

Mosquito Surveillance for EEE and Other Arboviruses in CT



Philip Armstrong

***Department of Environmental Sciences
Center for Vector Biology & Zoonotic Diseases
The Connecticut Agricultural Experiment Station
New Haven, CT***

Connecticut Mosquito Management Program

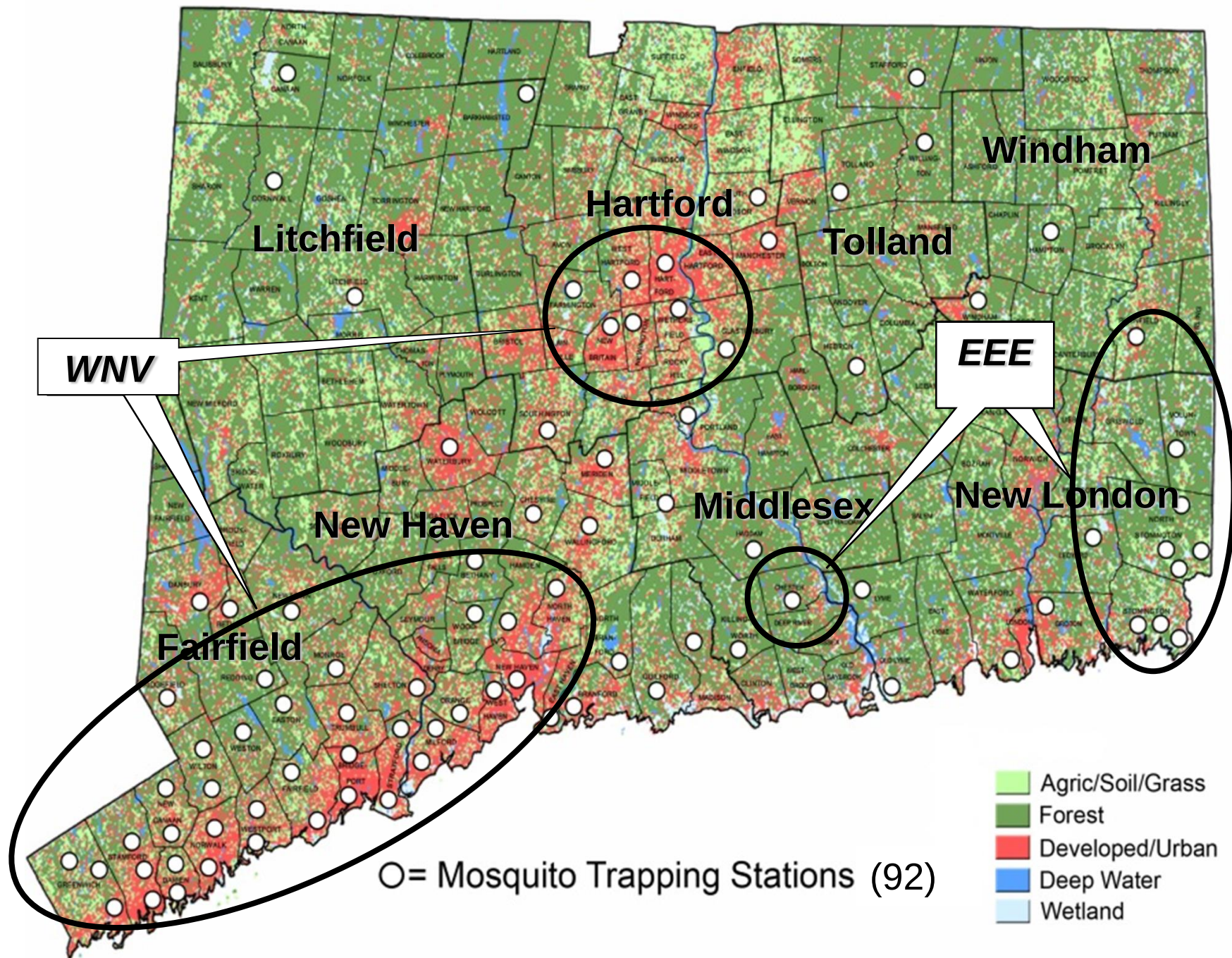
- **Established 1997 by Public Act 97-289**
- **Comprised of 5 State Agencies**
 - **The CT Agricultural Experiment Station** (*mosquito surveillance, virus testing*)
 - **Department of Public Health** (*epidemiology of human, veterinary cases*)
 - **Department of Energy & Environmental Protection** (*mosquito control, habitat restoration*)
 - **Department of Agriculture** (*veterinary cases*)
 - **Pathobiology Department at UCONN** (*necropsy, initial veterinary testing*)



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





Mosquito Surveillance

- Mosquito trapping from June – October
- 92 permanent trapping stations (ADD 15 in 2020)
 - 91 Sites maintained by CAES
 - 1 Site maintained by US Navy
 - Trap on a Rotational Basis (about every 10 days)
 - If WNV or EEE isolates from mosquitoes
 - Trap Weekly (twice if possible)
- 2 or 3 types of trap per location

Detect virus in mosquitoes *prior* to human or animal cases

CDC Light Trap

- Host

- C

- Coll

num

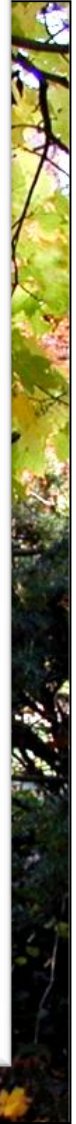
- A

- C

- C

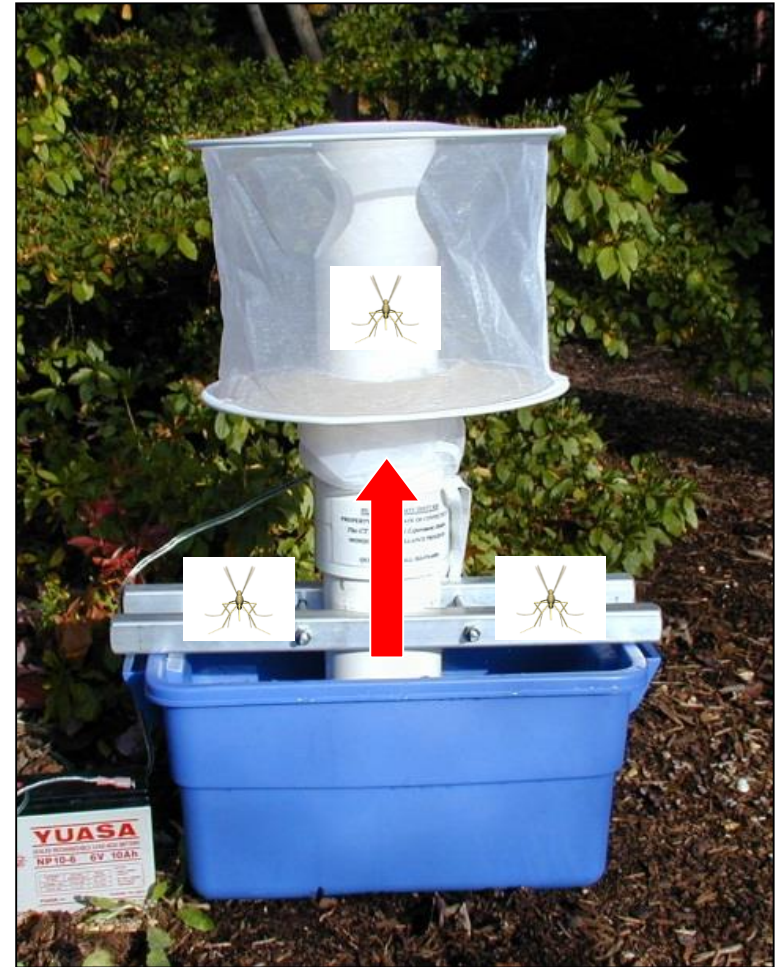
- C

- F



CDC Gravid Trap

- Hay-yeast-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*



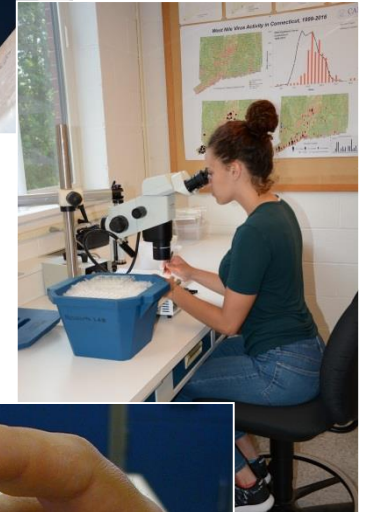
BG Sentinel Trap

- Designed for *Ae. albopictus*
 - Used at sites to evaluate population size
- Small populations in CT
 - Coastal Fairfield and New Haven counties
- Invasive Species
- Aggressive Human Biter
 - Secondary vector of Zika, Chikungunya and Dengue



Mosquito Identification

- Females identified to species
 - 43 species collected in 2019
- Completed on day of collection
 - 6 identifiers during peak season
- Pooled by species, site and trap type
 - Maximum of 50 / pool
- All species tested for arboviruses



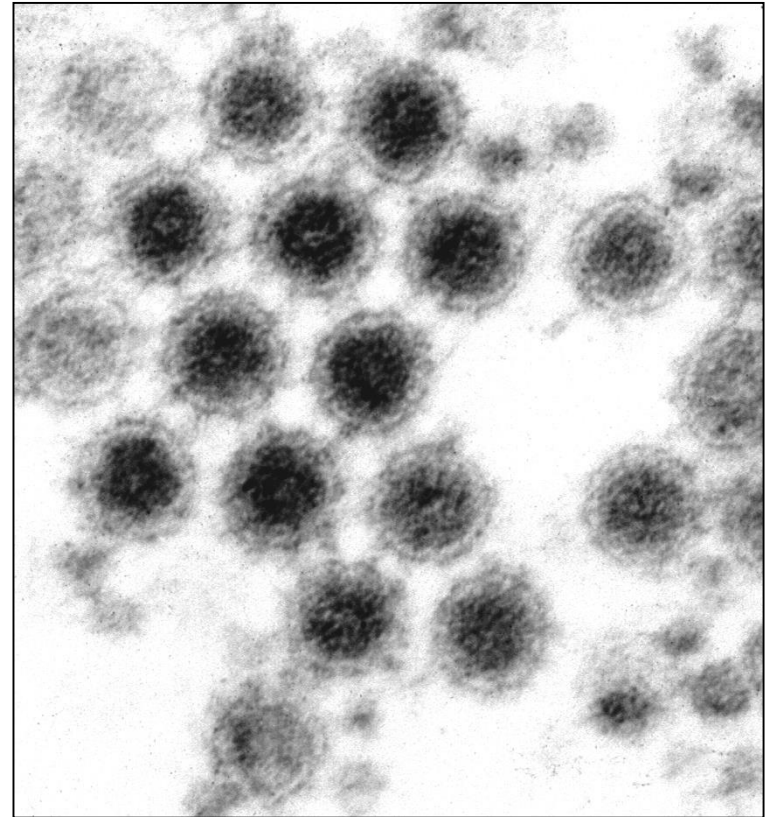
Virus Isolation & Identification

- **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



Mosquito-Borne Viruses in Connecticut

- ***West Nile Virus***
- ***Eastern Equine Encephalitis***
- ***Jamestown Canyon***
- ***Cache Valley***
- ***La Crosse***
- ***Trivittatus***
- *Potosi*
- *Highlands J*
- *Flanders*
- *Can detect Zika, Chikungunya, or other exotic viruses*



***Cause Human
Disease***

Human Disease Causing Mosquito-Borne Viruses in CT

Virus	No. isolations *	No. locations *	Reservoir	Age Group	Human disease
West Nile	2,440	106	Bird	Elderly	Moderate to severe, fever, encephalitis
Eastern Equine Encephalitis	534	48	Bird	Children, Elderly	Severe, encephalitis
Jamestown Canyon	557	88	White-tailed deer	All ages	Fever, meningitis, encephalitis
Cache Valley	226	71	Deer, horse, sheep	All ages	Fever, meningitis, encephalitis
Trivittatus	104	25	Rabbit, squirrel, raccoon, opossum	All ages	Febrile illness
La Crosse	5	3	Squirrel, chipmunk	Children	Severe, encephalitis

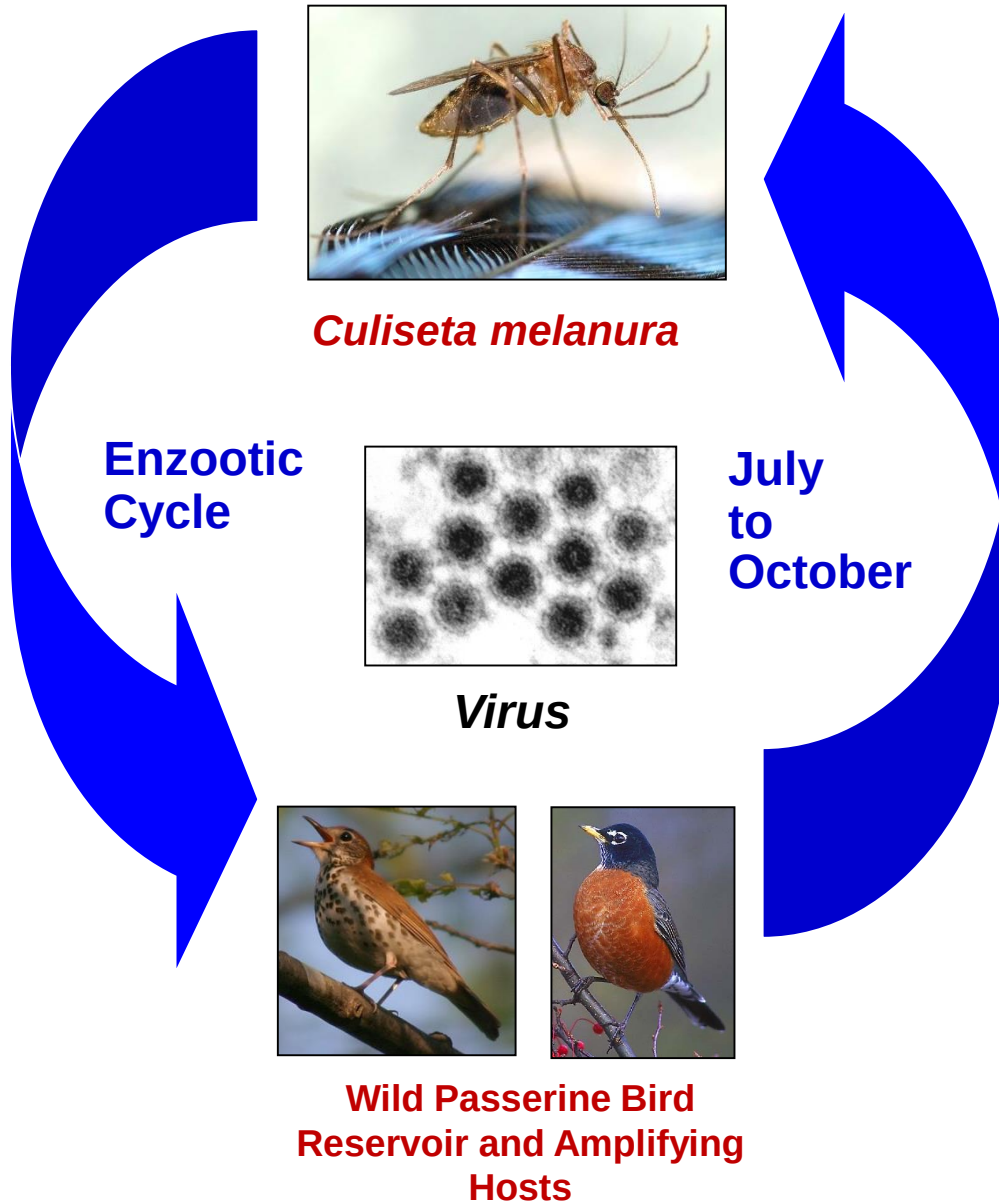
* = 1997-2019

Reporting of Results

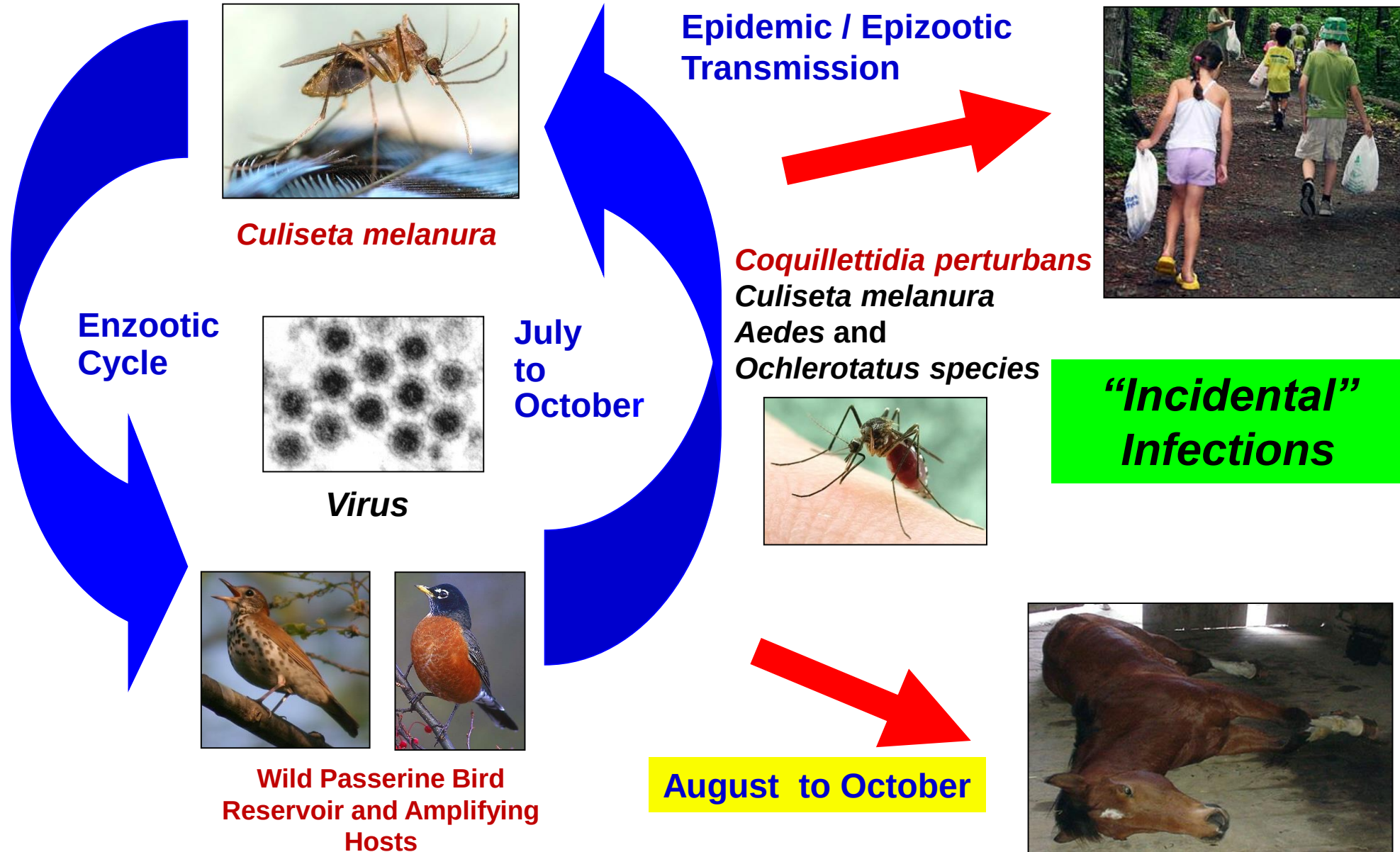
- **EEE, WNV, or exotic virus identified**
 - Notify CT DPH, DEEP
 - DPH contacts local Health Dept.
 - Report to CDC (ArboNet)
- **Post on CAES/Mosquito Management Website**
 - www.portal.ct.gov/caes
 - www.portal.ct.gov/mosquito
- Map
- Weekly & Cumulative Results Tables
- **Press Release may be issued (state or local)**

SEARCH: "CAES Mosquito Testing"

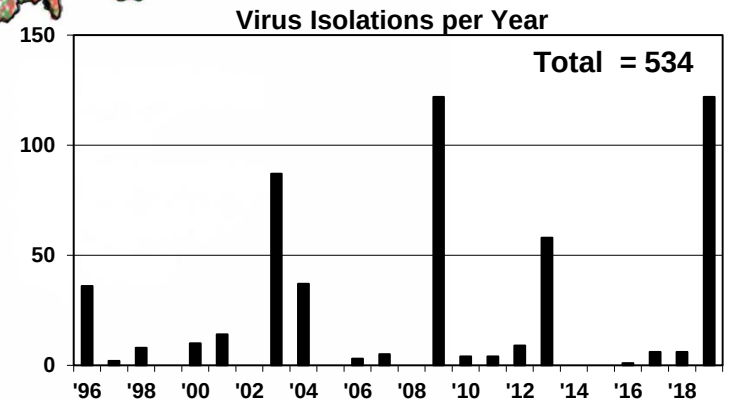
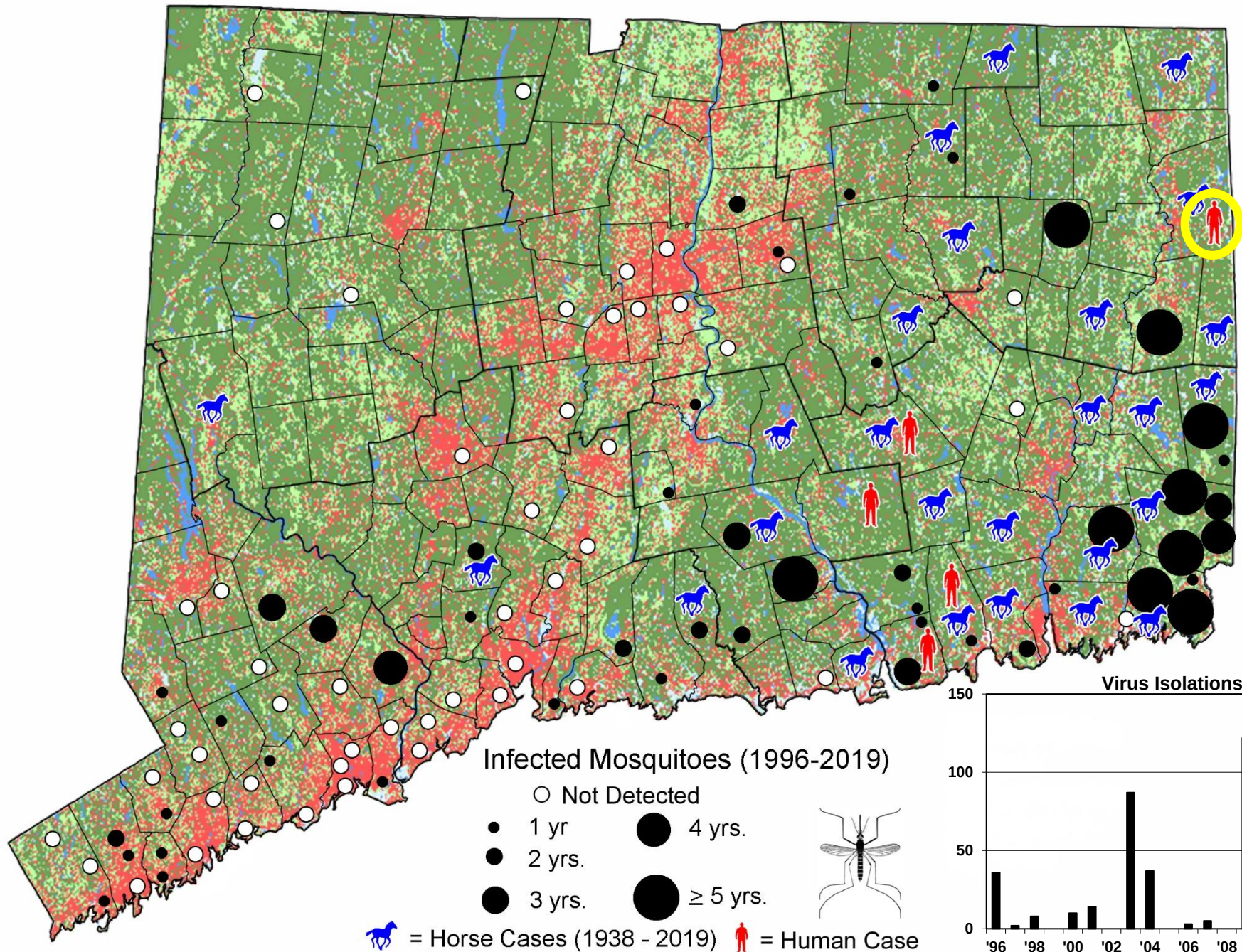
Northeastern US EEE Virus Transmission Cycle



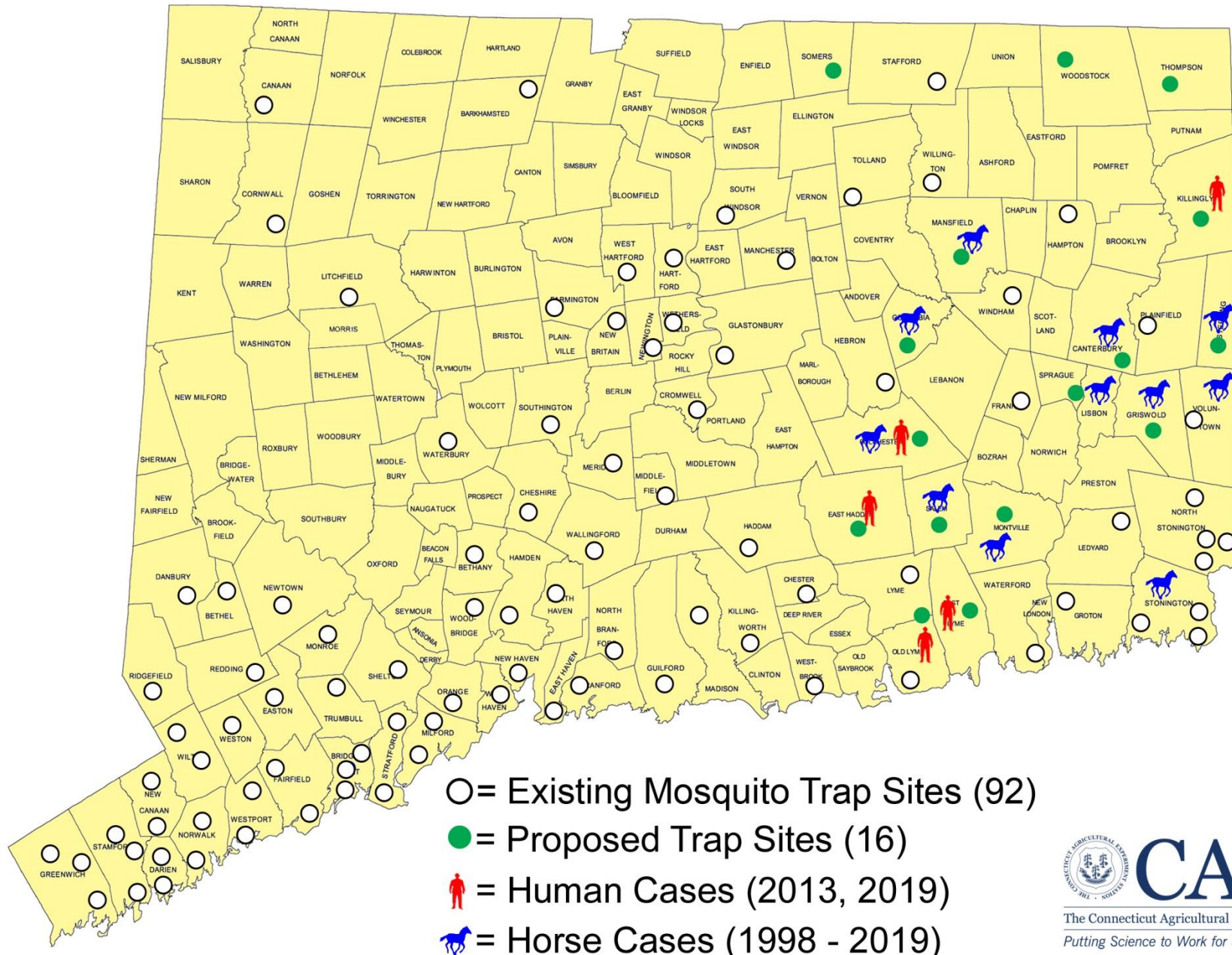
Northeastern US EEE Virus Transmission Cycle



Eastern Equine Encephalitis Activity, 1996-2019



Mosquito Trapping Stations



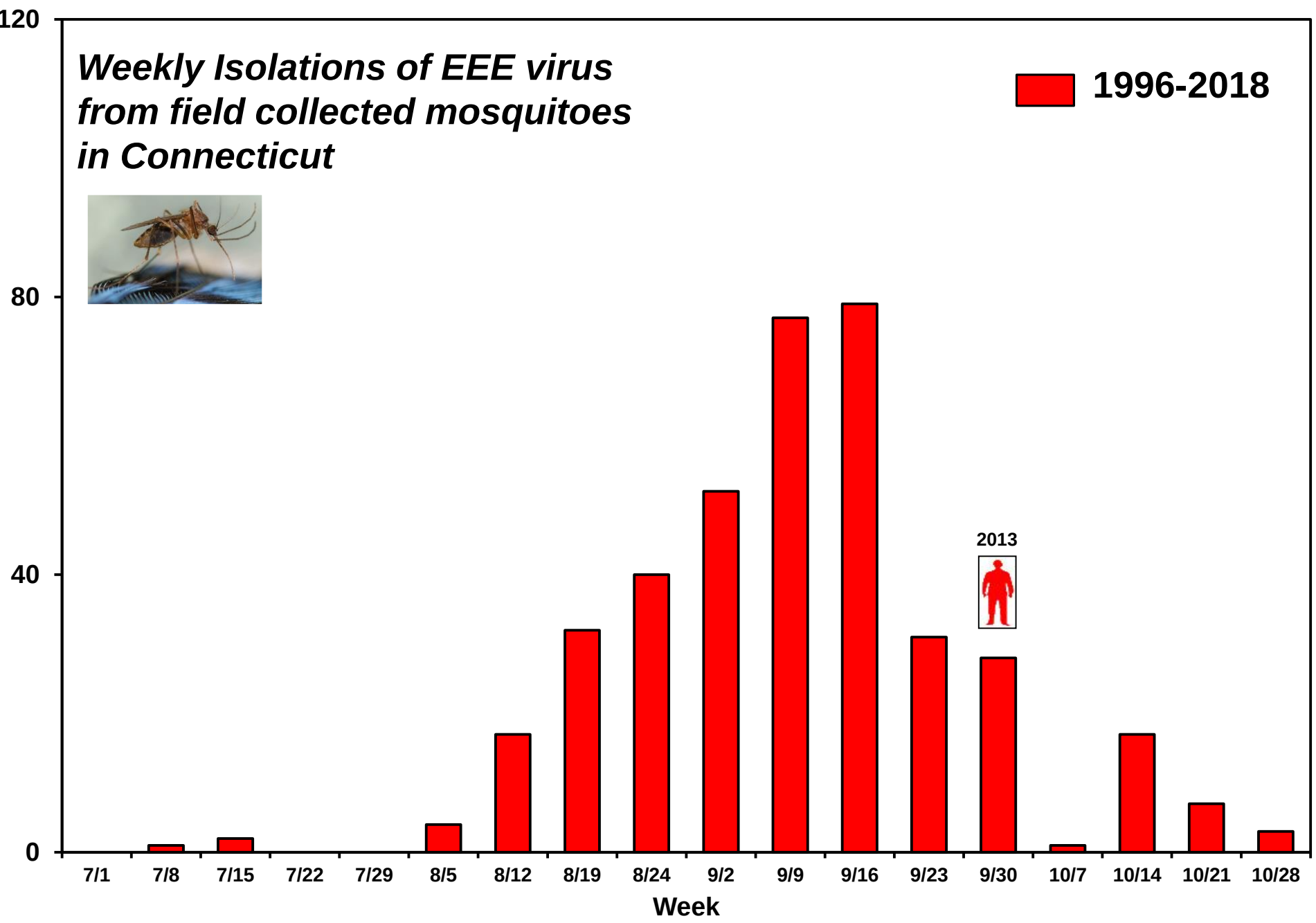
***Weekly Isolations of EEE virus
from field collected mosquitoes
in Connecticut***

1996-2018



No. EEE virus isolations

2013

2019 Eastern Equine Encephalitis Activity per Week

■ Non-mammalian biter (n=90)

■ Mammalian biter (n=32)



= Human Case* (n=4)



= Horse Case* (n=6)



= Pheasant or Partridge* (n=2)

* = onset of illness symptoms

EEE Isolates per Week

50

40

30

20

10

0

6/2-6/8

6/9-6/15

6/16-6/22

6/23-6/29

6/30-7/6

7/7-7/13

7/14-7/20

7/21-7/27

7/28-8/3

8/4-8/10

8/11-8/17

8/18-8/24

8/25-8/31

9/1-9/7

9/8-9/14

9/15-9/21

9/22-9/28

9/29-10/5

10/6-10/12

10/13-10/19

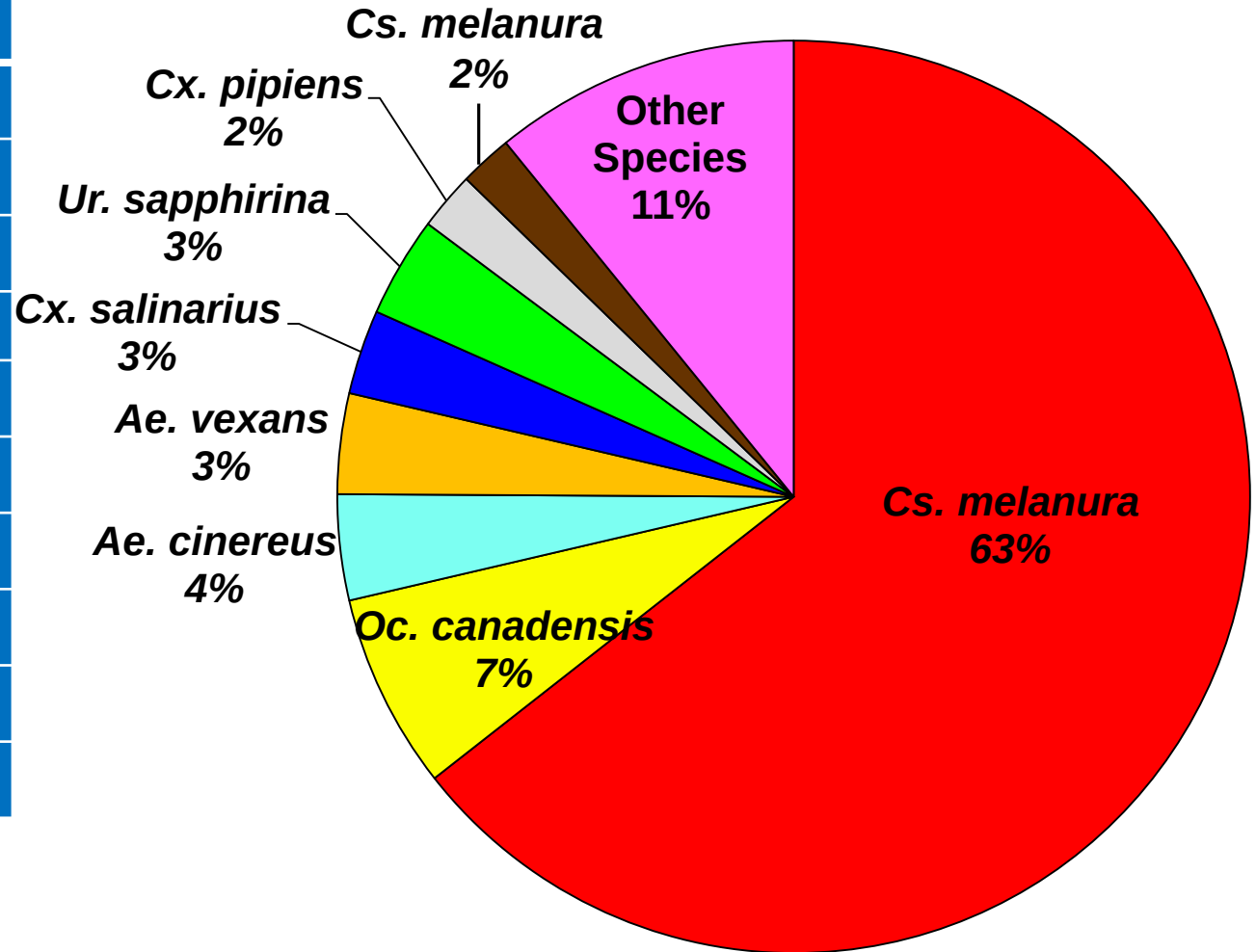
10/20-10/26

10/28-11/3

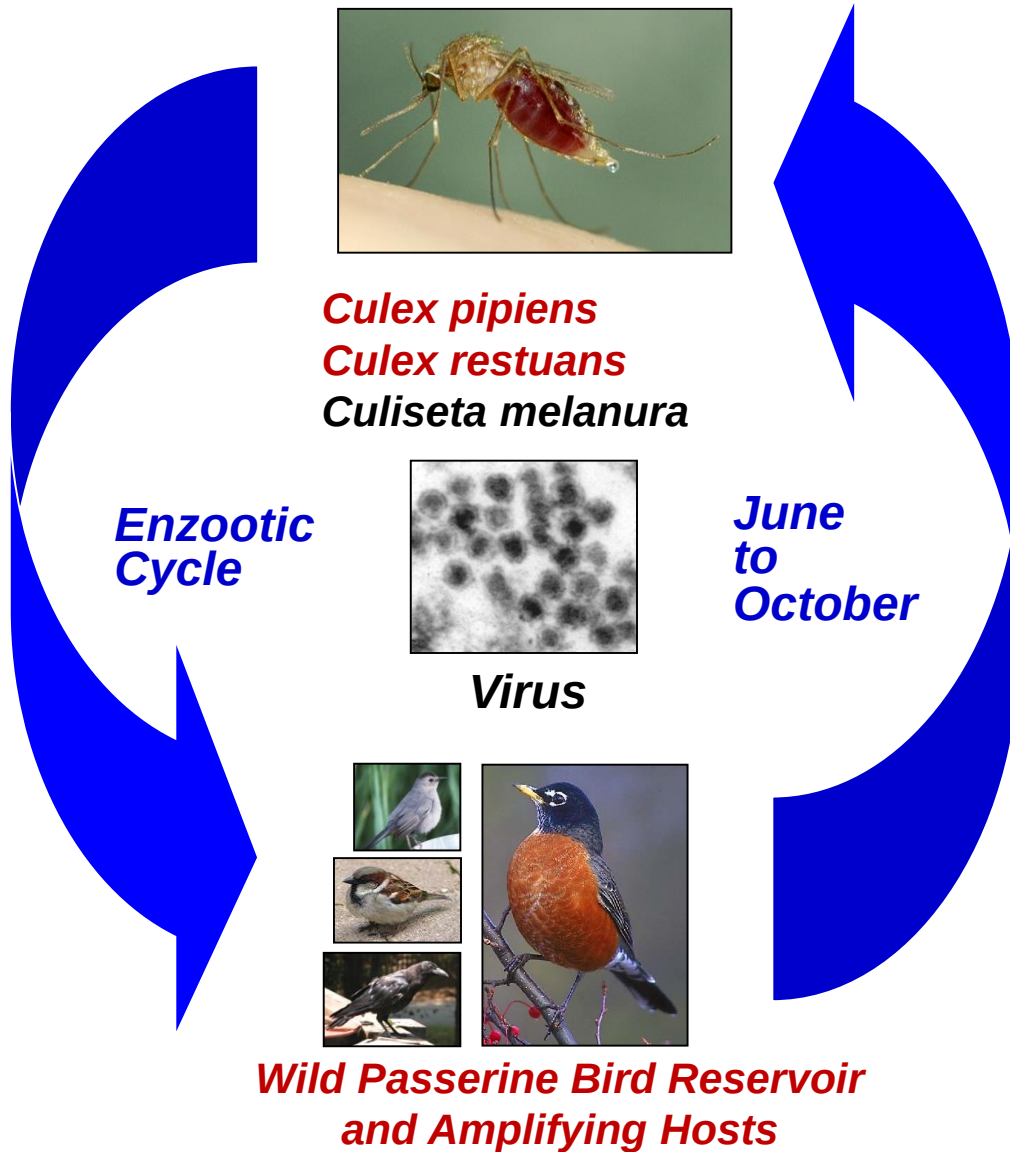
* = onset of illness symptoms

EEE Isolations from Mosquito Pools - CT 1996-2019

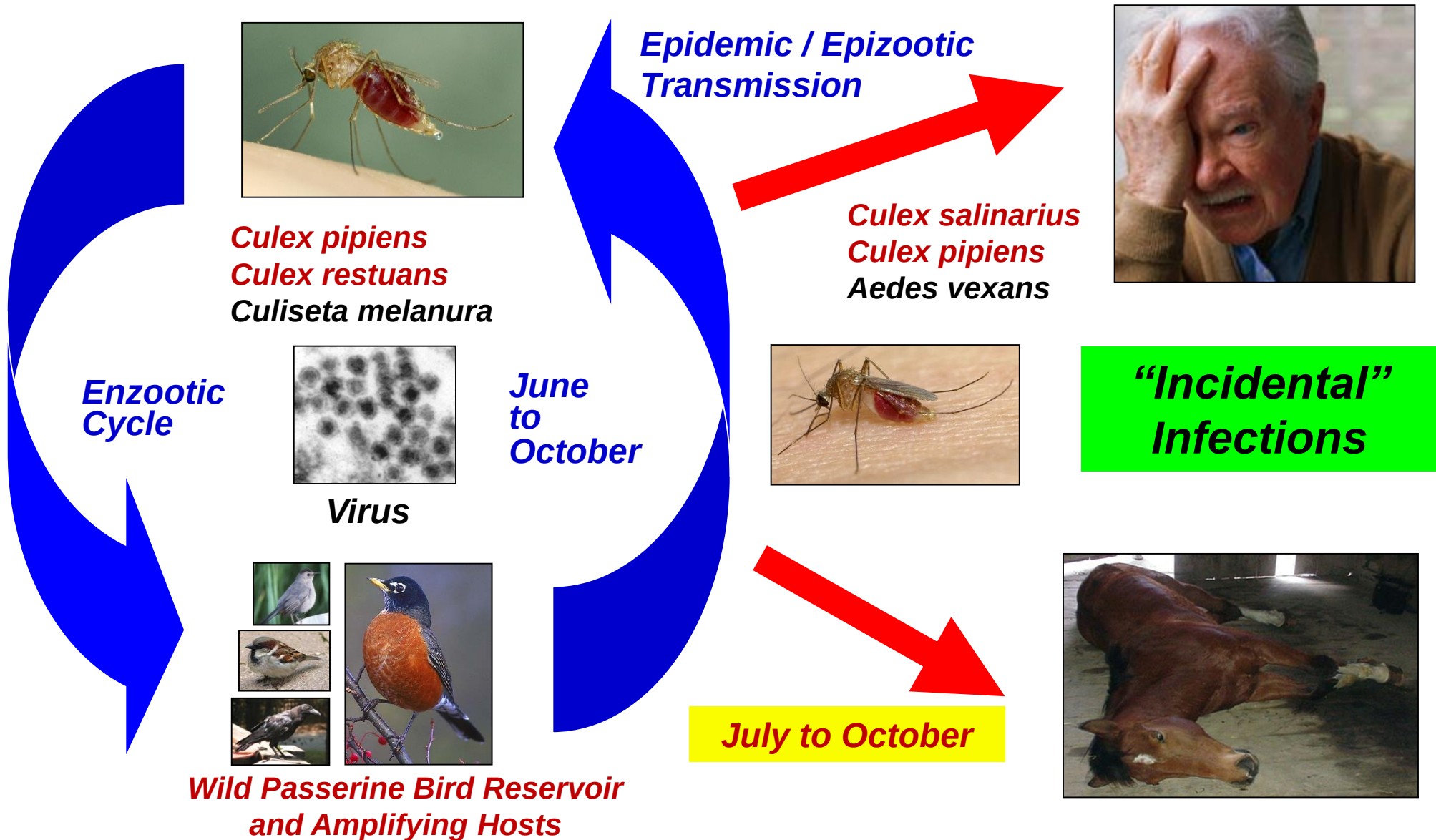
Species	Isolates
<i>Culiseta melanura</i>	344
<i>Ochlerotatus canadensis</i>	37
<i>Aedes cinereus</i>	20
<i>Aedes vexans</i>	19
<i>Uranotaenia sapphirina</i>	19
<i>Culex salinarius</i>	16
<i>Coquillettidia perturbans</i>	10
<i>Culex pipiens</i>	10
Other Species (11)	58
TOTAL	534



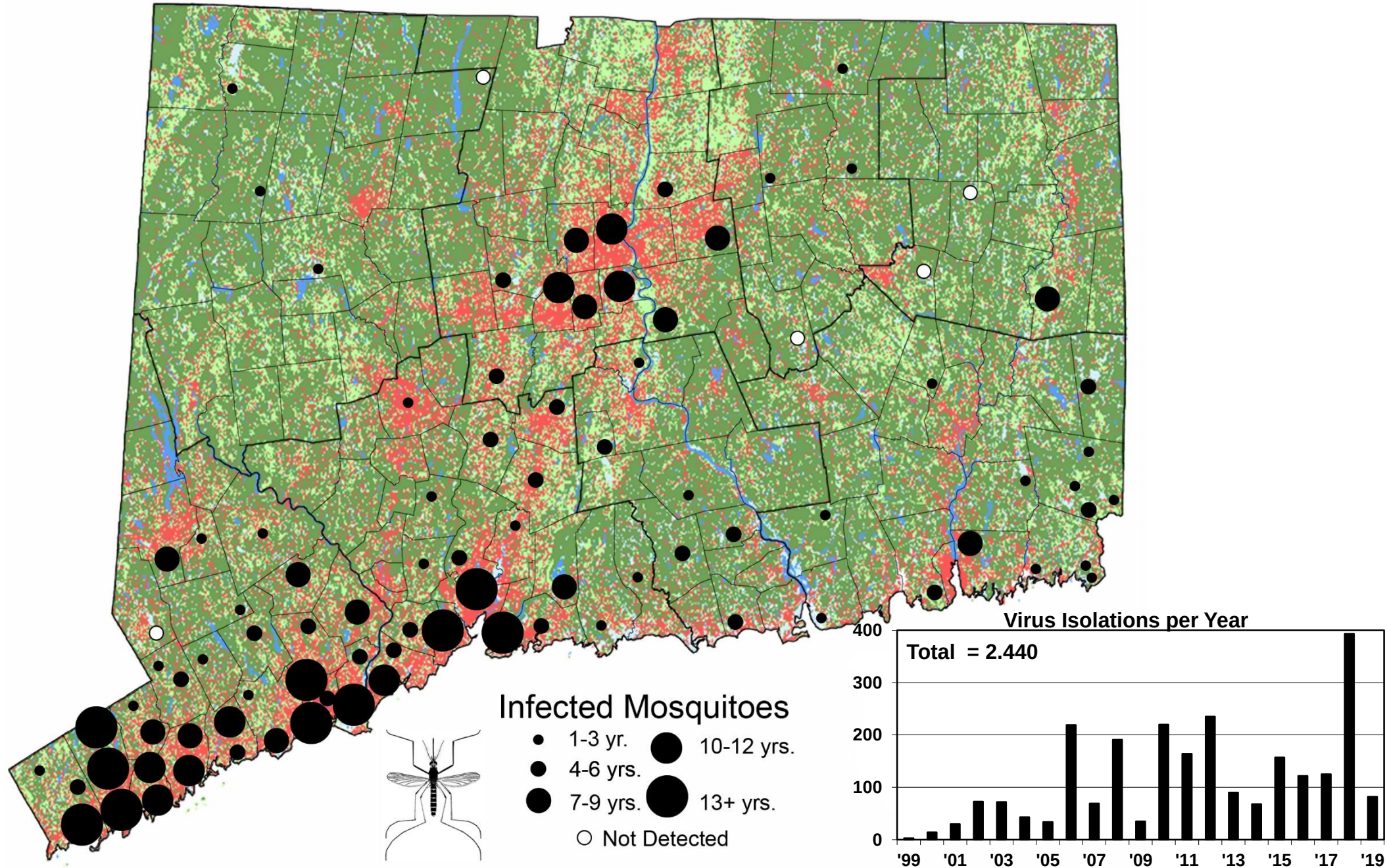
Northeastern US West Nile Virus Transmission Cycle



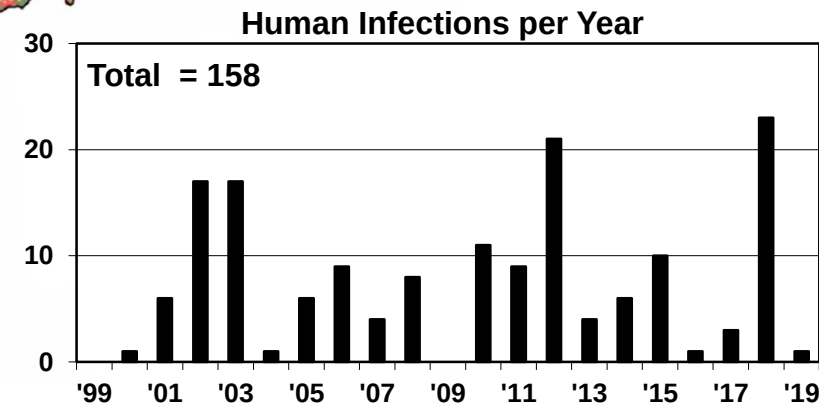
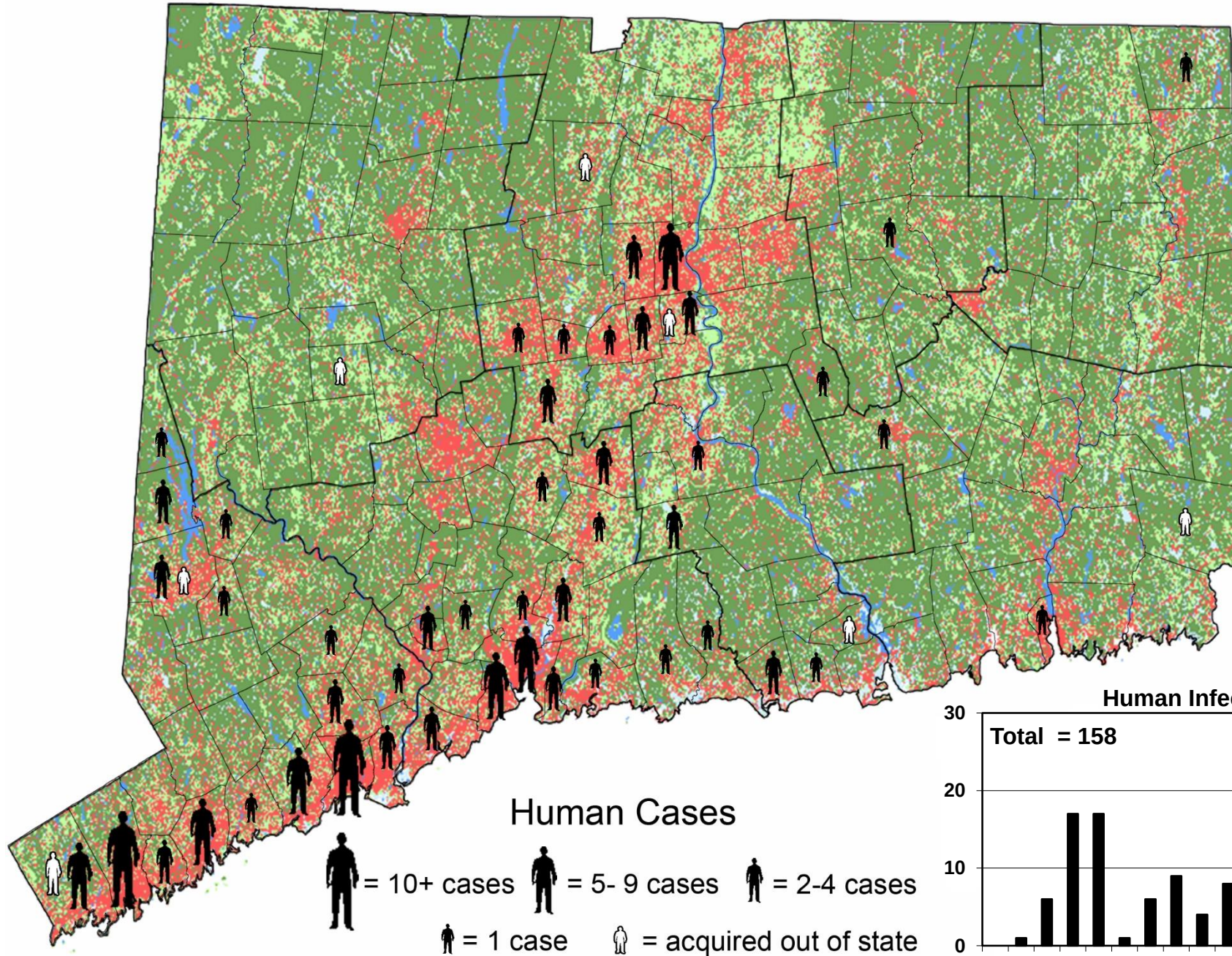
Northeastern US West Nile Virus Transmission Cycle



West Nile Virus Isolates from Mosquitoes, 1999-2019

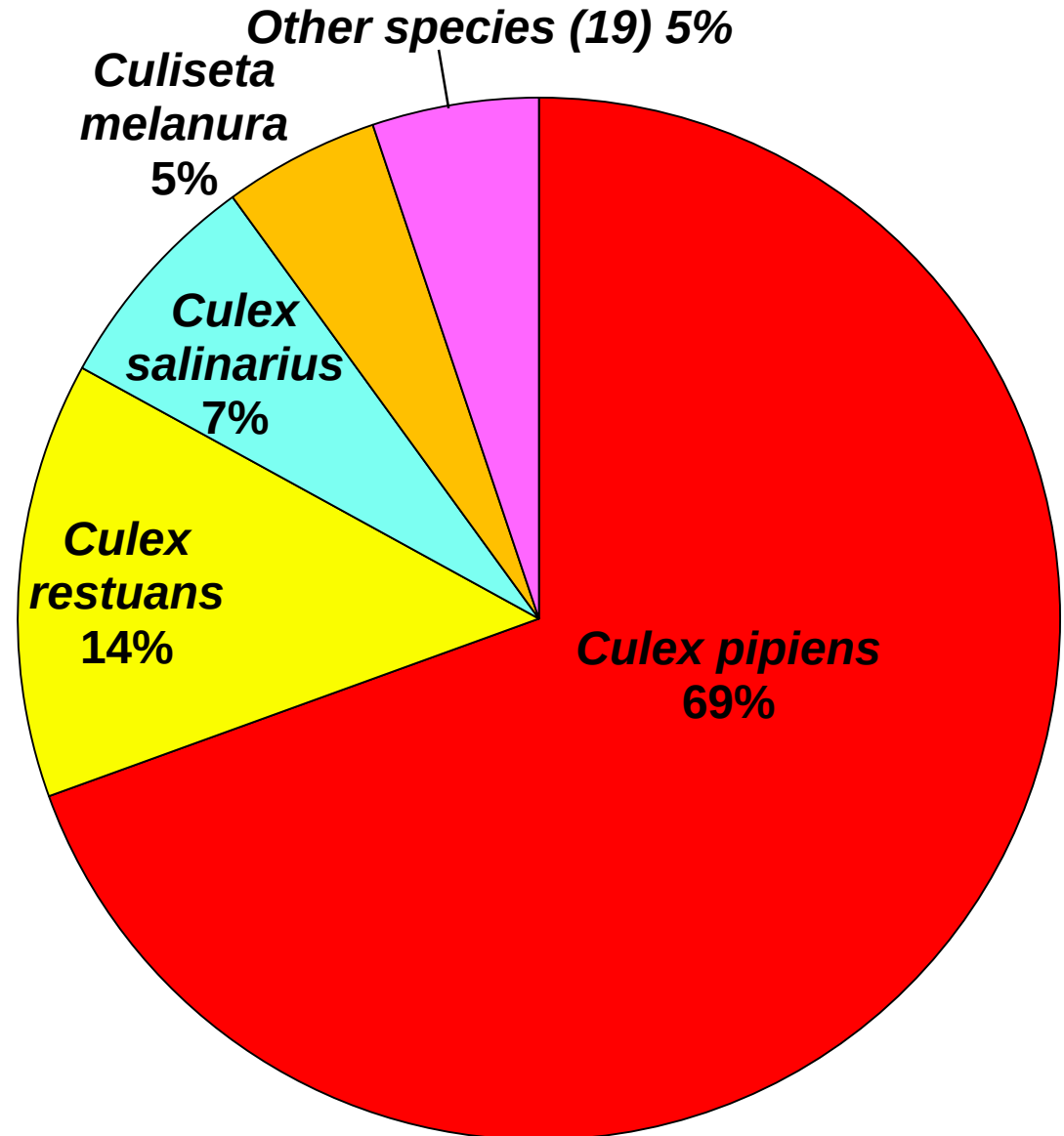


West Nile Virus Human Infections, 1999-2019

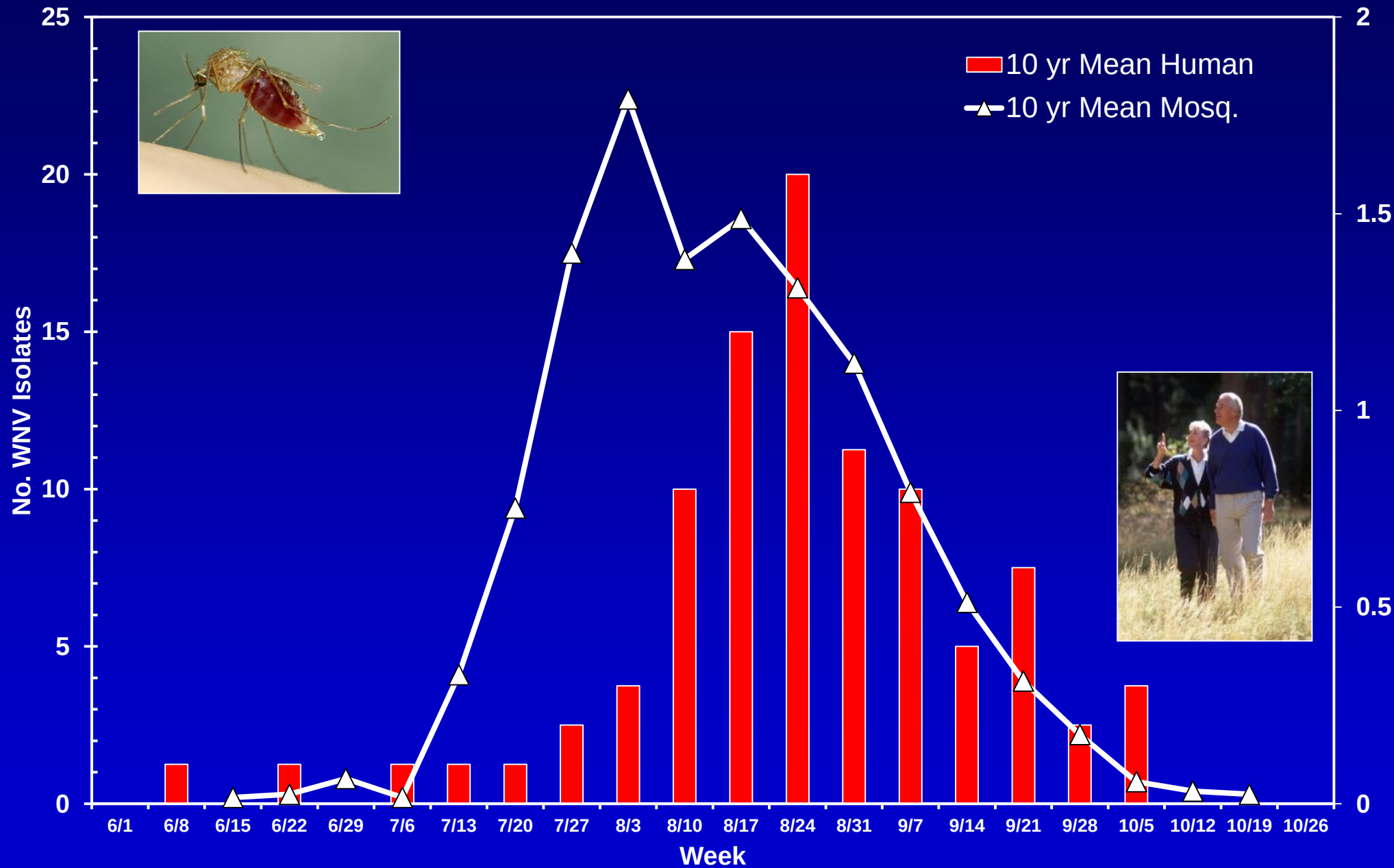


WNV Isolations from Mosquito Pools, CT 1999-2019

Species	Isolates
<i>Culex pipiens</i>	1,695
<i>Culex restuans</i>	341
<i>Culex salinarius</i>	171
<i>Culiseta melanura</i>	118
<i>Aedes vexans</i>	19
<i>Aedes cinereus</i>	13
<i>Coquillettidia perturbans</i>	14
<i>Ochlerotatus japonicus</i>	10
<i>Oc. canadensis</i>	12
<i>Oc. taeniorhynchus</i>	6
Other Species (14)	52
TOTAL	2,440



WNV Epidemic Curve



Jamestown Canyon Virus

Neurological illness in humans is rare

- 4-10% of the CT residents have antibody to the virus
- About ~1 case/year reported in US prior to 2013
- 181 human cases reported 2013-2018
 - Neuroinvasive cases in Northeast (CT, MA, ME, NH, NJ, NY, RI)c

Human Symptoms

- Mild
 - Flu-like
 - Fever, headache, fatigue
- Severe
 - Meningitis, encephalitis
- All ages affected

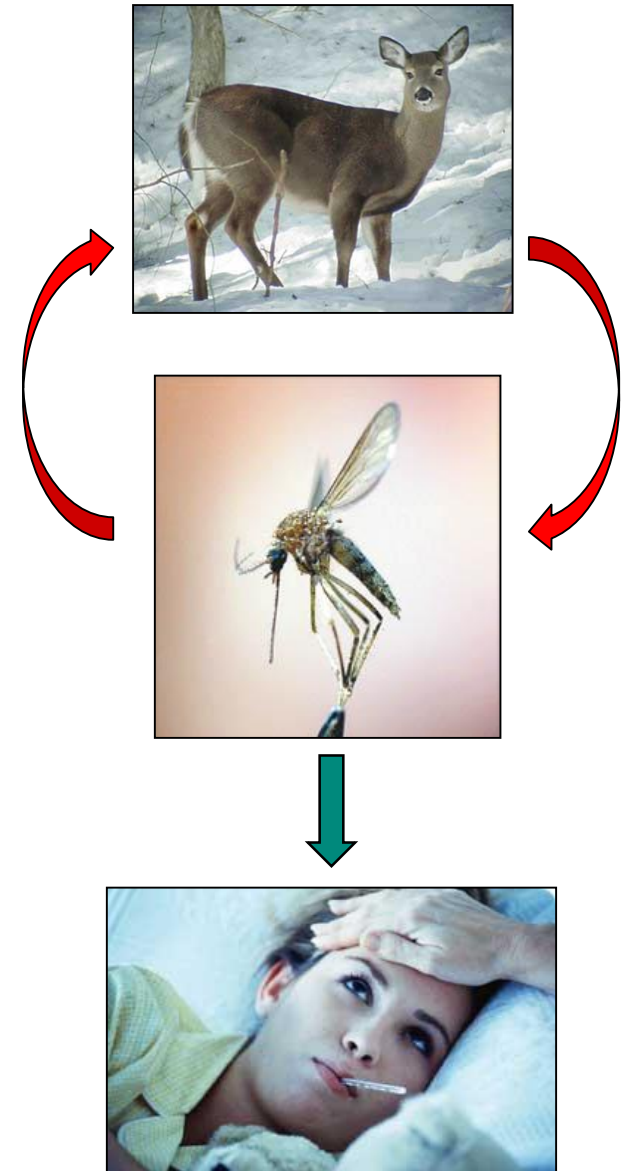


Human Case – CT, 2018

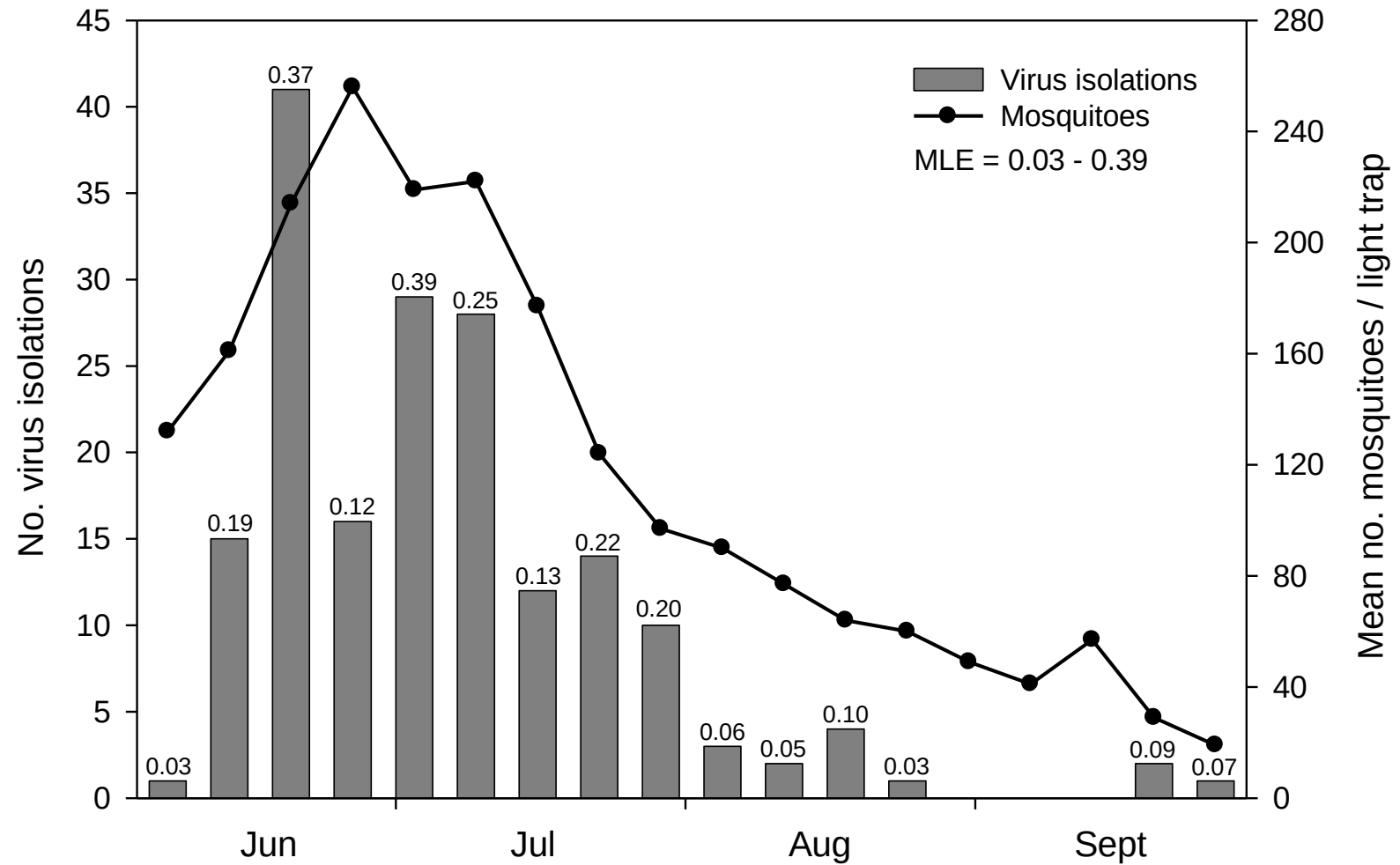
- Meningitis
- Bethlehem (Litchfield County)
- Onset of Symptoms on September 4th
- 1st CT case documented since 2001

Jamestown Canyon Virus

- **Enzootic Cycle between deer and mammal-biting mosquitoes**
 - Wide-spread distribution in CT (88 sites)
 - 557 isolates (1997-2019)
 - Higher prevalence in June & July
 - 25 species
 - “Snow-pool” *Ochlerotaus*, *Aedes* species
- **23 Virus Isolations – CT, 2019**
 - 15 sites in 15 towns
 - June 4th – September 9th
 - 9 species



Weekly Jamestown Canyon Virus Isolations from Mosquitoes



Acknowledgements

The Connecticut Agricultural Experiment Station

Mosquito Collection and Identification

John Shepard
Tanya Petruff

Virus Isolation and Identification (BSL-3)

Angela Bransfield
Michael Misencik

Station Director

Dr. Theodore Andreadis

Seasonal Staff

Catherine Cleary	Noelle Khalil
Caroline Cullen	Alyssa Marini
Will Cutrone	Joey Miller
Andrew Donnellycolt	Anthony Perugini
Patrick Daly	Mike Olson
Ron Ferrucci	Demi Rodriguez
Aiden Florio	Bill Sennett
Joshua Stumpf	

CT Department of Public Health

Dr. Matthew Cartter
Dr. Jocelyn Mullins
Brenda Esponda-Morrison

CT Department of Agriculture

Dr. Mary Jane Lis

CT Dept. of Energy & Environmental Protection

Roger Wolfe
Steve Rosa

U.S. Navy, Groton Sub Base

HM3 Ervin Jimenez
HM3 Hunter Baughman
HM1 James Limer



Questions?

Philip Armstrong

***Connecticut Mosquito and Arbovirus Surveillance Program
The Connecticut Agricultural Experiment Station
New Haven, CT***

Philip.Armstrong@ct.gov

203-974-8510

Mosquito Surveillance: www.portal.ct.gov/caes

Mosquito Management Program: www.portal.ct.gov/mosquito