Australian Government

Department of Agriculture, Fisheries and Forestry

Importation of zoo perissodactyls from approved countries

Final policy review

April 2012

Cataloguing data
Department of Agriculture, Fisheries and Forestry (2012), *Importation of zoo perissodactyls from approved countries: final policy review*. Department of Agriculture, Fisheries and Forestry, Canberra.

Internet
Importation of zoo perissodactyls from approved countries: final policy review is available via daff.gov.au/biosecurity.

The pictures of the Przewalski's horses, rhinoceros, tapir and zebras on the front cover were kindly provided by the Zoo and Aquarium Association, the Perth Zoo, Jennifer Conaghan of Taronga Western Plains Zoo and the Taronga Zoo, respectively.

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Acronyms and abbreviations

AGID	agar gel immunodiffusion
AHS	African horse sickness
ALOP	appropriate level of protection
ARAZPA	Australasian Regional Association of Zoological Parks and Aquaria
BDV	Borna disease virus
BTV	Bluetongue virus
C-ELISA	competitive ELISA
CEM	contagious equine metritis
CFT	complement fixation test
Code	OIE Terrestrial Animal Health Code 2012
DAFF	Australian Government Department of Agriculture, Fisheries and Forestry
EAV	equine arteritis virus
EEE	Eastern equine encephalitis
EEV	equine encephalosis virus
EGA	equine granulocytic anaplasmosis
EHV	equid herpesvirus
EI(V)	equine influenza (virus)
EIA	equine infectious anaemia
ELISA	enzyme-linked immunosorbent assay
EPM	equine protozoal myeloencephalitis
EVA	equine viral arteritis
FMD	foot-and-mouth disease
Horse IRA	Import risk analysis report for horses from approved countries
IRA	Import risk analysis
JE	Japanese encephalitis
OIE	World Organisation for Animal Health (formerly known as the Office International des Epizooties)
OIE Manual	OIE Manual of Diagnostic Tests and Vaccines for Terrestrial Animals 2011
PAQ	post arrival quarantine
PCR	polymerase chain reaction
PEQ	pre-export quarantine

QAP	quarantine approved premise
RVF(V)	Rift Valley fever (virus)
SPS Agreement	WTO agreement on the Application of Sanitary and Phytosanitary Measures.
VEE	Venezuelan equine encephalitis
VS	vesicular stomatitis
WEE	Western equine encephalitis
WNF	West Nile fever
WNV	West Nile virus
WTO	World Trade Organization
ZAA	Zoo and Aquarium Association Australasia

Summary

This policy review considers the biosecurity risks for Australia associated with the importation of zoo perissodactyls. Perissodactyls are hoofed, odd-toed, relatively large mammals that include Przewalski's horses, zebras, tapirs and rhinoceroses. The last review of biosecurity measures for the importation of zoo perissodactyls into Australia was conducted in 2003.

Following the outbreak of equine influenza in Australia in August 2007, the Australian Government commissioned an inquiry into the outbreak. On 12 June 2008, the Australian Government announced that it had accepted all 38 recommendations of the Commission of Inquiry. The Government's response to recommendation 34 stated that Biosecurity Australia would conduct an import risk analysis for horses from approved countries. Because of the potential implications for imports of related species, the importation of zoo equids was suspended until the policy was reviewed taking into account the final report of the import risk analysis for horses from approved countries.

This policy review for zoo perissodactyls from approved countries was developed by the Department of Agriculture, Fisheries and Forestry (DAFF) with the assistance of technical and scientific experts. It provides an assessment of the risks of introduction and spread of potential disease agents associated with the importation of zoo perissodactyls from approved countries and, where appropriate, recommends biosecurity measures in accordance with Australia's risk-based approach to biosecurity.

Countries, administrative regions and territories from which Australia previously permitted the importation of zoo perissodactyls, are referred to in the policy review as approved countries. These are: Canada, certain member states of the European Union (Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, Sweden and the United Kingdom), New Zealand, Singapore and the United States.

This policy review recommends the biosecurity measures necessary to achieve Australia's appropriate level of protection (ALOP) for the importation of zoo perissodactyls from approved countries. The Department of Agriculture, Fisheries and Forestry has made a number of changes to the policy review following consideration of stakeholder comments on the draft policy review. These changes include:

- biosecurity measures for Johne's disease in tapirs have been removed, the duration of residency for rhinoceroses on premises free of Johne's disease has been reduced to 180 days and faecal culture has been added as a testing requirement
- editorial corrections and amendments for clarification have been incorporated

This policy review concludes that for zoo equids, risk management is warranted for the following diseases: African horse sickness, anthrax, dourine, equid herpesviruses 6 and 9, equine infectious anaemia, equine influenza, equine piroplasmosis, equine rhinopneumonitis (EHV-1), equine viral arteritis, glanders, Lyme disease, rabies, Rift Valley fever, surra, *Trypanosoma vivax*, Venezuelan equine encephalitis and vesicular stomatitis.

For non-equid perissodactyls, this policy review concludes that risk management is

warranted for the following diseases: anthrax, bovine tuberculosis, Lyme disease, rabies, Rift Valley fever, surra, *Trypanosoma vivax*, Venezuelan equine encephalitis and vesicular stomatitis. In addition, for rhinoceroses, risk management is also warranted for Johne's disease and for tapirs, risk management is also warranted for foot-and-mouth disease.

The biosecurity measures for the importation of zoo perissodactyls into Australia differ from previous biosecurity measures for several diseases. Diseases that did not previously require biosecurity measures are anthrax, equid herpesviruses 6 and 9, equine viral arteritis, foot-and-mouth disease, Johne's disease, Lyme disease and rabies. For epizootic lymphangitis, heartwater and West Nile fever it is determined that zoo perissodactyls do not play a significant role in the epidemiology of these diseases and therefore biosecurity measures are no longer required.

This policy review is also based on general risk management measures common to most current import policies for zoo animals, including:

- the animal/s must be resident in an approved, licensed or registered zoo or wildlife park in the exporting country since birth or for at least 12 months immediately before export, unless otherwise approved by DAFF; the residency requirement may be achieved in more than one approved country or holding institution if specifically authorised by DAFF and the conditions for each country of residence and holding institution must be met
- the premises of origin must be under veterinary supervision and have a health monitoring program
- the animal must be held in pre-export quarantine (PEQ) for at least 30 days, during which it is inspected at least daily for signs of disease, treated for internal and external parasites, and tested for diseases in accordance with recommendations arising from the policy review
- the animal must be transported to a quarantine approved premises (QAP) in Australia in a manner that ensures no direct exposure to Australian animals en route, and must undergo a period of post-arrival quarantine (PAQ) of at least 30 days
- the receiving institution must be approved under relevant Australian State or Territory legislation to hold the species being imported.

The Department of Agriculture, Fisheries and Forestry recognises that there might be new scientific information and technologies, or other combinations of measures that may provide an equivalent level of quarantine protection for the diseases identified as requiring risk management. Submissions supporting equivalence measures will be considered on a case-by-case basis.

1 Introduction

Background

Perissodactyls are hoofed, odd-toed, relatively large mammals that feed by browsing and grazing. Perissodactyls are subdivided into three families:

Equidae: seven species in one genus.

Rhinocerotidae: five species in four genera.

Tapiridae: four species in one genus.

Wild species of equids live in grasslands and desert scrublands. Zebras and wild asses are found in Africa. Przewalski's horses and wild asses (including the onager) are found in Asia. In this policy review, the terms 'zoo equids or equidae' refer to these wild species (when housed in zoos), as distinct from 'domestic horses'.

Rhinoceroses can be found in rainforests, grasslands and scrublands. Black and white rhinoceroses are found in Africa. Asian species include the Indian rhinoceros, the Javan rhinoceros and the Sumatran rhinoceros.

Tapirs mostly live near permanent bodies of water and in tropical forests. The exception is the mountain tapir, which lives in the Andes Mountains. Other species of tapirs are found in South America (Brazilian or Lowland tapir), Central America (Baird's tapir) and Asia (Malayan tapir).

Representative species from all families are currently held in Australian zoos. However, to boost declining breeding stock and introduce new genetic material for zoo breeding programs, captive management plans, global species management programs and species survival programs, future importation is desirable.

It is standard procedure for zoo perissodactyls to be housed individually or in small groups isolated from domestic animals, allowing the animals to be closely monitored by zoo staff. Generally, zoological institutions have well developed preventative health programs with well maintained, written health and husbandry records for each individual animal. In Australia, zoo perissodactyls do not enter the food chain and all zoo animal deaths are thoroughly investigated via post mortem examination and appropriate testing to reach a diagnosis.

Australia's previous biosecurity measures required risk management for zoo perissodactyls for the following diseases: African horse sickness, Borna disease, bovine tuberculosis, dourine, epizootic lymphangitis, equine ehrlichiosis (*Ehrlichia risticii, E. equi*), equine infectious anaemia, equine influenza, equine piroplasmosis, equine viral encephalitides, glanders, heartwater, horse pox, trypanosomosis (*Trypanosoma vivax*), Venezuelan equine encephalitis, vesicular stomatitis and West Nile fever. The last review of Australian biosecurity requirements for the importation of zoo perissodactyls was conducted in 2003 with minor amendments in 2004.

In this policy review, Australia's previous biosecurity measures for the zoo perissodactyls were reviewed by the Australian Government Department of Agriculture, Fisheries and Forestry (DAFF), with due regard to their appropriateness to achieve Australia's appropriate level of protection (ALOP).

Australia's biosecurity policy

Australia's biosecurity policies aim to protect Australia against risks that may arise from exotic diseases and pests entering, establishing and/or spreading, thereby threatening Australia's unique flora and fauna, as well as agricultural industries that are relatively free from serious diseases and pests.

The Department of Agriculture, Fisheries and Forestry is responsible for developing and reviewing biosecurity policy for the import of animals and their products. It does this through a science-based risk analysis process. At the completion of the process and following consideration of stakeholder comments, recommendations are made to Australia's Director of Animal and Plant Quarantine (the Secretary of DAFF), who is responsible for determining whether or not imports can be permitted under the *Quarantine Act 1908*, and if so, under what conditions. Live Animal Imports within DAFF is responsible for implementing the import protocol, including any risk management measures.

Australia's science-based risk analysis process is consistent with Australian Government policy and Australia's rights and obligations under the World Trade Organization (WTO) Agreement on the Application of Sanitary and Phytosanitary Measures (SPS Agreement).

Australia implements a risk-based approach to biosecurity management. This approach is expressed in terms of Australia's ALOP, which reflects community expectations through government policy and is currently aimed at reducing these risks to a very low level, but not to zero.

If the risks exceed Australia's ALOP, risk management measures are proposed to reduce the risks to an appropriate level. However, if it is not possible to reduce the risks to an appropriate level, then no trade will be allowed.

Scope

This policy review considers the biosecurity risks posed by disease agents associated with the importation into approved Australian zoos of equidae, tapiridae and rhinocerotidae from approved, licensed or registered zoos or wildlife parks in Canada, certain member states of the European Union (Austria, Belgium, Denmark, Finland, France, Germany, Greece, Republic of Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden, United Kingdom only), New Zealand, Singapore and the United States. These countries are hereafter referred to as approved countries.

Current import policy

Biosecurity measures for the importation of zoo perissodactyls to Australian zoos were finalised in 2003, with minor amendments in 2004. The conditions applied to government-registered zoos/wildlife parks in Canada, the United States, certain member states of the European Union, and Singapore. There are import conditions for rhinoceroses but not equids or tapirs, from New Zealand zoos.

Following the outbreak of equine influenza in Australia in August 2007, the Australian Government commissioned an inquiry into the outbreak. On 12 June 2008, the Australian Government announced that it had accepted all recommendations of the Commission of Inquiry and stated that Biosecurity Australia would conduct an import risk analysis for horses from approved countries (Biosecurity Australia 2010).

Because of potential implications for imports of related species, the importation of zoo equids was suspended until completion of the horse IRA and a specific review into zoo equids was conducted. The importation of other zoo perissodactyls was limited to case-by case approval by the Australian Government. This policy review has been undertaken to ensure that the import policy for zoo equids is consistent with the findings and recommendations in the horse IRA. As the importation of zoo equids was included in the zoo perissodactyl import policy, this review considers all three families.

Australian zoos and the Zoo and Aquarium Association Australasia (ZAA), formerly the Australasian Regional Association of Zoological Parks and Aquaria (ARAZPA), have requested access to several species of zoo perissodactyls to boost declining domestic stocks and introduce new genetic material in line with captive management plans, global species management programs and species survival programs.

References

Biosecurity Australia (2010) *Import risk analysis report for horses from approved countries: final report*. Biosecurity Australia, Canberra.

2 Method

Background

The World Organisation for Animal Health (OIE) in its Terrestrial Animal Health Code (OIE 2011), hereafter referred to as 'the Code', describes 'General Obligations related to Certification' in Chapter 5.1.

The Code states at Article 5.1.2 that:

> 'The import requirements included in the international veterinary certificate should assure that commodities introduced into the importing country comply with the OIE standards. Importing countries should restrict their requirements to those necessary to achieve the national appropriate level of protection. If these are stricter than the OIE standards, they should be based on an import risk analysis.'

Article 5.1.2 further states that:

> 'The international veterinary certificate should not include measures against pathogens or diseases which are not OIE listed, unless the importing country has demonstrated through import risk analysis, carried out in accordance with Section 2, that the pathogen or disease poses a significant risk to the importing country.'

The components of an import risk analysis (IRA), as described in Chapter 2.1 of the Code, are:

- hazard identification
- risk assessment (release assessment, exposure assessment, consequence assessment and risk estimation)
- risk management
- risk communication.

Hazard identification, risk assessment and risk management are sequential steps within an IRA and risk communication is conducted as an ongoing process, and includes both formal and informal consultation with stakeholders.

Risk review

Although not defined or described in the Code, risk review is recognised by risk analysts as an essential component of the risk analysis process (Barry 2007; Brett et al. 1989).

Australia applies a process of risk review to the biosecurity risks associated with the importation of an animal commodity (animal product or live animal) for which biosecurity measures have already been developed.

Risk review differs from *the monitoring and review* component of risk management, as described in the Code, in that each component of the IRA process (hazard identification, risk assessment and risk management) is reviewed under the risk review process. If a change (either increase or decrease) in the biosecurity risk associated with importation of a live animal or animal product that is presently imported into Australia is identified, risk management measures may be revised accordingly on the basis of relevant updated scientific information, including expert advice where available.

This policy review has drawn on the following sources of information (not exhaustive):

- *Import risk analysis report for horses from approved countries: Final Report* (Biosecurity Australia 2010).
- *Import risk analysis: Review of conditions for the importation of rhinoceros from South Africa* (ABPM 1999/49)
- *Review of Zoo Perissodactyl (including rhinoceros, tapirs, zebras, Przewalski's horses and other non-domesticated equida) Import Policies* (ABPM 2003/28).
- *Terrestrial Animal Health Code 2011* (OIE 2011).
- suspended requirements for the importation of zoo perissodactyls into Australia
- a review of the relevant scientific literature
- expert opinion coordinated through the Zoo and Aquarium Association Australasia

Review of hazard identification

Hazard identification is described in the Code (Article 2.1.2) as a classification step that is undertaken to identify potential hazards that may be associated with the importation of a commodity.

In accordance with the Code, a disease agent was considered to be a potential hazard relevant to the importation of zoo perissodactyls if it was assessed to be:

- appropriate to the species being imported
- present in the exporting country
- OIE-listed, emerging and/or capable of producing adverse consequences in Australia
- not present in Australia, or present in Australia and a notifiable disease, or subject to official control or eradication.

Where evidence for the inclusion or exclusion of a particular disease agent was equivocal, a judgement was based on the strength of the available evidence to implicate perissodactyls in disease transmission. See Figure 2.1.

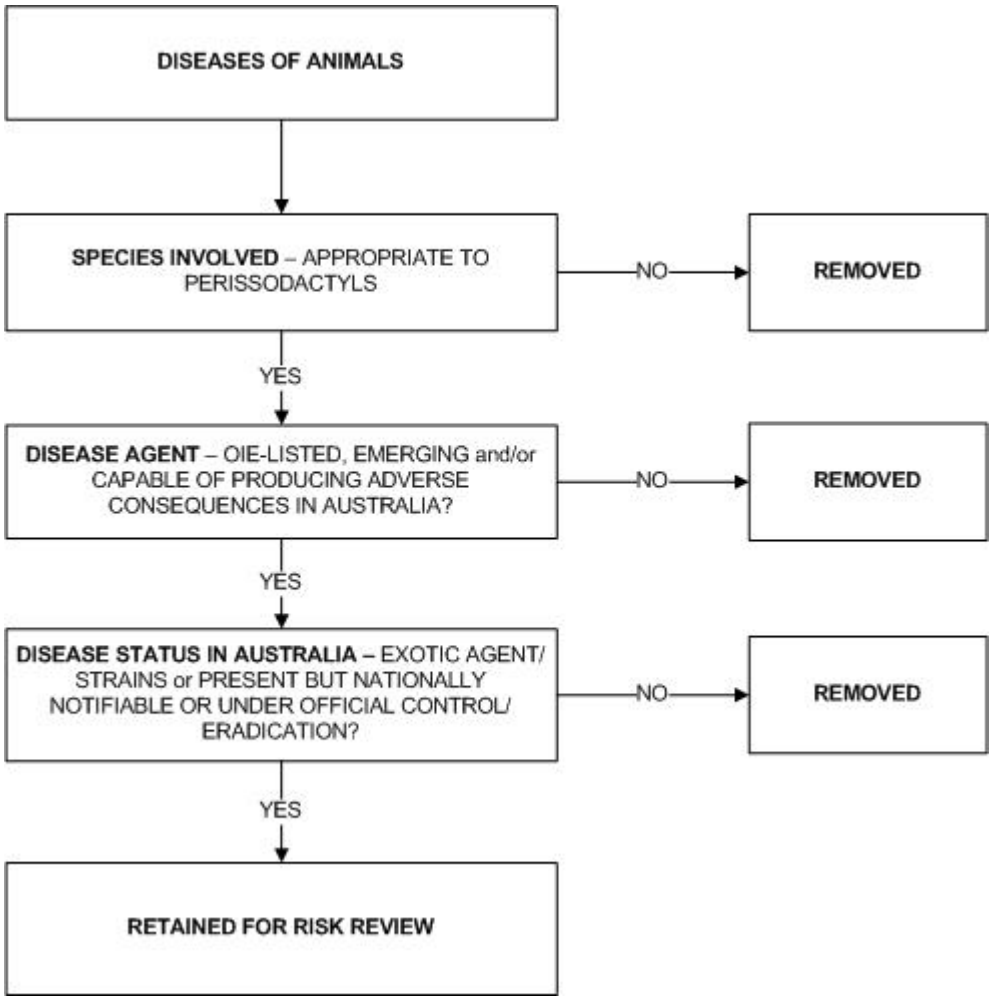

Figure 2.1 Decision tree for hazard identification and refinement

Review of risk assessment

Details of the risk assessment process relevant to live animals are provided in Chapter 2.1 of the Code.

A review of risk factors relevant to the release, exposure and consequence assessment of hazards identified for further review was conducted to identify any significant changes in disease agent attributes and/or geographic distribution that would be relevant to biosecurity considerations for Australia.

A literature review was conducted for each hazard retained for risk review. If definitive information on risk factors was not found through literature review or contact with relevant experts, any uncertainties were identified and documented.

Based on the information reviewed, a conclusion was made for each hazard regarding whether a significant change in biosecurity risk had occurred that was relevant to the importation of zoo perissodactyls into Australia. Any assumptions and/or judgements made in drawing conclusions were documented.

Review of risk management

The policy review focussed on determining whether risk management was warranted for each of the hazards identified with respect to the importation of zoo perissodactyls. If it was concluded that risk management was not warranted, then risk management was not proposed. Conversely, if it was concluded that risk management was warranted, current risk management measures were reviewed to determine if they were appropriate. If it was concluded that current risk management measures were not able to achieve Australia's ALOP, alternative and/or complementary risk management measures, which were considered to provide an appropriate risk management option, were proposed.

The current risk management measures were reviewed in the context of updated scientific information, including expert advice where available, as well as operational feasibility and practicality. For example, the adoption of advanced technologies for disease management and prevention (such as diagnostic techniques, vaccine manufacture) for certain hazards were considered appropriate for implementation not simply on the basis of technical efficacy to achieve Australia's ALOP, but also as measures that would be less resource intensive from an administrative perspective.

The policy review also incorporated long standing policy designed to manage the risks and animal welfare issues associated with the importation and handling of wild animal species. Those risk management measures include:

- the animal/s must be resident in an approved, licensed or registered zoo or wildlife park in the exporting country since birth or for at least 12 months immediately before export, unless otherwise approved by DAFF; the residency requirement may be achieved in more than one approved country or holding institution if specifically authorised by DAFF and the conditions for each country of residence and holding institution must be met
- the premises of origin must be under veterinary supervision and have a health monitoring program
- the animal must be held in pre-export quarantine (PEQ) for at least 30 days, during which it is inspected at least daily for signs of disease, treated for internal and external parasites, and tested for diseases in accordance with recommendations arising from the policy review
- the animal must be transported to a quarantine approved premises (QAP) in Australia in a manner that ensures no direct exposure to Australian animals en route, and must undergo a period of post-arrival quarantine (PAQ) of at least 30 days
- the receiving institution must be approved under relevant Australian State or Territory legislation to hold the species being imported.

Risk communication

Risk communication, as defined by the Code, is 'the interactive transmission and exchange of information and opinions throughout the risk analysis process concerning risk, risk-related factors and risk perceptions among risk assessors, risk managers, risk communicators, the general public and other interested parties.'

In conducting import risk analyses and policy reviews the Department of Agriculture, Fisheries and Forestry consults directly with the Department of Health and Ageing to enable input relevant to public health considerations to be included in the development of Australia's animal biosecurity policies. Furthermore, a formal process of consultation with external stakeholders is a standard procedure for all import risk analyses and policy reviews to enable stakeholder assessment and feedback on conclusions and recommendations regarding Australia's animal biosecurity policies.

References

Barry M (2007) *Effective approaches to risk assessment in social work: an international literature review*. Education Information and Analytical Services, Scottish Executive, Edinburgh.

Biosecurity Australia (2010) *Import risk analysis report for horses from approved countries: final report*. Biosecurity Australia, Canberra.

Brett SM, Rodricks JV, Chinchilli VM (1989) Review and update of leukemia risk potentially associated with occupational exposure to benzene. *Environmental Health Perspectives* 82: 267-281.

OIE (2011) Terrestrial Animal Health Code 2011. World Organisation for Animal Health (OIE). http://www.oie.int/en/international-standard-setting/terrestrial-code/access-online/ (Accessed 3 November 2011).

3 Hazard identification

The list of diseases (hazards) of potential biosecurity concern was compiled from:

- diseases listed by the OIE as an equine disease or multiple species disease affecting equids (OIE 2011)
- diseases identified in the *Import risk analysis for horses from approved countries*, as may affect other equids (Biosecurity Australia 2010)
- diseases identified in previous policy reviews and import conditions of zoo perissodactyls, conducted by DAFF
- other diseases identified as occurring in perissodactyls.

The method of hazard identification and refinement is described in Chapter 2. The preliminary list of disease agents/diseases is shown in Table 3.1. This table summarises the results of the hazard refinement process, including the reason for removal or retention of each identified hazard.

The list of hazards included parasitic infestations. Routine examination and treatment for external parasites, and treatment for internal parasites, are required before the international movement of horses (Ellis and Watkins 2004; IFHA 2002; IFHA 2008), dogs and cats (DEFRA 2007) and other animal species. Routine monitoring for external and internal parasites and treatment as appropriate are standard practice in zoos and for movement of zoo animals (A. Reiss, ZAA, pers. comm. December 2011). Accordingly, a risk review was not conducted for parasites where treatment occurs as routine standard practice as part of the importation process. Parasite resistance to treatments was not considered in the review.

There are many potential disease agents that are common commensals and may be present in Australia. There are others that are opportunistic, not reported to be pathogenic, or of uncertain relevance in perissodactyls due to limited or insufficient information. These agents were considered when compiling the list of potential hazards.

The diseases retained after hazard identification and refinement in Table 3.1 are listed at the end of this chapter.

Table 3.1 Hazard identification and refinement

Disease (disease agent)	Susceptible species	OIE-listed disease	Adverse effects in Australia	Occurrence in Australia	Present in approved countries	Reasons for removal/retention
Viruses						
African horse sickness	All equids, rarely other species	Yes	Yes	No	No	Retained: OIE-listed
Aujeszky's disease (suid herpesvirus1)	Pigs, ruminants, cats, dogs, rats and occasionally horses	Yes	Yes	No	Yes	Retained: OIE-listed, not present in Australia
Bluetongue disease	Ruminants, serological evidence in rhinoceroses	Yes	Yes	Yes 10 out of 24 serotypes	Yes	Retained: OIE-listed, strains not present in Australia
Borna disease	Horses, cats, dogs, cattle, sheep, New World camelids, humans, rabbits and ostriches.	No	Yes	No	Yes	Retained: not present in Australia
Equine encephalomyelitis (Eastern)	Birds, equids, humans, pigs, tapirs, and other animals	Yes	Yes	No	Yes	Retained: OIE-listed, not present in Australia
Equine encephalomyelitis (Western)	Birds, equids, humans, and other animals including non-equid perissodactyls	Yes	Yes	No	Yes	Retained: OIE-listed, not present in Australia
Equid herpesvirus 2, 3, 5-9	Equids	No	Yes	Yes some viruses	Yes	Retained: some viruses not present in Australia (considered with equine rhinopneumonitis, EHV-1,4)
Equine adenovirus 1 and 2	Horses	No	Yes	Yes	Yes	Removed: present in Australia
Equine coronavirus	Horses	No	Yes	Yes	Yes	Removed: present in Australia
Equine encephalosis	Equids	No	Yes	No	No	Removed: not OIE listed, not reported in approved countries
Equine enterovirus	Horses	No	No[1]	Not reported	Yes	Removed: not likely to produce adverse effects; possible worldwide occurrence
Equine infectious anaemia	Equids	Yes	Yes	Yes in limited areas	Yes	Retained: OIE-listed, nationally notifiable in Australia and control measures in place
Equine influenza	Equids	Yes	Yes	No	Yes	Retained: OIE-listed, not present in Australia

[1] Single isolation from oral cavity of clinically healthy horse in 1983 (Studdert 1996)

Disease (disease agent)	Susceptible species	OIE-listed disease	Adverse effects in Australia	Occurrence in Australia	Present in approved countries	Reasons for removal/retention
Equine parainfluenza virus	Horses	No	No	No	No	Removed: doubtful significance
Equine rhinitis A virus (formerly equine rhinovirus 1)	Horses, camels	No	Yes	Yes	Yes	Removed: present in Australia
Equine rhinitis B virus (formerly equine rhinovirus 2 or 3)	Horses	No	Yes	Yes	Yes	Removed: present in Australia
Equine rhinopneumonitis (equid herpesvirus 1 and 4)	Perissodactyls	Yes	Yes	Yes	Yes	Retained: OIE-listed, nationally notifable in Australia
Equine torovirus (Berne virus)	Horses	No	No	Not reported	Yes	Removed: not likely to produce adverse effects; possible worldwide occurrence
Equine viral arteritis	Equids	Yes	Yes	Yes low virulence strains present	Yes	Retained: OIE-listed; high virulence strains not present and nationally notifiable in Australia
Foot-and-mouth disease	All cloven-hoofed species, elephants and tapirs	Yes	Yes	No	No	Retained: OIE-listed
Hendra virus	Bats, humans, horses	No	Yes	Yes	No	Removed: present in Australia
Japanese encephalitis	Birds and pigs are the main hosts, also affects equids, humans, reptiles.	Yes	Yes	Not on mainland Australia; intermittently on some islands	No	Retained: OIE-listed
Louping ill virus	Sheep (main host), humans, horses and sometimes other animals	No	Yes	No	Yes	Retained: not present in Australia
Nipah virus	Bats, cats, dogs, humans, pigs and horses	Yes	Yes	No	No	Retained: OIE-listed
Poxviruses	Equids	No	Yes	No	No[2]	Removed: not OIE-listed, not reported in approved countries
Rabies	Mammals	Yes	Yes	No	Yes	Retained: OIE-listed, not present in Australia
Rift Valley fever	Ruminants, horses, pigs, wildlife and humans	Yes	Yes	No	No	Retained: OIE-listed

[2] Historical references to horse pox exist but there are no recent reports of this infection worldwide.

Disease (disease agent)	Susceptible species	OIE-listed disease	Adverse effects in Australia	Occurrence in Australia	Present in approved countries	Reasons for removal/retention
Venezuelan equine encephalomyelitis	Birds, equids, humans, and other animals	Yes	Yes	No	No	Retained: OIE-listed
Vesicular stomatitis	Bovids, equids, pigs and humans	Yes	Yes	No	Yes	Retained: OIE-listed, not present in Australia
West Nile fever	Birds, equids, humans, and other animals including non-equid perissodactyls	Yes	Yes	No	Yes	Retained: OIE-listed, not present in Australia
Bacteria						
Anthrax (*Bacillus anthracis*)	All mammals	Yes	Yes	Yes	Yes	Retained: OIE-listed, nationally notifiable in Australia and control measures in place
Bovine tuberculosis (*Mycobacterium bovis*)	Bovids, deer, perissodactyls, pigs, possums in New Zealand, badgers, and other mammals	Yes	Yes	No	Yes	Retained: OIE-listed, not present in Australia
Brucellosis (*Brucella abortus*)	Bovids, sheep, pigs, occasionally horses, hares and wild life reservoirs	Yes	Yes	No	Yes	Retained: OIE-listed, not present in Australia
Brucellosis (*Brucella melitensis*)	Goats, cattle, sheep, and humans	Yes	Yes	No	Yes	Retained: OIE-listed (considered with *B. abortus*), not present in Australia,
Brucellosis (*Brucella suis*)	Pigs, cattle, wild ruminants, camelids, elks, moose, dogsm hares, raccoons, and wildlife reservoirs	Yes	Yes	Yes	Yes	Retained: OIE-listed (considered with *B. abortus*), nationally notifiable in Australia and control measures in place
Contagious equine metritis (*Taylorella equigenitalis*)	Horses	Yes	Yes	No	Yes	Retained: OIE-listed, not present in Australia
Equine paratyphoid (*Salmonella* Abortusequi)	Equids	No	Yes	No	No	Removed: not present in approved countries
Glanders (*Burkholderia mallei*)	Equids, other mammals including humans	Yes	Yes	No	No	Retained: OIE-listed
Johne's disease (*Mycobacterium avium paratuberculosis*)	Ruminants, rhinoceroses and tapirs	No	Yes	Yes	Yes	Retained: nationally notifiable in Australia and control measures in place

Disease (disease agent)	Susceptible species	OIE-listed disease	Adverse effects in Australia	Occurrence in Australia	Present in approved countries	Reasons for removal/retention
Leptospirosis (*Leptospira* spp.)	Vertebrates; rodents are the main reservoir	Yes	Yes	Yes multiple serovars	Yes	Retained: OIE-listed; serovars not present in Australia
Lyme disease (*Borrelia burgdorferi*)	Small mammals (main hosts), humans, perissodactyls, wild animals, and other mammals	No	Yes (human)	No (not isolated)	Yes	Retained: not present in Australia
Melioidosis *(Burkholderia pseudomallei*)	Mammals	No	Yes	Yes	Yes	Removed: present in Australia
Proliferative enteropathy (*Lawsonia intracellularis*)	Horses	No	Yes	Yes	Yes	Removed: present in Australia
Q fever (*Coxiella burnetii*)	Multiple species	Yes	Yes	Yes	Yes	Removed: present in Australia
Spirochaetosis (*Borrelia theileri)*	Cattle, other ruminants and horses	No	No	Yes	Yes	Removed: present in Australia
Taylorella asinigenitalis	Equids	No	Yes	No	Yes	Retained: not present in Australia
Fungi						
Epizootic lymphangitis (*Histoplasma farciminosum*)	Equids, dogs, camels, and humans	No	Yes	No	Yes	Retained: not present in Australia
Helminths: Cestodes						
Cestodes affecting zoo perissodactyls (except those specifically identified for hazard review)	Perissodactyls and other mammals	No	Possible	Possible	Possible	All imported zoo perissodactyls to be treated for endoparasites
Echinococcosis (*Echinococcus granulosus, E. multilocularis*)	Equids (intermediate host), carnivores (definitive host)	Yes	Yes	*E. granulosus* yes; other species no	Yes	Retained: OIE-listed; species not present in Australia
Echinococcosus (*Echinococcus equinus*)	Equids	No	Yes	No	Yes	Retained: species not present in Australia (considered with *E. granulosus* and *E. multilocularis*)
Helminths: Nematodes						

Disease (disease agent)	Susceptible species	OIE-listed disease	Adverse effects in Australia	Occurrence in Australia	Present in approved countries	Reasons for removal/retention
Nematodes affecting zoo perissodactyls (except those specifically identified for hazard review)	Perissodactyls and other mammals	No	Possible	Possible	Possible	All imported zoo perissodactyls to be treated for endoparasites
Stephanofilaria dinniki	Rhinoceroses	No	Yes	No	No	Removed: not OIE listed, not present in approved countries
Trichinellosis (*Trichinella spiralis*)	Mammals, esp. carnivores	Yes	Yes	No	Yes	Retained: OIE-listed, not present in Australia
Helminths: Trematodes						
Trematodes affecting zoo perissodactyls	Perissodactyls and other mammals	No	Yes	Possible	Possible	Retained: some species not present in Australia
Insects						
Nasal bot (*Rhinoestrus purpureus*)	Equids	No	Yes	No	Yes	All imported equids to be treated and inspected for ectoparasites
New World screwworm (*Cochliomyia hominivorax*)	Mammals	Yes	Yes	No	No	Retained: OIE-listed
Old World screwworm (*Chrysomya bezziana*)	Mammals	Yes	Yes	No	No	Retained: OIE-listed
Warble fly (*Hypoderma bovis, H. lineata*)	Cattle, rarely equids, humans	No	Yes	No	Yes	Removed: horses are dead-end host
Mites						
Horse mange (*Sarcoptes scabei* var *equi*)	Equids, other mammals	No	Yes	No[3]	Yes	All imported equids to be treated and inspected for ectoparasites
Psoroptic mange (*Psoroptes equi*)	Equids	No	Yes	No	Yes	All imported equids to be treated and inspected for ectoparasites
Protozoa						
Dourine (*Trypanosoma equiperdum*)	Equids (donkeys, horses, mules) zebras seropositive	Yes	Yes	No	Yes	Retained: OIE-listed, not present in Australia
Equine piroplasmosis (*Babesia caballi, Theileria equi*)	Perissodactyls	Yes	Yes	No	Yes	Retained: OIE-listed, not present in Australia

[3] *Sarcoptes scabei* affects other species in Australia; evidence for host specificity is equivocal.

Disease (disease agent)	Susceptible species	OIE-listed disease	Adverse effects in Australia	Occurrence in Australia	Present in approved countries	Reasons for removal/retention
Equine protozoal myeloencephalitis (*Sarcocystis neurona*)	American opossums, horses	No	Yes	No	Yes	Retained: not present in Australia
Other piroplasmids	Mammals	No	Possible	Possible	Possible	Retained: some piroplasmids not present in Australia (considered with equine piroplasmosis)
Surra (Trypanosoma evansi)	Livestock, perissodactyls, dogs, humans, and some marsupials	Yes	Yes	No	No	Retained: OIE-listed
Trypanosomosis (tsetse-transmitted) (*Trypanosoma brucei brucei, T. congolense, T. vivax*)	Bovids, other livestock, perissodactyls, dogs, humans, and some marsupials	Yes	Yes	No	No	Retained: OIE-listed
Rickettsias						
Equine granulocytic anaplasmosis (*Anaplasma phagocytophilum*)	Ruminants, horses, cats, dogs, and rodents	No	Yes	No	Yes	Retained: not present in Australia
Heartwater (*Ehrlichia ruminatum*)	Ruminants, rhinoceroses (possibly)	Yes	Yes	No	No	Retained: OIE-listed
Potomac horse fever (*Neorickettsia risticii*)	Horses, cattle, dogs, and possibly other animals	No	Yes	No	Yes	Retained: not present in Australia
Ticks						
Ticks affecting zoo perissodactyls	Mammals, birds and reptiles	No	Yes	Yes some species	Yes	All zoo perissodactyls to be inspected and treated for ectoparasites

Conclusion

The following diseases were retained for risk review on the basis of the information provided in Table 3.1.

OIE-Listed Diseases

Viruses

- African horse sickness
- Aujeszky's disease (suid herpesvirus 1)
- bluetongue
- equine encephalomyelitis (Eastern)
- equine encephalomyelitis (Western)
- equine infectious anaemia
- equine influenza
- equine rhinopneumonitis (equid herpesvirus 1 and 4)
- equine viral arteritis
- foot-and-mouth disease
- Japanese encephalitis
- Nipah virus encephalitis
- rabies
- Rift Valley fever
- Venezuelan equine encephalomyelitis
- vesicular stomatitis
- West Nile fever

Bacteria

- anthrax (*Bacillus anthracis*)
- bovine tuberculosis (*Mycobacterium bovis*)
- brucellosis (*Brucella abortus*)
- brucellosis (*Brucella melitensis*)
- brucellosis (*Brucella suis*)
- contagious equine metritis (*Taylorella equigenitalis*)
- glanders (*Burkholderia mallei*)

Helminths: cestodes

- echinococcosis/hydatidosis (*Echinococcus granulosus, E. multilocularis*)

Helminths: nematodes

- trichinellosis (*Trichinella spiralis*)

Insects

- New World screwworm (*Cochliomyia hominivorax*)
- Old World screwworm (*Chrysomya bezziana*)

Protozoa

- dourine (*Trypanosoma equiperdum*)
- equine piroplasmosis (*Babesia caballi, Theileria equi*)
- surra (*Trypanosoma evansi*)
- trypanosomosis (tsetse-transmitted) (*Trypanosoma brucei brucei, T. congolense, T. vivax*)

Rickettsias

- heartwater (*Ehrlichia ruminantium*)

Other Diseases

Viruses

- Borna disease
- equid herpesvirus 2, 3, 5–9
- louping ill

Bacteria

- Johne's disease (*Mycobacterium paratuberculosis)*
- leptospirosis
- Lyme disease (*Borrelia burgdorferi*)
- *Taylorella asinigenitalis*

Fungi

- epizootic lymphangitis

Helminths: Cestodes

- echinococcosis (*Echinococcus equinus*)

Helminths: Trematodes

- various diseases caused by trematodes

Protozoa

- equine protozoal myeloencephalitis (*Sarcocystis neurona*)

Rickettsias

- equine granulocytic anaplasmosis (formerly equine ehrlichiosis) (*Anaplasma phagocytophilum*, formerly *Ehrlichia equi*)
- Potomac horse fever (formerly equine ehrlichiosis) (*Neorickettsia risticii*, formerly *Ehrlichia risticii*)

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There is limited published information on the diseases of zoo perissodactyls. The effects of a disease agent on zoo equids can, in most cases, be considered likely to be similar to that seen in horses and other domestic equids.

Other perissodactyls, wild tapirs in particular, are a very poorly studied group due to their secretive nature and tendency to avoid human contact. It is only with the advent of recent technology, such as remote tracking and camera devices, that information has been gathered on their populations, distribution, behaviour and ecology. However, there have been several hundred captive tapirs held in zoological institutions across the world that have provided information on tapir diseases encountered in captivity, most of which appear to be management related.

African horse sickness

African horse sickness (AHS) is caused by a virus of the Orbivirus genus of the family Reoviridae (Mertens et al. 2005). AHS virus affects dogs, donkeys, horses, mules and zebras (Coetzer and Guthrie 2004; Mellor and Hamblin 2004; van Rensburg et al. 1981). Although sub-clinical infection has been reported in camels, non-equids are not thought to be involved in the maintenance and spread of AHS (Wernery and Kaaden 2002).

AHS is endemic to sub-Saharan Africa and probably Yemen (Calisher and Mertens 1998; Mellor and Boorman 1995; Sailleau et al. 2000). There have been outbreaks in northern Africa, the Iberian Peninsula, the Indian subcontinent and the Middle East (Mellor and Hamblin 2004). AHS has never been reported in Australia.

AHS is an OIE-listed disease (OIE 2012). It is absent from Australia and is a nationally notifiable animal disease (DAFF 2011).

AHS virus is transmitted by biting arthropods, including midges, mosquitoes and ticks. Species of the genus *Culicoides* are the principal vectors (Mellor and Hamblin 2004). In Australia, several species of culicoides are vectors for bluetongue virus, and potential vectors for AHS virus.

Zebras are recognised as the natural reservoir for AHS and although they rarely show clinical signs of disease, infected animals can remain viraemic for up to four weeks (Mellor and Hamblin 2004). The incubation period for AHS is usually 4–9 days (Geering et al. 1995a). Infection in susceptible horse populations results in mortality of up to 95%. Mules generally develop a milder form of the disease and donkeys can be subclinically infected (Coetzer and Guthrie 2004).

There are no reports of clinical disease, AHS virus isolation or transmission in rhinoceroses, but serological results indicate they may sometimes be exposed to AHS virus or a cross-reacting virus, and produce antibodies.

A survey of 100 samples taken in 2007 from white rhinoceroses (*Ceratotherium simum*) in Kruger National Park showed no positive titres for AHS virus antibodies on indirect enzyme-linked immunosorbent assay (ELISA) (Miller et al. 2011). An earlier survey of sera collected between 1993–95, also found no antibodies to AHS virus in

samples collected from 66 white and 36 black rhinoceroses (*Diceros bicornis*) using an ELISA (Barnard 1997). However, a third survey using ELISA has detected antibodies in rhinoceros sera at low titres (Fischer-Tenhagen et al. 2000). Whether rhinoceroses develop a viraemia or are capable of infecting culicoides is unknown, and there is no evidence to support this.

Wild tapirs' native geographical distribution does not overlap that of AHS, there are no reports of AHS in tapirs and their susceptibility and ability to transmit AHS virus is unknown.

There is no evidence that non-equid perissodactyls play a significant role in the epidemiology of AHS and it is not considered further in these species.

Australia's previous biosecurity measures for AHS in zoo perissodactyls included country freedom. For trade in horses, the Code recommendations include country freedom without vaccination within 40 days of export.

Conclusion

AHS is not present in approved countries. Based on the preceding information and in accordance with the recommendations in the Code (OIE 2011a), risk management measures continue to be warranted for zoo equids. No risk management measures are required for non-equid perissodactyls.

Australia's biosecurity measures for AHS for zoo equids are:

- For 40 days immediately before export the animal was continuously resident and free of quarantine restriction in a country where no clinical, epidemiological or other evidence of African horse sickness has occurred during the previous two years and the disease is compulsorily notifiable.

  AND

- The animal was not vaccinated against African horse sickness during 40 days before export.

Anthrax

Anthrax is an infectious bacterial disease of humans, animals and several species of birds. It is caused by a spore-forming bacterium, *Bacillus anthracis*, and is characterised by rapidly fatal septicaemia with widespread oedema, haemorrhage and necrosis.

Domesticated and wild ruminants are most susceptible, horses less susceptible and omnivores and carnivores relatively resistant. Although *B. anthracis* occurs worldwide, outbreaks occur most commonly in parts of Africa, Asia and the Middle East, with sporadic cases in Australia, Europe and the United States (CFSPH 2007a; OIE 2011i).

Anthrax is a multiple species, OIE-listed disease (OIE 2012). It is a nationally notifiable animal disease in Australia (DAFF 2011) and control measures include vaccination, premises quarantine, movement controls and surveillance (Animal Health Australia 2005).

B. anthracis is thought to multiply almost exclusively inside the body and exists in the environment as dormant spores, which remain viable in the soil or in animal products

for decades. However, there is experimental evidence of vegetative *B. anthracis* multiplying in soils on or around roots of grass seedlings (Saile and Koehler 2006) and of bacteriophages and earthworms providing *B. anthracis* with alternatives to sporulation for survival and possibly multiplication in the soil (Schuch and Fischetti 2009). Once the soil has been contaminated by spores, it is very difficult to decontaminate. Transmission occurs by entry through skin lesions, ingestion or inhalation of spores in soil or on plants. Contaminated bone meal and other feed can also spread anthrax, and flies can disseminate anthrax mechanically. Outbreaks are often associated with heavy rainfall, flooding, or drought (CFSPH 2007a).

The incubation period is generally 1–7 days, but spores can germinate in the lungs up to six weeks post-infection (CFSPH 2007a). Affected animals usually die within 1–3 days, with some surviving up to seven days.

There are no previous biosecurity measures for anthrax. The Code recommendations include premises freedom or vaccination (OIE 2011b).

Conclusion

Anthrax is present in approved countries. Based on the preceding information and in accordance with the recommendations in the Code (OIE 2011b), risk management measures are warranted.

Australia's biosecurity measures for anthrax for zoo perissodactyls are:

- For 20 days immediately before export the animal has not resided on any premises in the country of export where clinical, epidemiological or other evidence of anthrax has occurred in any species during the previous 20 days and the disease is compulsorily notifiable.

Aujeszky's disease

Aujeszky's disease, also known as pseudorabies or 'mad itch', is caused by suid herpesvirus 1 (SHV-1) (ICTV 2009; Kimman et al. 1991). It is predominately a disease of pigs but can affect a wide range of species, including cats, dogs, cattle, goats, sheep, mice and rats (Studdert 1996). Aujeszky's disease had an almost worldwide distribution including North and South America, Europe and Asia. However, many countries have either eradicated the disease — including several European countries, New Zealand and Singapore — or are in the process of doing so. The disease has never been reported in Australia (Geering et al. 1995b).

Aujeszky's disease is a multiple species, OIE-listed disease (OIE 2012). It is absent from Australia and is a nationally notifiable animal disease (DAFF 2011).

Birds, horses and humans are considered resistant to SHV-1 infection (Kluge et al. 1999) although cases have been reported in horses housed in close proximity to infected pigs, and in ponies after experimental infection with high doses of SHV-1 (Kimman et al. 1991). Pigs are the primary host and reservoir of SHV-1 and the sole source of infection and transmission to other animals (Studdert 1996). Aujeszky's disease in species other than pigs is only reported to occur when the disease is endemic in the pig population (Vandevelde 2006).

There is little known about Aujeszky's disease in zoo perissodactyls and no evidence that they are susceptible to SHV-1.

There are no previous biosecurity measures for Aujeszky's disease. The Code only has recommendations for trade in pigs (OIE 2011c).

Conclusion

Aujeszky's disease is present in approved countries. However, there is no evidence that zoo perissodactyls play a significant role in the epidemiology of Aujeszky's disease.

Accordingly, based on the preceding information, risk management measures for Aujeszky's disease are not warranted.

Bluetongue disease

Bluetongue disease is an insect-borne viral disease of all ruminant species (antelopes, buffaloes, cattle, deer, goats and sheep) in the order Artiodactyla. There are 24 serotypes of bluetongue virus (BTV) and strains differ in virulence and pathogenesis. Ten serotypes (1, 2, 3, 7, 9, 15, 16, 20, 21 and 23) of BTV have been isolated in Australia from insects or clinically healthy cattle (Animal Health Australia 2009; Geering et al. 1995c).

Bluetongue disease is endemic in most countries between 53° N and 34° S with occasional outbreaks occurring outside these latitudes. Clinical disease has not been seen in cattle or reported in sheep or goats in Australia (Animal Health Australia 2010; Geering et al. 1995c).

Bluetongue disease is a multiple species OIE-listed disease (OIE 2012) and clinical disease is nationally notifiable in Australia (DAFF 2011).

Bluetongue disease is non-contagious and is transmitted by biting midges (*Culicoides* spp.). Viraemia is detectable two to three days post-infection and often lasts less than four weeks but can in exceptional cases persist for eight weeks (Bonneau et al. 2002; Gard 1998; Gard and Melville 1992; Koumbati et al. 1999; Melville et al. 2005; Richards et al. 1988; Singer et al. 2001).

Clinical bluetongue disease has not been reported in zoo perissodactyls. Although serological surveys of African wildlife have demonstrated antibodies to BTV in black and white rhinoceroses, they are thought to be unimportant in the epidemiology of the disease (Anderson and Rowe 1998; Fischer-Tenhagen et al. 2000; Miller et al. 2011). It is also unlikely that other perissodactyl species play any role in the epidemiology of bluetongue disease.

There are no previous biosecurity measures for bluetongue disease. The Code recommendations include country or zone freedom, testing or vaccination for multiple species (OIE 2011d).

Conclusion

Bluetongue disease is present in approved countries. However, there is no evidence that zoo perissodactyls play a significant role in the epidemiology of bluetongue disease.

Accordingly, based on the preceding information, risk management measures for bluetongue disease are not warranted.

Borna disease

Borna disease is an infectious encephalomyelitis caused by a virus belonging to the genus Bornavirus in the family Bornaviridae (Schwemmle et al. 2005). Natural infection with Borna disease virus (BDV) occurs in horses and sheep (Reeves et al. 1998); however, many species are susceptible to experimental infection (Lipkin and Briese 2007). Serological evidence of infection has been found in cattle, dogs, new world camelids, ostriches and rabbits (Ludwig and Bode 2000).

Serological evidence suggests BDV occurs in many parts of the world; however, the exact geographical distribution is unknown (Ludwig and Bode 2000). The disease is endemic in horses and sheep only in certain parts of Europe (Austria, Germany, Lichtenstein and Switzerland) and BDV-specific antibodies have been detected in an increasing number of countries, including Japan and the United States (Herden and Richt 2009). Borna disease can recur in specific areas or individual farms during spring and summer, a phenomenon that remains unexplained. Clinical disease, although rare, is almost invariably fatal in the horse (Herden and Richt 2009; Priestnall et al. 2011).

Australia is considered to be free from Borna disease (Geering et al. 1995d; Kamhieh et al. 2006). Although there is some serological evidence of exposure to BDV or Borna disease-like virus in Australia, there are no confirmed clinical cases and the virus has never been isolated (Kamhieh et al. 2006; Kamhieh et al. 2008).

Borna disease is not an OIE-listed disease (OIE 2012). It is absent from Australia and is a nationally notifiable animal disease (DAFF 2011).

The mode of transmission and possible reservoir hosts of infection of BDV are unknown (Staeheli et al. 2000).

The disease occurs sporadically with an incubation period ranging from one to six months. The reliability of viral antigen in confirming the presence of BDV or Borna disease may be questionable (Herzog et al. 2008) and clinically affected animals may have very low or undetectable levels of antibody (Radostits et al. 2007g). Ante mortem diagnosis of Borna disease is difficult and the clinical signs of disease are not specific. A definitive diagnosis in dead animals is based on neuropathological examinations which show distinctive intranuclear antigen, the presence of viral nucleic acid in brain tissue, or virus isolation (Lipkin and Briese 2007).

There is no information about susceptibility in zoo perissodactyls but as it affects multiple species it is possible that transmission could occur. However, due to the limited occurrence and distribution of clinical Borna disease it is unlikely that zoo perissodactyls would be exposed to infected animals or pose a risk of introducing the disease to Australia.

There are no previous biosecurity measures for Borna disease and there are no recommendations in the Code. A risk assessment was undertaken for the horse IRA and no specific risk management measures were recommended for Borna disease (Biosecurity Australia 2010).

Conclusion

Borna disease is present in approved countries. However, there is no evidence that zoo perissodactyls play a significant role in the epidemiology of Borna disease.

Accordingly, based on the preceding information and consistent with the recommendations in the horse IRA, risk management measures for Borna disease are not warranted.

Bovine tuberculosis

Bovine tuberculosis, caused by *Mycobacterium bovis*, is an infectious, chronic respiratory disease in cattle, deer, goats, pigs, water buffalo and a wide range of other animal species. Tuberculosis in humans is caused by *M. bovis* and *M. tuberculosis* (Animal Health Australia 2007b).

Bovine tuberculosis is widespread throughout the world. Eradication campaigns in many countries have effectively reduced the incidence of bovine tuberculosis (OIE 2010a). Bovine tuberculosis was eradicated from Australia and freedom in accordance with the Code was declared in 1997.

Bovine tuberculosis is an OIE-listed disease (OIE 2012). It is absent from Australia and is a nationally notifiable animal disease (DAFF 2011).

Horses may be infected by grazing contaminated pasture (Seddon 1965) or by direct exposure to infected cattle (Radostits et al. 2007a). However, due to limited exposure to infection and possibly innate resistance, *M. bovis* is rare in horses even in countries with high rates of infection in other species. Transmission from horses to other species has not been reported (Oaks 2007).

Bovine tuberculosis has not been reported in zoo equids (Radcliffe and Osofsky 2002), and a survey of zebras in South Africa found no evidence of tuberculosis (Grange 2006). Bovine tuberculosis in rhinoceroses and tapirs has been reported (Espie et al. 2009; Hoyer et al. 2008; Ramsay and Zainuddin 1993; Reichel 1982). Transmission was attributed to contact with other infected animals (Duncan et al. 2009).

Diagnosis of bovine tuberculosis using the intradermal skin test, the prescribed test for international trade, is unreliable and difficult to perform in rhinoceroses. However, serological techniques have shown diagnostic potential for a variety of both captive and free-ranging wildlife hosts including rhinoceroses (Duncan et al. 2009) and tapirs (Calle et al. 2011; Jurczynski et al. 2011).

Australia's previous biosecurity measures for bovine tuberculosis in zoo perissodactyls included premises freedom and testing (rhinoceroses only). Recommendations in the Code are for bovid species only (OIE 2011f). Those recommendations include country, zone or compartment freedom and testing.

Conclusion

Bovine tuberculosis is present in approved countries. However, there is no evidence that equids play a significant role in the epidemiology of bovine tuberculosis and risk management measures for bovine tuberculosis are not recommended for zoo equids. However, based on the preceding information and in accordance with the recommendations in the Code (OIE 2011f), risk management measures for non-equid perissodactyls continue to be warranted.

Australia's biosecurity measures for bovine tuberculosis for non-equid perissodactyls are:

- For 180 days immediately before export the animal was continuously resident and free of quarantine restriction in a country where no clinical, epidemiological or other evidence of bovine tuberculosis has occurred during the previous five years and the disease is compulsorily notifiable.

OR

- For 180 days immediately before export the animal has not resided on any premises in the country of export where clinical, epidemiological or other evidence of bovine tuberculosis has occurred during the previous five years

AND

- A blood sample was taken from the animal immediately at the start of pre-export quarantine and tested using a serological multi-antigen print immunoassay or an antibody detection test, with negative results.

Brucellosis

Brucellosis is caused by bacteria of the *Brucella* genus. The three species *Brucella abortus*, *B. melitensis* and *B. suis* are important causes of disease in livestock. *B. abortus* preferentially infects cattle, *B. melitensis* goats and sheep and *B. suis* pigs. Brucellosis is an important zoonosis.

Bovine brucellosis, caused by *B. abortus*, is widespread throughout the world, but was eradicated from Australia and freedom in accordance with the Code was declared in 1989 (Animal Health Australia 2011a). Other countries reporting eradication of bovine brucellosis include Austria, Belgium, Canada, Denmark, Finland, Germany, Japan, the Netherlands, New Zealand, Norway, Sweden, Switzerland and the United Kingdom.

Australia is also free from brucellosis caused by *B. melitensis* (never reported) but not *B. suis*, which is endemic in feral pigs in Queensland. However, control measures for porcine brucellosis are in place (herd accreditation and pig movement restrictions).

Brucellosis caused by *B. abortus*, *B. melitensis* and *B. suis* are multiple species OIE-listed diseases (OIE 2012) and are nationally notifiable in Australia (DAFF 2011).

There is no evidence that zoo perissodactyls play a significant role in the epidemiology of *B. melitensis* and *B. suis*. This draft policy review will only consider *B. abortus* as it is exotic to Australia and can affect equids.

B. abortus is transmitted by ingestion, inhalation, through skin abrasions and mucous membranes from contact with infected cattle and discharges, or contaminated pasture and feed (Cohen et al. 1992; Corbel and MacMillan 1998; Denny 1972). The major reservoir of *B. abortus* is domestic cattle, though some wild ruminants (bison and elk) are known to harbour infection and can reinfect bovine herds. Other wild and domestic species are susceptible to infection, but transmission from horses to other animals is considered rare and horse to horse transmission is unlikely (Cohen et al. 1992).

In countries where bovine brucellosis is endemic in cattle and/or small ruminants, 0.2% to 40% of horses have serological evidence of exposure (Acosta-Gonzalez et al. 2006; Denny 1973; Hutchins and Lepherd 1968; Refai 2002; Thakur et al. 2003).

Although serological surveys of African wildlife have demonstrated antibodies to

Brucella spp. in zebras (*Equus burchellii*), they are thought to be unimportant in the epidemiology of the disease (Godfroid et al. 2004; Radcliffe and Osofsky 2002; Zheludkov and Tsirelson 2010). A serological survey in South Africa showed no antibodies to *B. abortus* in African rhinoceroses (Fischer-Tenhagen et al. 2000). Similarly there was no serological evidence of antibodies to *B. abortus* in free-ranging tapirs in Brazil (Furtado et al. 2010).

There are no previous biosecurity measures for brucellosis. The Code recommendations include country or zone freedom and testing for bovids (OIE 2011e).

Conclusion

Brucellosis is present in approved countries. However, there is no evidence that zoo perissodactyls play a significant role in the epidemiology of brucellosis.

Accordingly, based on the preceding information, risk management measures for brucellosis are not warranted.

Contagious equine metritis

Taylorella equigenitalis is the causal agent of contagious equine metritis (CEM), a venereal disease of horses and donkeys. Different isolates vary in pathogenicity (Baverud et al. 2006). *T. equigenitalis* affects horses and donkeys, although infection in donkeys appears to be self limiting and clinical signs are minimal (Timoney et al. 1985).

CEM is an OIE-listed disease (OIE 2012). It is absent from Australia and is a nationally notifiable animal disease (DAFF 2011).

Infection may occur during natural service or through contaminated semen. Mechanical transmission of infection may occur via contaminated instruments and inadequate sanitary measures between handling of breeding stock, including teaser stallions (Timoney 1996; Timoney and Powell 1988). Transplacental transmission may occur in infected mares, resulting in the birth of congenitally infected foals (Timoney and Powell 1982).

Although the possibility of *T. equigenitalis* infection in other equids and perissodactyls exists, their role in the epidemiology of CEM appears minimal. Samples from a number of species including asses, donkeys, zebras, rhinoceroses and tapirs have not detected *Taylorella* species (Jackson and Heath 2006). Limited sampling in zebras in both Europe and South Africa did not find evidence of infection (Parlevliet et al. 1997) and it is not known whether zebras are susceptible (Chanter et al. 1998; Chanter 2004).

Although zoo equids may be susceptible to *T. equigenitalis* infection, these animals are unlikely to play a significant role in the epidemiology of CEM.

There are no previous biosecurity measures for CEM. The Code recommendations include country freedom or clinical freedom and testing for equines (OIE 2011g).

Conclusion

CEM is present in approved countries. However, there is no evidence that zoo

perissodactyls play a significant role in the epidemiology of CEM.

Accordingly, based on the preceding information, risk management measures for CEM are not warranted.

Dourine

Dourine is a sexually transmitted disease of horses, mules and donkeys, caused by the protozoan *Trypanosoma equiperdum*. The disease occurs in Central and South America, Asiatic Russia, Asia Minor, Iran, Iraq, the Arabian Peninsula, Indonesia, North Africa and parts of southern Africa, including South Africa (Hoare 1972; Soulsby 1982b). It has been eradicated from Canada and the United States. Several cases of dourine in horses were detected in Italy in 2011 (Promed Mail 2011c; Promed Mail 2011d). Dourine has never occurred in Australia (Geering et al. 1995e).

Dourine is an OIE-listed disease (OIE 2012). It is absent from Australia and is a nationally notifiable animal disease (DAFF 2011).

Zebras have tested positive by serology, but there is no conclusive evidence of infection. Horses and donkeys appear to be the only natural reservoir for *T. equiperdum*. Male donkeys can be subclinically infected carriers (CFSPH 2009b). There is no evidence of dourine in non-equid perissodactyls.

T. equiperdum is transmitted by seminal fluid and genital exudates at mating. Foals can be infected by genital tract discharges from infected mares or from milk contaminated with discharges from lesions on the udder (Hoare 1972). Transmission by needles and arthropod vectors can occur but due to the transient and low grade parasitaemia, transmission by these methods is unlikely.

Three clinical stages in dourine are described (Barrowman et al. 1994; Uilenberg 1998) following an incubation period which may vary from weeks to months. Clinical signs in trypanosomal disease are not pathognomonic with recovery/relapse cycles at various stages.

Diagnostic testing for humoral antibody can be done by complement fixation (CFT), agar gel immunodiffusion (AGID), ELISA, card agglutination and by indirect fluorescent antibody test (IFAT). Cross-reactions with other trypanosomes can confuse results (Zablotskij et al. 2003), as can anti-complementary effects of some sera in uninfected equids (OIE 2008a).

Australia's previous biosecurity measures for dourine in zoo perissodactyls included premises freedom. The Code recommends country freedom or premises freedom and testing for equines (OIE 2011j).

Conclusion

Dourine is present in approved countries. Based on the preceding information and in accordance with the recommendations in the Code (OIE 2011j), risk management measures continue to be warranted for zoo equids. No risk management measures are required for non-equid perissodactyls.

Australia's biosecurity measures for dourine for zoo equids are:

- For 12 months immediately before export the animal has not resided on any premises in the country of export where clinical, epidemiological or other

evidence of dourine has occurred in any species during the previous 12 months.

Echinococcosis

Echinococcosis is a zoonotic disease caused by the cestode *Echinococcus* in the family Taeniidae. The most significant zoonotic species are *E. granulosus* and *E. multilocularis*.

E. granulosus has a worldwide distribution including Australia. *E. multilocularis* is found in Africa, Asia, Canada, Europe and the United States and can cause disease in humans (Sréter et al. 2003). *E. equinus* is found in Africa, Europe (it is endemic in horses in Ireland, Italy, Spain and the United Kingdom) and the Middle East and appears to be non-pathogenic to humans (Blutke et al. 2010; Torgerson and Budke 2003).

There are no reports of *E. equinus* or *E. multilocularis* in Australia (Animal Health Australia 2007a; Thompson and McManus 2001).

Echinococcosis is a multiple species OIE-listed disease (OIE 2012).

Carnivores are the definitive hosts for *Echinococcus* spp., and shed infective proglottid stages in the faeces (Romig et al. 2006; Torgerson and Budke 2003). After ingestion of proglottids from contaminated pasture, cysts occur in the liver and lungs of intermediate hosts. The cycle is maintained by dogs ingesting raw or undercooked offal (Torgerson and Budke 2003).

Equids (donkeys, horses and zebras) are the intermediate hosts for *E. equinus* (Blutke et al. 2010; Jenkins et al. 2005; Kumaratilake et al. 1986; Torgerson and Budke 2003). Other *Echinococcus* spp. and strains can also cause cystic echinococcosis in equids, but the cysts are infertile (Varcasia et al. 2008), which means equids are dead end hosts.

In the United States disease due to *E. equinus* was reported in four horses, which originated from the United Kingdom and Ireland, where the disease is endemic. In the United Kingdom, the prevalence of *E. equinus* is higher in horses used for hunting (Sellon 2007).

A number of carnivores act as the definitive hosts for *E. multilocularis*. Intermediate hosts are small mammals, usually rodents. In rare cases, domestic animals (including horses) and humans can also become infected (CFSPH 2005a).

There are no previous biosecurity measures for echinococcosis and there are no recommendations in the Code other than for carnivores (OIE 2011k).

Conclusion

E. equinus and *E. multilocularis* are present in approved countries. However, there is no evidence that zoo perissodactyls play a significant role in the epidemiology of echinococcosis.

Accordingly, based on the preceding information, risk management measures for echinococcosis are not warranted.

Epizootic lymphangitis

Epizootic lymphangitis is a contagious, chronic disease of horses, mules and donkeys caused by the saprophytic soil fungus, *Histoplasma capsulatum* var. *farciminosum*. Infection in other species is rare, but has been reported to occur in camels, dogs and humans (CFSPH 2005b; Ueda et al. 2003). Also known as pseudofarcy, pseudoglanders or equine histoplasmosis, epizootic lymphangitis is characterised by a spreading, suppurative dermatitis and lymphangitis, ulcerating conjunctivitis or multifocal pneumonia.

Epizootic lymphangitis is more common in the tropics and subtropics and is endemic in northern Africa, southern Europe and parts of Asia including China, India and Pakistan (Al-Ani 1999; Kohn 2007; Picard and Vismer 2004). Epizootic lymphangitis is reported to have occurred in Japan prior to World War II (Ueda et al. 2003) and one autochthonous case was described in 2001 (Katayama et al. 2001). There are no reports of epizootic lymphangitis in approved countries other than southern European countries bordering the Mediterranean Sea (Al-Ani 1999; Kohn 2007).

Epizootic lymphangitis is not an OIE-listed disease (OIE 2012). It is absent from Australia and is a nationally notifiable animal disease (DAFF 2011; Geering et al. 1995f).

The incubation period varies from several weeks to six months (Kohn 2007) and once established, the organism spreads locally by invasion and then via the lymphatics. It is transmitted via fomites, biting flies of the *Musca* or *Stomoxys* genera, contact of infected material with traumatised skin, venereally and inhalation (Kohn 2007; Picard and Vismer 2004).

Epizootic lymphangitis infection of species other than horses, mules and donkeys is rare and there is no evidence of infection of non-equid perissodactyls, therefore it is not considered further in these species.

Australia's previous biosecurity measures for epizootic lymphangitis for zoo perissodactyls included premises freedom. There are no recommendations in the Code.

Conclusion

Epizootic lymphangitis is not present in approved countries other than southern European countries bordering the Mediterranean Sea. There is no evidence that zoo perissodactyls play a significant role in the epidemiology of epizootic lymphangitis.

Accordingly, based on the preceding information, risk management measures for epizootic lymphangitis are not warranted.

Equid herpesviruses

Equid herpesviruses (EHV), members of the family Herpesviridae, are present in equid populations worldwide (Davison et al. 2005). Equids are susceptible to at least nine herpesviruses, including six genera of the subfamily Alphaherpesvirinae — EHV-1, EHV-3, EHV-4, EHV-6 (asinine herpesvirus-1), EHV-8 (asinine herpesvirus 3), EHV-9 (gazelle encephalitis herpesvirus) and three of the subfamily

Gammaherpesvirinae — EHV-2, EHV-5, EHV-7 (asinine herpesvirus 2) (Davison et al. 2009).

Equine rhinopneumonitis (EHV-1 and EHV-4) is an OIE-listed disease (OIE 2012) and EHV-1 (abortigenic and neurological strains) is a notifiable animal disease in Australia (DAFF 2011).

Isolates related to EHV-1 from domestic horses have been associated with clinical signs of disease in Przewalski's horses, zebras and onagers (Borchers et al. 1999; Borchers et al. 2005; Borchers and Frolich 1997; Ghanem et al. 2008; Ibrahim et al. 2007; Montali et al. 1985).

EHV-1, EHV-2 and EHV-4 are widespread in free-range zebras (Borchers and Frolich 1997). Specific antibodies against EHV-2, EHV-4 and EHV-5 have been demonstrated in Przewalski's horses and zebras in German zoos (Frölich et al. 1999). EHV-6, EHV-7 and EHV-8 have been reported in donkeys (Browning et al. 1988). EHV-1 was isolated from an onager abortion and a zebra neurological case in a Chicago zoo (Montali et al. 1985) and abortions and perinatal foal mortality in zoo zebras (Wolff et al. 1986).

Serological evidence of EHV-9 is reported in captive zoo animals including gazelles, giraffes, onagers, polar bears (Fukushi et al. 1997; Kasem et al. 2008; Schrenzel et al. 2008) and in free-range zebras (Borchers et al. 2008). Zebras may serve as a source of EHV-9 infection for other species (Borchers et al. 2008), but active infection has only been reported in an immunocompromised zebra (Schrenzel et al. 2008) and has never been conclusively documented in equidae (Taniguchi et al. 2000).

The significance of EHV infection in rhinoceroses and tapirs is unclear. The deaths of a pregnant Indian tapir and a male black rhinoceros at the Berlin zoo in 1995 were attributed to herpesvirus infection (Göltenboth et al. 2011). However, the identification of the virus was not confirmed as only microscopic findings were reported and the virus was not isolated.

Latently infected horses present the main reservoir of infection. Close contact is required for transmission, which occurs through direct contact and through contaminated fomites. Herpesviruses commonly establish persistent latent infections which can recrudesce at times of stress (e.g. parturition, lactation) resulting in groups of mares and foals acting as reservoirs of virus for uninfected young horses (Gilkerson et al. 1999).

Isolation of virus, detection of viral antigens or nucleic acid, or detection of antibody is required to confirm EHV disease (Slater 2007).

Vaccines (live attenuated and inactivated) for EHV-1 and 4 are available commercially for horses. However, immunity is short-lived and revaccination at regular intervals is recommended (OIE 2008e).

There are no previous biosecurity measures for equid herpesviruses. The Code recommendations include premises freedom from EHV-1 (abortigenic and neurological strains) for equines (OIE 2011o).

Conclusion

EHV-1 to EHV-9 inclusive are present in approved countries. EHV-1 is notifiable in Australia and EHV-6 and EHV-9 have not been reported in Australia and have the potential for cross-species transmission. Accordingly, based on the preceding

information, risk management measures for EHV 1, 6 and 9 in zoo perissodactyls are warranted.

Australia's biosecurity measures for zoo perissodactyls are:

- For 21 days immediately before export the animal has not resided on any premises in the country of export where clinical, epidemiological or other evidence of equid herpesvirus-1 (abortigenic and neurological strains), equid herpesvirus-6 or equid herpesvirus-9 have occurred during the previous 21 days.

Equine granulocytic anaplasmosis

Equine granulocytic anaplasmosis (EGA) is caused by *Anaplasma phagocytophilum*, an obligate intracellular organism within the order Rickettsiales. It is transmitted by *Ixodes* spp. ticks and causes disease in horses, humans (human granulocytic anaplasmosis), deer, ruminants (tick-borne fever), cats, dogs and rodents (Dumler et al. 2001; Dumler et al. 2005). Infection with *A. phagocytophilum* has been reported in donkeys in Italy (de la Fuente et al. 2005).

A. phagocytophilum is endemic in regions of Asia, Europe, North America, Russia and South America. The disease agent has not been reported in Australia, Belgium, Finland, Hong Kong, Ireland, Luxembourg, Macau, New Zealand, Singapore and United Arab Emirates.

EGA is not an OIE-listed disease (OIE 2012). It is absent from Australia and is not a nationally notifiable animal disease.

Reservoir hosts are primarily rodents and ruminants. Other mammals such as cats, dogs, horses, humans and white-tailed deer are sentinels for the presence of infection (Bown et al. 2003; Dumler et al. 2005; Liz et al. 2000; Vredevoe et al. 1999). Horses are considered aberrant hosts due to the absence of persistent infection (Pusterla and Madigan 2007a). Although serological evidence of infection with *Anaplasma* spp. has been reported in zebras in Kenya, there are no reports of *A. phagocytophilum* in African wildlife (Ngeranwa et al. 2008).

The incubation period ranges from ten to 20 days and clinical signs vary with age, immune status and species of animal. Transmission to mammals occurs via the bite of an infected tick vector. *Ixodes* spp. are the principal biological vectors, the species of which varies depending on geographical location (Bown et al. 2003; Dumler et al. 2005; Rikihisa 2006). *Ixodes* spp. are present in Australia, mainly in coastal regions, and are likely to be capable of transmitting the disease.

There are no reports of EGA or *A. phagocytophilum* detection in non-equid perissodactyls and it is not considered further in these species.

There are no previous biosecurity measures for EGA and there are no recommendations in the Code. A risk assessment was undertaken for the horse IRA and risk management measures were not recommended for EGA (Biosecurity Australia 2010).

Conclusion

EGA is present in approved countries. However, there is no evidence that zoo perissodactyls play a significant role in the epidemiology of EGA.

Accordingly, based on the preceding information and consistent with the recommendations in the horse IRA, risk management measures for EGA are not warranted.

Equine infectious anaemia

Equine infectious anaemia (EIA), a debilitating disease of equids worldwide, is caused by a virus belonging to the lentivirus genus of the family Retroviridae (Linial et al. 2005). EIA only affects equids (Herholz et al. 2008).

EIA is widespread around the world. In Europe, EIA is endemic in Romania and sporadic cases and outbreaks have been reported in Belgium, Croatia, France, Germany, Greece, Ireland, Italy and the United Kingdom (OIE 2011h; Promed Mail 2010a; Promed Mail 2010b). Cases have also been reported in the United States (Promed Mail 2010c). Many countries implement control and eradication programs for EIA. EIA is endemic in parts of Queensland in Australia.

EIA is an OIE-listed disease (OIE 2012) and is a nationally notifiable animal disease in Australia (DAFF 2011).

The incubation period is usually 1–3 weeks but can be as long as three months (Cheevers and McGuire 1985). EIA is a typical blood-borne infection and the recognised routes of transmission are by the mechanical transfer of blood by biting flies or iatrogenically (Leroux et al. 2004). However, other forms of transmission are possible (More et al. 2008a; More et al. 2008b).

There are no reports of EIA or EIA virus isolation in non-equid perissodactyls and it is not considered further in these species. Similarly, there is very little information regarding EIA in zoo equids and one study from South Africa did not detect any antibodies to EIA in zebras (Barnard 1997).

Early diagnosis may be difficult because serologic tests can be negative 10–14 days after infection (Coggins et al. 1972). Diagnostic tests such as the AGID (also known as the Coggins test), ELISA and polymerase chain reaction (PCR) assay, used alone or in combination, identify infected horses which are then either isolated or euthanased in efforts to control the spread of disease (Brangan et al. 2008).

Australia's previous biosecurity measures for EIA in zoo perissodactyls included premises freedom. The Code recommendations include premises freedom and diagnostic testing for equines (OIE 2011l).

Conclusion

EIA is present in approved countries and in parts of Australia. The disease is nationally notifiable in Australia. Based on the preceding information and in accordance with the recommendations in the Code (OIE 2011l), risk management measures continue to be warranted.

Australia's biosecurity measures for EIA for zoo equids are:

- For 60 days immediately before export the animal has not resided on any premises in the country of export where clinical, epidemiological or other evidence of equine infectious anaemia has occurred during the previous 90 days.

Equine influenza

Equine influenza virus (EIV) is part of the family Orthomyxoviridae (genus Influenzavirus A), that cause influenza in humans and a variety of animals, including birds, horses and pigs. Influenza A viruses are further subtyped by haemagglutinin (H) and neuraminidase (N) envelope glycoproteins. All known subtypes (H1-15 and N1-9) have been isolated from aquatic birds. Two subtypes (H7N7 and H3N8), first isolated in 1956 and 1963 respectively, affect horses (Kawaoka et al. 2005). Antigenically distinct European and American lineages of the H3N8 subtype are recognised and, in addition to antigenic drift, this can influence vaccine efficacy. The H7N7 subtype (A/eq/Prague/56) has not been isolated since 1980 (Webster 1993), although serological evidence of virus presence was recorded in Eastern Europe in 1996 (Madic et al. 1996).

EIV is highly contagious in donkeys, horses, mules and zebras, affecting all ages and breeds (Nyaga et al. 1980). Experimental infection with equine H3N8 viruses has produced mild influenza-like illness and seroconversion in humans (Kasel and Couch 1969). EI is not considered a zoonotic disease and transmission of EIV to humans under natural conditions of exposure has not occurred (Davenport et al. 1967).

EI is an OIE-listed disease (OIE 2012). It is absent from Australia and is a nationally notifiable animal disease (DAFF 2011).

Australia was free from EI until August 2007, when the disease was introduced with imported horses. Australia and New Zealand are the only countries with significant equine industries that are currently free from equine influenza. EIV has not been reported in Iceland and some Pacific Islands.

Transmission of EIV can occur by aerosol inhalation, direct contact and via fomites (Radostits et al. 2007g). Aerosol spread over at least 32 metres of droplet-borne EIV from an infected horse was reported (Miller 1965) and infection by aerosol facilitates spread within closed groups (Radostits et al. 2007g). On a few occasions, transmission over longer distances has occurred.

Naïve, experimentally infected equids show clinical signs of disease, with pyrexia (38.5–41 °C) peaking at 48 to 96 hours after infection (Landolt et al. 2007; Radostits et al. 2007g). A dry and hacking cough develops and can last for 1–3 weeks. Serous nasal discharge can occur and may become mucopurulent. Virus is shed within 48 hours of infection and up to seven days (Crouch et al. 2004; Edlund Toulemonde et al. 2005; Heldens et al. 2004; Soboll et al. 2003). The fatality rate is generally less than 1% (Radostits et al. 2007g).

Definitive diagnosis of EI is achieved by detecting virus or viral product from nasopharyngeal swabs. Quantitative PCR assays have been developed that allow rapid detection and quantification of viral RNA in swab material. Serological tests can be performed on paired sera to demonstrate a rise in antibody concentration, with the first sample being taken as early in the course of infection as possible and the second approximately two weeks later (OIE 2008c). Antigen may be detected using an antigen-capture ELISA based on a monoclonal antibody to the nucleoprotein (Cook et al. 1988; Livesay et al. 1993).

Vaccination reduces both the clinical signs of EI and the extent of viral shedding in horses and ponies. However, viral shedding can occur in vaccinated horses without obvious clinical signs of disease (Chambers et al. 2001; Crouch et al. 2004).

Susceptibility to reinfection and the presence of mild clinical signs in infected vaccinated horses can make diagnosis difficult and this has been a major contributor to the spread of infection to susceptible populations (Hannant and Mumford 1996).

Equids are the only known reservoir of EI viruses. There is no evidence that non-equid perissodactyls play a significant role in the epidemiology of EI, but data are limited. However, due to zoos' high biosecurity levels, the risk of their involvement in disease transmission is negligible. Consequently EI is not considered further in these species.

There is limited information about the susceptibility of zoo equids to EI and their role in its transmission, but based on their close genetic relationship to domestic horses, they are likely to be similar.

Australia's previous biosecurity measures for EI in zoo equids included premises freedom and vaccination. The Code recommendations include country freedom or premises freedom, vaccination and optional testing for equines (OIE 2011m). A risk assessment was undertaken for the horse IRA and risk management measures were recommended for equids including country freedom, or premises freedom, vaccination, pre-export quarantine (PEQ), testing and post-arrival quarantine (PAQ) (Biosecurity Australia 2010).

Conclusion

EI is present in approved countries and Australia's biosecurity measures for EI differ to those in the Code (OIE 2011m). Accordingly, based on the preceding information and consistent with the recommendations in the horse IRA (Biosecurity Australia 2010), risk management measures for zoo equids continue to be warranted. No risk management measures are required for non-equid perissodactyls.

Australia's biosecurity measures for EI for zoo equids are:

- For 60 days immediately before export the animal was continuously resident and free of quarantine restriction in a country where no clinical, epidemiological or other evidence of equine influenza has occurred during the previous 12 months, vaccination against equine influenza is not practised, and the disease is compulsorily notifiable.

OR

For all animals including unweaned foals less than six months of age, except where otherwise specified:

- For 21 days immediately before export the animal has not resided in any premises in the country of export where clinical, epidemiological or other evidence of equine influenza has occurred during the previous 30 days.

  AND

- The animal (other than foals under six months of age) was vaccinated against equine influenza 21–90 days before commencement of PEQ with either a primary course or a booster according to the manufacturer's recommendations using an inactivated vaccine.

  AND

- The animal was held in PEQ before export. During this time the animal was

isolated at least 100 metres from equids not of equivalent health status.

AND

- A nasopharyngeal sample was taken from the animal four to seven days after commencement of PEQ and tested using a polymerase chain reaction for influenza A virus with negative results.

Requirements for PEQ include:

- All personnel entering the PEQ facility during PEQ must shower and change clothing on entry. Alternatively, they may shower off-site and must have no contact with equids or equid facilities between showering and entering the PEQ facility. Outer clothing used in the PEQ facility should be freshly laundered or dedicated to the facility and stored on site or disposable. Footwear used in the PEQ facility should be cleaned and disinfected before entry or dedicated to the facility and stored on site, or disposable covering should be used over existing footwear.
- All equipment used in feeding, handling and treating the equid in PEQ must be new or cleaned and disinfected with a product effective against equine influenza virus before use and must be used only in the PEQ facility for the duration of PEQ.
- Equids in PEQ must not access any areas used by other equids unless specifically authorised by DAFF.
- Vehicles for transporting equids from the PEQ facility to the place of export must be cleaned and disinfected with a product effective against equine influenza virus.

Requirements for post- arrival quarantine include:

- The animal must be held in PAQ for at least 14 days. During this time the animal was isolated at least 100 metres from equids not of equivalent health status.
- All personnel entering the quarantine approved premises (QAP) during PAQ must wear dedicated or disposable outer clothing and dedicated, cleaned, disinfected or disposable footwear. All personnel must shower and change outer clothing before leaving the QAP. Outer clothing and footwear used within the QAP must be cleaned to the satisfaction of DAFF before removal from the facility.
- All equipment used in feeding, handling and treating equids in PAQ must be either cleaned and disinfected with a product effective against equine influenza to the satisfaction of DAFF before removal from the QAP, or remain on site for the duration of PAQ and then be released with DAFF approval at the completion of PAQ.
- Vehicles for transporting horses are not permitted to leave QAP until thoroughly cleaned and disinfected to the satisfaction of the DAFF quarantine officer.

Equine protozoal myeloencephalitis

Equine protozoal myeloencephalitis (EPM) is a parasitic neurological disease caused by the parasite *Sarcocystis neurona*. Definitive hosts of *S. neurona* are American opossums (*Didelphis virginiana* and *D. albiventris*). EPM is the most common infectious neurological disease of horses in the United States and has also been reported in Brazil, Canada (Sellon and Dubey 2007), France (Lam et al. 1999; Pitel et al. 2003), Hong Kong (Lam et al. 1999; Pitel et al. 2003), India (Brown et al. 2006) and Japan (Katayama et al. 2003). There are no reports of infection or disease in zoo perissodactyls.

EPM is not an OIE-listed disease (OIE 2012). It has not been reported in Australia and is not a nationally notifiable animal disease.

Definitive hosts are infected by ingesting sarcocyst-containing tissue of intermediate hosts. The sarcocysts undergo sexual reproduction in the intestine of the definitive host and sporocysts are excreted in their faeces. Intermediate hosts ingest infective sporocysts and after a series of asexual reproductive cycles, sarcocysts locate in skeletal muscle (MacKay et al. 2000). Horses — considered to be aberrant, intermediate hosts — are infected through ingestion of feed or water contaminated with sporocyst-containing opossum faeces. The infective stages localise in the central nervous system and does not encyst in muscle, making the horse a dead-end host (Sellon and Dubey 2007). Occurrence of disease is sporadic in endemic areas although outbreaks confined to individual farms have been recorded. Seroprevalence of *S. neurona* infection in horses is 30–50% in Argentina and the United States (Dubey et al. 2001) and 36–69.6% in Brazil (Dubey et al. 1999).

The definitive hosts of *S. neurona* do not occur in Australia.

Many horses do not show clinical signs of disease which include focal muscle asymmetry, gait abnormalities, depression, facial paralysis, head tilt and dysphagia. The clinical signs can progress rapidly or remain stable for a prolonged period (Sellon and Dubey 2007). Treatment with antiprotozoal drugs is prolonged and relapses can occur when treatment ends (Radostits et al. 2007d). Definitive diagnosis can be difficult due to the high prevalence of antibody to *S. neurona* in North American horses (Sellon and Dubey 2007).

There are no previous biosecurity measures for EPM and there are no recommendations in the Code.

Conclusion

EPM is present in approved countries. However, there is no evidence that zoo perissodactyls play a significant role in the epidemiology of EPM.

Accordingly, based on the preceding information, risk management measures for EPM are not warranted.

Equine viral arteritis

Equine viral arteritis (EVA) is caused by equine arteritis virus (EAV) of the genus Arterivirus (Snijder et al. 2005). EVA is characterised by panvasculitis, respiratory disease and abortion (Del Piero 2000). The only countries in which EAV has not been reported are Iceland, Japan and Singapore (Timoney and McCollum 1993). EVA is a disease of horses and has been induced experimentally in donkeys. Serological evidence of infection has been found in donkeys, mules and zebras (Borchers et al. 2005; McCollum et al. 1995; Paweska et al. 1996; Turnbull et al. 2002) and an alpaca that aborted in Germany (Weber et al. 2006).

There is only one known serotype of EAV, but several strains differ in abortigenic potential, virulence in the respiratory and reproductive tracts, and in the severity of the clinical disease they cause (Balasuriya et al. 1999a; Balasuriya et al. 1999b; Belák et al. 1999; Murphy et al. 1992; Timoney and McCollum 1993). There is serological evidence that EAV has been circulating in the Australian horse population since before 1975 (Animal Health Australia 2008; Huntington et al. 1990). The strains present in Australia are of low virulence.

EVA is an OIE-listed disease (OIE 2012) and a nationally notifiable animal disease in Australia (DAFF 2011).

The most common routes of transmission are via semen and the respiratory tract (Timoney and McCollum 1993) and both can occur in an outbreak. Venereal transmission during natural service or artificial insemination is the primary method of infection on breeding farms and transmission rates can be as high as 85–100% (Glaser et al. 1997). EAV can also be transmitted by fomites and personnel (Timoney and McCollum 1993).

The carrier state occurs in 30–70% of stallions exposed to EAV and constitutes the natural reservoir of the virus (Balasuriya et al. 1998; Timoney et al. 1986; Timoney et al. 1987). Duration of the carrier state varies from months to life in mature stallions — with no adverse effects on stallion health or fertility (Holyoak et al. 1993). The level of EAV infection within breeds and populations is determined by the number of carrier stallions, and there is considerable variation in seroprevalence between countries and breeds (Holyoak et al. 2008). There is no evidence of a carrier state in mares, foetuses, foals under six months of age, or geldings (Timoney and McCollum 1988). Congenital infections can occur and the placenta, placental fluids and foetus are sources of virus (Vaala et al. 1992).

The incubation period is 2–14 days; however, the majority of cases are subclinical, especially in mares bred to carrier stallions (Cole et al. 1986; Glaser et al. 1997; Timoney and McCollum 1993). Clinical outbreaks are characterised by any of the following: abortion at 3–10 months gestation, severe interstitial pneumonia or enteritis in neonates, systemic illness in adult horses and persistent infection in stallions. EAV can be isolated from body fluids (nasopharyngeal washings, blood, semen and foetal fluids) and tissues as early as two days and up to 60 days post-infection (de Vries et al. 1996; Glaser et al. 1997). Horses can shed virus for up to 28 days after they have been vaccinated. To prevent infection of seronegative horses, vaccinated horses should be isolated for 21 days immediately after they have been vaccinated (OIE 2010c).

Outbreaks are controlled by quarantine and surveillance. The amount of time required for, and the inherent difficulties in diagnosing EVA (Holyoak et al. 2008), can allow the virus to be widely disseminated before control measures are implemented.

There is no evidence that EVA occurs in non-equid perissodactyls and it is not considered further in these species.

There is no evidence that zoo equids play a significant role in the epidemiology of EVA. A seroprevalence of 24% has been found in one wild zebra population in the Serengeti National Park (Borchers et al. 2005; Paweska et al. 1997), indicating exposure to EAV. However, earlier studies of wild zebras in the Kruger National Park and zebras in game reserves and zoos found no evidence of exposure to EAV (Barnard and Paweska 1993; Paweska et al. 1997). There are no reports confirming transmission or isolation of EAV in zoo equids.

There are no previous biosecurity measures for EVA. The Code recommendations include isolation, diagnostic testing and vaccination for trade in equines.

Conclusion

EVA is present in approved countries. Based on the preceding information and in accordance with the recommendations in the Code (OIE 2011p), risk management measures are warranted for zoo equids. No risk management measures are required for non-equid perissodactyls.

Australia's biosecurity measures for EVA for zoo equids are:

- For 28 days immediately before export the animal has not resided on any premises in the country of export where clinical, epidemiological or other evidence of equine viral arteritis has occurred during the previous 28 days.

Equine viral encephalitides

Equine viral encephalitides, caused by Eastern, Western and Venezuelan equine encephalitis (EEE, WEE and VEE, respectively) viruses are arthropod-borne infections of donkeys, horses, mules and humans. EEE and WEE viruses occasionally also cause disease in birds and other mammals (Geering et al. 1995g). They are Alphaviruses belonging to the family Togaviridae (Weaver et al. 2005). Their natural cycles are between birds and/or small mammals and mosquitoes (CFSPH 2008).

WEE occurs in Canada, Central and South America and the United States (Zacks and Paessler 2010). There are two variants of EEE virus — one found in Canada and the United States, and the other in Central and South America. The North American variant is more pathogenic. VEE virus is found in Central and South America. The United States is free of epidemic VEE virus — the last reported epidemics of VEE were during 1969–1972. EEE, WEE and VEE have never been reported in Australia.

EEE[1], WEE[1] and VEE[1] are OIE-listed diseases (OIE 2012). They are absent from Australia and are nationally notifiable animal diseases (DAFF 2011).

The incubation period for EEE and WEE is 1–14 days, and for VEE is 1–5 days. Infection with EEE and WEE viruses can be clinical or subclinical (CFSPH 2008). A

[1] The OIE uses the term equine encephalomyelitis. Most of the scientific literature refers to it as equine encephalitis and this is the term used herein.

large number of horses that survive have residual neurological deficits. Horses are considered dead-end hosts for both EEE and WEE and therefore do not transmit virus to other animals or vectors. The case fatality rate in equids ranges from 20% to 30% for infection with WEE virus and from 40% to 80% for EEE virus infections (Radostits et al. 2007g). Infection with endemic forms of VEE virus causes subclinical disease in horses. Infection with epidemic forms of the virus causes clinical signs similar to EEE and WEE viruses. VEE virus can also cause severe respiratory disease in horses.

Vaccines for EEE and WEE are formalin-inactivated, safe and effective (OIE 2008b); however, VEE vaccines must be attenuated since formalin-inactivated virulent VEE vaccines can cause severe illness in horses and result in epidemics of VEE (OIE 2008k).

There are no reports of EEE or WEE in zoo equids; but there is one report of VEE in zebras which is not specifically referenced (CFSPH 2008). However, vaccination of zoo equids against these diseases has been recommended (Bittle 1993; Woodford 2000). Based on this information the risk of equine viral encephalitides in zoo equidae is considered to be similar to that for domestic horses and they are very unlikely to transmit these viruses.

There are no reports of infection or transmission of these diseases in rhinoceroses. However, there is no overlap in the natural distributions of rhinoceroses and the equine viral encephalitides, so their susceptibility is unknown.

There are no reports confirming tapirs are susceptible to equine viral encephalitides, although positive serological titres have been reported for VEE in Baird's tapirs in Costa Rica, and for EEE and WEE in tapirs in Brazil (Hernandez-Divers et al. 2007). It has been recommended that tapirs should be vaccinated against EEE, WEE and VEE if the diseases are present in the area (Kuehn 1986). Generally speaking, current practice in North American zoos is to not vaccinate tapirs, although individual zoos may vaccinate depending on regional prevalence of these diseases (A. Reiss, Zoo and Aquarium Association, pers. comm. October 2011).

Australia's previous biosecurity measures for zoo perissodactyls were for VEE only and included country freedom. The Code recommendations include country freedom or vaccination and isolation (including from vectors) or isolation (including from vectors) and diagnostic testing (OIE 2011z).

Conclusion

EEE and WEE are present in approved countries. However, there is no evidence that zoo perissodactyls play a significant role in the epidemiology of the diseases.

Accordingly, based on the preceding information, risk management measures for EEE and WEE are not warranted.

VEE (epidemic form) is not present in approved countries. Based on the preceding information and in accordance with the recommendations in the Code (OIE 2011z), risk management measures continue to be warranted.

Australia's biosecurity measures for zoo perissodactyls include:

- For 60 days immediately before export the animal was continuously resident and free of quarantine restriction in a country where no clinical, epidemiological or other evidence of Venezuelan equine encephalitis has occurred during the

previous two years and the disease is compulsorily notifiable.

AND

- The animal was not vaccinated against Venezuelan equine encephalitis during the 60 days before export.

Foot-and-mouth disease

Foot-and-mouth disease (FMD) is a highly contagious viral disease that primarily affects cloven-hoofed animals. FMD is endemic in most of Asia, Africa, the Middle East and parts of South America. Much of Europe is free as are all of North America and the Australasian region.

FMD is primarily a disease of artiodactyls (even-toed ungulates); however, there are reports of other species being experimentally infected including elephants (Howell et al. 1973), hedgehogs, kangaroos (Bhattacharya et al. 2003; Snowdon 1968), wallabies and wombats (Snowdon 1968). FMD has been seen in South American and Malayan tapirs during an outbreak at a European zoo (Ramsay and Zainuddin 1993). There have also been unsubstantiated reports of deaths of tapirs in Peru due to FMD (Hernandez-Divers et al. 2007; Hernandez-Divers et al. 2005). Horses are not susceptible to FMD virus and there are no reports of equids or rhinoceroses being involved in the epidemiology of FMD outbreaks. Therefore FMD is not considered further in these species.

FMD is a multiple species OIE-listed disease (OIE 2012). It is absent from Australia and is a nationally notifiable animal disease (DAFF 2011).

The incubation period is variable, ranging from 18 hours to 14 days and there are a wide range of clinical signs. FMD spreads by direct contact between animals and contact with infected animal products, airborne virus or contaminated fomites.

A number of diagnostic tests are available for detecting and identifying whole virus, virus antigen and viral antibodies (OIE 2009b).

There are no previous biosecurity measures for FMD. The Code recommendations include country freedom (OIE 2011q).

Conclusion

FMD is not present in approved countries. There is no evidence that zoo equids and rhinoceroses play a significant role in the epidemiology of the disease and risk management measures are not recommended for these species. However, FMD is a significant disease in tapirs. Based on the preceding information and in accordance with recommendations in the Code (OIE 2011q), risk management measures are warranted.

Australia's biosecurity measures for FMD for tapirs are:

- For 90 days immediately before export the animal was continuously resident and free of quarantine restriction in a country where no clinical, epidemiological or other evidence of foot-and-mouth disease has occurred during the previous 12 months and the disease is compulsorily notifiable.

Glanders

Glanders is a highly contagious zoonotic bacterial disease caused by *Burkholderia mallei*, which mainly affects equids (Dvorak and Spickler 2008). Once prevalent virtually worldwide, glanders has been eradicated from many countries, including Canada, Western Europe and the United States (Dvorak and Spickler 2008). However, the disease persists in some African, Asian and South American countries (OIE 2010b). Several cases of glanders in horses were detected in Bahrain (Promed Mail 2010d; Promed Mail 2011a) and Lebanon (Promed Mail 2011b) in 2010–11.

Glanders is an OIE-listed disease (OIE 2012). It is absent from Australia and is a nationally notifiable animal disease (DAFF 2011).

In animals, the incubation period is typically 2–6 weeks but can vary from a few days to many months with natural infection (van der Lugt and Bishop 2004). Transmission occurs directly or indirectly through contact with skin exudates and respiratory secretions, which may contain large numbers of organisms (CFSPH 2007b) or in carnivores via consumption of infected meat (Miller et al. 1948). Transmission in equids most commonly occurs through ingestion of the organism, respiratory exposure or by entry through skin abrasions or mucous membranes (Dvorak and Spickler 2008).

There are no reports of glanders in non-equid perissodactyls and they are not considered important in the epidemiology of the disease. It is not considered further in these species. The susceptibility of zoo equids to glanders is poorly understood.

Isolation and identification of *B. mallei* in cultures of samples is considered the gold standard for diagnosis of glanders (Dvorak and Spickler 2008). The mallein test is sensitive and specific — and although it can give inconclusive results, the intradermo-palpebral test is the most sensitive, reliable and specific test for detecting infected perissodactyls (OIE 2008f). There are no vaccines available.

Australia's previous biosecurity measures for glanders in zoo perissodactyls included premises freedom. The Code recommendations include country freedom for trade in equines (OIE 2011r).

Conclusion

Glanders is not present in approved countries. Based on the preceding information and in accordance with recommendations in the Code (OIE 2011r), risk management measures continue to be warranted for zoo equids. No risk management measures are required for non-equid perissodactyls.

Australia's biosecurity measures for glanders for zoo equids are:

- For 180 days immediately before export the animal was continuously resident and free of quarantine restriction in a country where no clinical, epidemiological or other evidence of glanders has occurred during the previous three years and the disease is compulsorily notifiable.

Heartwater

Heartwater is a tick-borne, rickettsial disease of ruminants caused by *Ehrlichia ruminantium* (formerly *Cowdria ruminantium*). It is confined to Africa, some Caribbean islands and was reported as suspected but not confirmed in Vietnam in 2010. Its distribution is confined to that of its *Amblyomma* tick vectors (OIE 2009c).

Heartwater is a multiple species OIE-listed disease (OIE 2012). It is absent from Australia and is a nationally notifiable animal disease (DAFF 2011).

Although there is no definitive evidence, some consider that rhinoceroses could be susceptible to heartwater (Doyle et al. 1995). There are reports of a high prevalence of antibody to *E. ruminantium* in rhinoceroses from some parts of Africa (Doyle et al. 1995; Kock et al. 1992). However, due to the poor specificity of the competitive enzyme-linked immunosorbent assay (C-ELISA) used, positive results could be possible cross-reactions to antibodies raised against other *Ehrlichia* spp. (Deem 1998; Jongejan et al. 1993; Peter et al. 2002). There are no reports of clinical disease in, or isolation of *E. ruminantium* from rhinoceroses.

Heartwater tick vectors (*Amblyomma* spp.) have been identified on rhinoceroses imported into the United States from South Africa (Wilson and Richard 1984).This emphasises the importance of external parasite treatment in preventing the introduction of heartwater. Nonetheless, there are no reports of transmission of *E. ruminantium* to rhinoceroses from ticks and no evidence that heartwater occurs in other zoo perissodactyls.

Australia's previous biosecurity measures for heartwater in zoo perissodactyls included premises freedom. The Code recommendations include diagnostic testing and treatment for ticks for domestic and wild ruminants (OIE 2011s).

Conclusion

Heartwater is not present in approved countries and there is no evidence that zoo perissodactyls play a significant role in the epidemiology of heartwater.

Accordingly, based on the preceding information, risk management measures for heartwater are not warranted.

Japanese encephalitis

Japanese encephalitis (JE) is a mosquito-borne viral disease that causes encephalitis in humans, horses, donkeys, mules, zebra and humans, and abortion and stillbirths in sows (Calisher and Walton 1996). Pigs and ardeids (bitterns, egrets and herons) are the main amplifier hosts. Other mammalian species can become infected but are not considered significant in the epidemiology of the disease (Brown 2008a).

JE virus is widely distributed in Asia and Papua New Guinea (OIE 2009e; van den Hurk et al. 2002). It was last reported in 2000 in Hong Kong and in 1988 in Singapore (OIE 2009a; OIE 2009d). It has not been reported in the Americas or Europe (CDC 2008). JE virus is the prototype of the JE serogroup of flaviviruses, which includes Kunjin virus, Murray Valley encephalitis virus, St Louis encephalitis virus and West Nile virus (Thiel et al. 2005).

JE is a multiple species OIE-listed disease (OIE 2012). It is absent from the Australian mainland and is a nationally notifiable animal disease (DAFF 2011).

Horses and humans are susceptible to infection, which can cause severe illness (Lam et al. 2005) and mortality rates of 5–40% (Calisher and Walton 1996); however most infected horses do not show clinical signs of disease. In addition, the low grade viraemia is insufficient to infect mosquitoes (Gould et al. 1964) and horses are considered to be dead-end hosts.

The rates of natural infection in unvaccinated horses in Japan, where JE is endemic, range from 15 to 67% (Konishi et al. 2004).

The definitive diagnosis of JE in horses depends on isolation of virus, which can be difficult due to viral instability (Lian et al. 2002). Antibodies to other flaviviruses may cause serological cross reactivity and false positive results (OIE 2010e).

There is no information on infection of zoo perissodactyls with JE virus, but they are likely to be susceptible due to their close phylogenetic relationship with horses and the multi-host status of JE. Similarly, they are likely to be dead-end hosts.

There are no previous biosecurity measures for JE. The Code recommendations include insect-free isolation or vaccination for horses (OIE 2011t).

Conclusion

JE is not present in approved countries and there is no evidence that zoo perissodactyls play a significant role in the epidemiology of JE.

Accordingly, based on the preceding information, risk management measures for JE are not warranted.

Johne’s Disease

Johne’s disease is a chronic wasting disease of ruminants caused by the bacteria *Mycobacterium avium* subsp. *paratuberculosis (M. paratuberculosis).* There are three strains that usually affect different host species. Bovine Johne's Disease (BJD), caused by Type II or bovine strains of *M. paratuberculosis*, affects mainly cattle, goats, deer and alpaca. Ovine Johne's disease (OJD) caused by Type I or ovine strains of *M. paratuberculosis*, affects mainly goats and sheep. There is also a Type III or intermediate strain (Gwozdz 2010; Radostits et al. 2007h).

Equids are not susceptible and are not considered further.

There is one reported case of Johne’s disease in a rhinoceros in a zoo in Australia (Whittington et al. 2000). It is unknown whether *M. paratuberculosis* affects free-ranging or captive tapir populations.

Johne’s disease is not an OIE-listed disease (OIE 2012), but it is a nationally notifiable animal disease (DAFF 2011) and endemic in Australia although not common. Due to economic effects both BJD and OJD are subject to a national control program (Animal Health Australia 2011b).

Transmission of *M. paratuberculosis* is usually by ingestion of milk or feed or water contaminated with infected faeces. Johne’s disease has a typically long incubation period with clinical disease occurring only in older animals (Radostits et al. 2007h). There is no effective treatment and affected animals become emaciated and eventually

die or are destroyed.

Tests for Johne's disease in cattle and sheep lack sensitivity and specificity, making diagnosis of individual sub-clinically infected and disease-free animals difficult (Gwozdz 2010). These tests have not been validated in non-equid perissodactyls.

There are no previous biosecurity measures for Johne's disease and there are no recommendations in the Code.

Conclusion

Johne's disease is present in approved countries and in parts of Australia. The disease is nationally notifiable in Australia and there are control measures. Accordingly, based on the preceding information, risk management measures for Johne's disease are warranted for rhinoceroses. No risk management measures are required for zoo equids or tapirs.

Australia's biosecurity measures for Johne's disease for rhinoceroses are:

- For 180 days immediately before export the animal has not resided on any premises in the country of export where clinical, epidemiological or other evidence of Johne's disease has occurred during the previous five years.

  AND

- Within six months of export, a faecal culture for *Mycobacterium avium* subsp *paratuberculosis* was performed, with negative results.

Leptospirosis

Leptospirosis is a contagious disease of animals and humans caused by infection with the spirochaete *Leptospira*. There are more than 200 leptospiral serovars in 23 serogroups. Leptospirosis occurs worldwide and is more prevalent in tropical areas. Dogs are recognised as the maintenance host in most countries. Horses appear to be incidental hosts of seven leptospiral serovars and suspected maintenance hosts of serovar Bratislava (Divers et al. 1992; Ellis 1999). In Australia, serovars isolated from horses include Australis, Bratislava, Canicola, Grippotyphosa, Hardjo, Icterohaemorrhagicae, Pomona and Tarassovi (Biosecurity Australia 2000; Hogg 1983; Slatter and Hawkins 1982). Seroprevalence studies have shown 30% of eastern Australian horses have evidence of exposure (Dickeson and Love 1993; Slatter and Hawkins 1982). In Australia, disease occurs sporadically in humans, cattle, pigs and occasionally other species.

Leptospirosis is a multiple species OIE-listed disease (OIE 2012). It is not a nationally notifiable animal disease in Australia.

Leptospires live in renal tubules of carrier animals and are excreted in urine. Infections occur from direct exposure to urine, semen and milk, or indirectly via environmental exposure to contaminated water. Rodents, particularly rats, are the main reservoir hosts. Some serovars are carried by livestock. Humans are most likely to be infected by urine from carrier animals or contaminated surface water, mud and soil (Faine 1998).

The incubation period in animals is 2–20 days. Most infections in horses are subclinical. When overt disease develops clinical signs usually last 5–18 days, and

include mild pyrexia with anorexia — and in more severe forms — haemoglobinuria, icterus, mucosal petechiae, conjunctival oedema, uveitis, late term abortions and neonatal deaths (Faine et al. 1999; Hartskeerl et al. 2004; Hogg 1974).

Multispecies and multi-serotype disease has been recorded in equids (Radostits et al. 2007b). Serological evidence of leptospirosis has been recorded in rhinoceroses and tapirs (Fischer-Tenhagen et al. 2000; Hernandez-Divers et al. 2007).

Current serological tests and culture techniques are not able to demonstrate that an animal is free from leptospirosis. Antibiotic treatment to clear renal carriage of leptospires is not consistently successful and has not been validated in all species subject to international trade. Vaccination is not practical in horses as they are susceptible to multiple serovars and cross-immunity between serovars does not occur (Faine et al. 1999).

There are no previous biosecurity measures for leptospirosis and there are no recommendations in the Code.

Conclusion

Leptospirosis is present in approved countries and Australia. There are no recommendations in the Code and testing and treatment are unreliable.

Accordingly, based on the preceding information, risk management measures for leptospirosis are not warranted.

Louping ill

Louping ill is a tick-borne encephalitis caused by a virus belonging to the genus Flavivirus in the family Flaviviridae (Thiel et al. 2005). It is primarily a disease of sheep, although other species such as cattle, deer, dogs, goats, grouse, horses and llamas can be affected (Brown 2008b). Humans are rarely affected (Radostits et al. 2007g). The disease has been reported in Europe in areas where the tick vector *Ixodes ricinus* is distributed (Radostits et al. 2007g).

Louping ill is not an OIE-listed disease (OIE 2012). It is absent from Australia and is a nationally notifiable animal disease (DAFF 2011).

Other ixodid tick species capable of transmitting the virus include *I. persulcatus*, *Haemaphysalis anatolicum* and *Rhipicephalus appendiculatus* (CFSPH 2005c). There are no known tick vector species in Australia. In the absence of a competent vector, it is unlikely that the louping ill virus could become established (Geering et al. 1995h).

There are no previous biosecurity measures for louping ill and there are no recommendations in the Code.

Conclusion

Louping ill is present in approved countries. However, there are no known competent vectors for the virus in Australia.

Accordingly, based on the preceding information, risk management measures for louping ill are not warranted.

Lyme disease

Lyme disease is caused by the tick-borne spirochaete *Borrelia burgdorferi* sensu lato (s.l.) (Burgdorfer et al. 1982). Clinical and subclinical infections have been reported in humans (Parker and White 1992) and multiple species including donkeys, horses, onagers, Przewalski's horses and zebras (Divers 2007; Stoebel et al. 2003). A serological survey found evidence of widespread exposure to Lyme disease in zoo animals in Germany including perissodactyls (equids, rhinoceroses and tapirs) (Stöbel et al. 2002; Stoebel et al. 2003). Lyme disease is the most commonly reported tick-borne disease in humans in Asia, Europe and the United States (Steere et al. 2004).

Lyme disease is not an OIE-listed disease (OIE 2012). The disease agent has not been isolated in Australia and is not a nationally notifiable animal disease.

B. burgdorferi s.l. is maintained in a two year cycle between ixodid ticks and small mammals (Anda et al. 1996; Burgdorfer et al. 1982). Horses serve as hosts for adult and nymphal stages of *Ixodes* spp. ticks (Bushmich 1994). There is no information on whether larval *I. holocyclus* can be infected and whether they retain infection after moulting (Piesman and Stone 1991).

There are 25 species of *Ixodes* ticks in Australia, none of which has been examined for competence in transmitting *B. burgdorferi* s.l. Serosurveillance and attempts at isolation from possible tick vectors, have failed to reveal conclusive evidence of Lyme disease in Australia (Doggett et al. 1997; Russell 1995).

The incubation period for Lyme disease in horses is not known, but is 2–5 months in dogs (CFSPH 2005d) and can be years in humans (Steere et al. 2004).

Nonvector transmission has been demonstrated experimentally in dogs and mice (Burgess et al. 1986) via oral, intramuscular and subcutaneous routes. In horses, the organism has been isolated from blood, urine and synovial fluid (Burgess 1988; Madigan 1993; Manion et al. 1998), and transplacental transmission has been reported (Burgess 1988; Burgess et al. 1988). Iatrogenic transmission is possible (Parker and White 1992), and there is potential for zoonotic spread (Manion et al. 1998; Marcelis et al. 1987).

Serological diagnosis is complicated by the long incubation period, presence of latent infections, cross-reactions with other spirochaetes and persistence of antibody titres for months or years (CFSPH 2005d). ELISA and the IFAT are used to diagnose exposure (Bosler et al. 1988; Magnarelli and Anderson 1989).

No current treatment protocol is effective for naturally acquired infections in equids (Chang et al. 2005).

There are no previous biosecurity measures for Lyme disease and there are no recommendations in the Code. A risk assessment was undertaken for the horse IRA and risk management measures for equids were recommended including country freedom, or premises freedom, PEQ, preventative treatment against ticks and PAQ (Biosecurity Australia 2010).

Conclusion

Lyme disease is present in approved countries. Accordingly, based on the preceding information and consistent with the recommendations in the horse IRA (Biosecurity

Australia 2010), risk management measures are warranted.

Australia's biosecurity measures for Lyme disease for zoo perissodactyls are:

- For 90 days immediately before export the animal was continuously resident and free of quarantine restriction in a country where no clinical, epidemiological or other evidence of Lyme disease has occurred during the previous two years.

OR

- For 60 days immediately before export the animal has not resided on any premises in the country of export where clinical, epidemiological or other evidence of Lyme disease has occurred in any species during the previous 90 days.

  AND

- The animal was held in PEQ before export. During this time the animal was isolated from animals not of equivalent health status.

  AND

- On arrival at the PEQ facility the animal was thoroughly examined under the direct supervision of the Official Veterinarian and no ticks were found. The animal was then treated immediately, under the direct supervision of the Official Veterinarian, with a long acting parasiticide effective against ticks.

  AND

- The animal was treated 21–28 days after initial treatment, under the direct supervision of the Official Veterinarian, with a long acting parasiticide effective against ticks to provide continual protection against tick infestation beyond the day of export. The final treatment must occur within seven days of export.

  AND

- If any animal in the PEQ facility was found to have ticks, all animals in the facility were treated again seven days later with a long acting parasiticide effective against ticks, under the direct supervision of the Official Veterinarian.

  AND

- Within 48 hours of arrival at the post-arrival quarantine approved premises (QAP) the animal was thoroughly examined by a registered veterinarian and no ticks found.

  AND

- If any animal in the QAP was found to have ticks, all animals in the facility were treated immediately, under the direct supervision of a registered veterinarian, with a parasiticide effective against ticks **or**

- If a registered veterinarian concludes the animal was unable to be thoroughly examined for ticks within 48 hours of arrival at the QAP, it was treated under the direct supervision of a registered veterinarian, with a parasiticide effective against ticks.

Nipah virus encephalitis

Nipah virus is closely related to Hendra virus. They are both members of the henipavirus genus in the family Paramyxoviridae (Lamb et al. 2005), are highly pathogenic in humans, but vary in the range of species they infect and the manner and ease with which they are transmitted. Hendra virus is present in Australia, but Nipah virus is not.

Nipah virus encephalitis is an OIE-listed disease (OIE 2012). It is absent from Australia and is a nationally notifiable animal disease (DAFF 2011).

Fruit bats in the genus *Pteropus* are the reservoir hosts of both Nipah and Hendra viruses and do not display serious signs of disease (OIE 2010d). Pteropid bats are widely distributed from Madagascar, through the Indian subcontinent to south-east Asia and Australia, through the Pacific to the Cook Islands, and the southernmost islands of Japan (Eaton et al. 2005). Antibodies to Nipah virus, or assumed closely related viruses, have been reported in pteropid bats in Bangladesh, Cambodia, China, Indonesia, Madagascar and Thailand (Li et al. 2008). Malaysian pteropid bats have a seroprevalence for Nipah virus antibodies of up to 20% (OIE 2010d).

The mechanism of spread from pteropid bats to other animals and humans has not yet been definitively shown. Virus has been isolated from pteropid bat urine, kidneys and uterine fluids. Hence it is likely that Nipah virus spreads from bats to other species by contamination of food and water sources with bat urine, uterine fluids and tissues, and possibly saliva. It may also spread if infected, aborted bat foetuses or reproductive tissues are ingested, for example by a pig.

The major transmission mechanism appears to be from bats to pigs, which act as amplifying hosts and then spread the virus by direct contact to other pigs and/or to other species— including humans, cats, dogs, goats and horses (CFSPH 2007c; OIE 2010d).

Outbreaks of Nipah virus first occurred in Malaysia in 1998, then Singapore in 1999 which had imported pigs from a farm in Malaysia affected by Nipah virus. Subsequent outbreaks have occurred in India, and repeatedly in Bangladesh, where it has manifested as sudden death in humans (Luby et al. 2009; Rahman et al. 2010; Stone 2011).

Infection of humans is from animal contact, usually from an amplifier host rather than directly from the natural, reservoir host. However investigations of outbreaks of Nipah virus in humans in Bangladesh have indicated infection from pteropid bats. Human-to-human transmission has not been seen with Nipah virus in Malaysia and Singapore, but human-to-human transmission is suspected in recent outbreaks of Nipah virus in Bangladesh (OIE 2010d).

Serological surveys in Malaysia have demonstrated a seroprevalence of 15–55% in dogs, 4–6% in cats and 1.5% in goats (CFSPH 2007c).

Screening of polo, equestrian event and racing horses in Malaysia was conducted in March and April 1999. Of more than 3200 serum samples, only two horses were positive by serum neutralisation assay. These were from 47 horses tested in a polo club (Mahendran et al. 1999; OIE 1999). The affected horses in Malaysia were at one time stationed at a pig farm and the polo club was located within the Nipah virus outbreak area (Mahendran et al. 1999). The national horse population of Malaysia was

found to be free from Nipah virus in subsequent serological surveillance undertaken in 1999 and 2000 (OIE 2001).

A serological survey of humans potentially exposed to Nipah virus in Singapore found 22 of 1469 people tested had antibodies, suggestive of Nipah virus infection. In the same study, more than 500 horses in Singapore were tested and found to be seronegative for Nipah virus (Chan et al. 2002).

Infection of horses with Nipah virus appears to be very rare and clinical signs are similar to infection in other species — a generalised vasculitis with possibility of localisation in the lung or brain — and the few cases of infection described in horses may have originated from pigs (Hooper and Williamson 2000).

There are no reports of Nipah virus infection in zoo perissodactyls and they do not appear to be important in the epidemiology of the disease.

Identification methods following virus isolation include immunostaining, neutralisation and molecular characterisation. Serological tests available are virus neutralisation and ELISA as described in the OIE Manual (OIE 2008g).

There are no previous biosecurity measures for Nipah virus encephalitis and there are no recommendations in the Code.

Conclusion

Nipah virus is not present in approved countries and there is no evidence that zoo perissodactyls play a significant role in the epidemiology of the disease.

Accordingly, based on the preceding information, risk management measures for Nipah virus encephalitis are not warranted.

Piroplasmosis

Piroplasmosis is a general term for disease in animals and humans caused by protozoans within the order Piroplasmida. Some of the most significant piroplasmid-caused diseases are due to infection by the tick-borne genuses *Babesia* spp. and *Theileria* spp. In zoo equids, equine piroplasmosis is the most important disease and is well studied. In non-equid perissodactyls far less is known about diseases caused by piroplasmids.

Equine piroplasmosis — also known as equine babesiosis — is reported in donkeys, horses, mules, Przewalski's horses and zebras (Avarzed et al. 1997; Bhoora et al. 2010; Robert et al. 2005; Turnbull et al. 2002). The causative organisms, *Babesia caballi* and *Theileria equi* (formerly *Babesia equi*) are transmitted primarily by ixodid ticks. The tick must remain attached to the host for 5–10 days before the parasite becomes infective. The incubation period after infection can be up to 30 days (Rothschild and Knowles 2007). Prevalence of equine piroplasmosis is higher in tropical and subtropical regions (Radostits et al. 2007d). Serological studies of horses in endemic areas have shown prevalence of 30–98% for *B. caballi* and more than 90% for *T. equi* (Avarzed et al. 1997; Donnelly et al. 1980; Tenter et al. 1988; Tenter and Friedhoff 1986).

Zebras are an important reservoir of the disease in Africa (Bhoora et al. 2010). *T. equi*, is found in equids on all continents except Australia and is endemic in Africa, Asia (except Siberia) and Central and South America (de Waal et al. 1988). Outbreaks

have occurred in the last three years in Ireland and the United States (Promed Mail 2009; Promed Mail 2010c). In Europe, equine piroplasmosis extends from Portugal and Spain, through France and Italy to the Balkans, Hungary, Romania and Russia. Austria, Belgium, the Czech Republic, Poland and Switzerland are marginal areas where autochthonous infections can occur (Friedhoff and Soulé 1996).

Equine piroplasmosis is an OIE-listed disease (OIE 2012). It is absent from Australia and is a nationally notifiable animal disease (DAFF 2011).

In Australia, two species of tick — *Rhipicephalus (Boophilus) microplus*, the cattle tick and *R. sanguineus*, the brown dog tick — are capable of naturally transmitting both protozoa (Battsetseg et al. 2002; Rothschild and Knowles 2007). *Haemophysalis longicornis*, the bush tick, has been used as a vector for *T. equi* in experimental situations (Ikadai et al. 2007). It is not known whether *Otobius megnini* — a tick introduced into Western Australia — is able to transmit either *B. caballi* or *T. equi*.

Transmission of *B. caballi* and *T. equi* can also be iatrogenic or transplacental (de Waal and van Heerden 2004). Nearly all of Africa is considered endemic for *B. caballi* and *T. equi* and virtually all horses and zebras are infected, except in a few regions.

Acute *T. equi* infection is characterised by severe pyrexia, elevated pulse and respiratory rates, anaemia, haemolysis, icterus, haemoglobinuria and bilirubinuria. Pregnant mares can abort, neonates may show peracute signs, and surviving foals can become latent carriers (Allsopp et al. 2007). The disease is fatal in up to 50% of previously unexposed animals (Rothschild and Knowles 2007).

Equine piroplasmosis may be difficult to diagnose due to variable and nonspecific clinical signs. The primary serological tests used to detect antibody are the IFAT and the C-ELISA (OIE 2008d). These have replaced the CFT test as they are more sensitive and effective at detecting chronically infected animals, latent carriers and those treated with anti-parasitic drugs (Ogunremi et al. 2007; Ogunremi et al. 2008; OIE 2008d). However, the C-ELISA requires further validation. Whilst these tests have not been validated in non-domestic equids they could still be useful screening tests in these species (A. Reiss, Zoo and Aquarium Association, pers. comm. October 2011).

Molecular tests exist that detect DNA of *B. caballi* and *T. equi* are still being developed. However, they have not superseded the serological tests currently used for in international trade in horses.

Treatment with imidocarb can temporarily clear *B. caballi* and *T. equi* from the blood and result in transiently negative IFAT and real time-PCR results. However, *B. caballi* and *T. equi* DNA was again detected eight weeks after the treatment started (Butler et al. 2008; de Waal and van Heerden 2004). Therefore treatment does not completely clear horses of *B. caballi* and *T. equi* infection. It is considered that results of treatment in zoo equids would be similar to horses.

Black rhinoceroses can be infected by rhinoceros-specific piroplasms which typically cause subclinical disease unless the animals are stressed (Penzhorn 2006; Penzhorn et al. 2008).

There is no information about the presence of piroplasmids in tapirs but they do have abundant tick flora which makes it possible that they host undescribed piroplasmids.

There is no evidence that non-equid zoo perissodactyls play a part in the

epidemiology of significant diseases caused by piroplasmids including *B. caballi* and *T. equi*. Accordingly piroplasmosis is not considered further in these species.

Australia's previous biosecurity measures for equine piroplasmosis in zoo perissodactyls included premises freedom and diagnostic testing. The Code recommends diagnostic testing and treatment for ticks for equines (OIE 2011n). A risk assessment was undertaken for the horse IRA and risk management measures for equids were recommended including country freedom, or premises freedom, PEQ, diagnostic testing, preventative treatment against ticks and PAQ (Biosecurity Australia 2010).

Conclusion

Equine piroplasmosis is present in approved countries and Australia's biosecurity measures for equine piroplasmosis differ to those in the Code (OIE 2011n). Accordingly, based on the preceding information and consistent with the recommendations in the horse IRA, risk management measures continue to be warranted for zoo equids. No risk management measures are required for non-equid perissodactyls.

Australia's biosecurity measures for equine piroplasmosis for zoo equids are:

- For 60 days immediately before export the animal was continuously resident and free of quarantine restriction in a country where no clinical, epidemiological or other evidence of equine piroplasmosis has occurred during the previous two years.

OR

- For 60 days immediately before export the animal has not resided on any premises in the country of export where clinical, epidemiological or other evidence of equine piroplasmosis has occurred during the previous 60 days.

AND

- The animal was held in PEQ before export. During this time the animal has been isolated from animals not of equivalent health status.

AND

- On arrival at the PEQ facility the animal was thoroughly examined under the direct supervision of the Official Veterinarian and no ticks were found. The animal was then treated immediately with a long acting parasiticide effective against ticks, under the direct supervision of the Official Veterinarian.

AND

- The animal was treated 21–28 days after initial treatment, under the direct supervision of the Official Veterinarian, with a long acting parasiticide effective against ticks to provide continual protection against tick infestation beyond the day of export. The final treatment must occur within seven days of the date of export.

AND

- If any animal in the PEQ facility was found to have ticks, all animals in the facility were treated again seven days later with a long acting parasiticide effective against ticks, under the direct supervision of the Official Veterinarian.

AND

- During PEQ there was no opportunity for iatrogenic transmission.

AND

- Blood samples were taken from the animal not less than seven days after commencement of PEQ and tested using an IFAT for *Babesia caballi* and *Theileria equi* as described in the OIE Manual for equine piroplasmosis with negative results in each case. If there is no approved laboratory in the country of export, testing in another country must be undertaken in a laboratory recognised by the Veterinary Authority of the country of export.

AND

- Within 48 hours of arrival at the post-arrival quarantine approved premises (QAP) facility the animal was thoroughly examined by a registered veterinarian and no ticks found.

AND

- If any animal in the QAP was found to have ticks, all animals in the facility were treated immediately, under the direct supervision of a registered veterinarian, with a parasiticide effective against ticks **or**
- If a registered veterinarian concludes the animal was unable to be thoroughly examined for ticks, it was treated under the direct supervision of a registered veterinarian, with a parasiticide effective against ticks.

Potomac horse fever

Potomac horse fever (PHF) is an acute, pyrexic enterocolitis of horses, caused by *Neorickettsia risticii* (Palmer 2004). First recognised in the United States in 1979, PHF has subsequently been reported in Brazil, Canada, and Uruguay (Dutra et al. 2001). Serological evidence of PHF has been reported in France (Vidor et al. 1988); however, there are no reports of clinical or epidemiological evidence of infection. PHF has not been reported in Australia.

Serological studies in endemic regions have found antibody titres specific for *N. ristcii* in cats, coyotes, goats and pigs (Pusterla et al. 2000). Other studies have shown that cattle and dogs are susceptible to infection (Pusterla et al. 2000; Pusterla et al. 2001). There are no reports of PHF in zoo equids and it is unlikely it would affect them differently.

PHF is not an OIE-listed disease (OIE 2012). It is absent from Australia and is a nationally notifiable animal disease (DAFF 2011).

The incubation period is 1–3 weeks (Radostits et al. 2007e). The likely route of infection for horses is the ingestion, in water or pasture, of aquatic insect larvae and nymphs that are infected with trematodes containing *N. risticii* (Pusterla and Madigan 2007b). It appears that horses are accidentally infected with *N. risticii*, are unlikely to

be a source of infection and are a dead-end host (Radostits et al. 2007e). Transplacental transmission has been reported in both natural and experimental infection and is associated with delayed abortion (Coffman et al. 2008).

There are no reports of PHF or *N. risticii* isolation in non-equid perissodactyls and it is not considered further in these species.

The diagnosis of PHF is confirmed by isolation of *N. risticii* from blood or faeces. Serological testing is of limited use because antibodies to *N. risticii* may not be detectable for some time after infection. The immunofluorescent antibody test has a high rate of false-positive reactions (Madigan et al. 1995).

Australia's previous biosecurity measures for PHF in zoo perissodactyls included premises freedom. There are no recommendations in the Code.

Conclusion

PHF is present in approved countries. However, there is no evidence that zoo perissodactyls play a significant role in the epidemiology of PHF.

Accordingly, based on the preceding information, risk management measures for PHF are not warranted.

Rabies

Rabies is a virus in the genus Lyssavirus of the family Rhabdoviridae (Tordo et al. 2005), which causes a progressively fatal encephalitis in all species of mammals. Lyssaviruses are classified phylogenetically into seven genotypes. Genotype 1 is 'classical rabies' and there are six other genotypes of rabies-related viruses. All genotypes can cause disease in mammals but only genotype 1 has been reported in horses. The genotype has not been specified in cases reported in rhinoceroses (Rahman et al. 2004; Selvam et al. 2003).

Rabies is a multiple species OIE-listed disease (OIE 2012). It is absent from Australia and is a nationally notifiable animal disease (DAFF 2011).

The incubation period is variable. For the purposes of importation, the Code recommends that the incubation period for rabies is six months (OIE 2011v). In equids, periods of marked excitement and aggressiveness alternate with periods of relative calm, and death follows within days. Signs described in rhinoceroses include restlessness, recumbency, staggering gait, excitement and repeated falling and rolling (Rahman et al. 2004; Selvam et al. 2003).

Rabies is usually transmitted through the bite of a rabid animal, particularly carnivores. Horses and other large mammals are considered dead-end hosts because they usually succumb to disease and die without further transmission.

There are a number of tests available to confirm the diagnosis of rabies but these require post mortem to obtain samples of brain tissue. These include antigen detection assays such as fluorescent antibody tests; nucleic acid detection assays such as PCR tests; and viral cultures such as the rabies tissue culture infection test (OIE 2011w).

No reliable diagnostic tests for rabies are available for use on live animals.

There are no previous biosecurity measures for rabies. The Code recommendations include country or premises freedom (OIE 2011v).

Conclusion

Rabies is present in approved countries. Based in the preceding information and in accordance with the recommendations in the Code (OIE 2011v) risk management measures are warranted.

Australia's biosecurity measures for rabies for zoo perissodactyls are:

- For 180 days immediately before export the animal was continuously resident and free of quarantine restriction in a country where no clinical, epidemiological or other evidence of rabies has occurred during the previous two years and the disease is compulsorily notifiable.

OR

- For 180 days immediately before export the animal has not resided on any premises in the country of export where clinical, epidemiological or other evidence of rabies has occurred during the previous 12 months and the disease is compulsorily notifiable.

Rift Valley fever

Rift Valley fever (RVF) is caused by the arthropod-borne Rift Valley fever virus (RVFV), family Bunyaviridae, genus Phlebovirus (Nichol et al. 2005). RVF is a zoonotic disease of ruminants that is endemic in Madagascar, Saudi Arabia and Yemen in the Arabian Peninsula and sub-Saharan Africa (Arishi et al. 2000; Gould and Higgs 2009; OIE 2010f). RVFV affects a large number of species, including camels, monkeys, rodents and ruminants. Horses exhibit viraemia without clinical signs of disease (Yedloutschnig et al. 1981).

RVF is a multiple species OIE-listed disease (OIE 2012). It is absent from Australia and is a nationally notifiable animal disease (DAFF 2011).

RVF occurs as cyclical epidemics separated by quiescent periods. Vectors for transmission of RVFV are haematophagous insects, primarily mosquitoes. Sandflies and culicoides are also vectors, but do not play a role in maintenance of the virus (Radostits et al. 2007f). Several mosquito species present in Australia are considered to be competent vectors for RVFV (Turell and Kay 1998).

Mosquitoes transmit RVFV both transovarially and horizontally (Wilson 1994). Ruminants are highly susceptible to RVF and are the major amplifying hosts. Virus can be found in aborted foetuses, faeces and milk (Radostits et al. 2007f). The level of viraemia reported in horses is less than that required to successfully infect vectors (Yedloutschnig et al. 1981). Serological surveys have detected antibodies to RVFV in rhinoceroses (Anderson and Rowe 1998; Miller et al. 2011). However, clinical signs of RVF have not been reported in perissodactyls and there is no evidence they are involved in the epidemiology of RVF outbreaks.

Diagnosis of RVF is based on isolation of virus, demonstration of viral antigens and by serological tests (OIE 2008i).

Australia's previous biosecurity measures for RVF in zoo perissodactyls included country freedom. The Code recommendations include country or zone freedom (OIE 2011x).

Conclusion

RVF is not present in approved countries. Based on the preceding information and in accordance with recommendations in the Code (OIE 2011v), risk management measures for zoo perissodactyls continue to be warranted.

Australia's biosecurity measures for RVF for zoo perissodactyls are:

- For 30 days immediately before export the animal was continuously resident and free of quarantine restriction in a country where no clinical, epidemiological or other evidence of Rift Valley fever has occurred during the previous four years and the disease is compulsorily notifiable.

Screw-worm-fly myiasis

Two species of flies cause screw-worm-fly myiasis — New World screw-worm, *Cochlioma hominivorax* and Old World screw-worm, *Chrysomya bezziana*. Both species are members of the family Calliphoridae, subfamily Chrysomyinae. Screw-worms are the larvae of flies that feed on living flesh. 'New World' refers to the Americas and 'Old World' to Africa, Asia and Europe. *C. hominivorax* has never been reported in Canada and was eradicated from the United States with the last cases reported in 1982 (Branckaert et al. 1991). *C. bezziana* has not been reported in European countries, New Zealand or Singapore. However, *C. bezziana* is endemic in Malaysia (OIE 2008h). In Hong Kong, *C. bezziana* myiasis has been reported in dogs, cattle and pigs, and was thought to have been introduced from southern China (FEHD 2011).

Both species of flies can affect all warm-blooded animals, including humans. Infections in birds are rare (CFSPH 2007d). *C. hominivorax* and *C. bezziana* have similar climatic requirements. Australia is the only continent with a suitable climate where screw-worm-fly has not established.

New World screwworm and Old World screwworm are multiple species OIE-listed diseases (OIE 2012). They are absent from Australia and are nationally notifiable animal diseases (DAFF 2011).

Screw-worm-flies tend to be attracted to parts of the animal exposed by injury or husbandry operations where skin has been perforated and exudes blood. Three instars of larval development occur after adult females lay eggs in the living host tissue, the third stage having heavy bands of backwardly directed thorn-like spines — hence the name 'screw-worm'. Screw-worm-fly myiasis produces a characteristic odour. Secondary infection and tissue necrosis follow in untreated cases, resulting in weight loss, debility and death.

Identification of adult flies confirms the presence of screw-worm-fly in a region, but identification of larvae from clinical cases is required to confirm individual animal infection.

There are no previous biosecurity measures for screw-worm-fly myiasis. The Code recommendations include country freedom or inspection for external parasites, treatment of infested wounds and prophylactic treatment for domestic and wild mammals (OIE 2011u).

Conclusion

C. hominivorax and *C. bezziana* are not present in approved countries. Based on the preceding information and in accordance with the recommendations in the Code (OIE 2011u), risk management measures are warranted.

Australia's biosecurity measures for screw-worm-fly myiasis for zoo perissodactyls are:

- For 60 days immediately before export the animal was continuously resident and free of quarantine restriction in a country where no clinical, epidemiological or other evidence of screw-worm-fly (*Cochliomyia hominivorax* or *Chrysomya bezziana*) myiasis has occurred during the previous 12 months.

Surra

Surra is a disease caused by the flagellate protozoan *Trypanosoma evansi*, which can affect many domesticated mammals and some wild species. Infection may be subclinical or result in signs ranging from chronic wasting to acute death. Surra is most severe in donkeys, mules, deer, camels, llamas, cats and dogs (Geering et al. 1995i). Surra has been described in rhinoceroses (Clausen 1981; Mohamad et al. 2004), but there is limited information in other perissodactyls other than horses.

T. evansi is the most widely distributed pathogenic trypanosome and is found in Africa north of the tsetse fly belt, Asia, Central and South America and the Middle East (Radostits et al. 2007d).

Surra is a multiple species OIE-listed disease (OIE 2012). It is absent from Australia and is a nationally notifiable animal disease (DAFF 2011).

The incubation period of surra in equids is usually 1–2 weeks, but can be up to 60 days (Geering et al. 1995i; Losos 1980; Sellon 2007). Little is known about the progression of surra in rhinoceroses. Stress such as translocation can trigger clinical signs, with stressed animals succumbing to the infection (Clausen 1981).

T. evansi is transmitted mechanically, primarily by the horse fly (*Tabanus* spp.) and to a lesser degree by the stable fly (*Stomoxys* spp.) (Geering et al. 1995i). Carnivores can become infected after feeding on infected tissues or during fighting (Moloo et al. 1973). Transmission in milk and by the venereal route might also be possible (CFSPH 2009c).

Potential tabanid vectors and reservoir hosts for trypanosomes, such as feral pigs, occur in Australia (Reid 2002). Experimental studies have shown that two species of wallaby, the agile wallaby (*Macropus agillis*) and the dusky pademelon (*Thylogale brunii*) are susceptible to *T. evansi* (Reid et al. 2001).

A definitive diagnosis requires laboratory methods to detect the parasite. When parasitaemia is high, examination of blood films or lymph node materials may reveal the trypanosomes. In more chronic cases when parasitaemia is usually low, methods of parasite concentration and the inoculation of laboratory rodents are required (OIE 2000). For serological testing, an antibody-detection ELISA has been validated for use in horses (Monzon 2000). Other tests include an immunofluorescence test and a card agglutination test (OIE 2010g).

Australia's previous biosecurity measures for surra in zoo perissodactyls included premises freedom. There are no recommendations in the Code. A risk assessment was undertaken for the horse IRA and risk management measures for equids were recommended including country freedom, or premises freedom, PEQ, diagnostic testing, preventative treatment against biting flies and PAQ (Biosecurity Australia 2010).

Conclusion

Surra is not present in approved countries. Accordingly, based on the preceding information and consistent with the recommendations in the horse IRA (Biosecurity Australia 2010), risk management measures continue to be warranted.

Australia's biosecurity measures for surra for zoo perissodactyls are:

- For 60 days immediately before export the animal was continuously resident and free of quarantine restriction in a country where no clinical, epidemiological or other evidence of surra has occurred in any species during the previous 12 months.

Taylorella asinigenitalis

T. asinigenitalis is a contagious venereal disease of equids first isolated from male donkeys in the United States in 1997, recognised as a new species in 2001 and is now widely regarded as non-pathogenic. There is only a single study in which clinical disease was experimentally produced in horses with a mare developing mild endometritis (Katz et al. 2000). This study also showed the pathogenicity of *T. asinigenitalis* varies between strains but further studies are required to establish the pathogenicity of different strains (Baverud et al. 2006).

When first isolated *T. asinigenitalis* was thought to be *T. equigenitalis*, the cause of contagious equine metritis. Subsequently the isolates were established to be a separate species that appeared to be non-pathogenic (Jang et al. 2001). *T. asinigenitalis* is also present in the Italian donkey population and could potentially be transmitted to horses, causing possible misidentification as *T. equigenitalis* and also problems related to the national and international trade of equids(Franco et al. 2009). It has also been reported in Sweden (Baverud et al. 2006), France and Spain (Roest 2007).

None of these isolates have been associated with clinical disease in horses.

T. asinigenitalis is not an OIE-listed disease (OIE 2012). It is absent from Australia and is not a nationally notifiable animal disease (DAFF 2011).

Stallions and potentially clinically recovered mares may harbour *T. asinigenitalis* for extended periods — possibly for years after initial infection — whether or not clinical signs of disease or reduced fertility are apparent. In horses not used for breeding, or where there is no opportunity to mate, the risk of disease transmission would be minimal. Vertical spread of *T. asinigenitalis* has not been reported; however, it is likely that it would be similar to *T. equigenitalis*. If there was disease in foals it is likely to be acquired either *in utero* or at the time of parturition (Timoney and Powell 1982).

It is highly unlikely that *T. asinigenitalis* would cause infertility in mares.

There are no reports of *T. asinigenitalis* in zoo perissodactyls and they are unlikely to

play a role in the epidemiology of the disease.

Diagnosis is confirmed by culture of the organism from a series of urogenital swabs of mares or stallions.

There are no previous biosecurity measures for *T. asinigenitalis* and there are no recommendations in the Code. A risk assessment was undertaken for the horse IRA and risk management measures were not recommended for this disease (Biosecurity Australia 2010).

Conclusion

T. asinigenitalis is present in approved countries. However, there is no evidence that zoo perissodactyls play a significant role in the epidemiology of the disease.

Accordingly, based on the preceding information and consistent with the recommendations in the horse IRA, risk management measures for *T. asinigenitalis* are not warranted.

Trematodes

Perissodactyls have the potential to harbour a diverse range of internal parasites including trematodes. Some trematodes cause serious zoonoses, such as schistosomiasis. Other trematodes cause significant disease in domestic animals, such as fascioloiasis. Although some trematodes, for example *Fasciola hepatica*, are endemic in Australia, there are a large number of trematodes that remain exotic.

Schistosomes that affect equids include *Schistosoma indicum, S. intercalatum, S. japonicum, S. mattheei*, *S. nasale* and *S. spindale* (Kassai 1999b). Species of *Fasciola* affecting horses include *F. hepatica* and *F. gigantica* (Radostits et al. 2007c). There is limited information regarding trematode infections in zoo perissodactyls.

Schistosomes are found in Africa, India, the Far East, East and Southeast Asia, and Pakistan

(Kassai 1999b). Neither the intermediate hosts — freshwater snails — nor the schistosome species are present in Australia (J. Walker, University of Sydney, pers. comm. May 2009).

F. hepatica occurs in cooler climates, has a worldwide distribution (Radostits et al. 2007c) and is endemic in all Australian states except Western Australia. *F. gigantica* is restricted to warmer regions in Africa, China, southern Europe, India, Japan, the Middle East, some Pacific Islands, Pakistan, South East Asia and the United States (Urquhart et al. 1996a), and has not been reported in Australia.

Diseases caused by trematodes are not OIE-listed diseases (OIE 2012).

For schistosomes, transmission is seasonal and it is related to high rainfall and high temperature (Urquhart et al. 1996b). The prepatent period is 30 days or longer.

The prepatent period for *F. gigantica* is 12 weeks or more (Kassai 1999a).

A single case of schistosomiasis (probably caused by *Heterobilharzia americana*) that resulted in the animal's death has been reported in a Brazilian tapir (*Tapirus terrestris*) in a zoo in Michigan in the United States (Yamini and Schillhorn van Veen

1988). However, schistosomiasis in non-equid perissodactyls does not appear to be a common occurrence (Penzhorn et al. 1994; Zumpt 1964).

A comprehensive literature review on *F. gigantica* infections in horses resulted in limited information, indicating that horses are rarely infected. Infections have been reported in donkeys (Getachew et al. 2010), but there are no reports in other equid species. *F. gigantica* has been described in a rhinoceros calf in an Indian zoo (Bhattacharjee and Halder 1971).

Information on other families of trematodes affecting perissodactyls is lacking. Similarly, it is unknown if there are suitable intermediate hosts in Australia.

Diagnosis is based on a combination of clinical signs, seasonal occurrence, weather patterns, history of flukes in endemic areas, examination of faeces for fluke eggs and post-mortem findings. Detection of infestations by trematodes is not always reliable, particularly following recent infestation, when parasites are in the pre-patent phase of their life cycle and in mild or chronic infections.

Management and treatment for trematodes, like other internal parasites, requires an understanding of the life cycle, including intermediate and reservoir hosts where appropriate. Not only should the principal host be treated but it is also important to eliminate the life cycle stages from the environment and to control the animals' activities and diet to reduce the likelihood of exposure.

There are no previous biosecurity measures for trematodes and there are no recommendations in the Code.

Conclusion

Trematodes are present in approved countries. However, the limited information on trematodes in perissodactyls suggests infection is rare and there is no evidence that zoo perissodactyls play a significant role in the epidemiology of diseases caused by trematodes.

Accordingly, based on the preceding information, risk management measures for trematodes are not warranted.

Trichinellosis

Trichinellosis is a serious zoonotic disease caused by ingestion of raw or undercooked meat containing larvae of *Trichinella* spp., family Trichinellidae (Dupouy-Camet 2006). There are seven species and three genotypes of *Trichinella* (Murrell et al. 2000), three of which have been identified in horses (Pozio 2001). *T. pseudospiralis* has been reported in birds and native animals in Tasmania (Obendorf et al. 1990; Obendorf and Clarke 1992).

Primarily an infection of pigs, *Trichinella* spp. are maintained in a sylvatic cycle among carnivores (Pozio 2001) and infect a wide range of birds and mammals (Soulsby 1982a). *Trichinella* spp. in animals and trichinellosis in humans have been reported in Africa, the Americas, Asia, Europe, New Zealand and Oceania. In France and Italy human trichinellosis is attributed to the consumption of infected horse meat (Pozio et al. 2001; Pozio 2001).

Trichinellosis (*T. spiralis*) is a multiple species OIE-listed disease (OIE 2012). It is absent from Australia and is a nationally notifiable animal disease (DAFF 2011).

The life cycle of *Trichinella* spp. is initiated when larvae encysted in muscles are ingested. In the intestine of the host, larvae develop to adult stage and mate. Larvae enter the bloodstream via the lymphatics and localise in muscles, where they become encapsulated and survive many years until ingested by another host (Soulsby 1982a). Infection in horses is most likely to occur via ingestion of feed or pastures contaminated with infected carcasses or scraps. The horse is considered an aberrant host for *T. spiralis* (Pozio et al. 1998). There are no reports of trichinellosis in other perissodactyls and infection is unlikely given their herbivorous diet.

There are no previous biosecurity measures for trichinellosis. The Code has recommendations for fresh meat from pigs and horses, and there are no recommendations for live animals other than pigs (OIE 2011y). A risk assessment was undertaken for the horse IRA and risk management measures were not recommended for trichinellosis (Biosecurity Australia 2010).

Conclusion

Trichinellosis is present in approved countries. However, there is no evidence that zoo perissodactyls play a significant role in the epidemiology of trichinellosis.

Accordingly, based on the preceding information and consistent with the recommendations in the horse IRA, risk management measures for trichinellosis are not warranted.

Trypanosomosis

Trypanosomes are blood-borne protozoan parasites which cause diseases of livestock and humans and are transmitted by haematophagous arthropods. *Trypanosoma brucei brucei, T. congolense, T. simiae* and *T. vivax* cause trypanosomosis, also known as nagana, which results in anaemia, loss of body condition and emaciation in livestock. Of these *T. brucei brucei, T. congolense* and *T. vivax* are pathogenic to horses (Sellon 2007).

Trypanosomes are found in regions of Africa wherever the tsetse fly is endemic between latitude 15 °N and 29 °S, from the southern edge of the Sahara desert to Zimbabwe, Angola and Mozambique. *T. vivax* has spread beyond the ‘tsetse fly belt’ through mechanical transmission by biting flies and is found in South and Central America and the Caribbean (CFSPH 2009a). Tsetse flies are not present in Australia; however, mechanical transmission is possible by biting flies in Australia as there are suitable vectors in the genera *Stomoxys* and *Tabanus* in some regions.

Trypanosomes occur in the blood of a wide range of wild and domestic hosts. More than 30 species of wild animals, including zebras and rhinoceroses can become carriers of pathogenic trypanosomes, acting as reservoirs of infection for vectors and livestock (Connor and van den Bossche 2004).

Trypanosomosis (tsetse-transmitted) is an OIE-listed disease of cattle (OIE 2012). It is absent from Australia and is a nationally notifiable animal disease (DAFF 2011).

The incubation period for trypanosomosis ranges from four to 20 days in most livestock species (Radostits et al. 2007d). Infections with more virulent isolates have a shorter incubation period (CFSPH 2009a). Equids appear to be highly sensitive to certain trypanosomes (e.g. *T. brucei brucei and T. vivax*) (Mohamad et al. 2004).

Although relatively resistant, rhinoceroses may succumb to infection with *T. brucei brucei*, *T. congolense* or *T. simiae* if stressed by translocation (Clausen 1981). Little is known about trypanosome infection in tapirs.

Trypanosomes in Africa that cause disease in livestock (*T. congolense*, *T. brucei brucei* and *T. simiae*) require development in tsetse flies. Parasites are present in the saliva of an infected tsetse fly and transmitted when the fly bites an animal (Radostits et al. 2007d). *T. vivax* does not require tsetse flies to develop.

Trypanosomosis can be diagnosed using microscopic examination of blood films. Serological tests include an IFAT and an antibody-detection ELISA (OIE 2008j).

Australia's previous biosecurity measures for trypanosomosis (*T. vivax*) in zoo perissodactyls included premises freedom. There are no recommendations in the Code.

Conclusion

Tsetse-transmitted trypanosomes (*T. brucei brucei*, *T. congolense* and *T. vivax*) are not present in approved countries. Tsetse flies are not present but competent vectors for *T. vivax* are present in Australia. Accordingly, based on the preceding information, risk management measures for *T. vivax* continue to be warranted zoo perissodactyls.

Australia's biosecurity measures for *T. vivax* for zoo perissodactyls are:

- For 60 days immediately before export the animal has been continuously resident and free of quarantine restriction in a country where no clinical, epidemiological or other evidence of *T. vivax* has occurred in any species during the previous 12 months.

Vesicular stomatitis

Vesicular stomatitis (VS) virus in the family Rhabdoviridae (Tordo et al. 2005) causes disease characterised by vesicular lesions on the tongue, oral mucous membranes, mammary glands, external genitalia and coronary bands (McCluskey and Mumford 2000). Except for its occurrence in horses, it is clinically indistinguishable from foot-and-mouth disease (Letchworth et al. 1999). Outbreaks in the United States mainly affect horses and cattle, although VS viruses have caused disease in other species including other equids, pigs, llamas and humans. Serological evidence of infection has been found in many wild and domestic species including coyotes, cotton rats, deer, deer mice, dogs, ducks, elk, goats, pronghorn antelope, raccoons, turkeys and wood rats (McCluskey and Mumford 2000). The disease is limited to the Americas (OIE 2008l).

VS is a multiple species OIE-listed disease (OIE 2012). It is absent from Australia and is a nationally notifiable animal disease (DAFF 2011).

The epidemiology of VS is not well understood. Viral reservoirs, amplification hosts, and natural modes of transmission are unclear (Cornish et al. 2001), although direct and indirect contact with saliva and vesicular fluids have been implicated (Clarke et al. 1996; Letchworth 1996; McCluskey and Mumford 2000; Stallknecht et al. 2001). The virus has been isolated from many insect species such as black flies, culicoides, house flies, eye gnats, mosquitoes and sand flies (Rodriguez 2002). Virus shedding from an active lesion is thought to stop 6–7 days after lesion formation (McCluskey

and Mumford 2000).

The role of non-equid perissodactyls in this disease in not known but could be similar to equids due to its wide host range. VS has never occurred in countries where rhinoceroses are native. Although present in Central and South America, disease in tapirs has not been reported. However, seroconversion to VS virus has been reported in captive Baird's tapirs (*Tapirus bairdii*) (Pukazhenthi et al. 2008).

The preferred immunological methods for identifying viral antigens are the ELISA, the CFT and fluorescent antibody staining (OIE 2011{). For clinical samples, real time-PCR may be more sensitive than virus isolation or CFT (Letchworth 1996). These tests have not been validated in perissodactyls.

For serology, the prescribed tests for international trade described in the Manual are C-ELISA, virus neutralisation test and CFT. Antibody can usually be detected between 5 and 8 days post-infection (OIE 2011{). The C-ELISA can detect antibodies 5–6 days post infection and VNT 1–3 days later (McCluskey and Mumford 2000).

Australia's previous biosecurity measures for VS in zoo perissodactyls included premises and regional freedom. The Code recommends country freedom or premises freedom and testing (OIE 2011|). A risk assessment was undertaken for the horse IRA and risk management measures were recommended including country freedom or premises freedom, PEQ and diagnostic testing (Biosecurity Australia 2010).

Conclusion

VS is present in approved countries. Accordingly, based on the preceding information and consistent with the recommendations in the horse IRA, risk management measures continue to be warranted.

Australia's biosecurity measures for VS for zoo perissodactyls are:

- For 60 days immediately before export the animal was continuously resident and free of quarantine restriction in a country where no clinical, epidemiological or other evidence of vesicular stomatitis has occurred in any species during the previous two years and the disease is compulsorily notifiable.

OR

- For 30 days immediately before export the animal has not resided on any premises in the country of export where clinical, epidemiological or other evidence of vesicular stomatitis has occurred in any species during the previous 90 days and the disease is compulsorily notifiable.

AND

- The animal was held in PEQ for at least 14 days immediately before export. During this time the animal was isolated from equids and bovids not of equivalent health status.
- The PEQ facility is located in a defined area where no clinical, epidemiological or other evidence of vesicular stomatitis has occurred in any species for 90 days before export.

West Nile fever

West Nile fever (WNF) is a widespread zoonotic disease that can result in fatal encephalitis and is caused by the arbovirus West Nile virus (WNV) in the family Flaviviridae (Thiel et al. 2005). WNV is endemic in Africa with occasional expansions into Europe and Asia and most recently in the United States. WNV cycles between ornithophilic mosquitoes, primarily of the genus *Culex,* and wild birds. Humans, horses, and other vertebrates are incidental hosts (Njaa 2008).

WNV is classified into phylogenetically distinct lineages. Lineage 1 viruses are found in North Africa, Europe, Asia, the Americas and Australia; whereas lineage 2 viruses are found exclusively in southern Africa and Madagascar (Botha et al. 2011). Lineage 1 is divided into three clades (1a, 1b and 1c). Clade 1a contains many of the virulent viruses associated with outbreaks since 1997 (CFSPH 2009). Kunjin virus, a strain in clade 1b, is present in Australia (Gubler et al. 2007).

WNF is a multiple species OIE-listed disease (OIE 2012). It is absent from Australia and is a nationally notifiable animal disease (DAFF 2011).

The incubation period in horses ranges from one to 15 days. Due to the low levels and short duration of viraemia, horses are unlikely to serve as important amplifying hosts for WNV (Bunning et al. 2002).

WNF has never been definitively diagnosed in non-equid perissodactyls. However, during the initial outbreak of WNF in New York in 1999, two rhinoceroses developed clinical signs, including anorexia, depression, and a lip droop, but they spontaneously recovered. A blood sample from one of these rhinoceroses contained WNV-specific antibody, which indicated exposure to the virus (Ludwig et al. 2002). However, virus was not isolated. There are no reports of WNF in tapirs.

Methods for detecting infection in clinically affected animals may involve detection of either virus or antibody. Isolation of virus, PCR, and immunohistochemistry may be used to detect the presence of virus or viral antigen in tissue specimens. Antibody in equine sera can be detected using IgM capture ELISA, haemagglutination inhibition, IgG ELISA or a plaque reduction neutralisation test (PRNT). In regions where other flaviviruses of the JE serological complex occur, antibody testing may not differentiate WNV from other flavivirus infections, even when paired sera reveal rising titres.

Several types of effective vaccines are currently used in horses in endemic areas. These include inactivated vaccines, DNA vaccines, live attenuated vaccines and genetically modified vaccines (Seino et al. 2007). Rhinoceroses, tapirs and zebras have been vaccinated at zoos in the United States as a precaution against potential infection (Hernandez-Divers et al. 2007; Promed Mail 2002; Promed Mail 2003). However, vaccination of rhinoceroses against WNV with a killed equine product at the manufacturer's recommendations did not stimulate a measurable humoral immune response (Wolf et al. 2009). The efficacy of these vaccines when used in non-equid perissodactyls has not been evaluated.

Australia's previous biosecurity measures for WNF in zoo perissodactyls included vaccination before export. There are no recommendations in the Code for WNF. However, the Code recommends that import restrictions not be imposed on dead-end hosts such as horses (OIE 2011}). A risk assessment was undertaken for the horse

IRA and risk management measures were not recommended for WNF (Biosecurity Australia 2010).

Conclusion

WNF is present in approved countries. However, there is no evidence that zoo perissodactyls play a significant role in the epidemiology of WNF.

Accordingly, based on the preceding information and consistent with the recommendations in the horse IRA, risk management measures for WNF are not warranted.

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5 Biosecurity measures for the importation of zoo perissodactyls

The biosecurity measures described in this policy review apply to the importation of zoo perissodactyls including equids, rhinoceroses and tapirs from approved countries.

There are general risk management measures common to most Australian import policies for zoo animals that are required, including:

- the animals must be resident in an approved, licensed or registered zoo or wildlife park in the exporting country since birth or for at least 12 months immediately before export, unless otherwise approved by DAFF. The residency requirement may be achieved in more than one approved country or holding institution if specifically authorised by DAFF and the biosecurity measures for each country of residence and holding institution must be met
- the premises of origin must be under veterinary supervision and have a health monitoring program
- the animal must be held in pre-export quarantine (PEQ) for at least 30 days, during which it is inspected at least daily for signs of disease, treated for internal and external parasites, and tested for diseases in accordance with recommendations arising from the policy review
- the animal must be transported to a quarantine approved premises (QAP) in Australia in a manner that ensures no direct exposure to Australian animals en route and must undergo a period of post-arrival quarantine (PAQ) of at least 30 days
- the receiving institution must be approved under relevant Australian State or Territory legislation to hold the species being imported.

The World Organisation for Animal Health (OIE) Terrestrial Animal Health Code (the Code) recommends periods (ranging from less than 30 days to 90 days) that an animal must be resident on premises free from certain diseases. For zoo perissodactyls, with typically small group sizes and limited knowledge about disease occurrence, 90 days is recommended as the residency period required for certification of premises freedom where applicable.

The Code also recommends a period in which premises should remain free from certain diseases ranging from less than 30 days up to two or more years.

For disease agents of biosecurity concern that have no recommendations in the Code for the periods of premises residency and/or disease freedom, the periods are based on the epidemiology and information detailed in the relevant sections in Chapter 4, with more detailed information provided in the disease sections in the horse IRA.

The biosecurity measures for the importation of zoo perissodactyls are in section 5.1. The residency periods and timing of tests in section 5.1 are based on recommendations in the Code and are amended for consistency and clarity of certification.

The operational and quarantine facilities requirements apply to all zoo perissodactyls.

However, biosecurity measures for all diseases are not required for all species and this is indicated where applicable. There are a number of diseases that only affect zoo equids and therefore, separate biosecurity measures are considered most practical. An example of the biosecurity measures for a hypothetical approved country, Country X, for zoo equids, is provided in section 5.2 and for non-equid perissodactyls in section 5.3. These sections include the amended residency period of 12 months and timing for tests and will be included in the specific measures developed for each country.

5.1 Biosecurity measures for the importation of zoo perissodactyls from approved countries

Documentation

Each animal must travel with an original international veterinary certificate that conforms to Article 5.10.2. of the Code, signed by the Official Veterinarian of the country of export.

These biosecurity requirements apply to equids, rhinoceroses and tapirs.

An **Official Veterinarian** means a veterinarian authorised by the Veterinary Authority of the country of export to perform certain official tasks associated with animal health and/or public health, and inspections of commodities and, when appropriate, to certify in conformity with the Certification Procedures of Chapter 5.2 of the Code.

The veterinary certificate must:

- be written in English and a language understood by the Official Veterinarian of the country of export
- meet the requirements of the '**certification before export**' section and state that all the **pre-export quarantine requirements** have been met
- provide identification for each animal (microchip number/site or other permanent identification e.g. tattoo) including description, species, sex and age
- include the name and address of the zoological institution of origin
- include the name and address of the exporter and importer and identify the import permit against which it was issued.

The Official Veterinarian must:

- provide a separate veterinary certificate for each animal
- sign, date and stamp (with the stamp of the Veterinary Authority) each page of the veterinary certificate and all attached documents (e.g. laboratory reports) that form part of the extended veterinary certification
- endorse each page of copies of supporting documents with date, signature and Official Veterinarian stamp
- record his/her name, signature and contact details on the veterinary certificate.

Pre-export quarantine requirements

Pre-export quarantine

There are some disease agents that require PEQ as a risk management measure. The minimum PEQ period of 30 days for zoo animals applies.

Any variation from the **pre-export quarantine requirements** must be specifically authorised by DAFF.

Location

The PEQ facility must be located within a government registered or licensed zoological institution which is under veterinary supervision and in which the animals held in the premises are subject to a health monitoring program.

Facilities

1. The PEQ facility must meet the country and premises requirements specified in the **certification before export** section.
2. The entire PEQ facility must be surrounded by a physical barrier (e.g. fencing) that provides sufficient security to isolate the animals in PEQ from all other animals not of equivalent health status.
3. The PEQ facility including buildings, yards, fences, feeding and watering arrangements must address animal welfare considerations.
4. Buildings holding animals in the PEQ facility must be constructed so that they can be cleaned and disinfectant applied and must be maintained in good order.
5. The PEQ facility must have a separate area for the cleaning and disinfection of vehicles for transporting animals, and facilities for the safe loading and unloading of animals.
6. The PEQ facility must have facilities for veterinary examination and collection of samples.

Operation

1. The PEQ facility must have current approval from DAFF and the Veterinary Authority of the exporting country before commencement of PEQ.
2. DAFF may audit the approved PEQ facility.
3. All PEQ operations and procedures must be detailed in Standard Operating Procedures (SOPs), consistent with a risk-based approach and approved by DAFF.
4. The Official Veterinarian must inspect the PEQ facility before commencement of PEQ and must ensure that the facility has been cleaned and disinfectant applied to his/her satisfaction.
5. PEQ must be under the supervision of the Official Veterinarian.
6. All feed to be used during PEQ and transport to Australia must enter the PEQ facility before commencement of PEQ.
7. All bedding to be used during PEQ must enter the PEQ facility before

commencement of PEQ.

8. The PEQ period commences from the time the last animal in the export consignment has entered the PEQ facility and all animals have been examined by the Official Veterinarian.
9. All equipment used in feeding, handling and treating animals in PEQ must be new or cleaned and disinfected before entry, and must be used only in the facility during PEQ.
10. During PEQ, the facility should be occupied only by animals of the export consignment. If other animals are present, they must be of equivalent health and testing status.
11. Only personnel specifically authorised by the Official Veterinarian are permitted entry to the PEQ facility. Details of all visitor entries must be recorded.
12. Other than inspections, visits and treatments required for certification, all veterinary visits, health problems, tests, test results, treatments and reasons for removal from PEQ of any animal, must be reported to the Official Veterinarian within 24 hours, and to DAFF within 48 hours.
13. A detailed health record must be kept for each animal and be available to the Official Veterinarian and to DAFF on request.
14. Animals that leave the facility during PEQ for any reason cannot rejoin the consignment during PEQ.

Certification before export

The Official Veterinarian must certify:

1. During PEQ:
    a. the animal was not vaccinated
    b. all animals in the PEQ facility remained free from evidence of infectious or contagious disease and had no contact with animals not of equivalent health status
    c. all samples for testing were taken by the Official Veterinarian or a veterinarian authorised by the Official Veterinarian
    d. all testing was conducted in a laboratory approved and monitored by the Veterinary Authority in the country of export. If there is no approved laboratory in the country of export, testing must be undertaken in a laboratory recognised by the Veterinary Authority of the country of export.
2. All of the following risk management measures apply:

    <u>African horse sickness – for equids only</u>

    a. For 40 days immediately before export the animal was continuously resident and free of quarantine restriction in a country where no clinical, epidemiological or other evidence of African horse sickness has occurred during the previous two years and the disease is compulsorily notifiable.

AND

b. The animal was not vaccinated against African horse sickness during 40 days before export.

Anthrax

For 20 days immediately before export the animal has not resided on any premises in the country of export where clinical, epidemiological or other evidence of anthrax has occurred during the previous 20 days and the disease is compulsorily notifiable.

Bovine tuberculosis – for tapirs and rhinoceroses only

For 180 days immediately before export the animal was continuously resident and free of quarantine restriction in a country where no clinical, epidemiological or other evidence of bovine tuberculosis has occurred during the previous five years and the disease is compulsorily notifiable.

OR

a. For 180 days immediately before export the animal has not resided on any premises in the country of export where clinical, epidemiological or other evidence of bovine tuberculosis has occurred during the previous five years.

AND

b. A blood sample has been taken from the animal immediately at the start of pre-export quarantine and tested using a serological multi-antigen print immunoassay or an antibody detection test, with negative results.

Dourine – for equids only

For six months immediately before export the animal has not resided on any premises in the country of export where clinical, epidemiological or other evidence of dourine has occurred during the previous 12 months.

Equid herpesvirus-1 (abortigenic and neurological strains), 6 and 9

For 21 days immediately before export the animal has not resided on any premises in the country of export where clinical, epidemiological or other evidence of equid herpesvirus-1 (abortigenic and neurological strains), 6 or 9 have occurred during the previous 21 days.

Equine infectious anaemia – for equids only

For 60 days immediately before export the animal has not resided on any premises in the country of export where clinical, epidemiological or other evidence of equine infectious anaemia has occurred during the previous 90 days.

Equine influenza – for equids only

For 60 days immediately before export the animal was continuously resident and

free of quarantine restriction in a country where no clinical, epidemiological or other evidence of equine influenza has occurred during the previous 12 months, vaccination against equine influenza is not practised and the disease is compulsorily notifiable.

OR

For all animals including unweaned foals less than six months of age, except where otherwise specified:

a. For 21 days immediately before export the animal has not resided on any premises in the country of export where clinical, epidemiological or other evidence of equine influenza has occurred during the previous 30 days.

AND

b. The animal (other than foals under six months of age) was vaccinated against equine influenza 21–90 days before commencement of PEQ with either a primary course or a booster according to the manufacturer's recommendations using a vaccine not containing live equine influenza virus.

AND

c. The animal was held in PEQ before export. During this time the animal was isolated at least 100 metres from equids not of equivalent health status.

AND

d. A nasopharyngeal sample was taken from the animal four to seven days after commencement of PEQ and tested using a polymerase chain reaction for influenza A virus, with negative results.

Requirements for PEQ include:

1. All personnel entering the PEQ facility during PEQ must shower and change clothing on entry. Alternatively, they may shower off-site and must have no contact with equids or equid facilities between showering and entering the PEQ facility. Outer clothing used in the PEQ facility should be freshly laundered or dedicated to the facility and stored on site or disposable. Footwear used in the PEQ facility should be cleaned and disinfected before entry or dedicated to the facility and stored on site, or disposable covering should be used over existing footwear.
2. All equipment used in feeding, handling and treating the equid in PEQ must be new or cleaned and disinfected with a product effective against equine influenza virus before use and must be used only in the PEQ facility for the duration of PEQ.
3. Vehicles for transporting equids from the PEQ facility to the place of export must be cleaned and disinfected with a product effective against equine influenza virus.

Equine piroplasmosis – for equids only

For 60 days immediately before export the animal was continuously resident and free of quarantine restriction in a country where no clinical, epidemiological or other evidence of equine piroplasmosis has occurred during the previous two years.

OR

For all animals including unweaned equids less than six months of age:

a. For 60 days immediately before export the animal has not resided on any premises in the country of export where clinical, epidemiological or other evidence of equine piroplasmosis has occurred during the previous 60 days.

AND

b. The animal was held in PEQ before export. During this time the animal has been isolated from animals not of equivalent health status.

AND

c. On arrival at the PEQ facility the animal was examined under the direct supervision of the Official Veterinarian and there was no evidence of ticks. The animal was then treated immediately, under the direct supervision of the Official Veterinarian, with a long acting parasiticide effective against ticks.

AND

d. The animal was treated 21–28 days after initial treatment with a long acting parasiticide effective against ticks to provide continual protection against tick infestation beyond the day of export. The final treatment must occur within seven days of export.

AND

e. If any animal in the PEQ facility was found to have ticks, all animals in the facility were treated again seven days later with a long acting parasiticide effective against ticks.

AND

f. During PEQ there was no opportunity for iatrogenic transmission.

AND

g. The animal was thoroughly examined for ticks, and no ticks found, and blood samples were taken not less than seven days after commencement of PEQ and tested using an indirect fluorescent antibody test for *Babesia caballi* and *Theileria equi* as described in the OIE Manual for equine piroplasmosis, with negative results in each case. If there is no approved laboratory in the country of export, testing in another country must be

undertaken in a laboratory recognised by the Veterinary Authority of the country of export.

Equine viral arteritis – for equids only

For 28 days immediately before export the animal has not resided on any premises in the country of export where clinical, epidemiological or other evidence of equine viral arteritis has occurred during the previous 28 days.

Foot-and-mouth disease – for tapirs only

For 90 days immediately before export the animal was continuously resident and free of quarantine restriction in a country where no clinical, epidemiological or other evidence of foot-and-mouth disease has occurred during the previous 12 months and the disease is compulsorily notifiable.

Glanders – for equids only

For 180 days immediately before export the animal was continuously resident and free of quarantine restriction in a country where no clinical, epidemiological or other evidence of glanders has occurred during the previous three years and the disease is compulsorily notifiable.

Johne's Disease – for rhinoceroses only

a. For five 180 days immediately before export the animal has not resided on any premises in the country of export where clinical, epidemiological or other evidence of Johne's disease has occurred during the previous five years.

AND

b. Within six months of export, a faecal culture for *Mycobacterium avium* subsp *paratuberculosis* was performed, with negative results.

Lyme disease

For 90 days immediately before export the animal was continuously resident and free of quarantine restriction in a country where no clinical, epidemiological or other evidence of Lyme disease has occurred during the previous two years.

OR

a. For 60 days immediately before export the animal has not resided on any premises in the country of export where clinical, epidemiological or other evidence of Lyme disease has occurred during the previous 90 days.

AND

b. The animal was held in PEQ before export. During this time the animal has been isolated from animals not of equivalent health status.

AND

c. On arrival at the PEQ facility the animal was thoroughly examined, under the direct supervision of the Official Veterinarian, and no ticks were found. The animal was then treated immediately, under the direct supervision of the Official or Zoo Veterinarian, with a long acting parasiticide effective against ticks.

AND

d. The animal was treated 21–28 days after initial treatment with a long acting parasiticide effective against ticks to provide continual protection against tick infestation beyond the day of export. The final treatment must occur within seven days of export.

AND

e. If any animal in the PEQ facility was found to have ticks, all animals in the facility were treated again seven days later with a long acting parasiticide effective against ticks.

Rabies

For 180 days immediately before export the animal was continuously resident and free of quarantine restriction in a country where no clinical, epidemiological or other evidence of rabies has occurred during the previous two years and the disease is compulsorily notifiable.

OR

For 180 days immediately before export the animal has not resided on any premises in the country of export where clinical, epidemiological or other evidence of rabies has occurred during the previous 12 months and the disease is compulsorily notifiable.

Rift Valley fever

For 30 days immediately before export the animal was continuously resident and free of quarantine restriction in a country where no clinical, epidemiological or other evidence of Rift Valley fever has occurred during the previous four years and the disease is compulsorily notifiable.

Screw-worm-fly myiasis

For 60 days immediately before export the animal was continuously resident and free of quarantine restriction in a country where no clinical, epidemiological or other evidence of screw-worm-fly (*Cochliomyia hominivorax* or *Chrysomya bezziana*) myiasis has occurred during the previous 12 months.

Surra (*Trypanosoma evansi*)

For 60 days immediately before export the animal was continuously resident and free of quarantine restriction in a country where no clinical, epidemiological or

other evidence of surra has occurred during the previous 12 months.

Trypanosomosis (*Trypanosoma vivax*)

For 60 days immediately before export the animal was continuously resident and free of quarantine restriction in a country where no clinical, epidemiological or other evidence of trypanosomosis (*T. vivax*) has occurred during the previous 12 months.

Venezuelan equine encephalomyelitis

a. For 60 days immediately before export the animal was continuously resident and free of quarantine restriction in a country where no clinical, epidemiological or other evidence of Venezuelan equine encephalomyelitis has occurred during the previous two years and the disease is compulsorily notifiable.

AND

b. The animal was not vaccinated against Venezuelan equine encephalomyelitis during the 60 days before export.

Vesicular stomatitis

For 60 days immediately before export the animal was continuously resident and free of quarantine restriction in a country where no clinical, epidemiological or other evidence of vesicular stomatitis has occurred during the previous two years and the disease is compulsorily notifiable.

OR

a. For 30 days immediately before export the animal has not resided on any premises in the country of export where clinical, epidemiological or other evidence of vesicular stomatitis has occurred during the previous 90 days and the disease is compulsorily notifiable.

AND

b. The animal was held in PEQ for at least 14 days immediately before export. During this time the animal was isolated from equids and bovids not of equivalent health status.

AND

c. The PEQ facility is located in a defined area where no clinical, epidemiological or other evidence of vesicular stomatitis has occurred for 90 days before export.

3. The animal was examined by the Official Veterinarian within 24 hours before leaving the PEQ facility for the port of export and was found to be:
   a. free from evidence of infectious or contagious disease
   b. visibly free of external parasites

c. healthy and fit to travel.

4. Vehicles and transport containers used for transporting animals from the PEQ facility to the port of export, and to Australia, were new or must be cleaned and disinfected to the satisfaction of the Official Veterinarian before entering the PEQ facility to load the animals.
5. The Official Veterinarian was present during loading of animals when leaving the PEQ facility to supervise sealing of transport containers and/or vehicles for transporting animals, with tamper-evident seals.
6. At the port of export a government officer authorised by the Veterinary Authority of the exporting country must certify:
    a. during transport to the port of export, the animals had no contact with other animals not of equivalent health status.
    b. the seals on the vehicles were intact on arrival at the port of export.
    c. the compartment of the aircraft or vessel to be occupied by the animals and all removable equipment, penning and containers including loading ramps were satisfactorily cleaned and disinfected before loading.

Transport

1. Exporters or their agents must have detailed plans to cover procedures including contingency plans, for transporting the animal from PEQ until arrival in Australia.
2. Animals must be consigned to Australia by a route approved by DAFF.
3. Animals must travel in a container of no lesser standard than that required by "Container Requirement 1" of the International Air Transport Association (IATA) Live Animal Regulations.
4. All feed used during transport to Australia must enter the PEQ facility before commencement of PEQ.
5. The use of hay or straw as bedding during transport is not permitted. Treated wood shavings, sterilised peat and soft board can be used.
6. Animals must remain isolated from all animals not of equivalent health status during transport from the PEQ facility until arrival in Australia.
7. Insect netting must be carried on the flight at all times for contingencies. There must be sufficient insect netting to cover all travel containers completely. Insect netting must be in good condition to minimise entry of insect vectors into the travel containers.

Transit and transhipment

1. Animals must transit or tranship only at an approved airport. Any transhipment requires the prior approval of DAFF. Animals are not to leave the airport and must not be removed from their travel containers during transit or transhipment.
2. Animals must remain on board the aircraft at approved transit airports. Cargo doors can be opened at approved transit airports to allow for unloading or

loading of freight. Immediately after the cargo hold doors are closed, an approved knockdown aerosol insecticide must be sprayed throughout the cargo hold, in the manner recommended by the manufacturer.

3. In cases where animals in travel containers are to be unloaded, before opening the cargo door, the travel containers must be completely covered in netting to prevent insect access to the animals. The netting must remain in place until the animals are reloaded onto an aircraft. Immediately after the animals are reloaded onto an aircraft and the cargo hold doors are closed, an approved knockdown aerosol insecticide spray must be sprayed throughout the cargo hold in the manner recommended by the manufacturer. The insect netting must not be removed until 30 minutes after spraying.

Delayed takeoffs and unscheduled landings

1. Exporters or their agents must have contingency plans for the management of delayed takeoff and unscheduled landings.
2. If the aircraft lands at any airport other than in an approved country, DAFF must be informed immediately and the animal must not proceed to Australia without approval from DAFF. The decision as to whether the animal can continue to travel to Australia, and additional biosecurity measures that may be required, will be made by DAFF on a risk-based case-by-case basis.

Arrival in Australia

1. Importers or their agents must have a plan developed in consultation with DAFF to cover post-arrival procedures. The plan must include roles and responsibilities for their staff, vehicles for transporting animals to the quarantine approved premises (QAP) and road transport arrangements including contingency plans for vehicle and equipment failures.
2. Vehicles for transporting the animals from the port of entry to the QAP must be cleaned and disinfected to the satisfaction of the DAFF quarantine officer before loading the animals. DAFF must be advised of the transport route to the QAP.
3. After the animals arrive at an Australian airport they must be transferred in their transport containers onto vehicles, along with personnel and equipment, and proceed directly to the QAP.
4. All personnel travelling with, or that have had contact with the animals, quarantine risk material or travel containers, must undertake appropriate decontamination measures as specified by DAFF before leaving the airport or the QAP if they are accompanying the animal to the QAP.
5. All quarantine risk material (e.g. bedding, feed, water and waste material) remaining at the airport must be sealed in bags, ordered into quarantine and disposed of under DAFF supervision.
6. All equipment used during transport of the animal, and all baggage and personal equipment accompanying personnel, must be cleaned and disinfected under DAFF supervision before leaving the airport.

Post-arrival quarantine requirements

Post-arrival quarantine

There are some disease agents that require post-arrival quarantine (PAQ) as a risk management measure. The minimum PAQ period of 30 days for zoo animals applies.

Any variation from the **post-arrival quarantine requirements** must be specifically authorised by DAFF.

Location

The QAP should be located within a secure part of a zoo or wildlife park approved under relevant Australian State or Territory legislation to hold the species being imported, separated from public access areas and where it is under the direct management on day-to-day basis of a registered veterinarian.

Facilities

The PAQ facility must meet DAFF requirements for a QAP class 7.9 facility.

Operation

1. The QAP must be approved by DAFF before entry of any animal into the facility.
2. All PAQ operations and procedures must follow those outlined for a QAP class 7.9 facility and also include:
    a. A registered veterinarian must inspect the QAP before entry of any animal to ensure it has been cleaned and disinfectant applied to his/her satisfaction.
    b. The PAQ period will commence from the time of entry into the facility of the last animal.
    c. If any animal dies during PAQ, DAFF must be notified within 24 hours and the animal must undergo a post mortem examination by a registered veterinarian to determine the cause of death.
    d. DAFF is to be advised within 24 hours of any disease incident and its outcome.
    e. Animals must not leave the QAP during PAQ without permission of DAFF.
    f. At the satisfactory completion of PAQ, the animals will be released from quarantine into premises approved by the appropriate State or Territory governments for the holding of perissodactyls.
3. The following post-arrival risk management measures apply as appropriate:

Equine Influenza – equids only

The animal must be held in PAQ. During this time the animal was isolated at least 100 metres from equids not of equivalent health status.

Requirements for post- arrival quarantine include:

1. All personnel entering the QAP during PAQ must wear dedicated or disposable outer clothing and dedicated, cleaned and disinfected or disposable

footwear. All personnel must shower and change outer clothing before leaving the QAP. Outer clothing and footwear used within the QAP must be cleaned to the satisfaction of DAFF before removal from the facility.

2. All equipment used in feeding, handling and treating the animal in PAQ must either be cleaned and disinfected with a product effective against equine influenza virus to the satisfaction of DAFF before removal from the QAP, or remain on site for the duration of PAQ and then be released with DAFF approval at the completion of PAQ.
3. Vehicles for transporting animals are not permitted to leave the QAP until thoroughly cleaned and disinfected to the satisfaction of a DAFF quarantine officer.

Equine piroplasmosis – equids only

a. Within 48 hours of arrival at the QAP the animal was thoroughly examined by a registered veterinarian and no ticks found.

AND

b. If any animal in the QAP was found to have ticks, all animals in the facility were treated immediately, under the direct supervision of a registered veterinarian, with a parasiticide effective against ticks.

OR

c. If a registered veterinarian concluded the animal was unable to be thoroughly examined for ticks within 48 hours of arrival at the QAP, it was treated under the direct supervision of a registered veterinarian, with a parasiticide effective against ticks.

Lyme disease

a. Within 48 hours of arrival at the QAP the animal was thoroughly examined by a registered veterinarian and no ticks found.

AND

b. If any animal in the QAP was found to have ticks, all animals in the facility were treated immediately, under the direct supervision of a registered veterinarian, with a parasiticide effective against ticks.

OR

c. If a registered veterinarian concludes the animal was unable to be thoroughly examined for ticks within 48 hours of arrival at the QAP, it was treated under the direct supervision of a registered veterinarian, with a parasiticide effective against ticks.

5.2 Biosecurity measures for the importation of zoo equids from Country X

Documentation

Each animal must travel with an original international veterinary certificate that conforms to Article 5.10.2. of the Code, signed by the Official Veterinarian of the country of export.

These biosecurity requirements apply to zoo equids:

An **Official Veterinarian** means a veterinarian authorised by the Veterinary Authority of the country of export to perform certain official tasks associated with animal health and/or public health, and inspections of commodities and, when appropriate, to certify in conformity with the Certification Procedures of Chapter 5.2 of the Code.

The veterinary certificate must:

- be written in English and a language understood by the Official Veterinarian of Country X
- meet the requirements of the '**certification before export**' section and state that all the **pre-export quarantine requirements** have been met
- provide identification for each animal (microchip number/site or other permanent identification e.g. tattoo) including description, species, sex and age
- include the name and address of the zoological institution of origin
- include the name and address of the exporter and importer and identify the import permit against which it was issued.

The Official Veterinarian must:

- provide a separate veterinary certificate for each animal
- sign, date and stamp (with the stamp of the Veterinary Authority) each page of the veterinary certificate and all attached documents (e.g. laboratory reports) that form part of the extended veterinary certification
- endorse each page of copies of supporting documents with date, signature and Official Veterinarian stamp
- record his/her name, signature and contact details on the veterinary certificate.

Pre-export quarantine requirements

Pre-export quarantine requirements for the importation of zoo equids from Country X

Any variation from the **pre-export quarantine requirements** must be specifically authorised by DAFF.

Location

The pre-export quarantine (PEQ) facility must be located within a government registered or licensed zoological institution which is under veterinary supervision and in which the animals held in the premises are subject to a health monitoring program.

Facilities

1. The PEQ facility must meet the country and premises requirements specified in the **certification before export** section.
2. The entire PEQ facility must be surrounded by a physical barrier (e.g. fencing) that provides sufficient security to isolate the equids in PEQ from all other equids not of equivalent health status.
3. The PEQ facility including buildings, yards, fences, feeding and watering arrangements must address animal welfare considerations.
4. Buildings holding equids in the PEQ facility must be constructed so that they can be cleaned and disinfectant applied and must be maintained in good order.
5. The PEQ facility must have a separate area for the cleaning and disinfection of vehicles for transporting equids and facilities for the safe loading and unloading of animals.
6. The PEQ facility must have facilities for veterinary examination and collection of samples.

Operation

1. The PEQ facility must have current approval from DAFF and the Veterinary Authority of Country X before commencement of PEQ.
2. DAFF may audit the approved PEQ facility.
3. All PEQ operations and procedures must be detailed in Standard Operating Procedures (SOPs) consistent with a risk-based approach and approved by DAFF.
4. The Official Veterinarian must inspect the PEQ facility before commencement of PEQ and must ensure that the facility has been cleaned and disinfectant applied to his/her satisfaction.
5. PEQ must be under the supervision of the Official Veterinarian.
6. All feed to be used during PEQ and transport to Australia must enter the PEQ facility before commencement of PEQ.
7. All bedding to be used during PEQ must enter the PEQ facility before commencement of PEQ.
8. The PEQ period commences from the time the last animal in the export consignment has entered the PEQ facility and all animals have been examined by the Official Veterinarian.
9. All equipment used in feeding, handling and treating animals in PEQ must be new or cleaned and disinfected before entry, and must be used only in the facility during PEQ.
10. During PEQ, the facility must be occupied only by animals of the export

consignment.

11. Only personnel specifically authorised by the Official Veterinarian are permitted entry to the PEQ facility. Details of all visitor entries must be recorded.
12. All personnel entering the PEQ facility during PEQ must shower and change clothing on entry. Alternatively, they may shower off-site and must have no contact with equids or equid facilities between showering and entering the PEQ facility. Outer clothing used in the PEQ facility should be freshly laundered or dedicated to the facility and stored on site or disposable. Footwear used in the PEQ facility should be cleaned and disinfected before entry or dedicated to the facility and stored on site, or disposable covering should be used over existing footwear.
13. Other than inspections, visits and treatments required for certification, all veterinary visits, health problems, tests, test results, treatments and reasons for removal from PEQ of any animal must be reported to the Official Veterinarian within 24 hours, and to DAFF within 48 hours.
14. A detailed health record must be kept for each animal and be available to the Official Veterinarian and to DAFF on request.
15. Equids that leave the facility during PEQ for any reason cannot rejoin the consignment during PEQ.

Certification before export

The Official Veterinarian must certify:

1. During PEQ:
    a. the animal was not vaccinated
    b. all equids in the PEQ facility remained free from evidence of infectious or contagious disease, and had no contact with equids not of equivalent health status
    c. all samples for testing were taken by the Official Veterinarian or a veterinarian authorised by the Official Veterinarian
    d. all testing was conducted in a laboratory approved and monitored by the Veterinary Authority of Country X. If there is no approved laboratory in Country X, testing must be undertaken in a laboratory recognised by the Veterinary Authority of Country X.
2. On arrival at the PEQ facility the animal was examined under the direct supervision of the Official Veterinarian, and there was no evidence of ticks. The animal was then treated immediately, under the direct supervision of the Official Veterinarian, with a long acting parasiticide effective against ticks.

    AND

    The animal was treated 21–28 days after initial treatment with a long acting parasiticide effective against ticks to provide continual protection against tick infestation beyond the day of export. The final treatment must occur within seven days of export.

AND

If any animal in the PEQ facility was found to have ticks, all animals in the facility were treated again seven days later with a long acting parasiticide effective against ticks.

3. During the first seven days of PEQ, the animal was treated with a broad spectrum anthelmintic (or combination of anthelmintics) effective against nematodes and cestodes, and tested by appropriate parasitological techniques 14 days later. The animal was re-treated if there was evidence of parasites on testing (active ingredient/s, dose and date/s of treatment stated on the veterinary certificate).
4. Since birth, or for at least 12 months immediately before export, each animal for export was continuously resident in an approved government licensed or registered zoological institution in Country X.
5. No clinical, epidemiological or other evidence of glanders has occurred in Country X during the previous three years and the disease is compulsorily notifiable.
6. No clinical, epidemiological or other evidence of African horse sickness, rabies, Rift Valley fever, Venezuelan equine encephalomyelitis or vesicular stomatitis has occurred in Country X during the previous two years and the diseases are compulsorily notifiable. The animal was not vaccinated against African horse sickness or Venezuelan equine encephalomyelitis during the 60 days before export.
7. No clinical, epidemiological or other evidence of screw-worm-fly myiasis, surra or *Trypanosoma vivax* has occurred in Country X during the previous 12 months.
8. For 90 days immediately before export the animal has not resided on any premises in Country X where clinical, epidemiological or other evidence of anthrax, equid herpesvirus-1 (abortigenic and neurological strains), equid herpesviruses 6 – 9, equine infectious anaemia, equine influenza, equine piroplasmosis, equine viral arteritis or Lyme disease has occurred in the previous 90 days.
9. The animal has not resided on any premises in Country X where clinical, epidemiological or other evidence of dourine has occurred in the previous 12 months.
10. Equine influenza

    a. The animal (other than foals under six months of age) was vaccinated against equine influenza 21–90 days before commencement of PEQ with either a primary course or a booster according to the manufacturer's recommendations using a vaccine not containing live equine influenza virus.

    AND

    b. The animal was held in PEQ before export. During this time the animal was isolated at least 100 metres from equids not of equivalent health status.

    AND

    c. A nasopharyngeal sample was taken from the animal at least four days after commencement of PEQ and tested using a polymerase chain reaction

for influenza A virus, with negative results.

11. Equine piroplasmosis

    a. During PEQ there was no opportunity for iatrogenic transmission.

    AND

    b. The animal was thoroughly examined for ticks, and now ticks found and blood samples were taken not less than seven days after commencement of PEQ and tested using an indirect fluorescent antibody test for *Babesia caballi* and *Theileria equi* as described in the OIE Manual for equine piroplasmosis with negative results in each case. If there is no approved laboratory in Country X, testing in another country must be undertaken in a laboratory recognised by the Veterinary Authority of Country X.

12. The equid was held in PEQ for at least 30 days immediately before export in a facility that meets the requirements specified in the PEQ requirements. During this time the animal was isolated at least 100 metres from equids not of equivalent health status.

13. The animal was examined by the Official Veterinarian within 24 hours before leaving the PEQ facility for the port of export and was found to be:

    a. free from evidence of infectious or contagious disease

    b. visibly free of external parasites

    c. healthy and fit to travel.

14. Vehicles and transport containers used for transporting animals from the PEQ facility to the port of export, and to Australia, were new or were cleaned and disinfected to the satisfaction of the Official Veterinarian before entering the PEQ facility to load the animals.

15. The Official Veterinarian was present during loading of the animal when leaving the PEQ facility to supervise sealing of the vehicle for transporting the animal, with tamper-evident seals.

16. At the port of export a government officer authorised by the Veterinary Authority of Country X must certify:

    a. after due enquiry, that during transport to the port of export, the animals had no contact with other equids not of equivalent health status

    b. the seals on the vehicles were intact on arrival at the port of export

    c. the compartment of the aircraft or vessel to be occupied by the animals and all removable equipment, penning and containers including loading ramps were satisfactorily cleaned and disinfected before loading.

Transport

1. Exporters or their agents must have detailed plans to cover procedures including contingency plans, for transporting the equid from PEQ until arrival in Australia.

2. The equid must be consigned to Australia by a route approved by DAFF.

3. The equid must travel in a container of no lesser standard than that required by "Container Requirement 1" of the International Air Transport Association (IATA)

Live Animal Regulations.

4. All feed used during transport to Australia must enter the PEQ facility before commencement of PEQ.
5. The use of hay or straw as bedding during transport is not permitted. Treated wood shavings, sterilised peat and soft board can be used.
6. The equid must remain isolated from equids not of equivalent health status during transport from the PEQ facility until arrival in Australia.
7. Insect netting must be carried on the flight at all times for contingencies. There must be sufficient insect netting to cover all travel containers completely. Insect netting must be in good condition to minimise entry of insect vectors into the travel containers.

Transit and transhipment

1. Animals must transit or tranship only at an approved airport. Any transhipment requires the prior approval of DAFF. Animals are not to leave the airport and must not be removed from their travel containers during transit or transhipment.
2. Animals must remain on board the aircraft at approved transit airports. Cargo doors can be opened at approved transit airports to allow for unloading or loading of freight. Immediately after the cargo hold doors are closed, an approved knockdown aerosol insecticide must be sprayed throughout the cargo hold, in the manner recommended by the manufacturer.
3. In cases where animals in travel containers are to be unloaded, before opening the cargo door, the travel containers must be completely covered in netting to prevent insect access to the animals. The netting must remain in place until the animals are reloaded on an aircraft. Immediately after the animals are reloaded on an aircraft and the cargo hold doors are closed, an approved knockdown aerosol insecticide spray must be sprayed throughout the cargo hold in the manner recommended by the manufacturer. The insect netting must not be removed until 30 minutes after spraying.

Delayed takeoffs and unscheduled landings

1. Exporters or their agents must have contingency plans for the management of delayed takeoff and unscheduled landings.
2. If the aircraft lands at any airport other than in an approved country, DAFF must be informed immediately and the animal must not proceed to Australia without approval from DAFF. The decision as to whether the animal can continue to travel to Australia, and additional biosecurity measures that may be required, will be made by DAFF on a risk-based case-by-case basis.

Arrival in Australia

1. Importers or their agents must have a plan developed in consultation with DAFF to cover post-arrival procedures. The plan must include roles and responsibilities for their staff, vehicles for transporting animals to the quarantine approved premises (QAP) and road transport arrangements including contingency plans for vehicle and equipment failures.

2. Vehicles for transporting the animals from the port of entry to the QAP must be cleaned and disinfected to the satisfaction of the DAFF quarantine officer before loading the animals. DAFF must be advised of the transport route to the QAP.
3. After the animals arrive at an Australian airport they must be transferred in their transport containers onto vehicles, along with personnel and equipment, and proceed directly to the QAP.
4. All personnel travelling with, or that have had contact with the animal, quarantine risk material or travel containers, must undertake appropriate decontamination measures as specified by DAFF before leaving the airport or the QAP if they are accompanying the equid to the QAP.
5. All quarantine risk material (e.g. bedding, feed, water and waste material) remaining at the airport must be sealed in bags, ordered into quarantine and disposed of under DAFF supervision.
6. All equipment used during transport of the animal and all baggage and personal equipment accompanying personnel, must be cleaned and disinfected under DAFF supervision before leaving the airport.

Post-arrival quarantine requirements

Post-arrival quarantine requirements for the importation of zoo equids from Country X

Any variation from the **post-arrival quarantine requirements** must be specifically authorised by DAFF.

1. The equid must be held in post arrival quarantine (PAQ) for at least 30 days. During this time the animal was isolated at least 100 metres from equids not of equivalent health status.
2. Within 48 hours of arrival at the QAP the equid must be thoroughly examined for ticks by a registered veterinarian.

   AND

   If any equid in the QAP was found to have ticks, all equids in the facility were treated immediately, under the direct supervision of a registered veterinarian, with a parasiticide effective against ticks.

   OR

   If a registered veterinarian concludes the animal was unable to be thoroughly examined for ticks within 48 hours of arrival at the QAP, it was treated under the direct supervision of a registered veterinarian, with a parasiticide effective against ticks.

Location

The QAP should be located within a secure part of a zoo or wildlife park approved under relevant Australian State or Territory legislation to hold the species being imported, separated from public access areas and where it is under the direct management on day-to-day basis of a registered veterinarian.

Facilities

The PAQ facility must meet DAFF requirements for a QAP class 7.9 facility.

Operation

1. The QAP must be approved by DAFF before entry of any animal into the QAP.
2. All PAQ operations and procedures must follow those outlined for a QAP class 7.9 facility and also include:
    a. A registered veterinarian must inspect the QAP before entry of any animal to ensure it has been cleaned and disinfectant applied to his/her satisfaction.
    b. The PAQ period will commence from the time of entry into the facility of the last animal.
    c. All personnel entering the QAP during PAQ must wear dedicated or disposable outer clothing and dedicated, cleaned and disinfected or disposable footwear. All personnel must shower and change outer clothing before leaving the QAP. Outer clothing and footwear used within the QAP must be cleaned to the satisfaction of DAFF before removal from the facility.
    d. All equipment used in feeding, handling and treating the animal in PAQ must either be cleaned and disinfected with a product effective against equine influenza virus to the satisfaction of DAFF before removal from the QAP, or remain on site for the duration of PAQ and then be release with DAFF approval at the completion of PAQ.
    e. If any animal dies during PAQ, DAFF must be notified within 24 hours and the animal must undergo a post mortem examination by a registered veterinarian to determine the cause of death.
    f. DAFF is to be advised within 24 hours of any disease incident and its outcome.
    g. Animals must not leave the QAP during PAQ without permission of DAFF.
    h. At the satisfactory completion of PAQ, the animals will be released from quarantine into premises approved by the appropriate State or Territory governments for the holding of perissodactyls.

5.3 Biosecurity measures for the importation of non-equid perissodactyls from Country X

Documentation

Each animal must travel with an original international veterinary certificate that conforms to Article 5.10.2. of the Code, signed by the Official Veterinarian of the country of export.

These biosecurity requirements apply to rhinoceroses and tapirs.

An **Official Veterinarian** means a veterinarian authorised by the Veterinary Authority of the country of export to perform certain official tasks associated with animal health and/or public health, and inspections of commodities and, when appropriate, to certify in conformity with the Certification Procedures of Chapter 5.2 of the Code.

The veterinary certificate must:

- be written in English and a language understood by the Official Veterinarian of the Country X
- meet the requirements of the '**certification before export**' section and state that all the **pre-export quarantine requirements** have been met
- provide identification for each animal (microchip number/site or other permanent identification e.g. tattoo) including description, species, sex and age
- include the name and address of the zoological institution of origin
- include the name and address of the exporter and importer and identify the import permit against which it was issued.

The Official Veterinarian must:

- provide a separate veterinary certificate for each animal
- sign, date and stamp (with the stamp of the Veterinary Authority) each page of the veterinary certificate and all attached documents (e.g. laboratory reports) that form part of the extended veterinary certification
- endorse each page of copies of supporting documents with date, signature and Official Veterinarian stamp
- record his/her name, signature and contact details on the veterinary certificate.

Pre-export quarantine requirements

Pre-export quarantine requirements for the importation of non-equid perissodactyls from Country X

Any variation from the **pre-export quarantine requirements** must be specifically authorised by DAFF.

Location

The PEQ facility must be located within a government registered or licensed zoological institution which is under veterinary supervision and in which the animals held in the premises are subject to a health monitoring program.

Facilities

1. The PEQ facility must meet the country and premises requirements specified in the **certification before export** section.
2. The entire PEQ facility must be surrounded by a physical barrier (e.g. fencing) that provides sufficient security to isolate the animals in PEQ from all other animals not of equivalent health status.
3. The PEQ facility including buildings, yards, fences, feeding and watering arrangements must address animal welfare considerations.
4. Buildings holding animals in the PEQ facility must be constructed so that they can be cleaned and disinfectant applied and must be maintained in good order.
5. The PEQ facility must have a separate area for the cleaning and disinfection of vehicles for transporting animals, and facilities for the safe loading and unloading of animals.
6. The PEQ facility must have facilities for veterinary examination and collection of samples.

Operation

1. The PEQ facility must have current approval from DAFF and the Veterinary Authority of Country X before commencement of PEQ.
2. DAFF may audit the approved PEQ facility.
3. All PEQ operations and procedures must be detailed in Standard Operating Procedures (SOPs) consistent with a risk-based approach and approved by DAFF.
4. The Official Veterinarian must inspect the PEQ facility before commencement of PEQ and must ensure that the facility has been cleaned and disinfectant applied to his/her satisfaction.
5. PEQ must be under the supervision of the Official Veterinarian.
6. All feed to be used during PEQ and transport to Australia must enter the PEQ facility before commencement of PEQ.
7. All bedding to be used during PEQ must enter the PEQ facility before commencement of PEQ.
8. The PEQ period commences from the time the last animal in the export consignment has entered the PEQ facility and all animals have been examined by the Official Veterinarian.
9. All equipment used in feeding, handling and treating animals in PEQ must be new or cleaned and disinfected before entry, and must be used only in the facility during PEQ.
10. During PEQ, the facility must be occupied only by animals of the export

consignment.

11. Only personnel specifically authorised by the Official Veterinarian are permitted entry to the PEQ facility. Details of all visitor entries must be recorded.
12. Other than inspections, visits and treatments required for certification, all veterinary visits, health problems, tests, test results, treatments and reasons for removal from PEQ of any animal, must be reported to the Official Veterinarian within 24 hours, and to DAFF within 48 hours.
13. A detailed health record must be kept for each animal and be available to the Official Veterinarian and to DAFF on request.
14. Animals that leave the facility during PEQ for any reason cannot rejoin the consignment during PEQ.

Certification before export

The Official Veterinarian must certify:

1. During PEQ:
    a. the animal was not vaccinated
    b. all animals in the PEQ facility remained free from evidence of infectious or contagious disease, and had no contact with animals not of equivalent health status
    c. all samples for testing were taken by the Official Veterinarian or a veterinarian authorised by the Official Veterinarian
    d. all testing was conducted in a laboratory approved and monitored by the Veterinary Authority of Country X. If there is no approved laboratory in Country X, testing must be undertaken in a laboratory recognised by the Veterinary Authority of Country X.
2. On arrival at the PEQ facility the animal was thoroughly examined under the direct supervision of the Official Veterinarian, and no ticks were found. The animal was then treated immediately, under the direct supervision of the Official Veterinarian, with a long acting parasiticide effective against ticks.

    AND

    The animal was treated 21–28 days after the initial treatment with a long acting parasiticide effective against ticks to provide continual protection against tick infestation beyond the day of export. The final treatment must occur within seven days of export.

    AND

    If any animal in the PEQ facility was found to have ticks, all animals in the facility were treated again seven days later with a long acting parasiticide effective against ticks.
3. During the first seven days of PEQ, the animal was treated with a broad spectrum anthelmintic (or combination of anthelmintics) effective against nematodes and cestodes, and tested by appropriate parasitological techniques 14 days later. The animal was re-treated if there was evidence of parasites on testing (active ingredient/s, dose and date/s of treatment stated on the veterinary certificate).

4. Since birth, or for at least 12 months immediately before export, each animal for export was continuously resident in an approved government licensed or registered zoological institution in Country X.
5. No clinical, epidemiological or other evidence of foot-and-mouth disease, rabies, Rift Valley fever, Venezuelan equine encephalomyelitis or vesicular stomatitis has occurred in Country X during the previous two years and the diseases are compulsorily notifiable. The animal was not vaccinated against Venezuelan equine encephalomyelitis during the 60 days before export.
6. No clinical, epidemiological or other evidence of screw-worm-fly myiasis, surra or *Trypanosoma vivax* has occurred in Country X during the previous 12 months.
7. For 180 days immediately before export the animal has not resided on any premises in Country X where clinical, epidemiological or other evidence of bovine tuberculosis or Johne's disease has occurred in the previous five years.
8. For 90 days immediately before export the animal has not resided on any premises in Country X where clinical, epidemiological or other evidence of anthrax, equid herpesvirus-1 (abortigenic and neurological strains), equid herpesviruses 6 – 9 or Lyme disease has occurred in the previous 90 days.
9. Johne's disease (rhinoceroses only)

   Within six months of export, a faecal culture for *Mycobacterium avium* subsp *paratuberculosis* was performed, with negative results.
10. Bovine tuberculosis

    A blood sample has been taken from the animal immediately at the start of PEQ and tested using a serological multi-antigen print immunoassay or an antibody detection test, with negative results.
11. The animal was held in PEQ for at least 30 days immediately before export in a facility that meets the requirements specified in the PEQ requirements. During this time the animal was isolated from animals not of equivalent health status.
12. The animal was examined by the Official Veterinarian within 24 hours before leaving the PEQ facility for the port of export and was found to be:
    a. free from evidence of infectious or contagious disease
    b. visibly free of external parasites
    c. healthy and fit to travel.
13. Vehicles and transport containers used for transporting animals from the PEQ facility to the port of export, and to Australia, were new or were cleaned and disinfected to the satisfaction of the Official Veterinarian before entering the PEQ facility to load the animals.
14. The Official Veterinarian was present during loading of the animal when leaving the PEQ facility to supervise sealing of the vehicle for transporting the animal, with tamper-evident seals.
15. At the port of export a government officer authorised by the Veterinary Authority of Country X must certify:
    a. after due enquiry, that during transport to the port of export, the animals had no contact with other animals not of equivalent health status

b. the seals on the vehicles were intact on arrival at the port of export

c. the compartment of the aircraft or vessel to be occupied by the animals and all removable equipment, penning and containers including loading ramps were satisfactorily cleaned and disinfected before loading.

Transport

1. Exporters or their agents must have detailed plans to cover procedures including contingency plans, for transporting the animal from PEQ until arrival in Australia.
2. The animal must be consigned to Australia by a route approved by DAFF.
3. The animal must travel in a container of no lesser standard than that required by "Container Requirement 1" of the International Air Transport Association (IATA) Live Animal Regulations.
4. All feed used during transport to Australia must enter the PEQ facility before commencement of PEQ.
5. The use of hay or straw as bedding during transport is not permitted. Treated wood shavings, sterilised peat and soft board can be used.
6. The animal must remain isolated from animals not of equivalent health status during transport from the PEQ facility until arrival in Australia.
7. Insect netting must be carried on the flight at all times for contingencies. There must be sufficient insect netting to cover all travel containers completely. Insect netting must be in good condition to minimise entry of insect vectors into the travel containers.

Transit and transhipment

1. Animals must transit or tranship only at an approved airport. Any transhipment requires the prior approval of DAFF. Animals are not to leave the airport and must not be removed from their travel containers during transit or transhipment.
2. Animals must remain on board the aircraft at approved transit airports. Cargo doors can be opened at approved transit airports to allow for unloading or loading of freight. Immediately after the cargo hold doors are closed, an approved knockdown aerosol insecticide must be sprayed throughout the cargo hold, in the manner recommended by the manufacturer.
3. In cases where animals in travel containers are to be unloaded, before opening the cargo door, the travel containers must be completely covered in netting to prevent insect access to the animals. The netting must remain in place until the animals are reloaded on an aircraft. Immediately after the animals are reloaded on an aircraft and the cargo hold doors are closed, an approved knockdown aerosol insecticide spray must be sprayed throughout the cargo hold in the manner recommended by the manufacturer. The insect netting must not be removed until 30 minutes after spraying.

Delayed takeoffs and unscheduled landings

1. Exporters or their agents must have contingency plans for the management of delayed takeoff and unscheduled landings.

2. If the aircraft lands at any airport other than in an approved country, DAFF must be informed immediately and the animal must not proceed to Australia without approval from DAFF. The decision as to whether the animal can continue to travel to Australia, and additional biosecurity measures that may be required, will be made by DAFF on a risk-based case-by-case basis.

Arrival in Australia

1. Importers or their agents must have a plan developed in consultation with DAFF to cover post-arrival procedures. The plan must include roles and responsibilities for their staff, vehicles for transporting animals to the quarantine approved premises (QAP) and road transport arrangements including contingency plans for vehicle and equipment failures.
2. Vehicles for transporting animals from the port of entry to the QAP must be cleaned and disinfected to the satisfaction of the DAFF quarantine officer before loading the animals. DAFF must be advised of the transport route to the QAP.
3. After the animals arrive at an Australian airport they must be transferred in their transport containers onto vehicles, along with personnel and equipment, and proceed directly to the QAP.
4. All quarantine risk material (e.g. bedding, feed, water and waste material) remaining at the airport must be sealed in bags, ordered into quarantine and disposed of under DAFF supervision.
5. All equipment used during transport of the animal, and all baggage and personal equipment accompanying personnel, must be cleaned and disinfected under DAFF supervision before leaving the airport.

Post-arrival quarantine requirements

Post-arrival quarantine requirements for the importation of non-equid perissodactyls from Country X

Any variation from the **post-arrival quarantine requirements** must be specifically authorised by DAFF.

1. The animal must be held in PAQ for at least 30 days. During this time the animal must be isolated from animals not of equivalent health status
2. Within 48 hours of arrival at the QAP the animal must be thoroughly examined for ticks by a registered veterinarian.

   AND

   If any animal in the QAP was found to have ticks, all animals in the facility were treated immediately, under the direct supervision of a registered veterinarian, with a parasiticide effective against ticks.

   OR

   If a registered veterinarian concludes the animal was unable to be thoroughly examined for ticks within 48 hours of arrival at the QAP, it was treated under the direct supervision of a registered veterinarian, with a parasiticide effective against

ticks.

Location

The QAP should be located within a secure part of a zoo or wildlife park approved under relevant Australian State or Territory legislation to hold the species being imported, separated from public access areas and where it is under the direct management on day-to-day basis of a registered veterinarian.

Facilities

The PAQ facility must meet DAFF requirements for a QAP class 7.9 facility.

Operation

1. The QAP must be approved by DAFF before entry of any animal into the QAP.
2. All PAQ operations and procedures must follow those outlined for a QAP class 7.9 facility and also include:
    a. A registered veterinarian must inspect the QAP before entry of any animal to ensure it has been cleaned and disinfectant applied to his/her satisfaction.
    b. The PAQ period will commence from the time of entry into the facility of the last animal.
    c. Vehicles for transporting animals must not leave the QAP until thoroughly cleaned and disinfected.
    d. If any animal dies during PAQ, DAFF must be notified within 24 hours and the animal must undergo a post mortem examination by a registered veterinarian to determine the cause of death.
    e. DAFF is to be advised within 24 hours of any disease incident and its outcome.
    f. Animals must not leave the QAP during PAQ without permission of DAFF.
    g. At the satisfactory completion of PAQ, the animals will be released from quarantine into premises approved by the appropriate State or Territory governments for the holding of perissodactyls.