

Lecture 21 - Togaviridae

Russ Fraser, Fall 2023

Togaviridae: general

Size	70 nm
Morphology	Enveloped
	• Icosahedral symmetry • Spherical
Genome	Linear, ssRNA, ~ 10-12 kb
Site of Replication	• Cytoplasm
Properties	• Infectious RNA • Contain important arboviruses • Infect a wide range of animal species • Arboviruses

Togaviridae: general

- Subdivided into two genera:
  - Alphavirus
    - Eastern equine encephalitis virus
    - Western equine encephalitis virus
    - Venezuelan equine encephalitis virus
      - Foreign
    - All are zoonotic
  - (Rubivirus)
    - (Rubella virus)
- Present only in the Western hemisphere





Eastern and Western equine encephalitis viruses

EEE and WEE

Photograph: Corey Arnold/World Press Photo

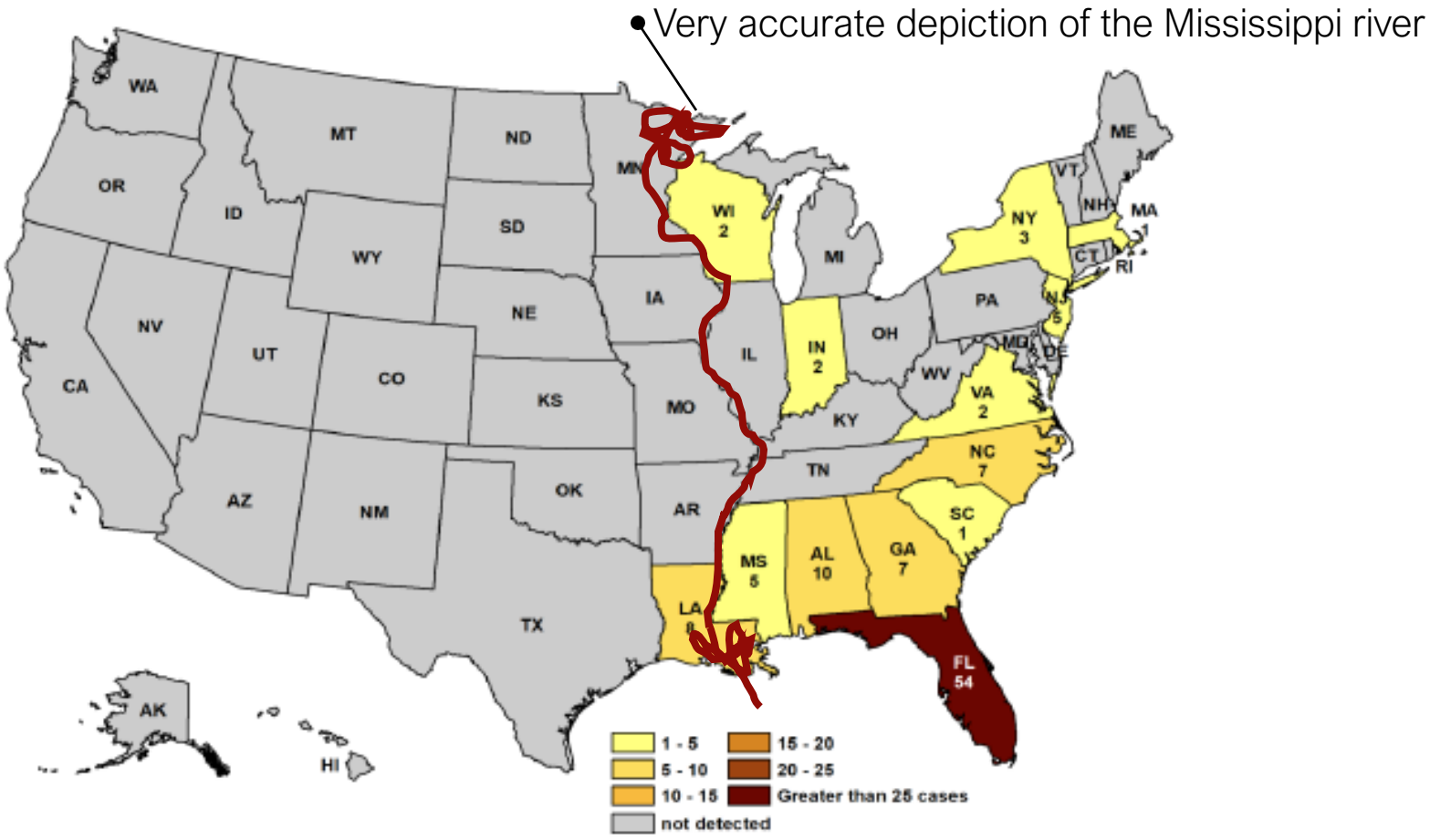
W/EEE: general

- Broadly speaking, the geographical range of the viruses is divided by the Mississippi river.

- WEE may be an historical issue – still rarely detected in mosquito and wild bird populations but no mammalian cases since 1999

- EEE is still a significant pathogen, occurring yearly in NE USA and in Canada
  - Both human and equine cases are still reported
  - As of this lecture, there have been 7 cases of human EEE in the USA.

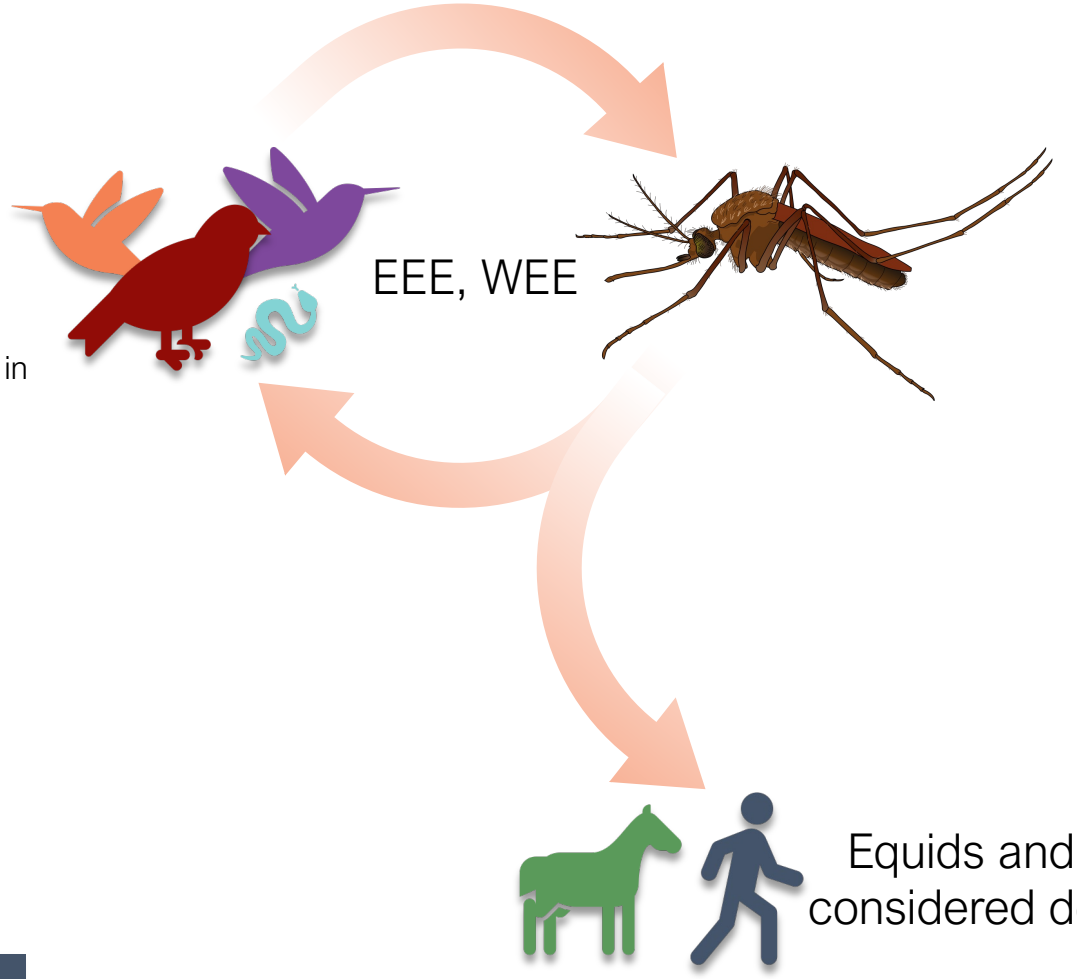
Togaviridae



2018 Eastern Equine Encephalitis cases
Total cases - 107

W/EEE: transmission

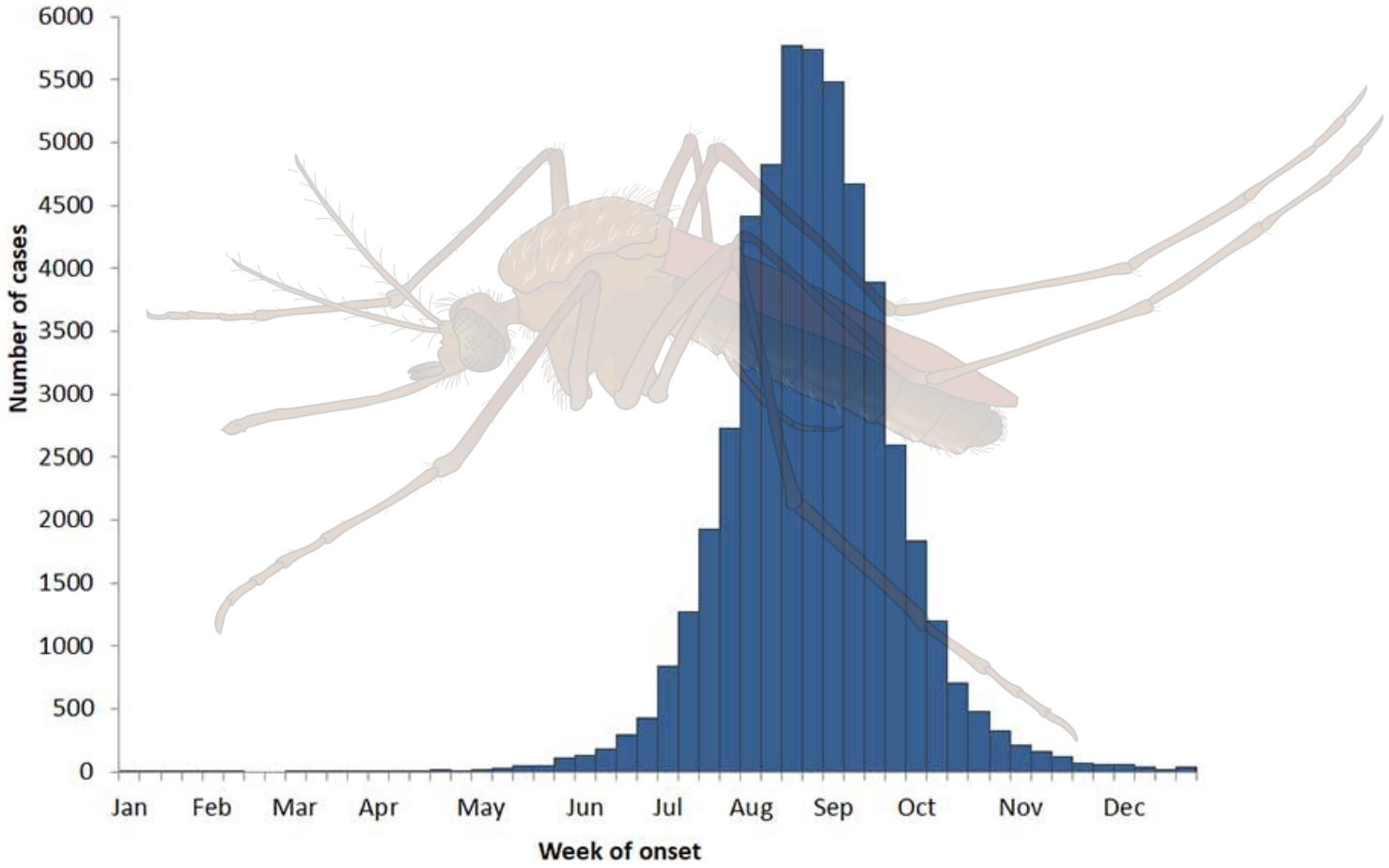
Passerine birds are the primary, asymptomatic reservoir species.
(Thought that reptiles may play a role in overwintering)



VEE has a more complicated story

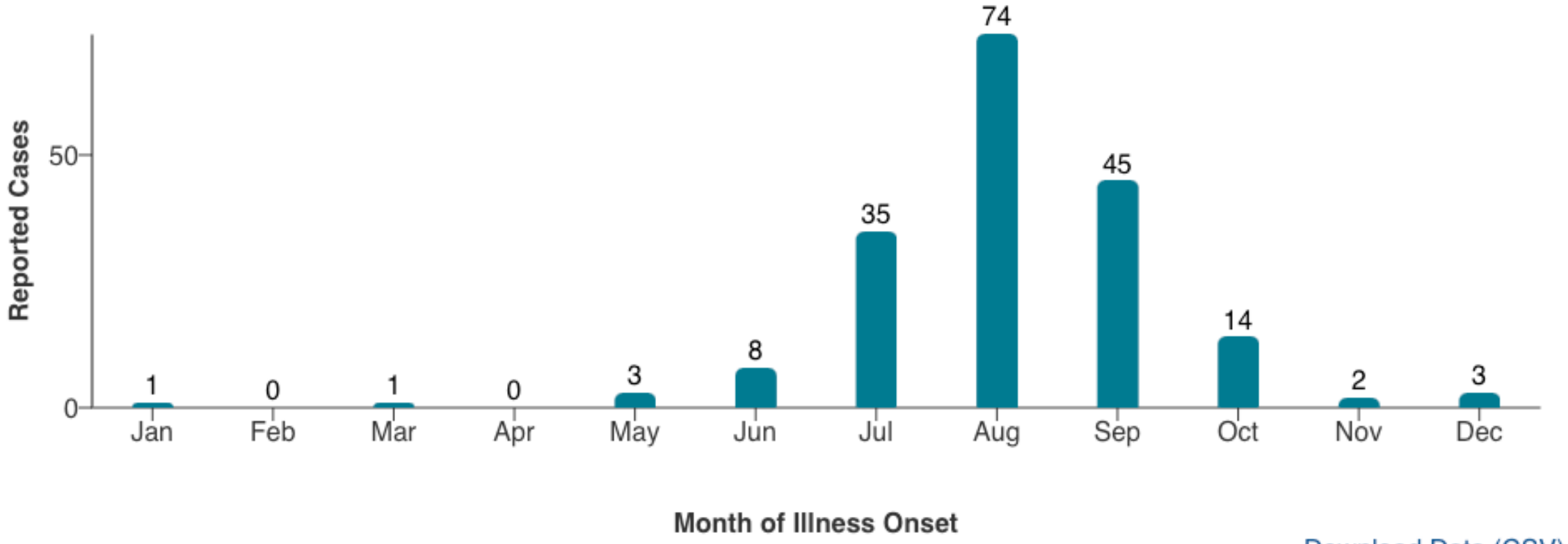
W/EEE: transmission

- Like WNV, the dependence on an arthropod vector (mosquitos, in this case) leads to a seasonal spike in cases



W/EEE: human cases

Eastern equine encephalitis virus human disease cases reported by month of illness onset, 2003-2022, Neuroinvasive disease cases



Download Data (CSV)

W/EEE: general pathogenesis

Mosquito bite

↓

Replication at site of entry

Keratinocytes, DCs, fibroblasts, etc.

↓

Primary viremia

↓

Various organs and leukocytes

↓

Secondary viremia

↓

Entry into the CNS

W/EEE: clinical signs

- Asymptomatic → Severe
- Fever, anorexia, depression
- Non-specific CNS signs:
  - Aggressiveness
  - Blindness
  - Head pressing
  - Circling
  - Ataxia
  - Paresis
  - Paralysis
  - ± Death
    - Recovered horses often have residual neurological deficits



W/EEE: clinical signs

- Consequences in birds:
  - Highly variable depending on species.
  - Many are completely asymptomatic.
  - Pheasants, partridges, emus, and turkeys are particularly susceptible to disease:
    - Clinical signs vary: encephalitis, necrotizing enteritis
  - Chickens are generally asymptomatic (but will seroconvert).

W/EEE: gross lesions, diagnosis, etc

Discussed along with VEE in later slides (all the same).



Venezuelan equine encephalitis

VEE

VEE: epidemiology

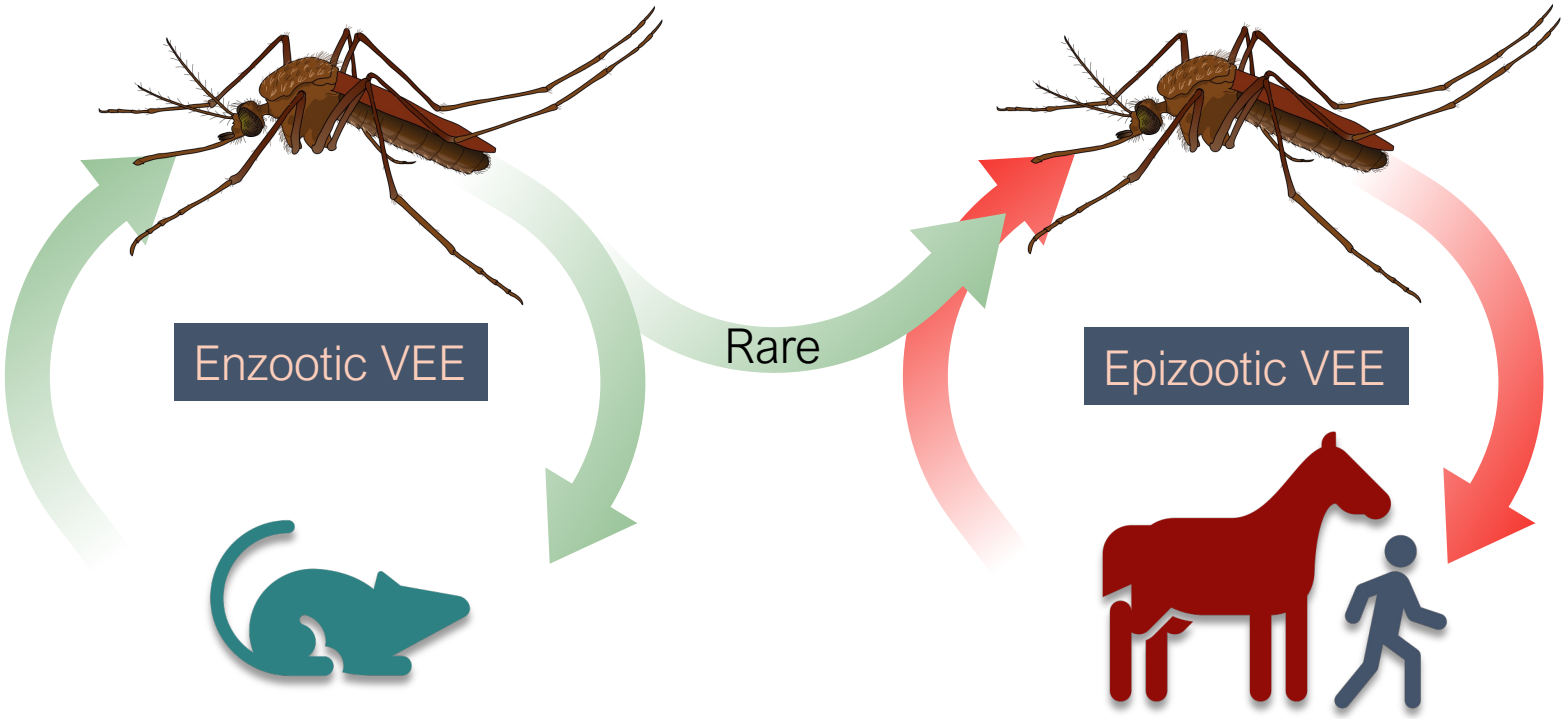
- VEE virus occurs in Central and South America.
  - Has not been detected in the US for 40 years.

- There are several strains of VEE, some of which are **epizootic** (epidemic) and some of which are **enzootic** (endemic)
  - What leads to an outbreak of an epidemic VEE strain is unknown (possible mutation of enzootic strain?)
  - Virus dies out once the epidemic ends

- Enzootic strains **do not** cause disease in horses (but can cause disease in people)

- Epizootic strains cause disease in both horses and people

VEE: transmission



Rodents are the primary reservoir species

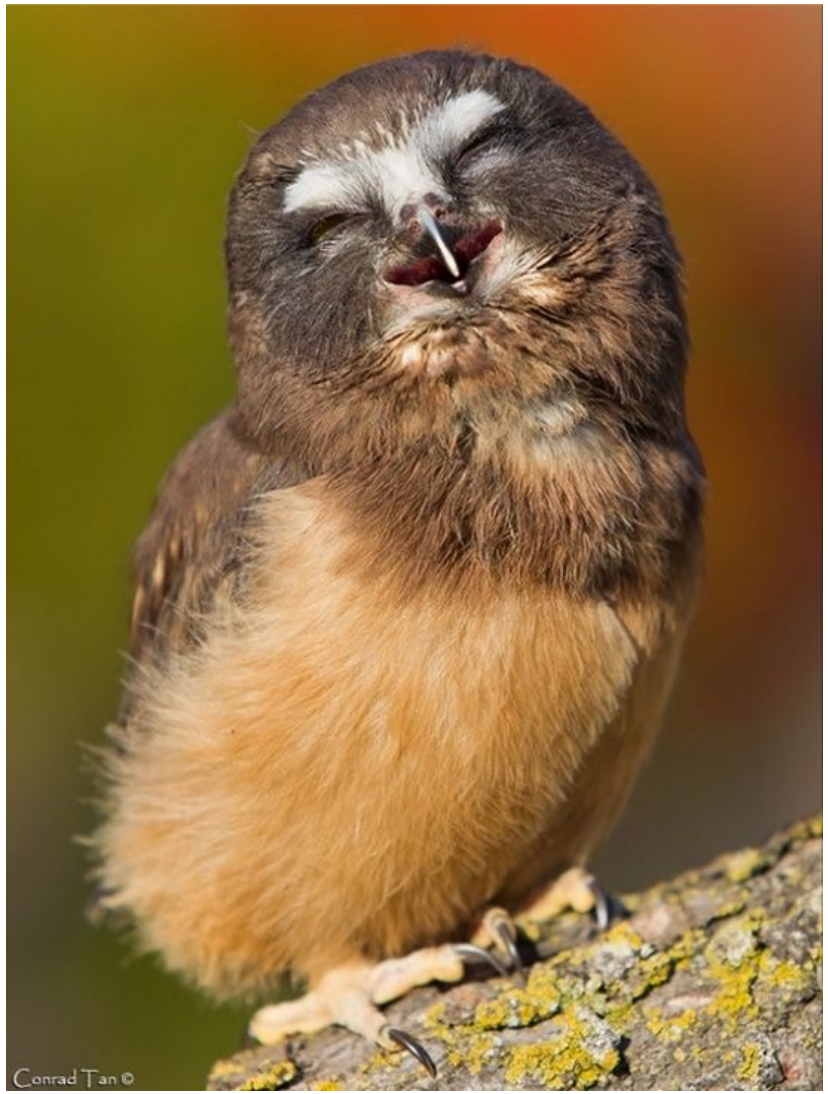
Horses are symptomatic amplifying hosts

Humans also develop significant viremia and disease, but are not thought to be part of the transmission cycle

VEE: clinical signs

- Same as W/EEE

- Does not infect birds.



W/E/VEE: gross lesions

- Often nothing significant in horses.
  - Depending on species, there may be no lesions or widespread hemorrhage and necrosis of various organs.

- Microscopic lesion in horses is primarily a non-suppurative encephalomyelitis.

W/E/VEE: diagnosis

- DDx:
  - WNV
  - EEE/WEE/VEE
  - Rabies
  - EHV-1

- Laboratory diagnosis is important to identify the first seasonal case in order to institute control measures. Lab tests include:
  - ELISA for antibody against W/V/EEE
  - Seroconversion in horses (or in sentinel dogs & chickens).
  - VEE – d/t ↑ viremia in horses, PCR may be occasionally be successful.
  - PM: IHC, PCR on brain.

- Control:
  - Vaccination with inactivated vaccines
    - W/EEE is considered a core vaccine in NA by the AAEP
  - Vector control (mosquitoes)

Sentinel chickens





White leghorn laying chickens, used as “sentinels” to detect the presence of mosquito-borne diseases, such as EEEV and West Nile Virus
(Correspondent photo by Leo Jarzomb)

From https://www.presstelegram.com/2018/03/29/how-139-flocks-of-sentinel-chickens-help-keep-you-safe-from-deadly-diseases/

W/E/VEE: public health

- These viruses are zoonotic
- Human infection is rare.
  - Mortality is
    - Low in WEE
    - Moderate in VEE
    - High in EEE.
  - Residual brain damage occurs in survivors, particularly children.



