非洲馬疫
African Horse Sickness

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內容大綱

Part 1

- 非洲馬疫
- 泰國經驗分享 - 向泰國獸醫取經
- 台灣現況與風險分析

Part2

- 馬匹乙類傳染病

2

非洲馬疫

- African horse sickness (AHS)
- World Organisation for Animal Health (WOAH) listed
- 病原：里奧病毒科中之環狀病毒屬
  - *Orbivirus, Reoviridae*, double-stranded RNA virus
  - 9 serotypes; serotype 9
- 節肢動物傳播: 庫蠓屬 (*Culicoides*)
- All species of Equidae
  - 馬 (highly susceptible)>騾 (curable)>斑馬 (asymptomatic)
- Fatal disease (up to 95%)

3

< 1881 | 1881-1897 | 1899-1900 | 1921 | 1944 | 1959-1960 | 1965-1966 | 1977 | 1987-1990

非洲馬疫的診斷起源

- At first, it was called “Horse-sickness”
- Enzootic in South Africa
- Worst outbreak record: 1854-1855
  - 64,850 horses
  - £ 525,000 economic loss
- ***Animals are well in the evening, then found dead in the next morning ; symptoms are seldom exhibited over 1-2 days***

4

< 1881 | 1881-1897 | 1899-1900 | 1921 | 1944 | 1959-1960 | 1965-1966 | 1977 | 1987-1990

非洲馬疫的診斷起源

- 1881: “Horse-sickness” was identified with anthrax.
  - Climatic outbreak
  - Post-mortem appearances
- 1887-1897: Bacteriological examination and experiments failed to demonstrate evidences of anthrax.
  - Conclusion was made it was not anthrax.
  - Post-mortem exam on the farm, but humans, sheep and cattle were spared.
  - More likely a malaria disease

5

< 1881 | 1881-1897 | 1899-1900 | 1921 | 1944 | 1959-1960 | 1965-1966 | 1977 | 1987-1990

非洲馬疫的診斷起源

- 1892-1895: First valuable report suggesting the “blood-borne transmission” hypothesis.
- 1899-1900: M'Fadyean, Royal Veterinary College, London
  - Bacteria-free blood filtrate
  - A “filterable” agent
  - Virus

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< 1881 | 1881-1897 | 1899-1900 | 1921 | 1944 | 1959-1960 | 1965-1966 | 1977 | 1987-1990

非洲馬疫的診斷起源

- 1921: First description of “African Horse Sickness”
  - Endemic in sub-Saharan Africa
  - Occurs annually or seasonally
  - Susceptible Equidae
  - Enzootic outbreaks appear suddenly after heavy, prolonged rain, and many deaths occur within a short time
  - Virus
  - Probably transmitted by a blood-sucking insect, perhaps mosquitos

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< 1881 | 1881-1897 | 1899-1900 | 1921 | 1944 | 1959-1960 | 1965-1966 | 1977 | 1987-1990

非洲馬疫的爆發－從南非、北非、到中東

- 1921 report: Sub-Saharan Africa
- 1944: Egypt, Palestine, Syria, Jordan
- 1959-1960: Iran, Pakistan, Afghanistan, Jordan, India, Turkey…
  - Serotype 9
  - 300,000 horses

Massive vaccination campaign

8

< 1881 | 1881-1897 | 1899-1900 | 1921 | 1944 | 1959-1960 | 1965-1966 | 1977 | 1987-1990

非洲馬疫的爆發－從北非、到南歐

- 1965-1966: Algeria, Morocco, Tunisia, and Spain
  - Serotype 9

9

< 1881 | 1881-1897 | 1899-1900 | 1921 | 1944 | 1959-1960 | 1965-1966 | 1977 | 1987-1990

J. Hyg., Camb. (1977), **79**, 279
Printed in Great Britain

Possible spread of African horse sickness on the wind

By R. F. SELLERS
Animal Virus Research Institute, Pirbright, Woking, Surrey
AND D. E. PEDGLEY AND M. R. TUCKER
Centre for Overseas Pest Research, London W8 5SJ

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< 1881 | 1881-1897 | 1899-1900 | 1921 | 1944 | 1959-1960 | 1965-1966 | 1977 | 1987-1990

跨海的疾病傳播

- 推斷1: 馬匹移動造成的傳播
  - Already warned; entry of live animals was banned.
- 推斷2: 交通工具（船隻）攜帶病媒昆蟲
- 推斷3: 風吹，造成病媒昆蟲跨海

11

< 1881 | 1881-1897 | 1899-1900 | 1921 | 1944 | 1959-1960 | 1965-1966 | 1977 | 1987-1990

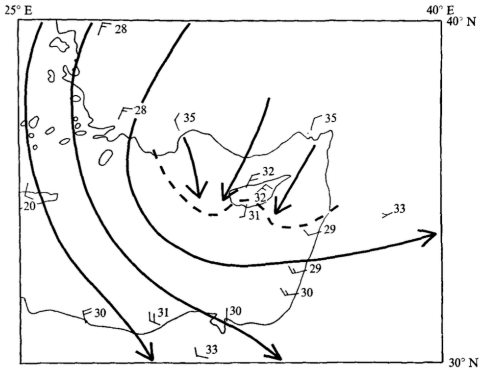


Fig. 4. Synoptic weather chart for 1200 GMT 28 August 1960, during a spell of north to north-east winds that probably brought infected midges from Turkey to Cyprus. The broken line shows the likely boundary between the north-westerly flow that has come around the western end of the mountains of Turkey, and the north-easterly flow that has crossed the mountains. Surface winds: ↖ 2·5 m s^{-1}; ↖ 5 m s^{-1}.

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< 1881 | 1881-1897 | 1899-1900 | 1921 | 1944 | 1959-1960 | 1965-1966 | 1977 | 1987-1990

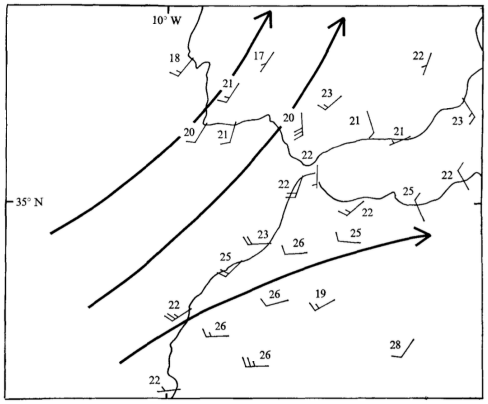


Fig. 2. Synoptic weather chart for 1800 GMT 3 October 1966, showing south to south-west winds that probably brought infected midges from Morocco to Spain. Winds and temperatures are shown at a selection of reporting stations. Arrows show the direction of the large scale wind flow. Surface winds: ↖ 2·5 m s⁻¹; ↖ 5 m s⁻¹.

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< 1881 | 1881-1897 | 1899-1900 | 1921 | 1944 | 1959-1960 | 1965-1966 | 1977 | 1987-1990

Veterinary Microbiology, 33 (1992) 129–142
Elsevier Science Publishers B.V., Amsterdam

African horse sickness in Spain

M. Rodriguez[a], H. Hooghuis[b] and Ma. Castaño[a]
[a]*Departamento de Patología Animal - II, Facultad de Veterinaria, Universidad Complutense, Madrid, Spain*
[b]*Laboratorio de Sanidad y Producción Animal Algete, Ministerio de Agricultura, Pesca y Alimentación, Madrid, Spain*

- 1966: Serotype 9 (Same as Morocco)
  - Eliminated in 3 weeks with vigorous vaccination and slaughter policy
- 1987/07: Outbreak in Madrid, Spain; serotype 4
  - Imported zebras in late June, close to a Safari Park in Madrid
- 1988-1991: 12 months later, outbreak in Cadiz; serotype 4

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< 1881 | 1881-1897 | 1899-1900 | 1921 | 1944 | 1959-1960 | 1965-1966 | 1977 | 1987-1990

突破 “冬季” 的傳播路徑

- 推斷1: 受感染的馬匹
- 推斷2: 受感染的病媒昆蟲
- 推斷3: vaccine reversion
- 推斷4: 受感染但無明顯症狀的騾、驢
- 推斷5: 南歐季節特性
- 推斷6: 疫苗覆蓋不完全（野馬、未登錄飼養）

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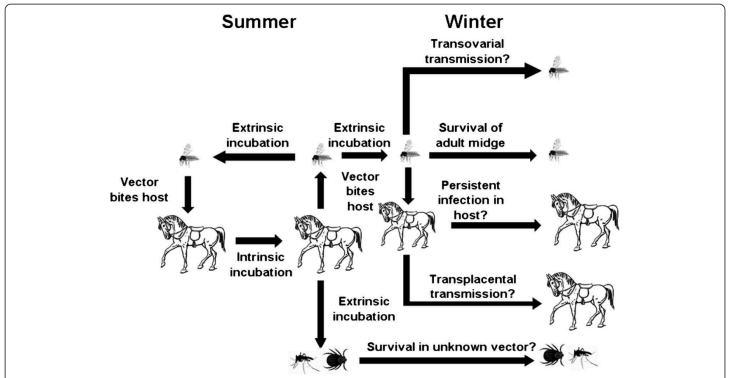


Figure 4 The normal transmission cycle of African horse sickness virus in summer (Left) and possible overwintering mechanisms (Right). Image created using Microsoft Clip Art with permission from Microsoft PowerPoint (2007).

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< 1881 | 1881-1897 | 1899-1900 | 1921 | 1944 | 1959-1960 | 1965-1966 | 1977 | 1987-1990

非洲馬疫 – 西班牙的經驗

Strong preventive measures + wide buffer zone

- 禁止移動
- 降低病媒昆蟲接觸馬匹的機率
  - 殺蟲劑、驅蟲措施
  - 蚊蟲活躍時間待在馬廄
  - 中斷蚊蟲的繁殖、生命週期
- 撲殺或隔離已/疑似感染動物
- 強制疫苗施打
  - 業界的配合是成功要素

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非洲馬疫 – 病原

- *Orbivirus, Reoviridae*
- 10 segments of linear double stranded RNA (dsRNA)
- Non-enveloped
- Triple capid structure
- 80nm in diameter

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非洲馬疫 – 主要病原結構

- VP2 protein
  - Principle component of the outer capsid
  - Main serotype-specific antigen
- VP5 protein
  - Located on the outer capsid, but less exposed
  - Does not seem to be involved in antibody-mediated neutralisation
- VP3 & VP7
  - Major components of the inner core
  - Contain group-specific antigenic determinants

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非洲馬疫 – 病原特性

- Acid sensitive: inactivated at pH<6.0
- Stable at more alkaline pH (7.0-8.5)
- Resistant to lipid solvents
- Relatively heat resistant
- Infectivity is very stable at 4°C
- Ultra-filterability

- 9 antigenically distinct serotypes, some cross-related:
  - Types 1-2, 3-7, 5-8, and 6-9
  - Share a common antigen: VP7

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Annals of Tropical Medicine and Parasitology, Vol. 89, No. 1, 1–15 (1995)

REVIEW

The transmission and geographical spread of African horse sickness and bluetongue viruses

By P. S. MELLOR
Institute for Animal Health, Pirbright Laboratory, Ash Road, Pirbright, Woking, Surrey GU24 0NF, U.K.

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Review article

Re-emergence of bluetongue, African horse sickness, and other Orbivirus diseases

N. James MACLACHLAN[1]*, Alan J. GUTHRIE[2]

[1] Department of Pathology, Microbiology and Immunology, School of Veterinary Medicine, University of California, Davis, CA 95616, USA
[2] Equine Research Centre, Faculty of Veterinary Science, University of Pretoria, Onderstepoort, 0110, Republic of South Africa

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非洲馬疫 – 病媒昆蟲

- *Culicoides* species
  - *Culicoides imicola*
  - As temperature increases
    - Infection rates increase
    - Midges survival rate decrease
  - Vice versa
    - 12°C , life span extends up to 90 days
    - Partly supports the “over-winter” theory in Spain.
  - The warm (El Niño) phase of the El Niño/Southern Oscillation (ENSO)
- Mosquitoes, ticks ?

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非洲馬疫 – Pathogenesis

- Entry into the vertebrate host.
- Initial multiplication of AHSV occurs in the regional lymph nodes.
- Dissemination throughout the body via blood (Primary viraemia).
- Subsequently infecting target organs.
- AHSV multiplication in target organs (Secondary viraemia).

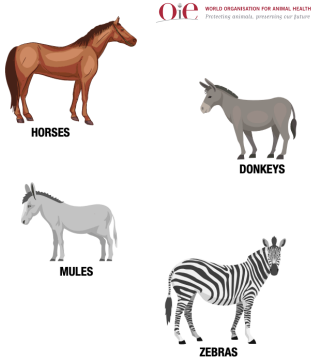
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非洲馬疫 – 發病

Under natural conditions:

- <9 days incubation period
- Viraemia: up to $10^{5.0}$ $TCID_{50}$ of virus/mL in horses
- In horses: Viraemia usually lasts for 4-8 days, and has not been detected >21 days
- In donkeys & zebras: Viraemia level is low but may extend up to 4 weeks
  - $10^{3.0}$ $TCID_{50}$ of virus/mL

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The disease is spread by tiny flying insects: midges, also called Culicoides



- Incubation period in horse: 5-9 days (2-21 days were also recorded)
- Virus is present in the blood 4 days before clinical signs & 2 days after
- 4-8 days after infection (about when clinical signs become apparent), virus in the blood reaches $10^{4.0}$ LD 50 per ml or higher → infecting midges

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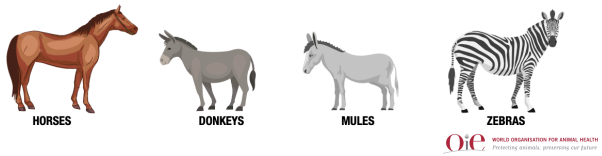
非洲馬疫 – *Culicoides* species

- Minimum dose needed to experimentally infect *Culicoides imicola* is 10^4–$10^{4.5}$ TCID50/0.02 ml blood.
- After an infected meal, the virus titre reaches 10^6 LD50 per midge on the 5th day, transmission of virus on the 7-13th days after feeding
- The midges remain infected for the rest of its life.

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It is spread by tiny flying insects, midges, also called Culicoides





7 days incubation in a horse
+
7 days in the midges
=
14 days: shortest period between a midge biting an affected horse and the disease being seen in another horse. (range from 12-16 days)

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THE SUSCEPTIBILITY OF THE DOG TO AFRICAN HORSE-SICKNESS.

By Dr ARNOLD THEILER, C.M.G., Government Veterinary Bacteriologist to the Transvaal.

曾被檢出病毒或抗體陽性

- 駱駝科
- 牛科
- 非洲象
- 家犬：
  - 感染後家犬的血，可感染馬匹並導致死亡
  - 部分感染的家犬死亡、發燒
  - 實驗感染、食肉後感染

X

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非洲馬疫 – 臨床症狀

四型

- Pulmonary form 肺臟型
- Mixed form 混合型
- Cardiac form/ Subacute form 心臟型
- Horse sickness fever 發燒型

Severity



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Horse sickness form 發燒型

- Mild to moderate fever
- Oedema of the supraorbital fossae
- Not lethal
- Equidae: zebras, African donkeys, vaccinated horses

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Cardiac form/ Subacute form 心臟型

- High fever (39-40°C) for weeks
- Main clinical findings: subcutaneous oedema, especially over the head (including supraorbital fossae), neck, and chest
- Congested conjunctivae, petechiae
- Ecchymotic haemorrhages on the ventral surface of the tongue
- Colic
- >50% mortality

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Pulmonary form 肺臟型

- Peracute, animals can die without previous signs of illness
- High fever (39-41°C)
- Marked depression
- Respiratory distress, severe dyspnoea, coughing spasm
- Severe sweating
- Large amount of frothy fluid discharges from the nostril at terminal stages
- >95% mortality

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Mixed form 混合型

- The most common form
- Cardiac + pulmonary
- >70% mortality
- Death occurs 3-6 days of fever onset

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非洲馬疫 – 區別診斷

- Equine infectious anaemia
- Equine viral arteritis
- Equine encephalosis virus (another orbivirus)
- Equine pneumonia caused by Hendra virus infection
- Anaplasmosis
- Babesiosis
- Theileriosis
- Anthrax
- Purpura haemorrhagica
- Poisonous plants

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非洲馬疫 – 肉眼病變 (1)

- 皮下（尤其肋間肌）：yellowish, gelatinous oedema
- 腹腔：
  - ascites
  - focal subcapsular splenic petechiae
  - mesenteric lymph nodes: slightly hypertrophic, moist, reddish/greyish
- 胃：pronounced submucosal congestion of the fundus of the stomach
- 小腸：subserous and submucous petechiae
- 大腸：diffuse congestion of the mucous membrane

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非洲馬疫 – 肉眼病變 (2)

- 胸腔：
  - accumulation of liquid
  - mediastinal lymph nodes: slightly hypertrophic, moist, reddish
- 肺：hypertrophic, interstitial and alveolar oedemae
- 氣管：frothy liquid, petechiae and oedema
- 心臟：hydropericardium, 500-2000ml of yellowish liquid
  - petechiae were seen on the coronary sulcus
  - subendocardial haemorrhage

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非洲馬疫 – 顯微病變 (1)

- 微血管：
  - increased permeability
- 肺：
  - serous infiltration of the interlobular tissues
  - distension of the alveoli
  - capillary congestion
- 肝臟：
  - distended central vein
  - interstitial tissue contains erythrocytes and blood pigments
  - parenchymous cells show fatty degeneration

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非洲馬疫 – 顯微病變 (2)

- 腎臟：
  - Cellular infiltration in the cortex
- 脾臟： congestion
- 消化道黏膜：congestion
- 心肌、骨骼肌：cloudy swelling

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非洲馬疫 – 實驗室診斷 (1)

- Ante-mortem sample: blood
  - EDTA tube
- Post-mortem sample: samples must be sent rapidly to a specialised laboratory at 4°C
  - Spleen
  - Lungs
  - Lymph nodes

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非洲馬疫 – 實驗室診斷 (2)

- Virus isolation
- Virus identification
  - Real-time or classical RT-PCR assays
  - Problem of serology
    - Horses will die before the induction of AHSV antibodies (10-14 days post-infection)
    - Vaccination
- Serological techniques prescribed by WOAH: for animal trade
  - Complement fixation test
  - Serum neutralisation test : some cross-neutralisation
  - ELISA

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B. DIAGNOSTIC TECHNIQUES

Table 1. Test methods available for the diagnosis of African horse sickness and their purpose

Method	Purpose					
	Population freedom from infection	Individual animal freedom from infection prior to movement	Contribute to eradication policies	Confirmation of clinical cases	Prevalence of infection – surveillance	Immune status in individual animals or populations post-vaccination
Identification of the agent[a]						
Real-time RT-PCR	+	+++	+	+++	++	–
Agarose gel-based RT-PCR	–	+	+	++	+	–
Virus isolation	–	++	–	+++	–	–
Detection of immune response						
ELISA (serogroup specific based on VP7)	+++	++	++	++	+++	++
CFT	+	+	+	+	+	+
VN	+	+	–	+	+	+++

Key: +++ = recommended for this purpose; ++ recommended but has limitations;
+ = suitable in very limited circumstances; – = not appropriate for this purpose.
RT-PCR = reverse-transcription polymerase chain reaction; ELISA = enzyme-linked immunosorbent assay;
VN = virus neutralisation; CFT = complement fixation test.
[a]A combination of agent identification methods applied on the same clinical sample is recommended.

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非洲馬疫 – 疫苗

At present only the live attenuated AHS vaccines (polyvalent or monovalent) are commercially available.

- Recorded issues of reversion to virulence and reassortment with field strains
- Cross protection documented between serotypes:
  - No cross-protection between serotypes 4 and any others
  - 1 & 2
  - 3 & 7
  - 5 & 8
  - 6 & 9

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非洲馬疫 – 預防 (1)

In order to prevent the import of infected equids from AHSV at-risk areas to AHSV-free countries.

1. The horse should show no clinical signs of illness on the day of shipment, and should not have been vaccinated against AHS within the last 40 days.
2. The horse should have been isolated in a vector-protected establishment for either:

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非洲馬疫 – 預防 (2)

- 28 days, with serological testing after this period to show a negative serological result
- 40 days, with two serological tests no less than 21 days apart to show lack of seroconversion
- 14 days, with an agent identification test carried out on day 14 to show absence of the virus (e.g. RT-qPCR)
- 40 days, after having been vaccinated against all serotypes that surveillance programmes have shown to be circulating in the area

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非洲馬疫 – 預防 (3)

If AHSV should emerge outside AHS endemic areas, the control programme implemented should contain three components:

- Quarantine
  - Insect-proof enclosures
- Vector control
  - Shielding stables
  - Authorised pesticides to reduce adult populations
  - Slaughter of confirmed/in-contact animals may be required
  - Movement restriction
- Vaccination
  - Central to AHS control

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Transboundary and Emerging Diseases

OUTBREAK ALERTS | Open Access

Outbreak of African horse sickness in Thailand, 2020

Simon King, Paulina Rajko-Nenow, Martin Ashby, Lorraine Frost, Simon Carpenter, Carrie Batten

First published: 27 June 2020 | https://doi.org/10.1111/tbed.13701 | Citations: 22

Received: 12 August 2020 | Accepted: 27 August 2020

DOI: 10.1111/evj.13353

EDITORIAL

Equine Veterinary Journal WILEY

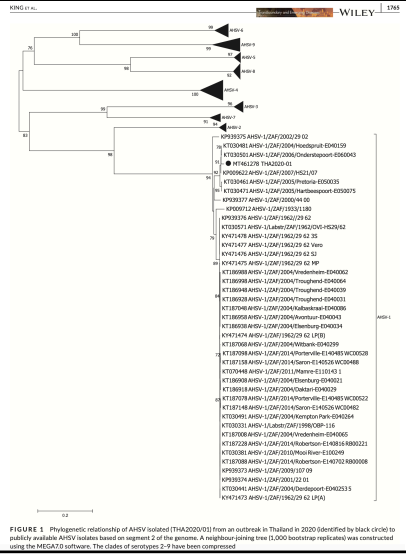
African horse sickness in Thailand: Challenges of controlling an outbreak by vaccination

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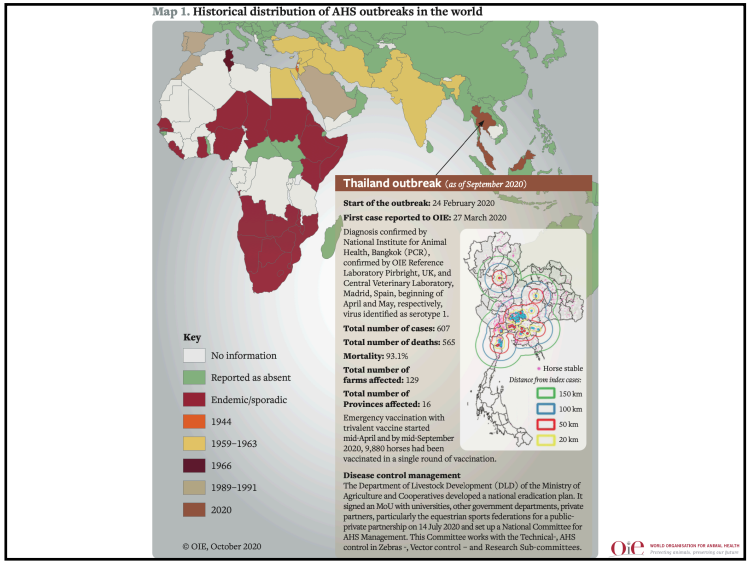
非洲馬疫 – 泰國

- Confirmed by Pirbright Institute, United Kingdom
  - EDTA blood & serum sent by a private veterinarian
- Clinical signs
  - Supraorbital oedema
  - Fever
  - Frothy discharge from mouth & nostrils
  - Sudden death within 12-24 of clinical signs
- Serotype 1
  - Closely related to strains from the Republic of South Africa
  - Likely recent introduction
  - Outbreak is thought to have started a few days earlier in February

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OPEN ACCESS Freely available online
PLoS one

Transmission and Control of African Horse Sickness in The Netherlands: A Model Analysis

Jantien A. Backer*, Gonnie Nodelijk
Department of Epidemiology, Crisis Organisation and Diagnostics, Central Veterinary Institute of Wageningen UR, Lelystad, The Netherlands

- 3 key differences between the model of bluetongue and AHS:
  1. Infectious period: 1 week for AHS in horses; 2-3 weeks for bluetongue in sheep and cattle
  2. Rapid show of severe clinical signs in AHS
  3. Hosts: population is larger for bluetongue
- Factors not taken into consider: other equids, other *Culicoides* species

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Thompson *et al. Irish Veterinary Journal* 2012, **65**:9
http://www.irishvetjournal.org/content/65/1/9
IRISH VETERINARY JOURNAL
Iris Tréidliachta Éireann
REVIEW Open Access

A review of African horse sickness and its implications for Ireland

Geoffrey M Thompson[1,2*], Stephen Jess[2] and Archie K Murchie[2]

- 3 possible pathways:
  1. Imported infected Equidae: originated countries
  2. Introduction of infected vectors: wind; countries in close proximity (maximum record 700km)
  3. Importation of infected biological substances

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Where are we now – 台灣現況

邊境防疫
- 馬匹
- 斑馬
- 蚊蟲
  - 地理環境與風向

國內防疫
- 馬場、馬匹數量登記
- 獸醫人數
- 社區意識
- 疫苗

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農業部
動植物防疫檢疫署

附件三馬輸入檢疫條件

一、本檢疫條件所稱馬匹，指馬科動物。

二、本檢疫條件所定檢測，應由輸出國政府所屬、指定或認可實驗室，以本檢疫條件所列檢測方法，或世界動物衛生組織（以下簡稱 OIE）陸生動物疾病診斷與疫苗手冊(以下簡稱診斷手冊)指定、推薦或認為適用於確認族群或個別動物無感染該疫病之方法實行診斷試驗。但診斷手冊無指定、推薦或認為適用之方法時，得依國際期刊所發表之方法為之。

三、馬匹限自中央主管機關公告之馬鼻疽及非洲馬疫非疫區國家（地區）輸入。

四、輸入之馬匹屬畜牧法或野生動物保育法規定經同意始得輸入者，應先取得各該中央主管機關之同意，始得向輸出入動物檢疫機關申請排妥輸入動物隔離場所或其他指定場所。

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農業部
動植物防疫檢疫署

五、輸入馬匹應符合下列條件：

(一) 來自過去二年內無委內瑞拉馬腦脊髓炎確定病例之國家（地區）。

(二) 來自過去一年無水疱性口炎確定病例之省(州)或相當之行政區域。

(三) 飼養場所應符合下列規定：

1.過去一年無狂犬病、馬媾疫、東方馬腦脊髓炎、西方馬腦脊髓炎、馬傳染性貧血、馬 A 型流行性感冒、流行性淋巴管炎及馬焦蟲病等傳染病之確定病例。

2.過去半年無亨德拉病毒病、立百病毒腦炎、馬接觸傳染性子宮炎、馬痘、馬病毒性動脈炎、馬腺疫、類鼻疽、馬鼻肺炎、日本腦炎、蘇拉病及炭疽等傳染病之確定病例。

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農業部
動植物防疫檢疫署

(四) 輸出前在輸出國政府認可獸醫師監督下且具防蚊功能隔離檢疫設施內隔離檢疫二十八日以上。隔離檢疫期間經檢查健康情形良好，無任何臨床疫病症狀，且符合下列規定：

1.實行下列疫病檢測且結果為陰性：

(1) 馬傳染性貧血：免疫擴散反應試驗或酵素結合免疫吸附試驗。

(2) 馬焦蟲病：補體結合反應試驗或間接螢光抗體試驗或酵素結合免疫吸附試驗。

(3) 馬接觸傳染性子宮炎：聚合酵素連鎖反應或生殖器之細菌培養試驗至少二次，每次間隔至少七天。但已去勢之公馬及已切除子宮之母馬，免予檢測。

(4) 馬病毒性動脈炎：血清中和試驗。

(5) 水疱性口炎：補體結合反應試驗、酵素結合免疫吸附試驗或血清中和試驗。

(6) 其他因應國際疫情由輸出入動物檢疫機關臨時指定之檢測。

2.驅蟲處理：輸出前十日以上實行內外寄生蟲之驅蟲。

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農業部
動植物防疫檢疫署

第十四條　輸入第五條至第十條動物前，輸入人或其代理人應申請排妥動物隔離場所或其他指定場所，始得輸入。

前項動物輸入後，應依下列期間隔離檢疫。但檢疫條件另有規定者，從其規定：

一、鳥綱動物，十日；受精蛋輸入隔離至孵化後十日為止。

二、哺乳綱奇蹄目馬科動物，十日。

三、哺乳綱偶蹄目動物，十五日。

四、哺乳綱食肉目動物，二十一日。

五、其他動物，七日。

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斑馬

- 斑馬的輸入條件？
  - 野生動物管理辦法？
  - 馬科管理辦法？
    - 輸入國家是非疫區嗎？
    - 隔離日期：無症狀感染？
    - 核酸檢測、抗體檢測？
- 國內斑馬？
  - 飼養分佈？
  - 數量登記？

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Oops…

1987/07: Outbreak in Spain

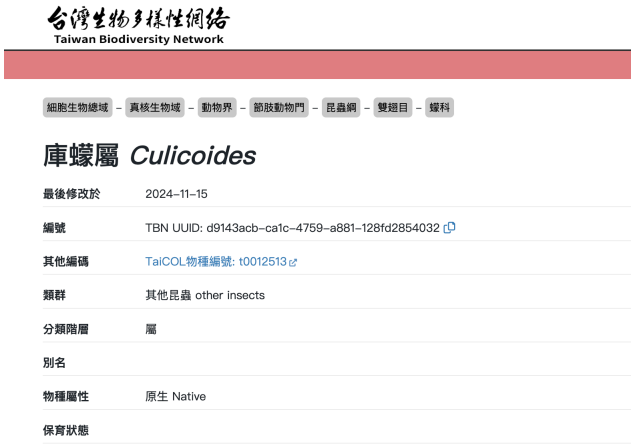
Imported zebras in late June, close to a Safari Park in Madrid

2020/03: Outbreak in Thailand

Likely introduced (zebra), estimated to be in Feb.

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What about the vectors?



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臺北市立動物園 112年度動物認養保育計畫成果報告

日期：113 年 2 月 28 日

中文摘要：

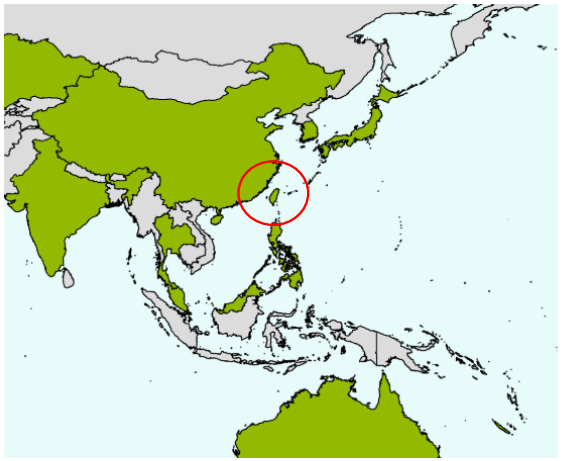
在動物園環境中，人、動物及多元環境長期密切互動，潛藏動物傳染病與人畜共通傳染病的發生風險。因此動物園在經營管理上，應更重視病媒與疾病的預防及監測，同時可提高動物福祉。自嚴重特殊傳染性肺炎 COVID-19 的全球性危害出現後，人們更加重視傳染病的存在，其中包括人畜共通傳染病，並隨著「永續管理」概念的出現，以及聯合國致力於推廣健康一體(One health)理念，並於 2022 年推出 One health joint plan of action 近 5 年的永續健康計畫，根據 One health 報告指出，最常傳播疾病的媒介為吸血節肢動物(Haematophagous Arthropods)，牠們以血液為食，主要叮咬哺乳類、鳥類及兩棲爬蟲類等，近幾年臺北市立動物園(以下稱本園)單食動物明顯受吸血節肢動物騷擾並對動物健康造成嚴重影響，如皮膚發炎、感染甚至嚴重皮膚潰瘍；況且吸血節肢動物的存在亦增加疾病傳播的風險。因此若能透過長期監測吸血節肢動物的種類、數量及密度發生峰度，應可對有效建立適合本園的吸血節肢動物防治策略提供具體科學數據的依證資料。本研究於 2023 年 6 至 12 月，在本園針對 20 種單食獸（7 種奇蹄目、13 種偶蹄目、1 種長鼻目）進行全區半年吸血節肢動物及蟲媒疾病監測，並透過所掌握的生態基礎資料，初步建立物理防治技術系統，藉此前驅作為，期能有效建立本園法定動物傳染病之防治網。在蟲媒傳染病原部分，使用多元生物條碼技術（metabarcoding）偵測蟲體內之動物病原與瞭解被吸血動物之物種，該數據可應用於園內是否有蟲媒傳染病之隱性傳播鏈與評估不同動物間的傳播風險，以利未來監測蟲媒傳染病之規劃。根據燈光誘集法調查結果顯示園內吸血節肢動物主要包括蚊科(Culicidae)、家蠅科(Muscidae)、虻科(Tabanidae)及蠓科(Ceratopogonidae)昆蟲，其中捕捉總量分別為蚊科 4058 隻；蠅科 464 隻；虻科 26 隻；蠓科 128,473 隻。計畫並利用交通部中央氣象局地面氣象站的觀測資料查詢系統(Central Weather Bureau Observation Data Inquire System, CODiS) 蒐集 2023 年 8 至 12 月臺北市文山區觀測站的降雨量(Precipitation)、平均氣溫(Temperature)、相對溼度(Relative humidity)及紫外線指數(UVI)與各科節肢動物數量用 Excel 進行相關性分析，分析結果均都為無顯著相關性。病原檢測結果顯示，由庫蠓樣本中共檢測出 72 個陽性樣本，在蚊子則檢出有 17 個陽性樣本，當中僅有 10 個樣本為單食動物的蟲媒病毒，而發熱病毒屬 4 個陽性樣本皆為金伯利病毒（Kimberley virus），本次研究為台灣首次檢測到該病毒，但該病毒在牛隻上並未紀錄有任何臨床症狀發生；正本鞭病毒屬的赤羽病毒（akabane virus）在臺灣所流行的赤羽病毒屬於第一基因群，可能會導致部份仔牛感染時會發生非化膿性腦膜炎或非化膿性腦脊髓炎，而對於懷孕

So we do have vectors…

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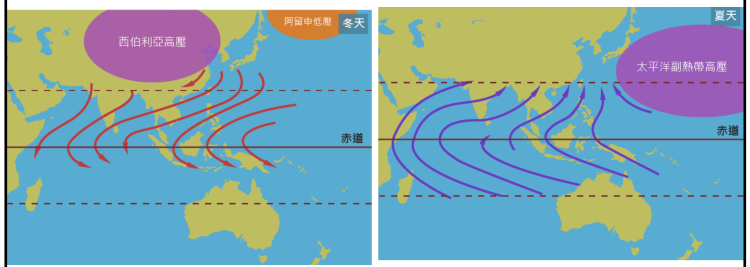
What about the wind?

Maximum record 700km



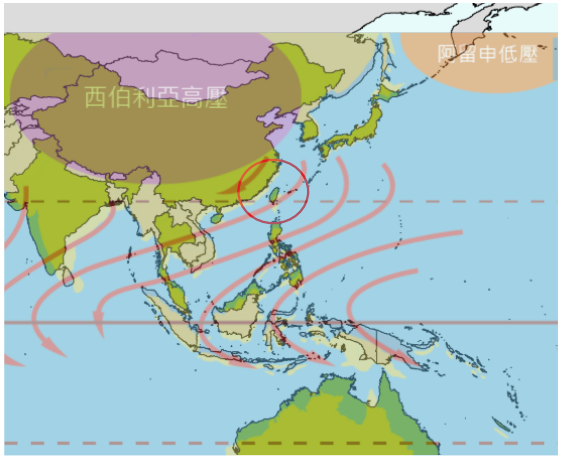
62

中央氣象署數位科普網



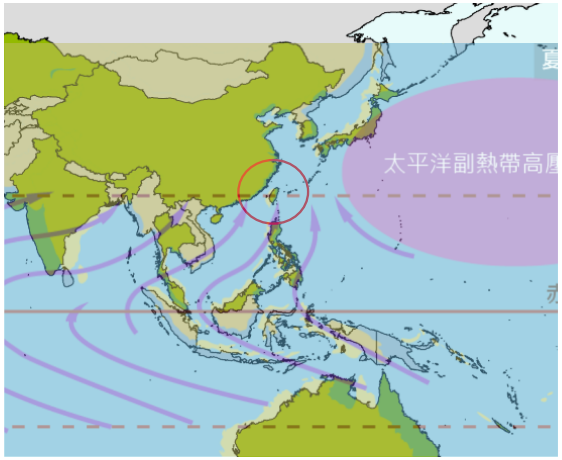
63

冬季



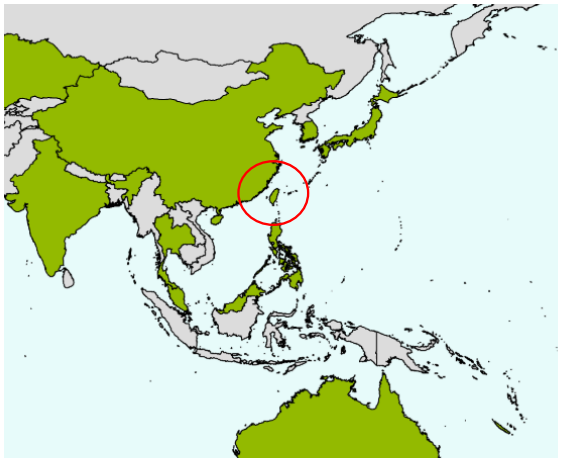
64

夏季



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Safe? For now…



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邊境防疫

- 馬匹
  - The risk is low
- 斑馬
  - Unknown risk?
- 蚊蟲
  - We do have vectors
  - Climate is perfect for vectors, especially in the mid & south → difficult to break the life cycle of *Culicoides*
  - Will be hard to eradicate if AHS do get in
  - Wind: low → high if China, Philippines, Japan, South Korea get AHS
  - Moderate risk

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Thompson *et al. Irish Veterinary Journal* 2012, **65**:9
http://www.irishvetjournal.org/content/65/1/9

IRISH VETERINARY JOURNAL
Iris Tréidliachta Éireann

REVIEW Open Access

A review of African horse sickness and its implications for Ireland

Geoffrey M Thompson[1,2*], Stephen Jess[2] and Archie K Murchie[2]

- 3 possible pathways:
  1. Imported infected Equidae: originated countries
  2. Introduction of infected vectors: wind; countries in close proximity (maximum record 700km)
  3. Importation of infected biological substances

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國內防疫

- 馬場、馬匹數量登記
- 獸醫人數
- 社區意識
- 疫苗

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馬場分佈

- 台北、新北：17
- 桃園：9
- 新竹：6
- 苗栗：2
- 台中、彰化、南投： 17
- 雲林：6
- 台南：9
- 高雄：7
- 屏東：3
- 宜蘭：7
- 花蓮：4

>87



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馬匹數量登記－未知！！！

- 非強制
- 飼主意識/ 衛教不足
- 中華民國馬術協會
- 小動物醫院？

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馬匹晶片施打位置

- Nuchal ligament
- Halfway between the poll and wither

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獸醫人數

- 泰國馬獸醫人數：~100

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社區意識

社區

- 政府
- 學校單位、公職獸醫
- 私人獸醫
- 馬場
- 動物園、動物園獸醫
- 馬主
- 民眾
- 協會、企業

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社區意識

意識

- 危機意識
  - 馬匹猝死
  - 臨床症狀
  - 掩埋
- 防疫意識
  - 日常監控、馬匹進出
  - 接觸、隔離
  - 環境、蚊蟲

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Vaccination for horses

Core vaccination

- Tetanus
- Eastern and Western equine encephalitis (EEE/WEE)
- West Nile Virus (WNV)
- Rabies

Risk-based

- Equine Influenza
- Equine Herpes Virus (EHV)
- Japanese Encephalitis (JE)

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國內防疫

- 馬場、馬匹數量登記
  - Private stables are unknown and scattered
  - Number of horses: unknown, no records
  - Experience from Spain → failed to eradicate
- 獸醫人數
  - Not enough
- 社區意識
  - Not enough
- 疫苗
  - Not fast enough

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OPEN ACCESS Freely available online PLOS one

Transmission and Control of African Horse Sickness in The Netherlands: A Model Analysis

Jantien A. Backer*, Gonnie Nodelijk

Department of Epidemiology, Crisis Organisation and Diagnostics, Central Veterinary Institute of Wageningen UR, Lelystad, The Netherlands

- 3 key differences between the model of bluetongue and AHS:
  1. Infectious period: 1 week for AHS in horses; 2-3 weeks for bluetongue in sheep and cattle
  2. Rapid show of severe clinical signs in AHS
  3. Hosts: population is larger for bluetongue
- Factors not taken into consider: other equids, other *Culicoides* species

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We will have a really hard time, with great loss…

- If AHS do get in…
- Low population + Short infectious period + Severe clinical signs
- "Overwinter" is possible
- Takes longer time to eradicate OR loss the entire population!

邊境防疫是重點

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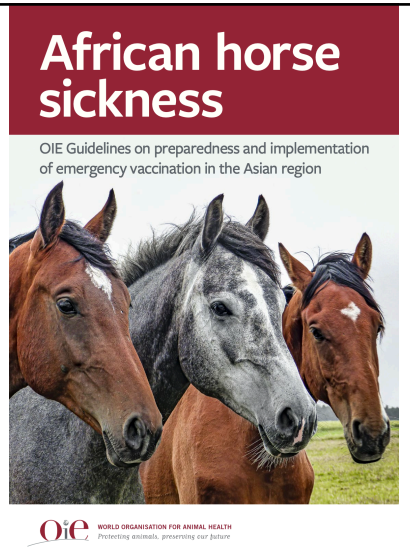
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