Mosquitoes and Zika Virus: Assessing the Threat

Dr. Philip M. Armstrong

Department of Environmental Sciences

Center for Vector Biology & Zoonotic Diseases

The Connecticut Agricultural Experiment Station

New Haven, CT

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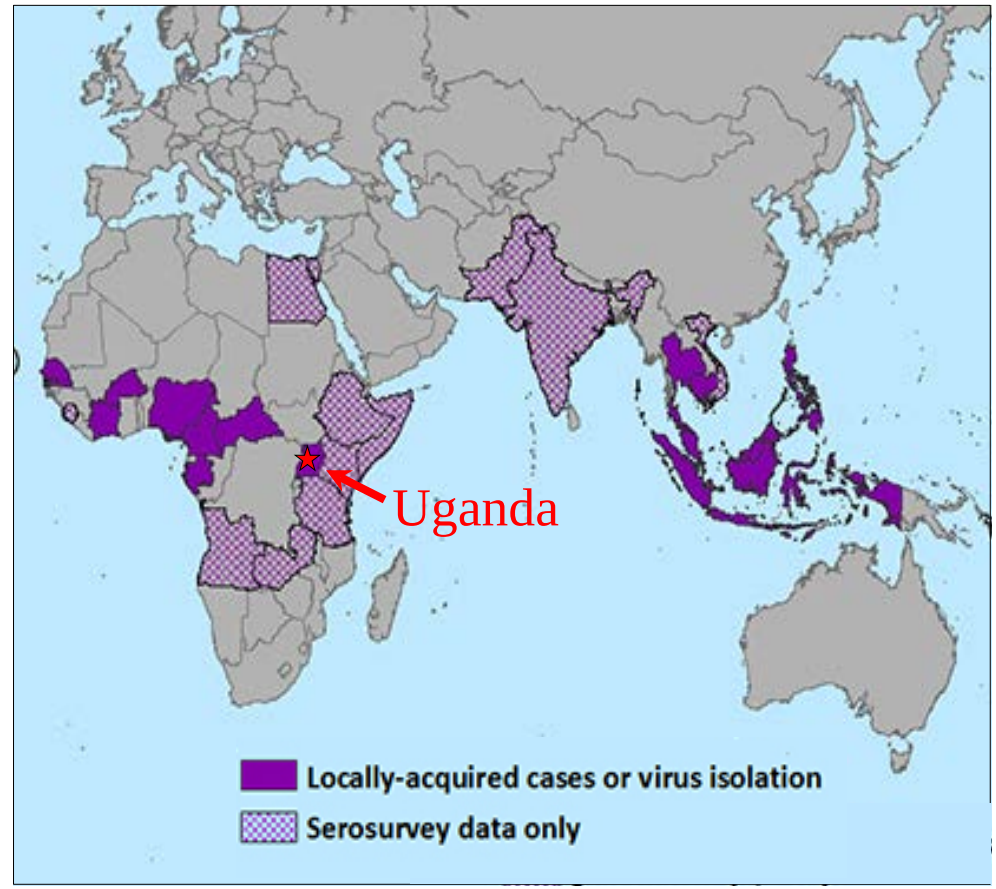
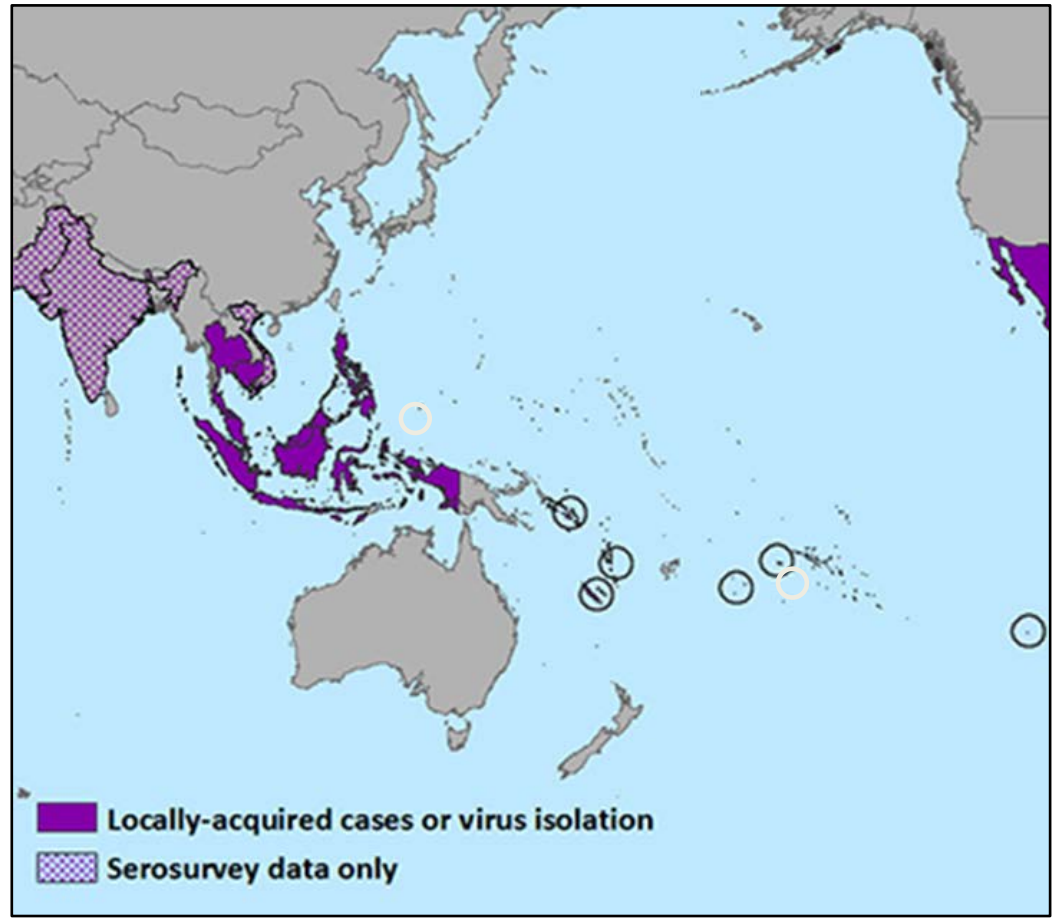
Origins of Zika Virus

- Zika virus discovered in Kampala, Uganda in 1947
  - Isolated from monkeys and mosquitoes
- First human case identified in Nigeria, Africa in 1954
- Zika virus documented in other African and Asian countries (1951-1981)
- Considered a rare and benign disease
  - <20 documented human cases
  - Fever and rash



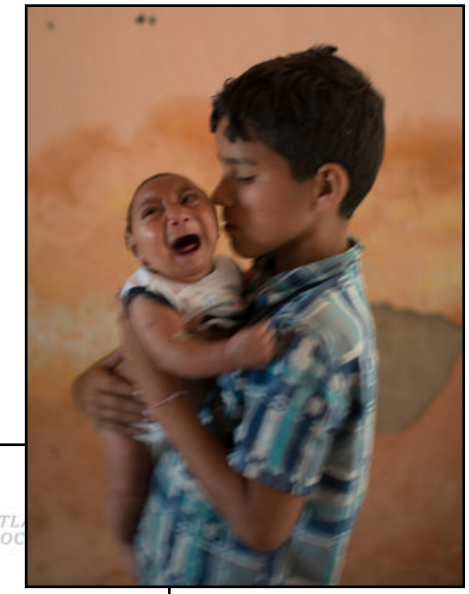
Zika Virus Spreads to the Pacific Islands

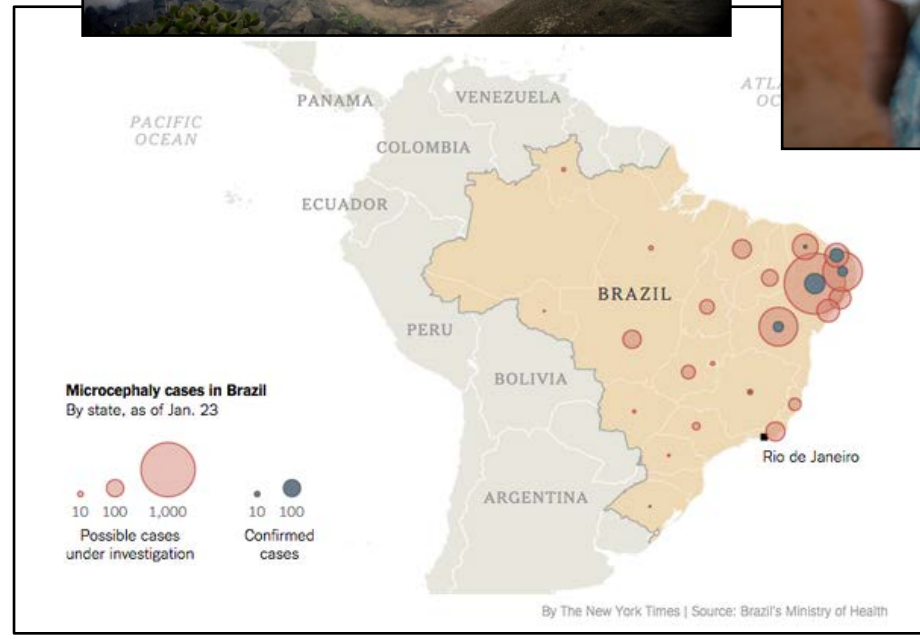
- Large outbreak on Yap Island, Micronesia in 2007
  - 75% of residents infected
- Virus spreads to more Pacific Islands
  - French Polynesia 2013
    - 30,000 human cases
    - Neurological complications in small percentage of cases
  - New Caledonia, Cook Island, and Easter Island 2014
  - Vanuatu, Solomon Islands, Samoa, and Fiji 2015



Zika Virus Epidemic in Brazil

- First documented cases in the Western Hemisphere in May 2015
- Epicenter in Recife Brazil
- Virus was most similar to strains circulating in the French Polynesia in 2013
- More than 20-fold rise of newborns born with microcephaly during the past year
- Estimated 1.5 million cases



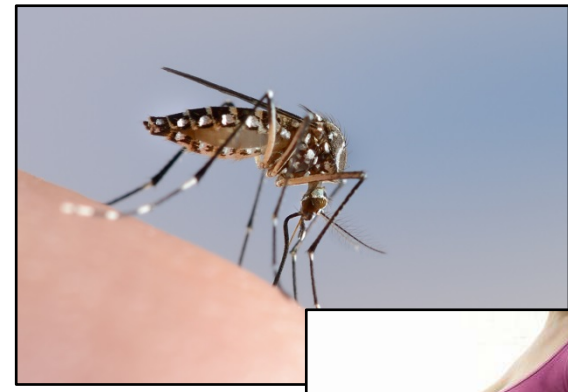


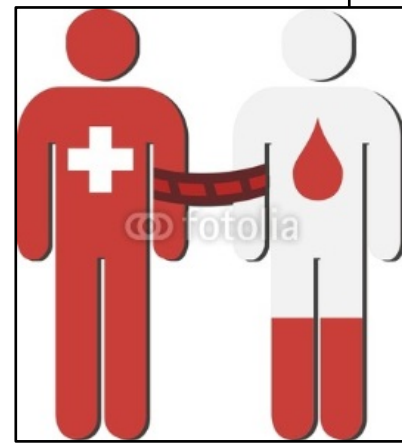
Zika Virus Spread in the Americas

- Virus spreads throughout Latin America and the Caribbean 2015-present
- Active transmission documented in 41 countries or territories.
- Zika virus infection documented in travelers returning to the U.S.

Zika Virus Transmission Modes

- Infectious mosquito bites
  - Vast majority of Zika infections acquired by mosquito bite
- Congenital infection by infected mothers
  - Virus crosses the placenta to infect the fetus
  - Microcephaly when virus attacks fetal nerve cells
- Blood transfusion from asymptomatic Zika infected blood donors
- Sexual transmission of Zika virus
  - Primarily by infected men to their partners





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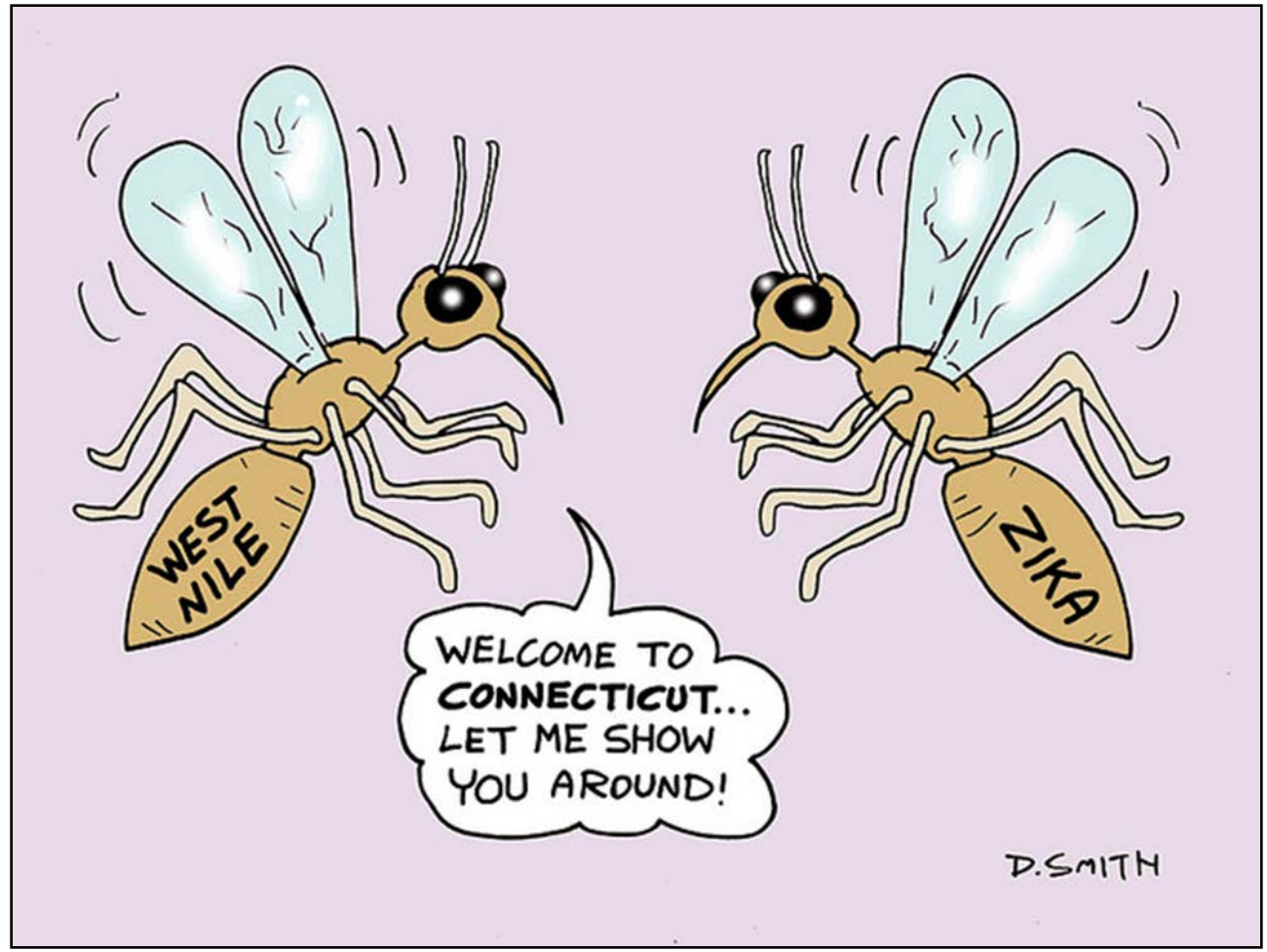
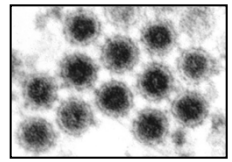


Transmission Cycles

Enzootic or Sylvatic Cycle

Enzootic Vector

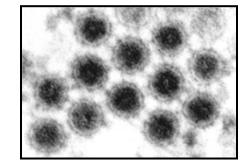


Virus

Enzootic Host

Epidemic Cycle or Urban Cycle

Human Host



Virus

Epidemic Vector

Mosquito vectors

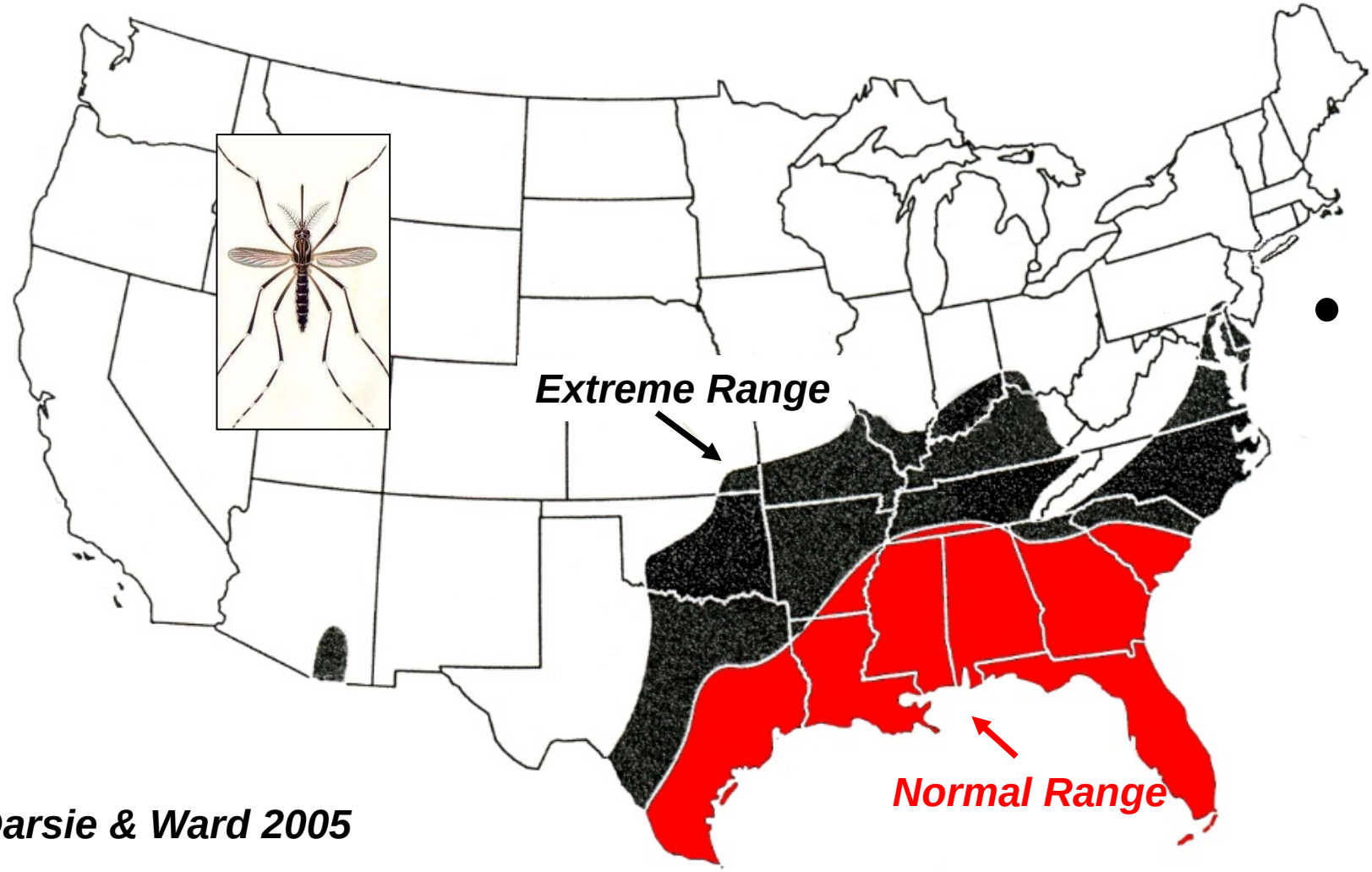
Yellow fever mosquito
(*Aedes aegypti)*

Asian Tiger Mosquito
(*Aedes albopictus)*

Aedes aegypti

- Primary urban vector of Dengue, Yellow Fever, Chikungunya, and Zika viruses
- Originated from sub-Saharan Africa
- Introduced into the Americas during the trans-Atlantic Slave trade during 15-17th centuries
- Currently has global distribution in tropical and subtropical regions
- Closely Associated with Humans
  - Eggs and larvae develop in artificial containers
  - Adults rest inside houses
  - Feed frequently and almost exclusively on human blood

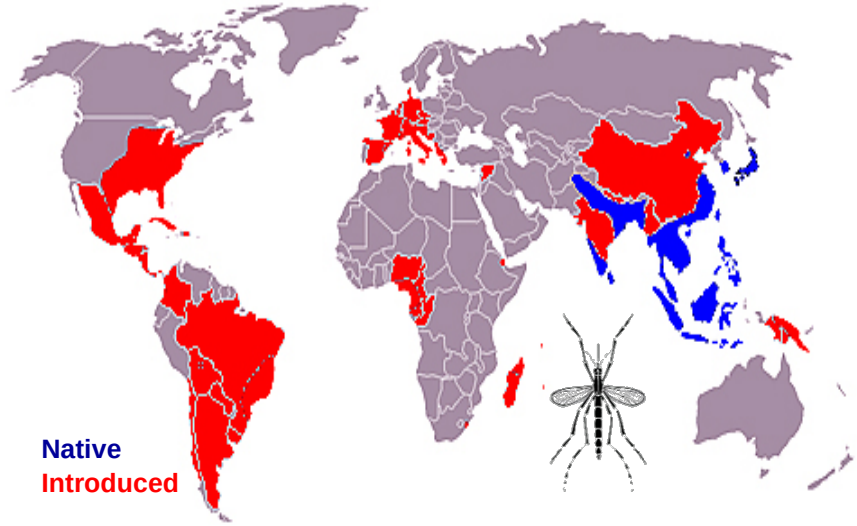
Distribution of *Aedes aegypti* in the U.S.

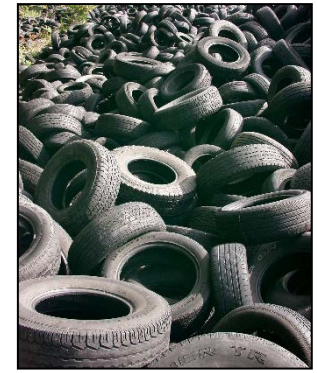


Darsie & Ward 2005

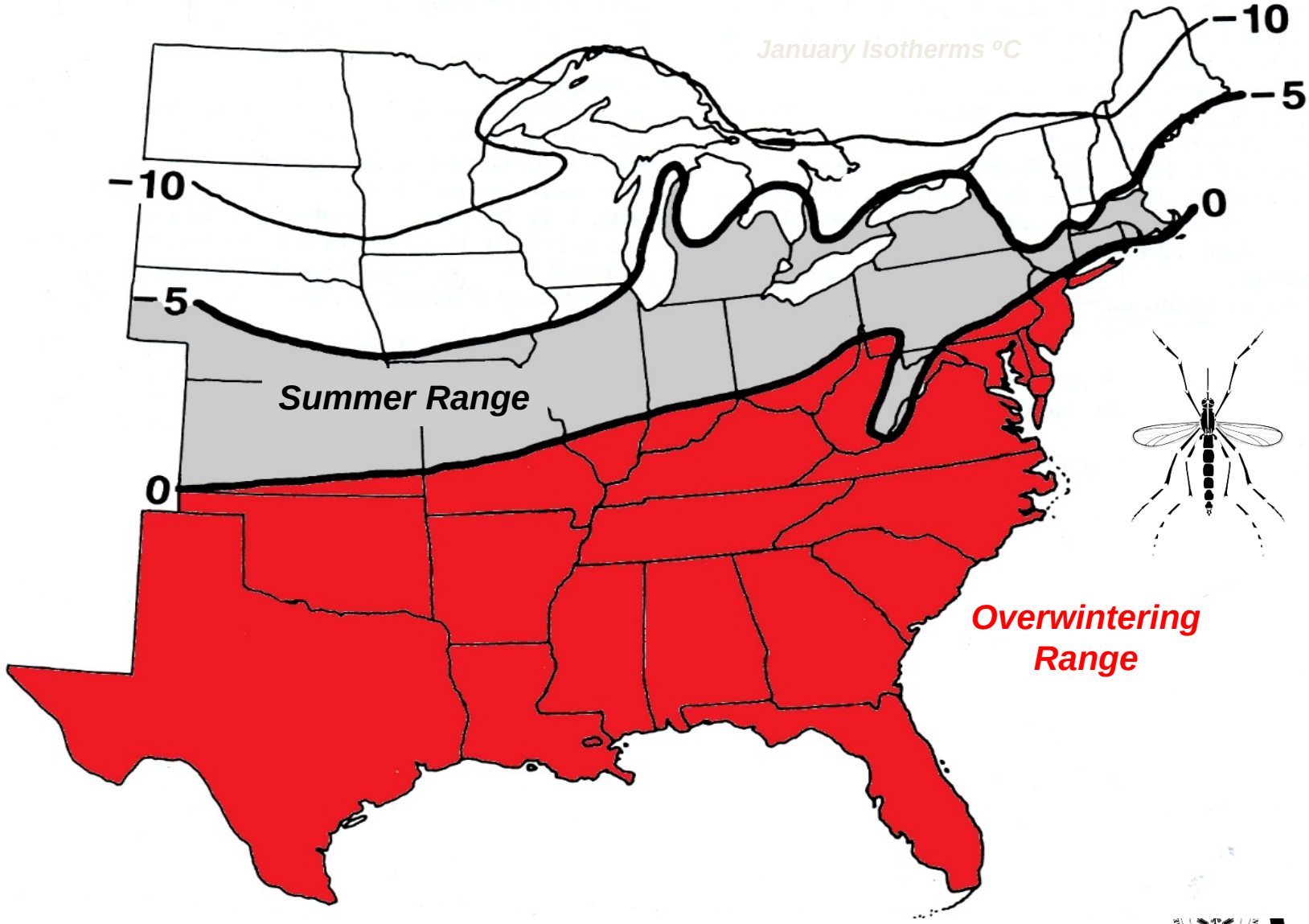
Aedes albopictus

- Most invasive mosquito in the world
- Native to SE Asia, has spread to > 50 countries over last 3 decades
  - Introduced into the U.S. in 1985
- Spread primarily in used tires and “lucky bamboo” plants
- Tolerates colder temperatures compared to *Aedes aegypti*
- Diverse habitats- rural, suburban, urban
- Breeds in artificial containers and tree holes
- Human biter but also feeds on other domestic and wild animals

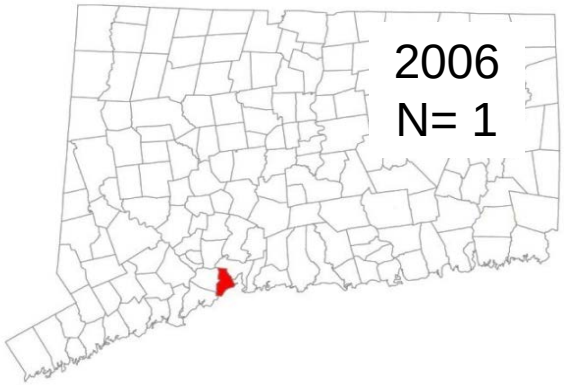


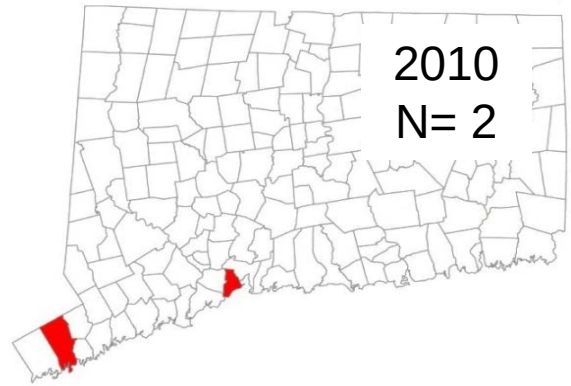


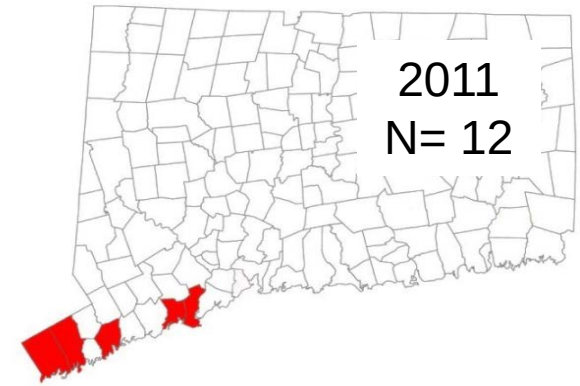
Distribution of *Aedes albopictus* in the U.S.

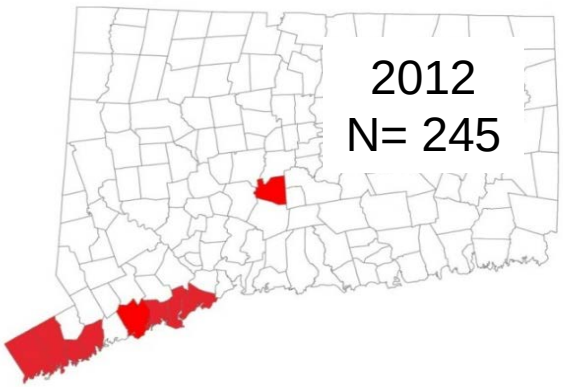


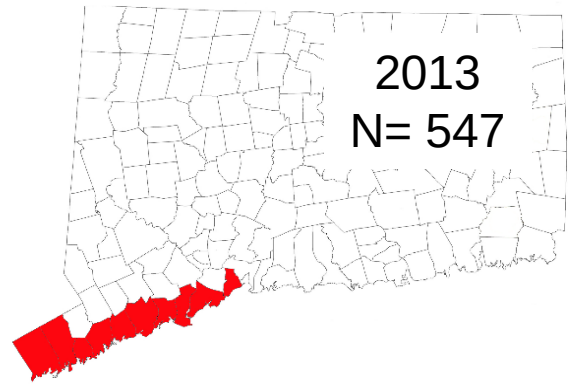
Distribution of the Asian Tiger Mosquito *Aedes albopictus* in Connecticut

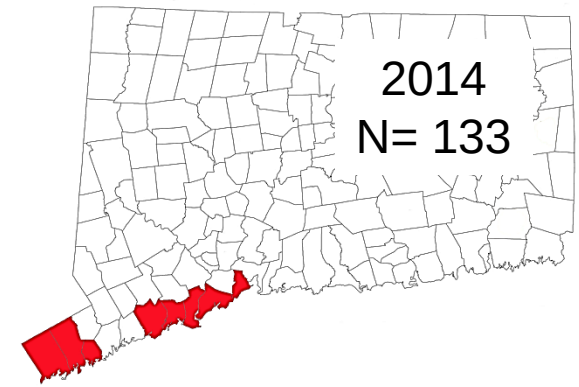


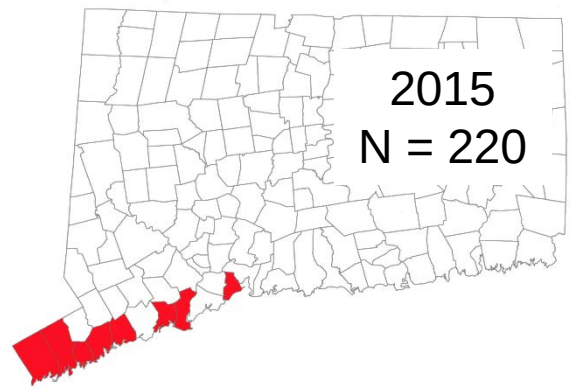












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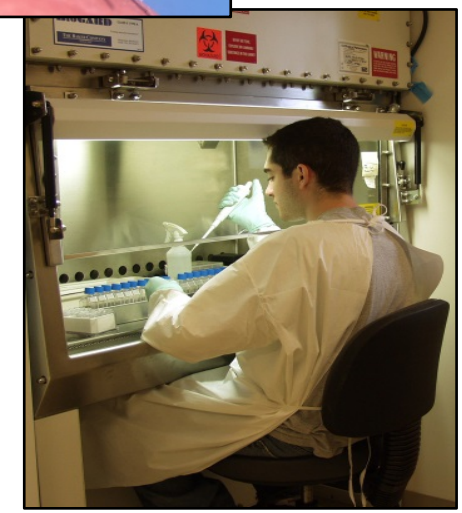
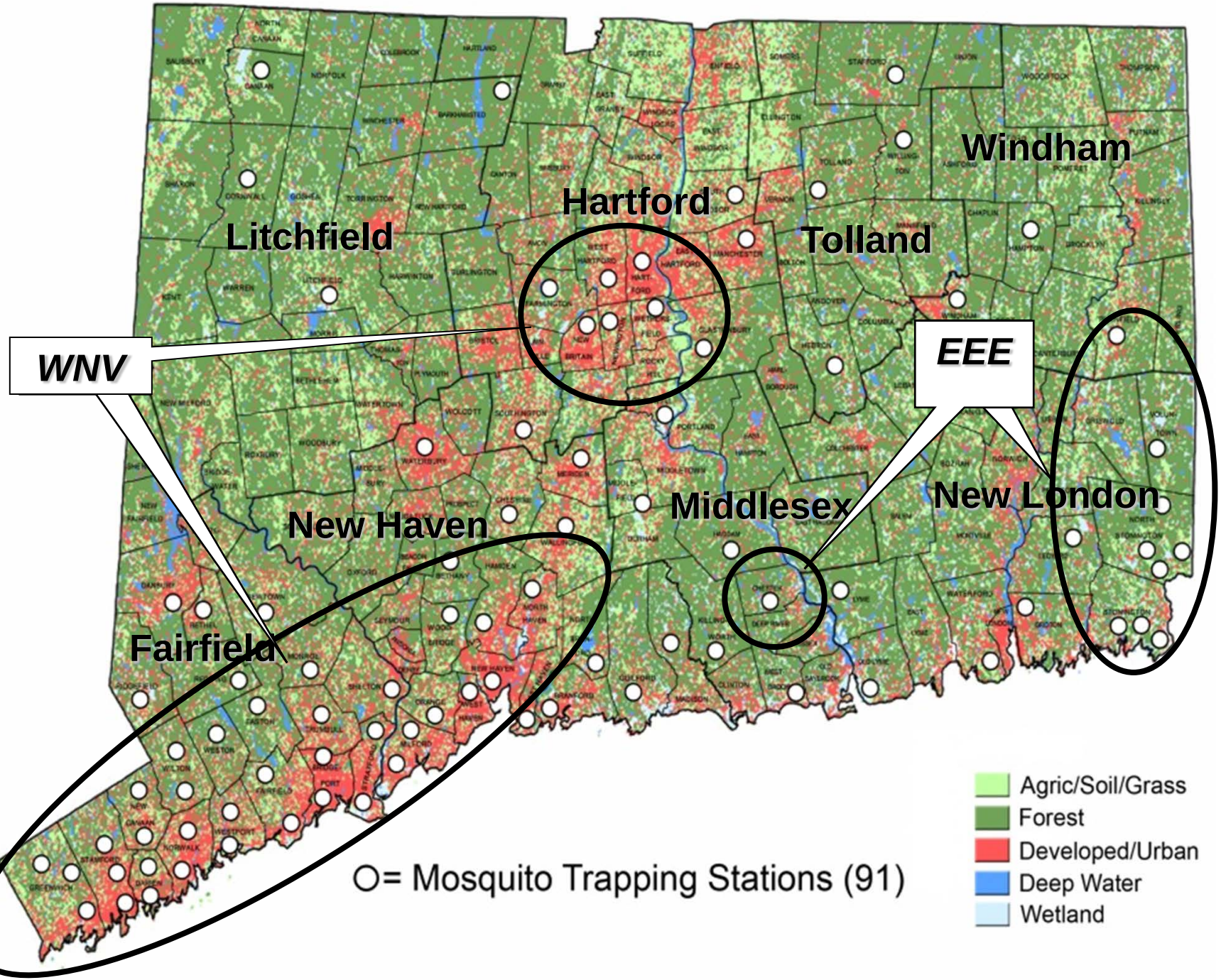
Connecticut Mosquito Monitoring Program

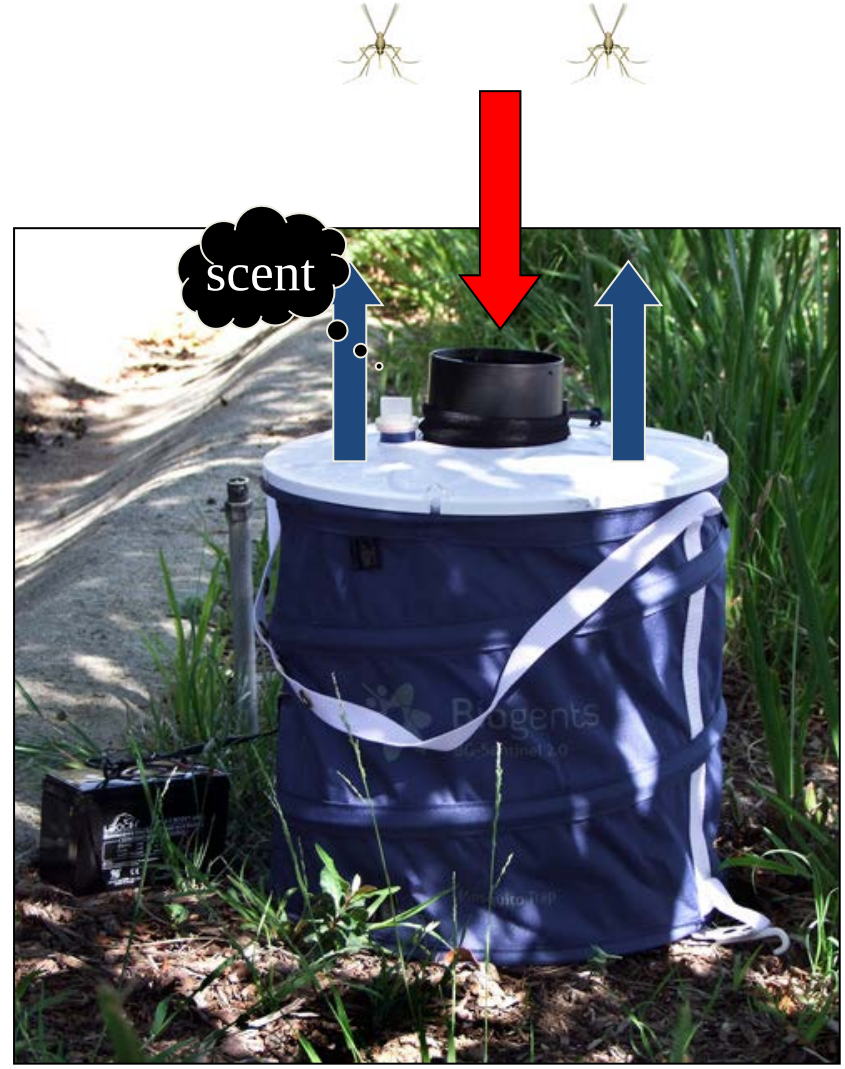
- Mosquito trapping June-October
- 91 trapping stations
  - Two types of mosquito traps- light and gravid traps
- Mosquitoes sorted and identified to species level
  - 50 mosquito species in CT
- Mosquitoes tested for virus infection in high-containment BSL-3 lab
- Information on virus-infected mosquitoes:
  - Early warning system
  - Assess risk of human infection
  - Guide mosquito control and disease prevention efforts




Windham
Hartford
Litchfield
Tolland
WNV
EEE
New London
Middlesex
New Haven
Fairfield
O= Mosquito Trapping Stations (91)
Agric/Soil/Grass
Forest
Developed/Urban
Deep Water
Wetland

Enhanced Mosquito Surveillance for Zika Virus

- Added BG Sentinel Traps
  - Placed in locations with appropriate habitat
- Designed for *Ae. albopictus*
  - Used at sites to evaluate population size
  - Baited with Human Scent Lure
- All mosquitoes tested for Zika virus in addition to EEE and West Nile viruses



Zika Virus: Assessing the Threat

The virus is spreading uncontrolled in the Latin America and the Caribbean

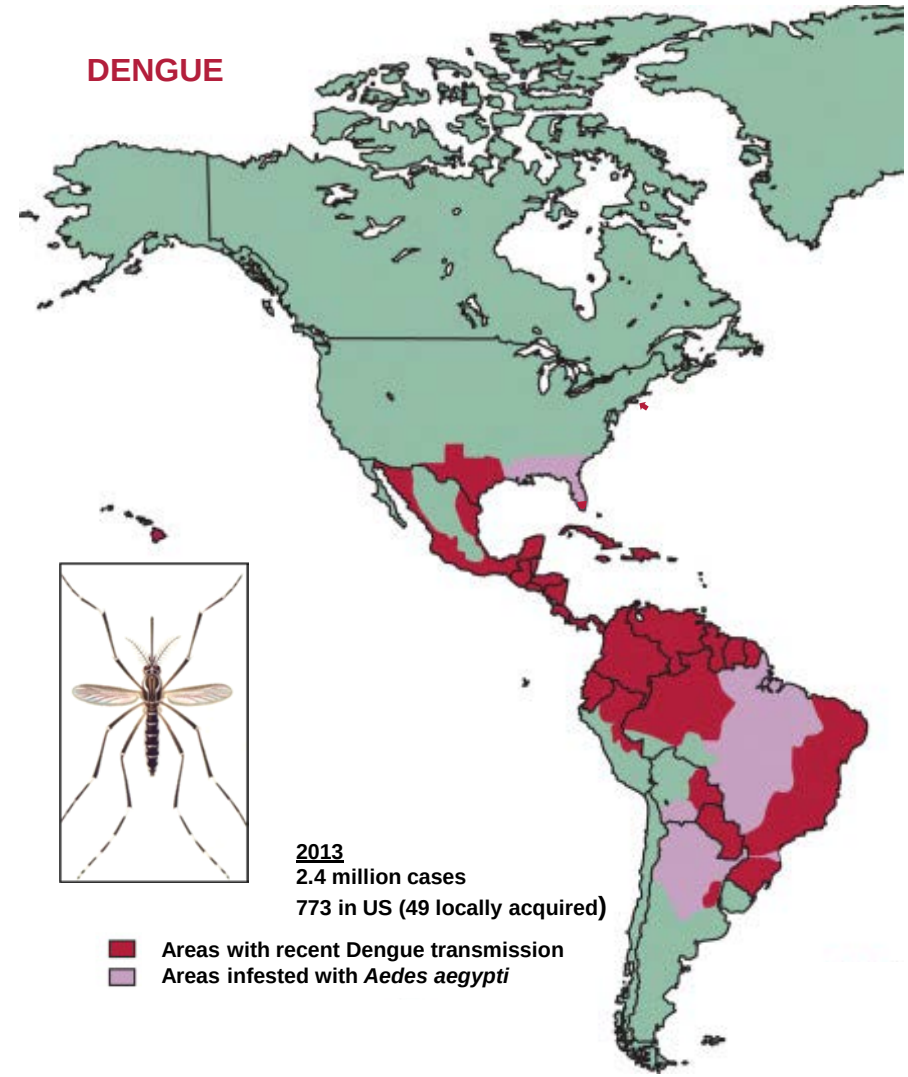
Will likely spread throughout the Americas wherever *Ae. aegypti* occurs similar to Dengue and Chikungunya viruses

Most of the population is naïve, setting the stage for major epidemics: hundreds of millions of people at risk

There could be potential for the virus to establish an enzootic monkey – human cycle as occurred with Yellow Fever

No vaccine is currently available

Prospects for control in Latin and South America are not good!



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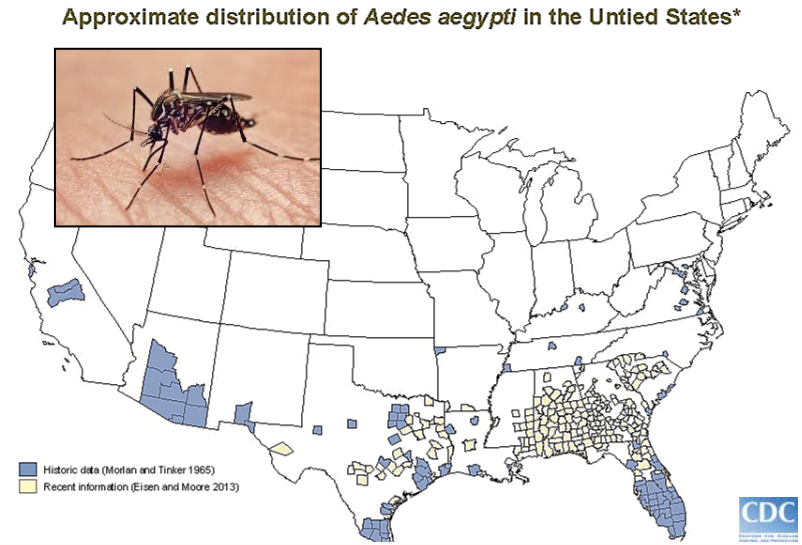
Zika Virus: Assessing the Threat in the U.S.

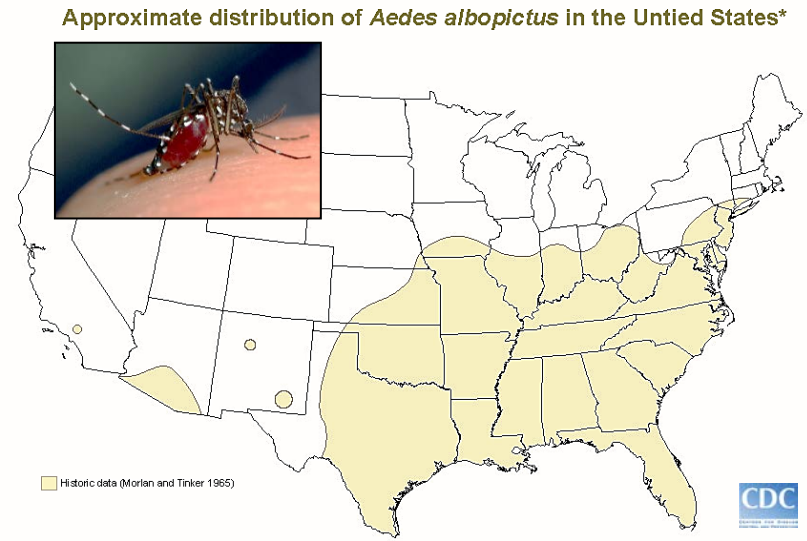
Most mosquito-mediated transmission in the U.S. will likely occur via *Ae. aegypti* which should limit geographic spread

The capacity for *Ae. albopictus* to transmit Zika virus provides potential for local transmission in the continental US where *Ae. albopictus* is common

Don't know what role *Ae. albopictus* will play in spreading the virus in more temperate regions

The ability of other U.S. mosquito species to transmit virus is unknown





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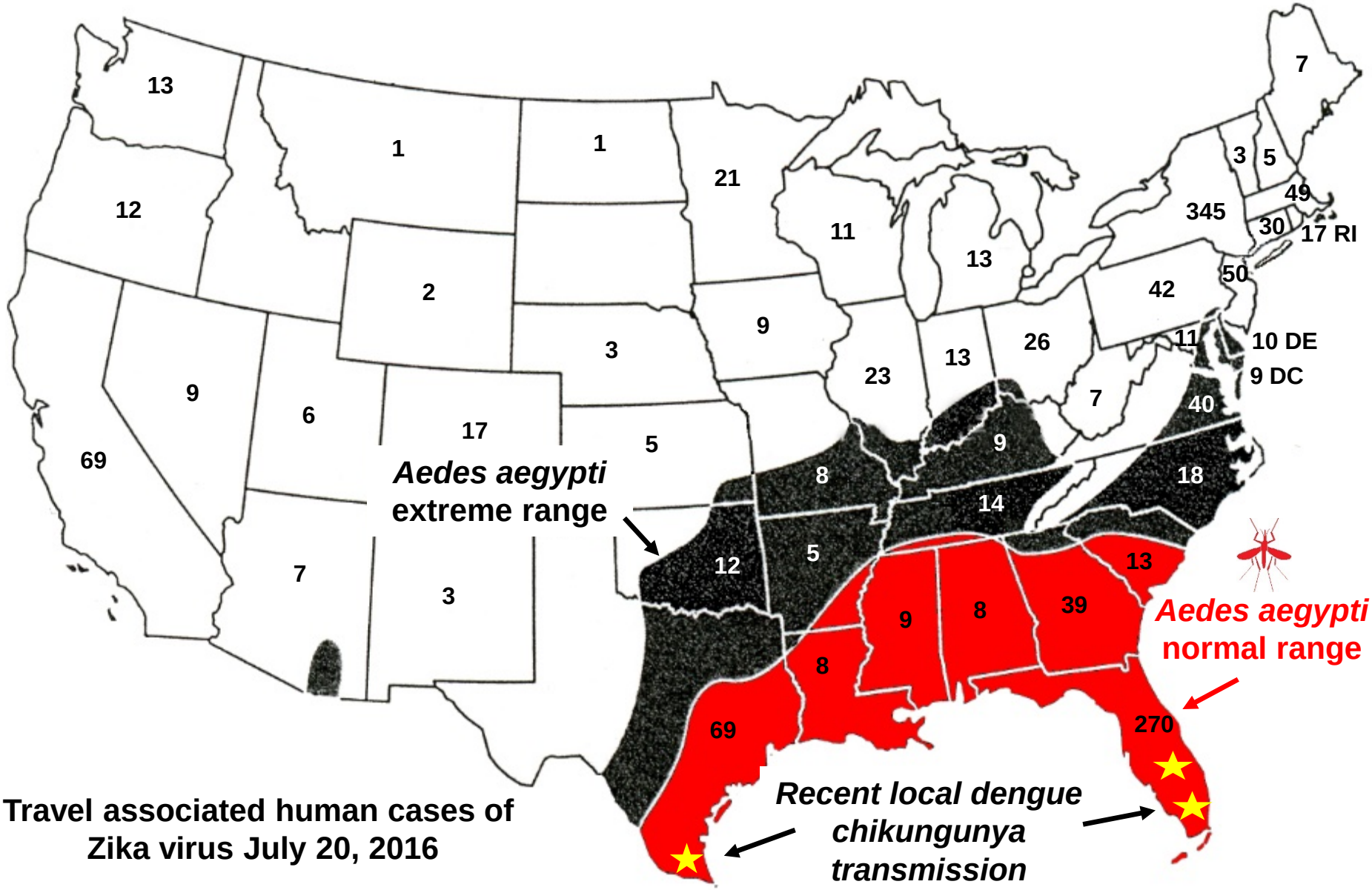

Travel associated human cases of Zika virus July 20, 2016

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Questions?

Dr. Philip Armstrong
Department of Environmental Sciences
123 Huntington St.
P.O. Box 1106
New Haven, CT 06504

Phone: 203-974-8510
Email: Philip.Armstrong@ct.gov
Websites: www.ct.gov/caes/mosquitotesting
www.ct.gov/mosquito