLIFE HEALTH CENTRE

Introduction

Gardner Murray the Chief Veterinary Officer of Australia formally welcomed participants, opened the workshop introduced the keynote speaker Dr Graham Mitchell.

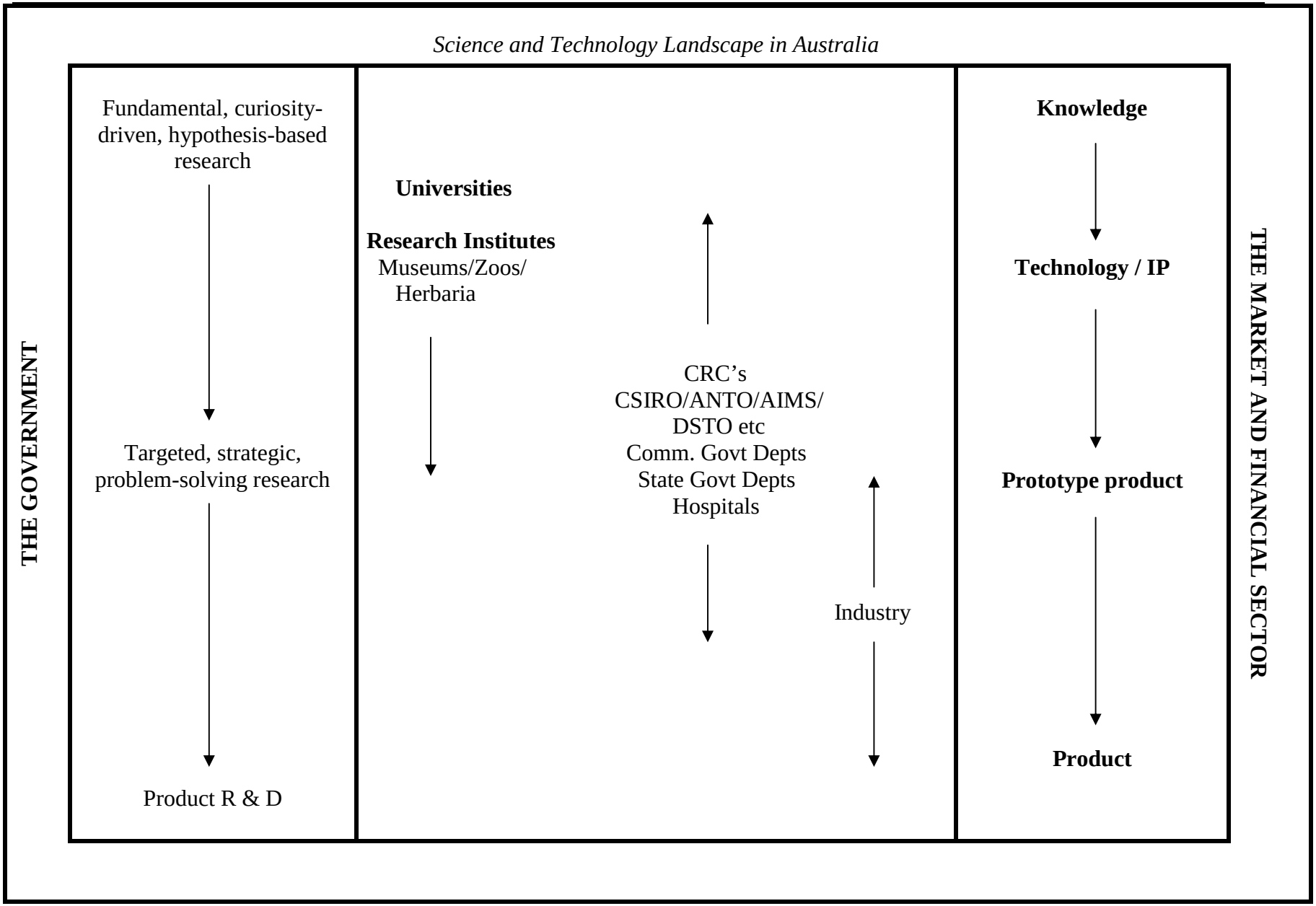
Dr Murray highlighted the absence of any nationally coordinated information base on wildlife health in Australia and hoped that this workshop would develop this concept and begin the process towards developing an Australian wildlife health centre/network.

Key note address

by Dr Graham Mitchell

> *Dr Graham F. Mitchell has extensive experience over a wide range of science, technology and its commercialisation, most recently with CSL Ltd where he was Director of Research, R&D Division (1993-96) and is recognised as one of Australia's leading biological scientists.*
> *He is a principal of Foursight Associates Pty Ltd, a consultancy at the interface of medical and scientific information and service with commercial operations. This consultancy was established in 1996 with Sir Gustav Nossal, Professor David Penington and Dr. John Stocker and has a client base of government, academia industry and the financial sector.*
> *In 1993 Dr. Mitchell was appointed as an Officer in the Order of Australia for services to science related to immunology.*
> *In August 1998 Dr Mitchell was appointed as Principal Adviser for Science, Engineering and Technology policy to the Victorian Government.*

Dr Mitchell discussed research funding in the context of Australia's science and technology capacity and the key need for sustainable secure funding to underpin any major issue or project. Investors today want advice on which projects to invest and whether the science is credible. "Will it pass the laugh test?" Apart from scientifically sound projects, it is extremely important to demonstrate networks, linkages, and cross-sectoral interactions, as modern research cannot be done in isolation without access to multiple skills.



Where are practitioners of wildlife diseases research located in the science and technology landscape in Australia?

Funding

Scientific funding in Australia is shifting away from its traditional source of government. Government funding is limited and the wider opportunities exist beyond this area. However, there is a larger role for government to provide funding for research that is in the public good which may not be funded from commercial sources and in providing seed money for good scientific projects.

The cooperative research centre (CRC) may provide a structural and funding model for a Wildlife Health network/centre. The CRC acts as a network, with various players ranging from academia, industry, and government, and receives dollar for dollar funding by government. The current CRC model to be adapted to a Wildlife health centre/network would require modification.

Another source of funding of a wildlife health centre/network is the ecotourism industry. This industry is present in Australia and is expected to grow enormously in the next 10-15 years. An example of emergence of ecotourism and the use of tourist dollars to raise revenue and fund management of wildlife is in Africa. This market targets the wealthier tourist of Europe and USA rather than the backpacker.

Is this industry interested in putting something back into the environment that serves them and to establish a sustainable income in the future for them?

Changes in Australian science and technology and social expectations

These changes may be a threat or benefit to a venture of the type we are discussing.

- *New Government initiatives*
  Federal Government funding to science has increased in some areas, eg. NHMRC has recently had funding doubled. Other government initiatives are in the support and reinforcement for R&D; technology parks, CRC programs, and in the area of tax–based support of support business research and development. There are State Government initiatives, eg developments recently by the Western Australia, Victorian and Queensland governments with the upcoming summit on innovation early next year. We are moving into a knowledge-based economy especially into regional Australia.

- *Increased cost of research*
  Industry is outsourcing its R&D. There is a portfolio approach to fund raising by research organisations and funding base needs to be diversified. There is a move to develop networks and co-location with infrastructure sharing in order to achieve a critical mass. This has lead to less inter-State competition with the realisation that there is a need to link within Australia to ‘compete’ with the rest of world.

- *Impact of societal expectations*
  The societal expectations encompass ethics, transparency, and accountability and have changed over the last 20 years. Of concern is the development of current thinking that science and technology is bad and the GMO debate has exacerbated this.

- *Reduced status of science and technology*
  The status of science and technology has fallen, both as a career choice and by the public in general. This has impacted most on the hard-edge sciences, such as physics and chemistry.

- *Increased understanding of the innovation culture and the constraints to commercialisation*

- *Lower public sector expenditure in higher education and hospital sectors.*

- *Impact of competition policy – user pays, provider charges*
  This issue is a problem for activities that are for the "public good" such as wildlife health. There is hardly an industry in wildlife health. The CRC model enables funding research that is in the public good that would not be supported by commercial interests.

Major changes in the conduct of biological research (20 year timeframe)

- *Sophistication of experimental methodology*
  Multi-disciplinary teams and collaboration dominates across the life sciences

- *Rate at which data are generated has increased*

- *Relative cost of equipment in a laboratory budget.*

- *Change from the reductionist approach of laboratory based research to holistic endeavours.*
  Epidemiology and modelling studies are now more common.

Conclusion

Knowledge, research, innovation, learning, and linking ('KRILL'), particularly linking, is critical to achieving funding and sustainability of a project. However, broader issues such as political timing, an awareness of regional requirements, and the development of industries such as ecotourism are vital to the endeavours to fund a project such as wildlife health centre/network.

Questions

Mining companies often put in money for environment. What do the companies get out of it?
Answer: True. In most companies, funding requests are now sent to the marketing division to ensure the company gets something back from these strategic partnerships/investment. Ag biotechnology and chemical companies should be looked upon for wildlife health support.

Ecotourism – What about hunters/harvesters? They do in US, put money into reserves etc.
Answer: Ecotourism is a better long term bet in terms of what is perceived by the general population as a 'noble' endeavour, rather than just from a 'single' group. Look for plurality.

In Tasmania regulation is at a high level, hunters are a good source of monitoring info etc.?
Answer: Yes. Lots of people can contribute.

What is the significance of wildlife health to Australia

by A J Robinson, CSIRO Wildlife and Ecology

The interaction of wildlife and humans has obviously had a long history and the distinction between what was wildlife and what was human "in the beginning" is probably academic. One form of wildlife exploiting another. Humans however emerged as a very successful and adaptable predator and gatherer.

Today we have reached the point where predation has been replaced, or at least modified, by the farm and gathering is now done in the supermarket – to simplify it to absurdity. Individuals can even feed themselves by buying and selling something called currency! During this process other wildlife moved from being an essential commodity to being a curiosity and often a nuisance. Some were pretty to look at or pleasant to listen to or even edible but many just got in the way. Some were downright dangerous. They either tried to poison you or eat you. It was recognised too that some gave you diseases. However, in recent years wildlife seem to have taken on another dimension. Over the centuries we have seen a move from disinterest or ignorance and fear, through Darwin's ideas of "survival of the fittest, to exploitation and, now, to concerns that wildlife might be just be important for human survival. Wildlife have reasserted themselves.

We are re-learning the importance of wildlife and this has led to a range of initiatives around the world. This workshop is one of those initiatives and I hope that the outcome will be a greater appreciation of wildlife, the costs as well as the benefits, and perhaps a more efficient way of incorporating wildlife into human activity in Australia.

What I want to talk about now is wildlife health and how it might relate to trade, agriculture, human health, biodiversity, national heritage, and tourism. I deliberately say wildlife health rather than wildlife disease, as disease is only one component of a discussion on wildlife. I also want to broaden the popular view of wildlife to include plants and microorganisms. It is often the complex interplay of all life forms that needs to be considered in a discussion of wildlife health not just the charismatic or, for that matter, disease ridden megafauna, although the latter are an important economic driver.

What initiatives have been developed recently and what have been the driving forces for those initiatives. First let's look at international treaties. With some exceptions, these treaties have driven national initiatives on wildlife.

International treaties

In 1947 the General Agreement on Tariffs and Trade (GATT) was established to reduce trade barriers between nations and to minimise dumping. Following the Uruguay round of negotiations in 1986-1994 GATT was replaced by the World Trade Organisation (WTO) in 1995. The WTO established an Agreement on the Application of Sanitary and Phytosanitary measures (SPS). In Article 5 of the SPS, Assessment of Risk and Determination of the Appropriate Level of Sanitary and Phytosanitary Protection, it is

stated that "Members shall ensure that their sanitary or phytosanitary measures are based on an assessment, as appropriate to the circumstances, of the risks to human, animal or plant life or health, taking into account risk assessment techniques developed by the relevant international organisations." The definition of "animal" includes fish and wild fauna and "plant" includes forests and wild flora.

It is the desire of WTO that the measures used be based in international standards developed by relevant international organisations including the Office International des Epizooties (OIE) and the International Plant Protection Convention (IPPC).

No measure is to be applied which would amount to arbitrary or unjustifiable discrimination against a WTO Member and this must be based on scientific evidence although where scientific information is insufficient, Members may adopt measures based on available pertinent information. Nevertheless the standards tend to ratchet up and the requirements of importing countries tend to become increasingly stringent. These issues of trade in animals and plants are of course of critical importance to the Australian Quarantine Inspection Service (AQIS) in their role in preventing or limiting the incursion of pests and diseases into Australia. The important new dimension that has been bought in under SPS is the environment and the threats to wildlife.

Regarding animals and the OIE, the Commonwealth Chief Veterinary Officer within Agriculture Fisheries and Forestry Australia (AFFA) is Australia's permanent member. WTO recognises OIE as the international organisation responsible for developing standards, guidelines and recommendations that are accorded the status of reference norms under the WTO Agreement.

Thus the OIE has assumed significant importance for Australia and other trading nations in agriculture. Pertinent to this workshop, the OIE is taking an increasing interest in wildlife disease. There is a working group on Wildlife Diseases. In the report of the Group to the 67th General Session of the International Committee held in Paris on 17-21 May 1999 it was noted in Paragraph 285 of the report of the meeting that the activity of translocations of wild animals is on the increase carrying with it economic, health and environmental risks in the event of concomitant introduction of infections. They also noted in Paragraph 286 that wildlife health surveillance is proving to be a subject of growing importance. The presence or absence of an infection in an outbreak in the wild cannot be officially declared by a country or local authority unless sampling has been carried out and the results subjected to appropriate statistical analyses. "Absence of evidence" is being replaced by "evidence of absence". As other countries become more proficient at wildlife disease surveillance, this will become increasingly important.

The Wildlife Disease Working Group believes that countries that carry out intensive disease surveillance with wildlife populations included are more likely to maintain domestic animals free of trade-sensitive diseases. However, notification of a disease in the wild is not meant to penalise exporting countries where domestic animals remain free of the disease. This was to reassure CVOs that reporting of wildlife diseases per se would not necessarily affect trade. The Group states that countries should strive to develop or

maintain wildlife disease surveillance programs emphasising broad-based data collection and analysis. They recommend methods for this. Clearly many of these recommendations are aimed at List A and List B diseases which have potential to spill over into production animals, companion animals or humans. For Australia most of these diseases are not present but Newcastle disease is a recent event where wildlife surveillance is important. It would seem that some form of centre or database, the brief of which is to concentrate on wildlife surveillance, would assist Australia in convincing trading partners that we have this one covered.

Another area of importance to the OIE is fish disease and there is a Fish Diseases Commission. The list of notifiable diseases of fish and crustacea is increasing and the opportunity for infection from the wild is apparent. The recent Nairn review of quarantine came to the conclusion that the incursion of fish diseases has been seriously underestimated. Other threats to marine species are the discharge of untreated ballast water and this is the concern of the International Convention for the Prevention of Pollution from Ships of which Australia is a signatory. Member States of the United Nations Convention on the Law of the Sea also have an obligation to protect and preserve the marine environment.

Recent events in Australia and overseas highlight the growing importance of wildlife disease as threats to trade, human health, agriculture, and aquaculture. Some of these threats in Australia, which will be discussed by others at this workshop, are Japanese encephalitis virus, Australian bat lyssavirus, Hendra virus, Menangle virus, kangaroo blindness orbivirus, and pilchard disease. Those wildlife-derived infections threatening human health are shown in the next slide.

Wildlife and human disease

Less spectacular but still important diseases of humans derived from wildlife in Australia are the notifiable diseases caused by the mosquito born Barmah Forest and Ross River viruses, and the bacterial zoonoses of leptospirosis and salmonellosis. They accounted respectively for 543, 4117, 296 and 6,266 human cases in the first 10 months of 1999.

Most of the salmonellosis cases would have been from contaminated foodstuffs but a proportion would have been from handling wild animals.
David Blyde of the Western Plains Zoo has compiled a list of zoonosis of wild animals that adds to that list
Psittacosis, yersiniosis, campylobacteriosis, erysipelas, Q fever, mycobacteriosis, brucellosis, dermatomycoses, rickettsial spotted fever, giardia, cryptosporidium, sarcocystis, schistosomiasis, hydatids, hook worm and sarcoptic mange. In addition, Dave Spratt at CSIRO has investigated a recent fatal case of infection with *Angiostrongylus cantonensis* which can be contracted from garden snails and also some cases of *Haycocknema perplexum* which is a parasite that invades muscles and for which the normal host is unknown but probably a wild species.

We have in place in Australia a reasonable surveillance and diagnostic capability that can respond to threats from disease in wildlife. However, there are limitations to what it is capable of because of the size of the country and the limited resources that are allocated to it. State agency field staff and State laboratories, AQIS, through the "Top Watch" Northern Australia Quarantine Strategy (NAQS) for instance, the Australian Animal Health Laboratory, universities, and the zoos have proven to be effective in recognising and diagnosing the more obvious diseases of wildlife usually where there is livestock or human health involved. There are also a number of networks, services, and organisations that try to bring facets of wildlife disease together but they are fragmented. For example, the National Animal Health Information Service (NAHIS) funded by the Australian Animal Health Council, the Communicable Disease Network of Australia and New Zealand, the Wildlife Diseases Association, the Australian Association of Veterinary Conservation Biologists, and the Wildlife Health Australia subscriber e-mail service set up recently by David Middleton.

The next stage of determining the extent of the problem is not so well done. Once the diagnosis is made there are often limited resources available for longer-term studies that are important for management of the problem. This needs to be addressed if we are to make progress in controlling diseases considered a problem. An exciting prospect is the use of microorganisms as disseminating and bait delivered vaccines for the control of disease in wildlife. A good example has been the control of rabies in foxes in Europe. The Pest Animal Control CRC is also working to develop tools for immuno-sterilisation of pest animals and the technology being developed could be adapted to delivering vaccines for wildlife.

Biodiversity, national heritage and tourism

I want now to move away from the more obvious needs for wildlife health surveillance in the area of trade, agriculture, and human health and expand the discussion of wildlife health to include biodiversity, national heritage, and tourism. Although it is obvious that we need to pay attention to wildlife as a reservoir for diseases of livestock and humans we also need to pay attention to the health of our wildlife *per se*. This needs to be broader than just disease and include other threats. In 1993, the United Nations established the Convention on Biodiversity (CoB). Australia is a signatory to CoB who's aims are the conservation of biological diversity, the sustainable use of its components and the fair and equitable sharing of benefits arising from the use of genetic resources.

Probably the biggest threat to our wildlife is habitat loss or modification. In a study to quantify threatening processes leading to species loss or decline in the USA, habitat loss came out on top. Of 1880 imperilled species, vertebrates (541), invertebrates (471) and plants (1478) for which data was available, 85% were threatened by habitat destruction and degradation, 49 % by alien species invasions, 22% by pollution, 18% by over exploitation and only 2% by diseases (Wilcove *et al*. (1998) BioScience 48: 607-615.

In Australia Steve Morton of CSIRO has also compiled a list of the percentage of species predicted to be lost as a result of the operation of six major agents in five main geographic zones in Australia. Again habitat loss or modification by clearing and grazing turned out to be by far the biggest threat. He predicts that between 56% and 86% of species will be lost in perhaps the next 10 to 100 years if these activities continue.

For example in high rainfall areas 100 mammals could go extinct, 40 amphibians, as well as 2,000 plant species.

So if we are to establish a network on wildlife health we need to keep these figures in the front of our mind. It is part of the emerging philosophy of triple bottom line accounting in sustainable agriculture - economic, social, and environmental.

We should not however, dismiss disease altogether. In wildlife, disease is often cryptic and often sick or dead animals are only found where there has been a major epizootic. Disease is one factor that regulates populations. To give an example, myxomatosis was found to be keeping a population down to 10% of its potential level as revealed by vaccinating one half of the study population. Prior to that study myxomatosis was thought not to be effective in controlling rabbits on that site, as very few cases of myxomatosis were seen (Parer et al. (1985) Aust. Wildl Res. 12: 407-423).

It is likely that disease is important in keeping numbers down in many wildlife populations and can be critical in those that are nearing extinction.

At this point I would like to mention another treaty to which Australia is a signatory. This is the Convention on International Trade in Endangered Species of Wild Fauna and Flora or CITES. This treaty has been in force since 1975. The member countries have drawn up agreed lists of endangered species. Under Australia, 91 mammals, 124 birds, 51 reptiles, 3 amphibians, 2 insects, 7 bivalves and 3 anthozoa (corals and sea anemones) are listed.

Responsibility for CITES is with Environment Australia under the Wildlife Protection (Regulation of Exports and Imports) Act 1982. So this bridges trade and biodiversity.

The implications of habitat destruction and wildlife diseases for biodiversity and thus national heritage and tourism are obvious. One of the draw cards for tourists coming to Australia, the “Australian experience” is the unique fauna and flora and its protection is crucial to sustaining that activity. With tourism there needs to be a balance between access to the wildlife and over-exploitation that might lead to loss of the particular resource. There is also a public-health dimension to some species such as the bats which needs to be taken into consideration. Easy access to quality information on how different species should be managed for tourism could be a useful component of a wildlife health network.

What I have been talking about so far has been animals with which most of us very familiar but it must be remembered that they are only a small component of the biota. Plants, some 20,000 species in Australia are threatened or pose a threat to native species.

Underground the situation is even more complex. Microorganisms such as the mycorrhiza are critical to the health of the environment. The total mass and number of species can exceed the species above ground. Denis Saunders of CSIRO Wildlife and Ecology has supplied me with some figures for the mass of organisms underground in the sheep/wheat belt, which includes protozoa, nematodes, arthropods, earthworms, bacteria, and fungi. The accumulated mass is in the region of 20,000 kilograms per hectare compared with 15,000 kilograms of wheat biomass producing 5000 kilograms of grain.

When we are talking wildlife health, we must try to take into the account the system that the species of interest occupies as well as the species in isolation.

The establishment of a wildlife health network

What might we do to address these issues? The Federal and State Governments can establish legislation and put operators on the ground to both protect our wildlife and address the threats they might pose to livestock and people but the task is enormous. One hurdle is coordination of effort and access to information. The establishment of a Wildlife Health Centre or Network would be a good start to pull together the various groups and a step toward achieving confidence with importing countries in the areas of trade. A Wildlife Health Centre or Network which can accumulate and post data on the health status of Australian wildlife and indicate to trading partners a raised level of awareness and a commitment to improvement. In a response to the Nairn Report which reviewed Australian quarantine arrangements in 1996, the Federal Government accepted in principle Recommendation 90 which called for the development and management of national pest and disease databases and information systems. This must include wildlife if it is to be credible and I think any network that was established must include the broadest definition of wildlife possible. The scope and structure of such an organisation is the subject of this workshop.

Questions

With the definition of wildlife, do we need to be restrictive? That is, including the megafauna only and not the totality.
Answer: I think we should try to start broadly. This is now feasible with a centre or a network having access to this information just by a ‘push of a button’ on a computer. From a funding point of view, it might need to be restricted because of the need to consider the economic drivers. However we need to remember that the megafauna depend on all the other less charismatic smaller organisms.

Are the megafauna good indicators for the health of the total system.
Answer: They can be, particularly if we examine the affects at the population level.

The impact of wildlife health — case studies

Introduced and chaired by Dr Tony English, Faculty of Veterinary Science, University of Sydney

The purpose of this portion of the workshop was to highlight the impact of wildlife health issues within Australia using a series of case studies. These reports were selected to illustrate how wildlife disease has the potential to influence trade, the agro-economy, human health, biodiversity, national heritage, and tourism.

Emerging diseases of bats

by Hume Field

Bats have suffered from a PR problem in recent times, stemming from the emergence of Hendra virus in 1994 and associated fatal disease outbreaks in horses and humans. In the aftermath of these events, surveillance of wildlife undertaken by the Queensland Department of primary Industries has identified flying-foxes as the probable natural hosts of the virus. As a consequence of the increased surveillance interest in bats, a previously undescribed lyssavirus was subsequently identified in flying-foxes by NSW Agriculture scientists. Australian bat lyssavirus has since been found to be geographically widespread (albeit at a low prevalence) in bat populations in Australia.

Hendra virus outbreaks - high (70%) case fatality rate in horses and humans. Epidemiological and laboratory evidence suggest that virus is not highly infectious. Short term impact on racing in SE Queensland. There is a likelihood of sporadic equine cases occurring. Wildlife surveillance identified flying foxes as a natural host of Hendra - distributed throughout flying-fox populations in Australia and PNG. Bats do not appear to pose a direct risk of infection to people based on serological studies of people working closely with bats.

Australian bat lyssavirus (a rabies-like agent) was identified in 1996 during surveillance of flying-foxes for hendra virus. Two human cases have occurred - both fatal. Whilst there is likely to be little impact directly on agricultural industry due to the high species specificity of the virus, there is the potential for trade impacts as a result of the genetic similarity with rabies. Lyssavirus is found in flying foxes and insectivorous bats with some genetic variation among these isolates. There is higher crude disease prevalence in sampled ‘rescued’ (sick and injured) flying foxes compared with wild-caught samples (7% vs 1%). Exposure to an infected bat constitutes a direct risk to humans. Health authorities are incurring substantial costs for human post-exposure prophylaxis. A heightened level of public awareness should lessen the frequency of future human cases.

Menangle virus - a new paramyxovirus identified in NSW in 1997 by NSW Agriculture scientists. It is highly infectious within piggery. Whilst there was a major short- and medium-term economic impact on the single piggery involved, there was no broader impact on industry. Two piggery workers who had severe febrile illness during the time

of the outbreak in pigs were found to have high neutralising antibody titres to menangle virus. Wildlife surveillance by Queensland DPI and NSW Agriculture found evidence of infection in sampled flying foxes (34% seroprevalence).

Nipah virus (1998/99) - a new paramyxovirus found in Malaysia. Nipah resulted in large numbers of pig and human deaths. The epidemic demonstrated both a temporal and spatial pattern of an infectious disease. Inability to effectively control the movement of infected pigs played a major role in the spread of the disease. The virus has serologic, antigenic and sequences similarities with Hendra virus (a 10% difference in amino acid sequence compared to Hendra virus). In humans, the disease manifests as an epidemic of viral encephalitis, with a case fatality rate of 40%. The clinical manifestation of the disease in pigs was respiratory (primarily) and neurological. The virus is highly infectious in pigs, however, infection was frequently asymptomatic with a low case fatality and minimal overall effects on production. Horses, dogs, cats were also infected, but pigs were the only known source of human infection. The pig isolate was found identical to the human isolate. Surveillance of wildlife for evidence of infection with Nipah virus was undertaken using a targeted approach, which focused on bats and wild boar. Also surveillance of ubiquitous peri-domestic species (rodents, shrews, birds) was undertaken.

Five species of bats (including two flying-fox species) were positive serologically, but no virus yet isolated from bats. Viral culture work is still underway. The geographic distributions of species of flying-foxes overlap from Australia to India. Little is know about the level of interaction of the different species within these overlaps, and it is unclear whether there is potential for the spread of agents across these boundaries.

Impacts
Malaysia 265 human cases with 105 fatal; Singapore 11 human cases with one fatal. Costs of the outbreak and its control were enormous - operational outbreak control expenses; a collapse in domestic pork consumption and price; cessation or restriction on international trade in pigs and horses; one million pigs (1/2 the national herd) culled; infrastructure destroyed; and domestic and international tourism downturn.

Question

What has been the strategy for examining bats?
Answer: Firstly, establish presence or absence of infection in different species, and locations - allows description of the geographic extent of the agent. Targeting presumed high-risk subsets of the populations can reduce necessary sample sizes. Secondly, estimate disease prevalence in bat populations. Representative sampling is the primary difficulty in surveying wild populations. Thirdly, determine risk factor for infection and spillover.

Kangaroo Blindness (viral chorioretinitis)
by Leslie Reddacliff

History
Late autumn 1994 - samples started to come in to the diagnostic laboratory from Western NSW and north western Victoria. 1995 spread to south east SA .1995-6 Present in southern WA The outbreak became popular in the press and public pressure demanded further investigation.

Species
Species affected included Eastern grey, Red kangaroo, wallaroo, uncertain if it infected the smaller, more difficult to trap species. Mostly prevalent in eastern grey kangaroos.

Clinical signs, pathology and pathology
Blindness, possibly uveitis (inflammation of the iris) and discharge. These findings were found months after the initial infection. Thus isolating the virus from animals with blindness is difficult, since the animal is often not still viraemic. On post mortem – non-suppurative often mild chorioretinitis (inflammation at the back of the eye). Wallal and Warrego groups of viruses (both groups belong to the genus Orbivirus) were isolated. These viruses infect invertebrates and vertebrates. Serologically the Wallal virus seemed to correlate with the outbreak, with Warego virus group being more widely spread.

Experimental studies
Experimental reproduction involved:
- NSW Agriculture;
- CSIRO Wildlife and Ecology;
- Zoological Parks Board of NSW;
- Specialist veterinary ophthalmologists;
- AAHL; and
- NSW National Parks and Wildlife.

Experimental results
Lesions in three out of eight exposed to cultured Wallal virus. Viraemic three weeks before lesions developed. (See *Aust. Vet. J.* Vol 77, No 8, 522 - 528, August 1999. Based on a number of population surveys, the population of macropods actually increased during the time of the outbreak.

Hydatids
by David Jenkins

Echinococcus granulosus is the only one of four species of Echinococcus that occurs in Australia. It was most likely brought in with dogs and livestock during settlement and spread quickly from dogs to wildlife. *E granulosus* was also introduced into New Zealand but has almost been eradicated, as it never established in the wildlife. The distribution of *E granulosus* in Australia is regulated by mainly rainfall.

Disease in humans
Few data regarding the distribution of hydatid disease in humans and livestock are available. No data are collected in abattoirs, and the disease in humans is notoriously under-reported. Local tracebacks from abattoirs are the only real source of data. There are approximately 100 new cases in humans in Australia each year. About 40% of these are in immigrants who became infected in their country of origin. The cases in people infected in Australia occur primarily in the rural areas. Cysts in humans most often are located in the liver, but can be located in any organ and can reach enormous sizes, posing a significant health risk if untreated.

Epidemiology
Canids (domestic dogs, foxes and wild dogs [dingoes and dingo/domestic dog hybrids] are the definitive host and contaminate the environment with infective eggs passed in the faeces. These eggs are accidentally ingested by herbivores or omnivores whilst eating or having close contact with infected canids. The eggs hatch in the intestine release a larva, which leaves the intestine, enters the blood stream, and is carried to an internal organ where it develops into a hydatid cyst over several years. The tissue cysts contain the next generation of tapeworms which if eaten by canids with offal lead to a new infection in the canid. There is a 42-day pre-patent period in canids. Kangaroos, wallabies, wombats, feral pigs, sheep, and cattle may act as intermediate hosts. Humans are occasionally parasitised. Dingos and wild dogs are excellent hosts. They often having high worm burdens up to 100,000 - 300,000 worms per dog with no apparent ill effects on the health of the dog. Cats do not act as a host for *E granulosus* tapeworms.

Foxes may be infected but are not significant with respect to environmental contamination with eggs because they have small worm burdens (usually less than 50 worms). Urban centres may be more at risk of hydatid disease caused by foxes. Wombats are occasionally found to act as an intermediate host for hydatids. Macropods commonly harbour hydatid cysts mainly in the lungs but also the liver (up to 30% prevalence). Swamp wallabies appear to be important in the parasite lifecycle since prevalence can reach 60% and these species are a favoured prey species of wild dogs. Wild pigs and sheep are also effective intermediate hosts. Cattle normally have sterile cysts, and are thus not important in sustaining the parasite.

The Kosciusko National Park and other mountain regions have provided an example of the impact of these epidemiological factors, which have resulted in high levels of hydatids. Historically, sheep were concentrated under grazing leases in summer, which provided a source of food and infection for dingos and sheep dogs fed offal. Heavy pasture contamination resulted, overtime, in the parasite becoming well established in sheep, domestic dogs, wild canids, and macropods. High Prevalence levels are seen in wild dogs. In some areas, it is 100%.

Conclusion
Wildlife is the most important reservoir for hydatids in Australia and is now acting as a reservoir for parasitic disease in sheep, cattle, and domestic dogs. (Reference was made to a study in Victorian). The Kosciusko National Park is an important site for human

recreation. The high concentrations of hydatids in animals, which can be spread readily by flies and human, may pose a significant threat to human health.

Feral Pigs – as wildlife hosts of diseases
by Jim Hone

Implications for trade, human health and other wildlife.
Pigs are widespread and abundant in eastern and northern Australia. Pigs are susceptible to many exotic livestock diseases – foot-and-mouth disease, the swine fevers, and Japanese encephalitis. Domestic and feral pigs are the same species.

Our understanding of exotic diseases in pigs is limited to overseas and not Australian experience, although some modelling work has been undertaken. Need to be cautious about extrapolating from overseas on the effects of disease, especially because of Australia's high density of feral pigs.

Implications of these diseases are:
- Trade: potential loss of export meat markets, vulnerability to sabotage;
- Human health: role of pigs in Japanese encephalitis and other diseases needs better understanding;
- Recreation and tourism: disease may limit use, especially with porcine brucellosis. Over 100 000 hunters within Australia plus overseas people coming to hunt pigs; and
- Wildlife diseases: pigs may be a good model system for studying dynamics and control of wildlife diseases in other species.

Question

How important are non-infectious diseases?
Answer: It is true that we concentrate on infectious diseases, but non-infectious causes such as toxicity and residue levels I can see emerging in future as significant issues.

Amphibian declines in Australia and epidemic disease
by Rick Speare

History
Apart from the study of the disease itself, this issue reflects the value of effective networking. Late 1970's - suspicion that populations of frogs were declining in south east Queensland. Mid 1980's - ecological data of moderate quality supported the suspicion. Early 1990's - good quality ecological information confirmed the suspicion.

The 15 year delay from when declines was suspected to the first pathological investigations in November 1993, demonstrates the need to have disease experts involved at a much earlier stage.

Epidemiology and disease
It took 3 years to identify the causative agent - Chytridiomycosis - infection with an unusual chytrid fungus, *Batrachocytrium dendrobatidis*. The fungus was discovered independently in 1991 in the National Zoo USA, in Australia in 1993 in wild frogs and in Panama in 1997 also in wild frogs. Interestingly the two US groups were not talking to each other.

B. dendrobatidis was shown to be the primary pathogen living only in the superficial epidermis. It probably causes death through the release of a toxin. There are 2 stages a zoosporangium and zoospores. The zoospores swim and live in water for approximately 24-48 hours and attaches to skin. A rhizoid is established which then forms a spherical body - the sporangium and internal zoospores. Sporangia form a discharge tube to release motile, flagellate zoospores. The lifecycle takes 72 hours.

The clinical signs vary from none to death. Superficial layer of skin is thickened and this layer sloughs off. Frogs sit abducted and occasionally small skin tags can be seen. Often appear normal, but then die suddenly. Frogs die from neurotoxicity.

B. dendrobatidis has very low host specificity and seems to be able to infect any species of amphibia. It behaves in the host as a new pathogen. Virulence appears to vary with the species of amphibian and environmental factors appear to increase pathogenicity, especially low temperature.

Distribution
Chytrid is behaving like an introduced pathogen. Amphibian declines spread in an epidemic front from SE QLD at an average speed of 100 km per year. *B. dendrobatidis* has become endemic in three zones in Australia (Adelaide, Perth, Cooktown to Northern Victoria) and found in 33 species of amphibians in Australia, (including cane toads and axolotls) - 17 of these are endangered.

Research network
The research network investigating this chytrid includes AAHL, James Cook Uni, WA museum and Amphibian Research Centre, Melbourne. It is a very collaborative exercise. Funding - Once show as significant cause received money from Environment Australia because of the threat to endangered species. Government funding for a web home page created by the network. This has helped government by providing a referral system Funding for research contracts.

Australian network component: frog ecologists, state national parks and wildlife employees, public, frog interest groups act as the eyes in the field. Overseas component: frog ecologists and scientists interested in amphibian diseases globally. There is a constant exchange of global information.

Questions

If chytrid free zone exists what are the implications for wildlife movements? Are there chytrid free countries? If so should restrictions be placed on movements between countries. A lot of countries still without records.
Answer: Cairns conference 2000 - to develop strategies to decrease the risk of diseases to amphibians - probably April 2000. When getting government funding, must assist government in the development of strategies. This conference has received funding from Heritage - Australia, as well as the world wildlife fund.

Will the conference take zoning further?
Answer: Will look at what we already know and what action should we take. We know for example that axolotls at pet shops now have the fungus. Look at how animals are moved around. In northern Victoria axolotls are bred in open ponds.

Is it true that the rainforest frogs disappeared from the higher country and not the lower?
Answer: Yes the upland species did suffer very badly with possibly 4 species going extinct. Suspected that it is temperature related.

How many hits have occurred with the web site and has it helped funding?
Answer: Yes, it has definitely helped with funding. It gets about 9 hits a day a third Australia, a third USA and the remainder from the rest of the world.

Japanese Encephalitis in Kangaroos
by Deborah Middleton

This study provides an exotic disease spin on the case studies and particularly Japanese encephalitis (JE).

Disease and occurrence
There are tens of thousands of human cases of encephalitis, particularly around rice fields. JE is also possibly the cause of encephalitis in horses and pigs, and possibly reproductive failure in pigs. This virus has recently been shown to be enzootic in portions of New Guinea. To become established Australia it must have competed with many other flaviviruses that are endemic here.

There have been two incursions of disease into Australia, in 1996 and 1998. One of these occurred on the mainland of Australia, at Mitchell River. A fisherman became clinically ill and seroconverted. Sentinel pigs and feral pigs in the area also seroconverted. This SE spread from New Guinea of the virus suggests that there will be future incursions.

Epidemiology
Arboviruses (to which JE belongs) circulate in specific ecosystems. Vertebrate hosts become clinically ill, usually in a seasonal pattern. Mosquitos are important arthropod vectors. The 3 main vectors for JE are zoophilic - they preferentially feed on animals,

particularly pigs, cattle and buffalo. *Culex annulirostris* is an important vector for endemic Kunjin and Murray Valley encephalitis virus - flaviviruses. Macropods are a favoured feeding source for C. annulirostris. Herons are an important amplifying reservoir for JE overseas as they are prevalent in rice field (shallow-water) ecosystems. Weber's line and Wallace's lines were used to demarcate the distribution especially of land birds and JE. Presumed and experimental evidence supports the premise that Australian wading birds, the herons and egrets, can act as amplifying hosts. Pigs, horses donkeys, cattle, buffalo, sheep, dogs, fowl, ducks are vertebrate domestic species hosts. Pigs are an important maintenance host.

Whilst other species seroconvert, they do not amplify the infection and increase the environmental load of the virus. Pigs are thus used as sentinel species in Northern Territory. While herons, egrets, sparrows, bats, snakes, frogs, (people) seroconvert, there is no structured surveillance for these species. The distribution of pigs in Australia is most dense in the regions were the virus is most likely to be introduced. If native mammals were amplifying hosts, the situation could be more severe and more of a risk for human health. Epidemic mortality among wildlife could be a problem if these species are infected, since they would be naive. We have limited information regarding JE in native fauna, thus, modelling the potential spread of the disease is difficult. Experimental trials are underway to monitor the effects of JE in agile wallabies and possums.

Question

Is C. annulirostris likely to be the main Australian host?
Answer: It is the one that the virus has been isolated from and it is widespread in many parts of Australia.

The role of wild birds in outbreaks of avian influenza in Australia
by Christine McClintock

The Australian poultry industry is currently considered free of AI. Outbreaks of AI have occurred on 5 occasions during the last 20 years. The first was in 1976 in Melbourne, Victoria, followed by 2 outbreaks in Bendigo, Victoria, in 1985 and 1992. The most recent outbreaks occurred in 1994 at Lowood in the Southeastern Queensland and 1997 at Tamworth, New South Wales. These outbreaks have had severe consequences first and foremost the high mortality and then subsequent destruction of birds to contain the outbreak.

Extensive monitoring of commercial poultry populations has failed to find any evidence of low-grade endemic infection in commercial poultry. Wild birds were implicated as the source of virus in each of these outbreaks however this has never been conclusively proven. In the 1985 Bendigo outbreak the virus was isolated from a starling but it could not be determined whether the virus had been transmitted from poultry to the starling or vice versa.

There are 2 potential hypotheses on the source of infection in these outbreaks. Either AI is endemic in Australian wild birds and under certain rare environmental conditions, sporadic epizootics occur that result in a spillover into commercial flocks; or avian influenza infections in resident Australian birds are due to occasional spillovers form international avian migrants which then spills over into the commercial birds.

In the event of an outbreak of virulent AI infection the following response as documented in AUSVETPLAN is:

- Stamping out (quarantine & slaughter) on infected premises of infected and exposed poultry and sanitary disposal of destroyed poultry and contaminated products (clinically normal flocks may be commercially processed under supervision).
- Quarantine & movement controls in declared areas on poultry, poultry products and equipment.
- Decontamination of facilities /equipment in declared areas to eliminate virus and prevent spread.
- Tracing & surveillance to determine source and extent of infection and provide proof of freedom of disease.
- Zoning to define infected and disease free areas (so that export markets do not all close.
- Public awareness campaigns to facilitate cooperation from industry and the community in the eradication and control program.

For low virulence strains the above policy is modified on case by case basis.

Consequences of AI outbreaks:
Agricultural Industry

- The consequences of an outbreak are felt most keenly by the agricultural industry. In addition to stock losses due to mortality and destruction of birds, affected farms suffer further losses due to downtime before restocking of sheds can go ahead.
- The industry as a whole has bears the cost of movement controls and quarantine.

Cost of eradication
The major cost of outbreak control has been borne by governments through the Commonwealth and States cost sharing agreement. The relative frequency of outbreaks has caused questioning of this and there is a concern that in the future governments will be less willing to foot this bill. The poultry industry may be required to take more responsibility.

Trade

- The OIE has expressed concern about the relative frequency of these outbreaks and in the absence of more conclusive evidence that wild birds are the source of infection have questioned the AI status of the Australian poultry industries.
- These concerns were partly responsible for the initiation of the study of the role of wild birds in outbreaks of avian influenza in Australia discussed in this paper.

Human Health

- In terms of a zoonotic link - it is considered extremely unusual for human influenza to be directly linked to livestock infection. There is a hypothesis that the 1918 influenza pandemic may have arisen from pigs and if this link were demonstrated in a future outbreak then animal surveillance would need to be considered.
- The 1997 influenza outbreak in Hong Kong, which resulted in 18 cases and 6 fatalities, was due to an influenza strain previously only isolated in poultry. There was no evidence of human to human transmission in this outbreak and a case control study identified contact with poultry as a significant risk factor, however the particular strain was not isolated from birds.

Biodiversity

AI has been found most commonly in waterfowl where it results in an unapparent infection or has very low pathogenicity. High pathogenicity has been observed in chickens, turkeys and ratites but generally the risk of highly pathogenic infections in wild birds is negligible. One exception was an outbreak in South Africa in 1961 that resulted in very high mortality in a population of Terns.

Tourism

Currently there is no recognised impact on tourism from the virus in Australia

The risk of an outbreak of Avian Influenza in commercial poultry, (due to the activities of wild birds) can be broken down into 2 categories:

- The first is the probability of contact between wild birds and commercial poultry. This is influenced significantly by poultry farm factors such as location of the farm and biosecurity practices and has been called the Post farm gate risk. All index properties where outbreaks have occurred have had breaches in biosecurity and the poultry industry believes that the approach to AI control is tightening up these procedures and perhaps introducing minimum biosecurity standards; and
- The second category is the probability of the local wild bird population being a reservoir for AI and the circumstances under which AI transmission is likely to occur. This probability is independent of poultry farm factors and is designated the pre-farm gate risk.

Our understanding of the epidemiology of AI infections in our wild bird population is limited. Traditionally this has been studied using the microbiological techniques that are expensive and logistically difficult.

The alternative but complimentary approach used in this study was to identify the bird species that were most likely to be a source of AI virus through an understanding of epidemic theory and bird behaviour.

The key points of the epidemiology of AI infections in birds are:

- There is a very short viraemic period and very short period of shedding in birds - probably no longer than 3 weeks;
- There is some persistence of immunity but it is type specific and may not be lifelong;

- The pathogenicity of the infection varies depending on the virus type and the bird species. Very high pathogenicity has only been reported in chickens and turkeys. To date it appears that infections in wild birds are inapparent or pathogenicity is very low; and
- The final point which is related to the previous point is that there are varying levels of innate susceptibility to AI infection at a species, genera or family level.

The key points about the survival of AI viruses in the environment are:
- There is good evidence that the virus will survive in water for a number of weeks depending on the temperature;
- Survival is also affected by salinity of the water and virus will survive for much longer in fresh water; and
- AI virus will also survive for short periods of time in faeces.

Based on these characteristics the following criteria were assessed to establish the characteristics of avian reservoirs for AI:
- High density of susceptible birds for maintenance;
- High contact rate between susceptible and infected birds;
- Contact with water; and
- Species susceptibility.

A simple model was developed based on these factors to measure the likelihood of an individual avian species being a host. These 4 factors were measured indirectly using proxy variables that were summed to produce a final risk assessment score for each species. Species were then compared based on the score; the species with higher scores representing those with a higher probability of being suitable reservoir hosts for AI.

The study site was the Redland Bay Shire which is located very close to Brisbane in south-east Queensland. This shire has:
- the highest density of poultry production for any shire in Queensland;
- relatively close to the site of the 1994 outbreak of avian influenza; and
- a coastal shire and located on important migratory routes for birds which travel down the Pacific flyway from north-east Asia and south-east Asia to Australia each year.

The model was applied to the 127 species of aquatic bird species found in the study area. The risk assessment scores for these 127 species ranged from 35 to 104. The scores were grouped into low, medium and high categories; most birds had medium scores between 63 and 91 but 17 birds had scores over 91, therefore according to the model have a high probability of being potential AI reservoirs.

This approach to understanding the epidemiology of AI infection is still in the early stages of development and needs further refining in a number of areas, including:
- The weighting given to variables in the model should reflect as closely as possible the relative contribution these factors make to the biological processes; and
- The data sources expanded and the quality improved - both qualitative (expert opinion, observations) and quantitative (surveys) data could be used.

Ecological aspects
At least two of the Australian outbreaks have been after long dry spells when water sources have dried up and water birds have congregated on remaining water holes which have also been the source of water for the poultry farm. Other habitat factors may also be involved but have not been investigated.

One of the major advantages of developing this type of model is that it is generic. It could be modified and applied to other study sites with respect to AI or it could also be applied to other diseases that have wild birds as reservoirs (eg Newcastle disease in poultry, Japanese encephalitis in humans).

Models of disease health centres presented

by Pam Whiteley and Karrie Rose

In this section, six wildlife health networks or centres were discussed. These were those of India, USA, France, Europe, Canada, and New Zealand. The Australian Registry of Wildlife Diseases was discussed with the view that it could be integral with the development of any Australian wildlife health network or centre.

Aims and objectives and the structure and funding were of particular interest.

Indian Wildlife Health Cooperative

Coordinator: Dr Pradeep K. Malik. Wildlife Institute of India, PO Box 18, Chandrabani, Dehra Dun – 248 001 (U.P.), India. Telephone 91 135 64012 to 640115, Fax 91 135 640117, Emai malikpk@wii.gov.in
Home page: http://www.si.edu/organiza/centers/wii/

Development

India's rich environment has made it home to a great diversity of wildlife and it was ranked sixth amongst twelve global megadiversity centres. As the demands of the human population continue to grow, it became harder to protect the endangered and threatened wildlife species.

The Wildlife Institute of India (WII) was established in 1982 to develop and promote wildlife science that would work to conserve India's endangered species and natural resources. To this end WII trains biologists, educators, wildlife managers and extension workers. Applied field research is also supported to improve health monitoring, disease prevention and control programs for Indian wildlife.

The U.S. Fish and Wildlife Service (USFWS) and the U.S. National Wildlife Health Centre (USNWHC) began their association with the WII in 1982, leading to the development of the WII-USFWS Collaborative Project, under the auspices of the Indo-US Subcommission on Science and Technology. This project began in 1989 with a focus on WII faculty development. In 1994, a second phase of the project began, this time focusing on training and research. From the realisation that WII could not accommodate all the wildlife health needs for the country, a strategy to develop regional wildlife health programs in veterinary colleges was initiated. This was called the Indian Wildlife Health Cooperative (IWHC).

Aim

To develop and provide wildlife health needs for India.

Objectives

- To assist State Forestry Departments to deal with the health and welfare of free-ranging and captive wild animals.
- To facilitate investigation, diagnosis, data collection and analysis of wildlife mortality.

Educational goals
To establish a standard wildlife health curriculum for India's veterinary colleges.
To train faculty members from selected veterinary colleges, to enable them to act as Wildlife Health Coordinators for the college. These Faculty members were asked to:

- Coordinate an undergraduate course;
- Serve as Indian Wildlife Health Cooperative (IWHC) regional contact;
- Participate in the WII Diploma Course in Wildlife Management;
- Participate in U.S. study tours and training;
- Provide assistance, consultation and training for IWHC staff, state wildlife departments and animal husbandry departments; and
- Participate in and supervise graduate students interested in wildlife health research.

Establishment
The Indian Wildlife Health Cooperative was established following collaboration of the regional Veterinary colleges in 1994. Five veterinary colleges agreed to participate in the program, and the selected WHC's have completed their domestic and foreign training.

Structure
Five regional Veterinary Colleges together with the Coordinator, Dr Malik based at the Wildlife Institute of India, constitute the Indian Wildlife Health Cooperative (IWHC). Selection of veterinary colleges was on a zonal basis to serve their respective regions and form the core of the IWHC (Eastern, Western, Northern, Southern, Central). The IWHC provides wildlife health programs for the Wildlife Institute of India and the State Forestry Departments.

The USNWHC has participated as the US Coordinator for the IWHC training, and consultant on IWHC field projects.

Activities and Achievements
In addition to coordinating IWHC activities, Dr. Malik has been actively involved in offering training programs in wildlife health at all levels for Forest personnel. Dr Malik is also involved in many disease investigation and research programs, both with WII and IWHC faculty.
Dr. Nasser Ahmed established a program with the Assam Forest Department to provide veterinary care for the Department's 130 working elephants. The IWHC-Eastern Centre has also participating in the health management for the largest population of Indian rhinoceros.

The Asiatic lion has been reduced to below 500 individuals. The IWHC- Western Centre, along with WII, participated in conducting a serological survey of feline disease viruses in the wild and captive population. They also worked on problems of overabundance of native ungulates, and pesticide effects on sarus cranes.

In 1997 there was a mortality event effecting 14 tigers in Van Vihar National Park. A team from the IWHC-Central Centre conducted an investigation, made the diagnosis of feline panleucopenia, and instituted control measures. The Madhya Pradesh government is now providing 1.2 million Rupees to the Centre for wildlife health assistance.

The IWHC-Southern Centre established the only Department of Wildlife Science in a veterinary college in India, with an emphasis on graduate education. They also provide veterinary services for the Arignar Ana Zoological Park.

Diseases at Sariska, Ranthambore, and Bharatpur National Parks have been a major activity of WII and the IWHC Northern Centre. This includes suspect foot–and–mouth disease in nilgai (a large species of antelope).

Funding
The collaborating Veterinary Colleges provided faculty, staff, and operating funds, and the WII-USFWS collaborative project offered training and equipment. Equipment provided includes field vehicles, immobilisation projectors, computers, cameras, binoculars, and laboratory supplies. The Madhya Pradesh state government is providing 1.2 million Rupees to the IWHC-Central Centre for wildlife health assistance.

United States of America's National Wildlife Health Center.

Director: Dr Robert McLean, 6006 Schroeder Rd, Madison, Wisconsin, 53711, USA. Telephone 1 608 270 2400, FAX 1 608 270 2415,
Home page: www.umesc.usgs.gov\nwhchome.html

Development
In 1975 the U.S. Fish and Wildlife Service established the National Wildlife Health Centre (NWHC) in Madison, Wisconsin. The Centre was established following an epizootic of Duck Plague (duck virus enteritis, herpesvirus) that caused the death of 40,000 Mallard ducks from a population of 100,000 waterfowl at Lake Andes, South Dakota in 1973. Duck Plague was an exotic disease that had been introduced into the Duck industry on Long Island, New York, in 1967.

The NWHC is housed in a two level building containing diagnostic and research laboratories, an animal house, administration and support facilities on a ten acre site of restored prairie.

Aim
To provide information, technical assistance, and research on national and international wildlife health issues. To fulfil the NWHC mission the Centre monitors disease and assesses the impact of disease on wildlife populations, defines ecological relationships leading to the occurrence of disease, transfers technology for disease prevention and control, and provides guidance, training and on-site assistance for reducing wildlife losses when outbreaks occur.

Assistance is provided for disease problems that involve migratory birds, endangered species and other warm-blooded wildlife that live on Department of Interior lands throughout the United States. (Note: The NWHC is involved with amphibian diseases.)

Objectives
Activities include:

- Studies of diseases affecting endangered species.
- Development of disease diagnosis and control techniques.
- Evaluation of the frequency, geographic distribution, and species affected by specific pathogens.
- Evaluation of the impacts of various disease agents on wildlife population dynamics.
- Assessment of the interactions between environmental contaminants and infectious agents.
- Laboratory diagnosis of wildlife mortality.
- Environmental profiles of wetlands and the eruption, perpetuation, and maintenance of avian botulism and avian cholera.
- Investigations of avian tuberculosis in whooping cranes.
- Ecology of inclusion body disease (herpesvirus) of cranes.
- Technical assistance on wildlife health issues through workshops and seminars both at the Centre and at other locations nationally and internationally.
- Technical consultations with government scientists and officials in Australia, New Zealand, Japan, Denmark, France, Russia, and England regarding lead poisoning in wild birds.
- Evaluation of wildlife disease risks associated with New Zealand's endangered species program.
- Production of a book-length field guide on wildlife disease and videotapes on special techniques underscores the Centre’s goal of relating technical information and concepts about wildlife diseases in a practical and relevant format.
- Wildlife Health Information Partnership (WHIP) an electronic communication system providing current information on wildlife disease nationally and internationally.

Structure
The US Department of Interior includes the US Geological Survey, which includes the Biological Resources Division consisting of 16 Science and Technology Centres including the NWHC (most Centres have nothing to do with Geology). The National Wildlife Health Centre’s works mainly with federal and state land managers (National Wildlife Refuge personnel, law enforcement agents, state conservation agency biologists, university-affiliated scientists). The Centre operates a field station in Hawaii and there is a Centre in Alaska.

The NWHC is made up of three teams: a Resource or Field Health or Response team, a Diagnostic team, and a Research team. In addition, there is administrative and laboratory support.

In the USA, several states have had staff veterinarians in their Departments of Natural Resources or Fish and Game for more than twenty years. The Southeastern Cooperative Wildlife Disease Study, based at the Veterinary College, University of Georgia, Athens, has also provided wildlife health services for thirteen states for at least twenty years. The Wildlife Disease Association was established almost fifty years ago and now has Sections based in four other continents. These people have made major contributions to the understanding of the role of health issues in wildlife populations.

Activities and Achievements

- During the 1980s the NWHC provided data and expert evidence on mortality due to lead shot (2 million dead waterbirds annually from a fall flight of 100 million) that resulted in legislation for the use of non-toxic shot.
- Identification of new pathogens of wildlife, and distribution and prevalence data nationally for major wildlife pathogens (Botulism, Avian Cholera – *Pasteurella multocida*, Duck plague – duck virus enteritis herpesvirus etc).
- The NWCH is collaborating with CDC and others investigating the 1999 epidemic of the arbovirus West Nile virus in people in New York. The disease has now spread to Washington DC. Mortality has occurred in crows, and many other bird species are expected to be wildlife reservoirs.

Funding

The annual budget is US$4 million from the federal budget. Approximately 80% of this if fixed cost including salaries for the 70 employees. Some extra funds are obtained for special projects including research.

Sustainability

There has been no increase in the base budget for some years.

European Wildlife Pathogens Network

Co-ordinator: Dr Victor Briones, Laboratorio de Diagnostico Microbiologico de Animales Salvajes y Exoticos, Dpto. De Sanidad Animal, Facultad de Veterinaria, Universidad Complutense Madrid, Spain. Telephone 34 91 3943910, Fax 34 91 3943908, Email v.briones@eucmax.sim.com.es

Development and Establishment

In the early 1990s Dr Frederick Leighton, Veterinary College, University of Saskatchewan, Saskatoon, Canada provided a survey called ‘Surveillance of Wild Animal Diseases in Europe.’

The first meeting of the European Pathogens Network was held in Madrid, Spain, in July 1999.

There were several reasons to start this project. One was a lack of information regarding the role of wildlife as reservoirs and transmitters of pathogens. Even though there were a number of institutions, several journals and individuals involved in the research of wildlife diseases, there was a lack of co-ordination in exchange of information, expertise and data management within the European Union and worldwide.

Aim

The main objectives of the Network are the establishment of an interrelationship among centres within the EU involved in the conservation of wild animals and laboratories devoted to the research and diagnosis of wildlife diseases and their implications for human and animal health.

A network will comprise the exchange of information in order to fulfil the following main objectives:

1. European wildlife diseases catalogue: including both diseases and animal species to be considered.
2. Epidemiologic alert system: for early outbreaks detection.
3. Wildlife diseases laboratory system: for optimisation of existing resources in diagnosis and research.
4. Disease database system: to collect data for the epidemiologic, wildlife diseases laboratory and communication systems.
5. Communication system: to allow the exchange of information among partners and other institutions. The establishment of an electronic Newsletter shall allow the access of other institutions and individuals to such information.
6. To design, among the Concerted Action participants, co-operative research projects focused on the main objectives of the network itself.

Objectives

Task 1: European wildlife diseases catalogue

The catalogue will consist of a framework document including the major diseases for the more important zoological groups (e.g. rabies for carnivores, tuberculosis for ruminants) and their consequences. A tentative document has already been circulated and the initial effort shall result in a catalogue of wildlife diseases of concern in the European Union. On the basis of this document, further improvements, aimed at the identification of the most important aspects of the diseases to be studies or to be reported, could then be carried out.

Task 2: Epidemiological alert system

Designed to collect data on the incidence, prevalence, mortality, geographic and temporal distribution, animal species which are affected etc., of those diseases which are of the most interest considering their implications in wild/domestic animals and human health. This shall allow:

- To make an approach to the real situation of the specific disease within the European Union;
- The establishment or the improvement of disease control programs, as well as wildlife conservation programs (relocations, reintroduction...).
- To work as an early alert system by detecting any increase on the incidence of any disease (previously present or not).
- The detection of epidemic outbreaks, pathogen characterisation, transmission modes and reservoirs.

Regarding the alert system itself, the network could serve as one of the reference points to report the detection of any disease outbreak in wildlife in the European Union.

Task 3: Wildlife diseases laboratory diagnostic system:
Initially, the interrelation among different laboratories with distinct specialities shall be aimed to exchange information on the research or diagnostic activities, which are being conducted by each one. Every more, sharing information, expertise and even materials will allow a dramatic increase in the capabilities for the whole system to accurately face any emergency.

Task 4: Disease database system:
It seems essential to develop a data base system providing information on wild animals disease, in which could be included animal species and pathogens, as well as epidemiological and practical criteria on diagnosis, prevention, control, public health implication and therapeutics.
This system shall provide the tools for disease monitoring and surveillance for epidemiological studies.
For this purpose, data provided should in principle include for example:
Animal species, sex age, geographic area, clinical signs and lesions, therapeutics, diagnostic tests performed and results, description of risks etc.

Task 5: Communication system:
It is planned to establish a discussion list via e-mail open to everyone interested in wildlife diseases, but focused on their role as reservoirs.
On the Internet System, a home page shall be designed describing the objectives, participants, and any other relevant data of the concerned Action.

Structure
Partners are:

- Victor Briones will carry out the overall project co-ordination with the help of Lucas Dominguez and Joaquin Goyache (Fac. Veterinaria UCM, Spain).
- Univ. Complutense Madrid; Fac. Veterinaria.
- Univ. Utrecht; School Veterinary Medicine.
- Univ. Liège; School Veterinary Medicine.
- Moredun Research Institute
- Aristotle University; Faculty Veterinary Medicine
- National Veterinary Institute, Uppsala, Sweden
- Parque National de Doana, Spain
- CNEVA (Maisons-Alfort/Nancy), Maisons-Alfort/Malzeville
- Centro de Investigacion en Sanidad Animal (CISA), Valdeolmos, Madrid, Spain.
- Institute for Zoo Biology and Wildlife Research (IZW) Berlin, Germany
- Central Veterinary Laboratory (CVL), Surrey, United Kingdom
- Community reference laboratory for Salmonella (RIVM) Bilthoven, The Netherlands
- Community reference laboratory for the epidemiologic of zoonoses (BgVV), Berlin, Germany
- WHO Centre VPH, Hanover School of Veterinary Medicine, Hannover, Germany

- Universities Federation for Animal Welfare, Hertfordshire, UK
- Centre d'Etudes et de Recherches Vétérinaires et Agrochimiques, Brussels (Uccle), Belgium

Activities and planned milestones

- Three general meetings will be organised together with several workshops covering specific sections or topics. In order to minimise the costs of the action, the workshops will be organised simultaneously whenever it is possible to do so, or as a parallel meeting of wildlife congresses by others (European Wildlife Association).
- The first meeting will be devoted to the organisation of the workshops for establishing a catalogue of wildlife diseases of sanitary concern in Europe, and for the setting up of wildlife diseases laboratory, communication and data base systems according to the tasks of the proposal.
- During the first year, the communication system shall be operative by means of electronic mail among partners and the web page devoted to the topics covered by this concerted action will be created.
- The epidemiological system will start as soon as the database system receives input. It will not be fully operative until the second year.

Funding

The project is funded by the European Union (EU FAIR 4361). EU FAIR programs are to promote and harmonise research in major European primary production food and non-food sector. 300,000 Euro over 3 years for some costs of administration, management and co-ordination of the project, costs of holding meetings for some or all participants, and costs of meeting with participants. Costs for publications (newsletter) aimed at dissemination of information also (not clear how much support each institution will receive).

The SAGIR Network — Surveillance of Wildlife Disease in France.

Coordinator: Dr Marc Artois, CNEVA-Nancy, Domaine de Pixerecourt, B.P. 9-F 54220 Malzeville, France. Email marc.artois@nancy.afssa.fr

Development

SAGIR is a national surveillance system of wildlife diseases created in 1986 by the "Office National de la Chasse" (ONC), a government agency in charge of wildlife. The network was reactivated in 1994.

Aim

The main goal is to detect the principal causes of wildlife mortality.

Objectives
SAGIR is now involved in the surveillance of:

- diseases of domestic livestock like brucellosis, Aujeszky's disease, hog cholera through serological surveys done on hunted deer, roe deer, wild boar and mountain ungulates ;
- radio-contamination of the environment through radiobiological analyses on hunted game ;
- the sanitary status of game species as part of the legislation on the commercialization of game meat.

Structure and Functions
SAGIR is organized as a cooperative venture among ONC, the National Center for Veterinary and Alimentary Studies (CNEVA) in Nancy, the toxicology laboratory of the National Veterinary School in Lyons (ENVL), the "Departemental" Veterinary Laboratories (LVD) and the "Departemental" Federations of Hunters (FDC). The latter two form the basic unit of the whole system.

The partners of the SAGIR network intervene at various stages of the network. Hunters, members of FDC, or national gamekeepers usually detect the cases of abnormal mortality of game in the field. In every Federation, a SAGIR representative is in charge of transmitting samples of dead animals to the LVD of his "département". The "departmental" laboratory performs the adequate tests (usually a necropsy, a bacteriological and a parasitic survey) and communicates the first results to FDC. If, according to the lesions observed or to the commemoratives collected in the field, an intoxication is suspected, the LVD sends the appropriate samples to the toxicology laboratory at ENVL for further investigation. The results of these investigations are forwarded to the LVD, which requested and forwards them to the FDC. The network is decentralized and works in an autonomous way at the departmental level.

CNEVA Nancy, the national laboratory collecting all data on wildlife diseases, gathers and handles the results from all LVD's and synthesizes the information. The data are computerized using database software (PARADOX®). Throughout these different stages, the carcass first, then the sample and the analysis results, are followed by a special SAGIR form. This form and the lab results are used to feed the database. Each result is computerized through three files. The file "*Pointeur*" refers to the different numbers given to the data (Number of the SAGIR form, number given by the lab to the analysis, reference number of the LVD). The file "*Origine*" allows to computerize all information contained in the SAGIR form (species, sex, age, commemoratives, place, date and description of the environment of the discovery, if possible the species density. The file "*Pathologie*" refers to three tables: Mortality, Pathology and Pathogens. The table mortality concerns the cause of mortality. The information stored here comprises: the conservation status of the sample, the body condition (fitness) and the cause of death (undetermined, impossible, waiting for complementary results, name) with two degrees of certainty: certain (C) or suspected (S). The table "*Pathology*" is used to computerize the information on everything found and susceptible to provoke pathological problems or possibly the death of the animal: lesions, syndrome, symptom, disease, and trauma etc.

The table "*Pathogen*" refers to all pathogens looked for and found or not found. It includes a classification of the pathogen ("toxic" = poison, bacteria, virus, parasite), its name and abundance when possible (mainly or the parasites). All data included in this database are used for publication of the syntheses and for specific studies on wildlife pathology.

The information is transmitted at appointed times to the Department of Wildlife Preservation (DPF) at ONC, which forwards the data to the "Departemental" Hunter Federations (in the form of half-yearly and yearly reports in which the surveillance results are presented and a monthly bulletin informing about the current incidence of wildlife diseases). CNEVA is responsible for informing other partners. These different returns of information are very important for motivating all partners of the network. There also is another flow of information coming from FDC and going directly to ONC. Every two months, the SAGIR coordinator is supposed to give a report indicating all analyses carried out during this period. This report permits to have a second control over the circulation of data and to avoid losses of information, which obviously occur at each stage of the network.

Because this procedure is quite long and heavy, in case of an unusual occurrence of high mortality, an emergency procedure is implemented by calling the DPF directly at ONC. Emergency measures may be organising a mission in the field or ordering prescription of specific analyses. Since the reactivation of the network in 1994, this procedure has been used more and more, both for infectious diseases like avian botulism in waterfowl (type C in ducks, type E in sea gulls), trichomoniasis in wild pigeons, EBHS in hare and for intoxications (by anticoagulants or seed-coating products).

The administrative subdivisions of France and the organization of hunting are outlined below. France is divided into 95 "départements". In each one of these, all hunters must be members of a special association called "Fédération départementale des chasseurs". These Federations, created in 1923, are in charge of organizing the hunting activities in their "département". They carry out technical missions like the management of game species and their habitats. But they also have an official mission of public service, since they are officially representing the designated authority for hunting in the "département". They fulfil a role of counsellor to the administration and the local representatives as far as wildlife is concerned, they participate in the organization of hunting license tests, compensation payments for damages caused by wildlife and policing of hunting through the national game keepers affected by ONC. In almost each "département" there is a LVD, which performs veterinary analyses, mainly on domestic species but, through SAGIR, also on wildlife. This departmental laboratory is not a state emanation, it is a service of the "conseil général" which is the departmental government locally elected by the inhabitants. The nature of the analyses (and eventually the subsidies for them) is then defined by the "conseil général". There is a huge disparity among the "départements" as far as SAGIR analyses are concerned.

Activities and Achievements

- SAGIR collects reliable data on wildlife diseases through some 2,000 laboratory tests performed per year, i.e. 21,402 since 1986 (13,860 computerized) and a data collection scheme covering almost the whole territory.
- These data can already be used for realizing in depth studies of two important game species: the hare (54 % of the collected samples) and the roe deer (14.9 %).
- These data and the infrastructure underlying the network, also allow the identification and implementation of research programs like those concerning the vaccination of the wild rabbit against VHD and myxomatosis.
- Epidemiological surveys or programs aiming to reduce the toxicity of pesticides are carried out in collaboration with the phyto-pharmaceutical firms. The latter studies are realized in the Ecotoxocology center opened by ONC in September 1996 which could be considered to be a SAGIR emanation. Since it has shown the effect of certain agricultural practices on wildlife, the SAGIR network has become the key point for all the accidents involving wildlife which are caused by the use of pesticides (treatments against field voles with anticoagulants which have been causing the death of hare and roe deer since 1988, use of seeds coated with insecticides: furathiocarbe, a carbamate insecticide used on proteagineous peas which has been responsible for several huge mortality episodes in wild pigeons in 1994, 1995 and 1997, imidacloprid, an insecticide belonging to the nitroguanidines family, used on winter barley implicated in the death of grey partridges in 1995).

Funding

The analyses are paid for by the departmental Federations of hunters. ONC grants a special financial aid to CNEVA Nancy and ENVL for their participation in SAGIR. The gross running cost of the network is estimated at some 1,000,000 F. ($ 170,000) per year, salaries of the personal not included.

Canadian Co-operative Wildlife Health Centre

Development:

The Canadian Co-operative Wildlife Health Centre (CCWHC) was established in 1992 in a co-operative venture among Canada's four veterinary colleges.

The CCWHC was conceived due to the perception that there was "insufficient collective knowledge regarding wild animal diseases in Canada to meet societal needs". No national agency held a mandate to undertake wildlife disease investigation or wildlife health surveillance. Information available regarding wildlife health was so fragmentary that it was often of little or no use. Meanwhile, health and disease issues were becoming more important in wildlife management and conservation. The significance of wildlife health to the agroeconomy, human health, and wildlife conservation were illustrated by the following high profile cases:

- bison and elk acting as Canada's last reservoirs of tuberculosis and brucellosis
- the northern spread of raccoon rabies along the eastern seaboard approaching the Canadian border

- the presence of the Lyme's disease agent, *Borellia burgdorferi*, in rodents, ticks and deer throughout the eastern and western coastal regions of Canada
- the black footed ferret recovery program threatened by bubonic plague
- the whooping crane recovery program threatened by systemic coccidiosis
- pollutants suspected as the cause of deformity and mortality in amphibians, fish and cormorants in the great lakes region
- pollutants associated with the development of tumours in beluga whales inhabiting the St. Lawrence seaway

Aim:
The aim of the CCWHC is to apply broad aspects of veterinary medicine to wildlife management and conservation in Canada.

Objectives:
Provision of information about wild animal disease to all sectors
Development and operation of a national database of wildlife health information
Diagnosis of disease in free-ranging wildlife
Field investigation of wildlife disease incidents
Educational programs in wildlife health and disease

Founding Principles:
The large geographic area and relatively small tax base in Canada necessitate efficient use of resources and maximising the use of existing surveillance activities. Cost-effective diagnostic services for wildlife are delivered through the use of the discretionary time of faculty, facilities, and equipment available in the country's four veterinary teaching hospitals. Ancillary diagnostic testing is conducted at low cost by collaborating government laboratories.
The CCWHC was founded by maximising co-operation and communication among existing agencies involved in wildlife health.

Establishment:
A proposal for the development of the CCWHC was presented to federal, provincial and territory governments, as well as several philanthropic organisations in 1987. The Max Bell Foundation approved an application providing $150,000 to the CCWHC contingent on the provision of government funds. Environment Canada committed funds in 1992 through the National Green Plan and the CCWHC then began operation based upon a five year business plan.
Structure:
The CCWHC has five business units: 4 Regional Centres of Wildlife Health Services located in the country's four veterinary colleges, and the CCWHC headquarters based at the Western College of Veterinary Medicine, Saskatoon. A faculty member directs each of the Regional Centres. Two faculty co-directors administer the headquarters.

The CCWHC is governed by a Board of Directors consisting of representatives of the sponsoring organisations, the dean of one of the veterinary colleges involved, and the Director General of the Canadian Wildlife Services (chairperson).

Activities & Achievements:

- providing cost effective diagnostic services for more than 1,200 wild animal submissions annually
- > 5,000 wildlife disease incidents catalogued in the computerised database
- > 2,000 information requests addressed each year
- >1,700 newsletter recipients
- >1,500 copies of the CCWHC Wildlife Disease Investigation Manual distributed
- training courses and workshops conducted for field and technical personnel regarding wildlife disease detection and diagnosis, wildlife health and wildlife management
- creation of a national directory of expertise in wildlife health
- technical information provided to the following organisations:
  - Federal, provincial and territorial government agencies
  - Non-government wildlife agencies
  - Federal and provincial veterinary services
  - Provincial public health programs
- principle source of information for the Canadian Working Group on Wildlife Disease of the International Office of Epizootics
- provided expertise and field assistance to the Commission for Environmental Cooperation in its investigation of mortality of migratory waterfowl at the Silva Reservoir in Mexico, 1995
- new diseases recognised through the CCWHC include:
  - canine distemper virus in bobcats
  - lungworm in musk oxen
  - poisoning of bald eagles
- surveillance efforts have defined the occurrence of Newcastle's disease in double-crested cormorants, *Mycoplasma gallisepticum* in songbirds, and lead poisoning in waterfowl
- the CCWHC participates in federal monitoring programs for rabies, tuberculosis, brucellosis, Lyme's disease, hantavirus, tularemia and plague
- multidisciplinary teams are engaged in wildlife health and conservation
- biology and veterinary students have increased access to teaching materials
- collaborative research based on wildlife health surveillance has been stimulated
- the veterinary profession in Canada now has an expanded role in environmental issues

Funding:

The current funding base for the CCWHC consists of a mixture of public and private sources. The targeted annual income is $550,000, but actual income varies from $350,000 to $500,000. This sum does not include the large gift-in-kind sponsorship from the participating universities.

The budget of the CCWHC has the same five elements described in the centre structure. Funds from the trust are directed to each of the participating universities and 15% of these funds are retained by the universities to pay overhead costs.

Public funds:
40% of the current budget is provided by Environment Canada, through the Canadian Wildlife Services.
Provincial and Territory governments contribute funds annually through their wildlife agencies.
The Ontario Ministry of Health and Heritage Canada provide annual grants.

Private funds:
The Max Bell Foundation provided seed funding to establish the CCWHC. The Canadian Wildlife Federation, Ducks Unlimited, and three pesticide manufacturers contribute funds on an ongoing basis through sponsorship contracts.

Sustainability:
The CCWHC has continually battled to attract enough funds for its operations. The financial situation of the CCWHC became critical in 1996, when the roles of many of the faculty, technical and administrative staff were markedly reduced. Due to this budgetary crisis the universities have foregone the 15% recoupment of overhead costs and many of the government laboratories conduct diagnostic tests for little or no cost. The CCWHC is now considering entering into consultancies to attract ongoing income.

CCWHC Principles of Wildlife Health Surveillance
The focus of the CCWHC is to maintain a nation-wide surveillance network for wild animal diseases. For this purpose, wildlife health surveillance has been categorised into the following functions:

- Detection: training field personnel in the skills of observation, disease recognition, occupational health and safety, and information and sample collection. Field personnel include conservation officers, biologists, fisheries officers, foresters, fishermen, hunters and naturalists. Information is available to these personnel in the form of a Wildlife Field Investigation Manual, and a toll free phone number. Sample collection has been facilitated through the distribution of sample collection kits and a toll free sample transportation system.
- Diagnosis: establishing a network of laboratories to conduct diagnostic test on samples from wild animals. This network consists of the provincial and federal veterinary diagnostic laboratories and the pathology departments of the four veterinary colleges.
- Information management: development and maintenance of a national computerised database regarding wildlife morbidity and mortality. The intent of this program is to develop a host specific inventory of diseases and disease causing agents that includes geographical and temporal distribution data. Analysis of this data is tailored to detect emerging disease, and monitor diseases that could influence wildlife management, conservation, human health and domesticated animal stock.
- Use of information: establishing channels for information collection and dissemination. The three main target groups for information dissemination include wildlife agencies, government policy makers, and members of the public.

New Zealand Wildlife Health Centre

Development

New Zealand's Department of Conservation manages an increasing number of threatened species programs, many of which involve intensive management of individual animals and their populations. Animal translocations have been conducted to ensure the long-term survival of takahe, black stilt, kiwi, tuatara, yellowhead, kokako, Whitaker's and Robust skinks. The re-introduction of animals from captive breeding programs to the wild is an essential tool in the recovery programs of the shore plover, black stilt, kiwi, weka, and takahe.

The DoC has identified that "there is a clear risk of disease becoming an important factor in the further decline of these threatened animals as this type of manipulative recovery management proceeds. The potential for transferring pathogens into new sites increases as more individuals are intensively managed".

Examples of disease contributing to significant mortality in threatened populations of New Zealand's native fauna include an outbreak of avian pox in Chatham Island black robins (1985/86), psittacine erythroblastosis in Antipodes Island parakeets fostered by New Zealand parakeets in captivity, aspergillosis and systemic coccidiosis in captive stitchbird colonies, and sub-optimal nutrition in fostered takahe chicks.

Along with increasing numbers of species being intensively managed, there has also been an increasing number of agencies becoming involved in captive management and re-introduction programs (eg. Zoos, Ducks Unlimited, NZ Forest & Bird Society, and the DoC itself). Control of disease through animal management protocols, hygiene protocols, monitoring programs, and quarantine measures became a focus for the DoC to ensure effective threatened species management.

Overseas consultants and local veterinarians thus became involved in wildlife health in New Zealand to improve the understanding of the threat of disease to threatened species and the role of disease as a factor in the historical decline of some populations. Effective wildlife health management, pro-active wildlife health surveillance and efficient dissemination of information were embraced as essential elements of threatened species conservation.

Aim

The aim of the NZWHC is to promote and implement collaborative investigation and management of wildlife health in support of the conservation of New Zealand's native fauna.

Objectives

1. To provide advice and best practice for:
   (a) wildlife health monitoring and surveillance,
   (b) population health and disease control,
   (c) contingency planning for maintenance of existing health status.

2. To secure, collate, interpret and disseminate wildlife health information on NZ native fauna
3. To identify and investigate disease in NZ native fauna
4. To establish normal population health baselines
5. To establish and maintain local and global wildlife health networks
6. To implement a response to threats, such as oil spills, against NZ native fauna health
7. To secure resources for the objectives above.

Establishment

The New Zealand Wildlife Health Centre (NZWHC) has evolved out of a core group of individuals interested and involved in wildlife health, and through excellent relationships among the NZ Department of Conservation (DoC), Massey University, and the Auckland Zoo.

Dr. Peter Stockdale, former dean of Massey University, offered his services to the Department of Conservation in the early 1990's. Dr. Milton Friend (Director, US Fish & Wildlife, National Wildlife Health Research Centre, Madison, Wisconsin) was invited to NZ to advise the departmental staff and wildlife veterinarians in 1993. Dr. Friend's recommendations following this trip included the development of a veterinary advisory committee, and the production of a series of wildlife health guidelines.

The veterinary advisory group was established in 1994. This group assessed and prioritised wildlife health requirements, prepared wildlife health guidelines, and established the terms of a contract for wildlife health services for the DoC. In 1997, negotiations between the DoC and Massey University were initiated. The delivery of this contract and a subsequent service contract with the Maritime Safety Authority brought together a "critical mass" of wildlife health veterinarians throughout the country.

The development of a Wildlife Health Centre was envisaged to ensure efficient use of resources, integrate the operation of various service contracts, develop and utilise multidisciplinary teams, and provide a focus on management and positive conservation outcomes for New Zealand's threatened species.

Initial meetings towards the development of the New Zealand Wildlife Health Centre were held in 1998, and operations began in 1999. Currently, the members of the NZWHC are further defining the roles of the directorate and members, assessing means to attract financial support, establishing research priorities and discussing intellectual property issues.

Structure

The NZWHC is a collaborative effort involving Massey University, the Department of Conservation, the Maritime Safety Authority, Auckland Zoo, the Ministry of Agriculture and Forestry, the Ministry of Health, and the Wildlife Society of the New Zealand Veterinary Association. The NZWHC also incorporates the activities of the Massey University Cetacean Investigation Centre and the Ratite Research Centre where there is an overlap in objectives.

The Centre has a director (Dr. P.J. Duignan, Massey University), and seven "principals" with expertise in avian pathology, comparative pathology, fish pathology, oil spill response, wildlife rehabilitation, captive management of wildlife, nutrition, ecology, and epidemiology. The Centre also has a large number of individual members who have an interest or are actively involved in wildlife health.

The Centre is governed by an Advisory Board consisting of relevant Massey University faculty and a representative from each of the collaborating agencies. The first meeting of the Advisory Board took place on the 4th of November 1999. These annual meetings are intended to provide an opportunity to review the director's report on the activities of the Centre, assist the director in identifying research priorities for wildlife health for he coming year; and provide a forum to discuss national wildlife health issues.

Activities & Achievements

- providing cost effective diagnostic services for more than 100 marine mammal and 200 avian submissions annually
- > 990 wildlife disease incidents catalogued in the computerised database
- > 350 information requests addressed each year
- providing ongoing technical advice to the Department of Conservation, and Maritime Safety Authority
- collaborative research based on wildlife health surveillance has been stimulated
- the veterinary profession in New Zealand now has an expanded role in environmental issues

Funding

At present the NZWHC operates as a collective of individuals involved in and interested in wildlife health. The centre itself has been described as a "paper centre" as it does not have any direct funding for its operation and administration.

Funding for several activities that are now incorporated into the Centre's operation is delivered through a series of service contracts for relevant government agencies. The following are some of the contracts listed as activities of the NZWHC:

Contractor	Contractee	Contract Title	Personnel Involved/ Funded	Outputs
Dept. of Conservation	Massey University	Conservation Services Contract	Faculty Advisor - ongoing ½ stipend of a Veterinary Resident Zoo Veterinarian (short-term subcontract) Computer Programmer (short term-subcontract) Data entry personnel	1. Develop & maintain a wildlife health database 2. Develop SOP's for: Wldlife translocations, Captive wildlife husbandry and hygiene, Gathering baseline health data 3. Provide ongoing technical advice
Dept. of Conservation	Massey University	Auckland Islands Outbreak Investigation	Faculty members Technical staff	Investigate an outbreak of mortality among NZ sea lions on the Auckland islands.
Dept. of Conservation	Massey University	Auckland Island Pinniped Health	Faculty members Technical staff	Provide ongoing health monitoring of the pinniped populations on the Auckland islands.
Dept. of Conservation	Massey University	Marine Mammal By-catch	Post-doctoral position Technical staff	Confirm the cause of death and collect life history data on cetaceans and pinnipeds trapped in fishing nets.
Maritime Safety Authority of NZ	Massey University	Marine Oiled Fauna Preparedness & Response	Full time faculty member ½ stipend of a Veterinary Resident ½ salary of a Technician	Develop and maintain a national preparedness and response program to care for wildlife affected by marine oil spills.

Sustainability

The NZWHC brings together a group of people who are active in wildlife management, disease investigation, and health surveillance. The interest of these people has been sustained over a long period of time. The Centre is now operating without any direct funding; however, an infrastructure has been established so that when funds become available activities in addition to those incorporated into the contracts listed above will be possible.

Australian Registry of Wildlife Pathology

Background

The Registry of Comparative Pathology was established at Taronga Zoo by Dr. Bill Hartley in 1985 to build a collection of information and materials relating to healthy and diseased native fauna and zoo animals.

The Registry now consists of case material from greater than 10,000 animals, including 900 macropods, 130 monotremes, 400 koalas and wombats, 550 possums and gliders, 360 dasyurids, 145 bandicoots and bilbies, 110 bats, 153 marine mammals, 230 lizards, 315 snakes, and 3,050 birds. This case material includes an intensive and extensive collection of samples of normal tissues as well as of diseased tissues. There are approximately 30,000 glass slides, 16,000 wax tissue blocks, 3,000 colour transparencies of gross and microscopic lesions archived within the Registry. Additional materials contained within the Registry include photographs of scanning and transmission electron microscopy, tissues in formalin, written case reports and a large number of relevant publications.

The Registry is the only one of its kind within the Southern Hemisphere and serves as a significant national and international resource in understanding the health of Australian ecosystems. It is continually being used by private, government and university veterinarians, and biologists as a source of reference for understanding and control of outbreaks of disease in native fauna and zoo animals. In addition, its extensive collection of normal tissues is invaluable for researchers in native fauna. It is imperative that this resource is used to its maximum potential so that its information and materials are freely available to all possible users now and in the future.
Access to materials within the Registry is free to those interested in the study of wildlife health.

Aim/Mission Statement
The Australian Registry of Wildlife Pathology is committed to contributing to the preservation of Australia's biodiversity through increased understanding of the interactions among animals, the environment, and disease agents. We will achieve this through diagnosing and documenting healthy and diseased states in zoo animals and native fauna, and becoming increasingly active in investigative pathology and the pro-active surveillance of wildlife health.

Objectives
- Diagnostic pathology services for Taronga Zoo, Western Plains Zoo, NSW National Parks and Wildlife Service, species recovery programs, researchers and wildlife rehabilitators
- Providing information and advice regarding diseases affecting free-living and captive wildlife in Australia to support species conservation and research endeavours
- Archiving materials and information on wildlife diseases for future reference and research
- Disseminating information regarding wildlife health through scientific articles, presentations at conferences, newsletters, and wildlife pathology workshops
- Providing a window into ecosystem health

Structure
The Australian Registry of Wildlife Pathology is supported by one full-time veterinary pathologist. Additional technical and administrative assistance is available from the Veterinary & Quarantine Centre of Taronga Zoo. Numerous veterinary students and

graduates have kindly donated their time to the complete projects for the Registry. Stakeholders of the Registry include:

- Zoological Parks Board of New South Wales
- University of Sydney
- Zoos within Australia, & the Australasian Regional Association of Zoos, Parks and Aquaria
- State and Commonwealth Veterinary Surveillance Agencies
- State and Commonwealth Conservation Agencies
- Species recovery programs throughout Australia
- Wildlife Disease Association - Australasian Section
- Australian Association of Veterinary Conservation Biologists
- Australian Museum
- Wildlife rehabilitators
- Commercial veterinary pathology laboratories
- Wildlife researchers
- Wildlife educators and students
- Human health professionals

Activities & Achievements

- 9,600 exotic and native wildlife pathology cases registered in the card file system
- 1329 exotic and native wildlife pathology cases registered in the new computerised archival system
- providing cost effective diagnostic services for more than 700 wildlife submissions annually
- providing technical advice and resource materials to wildlife managers, species recovery programs, researchers and educators
- > 150 information requests addressed each year
- > 28 published papers related to the activities of Registry participants
- Computerisation of the archival system through the co-operation of the Canadian Cooperative Wildlife Health Centre (CCWHC), the Department of Conservation New Zealand (DoC), and the Wildlife Disease Association - Australasian Section. The CCWHC invested over $50,000Cd to develop a computer program suitable for archiving and analysing wildlife pathology data. The DOC obtained a copy of the CCWHC software and invested $14,000NZ in programmer time to update and modify the software. The CCWHC and DOC have both graciously donated this software for our use. The Wildlife Disease Association — Australasian Section has donated $3,000 to further refine the software for our specific needs and have committed continued financial support for this project. International cooperation will result in ongoing software upgrading at minimum cost.

Current Projects

- Conducting marine mammal necrospy and sample collection workshops for NSW National Parks & Wildlife Rangers in conjunction with the Australian Museum
- Investigating an outbreak of mortality affecting more than 170 Tammar wallabies resident within 7 zoological parks and research facilities. This outbreak is being investigated in collaboration with NSW Agriculture and Macquarie University
- Increasing student participation in Registry activities by delivering presentations to the veterinary student interest groups, offering student internships in comparative pathology, and encouraging students to prepare case reports.
- Enhancing information dissemination by preparing summaries of interesting Registry cases for the Wildlife Disease Association - Australasian Section newsletters

Funding

The Zoological Parks Board of New South Wales (ZPB) has an 80 year history of caring for the health and welfare of Australian fauna. The ZPB has wholly supported the Registry of Comparative Pathology since its inception in 1985. The Registry is now operating with a very small operating budget. The generosity of commercial sponsors has provided opportunities to make the most of this small funding base. Maximising the value of the Registry, however, will rely on increasing stakeholder participation, and securing external financial support.

Sustainability

The ZPB has supported the Registry since its inception in 1985, and has recently increased its commitment by expanding the Registrar/Pathologists from a part-time casual to a full-time permanent position. Registry collaborators have had a long history of contributing to the Registry.

Acknowledgments

The Zoological Parks Board of NSW has a longstanding commitment of support for the operation of the Registry of Wildlife Pathology. The Registry and its users have also benefited from the kind donations of services and products from the following organisations:

- Veterinary Pathology Services - VPS
- Harvey Norman
- Smith - Nephew Surgical Pty. Ltd
- Wildlife Disease Association - Australasia
- Canadian Cooperative Wildlife Health Centre
- NZ Dept. of Conservation

Existing resources and responses in Australia

Introduced and chaired by Andrew Tribe, School of Veterinary Science, University of Queensland

What is the point of proposing a wildlife centre? We agree that such a centre is necessary, but maybe that is only an assumption. In society, they are called traditional society assumptions (TSA). Assumptions generally held in society but for which there is no or little evidence to support the assumption. For example, the legal profession is here to serve the community, or the Olympics are open to all Australians!

Therefore, what could a wildlife centre do better than with current resources. This session will present what actually happened, what did people do, who paid, and was it effective. How could it have been done better?

Willis Island and Michaelmas Cay seabird die-off

by Heather Gardner

This is a report of an exotic disease investigation of death of seabirds on Willis Island and Michaelmas Cay, Queensland, in May 1998.

The case study raised several issues:

- There is in existence an emergency response system (AUSVETPLAN) that could be applied to wild life.
- A tripartite communication network between the agriculture and environment-based bureaucracies and the wildlife carers is required in order to deliver an emergency response measure.
- The training and skilling of informed wild life carers and other "lay" people in basic diagnostic/collection skills is important in the investigation of disease in wildlife.
- Wildlife disease investigations can fall between the gaps. Once the disease is established not to be exotic diseases, there is no agency with responsibility to continue further investigation.

The Australian Quarantine and Inspection Service (AQIS) was notified that large numbers of seabirds were dying on Willis Island, a territory in the Coral Sea and on Michaelmas Cay, a popular tourist and dive spot just off the coast of Cairns. A response was undertaken because of the extent of the deaths (>20%) of the adult birds died, the description of the clinical symptoms and the concurrent death of 3 chickens on the island and the visit to the island of a foreign vessel. The diseases of concern were Newcastle disease and avian influenza, exotic diseases that would affect the avian industry and wildlife.

The purpose of the investigation was to establish whether these viruses caused the mass mortality.

Post-mortem examinations were conducted on ten birds (common noddy, white-capped noddy, and red-footed booby) on Willis Island by Bureau of Meteorology officers. Samples of the liver, kidney, pancreas and brain and cloacal swabs were collected for virus and bacterial isolation. Tissues were also collected for histological examination. Serum was collected from 2 dying birds for antibody identification of Newcastle disease and avian influenza.

The samples were prepared and stored in AAHL diagnostic containers that had been airdropped by Coastwatch. The Navy collected the samples and forwarded them the AAHL.

A veterinary officer of the Qld Department of Primary Industries collected samples from Michaelmas Cay. (In an exotic disease response, the state jurisdiction undertakes the investigation.)

Results
The serology and virus isolation revealed that neither Newcastle disease nor avian influenza caused the deaths of the birds. Small numbers of bacteria were isolated from tissues from some birds. Histopathology study revealed pathological changes in the liver in 2 birds.

Conclusion
The cause of death of the sea birds was not Newcastle diseases or avian influenza. No other cause of death of the seabirds could be established from the samples. However, high levels of Salmonella were isolated from the birds.

As exotic disease caused the death of the birds, further investigation may be undertaken at Qld Veterinary Diagnostic Laboratory in Townsville.

Questions
This was not an exotic disease as it eventuated, but it could have been. What was it?
Answer: We do not know, but possibly Salmonella. The major response only occurred because an exotic disease was suspected. AQIS/NAQS would not be involved if it was not an exotic disease.

Interested with your problem with wildlife carers. In NSW the agriculture authorities are responsible, under the State disaster plan, for all animals no matter what the emergency is – bushfire, flood etc. This arrangement certainly helps management for these circumstances.
Answer: I am not aware whether these arrangements exist in other States.

You said we will call you in your address. Who is "you"? How do you feed back to carers and Parks & Wildlife even if these become non events?
Answer: We do not have a formal system in place to hand over when it is an endemic event. However in this case it was handed back to the Queensland CVO and the Parks &

Wildlife were kept informed. It is not in our brief to continue with the diagnosis once it is known not to be an exotic disease.

What involvement did the local laboratory have with these investigations?
Answer: They were involved except where logistics were difficult. They were brought in to assist with investigations.

Aspects about the Initial Outbreak of Japanese Encephalitis
by Chris Bunn

This presentation covered some of the wildlife aspects during the early stages of the Japanese encephalitis outbreak in 1995. First of all, there were quite good relations between Health and Agriculture during this episode, possibly due to their experiences with the Hendra virus disease outbreak in the previous year. How the outbreak was handled is tabulated below using information assembled from the files.

April 19 1995	Late in the afternoon Commonwealth Agriculture received verbal advice from Queensland CVO (who had been called to a Commonwealth and States medical hook-up). Teams established to look at mosquito control and bird data. One human death due to JE reported from Badu Is Torres Strait
April 21	*Written report provided to the Consultative Committee of Exotic Animal Diseases (CCEAD)* - Qld health lead agency (Agriculture supportive) - Pig and horse specimens collected from island sent to Qld health. Positives detected. - Plans to sample wild birds on Badu planned by QDPI officers for the next week. - Qld health instituted mosquito control - NAQS staff (Commonwealth Quarantine) also assisting

Note: The speed with which pig and horse samples were collected and the early arrangements to sample wild birds.

April 24	Press release by Medical Director PHU "It is possible that the virus was introduced from Asia by migratory birds" "…from a medical public health point of view and from an animal health point of view this is big — this is going to generate a lot of concern internationally."

Note: Often people make public statements for which they are either not the expert or the issue does not come into their area of responsibility.

April 26	Official notification to the World animal health authority. Overseas Posts notified Sampling program established for sentinel pigs and chickens at top of Cape York Peninsula. Pigs and dogs sampled on Moa Is. Contact made with CSIRO Division of Wildlife and Ecology because of the role of free flying birds Access for horses, pigs and pig semen to a few countries will need to be negotiated.
April 27	Official statement made on PROMED (the global electronic reporting system for outbreaks of emerging infectious diseases)

The above reflects some of the activities that were occurring at the Commonwealth level in international notification and trade issues. While government usually will not be first to report an outbreak on the Internet, it is usually wise to make an official statement (as soon as the facts are known) to reduce global speculation.

May 5	Surveillance reports all pigs and dogs on Badu positive. Some poultry positive on Badu but none on Cape York. Other islands appear infected "Wild birds on Badu not sampled. There were few birds around and those that were seen were not of the species listed on the permit to shoot" "Work continues on collecting data on migratory patterns of wild birds to make a risk assessment for Northern Queensland"
May 10	Query Japan re movement of horses. Informed mainland so far free
May 16	Query from Lithuania re consignments of wool Consideration being given to extend the testing on the mainland
May 26	Another CCEAD meeting again reported mainland free
June 8	Results showed that pigs on the inner Torres Strait islands and northern Cape York were not infected Mosquitoes reported positive

Examination of the files, as summarised above, indicates that there was a lack of plans, communication, and preparedness for sampling of wildlife. Although such plans were mentioned early during proceedings, they either progressed very slowly or not at all.
Some of the trade queries that arose also demonstrated the odd requests that Australia had to answer. For example, the query from Lithuania on how dangerous is wool. Especially for trade reasons, efforts were aimed at determining mainland freedom from Japanese encephalitis.

July 19	Meeting of specialists on Thursday Island to work out a composite program for human health and a research program.

The above meeting (and a further meeting later in Cairns) did bring all the interested parties together and a composite plan was developed. However, the problem since then has been funding. Although AQIS, through its Northern Australian Quarantine Strategy is doing a good job, Japanese encephalitis preparedness is a matter that does not come under the mandate of any single government department and consequently will likely 'slip between the cracks'

Questions
Where could we have done a better job, especially if we had an Australian wildlife health centre?
Answer: The word is preparedness. For an emergency people need to have been trained and be aware of how they could be involved. They need to be a party to the planning.
Comment: Historically Agriculture authorities are not keen to be involved with wildlife sampling, while environment bodies are not keen to become involved with diseases.
Comment: Often as veterinarians we assume people have a greater knowledge about disease and disease risks than is the case.
Comment: This demonstrates an educational role that a centre could have.
Comment: Does demonstrate a governmental organisational problem. Problem with defining who has the mandate. Especially where are funds going to come from when departments have greater priorities than looking at wildlife disease.
Comment: Arrangements did function better during the 1998 outbreak.
Comment: Often it is a matter of just developing networks within and between departments. The expertise is there.

An emerging disease — An Epizootic of Sudden Death in Tammar Wallabies (*Macropus eugenii*)

by Karrie Rose

Resources Used

Taronga Zoo's diagnostic lab - gross & microscopic post mortem examinations, bacteriology, parasitology; Macquarie University - financial and physical support of the investigation, epidemiology review of the outbreak; Commercial veterinary pathology laboratory – toxicology; NSW Agriculture - virology and serology; University of Sydney, Institute of Clinical Pathology & Medical Research, Department of Medical Entomology - mosquito trapping; Australian Registry of Wildlife Pathology - linking cases; Wildlife Disease Association - Conference and Newsletter -communication and pro-active surveillance

The outbreak of sudden death of tammar wallabies and investigations to establish a definitive diagnosis will be described during this presentation. Establishing a definitive diagnosis into an epizootic such as this is imperative to better understand and control disease in both free ranging and captive wildlife populations.

An epizootic of sudden death in tammar wallabies (*Macropus eugenii*) was noted within 7 research facilities and zoological gardens within New South Wales from October through to December 1998. One hundred and twenty tammar wallaby deaths were confirmed during this period. Population censuses conducted after the outbreak, however, indicate that approximately 230 tammar wallabies died.

The majority of animals died without premonitory signs, yet a small proportion of wallabies exhibited increased respiratory rate, sat with a lowered head shortly before death, or were discovered in lateral recumbency, moribund, with muscle fasciculations. Gross post mortem findings consistently included massive pulmonary congestion, mottled hepatic parenchyma, and subcutaneous oedema throughout the hind limbs and inguinal region. Approximately 30% of the animals examined also had extensive haemorrhage within the fascial plains and skeletal muscle of the hind limb adductors, inguinal region, ventral thorax, dorsal cervical region, and peri-renal retroperitonial area. The tissues of affected animals became autolytic within a short period after death. Microbiological examination of tissues from 14 animals did not provide any significant findings. Toxicological examination of the gastric and colonic content of four animals did not reveal evidence of brodifacoume or other rodenticides.

Viruses, probably from an orbivirus group, were isolated from samples of the myocardium of two tammar wallabies, the liver and intestine of another tammar wallaby, and the cerebral cortex of six tammar wallabies that originated from a research facility in Sydney. An orbivirus was also isolated within the cerebrospinal fluid of a tammar wallaby that died suddenly in a research facility in Yeerongpilly, Queensland.

This is the first report of an epizootic of sudden deaths in tammar wallabies apparently associated with orbivirus infection.

Resource–related questions that were identified from this investigation:

- What should we do if tammar wallabies start dying when the weather warms up over the next few weeks?
- What resources are available to allow investigation of emerging diseases in wildlife within Australia?
- How can we differentiate endemic disease from emerging diseases in wildlife if we don't conduct ongoing wildlife health surveillance?
- How do we form communication networks that will allow more rapid identification of widespread outbreaks of wildlife disease?
- How do we inform all stakeholders of significant outbreaks of disease in wildlife?
- How do we train veterinarians and lay people to identify disease in wildlife, collect appropriate information and samples, and contact the appropriate people or agencies?

K.A. Rose - Veterinary & Quarantine Centre, Taronga Zoo, PO Box 20, Mosman, NSW, 2088; P.D. Kirkland , R.J. Davis - Virology Laboratory, NSW Agriculture, EMAI, PMB8, Camden, NSW; R. Claassens, D. Blumstein, D. Cooper - Macquarie University, NSW, 2109

Discussion arising from questions and comments

Members of the Australian Animal Health Laboratories commented that they required diagnostic samples from this type of incident to investigate the possibility of exotic or emerging diseases. Exotic diseases may manifest themselves in an unexpected manner in native wildlife. Members of AAHL commented that they need to obtain samples from endemic diseases in order to have a complete collection so those future mortality events can be compared.

Representatives of both NSW Agriculture and AAHL stated that investigations such as these should be treated without charge.

Computerised networks, such as Path Mail, would be extremely useful to increase communication regarding these types of events.

A participant stated that most regional labs are understaffed and would find it difficult to accommodate the workload brought on by such an investigation, ie 5 wallaby necropsies per day.

The need for a national referral system to follow up wildlife mortality events was highlighted.

Better relationships are needed among key stakeholders in wildlife health, and developing a communication system among stakeholders is essential.

Translocation/reintroduction scenario — potential issues
by Karen Viggers

A hypothetical reintroduction scenario was presented to stimulate discussion about the current level of involvement of veterinarians in captive breeding and release programs.

Scenario
A group of 15 animals has been captive bred with the aim of supplementing an existing, but declining population of an endangered species. The body overseeing the translocation had some foresight and fitted the captive animals intended for release with VHF radio-collars in order to monitor the release. Over the following 2 weeks, as the field biologist moved around the release site to monitor the success of the release, several uncollared (ie. wild) individuals were found recently dead, but in varying states of decay making conclusive necropsies difficult.

The following questions were posed to the group to initiate discussion of relevant issues.

Issues raised
- What protocols are currently in place:
  - for translocation and release programs for endangered and threatened species?
  - for screening captive animals and wild populations for potential diseases prior to release?
  - for post-release surveillance of captive and wild animals? and for what length of time?
  - for veterinary involvement in translocation programs?
- What safeguards and protocols are lacking and how can we establish these?
- What is constitutes a successful release? (ie. survival of the released individuals over 1 year, survival to reproduce etc.)?

It was suggested by members of the group that animals could not always be exhaustively tested for every known disease and that this would not always be productive. However it was agreed that an awareness of potentially pathological diseases both within captive and wild populations was necessary, and that these types of diseases could pose some risk and necessitate appropriate testing.

There was an acknowledgement of the importance and value of veterinary advice with respect to transport to the release site and minimization of the stress of handling. Most current translocation and reintroduction programs do involve a veterinary consultant. However, the importance of this in all reintroduction programs was acknowledged.

There is a current dearth of knowledge of the disease status of many wild populations, and helping to develop this type of knowledge was identified as a potential role for a future Wildlife Health Network. Currently the zoological system is financially supporting testing and treatment of animals destined for release or after release and there was some question of the ability to continue to provide these services in the long term.

Another issue raised was the problem of obtaining appropriate diagnostic samples should a field worker come across freshly dead animals. At present there are no standard protocols readily available for sample collection by field personnel. The value of a Wildlife Health network for establishing a communications network in this type of scenario was identified.

DAY 2 – FRAMEWORKING A WILDLIFE HEALTH CENTRE

Introduction and the background to Wildlife Exotic Disease Preparedness program (WEDPP)

by David Adams, Executive Officer, WEDPP

History

WEDPP is a joint Commonwealth-State/Territory program that began in 1984 as part of Australia's preparedness against exotic animal diseases. WEDPP aims at improving Australia's exotic disease preparedness by supporting AUSVETPLAN through the development of strategies to prevent, control or eradicate exotic disease in wildlife and feral animals.

Aim

The original aim was control of wild and feral animals for the management of exotic disease outbreaks. WEDPP was reviewed in 95/96 as part of a regular program. Conclusions were that WEDPP had performed its original role well but that circumstances had changed in view of new bat diseases, world trade arrangements and public health concerns.

Funding and future

The challenge now — what is the new role for WEDPP? Needs to be part of a broader policy.

At this stage it is funded on an equal dollar for dollar basis by States and the Commonwealth. There is no allowance for outside agencies. In kind contributions versus actual funding can also be an issue.
Funding is only distributed on a year by year basis.

Annual grant is $251K, unchanged since 1990, and will continue to erode with inflation. This workshop is funded by WEDPP and is for developing ideas.

Next step – to determine what policies to put in place, and how to market these ideas.

Future – funding arrangements?

Within government another submission will need to be developed to change funding arrangements.

Questions/Statements

Do we need to consider closer ties with NZ with our wildlife centre?

Workshop Program

Introduced, chaired and summarised by Ian Denney, Director, EMAI, NSW Department of Agriculture

Groups were formed to consider six questions as listed below. These questions were to be addressed taking into account the models from other countries and the needs of Australia.

National Wildlife Health Centre – areas for discussion

Discuss the following using the material provided

1. Aim and Objectives
2. Structure
3. What activities/priorities would you expect the centre to achieve?
4. Sources of information and reporting outputs.
5. Funding – Sources and Sustainability
6. What arguments would we put to government/industries and other funding sources for having a centre?

Workshop Discussion and Summaries

Aim and objective

Name suggestion
The name should reflect the coordinating role such as *Australian Wildlife Health Network.* This name also reflects collaboration, communication, consultation, continuity, etc. The name should be limited to "Australia" and rather than "Australasia" to reflect the national focus.

Aim
To promote and facilitate collaborative links in the investigation and management of wildlife health in support of human, animal health and biodiversity.

Objective
1. Establish and coordinate a network of wildlife health expertise and resources
2. Develop and operate a national database of wildlife health information
3. Identify wildlife health surveillance and research needs and priorities
4. Promote the development of regional and national wildlife health emergency preparedness and response strategies
5. Facilitate and monitor field investigation of disease incidents
6. Advance education and training in wildlife health
7. Provide information about wildlife health to the community
8. Seek and secure resources to achieve the objectives listed above

Structure

Stakeholders
The stakeholders can be divided into several groups – government, international organisations, non-governmental organisations, and industry.

Commonwealth:	AAHL, CSIRO, DHAC, AQIS, EA, CDNANZ
States:	Departments of natural resources, primary industry, health, tourism, zoos, SES
International:	WTO, OIE, FAO, WHO
NGOs:	RSPCA, ANZFAS, WWF, carer groups, WIRES etc, ACF
Institutions:	CRC's, museums, universities, museums, wildlife interest groups (ie wires, landcare groups)
Industry:	fauna parks, chemical companies, ARAZPA, AVA, private pathology labs, harvesters, hunters, ecotourism,

Structure
- Staged development dependent upon acquisition of funding
- Developing Stage
- Current Achievements: workshop, proceedings, network, web site, pathology registry, steering committee, identification of potential state representatives to identify existing local networks and establish missing links

Steering committee, project manager and project officer
Steering committee (champions), board, Executive officer/project officer, technical experts feeding in, regional liaison feeding in. Its legal status would have to be defined.

Steering committee – initial activities:
- Develop proceedings of the workshop
- Secure funding and agree on objectives and activities
- Draft business plan
- Prepare funding and government submissions
- Identify a project officer
- Identify a location for the centre headquarters

Project officer - identify and develop networks, web site, essential infrastructure, databases, maintain network, teleconference, email groups, public relations

Executive officer – IT, organisational, management, entrepreneurial, diplomatic, lobbying, scientific expertise

Timing – steering committee to be formed out of this workshop. Project officer to be appointed as soon as possible.

Other issues to consider:

- Regional inputs
- Local regional experts, liaison officers
- Level of formality/legality
- Steering committee/Board members to fund their own participation
- Attach project officer to a large organisation. eg. AFFA, EA etc.
- What about the AAHC model, to take account of agriculture, health and environment.
- But need industry funds in this model.
- Physical location – consider more neutral location. eg. CSIRO wildlife and ecology (but this is also not neutral).
- Working parties – create working parties to advance the development of several of the primary objectives
- Editorial panel/quality control eg. For web page.

What activities/priorities are expected to be achieved?

Establish identity and structure:

- aim/mission,
- logo,
- communications,
- PR,
- letter head,
- web site,
- MOU between organisations involved

Establish a communication network:

- national electronic newsgroup,
- web site,
- newsletter,
- working parties,
- eg. 1800 numbers, also international.
- Establish an expertise directory

Collate current data on wildlife health:

- Passive Surveillance:
  - data gathering/reporting,
  - data review,
  - data entry/analysis,
  - dissemination of information
- Active surveillance
  - seek funding for targeted wildlife health surveillance,
  - promote the development of local and national wildlife health emergency preparedness and response strategies

Identification and prioritisation of research and surveillance directions for wildlife health

Education and public awareness

- The education program will focus upon delivering information in a useful manner to policy makers, technical staff, interest groups, and the public.
- web site,
- workshops,
- field investigation,
- formal submissions,
- addressing media issues and
- development of fact sheets.

Sources of Information and Reporting Requirements

Sources

Data collation is the principal aim. Sources are Government departments, Universities, wildlife carers, industry, and hunting groups.

- identify relevant current electronic databases in Australia and Overseas eg. PROMED;
- access CABI (archival);
- establish directory with people, expertise, organisations, (Govt, private industry, and registry. This directory would outline who does what and where;
- surveillance info –NAHIS, NAMP, NAQS;
- obtain reports on a state by state basis (quarterly?) from government departments, zoos, environment organisations, etc; and
- scientific and wildlife interest newsgroups.

Data analysis

Aim:

- analyse data to meet surveillance, education and awareness needs;
- surveillance needs are priorities to detect emerging wildlife health issues; and
- monitor diseases that could influence wildlife management, conservation, human health and the agroeconomy.

Output reporting

Need to construct a route map of information. The information gathered and processed should be reported through an informational/ education loop in addition to the primary stakeholders. This could be achieved through a multitude of media, including:

- stakeholder commitments;
- provide information and reports to stakeholders: Gov and other funding bodies, eg OIE, AAHC, AFFA (including NAHIS), EA, Health & Aged Care, state conservation, agriculture, health agencies, animal welfare, wildlife researchers, industry and other sponsors;

- targeted information;
- emergency preparedness plan for various species;
- list of priorities for research;
- welfare guidelines;
- facilitate publication of materials and information to assist with the diagnosis, treatment and control of diseases in wildlife;
- general educational and promotional material;
- electronic web page and logo – educational, general info, question/answer;
- promotional/PR material; and
- quarterly newsletter (electronic or paper) targeting scientists and general community worldwide.

Funding Sources and Sustainability

Minimalist versus maximum model was considered.

Minimum model
Predicated on funding availability.
- data network;
- communication network; and
- need $100K PA, with infrastructure support etc. from a large agency.

Maximum model
- broad structure to meet all of the objectives listed above, including education; and
- cost will be over $1 million per annum.

Minimum model
- a secretariat;
- symbiotic to an agency;
- gap-plug, data, network; and
- $100K per year for 2-3 years.

Maximum model
Long Term Sustainable Funding (thinking creatively)
- trust/foundation/corporate structure with shareholders;
- fee for service eg. for data from database;
- membership subscriptions;
- industry (funds on a crisis by crisis basis) /users of wildlife eg. hunters /sponsors;
- Ministerial Councils or other 'public interest' funders (government funders);
- State fish and game agencies. eg. fishing licences in NSW / game licences;
- AAHC model. AAHC is a non-profit public company limited by guarantee;
- Funding comes from the annual subscriptions paid by the members: the Commonwealth, State and Territory governments, key primary industry groups and other key interest organisations;

- Consider the Pittman-Robertson/Dingle Johnson issue (USA) that funds wildlife research from the wildlife users eg fishing and hunting organisations. It is a levy; and
- At present in Australia, there is a 22% tax on fishing and hunting equipment. When the GST is introduced at 10% on goods, there will be a fall in the price of such items. The difference, instead of being passed onto the consumer, could be directed towards wildlife conservation through legislation. It is about changing the taxes on firearms going to wildlife rather than other purposes**.** Will our government be agreeable to these tax changes?

These issues should be considered and addressed by the Board of Directors when developing long-term funding strategies.

Justification

Six main stakeholder areas

- Sustainable harvesting, ecotourism;
- conservation and biodiversity;
- agriculture, industry, mining;
- human health;
- animal welfare; and
- educational institutions.

Wildlife health issues are presently not being addressed by any one agency. As a result they are falling between the cracks.

What would stakeholders want?

- Harvesting / ecotourism – requirement of healthy ecosystem for tourism and hunting;
- Conservation – conservation of fauna;
- Industry, Agriculture and Mining;
- disease freedom in wildlife for domestic and export markets(trade);
- active surveillance;
- active surveillance to demonstrate above;
- ability to cope with overseas perceptions;
- clean, green image for mining;
- Human Health – monitoring for zoonoses, surveillance/monitoring for these;
- Animal Welfare – minimise wildlife suffering from disease which may be generated by human interference; and
- Education institution – information suitable for courses, advice on wildlife research.

What would centres provide?

- providing services tailored to the different stakeholders eg rapid reporting of wildlife health incidents;
- meeting international obligations for disease;
- more efficient utilisation of national resources through co-ordination;
- national perspective of wildlife health;

- development of recommendation towards the effective management of wildlife;
- provide a source of professional advice;
- new capability – coordination of stakeholder activities;
- monitoring surveillance;
- rapid response across jurisdictions;
- identify gaps;
- coordinate research priorities;
- professional advice; and
- more efficient and cost effective.

After Lunch Discussion

The purpose of this session was to develop an action plan and define the outcomes that will go the Veterinary Committee of SCARM.

Naming of the centre

The name should reflect the coordinating, collaboration, communication, consultation, and continuity role. The name should be limited to 'Australia' and rather than 'Australasia' to reflect the national focus.

Two names were put forward: 'Australian Wildlife Health Network' and 'Wildlife Health Network'. 'Network' was considered too weak and 'Centre' implied a concrete structure and single location. As no decision was made at the meeting the steering committee chose to use Wildlife health network centre in the interim.

Collective Statement

> We recognise that considerable information exists about Australian wildlife health that needs to be linked together for Australia and Australians to gain the most benefit from protecting trade, human health, biodiversity, and the welfare of wildlife species.

Discussions ensued regarding the difficulties of obtaining matching funding from state organisations in order to receive Federal funding for wildlife disease initiatives through WEDPP.

Action plan

- summary of the workshop and the proceedings should be sent out quickly sent for agreement;
- request information from participants with workshop summary. Participants should indicate their areas of interest, expertise, resources and funding basis (information and dollars) that they have available for the network. Other names should be provided to extend the list of expertise nationally;
- provide a collective statement regarding current situation re information flow;
- introduce the wildlife health issues in our respective agencies/workplaces;
- develop a press release – using AVA PR person;
- prepare a report to WEDPP regarding the outcomes of the workshop; and
- set up of a steering committee – membership and terms of reference – look towards current working committee that set up this workshop in addition Graham Eggleston from NSW Agriculture.

The Steering Committee

Chris Bunn	AFFA
Tony Robinson	CSIRO Wildlife Ecology
Gerry Maynes	Environment Australia
Heather Gardner	AQIS
Tony English	Faculty of Veterinary Science, University of Sydney
Graeme Eggleson	NSW Agriculture
Pam Whiteley	Wildlife Disease Association
Karrie Rose	Zoological Parks Board of NSW
Karen Viggers	AVA – Wildlife

Duties of the steering committee are to:

- Report back to the participants at this meeting;
- Draft business plan for the structure and allowing for legal considerations;
- Seek funds to support a project manager. Create a job description and selection criteria**.** Consider secondment of someone to act as a project manager until further funds become available;
- Write a competitive application to WEDPP for a project officer to drive this for the next twelve months, until other sources of funding can be organised. Applications will close in Feb 2000 for commencement of funding in July 2000. (timeframe);
- Identify and use information that is currently available. Need a mechanism to feed this information existing sources;
- Inform workshop participants of progress, eg. quarterly reports;
- Group people into areas of expertise from the information receive from participants;
- Use existing networks/newsletter including Australian Wildlife Management Organisation, AVA, Mammal Society etc. as a way of distributing info about our network/centre to increase awareness;
- Consider developing a prospectus, as a marketing document. This will flow from the business plan, and be an early step for the project officer;
- Support the value and ensure the maintenance of the Australian Registry of Wildlife Pathology;
- Work with David Middleton and John Rodgers in their offer to modify the existing wildlife health Australia web page and e-mail list for the use of the network;
- Identify people in each State as practical liaison people.

State representatives

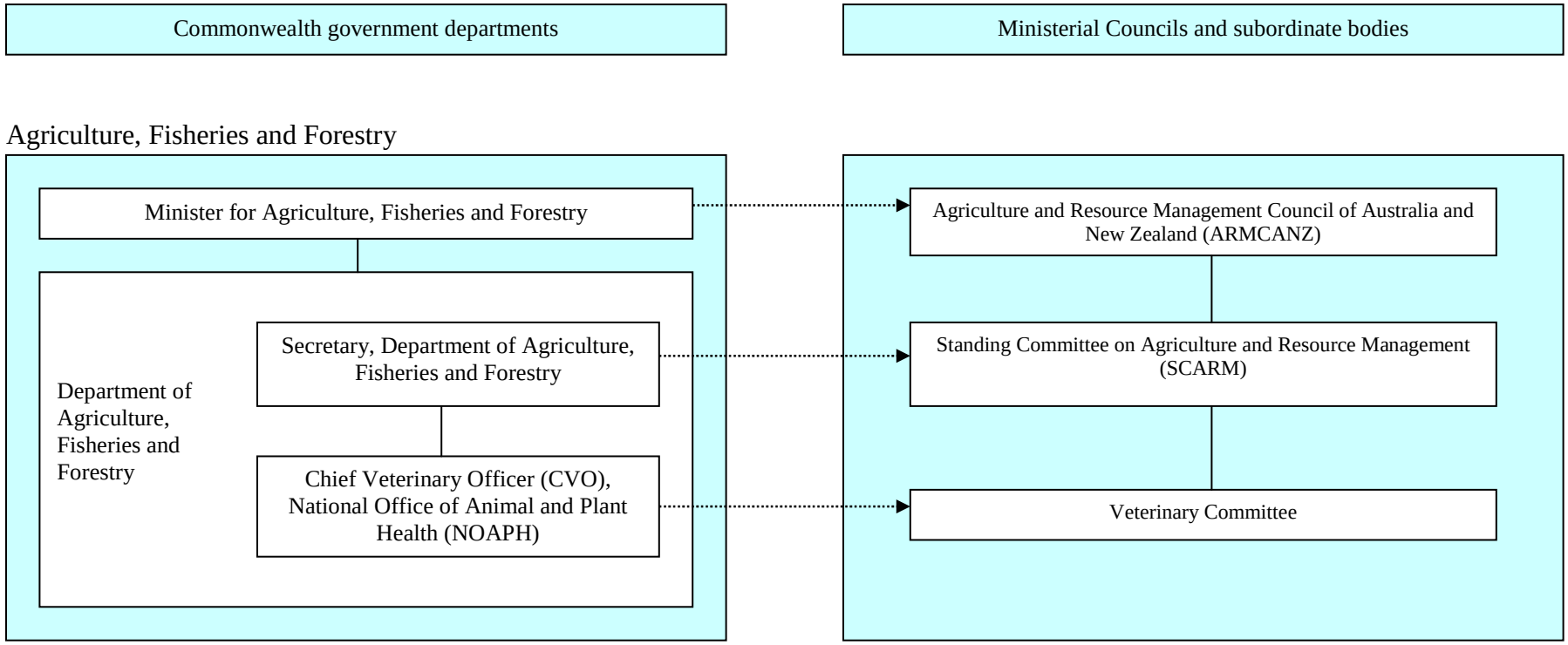
SA	Barbara St John and Sue Conaghty.
ACT	Karen Viggers and Will Andrews
WA	Cleve Main and Shane Raidel
NT	Derek Spielman
QLD	Hume Field and Geoff Lundie-Jenkins
TAS	Philip Ladds and Mark Holdsworth
NSW	Karrie Rose and Tony English
VIC	Ian Temby, Dave Middleton

Conclusion

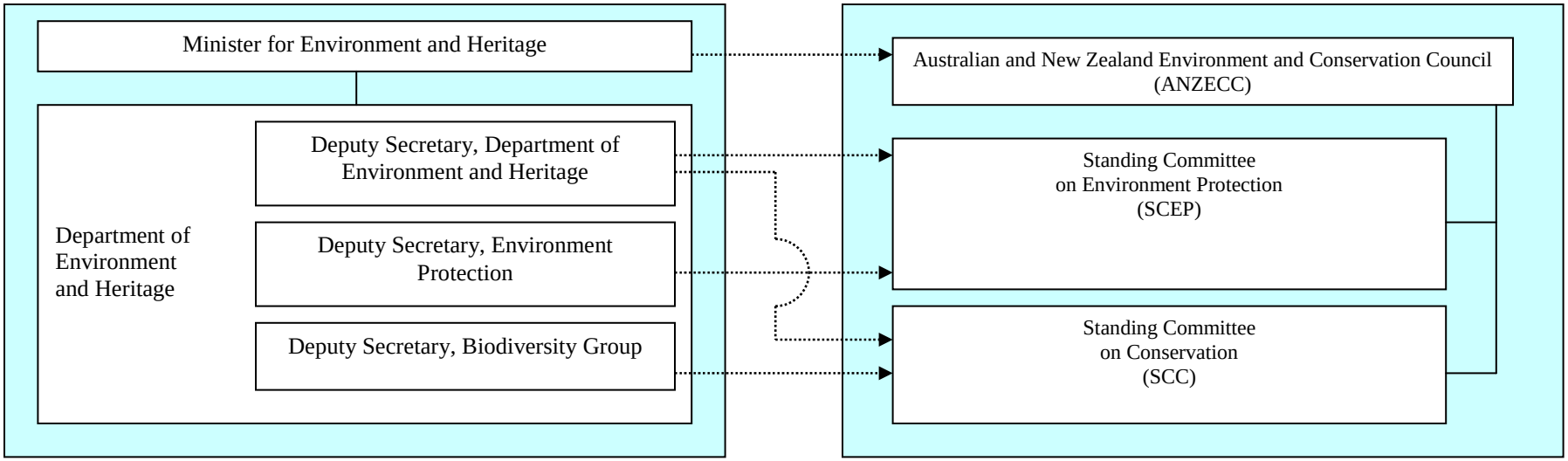
Chris Bunn thanked all attendants for their contribution to the workshop and for the positive outcome that had been achieved.

Appendix 1 – Organisational charts for AFFA, EA and Health

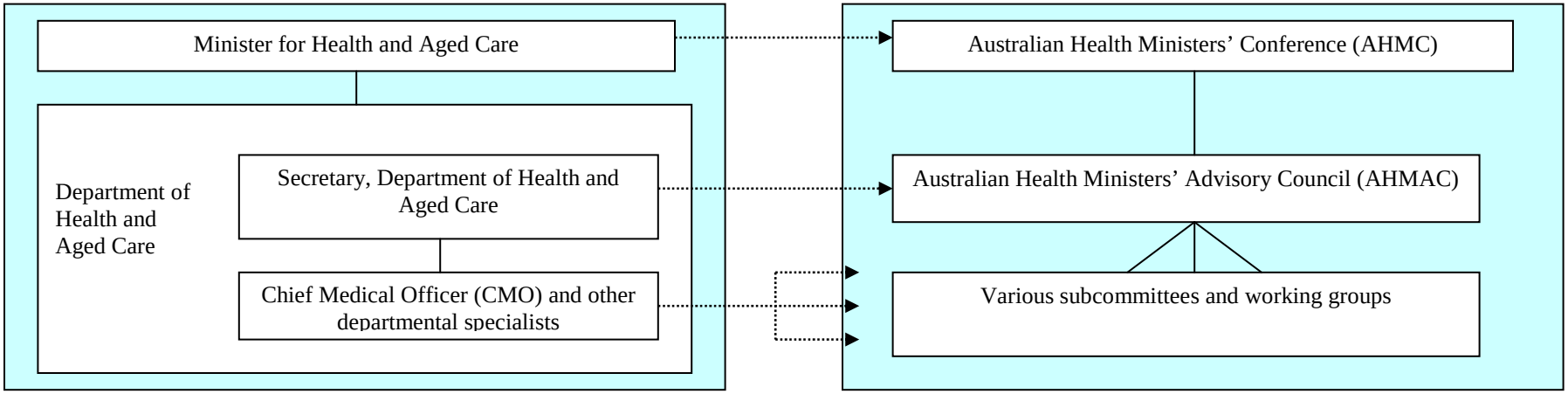
The councils and committees listed at the right draw membership from federal and state/territory ministers, in the case of ministerial councils, and from federal and state/territory departmental heads and the senior executive, as well as relevant expert and technical bodies (eg. CSIRO) in the case of standing committees and other subordinate bodies. Solid lines indicate lines of reporting; dashed lines indicate membership to listed bodies.



Environment and Heritage



Health and Aged Care



Appendix 2 – List of attendees

Name	First name	Address	Phone	Fax	Email
Adams	David	National Office of Animal and Plant Health AFFA GPO Box 858 CANBERRA ACT 2601	02 6272 4051		david.adams@affa.gov.au
Andrew	Will	Environment ACT PO Box 726 JAMISON CENTRE ACT 2614	02 6207 2357 0419 239 073	02 6207 2361	w.andrew@dynamite.com.au
Banks	David	Animal Quarantine Policy Branch AQIS GPO Box 858 CANBERRA ACT 2601	02 6272 5444	02 6272 3399	david.banks@aqis.gov.au
Beveridge	Ian	University of Melbourne			i.beveridge@vet.unimelb.edu.au
Biddle	Bob	Food Policy Branch AQIS GPO Box 858 CANBERRA ACT 2601	02 6272 5364 0419 273 391	02 6271 6522	bob.biddle@aqis.gov.au
Brown	Robert	Australian Deer Association c/- Locked Bag 29 PO Botany NSW 2019	02 9316 5644	02 9316 5967	boblee@bigpond.com
Buckett	Kevin	Commonwealth Department of Health and Aged Care GPO Box 9848 CANBERRA ACT 2601	02 6289 3700 0412 214 887	02 6289 4215	kevin.buckett@health.gov.au
Bunn	Chris	National Office of Animal and Plant Health AFFA GPO Box 858 CANBERRA ACT 2601	02 6272 5540	06 272 3372	chris.bunn@affa.gov.au

Name	First name	Address	Phone	Fax	Email
Canfield	Paul	Dept Vet Anatomy/ Pathology, B14 University of Sydney NSW, 2006	02 9351 2020	02 9351 7421	p.canfield@vetp.usyd.edu.au
Carlisle	Melissa	Veterinary Pathology Services PO Box 1119 COORPAROO DC QLD 4151	07 3391 8500	07 3891 0702	melissacarlisle@vps.com.au
Cleland	Paul	Primary Industries and Resources South Australia PO Box 115 Kingscote SA 5223	08 8553 2222 0417 811 250	08 8553 2531	cleland.paul@saugov.sa.gov.au
Conaghty	Sue	Royal Zoological Society of South Australia Frome Rd ADELAIDE SA 5000	08 8267 3255	08 8239 0637	sconaghty@monartozp.com.au
Deane	Elizabeth	University of Western Sydney, Nepean PO Box 10 KINGSWOOD NSW 2747	02 4736 0808	02 4736 0713	e.deane@uws.edu.au
Denney	Ian	EMAI NSW Agriculture PMB8 CAMDEN NSW 2570	02 4640 6392 0413 278 645	02 4640 6395	ian.denney@agric.nsw.gov.au
Eggleston	Graeme	NSW Agriculture Locked Bag 21 ORANGE NSW 2800	02 6391 3683	02 6391 3336	wilsonkl@agric.nsw.gov.au
English	Tony	Dept Veterinary Clinical Sciences PMB 3 Camden NSW 2570	02 9351 1675 0412 377 820	02 9351 1618	aeng5919@mail.usyd.edu.au

Name	First name	Address	Phone	Fax	Email
Field	Hume	QLD Dept Primary Industries Animal Research Institute LMB 4 MOOROOKA QLD 4105	07 3362 9420 0412 556 641	07 3362 9457	fieldh@prose.dpi.qld.gov.au
Fleming	John	National Office of Animal and Plant Health AFFA GPO Box 858 CANBERRA ACT 2601	02 6271 6395	02 6272 5697	john.fleming@affa.gov.au
Gardner	Heather	Animal Quarantine Policy Branch AQIS GPO Box 858 CANBERRA ACT 2601	02 6272 4723	02 6272 3399	heather.gardner@aqis.gov.au
Garner	Graeme	National Office of Animal and Plant Health AFFA GPO Box 858 CANBERRA ACT 2601	02 6272 5369		graeme.garner@affa.gov.au
Higgin-bottom	Karen	Tourism CRC School of Environmental and Applied Science Griffith University PMB 50 Gold Coast Mail Centre QLD 4217	07 5594 8059	07 5594 8067	K.Higginbottom@mailbox.gu.edu.au
Hills	Susan	Queensland Health c/-TPHU Locked Bag 16 Aitkenvale QLD 4814	07 4750 4000 0409 472 036	07 4750 4001	shills@health.qld.gov.au
Hinds	Lyn	CSIRO Wildlife Ecology GPO Box 284 CANBERRA	02 6242 1784	02 6242 1555	l.hinds@dwe.csiro.au

Name	First name	Address	Phone	Fax	Email
Holdsworth	Mark	Nature Conservation Branch DPIWE Tasmania GPO Box 44A HOBART TAS 7001	03 6233 6033	03 6233 3477	Markh@dpiwe.tas.gov.au
Hone	Jim	University of Canberra CANBERRA ACT 2601	02 6242 1770		hone@aerg.canberra.edu.au
Jenkins	David	Hydatid Control Program 12 Mildura St Fyshwick ACT 2609	02 6271 6331	02 6272 3124	djenkins@effect.net.au
Kelly	John	Kangaroo Industry Association of Australia PO Box 294 MOWBRAY TAS 7248	03 6326 8639 0417 585 163	03 6326 2790	kiaa@tassie.net.au
Ladds	Philip	Dept Primary Industry, Water and Environment Animal Health Laboratory PO Box 46 Kings Meadows LAUNCESTON TAS 7249	03 6336 5409 0416 130 745	03 6344 3085	Philip.ladds@dpiwe.tas.gov.au
Lloyd	Glenis	NSW Health PO Box 798 GLADESVILLE NSW 2111	02 9816 0373 0418 671 994	02 9816 0377	lloyd@doh.health.nsw.gov.au
Lundie-Jenkins	Geoff	Queensland Parks & Wildlife Service PO Box 731 TOOWOOMBA QLD 4350	07 4639 8372 0408 736 274	07 4639 4524	Geoff.lundiejenkins@env.qld.gov.au
Lynch	Michael	Melbourne Zoo PO Box 74 PARKVILLE VIC 3052	03 9285 9431	03 9285 9349	Vetmz@zoo.org.au
Main	Cleve	Animal Health Laboratory Agriculture WA Locked Bag 4 Bentley Delivery Service WA 6983	08 9368 3426	08 9474 1881	cmain@agric.wa.gov.au

Name	First name	Address	Phone	Fax	Email
Maynes	Gerry	Director Invasive Species Section Environment Australia GPO Box 787 CANBERRA ACT 2601	02 6274 2388	02 6274 2314	gerry.maynes@ea.gov.au
McClintock-Gobius	Christine	Epidemiology Services Health Information Centre GPO Box 48 BRISBANE QLD 4001	07 3234 1881		Christine_McClintock@health.qld.gov.au
McColl	Ken	CSIRO - AAHL PB 24 GEELONG VIC 3220	03 5227 5192	03 5227 5555	kenneth.mccoll@dah.csiro.au
McDonald	Ann	Quarantine and Exports Branch AQIS GPO Box 858 CANBERRA ACT 2601	02 6272 5506	02 6272 3110	ann.mcdonald@aqis.gov.au
Middleton	Deborah	CSIRO - AAHL PB 24 GEELONG VIC 3220	03 5227 5016	03 5227 5555	deborah.middleton@dah.csiro.au
Middleton	David	Wildlife Health Australia PO Box 626 LILYDALE VIC 3140	03 9739 1757 Mob 0418 588 362	03 9739 0137	davidmid@ozemail.com.au
Mitchell	Graham (Key Note speaker)	Foursight Associates Level 2, 164 Flinders St MELBOURNE VIC 3000	03 9288 5414		graham.mitchell@foursight.com.au
Murray	Gardner	Chief Veterinary Officer Agriculture, Fisheries and Forestry – Australia Canberra ACT 2601	02 6272 5848	02 6272 5697	gardner.murray@affa.gov.au
Pech	Roger	CSIRO Wildlife Ecology GPO Box 284 CANBERRA ACT 2601	02 6242 1657	02 6242 1555	r.pech@dwe.csiro.au

Name	First name	Address	Phone	Fax	Email
Phelps	Graeme	Parks and Wildlife Commission of the Northern Territory	08 8951 8722	08 8951 8777	graeme.phelps@nt.gov.au
Raidal	Shane	Murdoch University (currently in Sydney)	02 9351 1605	02 9351 1618	c/- aeng5919@mail.usyd.edu.au
Reddacliff	Leslie	EMAI PMB 8 Camden NSW 2570	02 4640 6314	02 4640 6400	leslie.reddacliff@agric.nsw.gov.au
Reid	Katie	Currumbin Sanctuary 28 Tomewin St CURRUMBIN QLD 4223	07 5534 0833	07 5534 7427	vet-hospital@currumbin-sanctuary.org.au
Reubel	Gerhard	CSIRO Wildlife Ecology GPO Box 284 CANBERRA			g.reubel@dwe.csiro.au
Robinson	Tony	CSIRO Wildlife Ecology GPO Box 284 CANBERRA			t.robinson@dwe.csiro.au
Robinson	Bernard	Animal Quarantine Policy Branch AQIS GPO Box 858 CANBERRA ACT 2601	02 6272 5330	02 6272 3399	bernard.robinson@aqis.gov.au
Rodger	John	Marsupial CRC PO Box 1927 MACQUARIE CENTRE NSW 2113	02 9850 9250 0419 211 071	02 9850 9254	jrodger@possum.bio.mq.edu.au
Rose	Karrie	Taronga Zoo Veterinary & Quarantine Centre PO Box 20 Mosman NSW 2088	02 9978 4749	02 9978 4516	Krose@zoo.nsw.gov.au
Scott	Lyndy	Australian Animal Health Council Suite 15, 26-28 Napier Close DEAKIN ACT 2600	02 6232 5522 0419 435 916	02 6232 5511	lyndy.scott@aahc.com.au
Seamark	Bob	Pest Animal Control CRC Box 284 Canberra, ACT, 2601	02 6242 1728 0418205017	02 6242 1511	b.seamark@dwe.csiro.au

Name	First name	Address	Phone	Fax	Email
Slocombe	Judy	Victorian Veterinary Pathology Services 14 Yarra St SOUTH YARRA VIC 3141	03 9828 7704 0411 259 454	03 9824 1174	jsloco@gribbles.com.au
Speare	Richard	School of Public Health & Tropical Medicine James Cook University QLD 4811	07 4722 5700	07 4771 5032	richard.speare@jcu.edu.au
Spielman	Derek	Parks and Wildlife Commission of the Northern Territory PO Box 771 PALMERSTON NT 0837	08 8988 7200 0418 898 279	08 8988 7291 08 8988 7201	derek.spielman@nt.gov.au
Spratt	David	CSIRO Wildlife Ecology GPO Box 284 CANBERRA ACT 2601		02 6242 1555	d.spratt@dwe.csiro.au
St John	Barbara	Parks and Wildlife Service Dept Environment, Heritage & Aboriginal Affairs South Australia	08 8204 8765 0409 672 108		bstjohn@dehaa.sa.gov.au
Tate	Steve	Department of Natural Resources and Environment 457 Mickleham Rd ATTWOOD VIC 3049	03 9217 4174 0417 356 790	03 9217 4322	stephen.tate@nre.vic.gov.au
Temby	Ian	Dept Natural Resources & Environment (VIC) 4/250 Victoria Parade EAST MELBOURNE VIC 3002	03 9412 4429	03 9412 4586	Ian.temby@nre.vic.gov.au
Tribe	Andrew	University of Queensland PO Box 125 KENMORE QLD 4069	07 3365 5708		a.tribe@mailbox.uq.edu.au

Name	**First name**	**Address**	**Phone**	**Fax**	**Email**
Tweddle	Neil	National Office of Animal and Plant Health AFFA GPO Box 858 CANBERRA ACT 2601	02 2272 4509 0417 235 648	02 6272 3372	neil.tweddle@affa.gov.au
Viggers	Karen	Research School of Biological Sciences Australian National University GPO Box 475 Canberra 2601 Australia	02 6249 4743		karen.viggers@rsbs.anu.edu.au
Walker	Linda	National Office of Animal and Plant Health AFFA GPO Box 858 CANBERRA ACT 2601	02 6272 5306	02 6272 3150	linda.walker@affa.gov.au
Whiteley	Pam	Wildlife diseases Association 1 Brinsley Rd CAMBERWELL VIC 3124	03 9882 5608		whiteley@vicnet.net.au
Wilson	Graham	NSW National Parks Threatened Species unit Conservation & Planning Division	02 9585 6542	02 9585 6544	graham.wilson@npws.nsw.gov.au
Witteveen	David	Commonwealth Department of Health and Aged Care MDP 6 GPO Box 9848 CANBERRA ACT 2601	02 6289 7674	02 6289 7791	david.witteveen@health.gov.au