Update on Recent Trends of Vector borne diseases Globally and in Asia Pacific

OIE Regional Workshop on Vector-borne disease
10 September 2018

AUSTRALIAN ANIMAL HEALTH LABORATORY
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Overview

- Vectors and vector-borne diseases
- Emerging
  - Schmallenberg
- Expanded geographical distribution
  - Bluetongue
  - Zika
- Epizootic
  - Murray Valley Encephalitis
- Challenges

Vectors

- Vectors: mosquitoes, ticks, flies, sandflies, midges, fleas, triatomine bugs, freshwater aquatic snails
- Viruses, bacteria, protozoa, nematodes

- Impacts on human & animal health
  - mortality, morbidity, economic, food security
- Vector borne diseases account for more than 17% of all infectious diseases in people, causing more than 700 000 deaths annually
- One-quarter of the terrestrial vertebrate pathogens of concern to the OIE are vector borne

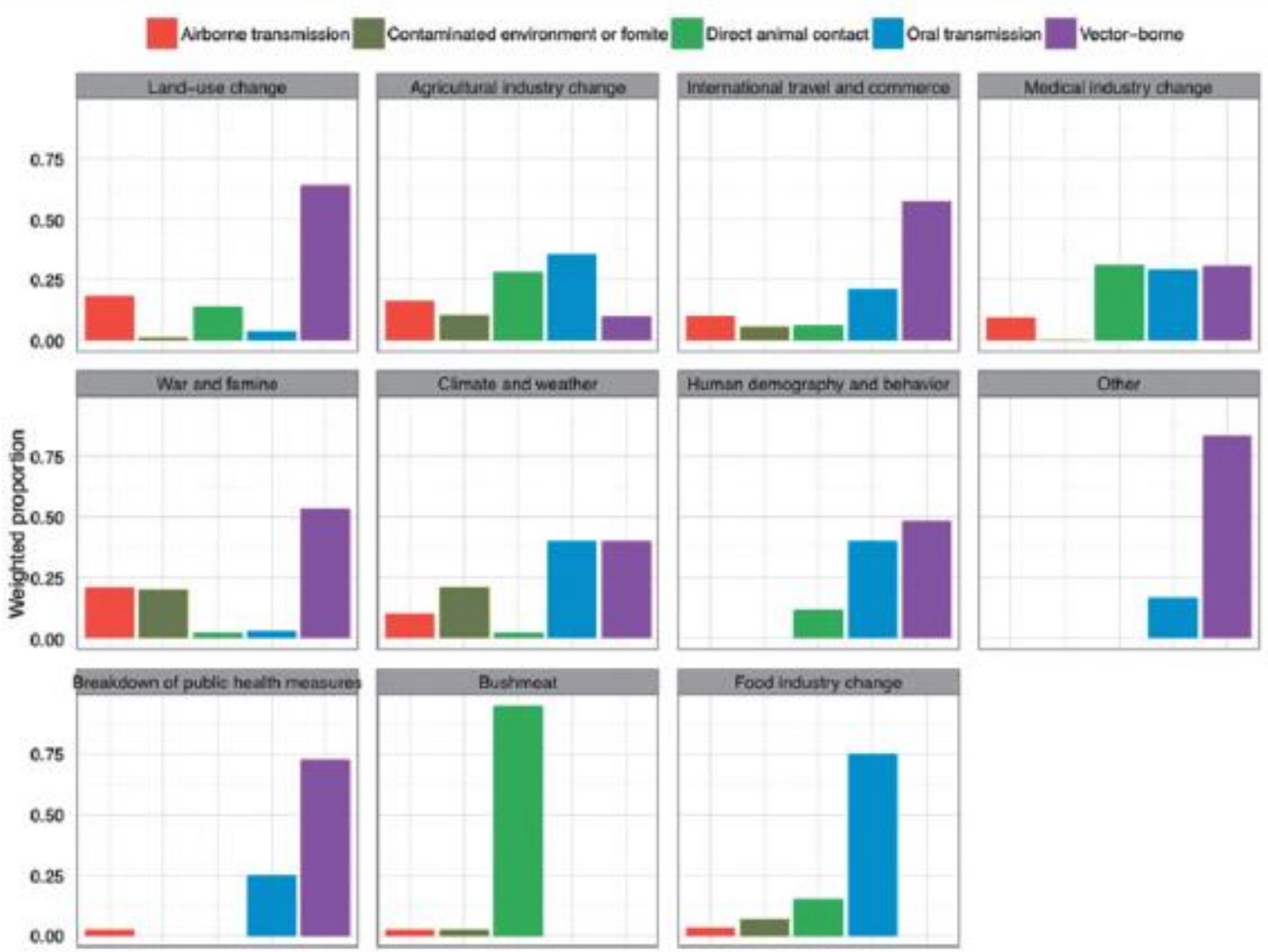
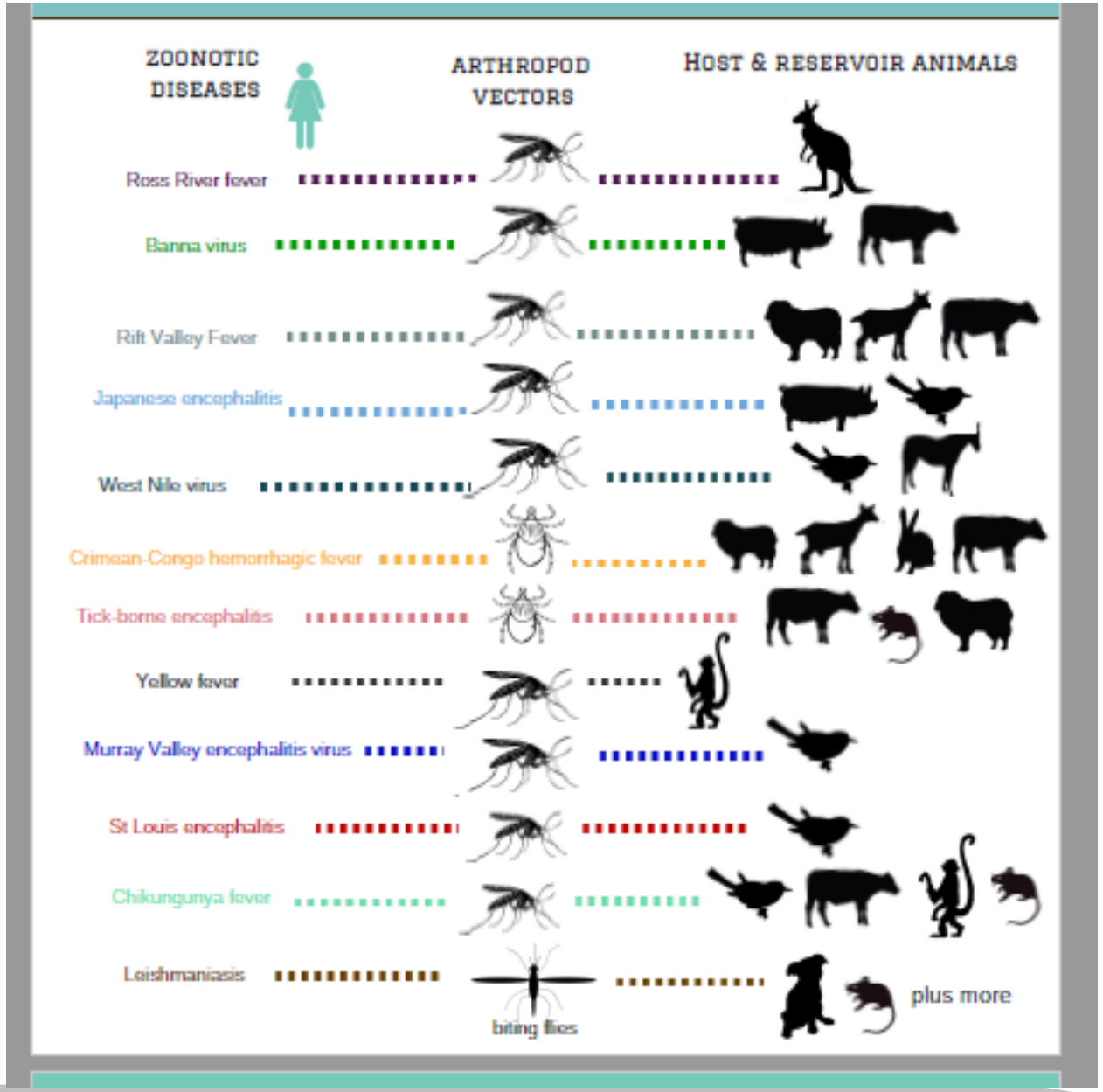


FIG. 2. Scaled number of zoonotic emerging infectious diseases (EID) events ($n = 145$) per transmission route categorized by the primary driver of disease emergence for each pathogen.

Loh et al, Vector-borne and Zoonotic Diseases, 2015



From: World Veterinary Association brochure 2015

Emerging Schmallenberg Virus

Background

Emergence of a new bunyavirus

• (1st phase) In summer/ autumn 2011, unidentified disease in dairy cattle reported in North Rhine-Westphalia, Germany and Netherlands

- Fever, decreased milk production, diarrhoea

• (2nd phase) From early December, first reported in the Netherlands

- Congenital malformations in newborn lambs

• Metagenomics analysis (454) by FLI (Germany) of 3 bovine blood samples identified a novel ***Orthobunyavirus***

- Schmallenberg (SBV)
- Of the 18 serogroups in Orthobunyavirus genus, SBV belongs to the Simbu serogroup (Akabane, Aino, Simbu, Douglas etc)

Clinical features

Adults

- Cattle: mild symptoms (milk drop, fever, diarrhoea), subside within a few days
- Sheep and goats: no symptoms reported
- Viraemia short (1-6 days)

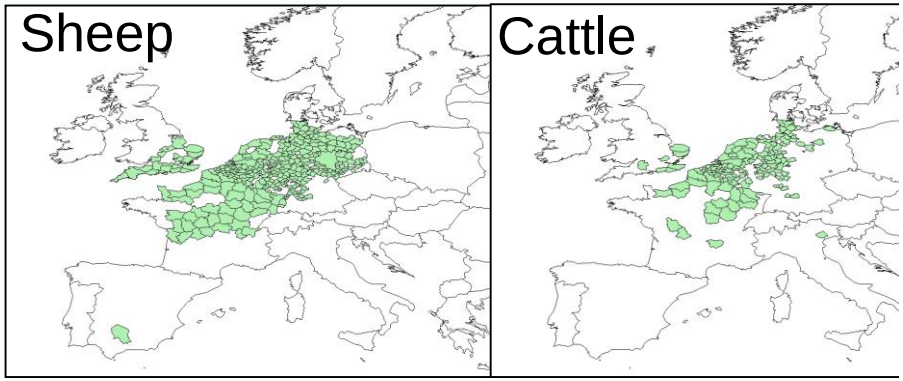
Foetal infection

- Abortion, mummified foetuses, premature or stillbirths, weak offspring, malformed lambs and calves
- Malformations:
  - Severe arthrogryposis (ankylosis, tendon shortening)
  - Torticollis (twisted neck)
  - Hydrocephalus (accumulation of CSF, absence of brain structures)

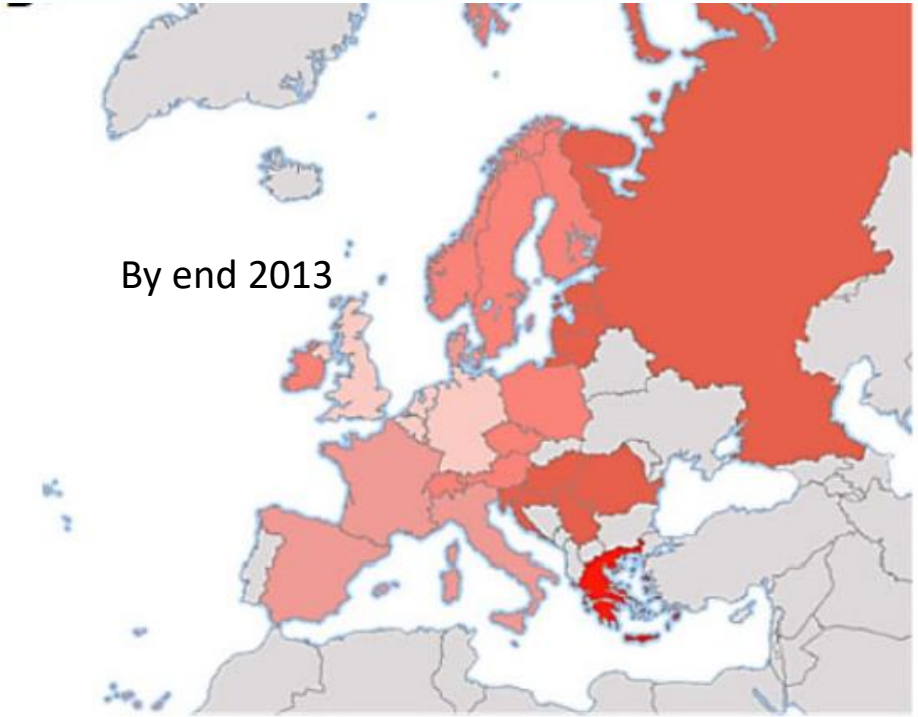
  → 'arthrogryposis hydranencephaly syndrome (AHS)'

Epidemiology

Geographic range: locations of SBV



European Food Safety Authority 2012 Technica



- Retrospective testing of serum from 2010 – negative for SBV antibodies;
- After first vector season – 70-100% prevalence in Germany, Netherlands, Belgium
- Geographical distribution now assumed to be across Europe

Claine et al, 2015

Epidemiology

Transmission

- Consistent with transmission of other Simbu group viruses
- A number of *Culicoides* species implicated in transmission (varying levels of experimental evidence)
- Transplacental infection (role in transmission minor)
- No evidence of mosquito involvement
- Limited evidence of transovarial transmission
- No evidence of direct horizontal transmission

- Clinical signs, viraemia, seropositives in cattle, sheep, goats
- A range of other species can be infected

Impact

- Frequency of clinical disease in adults low
- Impact greatest among sheep flocks
- Primarily on animal welfare, production
- Economic impacts (trade restrictions, costs of treatment, vaccination, birthing losses)
- 2012 = completely naïve population: worse case scenario
- Expect cyclical cases as per Akabane in Australia
  - Related to herd immunity, environmental conditions

Expanded Geographical Distribution

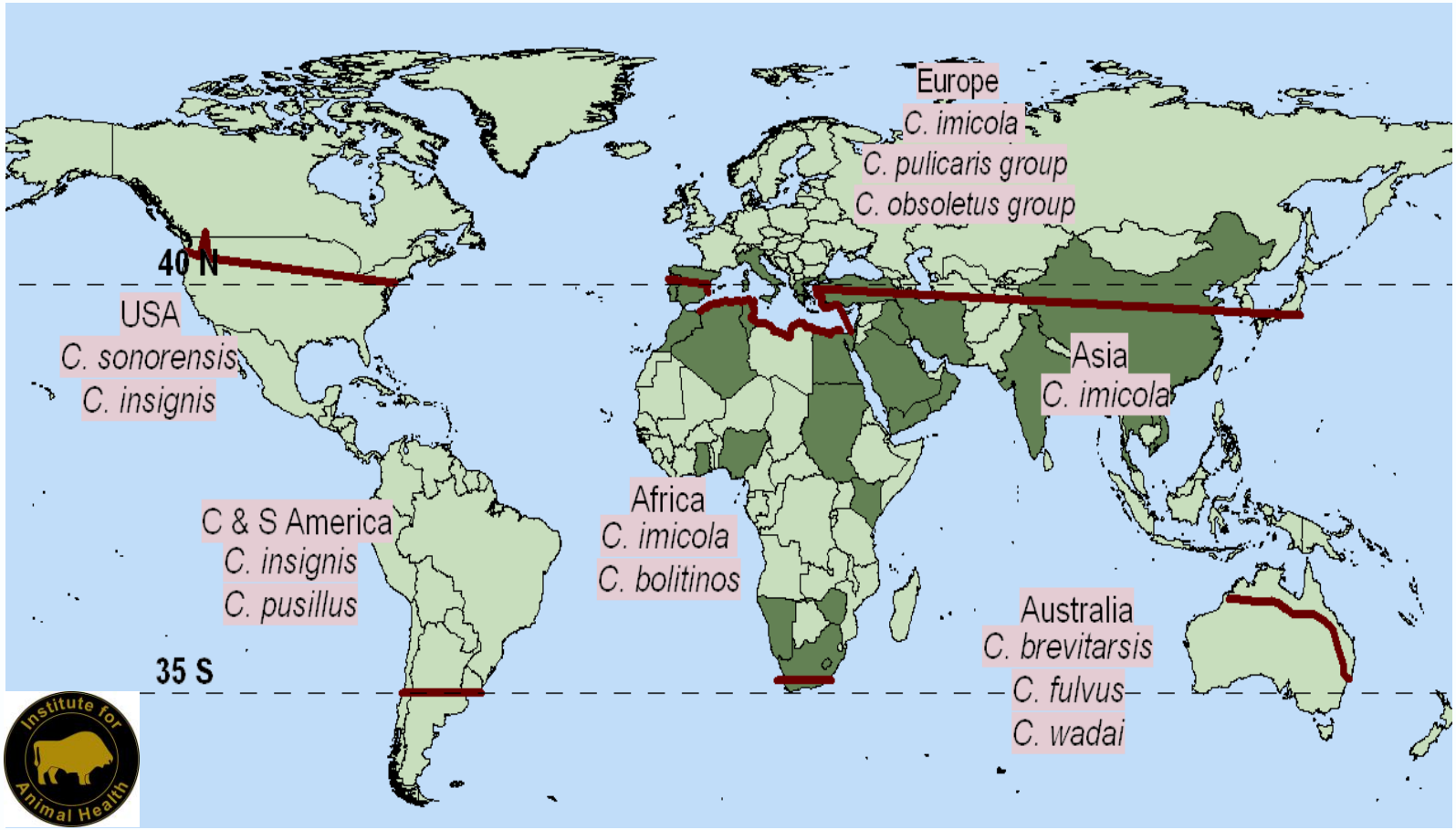
Bluetongue
Zika

(West Nile Virus, African Swine Fever …)

Global Distribution & Epidemiology

Pre ~ 2000

- Band 40°N and 35°S – tropical, subtropical, temperate

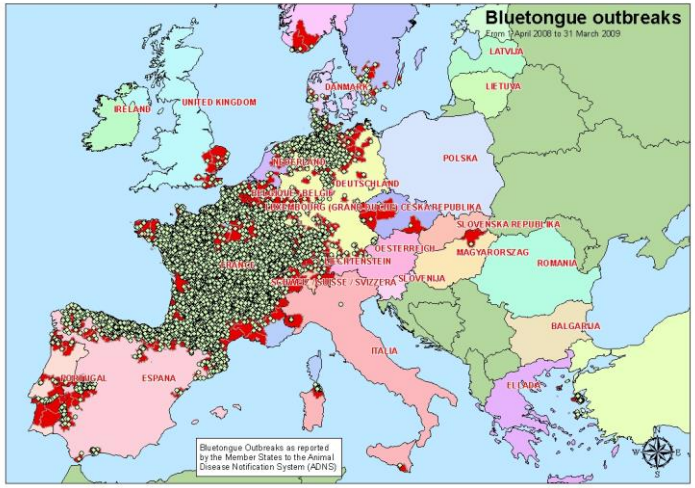


Global Distribution & Epidemiology Post ~2000

Mediterranean Outbreak 1997-2005

- 6 strains comprising 5 serotypes
- A number of countries infected for the first time
- Increasing range of *C. imicola*

BTV-8 Europe 2006-2008



- Involvement of new vector species (*C. dewulfi*)
- Changed pathogenicity (cattle)
- A jump to an area previously thought not susceptible
- Controlled with vaccination

Global Distribution & Epidemiology Post ~2000

Bluetongue, France

nformation received on 11/09/2015 from Dr Loic Evain, Directeur Général ad
Ministère de l'Agriculture, de l'Agroalimentaire et de la Forêt, Paris, France

Summary

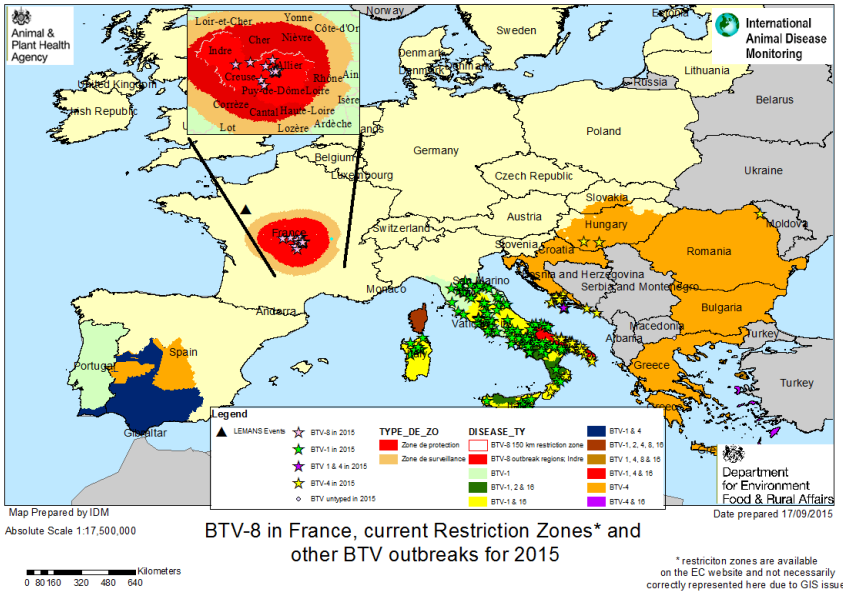
Report type	Immediate notification
Date of start of the event	21/08/2015
Date of confirmation of the event	11/09/2015
Report date	11/09/2015
Date submitted to OIE	11/09/2015
Reason for notification	Reoccurrence of a listed disease
Date of previous occurrence	2010
Manifestation of disease	Clinical disease
Causal agent	Bluetongue virus
Serotype	8
Nature of diagnosis	Laboratory (advanced)
This event pertains to	a defined zone within the country

Industries | Fri Sep 11, 2015 1:38pm EDT

Related: NON-CYCLICAL CONSU

France to vaccinate livestock following bluetongue outbreak

PARIS, SEPT 11



BTV-8 in France, current Restriction Zones* and other BTV outbreaks for 2015

* restriciton zones are available on the EC website and not necessarily correctly represented here due to GIS issues

BTV re-detected, France, September 2015; last seen in France in 2010

Closely related to previous BTV-8 virus

Low morbidity, but disease seen in both cattle and sheep

Emergence of BTVs in non-endemic areas

- BTV-2 detected in California, 2010; closely related to BTV-2 from Florida
- BTV-6, -11, 14 live attenuated vaccine strains detected in Europe (BTV-14 also in Russia, Poland, Lithuania)

- Complex interplay of environmental & anthropogenic factors
- Local vector population needs to have competence for transmission of the given serotype!

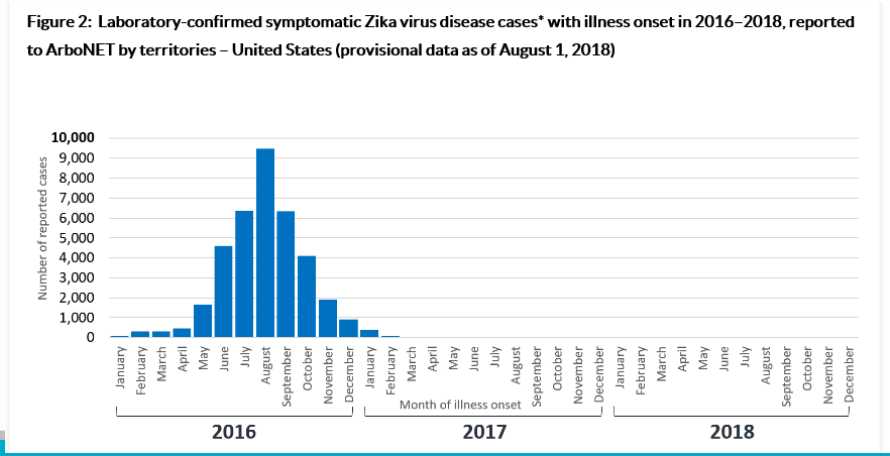
- BTV-25+ - differ in terms of epidemiology, clinical signs…

Zika Virus

- First discovered in 1947; named after the Zika Forest in Uganda
- First human cases 1952; since then outbreaks reported in tropical Africa, Southeast Asia, and the Pacific Islands
- Before 2007, 14 cases of Zika had been documented
  - Under-reporting likely as symptoms similar to those of many other diseases, many cases may not have been recognized
- Primary mode of transmission:
  - Vectored by *Aedes aegypti* or *Aedes albopictus*
- Secondary modes of transmission:
  - Vertical, sexual transmission, laboratory exposure

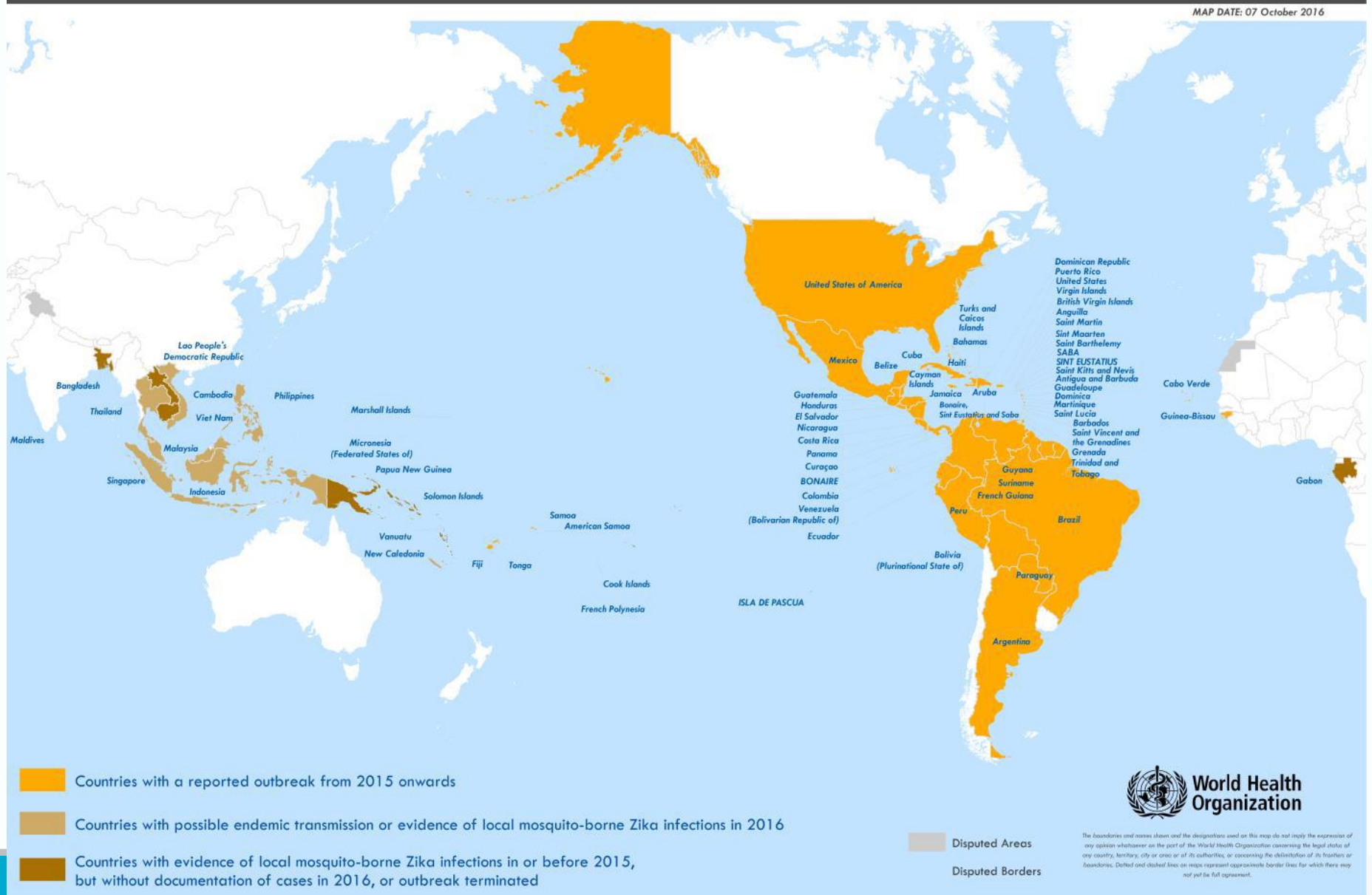
Zika - Timeline

- 2007: first large outbreak on Pacific Island of Yap in the Federated States of Micronesia
- 2013-14 Outbreaks occur in 4 other groups of Pacific islands: French Polynesia, Easter Island, the Cook Islands, and New Caledonia
- Early 2015: range of clinical syndromes in Brazil (early cases not suspected of Zika); >7000 mild cases across 3 months
- Declared an international emergency in February 2016

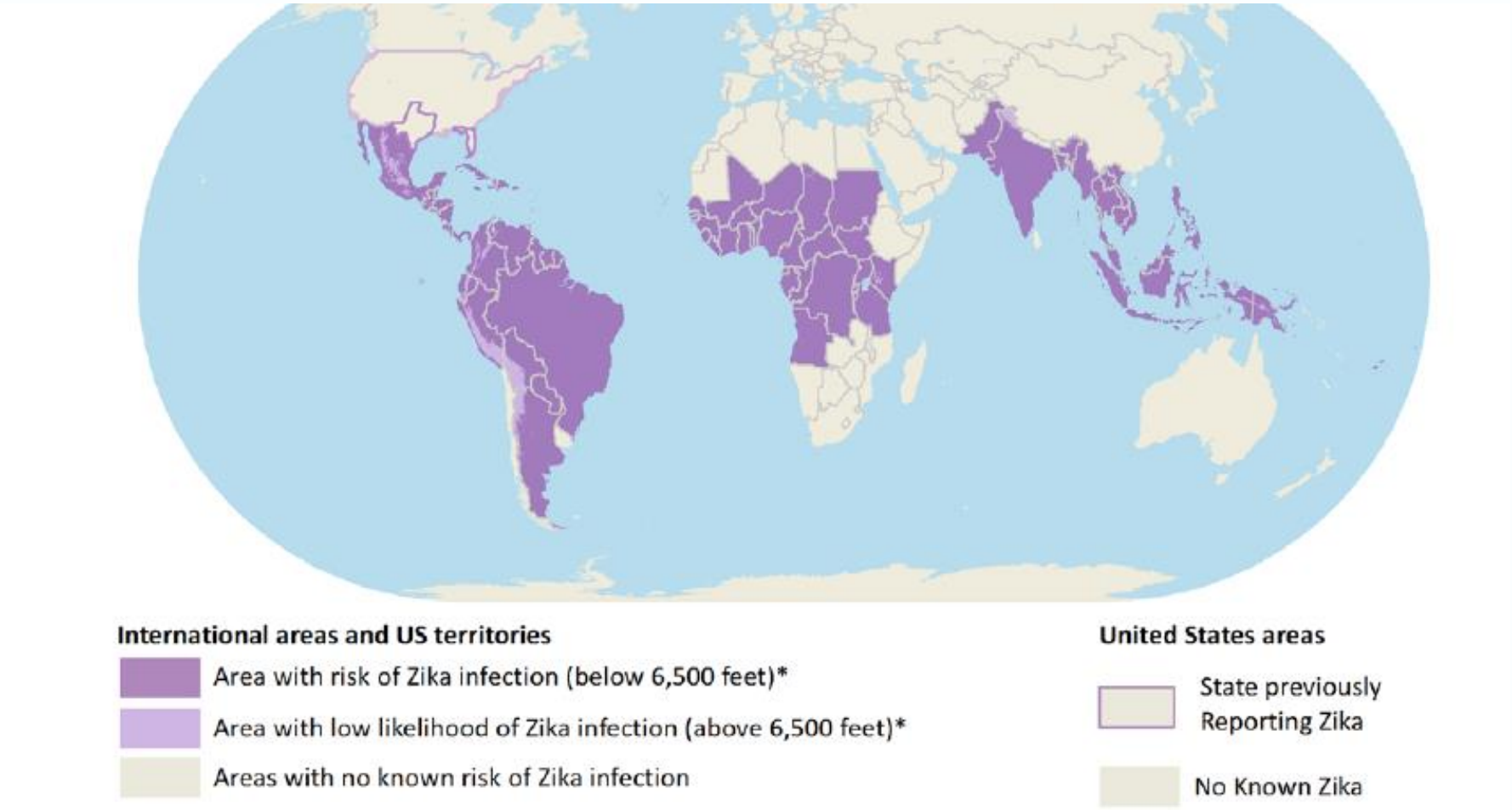


1 January 2015-August 2018: >42 000 cases in USA & territories (Source: CDC)

Global status of Zika virus



World Map – Areas of Zika Risk



Source: CDC

Epizootic

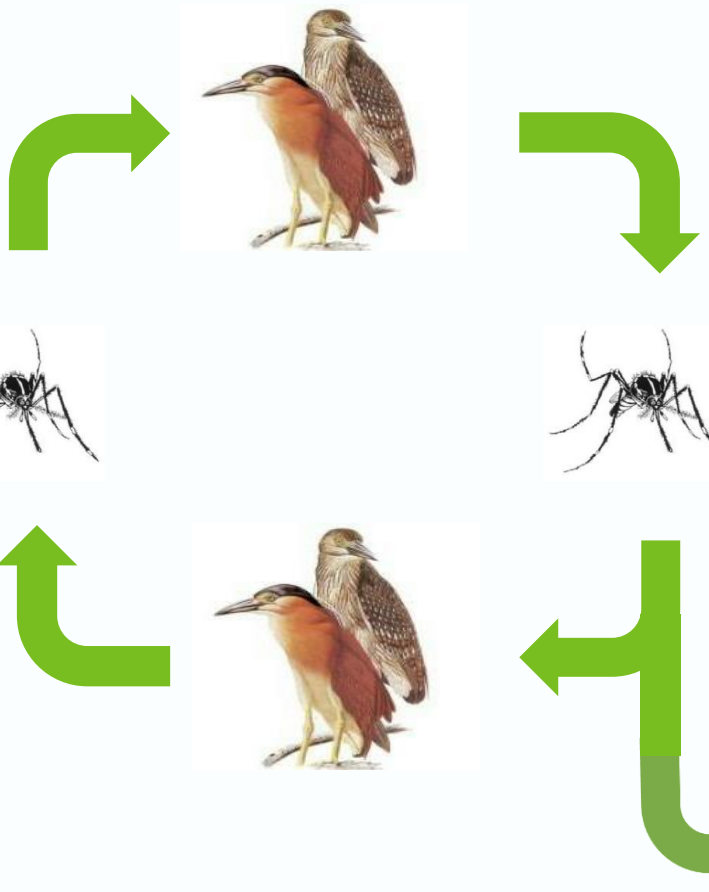
Murray Valley Encephalitis

Murray Valley Encephalitis (MVE)

- Most important cause of vector-borne encephalitis in Australia
  - Humans ~20% case-fatality rate
  - Horses ~10%
- Epidemics in Australia
  - **1917-1925 -** Eastern states (281 human cases)
  - **1950-51 –** SE states, first isolate from Murray Valley (45 human)
  - **1974 –** nationwide, centred in Murray Valley (58 human)
  - **2011** – nationwide (17 human, ~100 equine)
- Sporadic cases between epidemics
- Since 1974, ~130 human MVE cases reported

  → majority in northwestern Australia
- Documented cases in PNG

MVE - Transmission Cycle

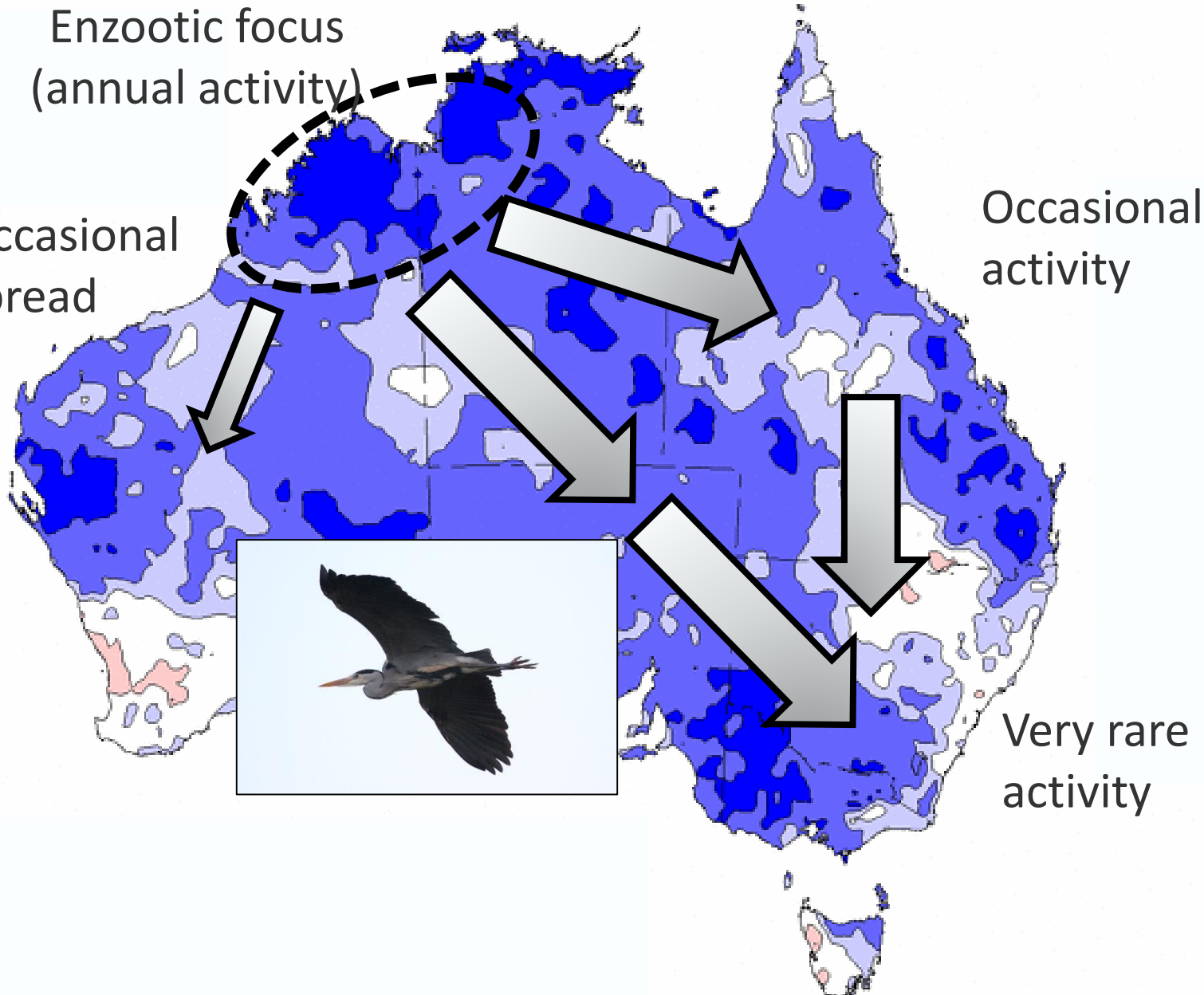


Culex annulirostris (>90%)
Cx. palpalis
Cx. australicus
Cx. quinquefasciatus
Aedes species

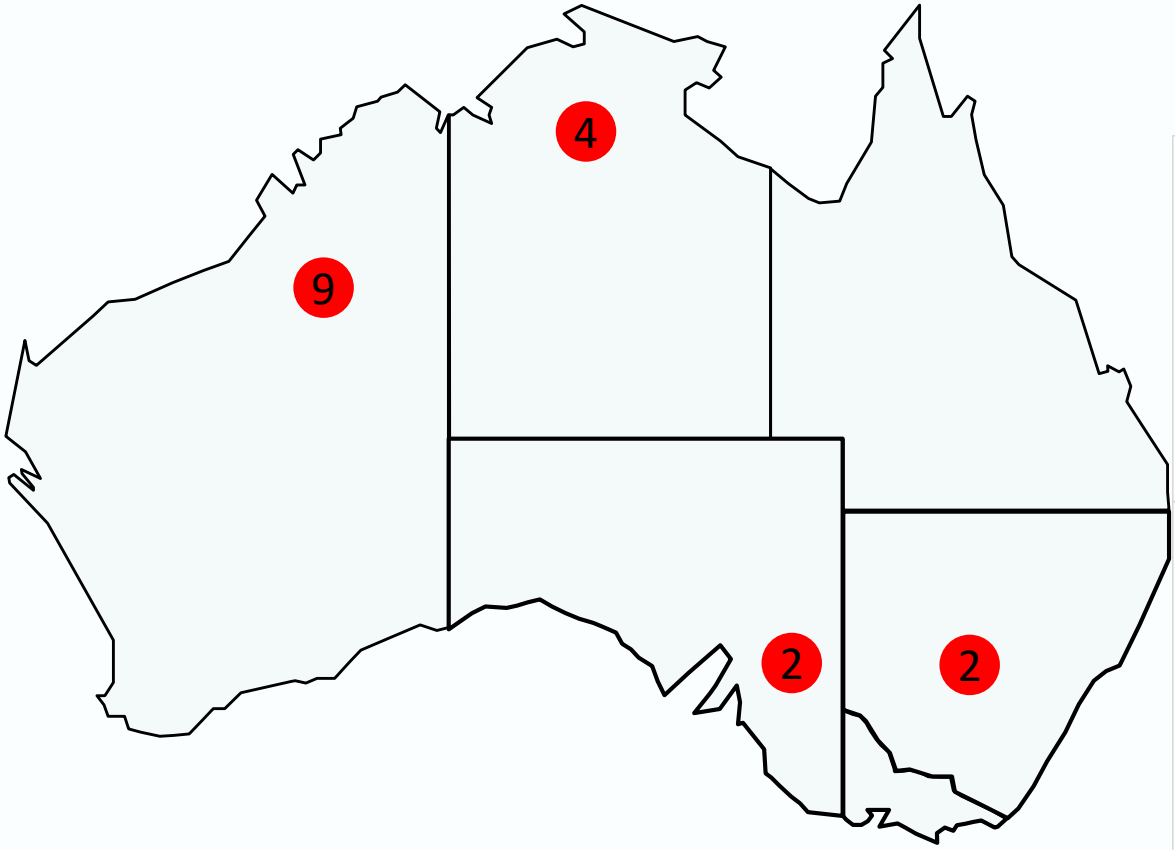
Water birds
(order *Ciconiiformes*):
Herons and egrets

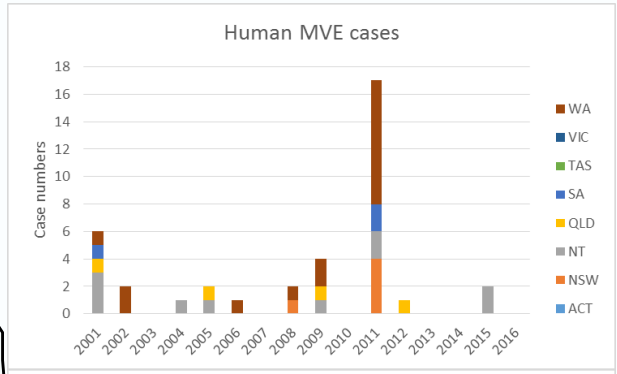
Dead-end

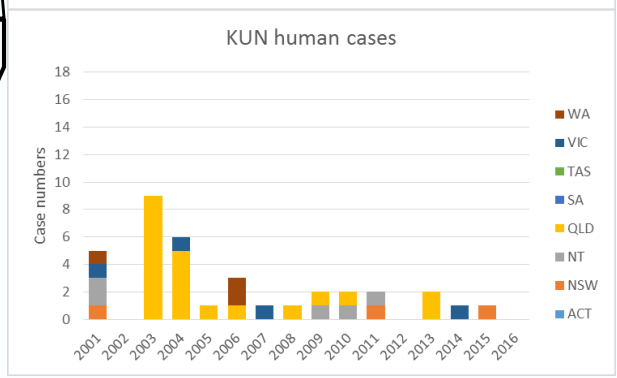
MVE - Virus movement



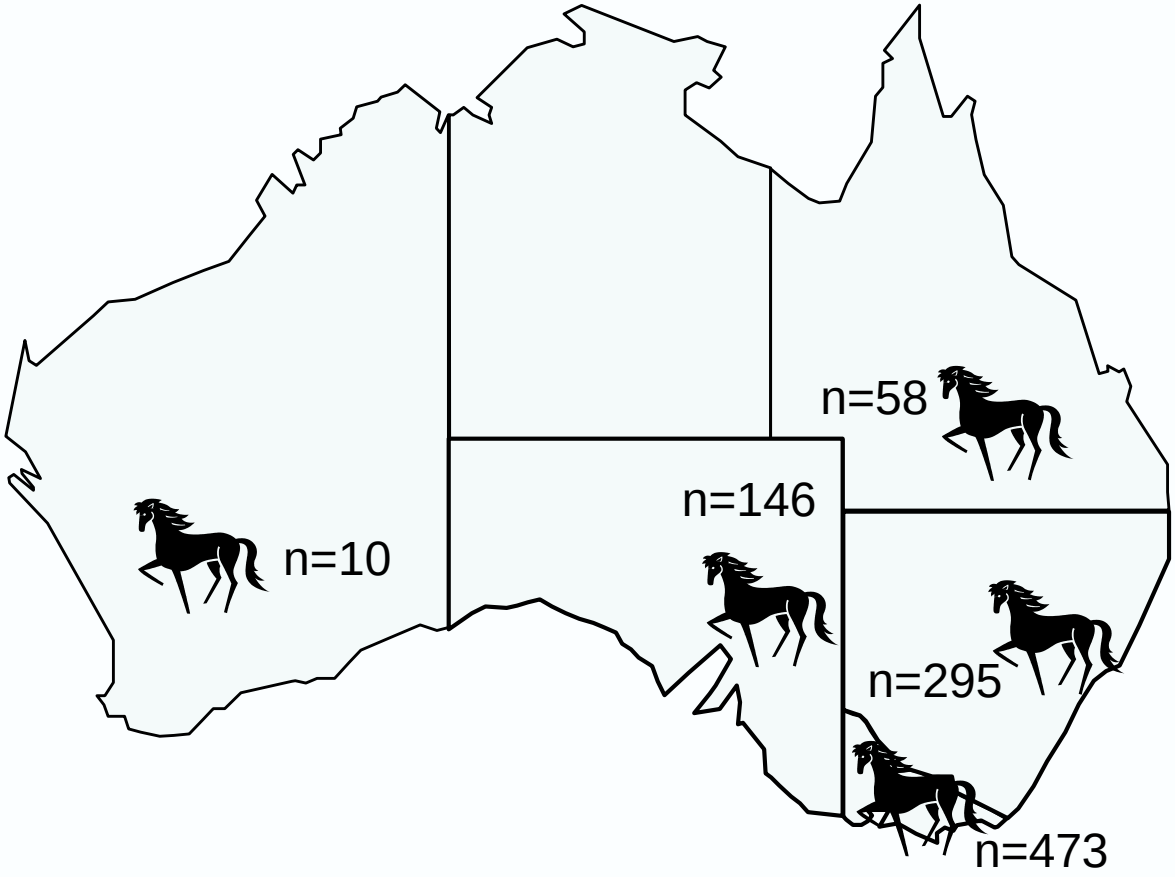
MVEV re-emergence in Southeast Australia, 2011







MVEV/KUNV re-emergence in SE Australia, 2011



982 cases, Jan-Jun

91 deaths (CFR ~5-20%)

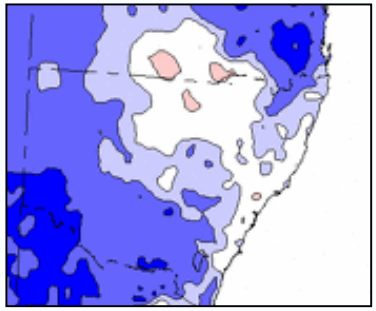
MVEV: ~100 cases

KUNV: ~150 cases

(RRV: ~200 cases)

Roche et al., 2012. Aust. Vet. J. 91:5

Factors underlying epizootic of MVEV, 2011



Environmental:

- Heavy rainfall and extensive flooding in Southeast Australia → increased mosquito and wild bird populations
- *Exceptions:* Equine cases in parts of NSW despite below average rainfall and low mosquito populations

Human:

- Low immunity to MVE (non-immune workers and tourists living and travelling in endemic and epidemic areas)

Viral:

- MVEV – sublineage (G1b) associated with SE Australian activity → fitter? (Williams *et al.*, 2016 PLoS NTD)

Rainfall Dec 2010 – May 2011

Australian Government
Bureau of Meteorology

Rainfall Decile Ranges

	Highest on Record
10	Very Much Above Average
8-9	Above Average
4-7	Average
2-3	Below Average
1	Very Much Below Average
	Lowest on Record

Australian Rainfall Deciles

1 December 2010 to 31 May 2011

Distribution Based on Gridded Data
Product of the National Climate Centre

The complex interplay between host, virus, vector factors driving emergence and vector distribution underscore the importance of regional laboratory based surveillance in both people and animals, in a multi-disciplinary One Health approach (public health, veterinary health, entomologists, sociologists. .)

Thank you

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With thanks to David Williams for input to many of these slides.