Update on Vector & Vector-borne Disease Activity in West Virginia 2016

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2017 Mid-Atlantic Mosquito Control Association meeting
February 2, 2017
Objectives

- Provide an update on mosquito species diversity in West Virginia.
- Describe the spatial distribution of Zika virus vectors (*Aedes aegypti, Aedes albopictus*) in the continental United States.
- Present an update on mosquito and mosquito-borne disease activity in West Virginia (following the June 2016 flood).
- Provide an update on tick and tick-borne disease activity in West Virginia.
Introduction

- New mosquito species state records for West Virginia:
  - *Aedes dorsalis*
  - *Aedes tormentor*
  - *Anopheles walkeri*
  - *Psorophora horrida*
  - *Psorophora howardii*


Zika virus

- Zika virus is a single stranded RNA virus.
- Belongs to the virus family Flaviviridae genus *Flavivirus*.
  - Yellow fever virus
  - Dengue virus
  - Japanese encephalitis virus
  - West Nile virus
- Transmitted to humans primarily by *Aedes* (*Stegomyia*) mosquitoes.
  - Sexual transmission and perinatal transmission of the virus have also been documented.
Zika Virus Transmission Cycle

Sylvatic (jungle) cycle

Epidemic (urban) cycle
Zika Virus Disease

- Mosquito vectors of Zika virus found in the continental United States.
  - Yellow fever mosquito (*Aedes aegypti*)
  - Asian tiger mosquito (*Aedes albopictus*)
- *Aedes aegypti* and *Aedes albopictus* also transmit dengue virus, chikungunya virus, and yellow fever virus.
- *Aedes albopictus* is also a competent vector for La Crosse virus.
Estimated range of *Aedes aegypti* and *Aedes albopictus* in the United States, 2016

Ae. aegypti occurrence records, 1995-2016

Ae. albopictus occurrence records, 1995-2016

Ae. albopictus Distribution in West Virginia

Distribution of *Ae. albopictus* in West Virginia, 2016

Mosquito surveillance conducted May 24 through October 12 in 70 localities in 24 counties.

Regular weekly sampling at counties with high La Crosse encephalitis (LAC) incidence (Raleigh, Fayette, Nicholas) and low LAC incidence (Kanawha, Wood, Jackson).

Outlying areas were surveyed on semi-regular basis by state or local West Virginia Department of Health & Human Resources’ agents.

Unsmoothed and smoothed cumulative incidence of La Crosse virus infections at the county and census tract levels in children 15 years and younger, West Virginia 2003-2007

Mosquito Surveillance 2016 (cont.’d)

- Standardized gravid trap and CDC light trap (CO₂ trap).
- Mosquitoes tested for pathogens by West Virginia Office of Laboratory Services.
  - West Nile virus (WNV)
  - La Crosse virus (LACV)
  - Eastern equine encephalitis virus (EEEV)
  - St. Louis encephalitis virus (SLEV)
Utilized BG Sentinel Trap to capture *Aedes albopictus* (and *Aedes aegypti*).
Eleven (2.8%) of the 395 mosquito pools were infected with WNV.

WNV positive mosquito pools by county: Kanawha (4), Wayne (3), Cabell (2), Mason (1), Nicholas (1).

LACV, EEEV, and SLEV were not detected in mosquito pools.
The first mosquito pool with WNV was collected on July 6, 2016 (Week 27).

In the adult mosquitoes, WNV activity began to increase in mid-August (Week 33) and reached its peak in September.

According to WNV minimum infection rate in *Culex* mosquitoes, there was only a ‘moderate’ human risk of West Nile encephalitis.
Confirmed and probable human cases of mosquito-borne disease in West Virginia
- Eleven Zika virus cases (all travel associated)
- One malaria case with travel to Cameroon
- Eight La Crosse encephalitis cases from Fayette, Kanawha, Mason, Nicholas, Summers, and Webster counties
- One West Nile virus case from Berkeley County
On June 23, 2016, thunderstorms brought torrential rain to much of West Virginia, resulting in accumulations of 10 inches in 12-24 hours.

On June 25, 2016, President Obama declared West Virginia a major disaster area and ordered aid provided to flood victims in Kanawha, Nicholas, and Greenbrier counties.
Mosquito larvae could develop in residual stagnant water near human habitat.

‘Floodwater’ mosquito eggs laid in moist substrate could hatch after being submerged underwater.
- *Culex pipiens* and *Culex restuans* are involved in the WNV transmission cycle.
- Larvae of both species will develop in stagnant bodies of water.
- In comparison with 2014 and 2015, *Culex pipiens* and *Culex restuans* showed the same or reduced adult activity in 2016.
Culex erraticus are a pestiferous mosquito species whose larvae develop in ponds and wetlands.

Mass emergence of adults occurred at approximately the same time in Elkview in 2014, 2015, and 2016.

Adult emergence patterns in Muddlety similar between 2014, 2015, and 2016.
- Slight increase in some LAC vectors (*Aedes albopictus*, *Aedes triseriatus*) and decrease in other LAC vectors (*Aedes japonicus*).
- There was no dramatic increase in nuisance floodwater mosquito species (*Aedes trivittatus*, *Aedes vexans*, *Psorophora ferox*) following the flood.

### Mosquito Species

<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td><em>Aedes albopictus</em></td>
<td>16</td>
<td>11</td>
<td>25</td>
</tr>
<tr>
<td><em>Aedes triseriatus</em></td>
<td>3</td>
<td>6</td>
<td>11</td>
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<td><em>Aedes japonicus</em></td>
<td>30</td>
<td>68</td>
<td>17</td>
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<tr>
<td><em>Coquillettidia perturbans</em></td>
<td>1</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td><em>Aedes trivittatus</em></td>
<td>0</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td><em>Aedes vexans</em></td>
<td>2</td>
<td>15</td>
<td>2</td>
</tr>
<tr>
<td><em>Psorophora ferox</em></td>
<td>0</td>
<td>1</td>
<td>0</td>
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</table>

<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td><em>Aedes albopictus</em></td>
<td>2</td>
<td>0</td>
<td>0</td>
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<tr>
<td><em>Aedes triseriatus</em></td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><em>Aedes japonicus</em></td>
<td>0</td>
<td>2</td>
<td>1</td>
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<tr>
<td><em>Coquillettidia perturbans</em></td>
<td>75</td>
<td>28</td>
<td>9</td>
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<tr>
<td><em>Aedes trivittatus</em></td>
<td>1</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td><em>Aedes vexans</em></td>
<td>5</td>
<td>31</td>
<td>1</td>
</tr>
<tr>
<td><em>Psorophora ferox</em></td>
<td>0</td>
<td>5</td>
<td>2</td>
</tr>
</tbody>
</table>
There was no increase in adult mosquito activity weeks after the flood in Nicholas or Greenbrier counties.

<table>
<thead>
<tr>
<th>Location</th>
<th>6/30/2016</th>
<th>7/8/2016</th>
<th>7/14/2016</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Rainelle</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Culex pipiens/restuans</td>
<td>20</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>Aedes triseriatus</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Aedes japonicus</td>
<td>5</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Aedes canadensis</td>
<td>11</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Aedes trivittatus</td>
<td>31</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Aedes vexans</td>
<td>1</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Psorophora ferox</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>White Sulphur Springs</strong></td>
<td>6/30/2016</td>
<td>7/8/2016</td>
<td>7/14/2016</td>
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<tr>
<td>Culex pipiens/restuans</td>
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</tr>
<tr>
<td>Aedes triseriatus</td>
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<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Aedes japonicus</td>
<td>1</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>Aedes trivittatus</td>
<td>0</td>
<td>2</td>
<td>0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Location</th>
<th>6/30/2016</th>
<th>7/8/2016</th>
<th>7/14/2016</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Summersville</strong></td>
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</tr>
<tr>
<td>Culex pipiens/restuans</td>
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<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Aedes japonicus</td>
<td>4</td>
<td>12</td>
<td>10</td>
</tr>
<tr>
<td>Aedes trivittatus</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Location</th>
<th>6/30/2016</th>
<th>7/8/2016</th>
<th>7/14/2016</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Coldwell</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Culex pipiens/restuans</td>
<td>65</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Aedes japonicus</td>
<td>10</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>Aedes trivittatus</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>
## Tick-borne Disease

### Tick-borne Diseases by Causative Organism(s) and Presence of Tick Vectors in West Virginia

<table>
<thead>
<tr>
<th>Tick-borne Disease</th>
<th>Pathogen(s)</th>
<th>Tick Vector(s) Present in WV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tularemia</td>
<td><em>Franciscella tularensis</em></td>
<td>American dog tick (<em>Dermacentor variabilis</em>)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lone star tick (<em>Amblyomma americanum</em>)</td>
</tr>
<tr>
<td>Anaplasmosis</td>
<td><em>Anaplasma phagocytophilum</em></td>
<td>Blacklegged tick (<em>Ixodes scapularis</em>)</td>
</tr>
<tr>
<td>Ehrlichiosis</td>
<td><em>Ehrlichia chaffeensis</em></td>
<td>Lone star tick (<em>Amblyomma americanum</em>)</td>
</tr>
<tr>
<td></td>
<td><em>Ehrlichia ewingii</em></td>
<td>Gulf Coast tick (<em>Amblyomma maculatum</em>)</td>
</tr>
<tr>
<td></td>
<td>Panola Mountain <em>Ehrlichia</em> sp.</td>
<td>Blacklegged tick (<em>Ixodes scapularis</em>)</td>
</tr>
<tr>
<td></td>
<td><em>Ehrlichia muris</em>-like agent</td>
<td></td>
</tr>
<tr>
<td>Lyme disease</td>
<td><em>Borrelia burgdorferi</em></td>
<td>Blacklegged tick (<em>Ixodes scapularis</em>)</td>
</tr>
<tr>
<td></td>
<td><em>Borrelia mayonii</em></td>
<td></td>
</tr>
<tr>
<td>Relapsing fever*</td>
<td><em>Borrelia miyamotoi</em></td>
<td>Blacklegged tick (<em>Ixodes scapularis</em>)</td>
</tr>
<tr>
<td>Powassan encephalitis*</td>
<td>Powassan virus</td>
<td>Groundhog tick (<em>Ixodes cookei</em>)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Blacklegged tick (<em>Ixodes scapularis</em>)</td>
</tr>
<tr>
<td>Babesiosis*</td>
<td><em>Babesia microti</em></td>
<td>Blacklegged tick (<em>Ixodes scapularis</em>)</td>
</tr>
<tr>
<td>Rocky Mountain spotted fever and other spotted fever rickettsioses</td>
<td><em>Rickettsia rickettsii</em> (and other spotted fever group <em>Rickettsia</em>)</td>
<td>American dog tick (<em>Dermacentor variabilis</em>) Brown dog tick (<em>Rhipicephalus sanguineus</em>) Lone star tick (<em>Amblyomma americanum</em>)</td>
</tr>
</tbody>
</table>

*This tick-borne disease has not been detected in West Virginia.*
Confirmed and probable Lyme disease cases reported by county—West Virginia, 2016 (n=354)

<table>
<thead>
<tr>
<th>Tickborne Diseasea</th>
<th># Confirmed or Probable Cases (2016) (as of January 9, 2017)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ehrlichiosis</td>
<td>6</td>
</tr>
<tr>
<td>Lyme disease</td>
<td>354</td>
</tr>
<tr>
<td>Spotted fever group rickettsiosesb</td>
<td>14</td>
</tr>
<tr>
<td>Q fever</td>
<td>1</td>
</tr>
<tr>
<td>TOTAL</td>
<td>375</td>
</tr>
</tbody>
</table>

a Table includes only confirmed or probable cases that have been reviewed and closed by Zoonotic Disease Epidemiologist.

b Includes Rocky Mountain spotted fever
Reported Cases of Lyme Disease by Year - West Virginia, 2000-2016*

Year Reported | Number of Cases
---|---
2000 | 35
2001 | 17
2002 | 26
2003 | 31
2004 | 39
2005 | 61
2006 | 28
2007 | 84
2008 | 125
2009 | 201
2010 | 125
2011 | 135
2012 | 97
2013 | 143
2014 | 136
2015 | 289
2016 | 354

*Updated as of January 9, 2017
Reported Cases of Lyme Disease -- United States, 2015

1 dot placed randomly within county of residence for each confirmed case

https://www.cdc.gov/lyme/stats/maps.html
Ixodes scapularis reported (blue) or established (red) in county
Ixodes pacificus reported (yellow) or established (green) in county

Update to Eisen et al. (2016) to include data collected from August 25 to December 30, 2015.

### West Virginia Veterinary Tick Submission Project

**Summary of veterinary tick submissions for the current reporting period in West Virginia.**

1. **Dermacentor variabilis**¹
   - 2013: 470
   - 2014: 998
   - 2015: 677
   - 2016: 723

2. **Amblyomma americanum**²
   - 2013: 5
   - 2014: 16
   - 2015: 85
   - 2016: 109

3. **Ixodes scapularis**³
   - 2013: 121
   - 2014: 179
   - 2015: 410
   - 2016: 171

4. **Ixodes cookei**⁴
   - 2013: 7
   - 2014: 18
   - 2015: 86
   - 2016: 27

5. **Haemaphysalis leporispalustris**⁵
   - 2013: 1
   - 2014: 8
   - 2015: 0
   - 2016: 3

6. **Amblyomma maculatum**⁶
   - 2013: 0
   - 2014: 1
   - 2015: 0
   - 2016: 1

7. **Rhipicephalus sanguineus**⁶
   - 2013: 0
   - 2014: 0
   - 2015: 4
   - 2016: 119

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¹Vector of tularemia and Rocky Mountain spotted fever
²Vector of ehrlichiosis, tularemia, STARI, and spotted fever rickettsioses
³Vector of Lyme disease, anaplasmosis, babesiosis, and Powassan encephalitis
⁴Vector of Powassan encephalitis
⁵Vector of tularemia in rabbits
⁶Vector of spotted fever rickettsioses
Although the yellow fever mosquito (Aedes aegypti) is established in neighboring states, this Zika competent vector has not been recorded in West Virginia.

The Asian tiger mosquito (Aedes albopictus), another competent mosquito vector for Zika virus, is established in most West Virginia counties.

La Crosse encephalitis is the major mosquito-borne disease in West Virginia.

The June 23, 2016 flood of West Virginia did not result in an increase in adult mosquito activity.

Human cases of Lyme disease are increasing in West Virginia.
Contact

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