

Importation of flamingos into A Class Zoo's in Australia

Technical Issues Paper

December 1999

**Australian Quarantine and Inspection Service
GPO Box 858
ACT, Australia, 2601**

Table of Contents

<i>Abbreviations and acronyms</i>	<i>ii</i>
1. Introduction	1
1.1. Purpose and Scope.....	1
1.2. Stakeholders.....	1
1.2.1. Zoo syndicate	1
1.2.2. Commercial poultry industry.....	2
1.2.3. Aviculture industry.....	2
1.2.4. Wild birds/Water birds/ Pet birds /Environmental effects	2
1.3. History of policy development	2
1.4. Legislative requirements.....	3
1.5. Factors in the establishment of disease	3
1.5.1. Country factors	3
1.6. Flamingo management issues	4
1.7. Notes on scientific data	4
2. Hazard Identification	5
2.1. Criteria for Hazard Identification.....	5
3. Review of Diseases of Quarantine Concern	8
3.1. OIE list A Diseases	8
3.1.1. Highly Pathogenic Avian Influenza.....	8
3.1.2. Newcastle disease.....	9
3.2. OIE List B diseases.....	9
3.2.1. Venezuelan equine encephalomyelitis	9
3.2.2. Japanese Encephalitis	10
3.2.3. Avian Mycobacteriosis	10
3.2.4. Fowl Typhoid (<i>Salmonella Gallinarum</i>)	12
3.2.5. Antibiotic resistant <i>Mycoplasma</i> spp	12
3.2.6. Psittacosis (<i>Chlamydia psittaci</i>)	13
3.2.7. <i>Salmonella Pullorum</i>	13
3.3. FAO List C diseases.....	14
3.3.1. Avian Salmonellosis (other than fowl typhoid or Pullorum disease).....	14
3.4. Other diseases of quarantine concern.....	15
3.4.1. Other Avian paramyxoviruses.....	15
3.4.2. St Louis Encephalitis	16
West Nile Virus	17
References	18

Abbreviations and acronyms

ABARE	Australian Bureau of Agriculture and Resource Economics
AIV	Avian influenza virus
ALV	Avian leucosis virus
ALVJ	Avian leucosis virus strain J
APMV 1	Avian Paramyxovirus Type 1
APMV 3	Avian Paramyxovirus Type 3
AQIS	Australian Quarantine and Inspection Service
AI	Avian influenza
FAO	Food and Agriculture Organisation
IB	Infectious bronchitis
IBD	Infectious bursal disease
IBDV	Infectious bursal disease virus
ND	Newcastle disease
NDV	Newcastle disease virus
OIE	Office International Des Epizooties
SHS	Swollen head syndrome
TRT	Turkey rhinotracheitis
TRTV	Turkey rhinotracheitis virus
vvIBD	Very virulent infectious bursal disease
WTO	World Trade Organisation

1. Introduction

The issues paper “Quarantine Issues Associated with Importation of Live Flamingos” introduces the Import Risk Analysis (IRA) of the import of flamingos from overseas countries. The general issues pertaining to the introduction of exotic diseases in live flamingos are raised in this paper as guidance for the review.

The introduction of an exotic pathogen in imported flamingos has the potential to impact on all avian species in Australia, and may also have far reaching effects on the environment. There is also potential for impact on human health.

Australia is a member of the World Trade Organisation and is obliged to uphold the principles of facilitation of trade. All decisions made by Australia which have the effect of limiting trade access can only be based on disease and scientific grounds. The processes of scientific evaluation and decision making must be transparent, enable participation from stakeholders and the public, and be clearly recorded. These process and decisions are subject to scrutiny from national and international sources.

1.1. Purpose and Scope

This Issues paper is intended to identify those diseases which are of potential quarantine concern in relation to the importation of flamingos, or hatching eggs of flamingos, from any country to Australia. To this end, it reviews the unmitigated risks associated with the import. No attempt has been made to quantify the risk associated with the importation. Neither has there been any attempt to develop, or take into account the effects of, risk management measures. The identification of any disease as a potential hazard does not mean the risk can not be managed, nor that importation should not occur.

The Risk Analysis Panel will further consider diseases identified in the issues paper as posing a potential risk, and their findings will be reported in the draft Import Risk Assessment, which is expected to be completed by February 2000. Possible risk management measures and their effect on the overall risk of introduction of exotic disease will be included in the draft IRA.

1.2. Stakeholders

The stakeholders include industries of high economic value, encompassing both domestic and export trade. Whilst the traditional avian industries are mostly directed at the Australian market, export value is increasing. Maintenance of a specified disease-free status protects the Australian industry and provides a competitive edge for exports. In addition, the Australian environment must be considered.

1.2.1. Zoo syndicate

Members of the Australasian Regional Association of Zoological Parks and Aquaria (ARAZPA), the peak industry body representing zoos and aquaria, have requested that conditions be developed for the importation of a number of high profile exotic birds. The Australasian Species Management Program (ASMP) and its Exotic Bird Taxon Advisory Group (TAG) identified the greater flamingo (*Phoenicopterus ruber roseus* or *Phoenicopterus ruber ruber*) as a key species of bird to be represented in Australian zoos. The display of flamingos would meet the aims and objectives of ARAZPA of cultural enhancement, conservation and education.

There are only 5 remaining flamingos in Australia. ASMP intends to maintain the species through initial importation and a breeding program.

1.2.2. Commercial poultry industry

Flamingos are susceptible to a number of exotic pathogens, which are also transmissible to commercial poultry. The introduction of such exotic avian pathogens with imported flamingos would have a major impact on the commercial poultry industry. In particular, the poultry industry has concerns about the major OIE List A and List B diseases such as highly pathogenic avian influenza, Newcastle disease (ND) and very virulent and variant forms of infectious bursal disease. The poultry industry also regards some FAO list C diseases, and other diseases that are not listed in the OIE classification, with some concern. Recent advice from the commercial poultry industry is that food poisoning organisms such as *Salmonella* Typhimurium and *S. Enteritidis* are assuming greater importance.

The combined egg and poultry meat industries are worth in excess of A\$1,000 million.¹ In addition, industries such as the ostrich, duck and turkey growers, while of smaller size than the mainstream poultry market, could be adversely affected. Harvest of avian wildlife for gourmet foods for local consumption and export - mutton-birds and possibly Cape Barron Geese - are very small industries but with important local socioeconomic value.

1.2.3. Aviculture industry

The aviculture industry in Australia covers a wide spectrum of the population, from individuals with a single pet bird, to commercial enterprises worth millions of dollars. A recent Bureau of Statistics report on pet ownership in Australia reported that 3 out of 5 households in Australia have one or more birds as pets. The Avicultural Federation of Australia, the peak body for the industry, claims to represent 10,000 bird keepers.

1.2.4. Wild birds/Water birds/ Pet birds /Environmental effects

The economic value of wild birds, water birds and pet birds is difficult to measure. However, in addition to its responsibility to the commercial industries, AQIS has a responsibility towards the protection of these birds, and the environment. The potential effects of an outbreak of exotic disease in our avian population are difficult to estimate. Despite the difficulties associated with estimating the value of wild birds in economic terms, the conservation value of the Australian avian fauna is extremely high.

1.3. History of policy development

In 1949, Australia banned imports of all birds and avian genetic material, from all countries except New Zealand (NZ). This ban was extended to include NZ in 1972. As a result of concerns at the level of bird smuggling which was occurring, and the potential for introduction of exotic avian disease through this pathway, conditions for the legal import of live birds from Category 1 and Category 2 countries were finalised in 1989. It was hoped that the incentive to smuggle birds would be reduced by the existence of a legal import option. Import of live birds under these protocols commenced in 1990.

A routine review of the live bird importation program was initiated in 1992, and completed in 1993. The review raised some concerns that the importation of live birds other than pigeons presented an unacceptable risk of introduction of particular exotic diseases of birds and BRS was commissioned to undertake a review of relevant literature in 1994. The concerns raised by the review were further highlighted by reports of exotic disease in legally imported macaws.²

In light of incomplete knowledge on diseases of live birds, and with a lack of definitive methods for testing imported birds for the presence of these diseases, AQIS suspended importation of live birds, other than

pigeons in 1995. Veterinary respondents and the Bureau of Resource Sciences generally supported the decision.

1.4. Legislative requirements

Imports of live birds or hatching eggs are subject to the *Quarantine Act* 1908, Quarantine Regulations and Quarantine Proclamation 1998. Prospective importers will also need to comply with Other Commonwealth legislation, including the *Wildlife Protection (Regulation of Exports and Imports) Act* 1982. The present import risk analysis will not address issues related to the *Wildlife Protection Act*.

1.5. Factors in the establishment of disease

In order for a disease to become established in Australia as a result of the importation of live flamingos into A class zoos in Australia the following chain of events must occur:

- The disease agent must be present in the exporting country
- The disease agent must be present in the zone from where birds are to be exported
- The disease agent must infect at least one of the flamingos for export
- The infected flamingos must not be detected by routine surveillance and testing in pre-export quarantine
- The disease agent must survive in the infected bird during transport to Australia, without causing illness or death, either of which should result in detection of the disease agent
- The infected flamingos must not be detected by surveillance and testing during post-arrival quarantine
- The infected flamingos must shed disease agent
- A susceptible bird or other susceptible animal in Australia must come in contact with an infective dose of the disease agent, and become infected
- The infection must be capable of being passed on to other birds in Australia.

1.5.1. Country factors

1.5.1.1. Exporting country factors

Exporting country factors which have the greatest potential effect on the likelihood of introduction of exotic diseases to Australia are:

- the avian health status of the country in question;
- the policy of the country on control of avian diseases; and
- the reliability of the veterinary services available in that country.

In particular, the prevalence of the individual diseases of concern in the avian population in the exporting country generally, and among zoo birds, and the level of surveillance for avian diseases which occurs are highly relevant.

For some of the diseases of concern, there is no readily available, sensitive and specific test which can be used to accurately identify individual infected birds, nor to verify the prevalence of the disease of concern in the exporting country, or in Australia.

1.5.1.2. Importing country factors

The major importing country factor is the degree of control which can be exercised over the flamingos after arrival in Australia. In order for a disease to become established here as a result of importation of flamingos, susceptible Australian birds must be exposed, either directly or indirectly, to the imported flamingos. The fact that the imported flamingos are not permitted to be removed from "A" class zoos provides some assurance that exposure will not occur. However, the housing of imported flamingos in open aviaries for display/breeding purposes allows the possibility of direct contact with wild birds, even within the "A" Class Zoo facility. Sparrows and other small birds are often found in and around displays in

zoos, and these could serve as the indirect link between flamingos in zoos and commercial poultry. Further work may be necessary to review the security arrangement at “A” Class Zoos, in order to more accurately determine the actual risk of exposure to susceptible birds in Australia.

1.6. Flamingo management issues

Discussion with experts in flamingo husbandry at the Wildfowl and Wetlands Trust (Slimbridge UK) revealed that there may be significant animal welfare concerns associated with the transport of flamingos over long distances. These problems arise from:

- the susceptibility of flamingos to capture myopathy; and
- the chance of damage to legs and necks due to struggling against the slings in which flamingos are commonly transported.

These problems lead to the staff at Slimbridge suggesting that alternatives to the importation of live birds by air transport should be considered. The alternatives canvassed have significant implications for quarantine, and are raised here to allow a full consideration of the proposals.

It was suggested that, in addition to importation by air, AQIS should consider:

- importation of hatching eggs; or
- importation of live birds, by sea.

The importation of hatching eggs has advantages from a quarantine point of view. However, the reproductive physiology of the birds is such that handling in the immediate pre-nesting period, as is likely to be required for serological testing of parent birds, is likely to result in cessation of nesting for that breeding season. The ability to collect eggs that can be certified as being produced by parent birds free of diseases of concern is therefore possibly limited. There are also difficulties associated with hand rearing of flamingo chicks. There has been little success with hand rearing, although some workers in the United States of America are reported to have successfully raised flamingos from the egg.

The importation of live birds by sea was suggested as being probably the most appropriate flamingo management option. Practical details such as the nature of the container in which the birds are transported, the route taken by the vessel, and the ability to have samples taken and analysed while the birds are in transit, are still to be resolved.

Of greater relevance to the quarantine risk is the fact that the birds are only to be imported for display in “A” Class zoos. This fact provides some degree of on-going control over the imported birds, and helps to limit the likelihood of imported birds being exposed directly to Australian poultry. However, the fact that zoos display species in as natural surroundings as possible means that it is probable that imported flamingos will be exposed to wild waterbirds, which are attracted to the ponds on which the flamingos are housed. The fact that the birds are to be kept at a zoo does not remove the risk of indirect exposure to susceptible Australian birds.

1.7. Notes on scientific data

The scientific information contained in this issues paper has been derived from a number of sources including peer-reviewed journals, unpublished reports and personal communication with experts in the field. Scientific data on a number of diseases relevant to the importation of flamingos is very limited, because systematic research to isolate pathogens in live or dead birds of this species has rarely been carried out.

2. Hazard Identification

2.1. Criteria for Hazard Identification

In identifying the disease agents of potential quarantine concern in the importation of flamingos, diseases of poultry reported in the FAO-OIE-WHO Animal Health Yearbook as List A, List B and List C diseases, along with a number of other diseases of poultry exotic to Australia, were considered.

OIE List A diseases are defined as “communicable diseases which have the potential for very serious and rapid spread, irrespective of national borders, which are of serious socio-economic or public health consequence and which are of major importance in the international trade of livestock and livestock products”.

OIE List B diseases are “communicable diseases which are considered to be of socio-economic and/or public health importance within countries and which are significant in the international trade of livestock and livestock products”.

OIE List C diseases are “communicable diseases with important socio-economic and/or sanitary influence at the local level”.

Other diseases previously raised by the Australian Poultry Industry Association as being of concern are:
 Turkey rhinotracheitis
 Infectious bronchitis
 Chicken anaemia agent
Bordetella spp.

In addition to the diseases named above, a range of other significant disease agents that have the potential to infect or act as vectors in transmitting diseases to avian species as well as other animal populations in Australia has been identified.

OIE List A, B and C diseases of poultry, plus those unlisted diseases or vectors which have been identified as being of potential quarantine concern, are listed in Table 1 along with information on the potential of the disease to infect flamingos, and its status in Australia. Of the disease agents detailed in Table 1, AQIS intends to exclude from further consideration, those which are endemic in Australia, and those which are not likely to be present in flamingos.

Table 1: Diseases which are potential hazards

Disease	Disease affects flamingos?	Australian status	Identified as a potential hazard?
OIE List A diseases			
Highly pathogenic avian influenza	Yes	exotic	Yes
Newcastle disease	Yes	Exotic	Yes

Disease	Disease affects flamingos?	Australian status	Identified as a potential hazard?
OIE List B diseases			
Equine encephalomyelitis	Yes	exotic	Yes
Japanese encephalitis	?	Reported in Torres Strait islands and at Mitchell River in 1998	Yes
Avian infectious bronchitis	?	endemic	No
Avian infectious laryngotracheitis	?	endemic	No
Avian tuberculosis	Yes	eradicated from commercial poultry, but presents a serious human health concern	Yes
Duck virus hepatitis	No	exotic	No
Duck virus enteritis (duck plague)	No	exotic	No
Fowl cholera	?	endemic	No
Fowl pox	?	endemic	No
Fowl typhoid (<i>Salmonella Gallinarum</i>)	Yes	exotic	Yes
Infectious bursal disease	No	very virulent form exotic to Australia	No
Marek's disease	?	Classical Marek's disease endemic, very virulent strains may not be present.	No
Mycoplasmosis	?	Endemic, but antibiotic resistant strains occur overseas	Yes
Psittacosis/Chlamydiosis	Yes	endemic, but presents a serious human health concern	Yes
Pullorum disease (<i>Salmonella Pullorum</i>)	Yes	eradicated from commercial birds, probably rare otherwise	Yes
FAO List C diseases			
Infectious coryza	?	endemic	No
Avian encephalomyelitis	?	endemic	No

Disease	Disease affects flamingos?	Australian status	Identified as a potential hazard?
Avian spirochaetosis	?	endemic	No
Avian salmonellosis (excluding fowl typhoid and Pullorum disease, and <i>S. Enteritidis</i>)	Yes	endemic	Yes
Avian leukosis	No	endemic	No
Other diseases of concern			
Turkey rhinotracheitis	No	exotic	No
Chicken anaemia agent	No	endemic	No
<i>Bordetella</i>	No	endemic	No
Avian paramyxovirus serotype3	Yes	exotic	Yes
St. Louis Encephalitis	Yes	exotic	Yes
West Nile Virus	Yes	exotic	Yes
<i>Aspergillus fumigatus</i>	Yes	endemic	No
<i>Cladosporium herbarum</i>	Yes	endemic	No
<i>Geotrichum candidum</i>	Yes	endemic	No
Tapeworm	Yes	endemic	No
Nematode (<i>Tetramere</i> Spp)	Yes ?	endemic	No
<i>Pseudomonas</i> Spp	Yes ?	endemic	No
<i>Actinobacillus</i> Spp	Yes ?	endemic	No
Haemoparasites Plasmodium Haemoproteus Leucocytozoon	Yes ?	<i>endemic</i>	No

From the information provided in Table 1, it can be seen that a number of diseases might be introduced into Australia with imported flamingos. The diseases that may be introduced into Australia that are of Quarantine concern are listed below:

Highly pathogenic avian influenza
Newcastle disease
Equine encephalomyelitis
Japanese encephalitis
Avian tuberculosis (*Mycobacterium* spp)
Fowl typhoid (*Salmonella Gallinarum*)
Antibiotic resistant *Mycoplasma* spp
Psittacosis/Chlamydiosis
Salmonella Pullorum
Avian *Salmonellosis*
Salmonella Enteritidis phage type 4 *et al*
Salmonella Typhimurium DT104

Other avian Paramyxoviruses
 St Louis Encephalitis
 Venezuelan encephalitis

3. Review of Diseases of Quarantine Concern

3.1. OIE list A Diseases

3.1.1. Highly Pathogenic Avian Influenza

3.1.1.1. *Description*

Avian influenza virus (AIV) is a member of the Orthomyxoviridae family. The influenza viruses can be further sub-divided into two groups, designated A and B. Closely related influenza viruses have been isolated from birds, humans, pigs, horses, mink, seals and whales. Influenza viruses have a high rate of genetic recombination, so that antigenic shift is common. Influenza viruses are categorised into subtypes based on the antigens of the haemagglutinin and neuraminidase projections on their surfaces. All highly pathogenic avian influenza subtypes are found in the H5 and H7 subtypes. An outbreak of a zoonotic form of avian influenza, caused by an H5N1 subtype occurred in Hong Kong in 1997.

Influenza viruses have a high rate of genetic recombination, so that antigenic drift is common.³ Highly pathogenic avian influenza is distributed widely throughout the world, although due to the application of a strict stamping out policy, Australia remains free. There have been five outbreaks of virulent disease in Australia: in 1976 in Melbourne, 1985 and 1992 near Bendigo, 1994 at Lowood in Queensland and in 1997 at Tamworth in NSW. In none of these outbreaks was the source of infection definitely identified, although there was generally a history of association with wild ducks or access to water that had been frequented by wild ducks.

3.1.1.2. *Transmission of the disease agent and its potential to be present in flamingos*

AIV is distributed around the world by migration of many avian species. Within Australia, spread is likely by bird movements, although maybe not by migratory pathways. In the Australian outbreaks, the source of virulent virus has not been positively determined. However, avirulent H7N7 was isolated from ducks from the farm opposite the layers in 1976, and in the other cases, affected birds had access to water that had been frequented by wild ducks.

Infected birds shed the virus in respiratory secretions, conjunctival secretions and faeces. Transmission through direct contact and indirect transmission through vectors is possible. Contaminated eggshells can distribute the agent, although vertical transmission through embryonated eggs is not known to occur. Once established in domestic poultry, the disease is highly contagious. The most important means of spread of AI virus from farm to farm is mechanical, by movement of people, utensils, feed trucks or other fomites.

Studies conducted by Arenas and co-workers⁴ have shown that a high percentage (43 percent) of flamingos can be infected with avian influenza virus.

3.1.1.3. *Conclusions.*

Avian influenza is a threat to Australia's wild birds, the aviculture and poultry industries, and potentially to the Australian environment. The virus could be introduced and become established as a result of uncontrolled importation of flamingos.

3.1.2. Newcastle disease.

3.1.2.1. *Description*

Newcastle disease virus is an avian paramyxovirus (APMV1), with a very broad host spectrum including most species of domestic poultry, psittacines, wild birds, and water birds including flamingos and pet birds. Historically, isolates of NDV have been divided into lentogenic, mesogenic and velogenic groups on the basis of their virulence. More recently, viruses have been classified as being of high or low virulence, on the basis of the intra-cerebral pathogenicity index (ICPI) and/or the presence or absence of particular molecular sequences associated with virulence at the cleavage site of the F protein.

Pathogenic strains of the virus are found virtually worldwide, with the exception of Australia, New Zealand and various islands of Oceania. Low virulence strains are endemic in Australia, but more virulent strains are routinely “stamped out”. Virulent Newcastle disease has occurred in Australia on five occasions - in Melbourne, in 1930 and 1932⁵ and more recently after an absence of nearly 60 years, virulent NDV derived by mutation from a local endemic low pathogenic strain, was responsible for disease outbreaks in NSW at Dean Park in 1998, and at Mangrove Mountain and Schofields in 1999.

3.1.2.2. *Transmission of the disease agent and its potential to be present in flamingos*

Mechanical vectors such as wind, insects, equipment and humans readily spread the virus. Virus enters the host mainly through the respiratory or gastrointestinal tract. The most common carriers include pigeons, free ranging wild birds, waterbirds and members of the family *Psittaciformes*. The wild birds and water birds can carry the virus without showing clinical signs of disease and infect susceptible species of birds. Kaleta and Marschall⁶ showed that NDV isolated from flamingos that died due to ND, could be experimentally transmitted to day old chickens, where it produced clinical and pathological lesions similar to that caused by the virulent viscerotropic ND. The result of this study clearly shows that flamingos can be infected with APMV1, and may serve as a means of introduction of the virus.

3.1.2.3. *Conclusions*

Newcastle disease is a threat to Australia’s poultry industries, aviculture, wild birds, and waterbirds and potentially to the Australian environment. The virus could be introduced and become established as a result of uncontrolled importation of flamingos.

3.2. *OIE List B diseases*

3.2.1. Venezuelan equine encephalomyelitis

3.2.1.1. *Description*

Venezuelan equine encephalomyelitis (VEE) is caused by an arbovirus belonging to genus Alphavirus of the family *Togaviridae*. VEE can infect a wide variety of birds belonging to several genera and species and many mammalian animals, notably horses. The virus has also been isolated from blood and tissues of emus.⁷ This disease has high public health significance because of its ability to infect humans, sometimes resulting in severe disease and death.

3.2.1.2. *Transmission of the disease agent and its potential to be present in flamingos*

Culex and *Aedes* mosquitoes are effective vectors in transmitting the infection to susceptible species. Antibody to the virus was detected from two of nine moribund flamingos in Mexico.⁸ Since many wild birds that carry the virus may not necessarily show any overt signs of clinical disease, a similar situation

could occur with flamingos. The foregoing data strongly indicates that the virus may be present in flamingos imported from countries where the disease is endemic.

3.2.1.3. *Conclusions*

The significance of VEE to the Australian poultry and other avian populations is not clear. However, VEE is a significant threat to humans, because the disease can cause high morbidity and mortality. The virus could be introduced and become established as a result of uncontrolled importation of flamingos.

3.2.2. Japanese Encephalitis

3.2.2.1. *Description*

Japanese encephalitis is a mosquito borne viral disease of humans and animals caused by a member of the *Flavivirus* genus of the family *Togaviridae*.⁹ Many species of water birds, free flying birds, poultry and pigs act as reservoir and amplifying hosts.⁹ The disease can cause encephalitis and some times death in humans, horses and pigs. Japanese encephalitis infection occurs in most countries of Asia such as Korea, China, Thailand, Indonesia, Cambodia and Vietnam. The disease has been reported in humans and animals in the Torres Strait Islands of Australia¹⁰ and more recently in the Cape York peninsula in Northern Australia.¹¹ Many species of mosquitos especially *Culex annulirostris*, *C. vishnui*, *C. tritaeniorhynchus* and *C. gelidus* can act as vectors in transmitting the virus from reservoir hosts to other susceptible animals.

3.2.2.2. *Transmission of the disease agent and its potential to be present in flamingos*

Many species of birds including water birds such as waterfowl and ducks carry the virus without showing any signs of illness.¹² In addition pigs and other mammals can carry the virus with or without showing clinical signs. Since serological surveys and virus isolation studies have not been carried out in flamingos, the susceptibility to infection cannot be ruled out unless experimental studies are conducted. Flamingos are susceptible to many pathogens infecting other avian species and hence it should be concluded that it is possible that the disease may be present in and transmitted by flamingos.

3.2.2.3. *Conclusion*

Japanese encephalitis is a zoonotic disease with a potential to be introduced and become established as a result of uncontrolled importation of flamingos.

3.2.3. Avian Mycobacteriosis

3.2.3.1. *Description*

A number of species of mycobacteria have been implicated as causative agents of disease in birds. *Mycobacterium avium* is the commonest cause of tuberculosis in most avian species, notably chickens, turkeys, captive wild birds, pet birds, ducks, geese, swans, peacocks, pigeons, water birds (including flamingos) and wild birds. *M avium* infection has also been reported in Australian birds such as little penguin, black duck, cassowary and little eagle.^{13, 14}

Waterfowl appear to be highly susceptible while flamingos have very low susceptibility. Studies at Slimbridge shows that over a third of adult waterfowl die from avian tuberculosis compared to 2.4 percent of deaths in flamingos.¹⁵ Nevertheless avian tuberculosis is an important problem in all captive exotic birds. *M. avium* is classified in to 20 serovars of which serovars 1, 2, 3 and 8 primarily cause disease in avian species. *M. avium* serovar 1, predominantly causes disease in birds and immunocompromised humans while *M. avium* serovar 2, causes disease in chickens. *M avium* serovar 4 to 20 are primarily human pathogens. There are several *M avium* isolates that cannot be assigned to any of the 20 serovars.

Generally in chickens signs may vary from asymptomatic infection to severe emaciation due to atrophy of muscles, especially the pectoral muscle. Post mortem examination usually reveals tubercular nodules in many organs, especially in spleen, liver and the intestinal tract. The distribution of lesions can vary widely in birds but may depend on the stage of infection and the species affected. Psittacine and passerine birds tend to show a diffuse granulomatous reaction.

There are several reports of *M. avium* infection in flamingos held in captive conditions in zoos.¹⁵ There are also reports of deaths in free ranging flamingos. Death of flamingos that inhabit Lake Nakuru in Kenya has been reported.¹⁶ More recently, there have been reports of deaths in a large number of free ranging flamingos (30,000) during a period of 6 months in 1993-1994 along the Rift Valley in Kenya.¹⁷ Necropsy examination of infected birds revealed nodular caseous lesions particularly the lung, pericardium, intestine, and liver. The organs affected differed from bird to bird. However, nodular caseous lesions were a consistent feature.

M. genavense, which is the causative agent of a wasting illness in human patients with AIDS¹⁸, has been implicated in causing disease in a number of birds, including 7 members of the order Psittaciformes.¹⁹ In the study, 27 birds of various orders, all kept in the Antwerp Zoo, were reported as showing non-specific gross necropsy findings, but all were smear positive for acid fast bacilli. In most birds, the intestinal mucosa was generally heavily infiltrated, indicating an intestinal origin of the infection. Most birds had an extensive invasion of the lungs. In some of these cases, birds died without prior signs of illness, while others showed emaciation prior to death. Culture of the organisms took at least 6 months, and required special culture media.

M. genavense has also been reported to cause mycobacteriosis in budgerigars, and an orange winged amazon, as well as in other non-psittacine birds. Gross lesions in these birds included severe muscular wasting, hepatomegaly, and thickening of the wall of the small intestine. Microscopic lesions included granulomas in the lung (1 case) and in the sub-cutis (1 case).²⁰ In a study of pet birds reported in 1997, *M. genavense* was found to be the causative agent of mycobacteriosis in 19 of 24 birds.²¹

M. tuberculosis has also been recorded as a cause of mycobacteriosis in birds. Psittacine birds which have been reported to be infected with *M. tuberculosis* include a yellow-naped Amazon parrot,²² an unidentified parrot,²³ and 2 unidentified pet birds.²⁴

3.2.3.2. *Transmission of the disease agent and its potential to be present in flamingos*
Avian tuberculosis caused by *M. avium* is transmitted via the alimentary tract, following ingestion of material contaminated with faeces of infected birds or other animals. Tubercle bacilli are stable in the environment and may survive for long periods (up to 4 years in a fowl –yard).²⁵

The source of *M. genavense* in nature and the epidemiology of the disease in birds remain obscure. However, an oral route of infection has been suggested. Direct bird-to-bird transmission in zoo birds was considered unlikely, and contaminated local water supplies may have been the source of infection for birds in Antwerp Zoo.¹⁹ Hoop *et al*²⁰ consider an environmental source of contamination to be likely for *M. genavense*.

Flamingos held in captive conditions, as well as free ranging flamingos, are susceptible to avian tuberculosis. Infected flamingos as well as other infected bird species excrete the virus in faeces as well as through the respiratory route. The excreted bacteria persist in muddy soil for prolonged periods of time and act as a source of infection to susceptible birds. The susceptibility to infection of flamingos is increased due to the

stress of being held in captive conditions. Susceptible flamingos acquire the infection by ingestion or inhalation of the bacilli. The bacilli are present in most organs, especially, the lung, pericardium, intestine and liver.

3.2.3.3. *Conclusion*

Although avian tuberculosis is present in Australia, the zoonotic potential of the disease warrants further consideration. There is the potential for the agent to be introduced into Australia as a result of the uncontrolled importation of psittacine birds.

3.2.4. Fowl Typhoid (*Salmonella Gallinarum*)

3.2.4.1. *Description*

Fowl typhoid is an acute or chronic infection of chickens caused by infection with *Salmonella enterica* serovar Gallinarum. Many species of poultry including turkeys, ducks, guinea fowl, quail, grouse, and pheasants are susceptible to infection. Fowl typhoid has a worldwide distribution, but has been diagnosed in Australia only in Victoria and Tasmania - in turkeys in Victoria and in both fowls and turkeys in Tasmania. The disease was last seen in Tasmania in 1940. The Victorian outbreak was in 1952.

3.2.4.2. *Transmission of the disease agent and its potential to be present in flamingos*

Salmonella Gallinarum can be transmitted from hen to progeny through eggs by vertical transmission and between birds, horizontal transmission occurs by ingestion of contaminated faeces or fomites. No data are available about *Salmonella Gallinarum* infection of flamingos. Since *Salmonella Gallinarum* infection has been reported in most avian species, it should be assumed that flamingos are susceptible to infection unless contrary evidence is presented.

3.2.4.3. *Conclusions*

Fowl typhoid is a significant threat to Australia's poultry industry. It has to be assumed that flamingos are susceptible and that the agent could be introduced with imported flamingos. The disease could become established following introduction of the agent.

3.2.5. Antibiotic resistant *Mycoplasma spp*

3.2.5.1. *Description*

Unlike bacteria, Mycoplasmas are devoid of cell wall and are contained within a cell membrane. There are several species of avian mycoplasmas that infect many species of poultry and other birds, notable among them being: *M. gallisepticum*, *M. synoviae* of chickens, *M. meleagridis* of turkeys, *M. imitans* of ducks, geese and partridge, *M. anseris* and *M. cloacale* of geese,²⁶ *M. columbinasale*, *M. columbium*, *M. columborale* of pigeons.^{27, 28} Many species of mycoplasmas are yet to be isolated and this is in part due to the lack of development of adequate isolation media and /or diagnostic tests. Mycoplasmas are significant in relation to the importation of flamingos, because captive birds such as flamingos kept in the zoos are very likely to suffer from stress and may acquire the infection even though these organisms have not yet been reported from this species of birds. In addition, the sporadic reports of isolation of drug resistant mycoplasmas coupled with the finding that these organisms can interfere with vaccination programs of chickens (Newcastle disease-Infectious bronchitis vaccine) need consideration.

3.2.5.2. *Transmission of the disease agent and its potential to be present in flamingos*

Mycoplasmas are transmitted by the horizontal and vertical routes. Mycoplasmas are ubiquitous and occur worldwide in avians and other animals. It is possible that flamingos might have mycoplasma infection without showing any apparent signs of disease.

3.2.5.3. Conclusion

It is possible that the uncontrolled importation of flamingos could lead to the introduction and establishment of drug resistant mycoplasmas. Presence of drug resistant mycoplasma strains in Australia could have a detrimental effect on the export of poultry and poultry products (including ostriches).

3.2.6. Psittacosis (*Chlamydia psittaci*)

3.2.6.1. Description

The disease is caused by *Chlamydia psittaci*. There are a number of strains, which commonly affect birds, but also cause significant zoonotic disease. There are no characteristic clinical signs in birds, but conjunctivitis or keratoconjunctivitis with swollen eyelids and discharge are common. These signs may be accompanied by systemic disease, with ruffled feathers, severe depression and diarrhoea. Mortality rates vary from nil to 90%, depending on the virulence of the strain and the age of the birds. Young birds are more severely affected than adults.²⁹ The spectrum of disease produced in birds by infection with *Chlamydia psittaci* ranges from inapparent infection, through chronic upper respiratory infection to acute and rapidly fatal systemic disease.³⁰

The infection is worldwide, and is endemic in Australia. McElnea and Cross³¹ reported on a cross sectional study to determine the occurrence of *Chlamydia psittaci* in domesticated and wild birds. They found that there was significant infection with *C. psittaci* in racing pigeon lofts, private aviaries and pet shops in NSW and the ACT. They were unable to detect *C. psittaci* in samples taken from ducks, geese, wild waterfowl, or wild psittacine birds, although *Chlamydia* have been previously reported in Australian commercial duck flocks.³²

However, tetracycline resistant strains of *Chlamydia psittaci* have been reported overseas, including in the UK.^{33, 34} These strains are not known to occur in Australia. Tetracycline resistant strains are of concern, since the major control measures for the disease rely on the use of tetracyclines.

3.2.6.2. Transmission of the disease agent and its potential to be present in flamingos

Infection takes place by the inhalation of airborne chlamydia. Organisms are shed in enormous numbers in the faeces of diseased birds, and dust contaminated with faeces is heavily infected. Chlamydia are shed in discharges from the respiratory tract and eyes. Egg transmission has been shown to occur in chickens and ducks, and the organism has been found in the eggs of some species of wild birds.

Chlamydial infections commonly persist for long periods of time, irrespective of whether the original infection was subclinical, or caused disease. Chronic infections are mostly latent, but can flare up and lead to disease or shedding of the organism if the birds are subject to stress.²⁹

3.2.6.3. Conclusion

There is a risk of introduction of tetracycline resistant chlamydia with uncontrolled importation of flamingos. Occupational health and safety concerns also require consideration.

3.2.7. *Salmonella Pullorum*

3.2.7.1. Description

Salmonella Pullorum is the causative agent of pullorum disease primarily in chickens and turkeys. The disease has also been reported in many other avian species including ducks, guinea fowl, pheasant, and quail.³⁵ Infection of chicks and poults usually results in bacteraemia with localisation in visceral organs such as the reproductive tract including the ovary, lung, heart, gizzard, and caecum. Infection of adult hens may produce carrier hens which can perpetuate the infection by vertical transmission to the progeny as well as

horizontal transmission to non infected birds in the pen. Pullorum disease has been eliminated from commercial poultry flocks in Australia and there has been no reported isolation of *Salmonella* Pullorum at least during the last 5 years.

Salmonella Pullorum infection has not been reported in flamingos, either because the disease does not exist or because disease in these birds has not been investigated fully.

3.2.7.2. *Transmission of the disease agent and its potential to be present in flamingos*

Since there is no information about this disease in flamingos it should be assumed that the disease is transmitted in a manner similar to other avian species (vertical and horizontal transmission). The bacteria are widely disseminated in most organs of the body, especially the ovary and the reproductive tract. Transmission of infection during hatching, from infected to non-infected birds and from carrier birds to non-infected birds has been well documented in other species of birds and a similar situation can occur with flamingos.

3.2.7.3. *Conclusions*

Salmonella Pullorum is an important poultry pathogen that has been eradicated from Australia by accreditation programs, and the agent has not been isolated in the poultry population during the last 5 years. Pullorum disease is a significant threat to the Australian poultry industry and to a lesser extent on other species of birds. The bacteria could be introduced and become established as a result of the uncontrolled importation of flamingos.

3.3. FAO List C diseases

3.3.1. Avian Salmonellosis (other than fowl typhoid or Pullorum disease)

Salmonella is a gram negative rod shaped bacteria harboured in the digestive tract of reptiles, birds and mammals. Even though there are more than 2200 serotypes of *Salmonella* only a few serotypes cause serious disease in man, avian species and other animals. Issues relating to the presence of *Salmonella* Enteritidis phage types 4, 8 and 13a, and *Salmonella* Typhimurium DT104 deserve careful consideration before the importation of flamingos. These will be discussed under their respective headings.

3.3.1.1. *Salmonella Enteritidis*

3.3.1.1.1. Description

Salmonella Enteritidis phage type 4 harboured in the digestive tract of poultry has been incriminated as a causative agent of severe food poisoning outbreaks in humans in several countries.³⁶ However, this bacterium has not been isolated from commercial poultry products in Australia (National Enteric Pathogens Surveillance Scheme). Most Australian States now have a disease freedom accreditation schemes for pullorum, fowl typhoid, and *S. Enteritidis*.

3.3.1.1.2. Transmission of the disease agent and its potential to be present in flamingos

Salmonella Enteritidis infection is transmitted among avian species by ingestion of contaminated faeces of infected avians or droppings of rodents or faecal spread from other infected species, including from humans via septic systems etc. *S* Enteritidis Phage type 4 is present in broilers and layers in most countries of the world including countries in Asia, Europe, Africa, Canada, South America and the USA.^{37,38,39} *S* Enteritidis is primarily associated with poultry products.⁴⁰ Presence of *S* Enteritidis in other species of birds has been widely reported.⁴¹ *S* Enteritidis has been isolated from flamingos.

3.3.1.1.3. Conclusion

Salmonella Enteritidis is a significant threat to the Australian poultry industry and human health. The bacteria could be introduced and become established as a result of the uncontrolled importation of flamingos.

3.3.1.2. *Salmonella* Typhimurium DT104

3.3.1.2.1. Description

Multiresistant *Salmonella* Typhimurium DT104 from food producing animals including avian species as well as humans in several countries has been widely reported in the scientific literature.⁴² It is well known in the scientific community that antibiotics such as ampicillin, chloramphenicol, streptomycin, sulphonamides, and tetracyclines, have become ineffective in treating infections caused by *S* Typhimurium phage type DT104.

3.3.1.2.2. Transmission of the disease agent and its potential to be present in flamingos

Infection occurs by ingestion of bacteria excreted in the faeces. There is one reported isolation of *S* Typhimurium in a flamingo but phage typing was not carried out.

3.3.1.2.3. Conclusion

Salmonella Typhimurium DT 104 is a significant threat to the Australian Poultry Industry as well as human health. The bacteria could be introduced and become established as a result of the uncontrolled importation of flamingos.

3.4. Other diseases of quarantine concern

3.4.1. Other Avian paramyxoviruses

3.4.1.1. Description

Avian paramyxoviruses are RNA viruses grouped within the family paramyxoviridae. Avian paramyxoviruses are classified into nine serotypes designated APMV-1 to APMV-9 based on serum neutralisation test using monoclonal antibodies directed to haemagglutinating and neuraminidase activity of the virion. Avian paramyxovirus 1 has been dealt with previously in this paper as the cause of Newcastle disease.

Avian paramyxoviruses of serotypes 2 – 9 have been isolated from a wide variety of captive cage birds, feral birds and domestic poultry. All serotypes other than APMV1 that have been isolated from feral birds have come from hunter killed or apparently healthy trapped birds, or birds found dead. There is no evidence to suggest that avian paramyxoviruses cause disease in wild birds.⁴³

APMV2 have been isolated from symptomless or dead caged birds, and have been shown to be a cause of egg production problems in turkeys and other poultry. They have been isolated from a range of birds including coots and mallard ducks, but isolation from flamingos has not been reported.

APMV 3 was first isolated in turkeys.⁴⁴ Subsequently the virus was recovered from several captive exotic birds belonging to psittacine and passerine species held in quarantine stations in Great Britain,⁴⁵ The Netherlands, Germany and Japan.⁴³ APMV 3 has also caused high mortalities in flamingos.⁴⁶ There have been no reports of natural infection of chickens with APMV3, but the virus can be associated with significant production losses in turkeys, and under experimental conditions, young chicks are highly susceptible and die following infection. APMV3 has also been associated with mortalities of Australian finches in quarantine in Hong Kong.

The clinical signs of the disease are not specific, but may include signs of respiratory disease and lethargy. Necropsy examination is characterised by severe haemorrhages under the skin, in the liver, pericardium, spleen, kidneys, and intestine, and by pulmonary oedema.

APMV 4, 7, 8, and 9 have not been shown to cause disease in birds under any conditions.

APMV 5 has been shown to cause up to 100% deaths in budgerigars, but has not been isolated from other species of birds.

APMV6 was associated with low but increased mortality in turkeys. However, no causal association was demonstrated and there were other pathogens present in the flock. This serotype of APMV has been isolated from ducks, geese, turkeys, but has not been isolated from flamingos. Serological evidence of infection has been found in ostriches in Australia, emus in NZ and in pacific black ducks.

From the above it appears that APMV3 is the only serotype (other than APMV1) which has been associated with serious disease, and which has been isolated from flamingos.

3.4.1.2. *Transmission of the disease agent and its potential to be present in flamingos*

Flamingos become infected either by inhalation or ingestion of the virus. The virus can be transmitted via infectious air borne droplets, contaminated equipment, insects, rodents and humans. Susceptible avian species of birds particularly members of the family psittacines and passerines that do not succumb to the disease can act as carriers and spread the virus far and wide. 26 of 43 flamingos held captive in a Zoological Garden in Jerusalem succumbed to APMV 3 infection.⁴⁶

3.4.1.3. *Conclusion*

APMV 3 has come in to prominence during the last few years. The significance of this disease is unclear. The virus could be introduced to Australia with imported flamingos.

3.4.2. **St Louis Encephalitis**

3.4.2.1. *Description*

St Louis encephalitis is caused by an arbovirus belonging to genus *Flavivirus* of the family *Flaviviridae*.⁴⁷ Antibodies to SLE virus has been detected in emus, chickens, pheasants and water birds of the genera *Ciconiiformes* and *Pelecaniformes*.⁷ Detection of antibodies in flamingos has also been reported by Aguirre and co-workers.⁸

3.4.2.2. *Transmission of the disease agent and its potential to be present in flamingos*

The disease is transmitted by mosquitoes of the *Culex* species notably *Culex nigripalpus* and *Culex tarsalis*. Water birds have been shown to be infected although there is no record of isolation of the virus from flamingos. The possibility of virus being present in flamingos cannot be ignored, if they were to be obtained from a region where the virus is endemic.

3.4.2.3. *Conclusions*

The significance of SLE to the Australian poultry and other avian populations is not clear. However, SLE is a significant threat to humans, because the disease can cause high morbidity and mortality. The virus could be introduced and become established as a result of the uncontrolled importation of flamingos.

3.4.5. West Nile Virus

3.4.5.1. *Description*

West Nile Virus (WNV) is a member of the *Flavivirus* genus of the family *Togaviridae*.⁴⁸ It has been reported to cause encephalitis and death of humans and animals. Most species of birds act as reservoir and amplifying hosts without showing any clinical signs of disease. The recent outbreak of WNV in New York⁴⁹ seems to suggest that some species of birds such as flamingos, crows, and pigeons are probably very susceptible to this disease with fatal outcome.

The virus which originated from Africa, has spread to many countries of the world^{50 51} with the possible exception of Canada, South America and Australia. Recently, the disease has been reported in the USA.⁴⁹

A virus closely related to the WNV, named Kunjin virus has been isolated in many states of Australia.⁵² The Kunjin virus occasionally cause mild encephalitis in humans with full recovery occurring after a few weeks.

3.4.5.2. *Transmission of the disease agent and its potential to be present in flamingos*

The disease agent can be transmitted from birds which generally act as amplifying hosts, though recent studies indicate that a few species of birds including flamingos are susceptible to infection⁴⁹ which may result in mortalities. Many species of mosquitos and ticks can transmit the virus from birds to susceptible mammalian hosts especially humans and horses. The transmission of the virus can only occur if the vector population exceeds the threshold value and this is dependent on climatic factors such as ambient temperature, rainfall, and migratory pattern of birds. The virus circulates in blood during the viraemic period and circumstantial evidence strongly suggests that the virus can persist in the brain and neural tissue for prolonged periods of time.

3.4.5.3. *Conclusion*

The virus could be introduced and become established as a result of the uncontrolled importation of flamingos.

References

1. Anon. AUSVETPLAN The Australian Veterinary Emergency Plan [Web Page] Located at: <http://www.brs.gov.au/brs/aphb/aha/ausvet.htm>. Accessed 1999 Jul 16.
2. Macwhirter P, Perry R . Introduction of exotic avian diseases through legal importation. *Australian Veterinary Journal* 1997;75:677-8.
3. Gerlach H. Viruses. In : Ritchie B, Harrison G J, Harrison LR, Editors. *Avian Medicine: principles and application*. Lake Worth Florida, Wingers Publishing Inc; 1994. p 862-948.
4. Arenas A, Carranza J, Perea A, Miranda A, et al. Type A influenza viruses in birds in southern Spain: serological survey by enzyme-linked immunosorbent assay and haemagglutination inhibition tests. *AVIAN PATHOLOGY* 1990;19(3):539-46.
5. Geering WA, Forman AJ, Nunn MJ. *Exotic diseases of animals*. Canberra: Australian Government Publishing Service; 1995.
6. Kaleta EF, Marschall HJ. Newcastle disease in a zoo affecting demoiselle cranes (*Anthropoides Virgo*), greater flamingos (*Phoenicopterus Ruber*) and a pied imperial pigeon (*Ducula Bicolor*). *AVIAN PATHOLOGY* 1981;10:395-401.
7. Day JF, Stark LM. Eastern equine encephalitis transmission to emus (*Dromaius novaehollandiae* in Volusia Country, Florida: 1992 through 1994. *Journal of the American Mosquito Control Association* 1996;12::429-36.
8. Aguirre AA, Cook RS, McLean RG, et al. Occurrence of potential pathogens in wild Caribbean flamingos (*Phoenicopterus ruber ruber*) during a lead poisoning die off in Yucatan, Mexico. *Journal of Zoo and Wildlife Medicine* 1991;22.
9. Rodhain F . Recent data on the epidemiology of Japanese encephalitis. *Bull Acad Natl Med* 1996;180 :1325-40.
10. Hanna JN, Ritchie SA, Phillips DA, Shield J() An outbreak of Japanese encephalitis in the Torres Strait A1. An outbreak of Japanese encephalitis in the Torres Strait, Australia, 1995. 1996.
11. Hanna JN, Ritchie SA, Phillips DA , Lee JM, et al. Japanese encephalitis in north Queensland, Australia, 1998. *Med J Aust* 1999;170:533-6.
12. Dhanda V, Banerjee K, Deshmukh PK, Ilkal MA . Experimental viraemia and transmission of Japanese encephalitis virus by mosquitoes in domestic ducks. *Indian Journal of Medical Research* 1977;66:881-8.
13. Reece R, Hartley WJ. The Pathology Registry and some interesting cases. In . *Wildlife Proceedings Post Graduate Committee in Veterinary Science, University of Sydney, Sydney, Australia*. 217-233; 1994. p 217-33.
14. Schultz DJ, Hough IJ, Boardman W. Special challenges of maintaining wild animals in captivity in Australia and New Zealand: prevention of infectious and parasitic diseases. *Rev. Sci. Tech.*

Off. Int. Epiz. , 1996;15:289-308.

15. Brown MJ, Pickering SPC. The mortality of captive flamingos at Slimbridge 1975-89. *Wildfowl* 1992;43:185-90.
16. Cooper JE, Karstad L. Tuberculosis in lesser flamingoes in Kenya. *J of Wildlife Dis* 1975;11:32-6.
17. Kock N. Disease epidemic in lesser Flamingos (*Phoeniconaias minor*) in Kenya. Joint Conference AAZV/ WDA /AAWV. 1995.
18. Kiehn T, Hoefler H, Bottger E, Ross R, Wong M, Edwards F, Antinoff N, Armstrong D. *Mycobacterium genavense* infections in pet animals. *Journal of Clinical Microbiology* 1996;34(7):1840-2.
19. Portaels F, Realini L, Bauwens L, Hirschel B, Meyers W, de Meurichy W. Mycobacteriosis caused by *Mycobacterium genavense* in birds kept in a zoo: 11 year survey. *Journal of Clinical Microbiology* 1996;34(2):319-23.
20. Hoop R, Bottger E, Ossent P, Salfinger M. Mycobacteriosis due to *mycobacterium genavense* in six pet birds. *Journal of Clinical Microbiology* 1993;31(4):990-3.
21. Holsboer-Buogo C, Bacciarini L, Robert N, Bodmer T, Nicolet J. Presence of *Mycobacterium genavense* in birds. *Schweizer Archiv Fur Tierheilkunde* 1997;139(9):397-402.
22. Woerpel R W, Roskopf WJ Jr. Retro-orbital *Mycobacterium tuberculosis* infection in a yellow-naped Amazon parrot (*Amazona ochrocephala auropalliata*). *Avian Exotic Practice* 1984;1(3):7-10.
23. Petrak M. A possible case of *Mycobacterium tuberculosis* in a parrot. AAV Proceedings. International Conference on Avian Medicine; 1984 Jun 20-1984 Jun 23; Toronto, Ontario, Canada Association of Avian Veterinarians; 1984. p 165-6.
24. Hoop R, Bottger E, Pfyffer G. Etiological agents of mycobacterioses in pet birds between 1986 and 1995. *Journal of Clinical Microbiology* 1996;34(4):991-2.
25. Hart L. Tuberculosis. In : Beveridge W, Hart L, Editors. *Animal health in Australia*> Volume 7. Viral, bacterial and fungal diseases of poultry. Canberra: Australian Government Publishing Service; 1985. p 11-5.
26. Stipkovits L, Varga Z, Dobos-Kovacs M, Santha M. Biochemical and serological examination of some mycoplasma strains of goose origin. *Acta Vet Hung* 1984;32:117-25.
27. Jordan FTW, Howse JN, Adams MP, Fatunmbi OO. The isolation of *Mycoplasma columbinum* and *M.columborale* from feral pigeons. *Veterinary Record* 1981;109:450.
28. Shimizu T, Erno H, Nagatomo H. Isolation and characterisation of *Mycoplasma columbinum* and *Mycoplasma columborale*, two new species from pigeons. *Int J Syst Bacteriol* 1978;28:538-46.
29. Beveridge W. Chlamydial Diseases. In : Beveridge W, Hart L, Editors. *Animal health in Australia*. Volume 7. Viral, bacterial and fungal diseases of poultry. Canberra: Australian Government

Publishing Service; 1985. p 11-5.

30. Phalen DN. Chlamydia psittaci infection in birds: a diagnostic dilemma. In: Cross G, Editor. Association of Avian Veterinarians Australian Committee Annual Conference Proceedings; 1998 Oct 8-1998 Oct 10; Canberra ACT Association of Avian Veterinarians Australian Committee; 1998.
31. McElnea CL, Cross GM. Methods of detection of *Chlamydia psittaci* in domesticated and wild birds. Australian Veterinary Journal 1999;77(8):516-21.
32. Arzey K, Arzey G, Reece RL. Chlamydiosis in commercial ducks. Australian Veterinary Journal 1990;67(9):333-4.
33. Henning K, Krauss H. Field studies on development of resistance to tetracycline in *Chlamydia psittaci*. Berliner Und Munchener Tierarztliche Wochenschrift 1986;99(11):381-2.
ORIGINAL TITLE: Felduntersuchung zur Frage einer Resistenzbildung von *Chlamydia psittaci* gegen Tetrazykline.
34. Johnson F, Spencer W. Multiantibiotic resistance in *Chlamydia psittaci* from ducks. VETERINARY RECORD 1983;112:208.
35. Snoeyenbos GH. Pullorum disease. In: Calnek B W, Barnes HJ, Beard CW, Reid WM, Yoder HW Jr, Editors. Diseases of Poultry. 9 ed. Ames Iowa USA: Iowa State University Press; 1991. p 87-99.
36. Rampling A, Upson R, Ward LR, et al. *Salmonella* Enteritidis phage type 4 infection of broiler chickens: a hazard to public health. Lancet 1989;2:436-8.
37. Binkin N, Scuderi G, Novaco F, et al. Egg related *Salmonella* enteritidis, Italy, 1991. *Epidemiol Infect* 1993;110:227-37.
38. Caffer MI, Eigner T. *Salmonella* enteritidis in Argentina. International Journal of Food Microbiology 1994;21:15-9.
39. Gast RK, Benson ST. The comparative virulence for chicks of *Salmonella* enteritidis Phage Type 4 isolates and isolates of Phage types commonly found in poultry in the United States. AVIAN DISEASES 1995;39:569-74.
40. Crerar SK, Nicholls TJ, Barton MD. Multiresistant *Salmonella* Typhimurium DT104-implications for animal industries and the veterinary profession. Australian Veterinary Journal 1999;77:170-1.
41. Kinde H, ead DH, in RP, et al. *Salmonella* Enteritidis, phage type 4 infection in a commercial layer flock in southern California: bacteriologic and epidemiologic findings. Avian Diseases 1996;40:665-71.
42. Boonmar S, Bangtrakulnonth A, Pornruangwong S, et al. Significant increase in antibiotic resistance of *Salmonella* isolates from human beings and chicken meat in Thailand. Veterinary Microbiology 1998;62.
43. Alexander DJ. Avian Paramyxoviridae: recent developments. Proc. First Congress of European

Society for Veterinary Virology; 1989; Liege, Belgium 1989.

44. Tumova B, Robinson JH, Easterday BC. A hitherto unreported paramyxovirus of turkeys. *Res Vet Sci* 1979;27:135-40.
45. Ashton GL, Alexander DJ. A two-year survey on the control of the importation of captive birds into Great Britain. *Veterinary Record* 1980;106:80-3.
46. Shihmanter E, Weisman Y, Lublin A, Mahani S, Panshin A, Lipkind M. Isolation of avian serotype 3 paramyxoviruses from imported caged birds in Israel. *Avian Diseases* 1998;42(4):829-31.
47. Calisher CH. Medically important arboviruses of the United States and Canada. *Clin Microbiol Rev* 1994;7:89-116.
48. Pierre V, Drouet MT, Deubel V. Identification of mosquito-borne Flavivirus sequences using universal primers and reverse transcription/polymerase chain reaction. *Res in Virol* 1994;145:93-104.
49. Anon. West Nile-Like-Virus-USA (New York City) . [E-mail to (Members of list Pro-Med), 1999].
50. Pitigoi D, Popa MI, Streinu-Cercel A. The Epidemiological process of West Nile viral infection. *Bacteriol Virusol Parazitol Epimediol* 1998;43:281-8.
51. Lundstrom JO. Mosquito-borne viruses in Western Europe: a review. *J Vector Ecol* 1999;24:1-39.
52. Lobigs M, Weir RC, Dalgarno L. Genetic analysis of Kunjin virus isolates using HaeIII and Taq I restriction digests of single-stranded cDNA to virion RNA. *Aust J Exp Biol Med Sci* 1986;64:185-96.