Arbovirus Surveillance in Connecticut

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Connecticut Mosquito Management Program

• Comprised of 5 State Agencies
  – The CT Agricultural Experiment Station (mosquito surveillance, virus testing)
  – Department of Energy & Environmental Protection (mosquito control, environmental management)
  – Department of Public Health (epidemiology of human cases)
  – Department of Agriculture (veterinary cases)
  – Pathobiology Department at UCONN (necropsy, initial veterinary testing)
Mosquito Surveillance

- Mosquito trapping from June – October
- 92 permanent trapping stations
  - 91 Sites maintained by CAES
  - 1 Site (Groton) maintained by US Navy
- Trap on a Rotational Basis (every 10 days)
  - WNV or EEE isolates from mosquitoes
  - Trap twice a week after detection of virus
- 2 or 3 types of trap per location
• Host seeking females
• Out for blood
• Collects a large & diverse number of mosquitoes
  • Aedes
  • Ochlerotatus
  • Coquillettidia
  • Culex
  • Culiseta
  • Psorophora

CDC Light Trap
• Hay-lactalbumin infusion

• *Culex pipiens* & *Cx. restuans*
  • Ready to lay eggs
  • Obtained blood meal
  • More Likely to be WNV (+)
  • 90% of collection

• Accounts for 75% of WNV (+) isolates from *Cx. pipiens* and *Cx. restuans*
• Designed for *Ae. albopictus*
  • Used at sites to evaluate population size

• Invasive Species

• Small populations in CT
  • Coastal Fairfield county

• Aggressive Human Biter
  • Zika
  • Chikungunya
  • Dengue
Mosquito Trapping Locations

• Rural Areas
  – Permanent swamps and bogs
  – Marsh areas (fresh and salt)

• Urban / Suburban Sites
  – Neighborhood parks and schools
  – Along waterways and streams
  – Sewage treatment plants
  – Horse stables
  – Tire dumps
Mosquito Identification

- Mosquito identification to species
  - 52 species in CT
  - Routinely collect 35 species
- Completed on day of collection
- Pooled by species, site and trap type
  - Maximum of 50 / pool
- All species tested
**Virus Isolation & Identification**

- **Biosafety Level 3 Laboratory**
- **Virus isolation in Vero cell cultures (African Green Monkey)**
  - Incubate for 7 days at 37 °C in 5% CO₂
  - Examine daily for virus growth
- **Virus identification by Real time PCR, RT-PCR, molecular techniques**

  *4 to 6 days turnaround*
Mosquito-Borne Viruses in Connecticut

- West Nile Virus
- Eastern Equine Encephalitis
- Jamestown Canyon
- Cache Valley
- Trivittatus
- La Crosse
- Highlands J
- Potosi
- Flanders

Zika and Chikungunya can be tested for from mosquito pools

Cause Human Disease
West Nile Virus

- Widely distributed - occurs in tropical and temperate climates on every continent
- Introduced into North America in 1999 and rapidly spread throughout the Americas
- Transmitted by *Culex* mosquitoes
- Maintained in a bird-mosquito transmission cycle
- Humans are infected when mosquitoes feed opportunistically on birds and mammals
Human Cases of WNV in US 1999 - 2017

Total Cases = 48,183
Incidence of WNV Neuroinvasive Disease by Age Group
West Nile Virus Isolations from Mosquitoes, 1999-2018

Virus Isolations per Year

N = 2,358
West Nile Virus Human Cases, 1999-2018

N = 157
WNV Epidemic Curve

No. WNV Isolates

Week


10 yr Mean Mosq.
WNV Epidemic Curve

No. WNV Isolates vs. Week

10 yr Mean Human
10 yr Mean Mosq.
### WNV Isolations from Mosquito Pools - CT 1999-2018

<table>
<thead>
<tr>
<th>Species</th>
<th>Isolates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Culex pipiens</td>
<td>1,647</td>
</tr>
<tr>
<td>Culex restuans</td>
<td>330</td>
</tr>
<tr>
<td>Culex salinarius</td>
<td>166</td>
</tr>
<tr>
<td>Culiseta melanura</td>
<td>108</td>
</tr>
<tr>
<td>Aedes vexans</td>
<td>18</td>
</tr>
<tr>
<td>Aedes cinereus</td>
<td>13</td>
</tr>
<tr>
<td>Coquillettidia perturbans</td>
<td>11</td>
</tr>
<tr>
<td>Ochlerotatus japonicus</td>
<td>10</td>
</tr>
<tr>
<td>Oc. canadensis</td>
<td>10</td>
</tr>
<tr>
<td>Oc. taeniorhynchus</td>
<td>6</td>
</tr>
<tr>
<td>Other Species (14)</td>
<td>45</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>2,358</strong></td>
</tr>
</tbody>
</table>

- **Culex pipiens** 70%
- **Culex restuans** 14%
- **Culiseta melanura** 5%
- **Culex salinarius** 7%
- **Other species (19)** 5%
Northeastern US West Nile Virus Transmission Cycle

**Enzootic Cycle**
- *Culex pipiens*
- *Culex restuans*
- *Culiseta melanura*

**Virus**

**June to October**

**Epidemic / Epizootic Transmission**
- *Culex salinarius*
- *Culex pipiens*
- *Aedes species*

**Incidental Infections**

**August to October**

**Wild Passerine Bird Reservoir and Amplifying Hosts**
Eastern equine encephalitis (EEE) virus

- Discovered in the 1930’s
- Sporadic disease outbreaks in horses and humans
- Maintained in a bird-mosquito cycle
- *Culiseta melanura*- the main mosquito vector
- Occurs mainly in fresh-water hardwood swamps
Eastern Equine Encephalitis Activity

Infected Mosquitoes (1996-2018)
- Not Detected
- 1 yr
- 2 yrs.
- 3 yrs.
- ≥ 5 yrs.

Virus Isolations per Year

N = 412
<table>
<thead>
<tr>
<th>Species</th>
<th>Isolates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Culiseta melanura</td>
<td>263</td>
</tr>
<tr>
<td>Ochlerotatus canadensis</td>
<td>32</td>
</tr>
<tr>
<td>Aedes cinereus</td>
<td>19</td>
</tr>
<tr>
<td>Aedes vexans</td>
<td>15</td>
</tr>
<tr>
<td>Culex salinarius</td>
<td>12</td>
</tr>
<tr>
<td>Uranotaenia sapphirina</td>
<td>12</td>
</tr>
<tr>
<td>Culex pipiens</td>
<td>10</td>
</tr>
<tr>
<td>Other Species (12)</td>
<td>49</td>
</tr>
<tr>
<td>TOTAL</td>
<td>412</td>
</tr>
</tbody>
</table>
1996-2017
Weekly Isolations of EEE virus from field collected mosquitoes
Northeastern US EEE Virus Transmission Cycle

Culiseta melanura

Enzootic Cycle

Virus

Wild Passerine Bird Reservoir and Amplifying Hosts

July to October
Northeastern US EEE Virus Transmission Cycle

**Enzootic Cycle**

*Culiseta melanura*

**Wild Passerine Bird Reservoir and Amplifying Hosts**

**Epidemic / Epizootic Transmission**

*Virus*

**Incidental Infections**

*August to October*

*July to October*

*Aedes species*

*Ochlerotatus canadensis*

*Culiseta melanura*
Reporting of Results

- WNV, EEE, or exotic virus identified
  - Notify CT DPH, DEEP
    - DPH contacts local Health Dept.
  - Report to CDC (ArboNet)

- Post on CAES/Mosquito Management Website
  - www.ct.gov/caes/mosquitotesting
  - www.ct.gov/mosquito

- Map

- Weekly, Cumulative Results Tables

- Press Releases
2018 West Nile Virus Activity

Updated: October 16, 2018

Mosquitoes (# positive pools) = 393
- Culex pipiens (242)
- Culex restuans (59)
- Culex meigeni (34)
- Culex salinarius (24)
- Aedes cimex (6)
- Ochlerotatus caradoni (5)
- Coquillettidia perturbator (4)
- Ochlerotatus japonicus (3)
- Aedes albopictus (1)
- Aedes japonicus s.l. (1)
- Ochlerotatus stigmatipes (1)
- Ochlerotatus taeniorhynchus (1)
- Pascophora ferox (1)

- = Positive Mosquitoes
- = Human Case (n=21)
- = Horse Case (n=2)
2018 West Nile Virus Activity per Week

- 2018 Isolates from Mosquitoes
- 12 Year Mean Isolates
Updated October 28

The following numbers of mosquitoes were collected, identified, and tested at the Connecticut Agricultural Experiment Station in New Haven. The towns and locations of the sites, number of mosquitoes tested, and virus isolations are listed. The total number tested to date: 177,509

WNV = West Nile virus
EEE = Eastern Equine Encephalitis virus
JC = Jamestown Canyon virus

Follow this link to see a description of the Mosquito Management Program

Follow this link to see current week’s results

<table>
<thead>
<tr>
<th>Town</th>
<th>Trop Site</th>
<th>Number of Mosquitoes</th>
<th>Pos. or Neg.</th>
<th>WNV, EEE, JC</th>
<th>Mosquito Species (No.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barkhamsted</td>
<td>Hoyt Hayes Swamp</td>
<td>649</td>
<td>Neg.</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Bethany</td>
<td>Bethany Bog</td>
<td>1,942</td>
<td>Neg.</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Bethel</td>
<td>Meckauer Park</td>
<td>419</td>
<td>Neg.</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Branford</td>
<td>Hosley Ave.</td>
<td>556</td>
<td>Neg.</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Bridgeport</td>
<td>Beardsley Zoo</td>
<td>802</td>
<td>Pos.</td>
<td>WNV:3</td>
<td>Cx. pipiens (3)</td>
</tr>
<tr>
<td>Bridgeport</td>
<td>Barnum Blvd.</td>
<td>2,345</td>
<td>Pos.</td>
<td>WNV:16</td>
<td>Cx. pipiens (6) Cx. restuans (1) Cx. salinarius (8) Ae. vexans (1)</td>
</tr>
<tr>
<td>Canaan</td>
<td>Robin’s Swamp</td>
<td>7,494</td>
<td>Pos.</td>
<td>JC: 1</td>
<td>Oc. provocans (1)</td>
</tr>
<tr>
<td>Cheshire</td>
<td>Lock 12</td>
<td>807</td>
<td>Pos.</td>
<td>WNV:2</td>
<td>Cx. pipiens (1) Cx. restuans (1)</td>
</tr>
<tr>
<td>Chester</td>
<td>Cockaponset St. Forest</td>
<td>2,360</td>
<td>Pos.</td>
<td>WNV:1</td>
<td>Cs. melanura (1) Oc. abserratus (1)</td>
</tr>
<tr>
<td>Cornwall</td>
<td>Mohawk Pond</td>
<td>5,691</td>
<td>Neg.</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Cromwell</td>
<td>Cromwell Meadows</td>
<td>3,259</td>
<td>Pos.</td>
<td>JC: 1</td>
<td>Oc. trivittata (1)</td>
</tr>
<tr>
<td>Danbury</td>
<td>Reservoir Road</td>
<td>1,476</td>
<td>Neg.</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
## Acknowledgements

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- Dr. Philip Armstrong

### Mosquito Collection and Identification
- John Shepard
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### Virus Isolation and Identification (BSL-3)
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