Eastern Equine Encephalitis Virus

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Objectives

• Brief background of eastern equine encephalitis virus (EEEV)
• Describe recent multi-state phylogenetic analysis
• Discuss implications for Florida, surveillance, and control
• Describe a recent animal outbreak
EEEV Background

- Family Togaviridae
- Genus *Alphavirus*
- Enveloped
- Single-stranded
- Positive sense RNA
  - 10-12 kb

Cryoelectron Microscopic Reconstruction of an Alphavirus Virion (Strauss & Strauss, 2001)
Transmission Cycle of EEEV (CDC, 2010)
• EEEV is one of the most deadly mosquito-borne viruses
  – 3 to 15 cases per year develop encephalitis
  – 50-75% case fatality rate
  – no vaccine or specific treatment
• Circulation
  – primarily in North America east of the Mississippi River
  – typically occurs from July to October
  – Florida is year-round
Eastern equine encephalitis virus neuroinvasive disease cases reported by state of residence, 2007–2016, (CDC, 2017)
• Long standing hypothesis: Florida is the source of EEEV for northern states
• The genetic analysis of EEEV was limited
  – Sequencing of genome portions
  – Number of isolates
  – No large scale multi-state analyses
Large-Scale Complete-Genome Sequencing and Phylodynamic Analysis of Eastern Equine Encephalitis Virus Reveals Source-Sink Transmission Dynamics in the United States

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WGS Study

• Large scale molecular phylogenetic analysis of EEEV from historical isolates from multiple states

• 433 specimens
  – Florida (88), New York (184), Massachusetts (85) public health laboratories
  – 1934 – 2014

• Collaborators: J. Craig Venter Institute, Vanderbilt University, University of Hong Kong, University of Texas, and University of South Florida
Inference of the Ancestral States of EEEV

Inference of the ancestral states in the MCC tree of EEEV (Tan, Y. et al, 2018)
Map of the United States showing the EEEV cases and the virus movement inferred from the Bayesian phylogeographic analysis (Tan, Y. et al, 2018)
Implications

- Surveillance
  - Human
  - Animal
  - Mosquito
- Mosquito Control
- Reduction in patient treatment costs
  - Return on investment
Florida EEE Emu Outbreak

- March 2018
- Reports of an increase in mortality at an emu farm in Levy County, FL

Photos and investigation information courtesy of Dr. Dan Wolf, Florida Department of Agriculture and Consumer Services
Investigation

- 29 emus in the flock
- 5 deaths
- Several other emus lethargic, ataxic
- Owner had no regular veterinarian
Testing Results

- 4/5 tracheal samples positive for EEEV
- 2/2 fecal samples positive for EEEV

<table>
<thead>
<tr>
<th>Sample</th>
<th>PCR Result</th>
<th>Target A</th>
<th>Target B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emu Respiratory Sample #1</td>
<td>Positive</td>
<td>24.91</td>
<td>26.28</td>
</tr>
<tr>
<td>Emu Respiratory Sample #2</td>
<td>Positive</td>
<td>32.37</td>
<td>31.93</td>
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<tr>
<td>Emu Respiratory Sample #3</td>
<td>Equivocal</td>
<td>35.04</td>
<td>Undetected</td>
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<tr>
<td>Emu Respiratory Sample #4</td>
<td>Positive</td>
<td>31.52</td>
<td>31.88</td>
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<tr>
<td>Emu Respiratory Sample #5</td>
<td>Positive</td>
<td>29.15</td>
<td>29.63</td>
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<tr>
<td>Emu Fecal Sample #1</td>
<td>Positive</td>
<td>18.75</td>
<td>19.46</td>
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<tr>
<td>Emu Fecal Sample #2</td>
<td>Positive</td>
<td>16.55</td>
<td>17.11</td>
</tr>
</tbody>
</table>

- Mosquito pools – all PCR negative
- Human contacts - all PCR, IgM, and IgG negative
Follow Up

• Met with owners who suggested euthanasia of remaining birds
• Euthanasia and burial on site
• Destruction of eggs
• Removal of tires
• Transmission suspected emu to emu
• Guidance for emu farms
Questions?
References

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