Other 'non listed' diseases of particular interest and unusual mortalities in wildlife:

"Non-listed" diseases of particular interest

Free-ranging wildlife

- A syndrome referred to as "**Devil Facial Tumour Disease - DFTD**", which affects Tasmanian Devils (*Sarcophilus harrisii*) is currently being investigated in Tasmania. The disease has now been recorded over 65 per cent of the State and is almost certainly present in a larger area. It is estimated that there are now likely to be a third to about half the wild Devil numbers in the State compared to 10 years ago. Assessment for DFTD is hampered by a lack of understanding of the aetiology and thus a diagnostic test. A case definition has yet to be developed. Immunohistochemistry has shown that the most consistent tumour type is of neuroendocrine origin. Cytogenetics work has established the normal Tasmanian Devil karyotype and the chromosome rearrangements of the tumour. This has led to the hypothesis that DFTD may be directly passed from animal to animal by implantation of the cell line during fighting and biting. Further testing of this hypothesis is planned. The results of transmission electron microscopy of tumour tissue for the presence of virus particles have so far been negative. A tissue culture laboratory was established in July 2004 and cultures made of tumour cells. The role of environmental intoxicants in the aetiology of the condition has now been proposed and is under development. A captive insurance population is also being considered for mainland Australia.

- **Brushtail Possum** (*Trichosurus vulpecula*) NSW euthanased due to blindness and neurological dysfunction. **Chronic encephalitis of Brushtail Possums**. Cause unknown, but suspected to be a virus.

- **Spironucleosis** in **Australian king-parrot** (*Alisterus scapularis*) (n = 39).

- **Rainbow lorikeet***(Trichoglossus haematodus moluccanus*): inflammation in the skin with hyperkeratosis. Skin and feather follicle sections showed mites that were identified as being of the **Cnemidocoptidae** family. However, the mite does not fit any of the Cnemidocoptid species described for avians at this time and may be a new species.

- **Ringtail possum** (*Pseudocheirus peregrinus*): **poxvirus** (not speciated). Localized to one digital pad and mild.

- **White Bellied Sea-eagle** (*Haliaeetus leucogaster*) (n = 2) found dead NSW **dioxin intoxication** (a neurotoxin from the environment).

- **Australian Wood Ducks** (*Chenonetta jubatta*)(n = 75) found dead Tasmania. **Diazinon poisoning**.

- **Green Turtle** (*Chelonia mydas*) (n = 6) neurological disease due to the coccidial parasite *Caryospora cheloniae*. Epidemiology unknown.

- An unspeciated orbivirus is present in **Tammar Wallabies** (*Macropus eugenii*) in Australia. It is responsible for Tammar Wallaby sudden death syndrome.

- **Eastern Grey Kangaroo** (*Macropus giganteus*) and Red-necked Wallabies (*Macropus rufogriseus*) Pindima area NSW. Mass mortality (n > 40). Unidentifiable microscopic protozoan-like parasites observed in blood vessels of the brain and kidney and thought to be akin to an outbreak of **hematozoan** disease in this species of kangaroo in 1994 (n = 2). Unable to characterize the organisms.

- **Tawny frogmouth** (*Podargus strigoides*) – ***Angiostrongylus cantonensis*.** A parasitic disease affecting the central nervous system of wild tawny frog mouths emerged around Sydney (NSW) in early March 2004. The signs included: weakness, inability to perch or fly and eventual loss of the righting reflex. The disease is usually progressive and potentially fatal.

  The causative parasite was identified as *Angiostrongylus cantonensis* by worm recovery at necropsy and/or histological evidence in the brains and spinal cords of the affected birds. *Angiostrongylus cantonensis* is the lung

worm of wild rats which must develop into third stage larvae, mainly in slugs and snails, before they can become infectious. Upon ingestion of these intermediate hosts, the larvae have been shown to migrate to the birds's spinal cords and brains and cause the clinical disease described above. Hosts, other than the rat are considered as accidental hosts, and can only contract the disease by ingesting the third stage that form in the intermediate hosts. A*ngiostrongylus cantonensis* has also occurred in other wild life species including flying foxes, possums and macropods, as well as in domestic animals and humans.

Between December 2000 and May 2002, two cases of *A. cantonensis* were diagnosed in tawny frogmouths in the Sydney area by the Australian Registry of Wildlife Health at Taronga Zoo. Between March and June 2004, 13 /22 tawny frog mouths necropsied were positive for cerebrospinal angiostrongylosis identified mostly from the northern suburb areas of Cremorne, Mosman, Warringah, Lane Cove and as far North as Clareville This range of cases indicates an increase in the prevalence of *A. cantonensis* in tawny frogmouths in the wider Sydney area, and possibly represent a sentinel species for this parasite in other animals and humans.

In Australia, the occurrence of *A. cantonensis* in Queensland has been well known but the geographical shift into hosts in New South Wales appears to be on the increase. Risk factors that could influence the infection rate in tawny frogmouths for *A. cantonensis*, among others, may be the availability and ease of these nocturnal feeding birds finding and consuming infected slugs and snails.

Captive Australian native wildlife

- Endangered **Corroboree frogs** (*Pseudophryne corroborree*) from Endangered Species Breeding Program (n = 5). Opportunistic fungal and bacterial infections probably associated with water quality. No evidence of chytrid or other specifically known amphibian diseases.

- **Ophidian paramyxovirus** – OPMV. Presumptive diagnoses of OPMV based on clinical history and histological grounds have now been made in several collections in Queensland, New South Wales and South Australia. Attempts to isolate OPMV from three live cases were unsuccessful and OPMV like viruses were not seen on electron microscopy of selected tissues from the affected snakes. However, a panel of 25 sera from snakes in various collections in New South Wales was assembled and sent to VLA Weybridge UK where they were examined in two separate haemagglutination inhibition tests. One test used an avian paramyxovirus antigen and the other test an OPMV isolate. The results showed that 9 of 25 snakes were positive for antibodies to OPMV-1 and 7 of 25 to OPMV-7. Seven snakes were positive in both tests. Positive snakes originated from two separate collections in NSW where there have been clinical and pathological findings consistent with OPMV. The significance of individual titres and differences between species is not yet clear. This appears to be the first confirmation of Paramyxoviral infection in captive snakes in Australia. Another outbreak has now been confirmed in South Australia. Species involved include: Death Adders (*Acanthophis* sp.), Taipans (*Oxyuranus* sp.), Tiger (*Notechis scutatus*) and King Brown Snakes (*Pseudechis* sp.), some non-venomous pythons (*Morelia* sp.) and corn snakes (*Elaphe guttata*). The extent and significance of infection is unknown and a retrospective sero-survey is underway to determine host range and locations for OPMV affected animals in Australia. Results are due in early 2005.

Captive exotic wildlife

- **Psittacid Herpesvirus** in captive **Green-winged macaws** (*Ara chloroptera*), NSW, Australia.

  1) Diagnosis of internal papillomatous disease (IPD) in a captive, male Green-winged Macaw and ;
  2) Diagnosis of Psittacid Herpesvirus (PsHV1) in three captive, Green-winged Macaws (two confirmed positive, one suspect positive).

  IPD is associated with PsHV1 (the cause of Pacheco's Disease: there are four known genotypes 1 - 4). The male Green-winged Macaw, which had tested positive for IPD (above) was positive for PsHV1 Genotype 2 and the female with whom he had been paired for a number of years (and bred successfully) was positive for PsHV1 genotype 3.

  Genotype 2 is a complex group of viruses. The variant found in the male macaw has the potential to cause papillomas but has most commonly been found in birds as an incidental finding and is not typically associated with Pacheco's disease or mucosal papillomas.
  Genotype 3 is most commonly associated with mucosal papillomas, it can affect macaws without causing Pacheco's disease, but it is highly pathogenic for Amazon parrots (Amazona spp.; 31 species) and can cause Pacheco's disease in them as well as other species (including some Australian natives species overseas: Sulfur-crested Cockatoos (*Cacatua galerita*), Gang-gang cockatoos (*Callocephalon fimbriatum*),

Galahs (*Cacatua rosecapillus*), rosellas (*Platycercus* spp.), fig parrots (*Cyclopopsitta* spp.), Eclectus Parrot (*Eclectus roratus*) and Cockatiels (*Nymphicus hollandicus*)).

A third bird, a male offspring of the above pair, had a weak positive, that is the virus concentration in the sample was low. This may represent an infected bird, but there is a possibility of contamination and multiple genotypes were identified. Because multiple genotypes were present specific genotypes could not be determined without cloning the amplification products and sequencing each clone separately. This bird has been re-tested and results are pending.

Confirmation of the presence of PsHV1 in the Green-winged Macaws is of no great consequence in this species in that it will only cause IPD in a small percentage of cases and does not cause Pacheco's disease in this species. (Pacheco's disease has never been reported in Green-winged Macaws.)

However, should the virus be transmitted to other species it may cause Pacheco's disease. This is more likely in other Neotropical parrots such as Amazons, however Australian native parrots are susceptible (above). (The birds currently affected in this incident and other in contacts have never been housed with Australian native species.) Other than in this incident, Pacheco's disease and IPD have never been diagnosed at the institution involved and Pacheco's disease has never been reported in Australia.

Other unusual mortalities

- **Dinoflagellate intoxication** involving various species of wild teleost and elasmobranch fishes in the Arafura Sea and several surrounding estuaries near Maningrida, Northern Territory. Hundreds to thousands of animals affected. Histopathology on mixed species did not reveal any evidence for a significant infectious disease (n = 12). The bloom may have been precipitated by unseasonably cool water temperatures.

- Mortalities of **Threadfin Leather Jacket fish** (*Paramonacanthus filicauda*) reported over a two week period in late March involving up to an estimated two million animals washed up along the entire east coast of Fraser Island, Queensland. Concluded to have been the latest in a series of occasional natural events (virus isolation negative). (A similar incident was reported at the same time last year when four million animals washed up along the east coast of Fraser Island. Cause of death in this incident was unknown.)

Prominent management issues

- **Australian Wildlife Health Network update**

Background

The aim of the Australian Wildlife Health Network is to promote and facilitate collaborative links in the investigation and management of wildlife health in support of human and animal health, biodiversity and trade. Its vision is for a nationally integrated wildlife health system for Australia. The network is hosted by Taronga Zoo and New South Wales Agriculture (Elizabeth Macarthur Agricultural Institute, PMB 8, Camden, NSW 2570, Australia). It was launched in August 2002 and is funded from a grant from the Wildlife Exotic Disease Preparedness Program (Agriculture, Fisheries and Forestry – Australia). The network's core business is wildlife disease surveillance. It manages a database of wildlife disease surveillance information. It has 600 members from around the country and overseas. Members come from all walks of life.

The focus of year two of operations of the Network has been in identifying priorities (below), promoting these projects to providers and supporting the **National Animal Health Surveillance System working group.** This group has been set up by the Australian Department of Agriculture, Fisheries and Forestry in 2004 to review all animal surveillance activities in Australia and develop and implement a new national surveillance system, including wildlife.

Priorities

The Australian Wildlife Health Network has identified ten priorities for wildlife health work in Australia.

i. Research

1. Review existing models and mechanisms for research prioritisation and adapt optimal model for wildlife health.
2. A series of specific workshops to identify current level of knowledge, prioritise research questions and identify policy shortfalls for selected diseases that include wildlife as part of their ecology.
3. Specific projects exploring ecology, epidemiology and management of diseases of interest e.g. Avian influenza,.
4. Support a research Masters and QA program in wildlife pathology.

ii. Education and training

5. Support development and provision of a wildlife health communication and education package.
6. Encourage digitisation, web-enablement and dissemination of material contained within the Australian Registry of Wildlife Health.

iii. Capacity building

7. Support development of a real-time wildlife health surveillance system, which includes the ability to detect emerging diseases. **This has been identified as the highest priority**.
8. Develop a mechanism for emerging and emergency wildlife disease management: "How do we notify? How do we respond"?
9. Support a feasibility study examining development of a National Wildlife Research Centre.
10. Support development and implementation of a management strategy and succession plan for the Australian parasitology catalogue and database and the National Insect collection.

A major milestone review of Network activities commenced in 2004. Results of this review will drive the new business case for continued operations for 2005 – 2008. The Network now produces a quarterly newsletter presenting Australian wildlife health surveillance data and discussion wildlife health issues (available from awhn@zoo.nsw.gov.au).

- **Australian Bat Lyssavirus group formed**

The Network has facilitated the development of an Australian Bat Lyssavirus/ rabies focus group. This group will act as a focus for identifying areas for research and further work, as well as acting as a link and catalyst to improve collaboration, communication and coordination of Australian Bat Lyssavirus and rabies issues for the region.

- **Australian Biosecurity (Cooperative Research Centre) CRC update**

The Australian Biosecurity CRC is now operational. Is has been awarded $17.8 million in Commonwealth funding. The aim of the Australian Biosecurity CRC is to develop new capabilities to monitor, assess, predict and respond to emerging infectious disease threats which impact on national and regional biosecurity. The CRC's research programme focuses on developing new technology and knowledge platforms for disease detection and surveillance. Research outcomes will include devices to detect pathogens on-site and new platform technologies to enhance the speed, sensitivity and specificity of laboratory and on-site tests. A key focus area for the CRC is in wildlife diseases under the program "Ecology of Disease". This program has now been broadened from a focus on wildlife reservoirs to Ecology of Disease in recognition of complex host ecology of novel emerging infectious diseases and the need to look at both wildlife reservoirs and 'spill-over' hosts to determine the risk factors for transmission.

The key objectives of the Ecology of Disease Program are to:

(1) develop methodologies that identify the natural history of disease, risk factors for transmission and strategically important points in the ecology of disease for prioritized emerging infectious disease threats, and
(2) determine the susceptibility of livestock and fauna to these emerging infectious disease threats.

- **New Australasian Invasive Animal Cooperative Research Centre**

A new Australasian invasive animal CRC has been awarded approximately $90M in Commonwealth funding and will go operational in July 2005. The CRC will focus on solving invasive animal pest problems through the development of commercial outputs and a business partnership that brings together national and international skills in science, management, commerce and industry. Outcomes will help solve the prominent and costly impacts of invasive species on agricultural, environmental and social values. Many outcomes have implications for improved management of diseases with wildlife as part of their ecology. However, Outcome 7 specifically relates to wildlife disease management and is to "Reduce risk of disease transfer from invasive animals to livestock and humans." Outputs include:

1) Management recommendations for endemic and exotic diseases of invasive animals (uptake 2011). The milestones are:

- Current information relating to invasive animal diseases (exotic and endemic) collated, published and disseminated, and potential risks to Australasia assessed. (June 2006)
- Recommendations developed for improved practices to reduce impact of endemic disease infections carried by invasive animals. (June 2009)
- "Quick-knockdown" (e.g. cyanide) baits registered for disease surveillance and containment in key invasive animals. (December 2009)
- Recommendations for disease management in invasive animals incorporated in appropriate training packages and disease management plans e.g. AUVETPLAN. (June 2011)

2) Remote vaccine delivery systems (RVDS), such as species-targeted baits and feeders. The milestones are:

- Existing vaccine technology, in relation to invasive animal diseases of economic importance to Australia and international partners, and market potential of remote vaccinations assessed. (June 2006)
- Economic and feasibility analysis of developing new or improved invasive animal disease vaccines conducted. (June 2007)
- RVDS registered and commercialised for multiple vaccines/species, and governments assisted in their appropriate use. (June 2010)

The new CRC should significantly improve Australia's ability to manage endemic and exotic disease in wildlife.

Serological surveys/ disease investigations and surveys

- **Bat disease research and surveys:** Surveillance of flying foxes (*Pteropus* spp.) and associated research focused on henipaviruses in 2004., and the repeated outbreaks of Nipah virus-associated encephalitis in humans in Bangladesh underline our still-limited understanding of the ecology of these agents, and the need to maintain surveillance and research efforts.

  Current henipavirus surveillance is concentrated in northern Australia in two projects – an international collaboration funded by the US National Institutes of Health Risk factors for the emergence of henipaviruses (project officer Raina Plowright, University of California, Davis) and the Australian Biosecurity CRC funded Assessment of the risk of introduction of Nipah virus to Australia by flying foxes (project officer Andrew Breed, University of Queensland). The former incorporates disease and landscape ecology data to develop and test alternative models for the maintenance of Hendra virus infection in flying foxes, and thus predictive models for spillover events. This study follows preliminary modelling (Field, 2005) that suggests infection may not be endemic in all flying fox populations continuously, but rather maintain in a dynamic spatial and temporal mosaic in sub-populations within the greater metapopulation. The second project incorporates serologic, virologic, genetic and satellite telemetry studies to quantify contact between flying foxes pre- and post-border, and thus assess the risk of introduction of Nipah virus to Australia by flying foxes. Preliminary satellite telemetry shows seasonal movement of black flying foxes between Cape York and New Guinea.

  Surveillance to monitor flying foxes for novel and zoonotic viruses, including Nipah, Hendra and Australian bat lyssavirus, is carried out throughout the year in the Kimberley region. Surveillance involves opportunistic sampling of flying foxes under the care of wildlife carers and clinical cases submitted from the Western Australian Department of Land Management. There is no evidence to suggest Nipah virus is present in north-western Australia.

- **Marine mammal disease research:** The main development in marine mammal disease work in 2003 has been agreement on the need for development of a marine mammal stranding network. This network is now being set up

under the auspices of the Commonwealth Department of Environment and Heritage. It aims to improve understanding and management of marine mammal strandings in Australia. This is of significance in that it will provide an operational framework for disease surveillance work identified as important by the wildlife community. Disease of interest for Australia include: 1) sea louse arbovirus and arboviruses in Southern elephant seals (*Mirounga leonine*), Leopard Seals (*Hydrurga leptonyx*), Weddell Seals (*Leptonychotes weddelli*); 2) *Brucella* sp. serology in marine mammals from the Australian coastline (*B. abortus* and *B. melitensis*); 3) tuberculosis monitoring in seals from Tasmania and other Southern states.; 4) toxoplasma serology in Dugong (*Dugon dugon*) and other marine mammals; 5) leptospirosis.

- Ongoing introduced and native animal **surveillance in Northern Australia** and offshore islands for foot and mouth disease and screwworm fly (clincial signs), classical swine fever, porcine reproductive and respiratory syndrome, surra (*Trypanosoma evansi*), Japanese encephalitis virus, Nipah virus, Aujesky's disease West Nile virus, avian influenza, infectious bursal disease and Newcastle disease. Target animals include feral pigs (*Sus scrofa*), Swamp Buffalo (*Bubalus bubalis*), wild cattle (*Bos taurus*), Brown Boobies (*Sula leucogaster*) and Rusa deer (*Cervus timoriensis*). Australian surveillance in 2004 detected Japanese encephalitis on Badu Island and, for the first time since 1998, on the mainland. The sentinel herd at Bamaga sero-converted and virus was isolated. Later in the year feral pigs sampled from south of Mapoon showed a pattern of serology consistent with exposure to JE virus, but the time of exposure is undetermined.

- On-going **general surveillance by the Australian Wildlife Health Network:** A system of State and Territory co-ordinators captures and reports wildlife disease events and information primarily to support the National Animal Health Information System, but also to support human health and biodiversity agencies. Co-ordinators report quarterly by teleconference, or on an "as needs" basis: a model based on that used by the Communicable Diseases Network of Australia. Data submission is by standard pro forma. Information is moderated and entered on a purpose built database (WHIS, the Wildlife Health Information System). Reports are generated quarterly for Animal Health Surveillance Quarterly, Wildlife Diseases Association, National Enteric Pathogen Surveillance Scheme, the World Conservation Union Species Survival Commission Veterinary Specialists Group and the AWHN. Reports are produced yearly for the Office International des Epizooties and Animal Health in Australia.

  Six disease categories form the basis for reporting and include: 1) OIE list diseases; 2) bat viral diseases; 3) mass, or unusual mortality events; 4) Salmonella cases; 5) Arbovirus cases; 6) diseases State/ Territory co-ordinators think are interesting or unusual.

Relevant publications 2004

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