WILDLIFE HEALTH & BIOSECURITY WORKSHOP

THE NEED FOR IMPROVED DISEASE DETECTION, DIAGNOSIS, RISK ASSESSMENT, COMMUNICATION AND RESONSE

Executive Summary:

The risks are clear and tangible. Diseases with wildlife as part of their ecology pose a direct threat to human health, livestock health, biodiversity, trade, tourism, and the Australian economy.

In a global environment where approximately 60% of all human pathogens are zoonotic, 75% of emerging and re-emerging human diseases in the past 30 years have been zoonotic, and most of the emerging diseases over the past 10 years have originated in wildlife, there has never been more interest in wildlife health (Woolhouse 2002). Global examples of the emergence of zoonotic disease from wildlife reservoirs include avian influenza (H5N1 and others), West Nile virus, Chikungunya virus, Japanese encephalitis, malaria, SARS, Nipah virus, Ebola virus, bovine tuberculosis, Monkey Pox, Rabies, new strains of human immunodeficiency virus, Lyme disease, and diseases caused by many other agents. Australian examples of these diseases include Australian Bat Lyssavirus, Hendra virus, Menangle virus, various forms of chlamydiosis, and mycobacteriosis.

Historically, wildlife and invasive species health surveillance in Australia has fallen into gaps between agriculture, conservation and human health agencies. There is no direct agency responsibility for wildlife and invasive species health. Thus, we lack an integrated policy approach, along with operational tools, and critical resources for nationally coordinated wildlife health surveillance, risk assessment, education, communication and research.

We have obligations. Australia has a number of international obligations that require robust, transparent, and auditable disease surveillance systems to allow its animal disease status to be determined. The World Health Organization for Animal Health (OIE) sets standards and coordinates the flow of information regarding disease of concern for international trade. Annual reporting of disease in wild and feral animals is now required as part of this process. Additionally, as a signatory to the Sanitary and Phytosanitary Agreement under the World Trade Organization it is also incumbent upon Australia to have adequate levels of surveillance to demonstrate disease freedom to support our stringent quarantine restrictions as well as to support growing exports of game produce. Australia must maintain its competitive advantage by implementing suitable systems to determine wildlife health status, manage wildlife disease and fulfil international obligations.

As a signatory of the United Nations Convention on Biological Diversity (1992), Australia also has obligations to have national strategies and programs to monitor biological diversity, and to identify and monitor processes that are likely to have significant adverse effects.[1] Our unique fauna and high biodiversity means that there is still much to learn to demonstrate to trading partners that our wildlife health is effectively monitored and managed.

National health platforms are evolving towards the integration of wildlife health and environment into biosecurity policy and procedures. This evolution is illustrated by the proposed amalgamation of Primary Industry Health Council and Environmental Health Council to form the National Biosecurity Council, by the creation of AusBIOSEC, and by Animal Health Committee recently accepting direct responsibility for wildlife health matters. These policy initiatives clearly highlight the need for an operational structure for national wildlife health surveillance and research tools.

The need is urgent. The World Health Report 2007 illustrates how infectious disease is spreading further and more rapidly than ever before, and how new diseases are emerging at the increased rate of approximately one each year. The World Health Organization highlights the sharing of essential health information as one of the most feasible routes to global public health security. The recommendations of the report include calls for global coordination, collaboration and investment, along with cross-sector collaboration within governments, to prevent significant adverse economic, social and environmental outcomes resulting from the spread of infectious disease. The report also recommends

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[1] United Nations Convention on Biological Diversity (1992). Article 6: Develop ***national strategies, plans or programs*** for the conservation and sustainable use of biodiversity.
Article 7: ***Monitor***, through sampling and other techniques, the components of ***biological diversity***.
Article 7: ***Identify*** processes and categories of activities which have or are likely to have ***significant adverse impacts*** on the conservation and sustainable use of biological diversity, and ***monitor their effects*** through sampling and other techniques.

increased global and national resources for training, surveillance, laboratory capacity, response networks and disease prevention campaigns. Yet the current systems in place in Australia for national coordination of wildlife disease investigation, surveillance, preparedness, education, and research are under-resourced and fragile, and require immediate co-investment.

One World - One Health:

Human health, livestock health, plant health, aquatic animal health, wildlife health, and environment health are inextricably linked. In the last decade there has been increasing acceptance of a unified approach to share resources and better understand and control health and disease through the concept of "One World, One Health" (Karesh and Cook 2005, Zinsstag et al. 2005). Through the 1980's and 90's there has been an evolution of thinking from a concept of "One Medicine", which incorporates the science of human and animal health and disease, to one of "One Health": which incorporates an ecosystem health approach for the sustainable development of health of people, animals and the ecosystems in which they live (Zinsstag et al. 2005).

In a global environment where approximately 60% of all human pathogens are zoonotic, 75% of emerging and re-emerging human diseases in the past 30 years have been zoonotic, and most of the emerging diseases over the past 10 years have originated in wildlife, there has never been more interest in wildlife health (Woolhouse 2002). Global examples of the emergence of zoonotic disease from wildlife reservoirs include avian influenza (H5N1 and others), West Nile virus, Chikungunya virus, Japanese encephalitis, malaria, SARS, Nipah virus, Ebola virus, bovine tuberculosis, Monkey Pox, Rabies, new strains of human immunodeficiency virus, Lyme disease, and diseases caused by many other agents. Australian examples of these diseases include Australian Bat Lyssavirus, Hendra virus, Menangle virus, various forms of chlamydiosis, and mycobacteriosis.

Additional compelling factors that are driving an interest in wildlife health include: public concern regarding animal welfare, zoonotic diseases and food safety issues associated with endemic and exotic disease, biodiversity protection, bioterrorism detection, climate change and its effects on animal and human health and disease, and the development of a nationally integrated biosecurity strategy (Bengis et al. 2004).

Infectious agents and disease have contributed to ecosystem stability and resilience for millions of years through the process of natural selection. Disease causing agents are part of ecosystems and their emergence in the form of emerging diseases and epidemics are most often the result of anthropogenic change. In addition to the direct and indirect transmission of disease causing agents among humans, livestock, and wildlife, disease modelling has been undertaken to support the hypothesis that biodiversity in its own right increases the resistance of communities to invasion by emerging and exotic infectious diseases (Kennedy et al. 2002, Maillard and Gonzalez 2006, Millennium Ecosystem Assessment - Ecosystems and Human Well-Being: Biodiversity Synthesis 2005).

Economic Impacts

Table 1 summarises some of the economic consequences of diseases that have wildlife as part of their ecology. All listed diseases, except for Foot and Mouth Disease pose a considerable zoonotic threat. In addition to economic costs, diseases that have wildlife as part of their ecology can present social costs such as death, unemployment, loss of productivity, trade and travel restrictions, and loss of development opportunities.

Table 1: Examples of the Economic Impacts of Diseases with Wildlife as Part of their Ecology

Disease	Source	Year	Cost	Comment
Influenza	World Bank	2006	$US1.25 trillion	Estimate for a human pandemic
SARS	Parliament of Australia and Australian Biosecurity CRC	2003 and 2006	$US10 billion to $US30 billion $A930 million in Australia	Worldwide estimate including cost to tourism. CRC estimate for Australia, even though there was no disease here
Foot and Mouth Disease (FMD)	OCVO, DAFF Ausvetplan 3rd edition	2006 2006	$A19 billion. Up to $37 billion if trade and tourism costs are included $A8 - 13 billion	Approximate losses to the UK economy after the 2001 outbreak of FMD. Estimated cost to GDP of an epidemic in Australia. The economic consequences would be felt for nearly 10 years after the event.
Tuberculosis	NZ Animal Health Board DAFF	2000 1992	$NZ30 million to $NZ60 million pa $A1.3 billion	Lower bound estimate is for vector management (possums). Upper bound estimate is for eradication. Costs of eradication from Australia in 1992.
Ross River Fever	Medical Journal of Australia	2003	$A5 million pa	Australia only estimate for direct medical costs
Chikungunya	Indian Journal of Medical Ethics	2007	$A65 million	Estimate prepared by using a $A50 per case assigned value
West Nile Fever	National Library of Medicine	2002	$US20.1 million	Single US outbreak (Louisiana 2002)
Japanese Encephalitis	WHO and IOWA State University	2003 and 2004	$US40 million and $US125 million pa	Human health costs only. No allowance for livestock losses and other indirect costs
Murray Valley Encephalitis	NZ Government	2007	$NZ6.1 million	Vector control cost only and also includes protection for RRF and others
Nipah Virus	CRC for Emerging Infectious Diseases	1999	$US400 million	Malaysia only - cost estimate.

Wildlife Biosecurity and Biodiversity

The significance of disease in wildlife populations and its impact on the conservation of biodiversity in Australia is poorly understood. Disease-causing organisms are a component of natural ecosystems. A balance among the relationships of host, pathogen and environment most often meters the occurrence of disease. As wildlife habitats are modified through human activity, and an increasing number of species are intensively managed in the wild, the possibility of disturbing these relationships increases.

While in the past the significant impact of disease in wildlife was thought to be limited to populations that were already in decline, more recently disease has been included as a key threatening process to previously healthy wildlife populations. Chytrid fungus infection, psittacine circovirus, and diseases transmitted by feral pigs have recently been classified by the Australian Government Department of Environment and Heritage as key threatening processes affecting biodiversity (DEH, 2006). Additional research is required to assess the impacts of these and other diseases on biodiversity, and to characterise the biodiversity of disease causing agents in Australia.

One example of the effects of disease on biodiversity is Tasmanian Devil Facial Tumour Disease (DFTD). Facial tumours were first noted in 1996. Currently the disease is estimated to cover 59% of Tasmania, and there has been a 53% decline in average sightings of Tasmanian devils, with some regions reporting a 90 per cent decline of average spotlighting sightings from 1992-95 to 2002-05. Up to 83% of trapped adult Tasmanian devils display signs of the disease (Source: http://www.dpiw.tas.gov.au/inter.nsf/WebPages/LBUN-5QF86G?open).

Thus DFTD has had a tremendous impact on the Tasmanian devil population. As a top order scavenger, this impact is likely to have biodiversity repercussions down the food chain, and may decrease the natural buffer to the establishment of foxes in Tasmania. However, the importance of DFTD extends far beyond the wildlife arena. This disease is a disturbing model for epidemics of directly transmissible malignancy. The only previous example of a directly transmitted neoplasm is canine transmissible venereal granuloma, an indolent disease endemic in dog populations in some regions (including Aboriginal communities in northern Australia) and regarded as a curiosity. DFTD has changed this picture and represents an emerging disease transmission mechanism. The mechanism will result in a more critical analysis of host to host transmission of malignant neoplastic cells. The implications of this transmission mechanism have yet to be appreciated in the human and veterinary health fields, but will produce a paradigm shift.

A case study of amphibian Chytridiomycosis (infection with the fungus *Batrachochytrium dendrobatidis*) emphasises the importance of possible anthropogenic introduction of disease, and the need to recognise that disease can cause major declines in wildlife populations, affecting biodiversity. "Chytridiomycosis is an extreme example of the impact of a wildlife emerging infectious disease on biodiversity" (Daszak et al. 2003). Chytridiomycosis has been a pandemic emerging infectious disease that has caused mass extinctions on a global scale. The impact of chytridiomycosis includes: local population declines, local population extinctions, and multiple species extinctions. Chytridiomycosis is now found in 15% of non-endangered amphibian populations and 60% of endangered species (Skerratt et al. 2007).

The lessons from amphibian chytridiomycosis in Australia are highly relevant for any new diseases entering Australian wildlife populations. However, although awareness and expertise has improved in Australia, the funding and infrastructure to investigate and manage a new wildlife emerging infectious disease (EID) are not adequate.

Lessons learned through these disease investigations include the need for:

- recognition that infectious disease can have significant impacts on populations of wildlife
- much more rapid disease detection and diagnosis (<15 years and 4 years respectively)
- a rapid and managed wildlife disease response - with intervention/response strategies
- better funding and other resources for investigations
- dedicated personnel with skills and time
- a multidisciplinary network
- a clear understanding of the lead agency responsible for wildlife health issues and events
- a cost-sharing program, or dedicated source of funds in advance of the event
- a program for early intervention and ongoing monitoring and surveillance
- a database of biodiversity
- data acquisition and mapping tools to track the wildlife disease event
- a database of wildlife health and disease.

Wildlife as Sentinels for Environmental Risks to Human Health

The detection of environmental pollution by lead was dramatically detected after epidemic deaths of native birds at Esperance, Western Australia (Department of Environment and Conservation 2007). This resulted in the involvement of additional government agencies, including health, suspension of the transport of lead dust and rapid remediation action. Without the dramatic signal of bird deaths public concern and government action would arguably have been much slower. A good counter case study is that environmental lead pollution has been recognised for decades at Mt Isa, Queensland, where lead levels above WHO standards have been demonstrated in at least 5% of children less than 5 years of age, but no significant remedial action has been taken. Public authorities dismiss these high levels (ABC News 19 March 2007), ignoring lessons well established globally about the serious effects of sub-clinical lead levels on children. A news-worthy outbreak in wildlife would probably undermine this dangerous parochial stance.

Another example of the potential value of wildlife as sentinels includes the better understanding of diseases such as salmonellosis. We know that predominant serovars of *Salmonella* sp. that cause human disease vary with geographic location. *S. Virchow* predominates in north Queensland, whereas *S. Birkenhead* predominates in southern Queensland/northern New South Wales, and *S. Mississippi* is most prevalent in Tasmania. We also know that in various cases, wildlife have been implicated as a source of human and livestock infection, particularly through untreated drinking water (Ashbolt and Kirk 2006, Ashdown and Ryan 1990, Taylor et al. 2000). High rates of salmonellosis in remote rural Aboriginal communities, despite poor specimen collection per case are also suggestive of a wildlife link or source. Despite this knowledge, when risk factors for human infection with *S. Birkenhead* were investigated, major risk factors were not identified (Beard et al. 2004), probably because only human factors were examined. This case represents just one example where improved outcomes would be gained by a synergistic approach of analysing integrated human, livestock, and wildlife data sets that are linked with accurate temporal, and geographic locators, along with other generic data sets.

CURRENT ARRANGEMENTS

AWHN

The Australian Wildlife Health Network (AWHN - The Network) was established under the Commonwealth Government Department of Agriculture, Fisheries and Forestry (DAFF) to provide nationally coordinated wildlife health information management and communication.

The vision of the AWHN is to facilitate collaborative links across Australia in the investigation and management of wildlife health to support Australia's trade, human health and biodiversity. It works in five key strategic areas of activity: surveillance; education and training; emergency animal disease preparedness and response; research, and; communications.

Core Activities of the AWHN include:

1. Coordinate a network of wildlife health expertise and resources (including administrative support)
2. Maintain and expand the functionality of a national database of wildlife health information (eWHIS) including access through a dedicated web site
3. Monitor and on occasions coordinate field surveys and/or investigations of disease incidents
4. Promote the development of regional and national wildlife health emergency preparedness and response strategies
5. Improve education and training in wildlife health

ARWH

The Australian Registry of Wildlife Health (ARWH - The Registry) is a diagnostic and resource centre that improves Australia's ability to detect and diagnose endemic, emerging and exotic diseases of wildlife that could have negative impacts on Australia's trade/economy, biodiversity, tourism and human health. The Registry was established by the Taronga Conservation Society Australia (TCSA) in 1985, and it is now a significant resource centre that allows us to better understand the health of Australian ecosystems. The Registry is regularly used by private, government and university based veterinarians, students and biologists for surveillance, research, and to improve animal care. As a diagnostic centre the Registry manages a higher wildlife caseload than all of the state and commonwealth veterinary laboratories combined (Ladds, 1995).

The Registry uses a data model and database that have been developed with the collaboration of the Canadian Cooperative Wildlife Health, and the NZ Wildlife Health Centre. This wildlife health information management system is the basis for wildlife health related disease surveillance, tracking, modelling, education, and research in Canada and New Zealand. The database systems have recently been enhanced for digital image archiving, retrieval, and communication (integrated with a global Digital Imaging Network -DINS). Additional funds are required to integrate the database with other applications and to make the data available nationally.

The Australian Wildlife Health Network and Australian Registry of Wildlife Health have been formed and enhanced to coordinate wildlife disease surveillance in Australia. These centres have been extremely busy and successful, and have attracted funds from stakeholders to undertake education, research and training activities. While core salary costs have been covered, a fundamental lack of infrastructure and ongoing resource commitments have prevented the required growth of these agencies to address the risks, lack of knowledge and national significance of the work. Global developments such as climate change, emerging disease threats and bioterrorism mean that it is timely to establish ongoing infrastructure to secure Australia's capability in wildlife health related biosecurity in the future.

GAPS & PROBLEMS

Historically, wildlife and invasive species health surveillance in Australia has fallen into gaps between agriculture, conservation and human health agencies. There is a disparate and poorly-defined nature of agency responsibility for wildlife and invasive species health. Thus, we lack an integrated policy approach, along with operational tools, and critical resources for nationally coordinated wildlife health surveillance, risk assessment, education, communication and research.

There is fragility in the current system that clearly needs strengthening. The current system of wildlife and invasive species biosecurity is disjointed and under-resourced. There is a clear need for critical mass to be established for the national good.

The current "stand alone" nature of wildlife and invasive species health increases our vulnerability to undetected and undiagnosed disease. There is a clear need to improve relationships, communication, and collaboration among wildlife health, human health, livestock health, plant health, aquatic health, and environment sectors.

The drivers for wildlife health are not state based, nor can they be represented exclusively by government or industry.

Thus, there is a need for a nationally integrated and sustainable approach to wildlife health disease research and surveillance.

Additional gaps and problems include:

- delays of between 1 and 15 years between disease detection and diagnosis in wildlife;
- lack of available tests for key wildlife diseases within Australia, and a difficult process to export samples;
- the long process to characterise emerging disease agents in wildlife (due to low prioritisation of wildlife samples);
- difficulty in obtaining agreement regarding roles and responsibilities related to wildlife and feral animal disease events, which impedes a rapid investigation and response;
- for biosecurity purposes it is essential that wildlife and feral animal disease syndromes and outbreaks are investigated with the view of establishing an aetiological agent, rather than just ruling out perceived pathogens of importance;
- the issue of who pays – need to consider a cost sharing agreement between states and commonwealth;
- low diagnostic flow and difficulties in getting materials processed in state laboratories as there is no-one to pay the bills for wildlife;
- personal ownership of data and intellectual property issues;
- standardisation of data (the Registry and Network databases are some of the very few databases to use the National Animal Health Information Standards);
- problems related to state and national agencies and legislative differences between states that can impact sample collection and analysis (need for permitting and prescriptive sample handling protocols);
- difficulty in involving ecologists and field veterinarians in the wildlife strategy;
- short-term funding makes it difficult to plan, and to recruit and retain quality staff, threatening sustainability;
- lack of agreed standard operating procedures for disease diagnosis, communication, and response;
- difficulty in recruiting multidisciplinary teams and obtaining funding for disease investigations in the absence of a cost-sharing agreement;
- difficulty in getting critical agencies to agree on wildlife disease intervention strategies and actions;
- lack of integration of wildlife and invasive species health with other critical data sets;
- lack of mapping, tracking and modelling tools;
- current lack of resources results in the promulgation of one report - the communication type needs to be tailored to the needs of each stakeholder group;

HOW WE BENCHMARK SUCCESS

Nationally integrated electronic data exchange programs.

Wildlife and invasive species health and disease information integrated into national policy, risk assessment frameworks, risk mitigation plans, and national disease control

Enhanced infrastructure for biosecurity and biodiversity related research.

Facilitate and leverage strategic investment in biosecurity related operations and research.

Provision of data/evidence to support Australia's disease free status.

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