

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

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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

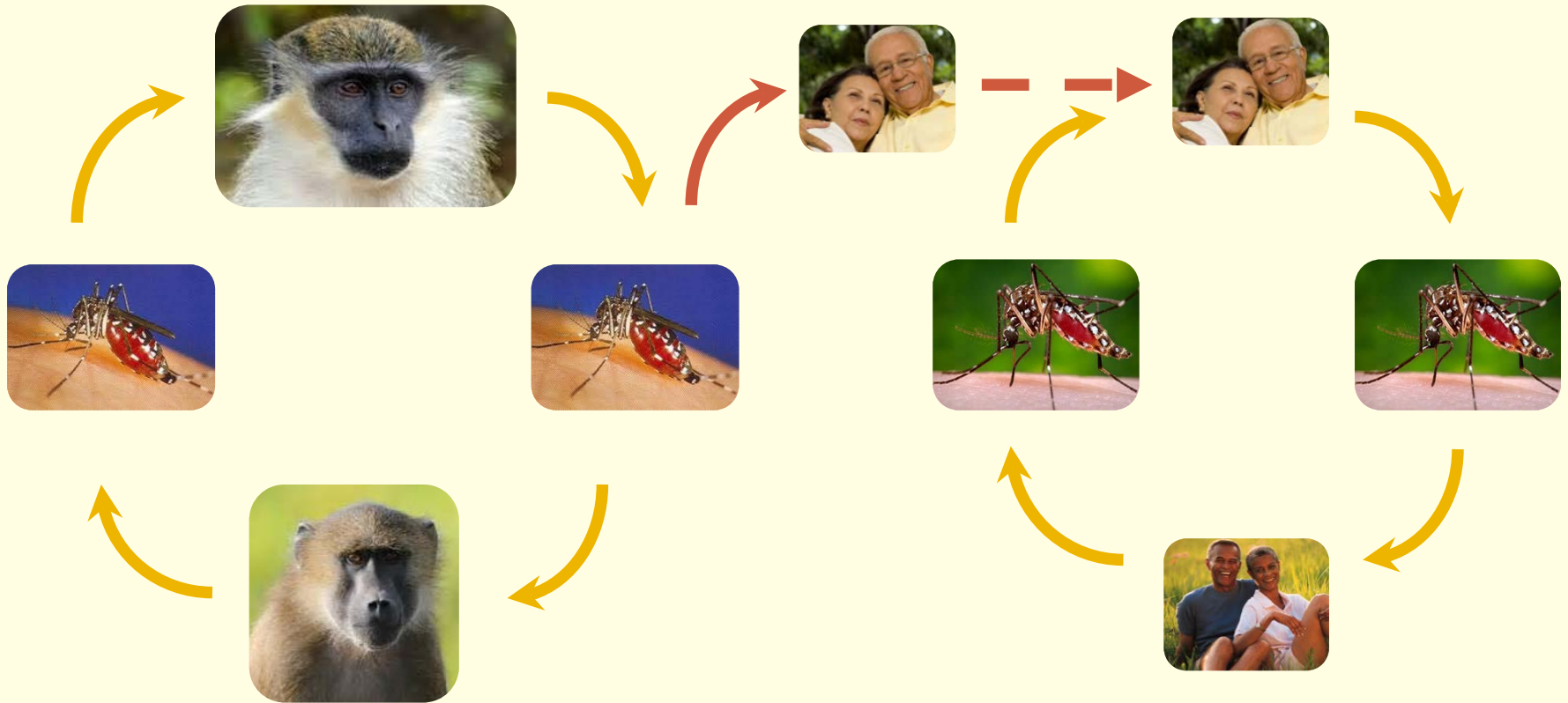
- **New mosquito species state records for West Virginia:**
 - *Aedes dorsalis*
 - *Aedes tormentor*
 - *Anopheles walkeri*
 - *Psorophora horrida*
 - *Psorophora howardii*
- Update in Harrison, B. *et al.* 2016. Mosquitoes of the Mid-Atlantic Region: An Identification Guide. Mosquito and Vector-borne Infectious Diseases Laboratory Publication 2016-1, Western Carolina University, Cullowhee, North Carolina, 201 pp.
- Dotseth, E. J. & B. A. Harrison. 2016. West Virginia mosquitoes: Sequential list by publication, newly found species, corrections, and notes for earlier records. *Journal of the American Mosquito Control Association* 32 (3): 240-243.



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.



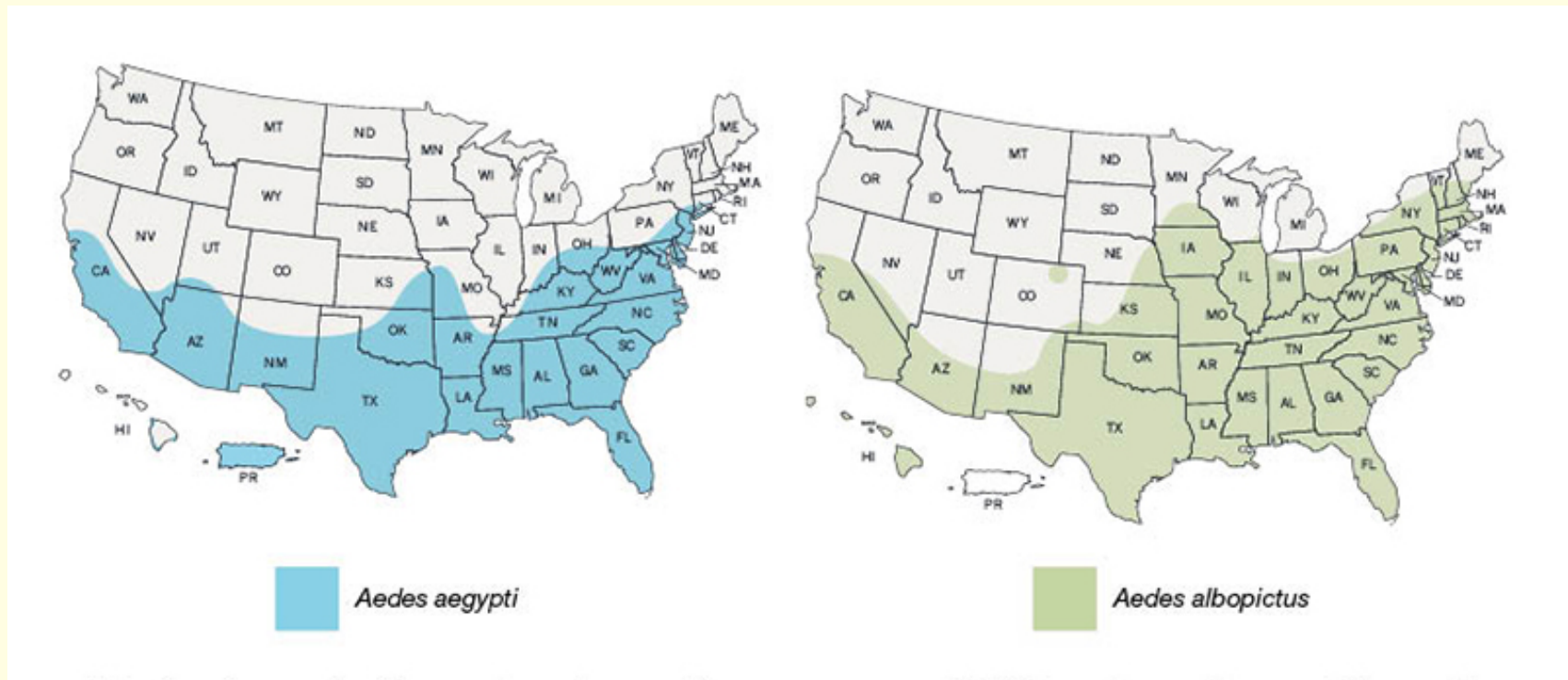
Aedes aegypti



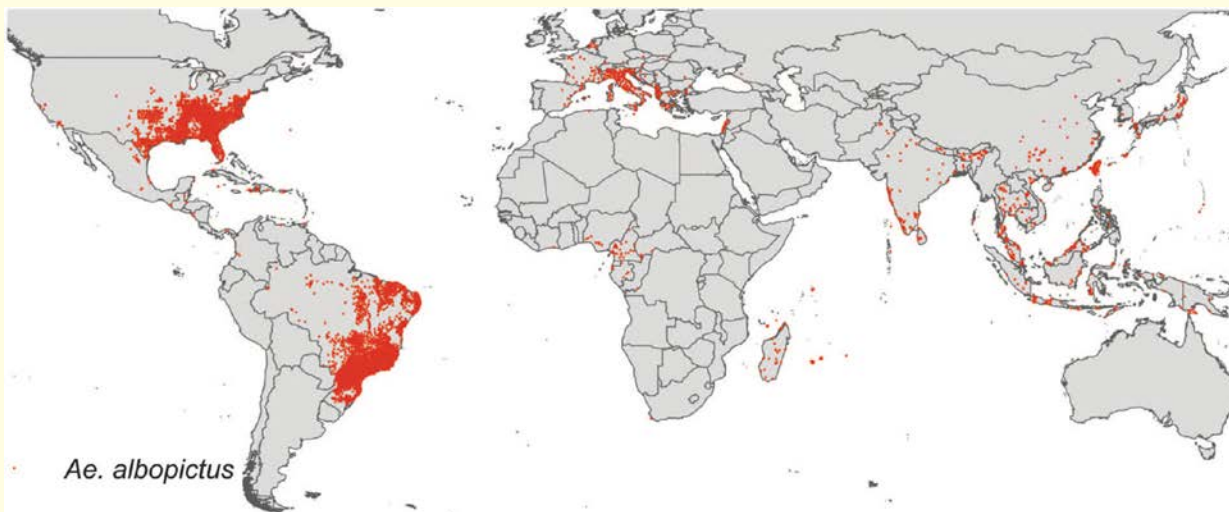
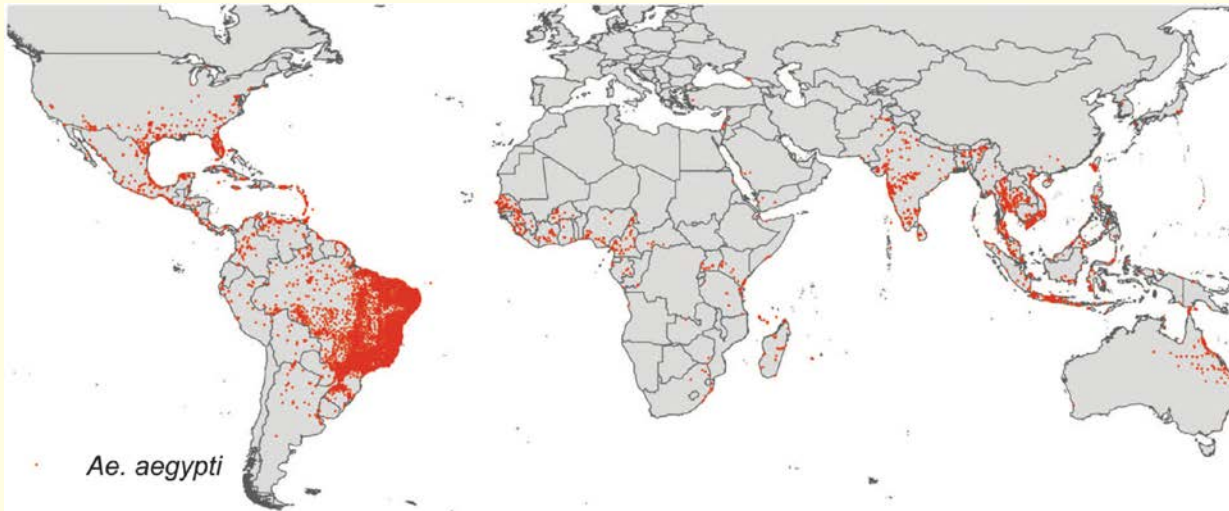
Aedes albopictus

Zika Virus Mosquito Vector Distribution

Estimated range of *Aedes aegypti* and *Aedes albopictus* in the United States, 2016



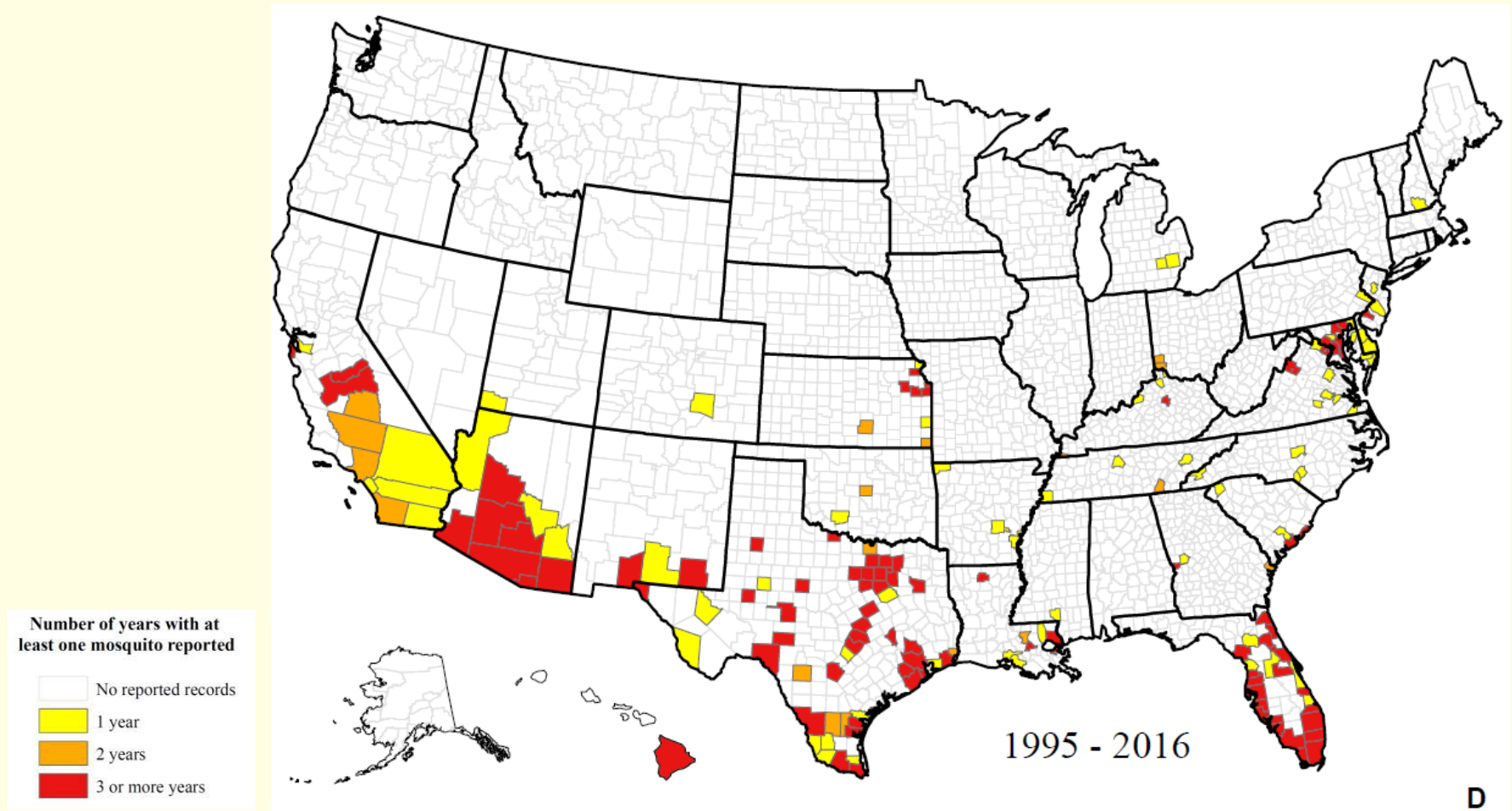
Zika Virus Mosquito Vector Distribution (cont.'d)



Kramer, M. U. G. *et al.* 2015. The global occurrence of *Aedes aegypti* and *Ae. albopictus* occurrence. *Scientific Data* 2: 150035.

Zika Virus Mosquito Vector Distribution (cont.'d)

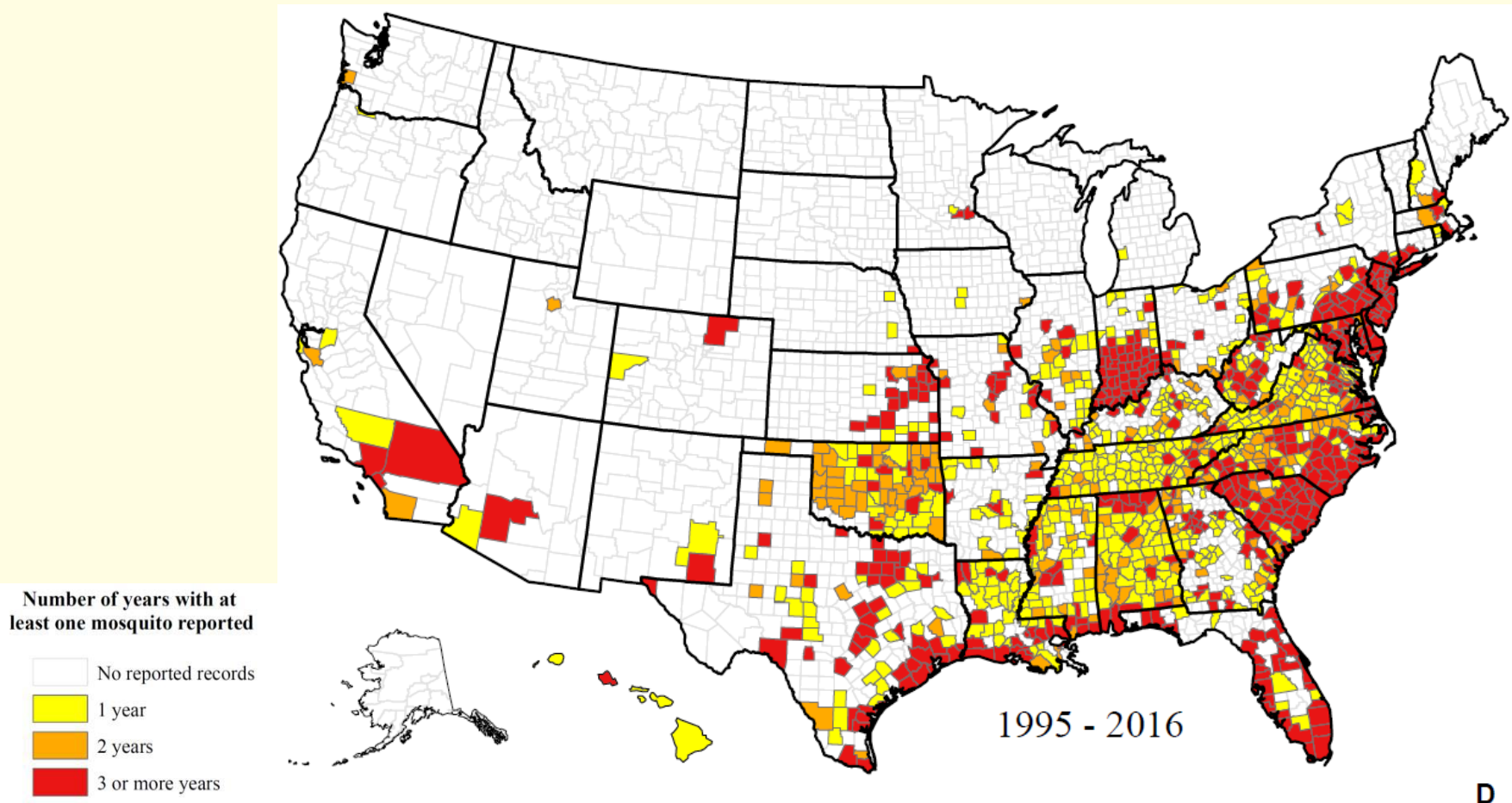
Ae. aegypti occurrence records, 1995-2016



Hahn, M. B. *et al.* 2016. Reported distribution of *Aedes (Stegomyia) aegypti* and *Aedes (Stegomyia) albopictus* in the United States, 1995-2016 (Diptera: Culicidae). *Journal of Medical Entomology* 53 (5): 1169-1175.

Zika Virus Mosquito Vector Distribution (cont.'d)

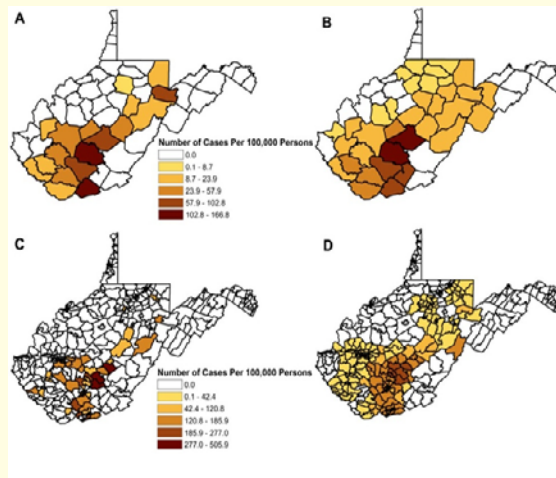
Ae. albopictus occurrence records, 1995-2016



Hahn, M. B. *et al.* 2016. Reported distribution of *Aedes (Stegomyia) aegypti* and *Aedes (Stegomyia) albopictus* in the United States, 1995-2016 (Diptera: Culicidae). *Journal of Medical Entomology* 53 (5): 1169-1175.

Mosquito Surveillance 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

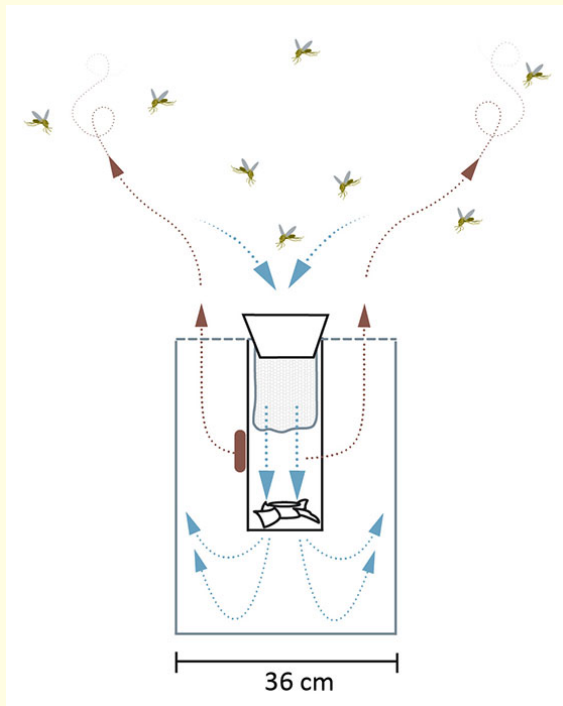
Mosquito Surveillance 2016 (cont.'d)

- **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)



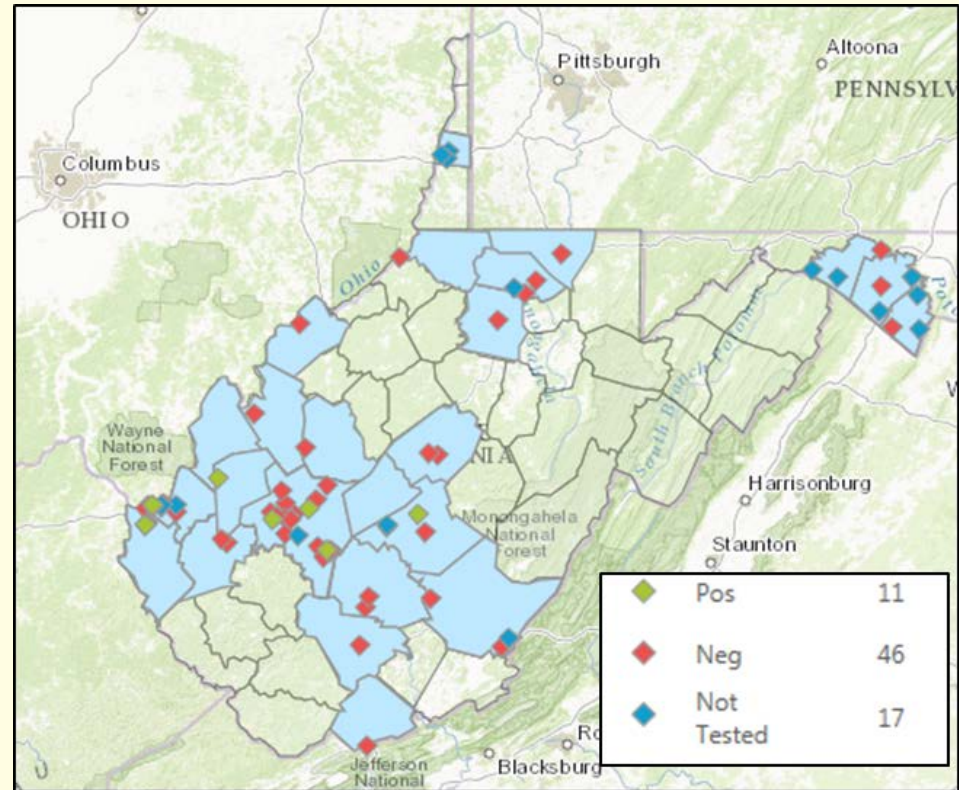
Mosquito Surveillance 2016 (cont.'d)

- Utilized BG Sentinel Trap to capture *Aedes albopictus* (and *Aedes aegypti*).



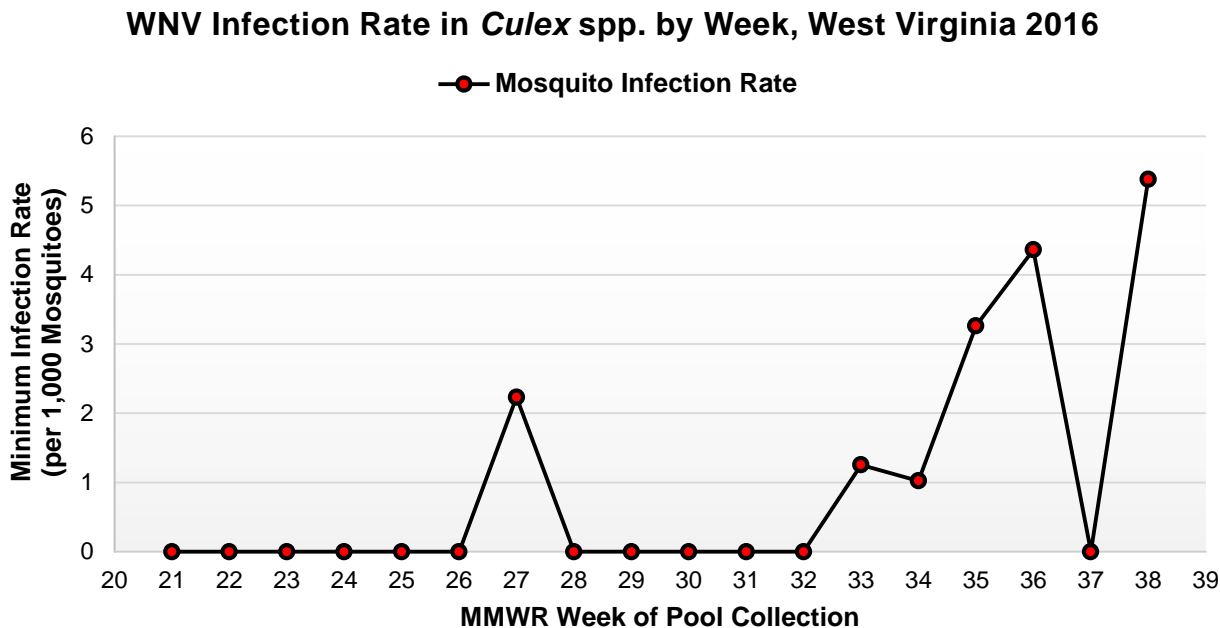
Mosquito Surveillance 2016 (cont.'d)

- 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.



Mosquito Surveillance 2016 (cont.'d)

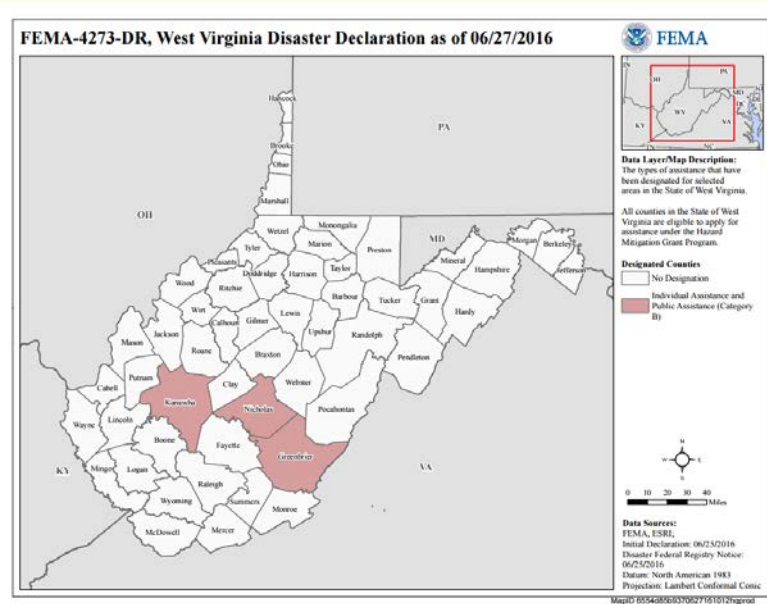
- The first mosquito pool with WNV was collected on July 6, 2016 (Week 27).
- In the adult mosquitoes, WNV activity began to increase in mid-August (Week 33) and reached its peak in September.
- According to WNV minimum infection rate in *Culex* mosquitoes, there was only a 'moderate' human risk of West 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

Mosquitoes & Floods

- 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.



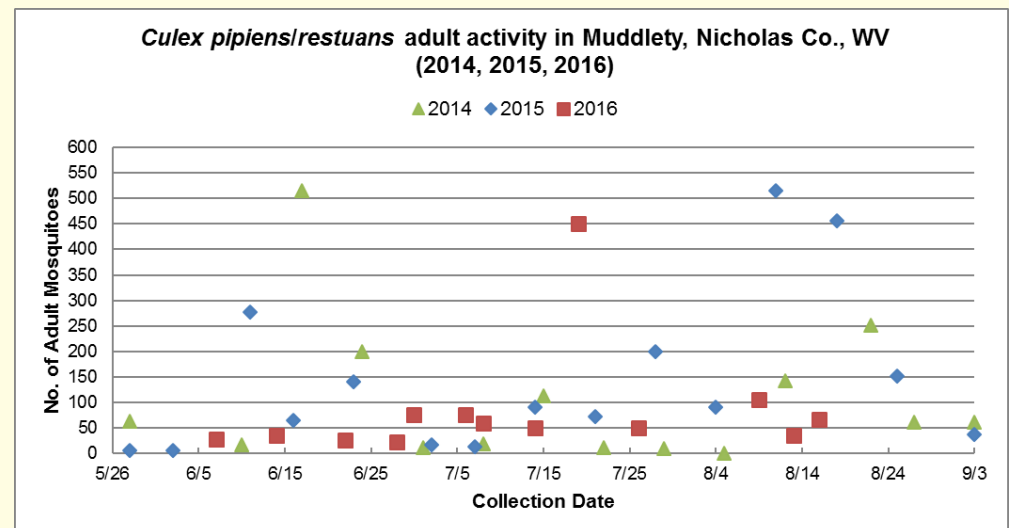
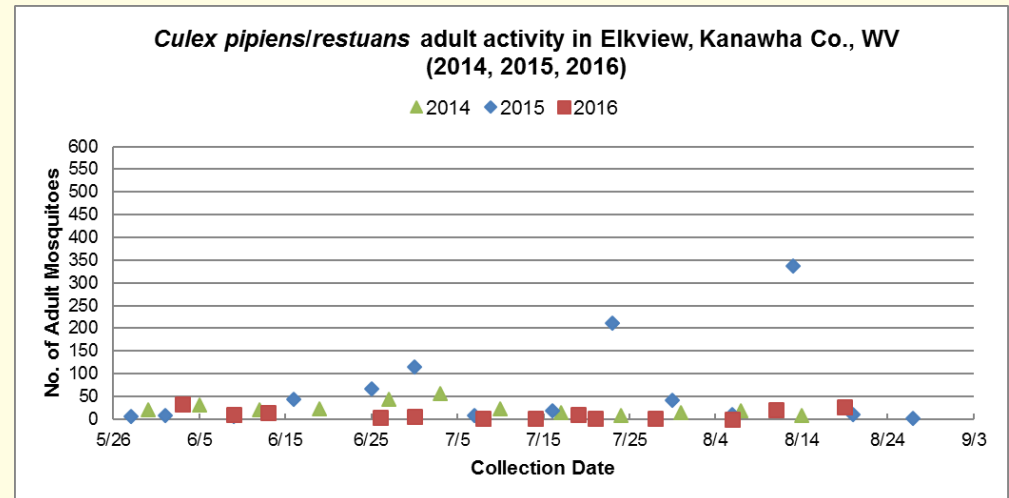
Mosquitoes & Floods (cont.'d)

- Mosquito larvae could develop in residual stagnant water near human habitat.
- 'Floodwater' mosquito eggs laid in moist substrate could hatch after being submerged underwater.

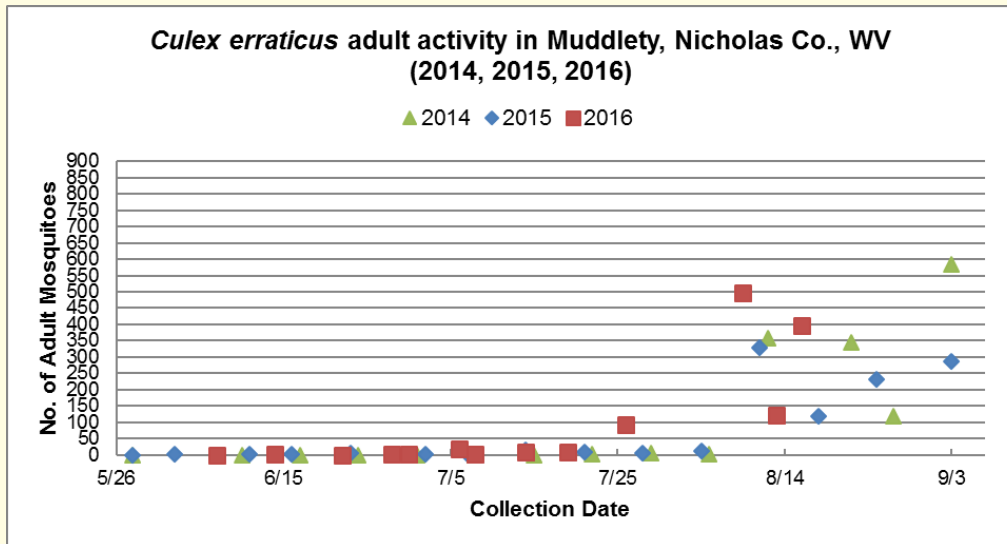
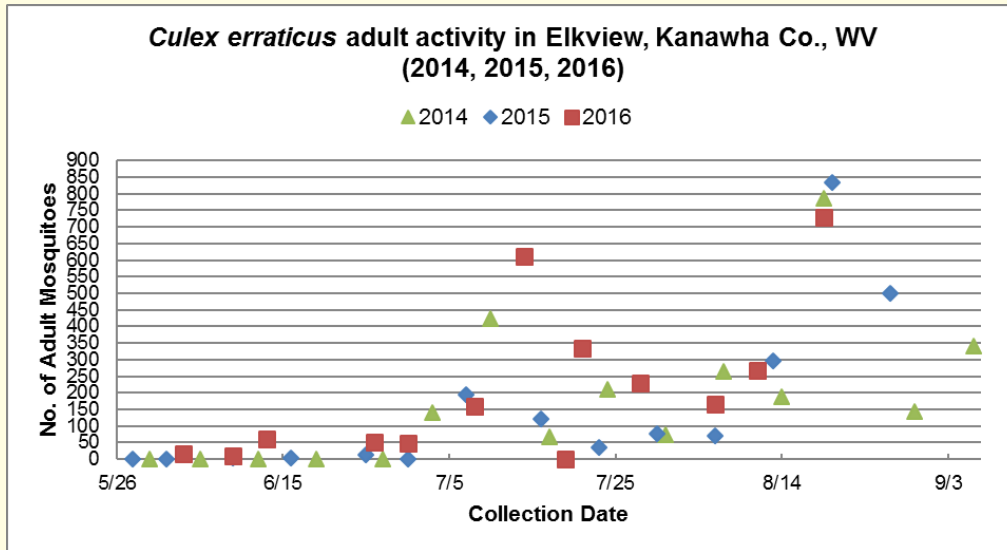


Mosquitoes & Floods (cont.'d)

- *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.



Mosquitoes & Floods (cont.'d)



- *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.

Mosquitoes & Floods (cont.'d)

- 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	Elkview, 2014	Elkview, 2015	Elkview, 2016
<i>Aedes albopictus</i>	16	11	25
<i>Aedes triseriatus</i>	3	6	11
<i>Aedes japonicus</i>	30	68	17
<i>Coquillettidia perturbans</i>	1	0	2
<i>Aedes trivittatus</i>	0	1	3
<i>Aedes vexans</i>	2	15	2
<i>Psorophora ferox</i>	0	1	0

Mosquito Species	Muddlety, 2014	Muddlety, 2015	Muddlety, 2016
<i>Aedes albopictus</i>	2	0	0
<i>Aedes triseriatus</i>	0	0	0
<i>Aedes japonicus</i>	0	2	1
<i>Coquillettidia perturbans</i>	75	28	9
<i>Aedes trivittatus</i>	1	12	12
<i>Aedes vexans</i>	5	31	1
<i>Psorophora ferox</i>	0	5	2

Mosquitoes & Floods (cont.'d)

- There was no increase in adult mosquito activity weeks after the flood in Nicholas or Greenbrier counties.

Rainelle	6/30/2016	7/8/2016	7/14/2016
<i>Culex pipiens/restuans</i>	20	6	3
<i>Aedes triseriatus</i>	1	0	0
<i>Aedes japonicus</i>	5	0	0
<i>Aedes canadensis</i>	11	0	0
<i>Aedes trivittatus</i>	31	1	2
<i>Aedes vexans</i>	1	0	2
<i>Psorophora ferox</i>	2	0	0

Summersville	6/30/2016	7/8/2016	7/14/2016
<i>Culex pipiens/restuans</i>	2	0	0
<i>Aedes japonicus</i>	4	12	10
<i>Aedes trivittatus</i>	1	0	0

White Sulphur Springs	6/30/2016	7/8/2016	7/14/2016
<i>Culex pipiens/restuans</i>	4	2	0
<i>Aedes triseriatus</i>	1	0	0
<i>Aedes japonicus</i>	1	0	4
<i>Aedes trivittatus</i>	0	2	0

Coldwell	6/30/2016	7/8/2016	7/14/2016
<i>Culex pipiens/restuans</i>	65	1	2
<i>Aedes japonicus</i>	10	0	4
<i>Aedes trivittatus</i>	0	1	1

Tick-borne Disease

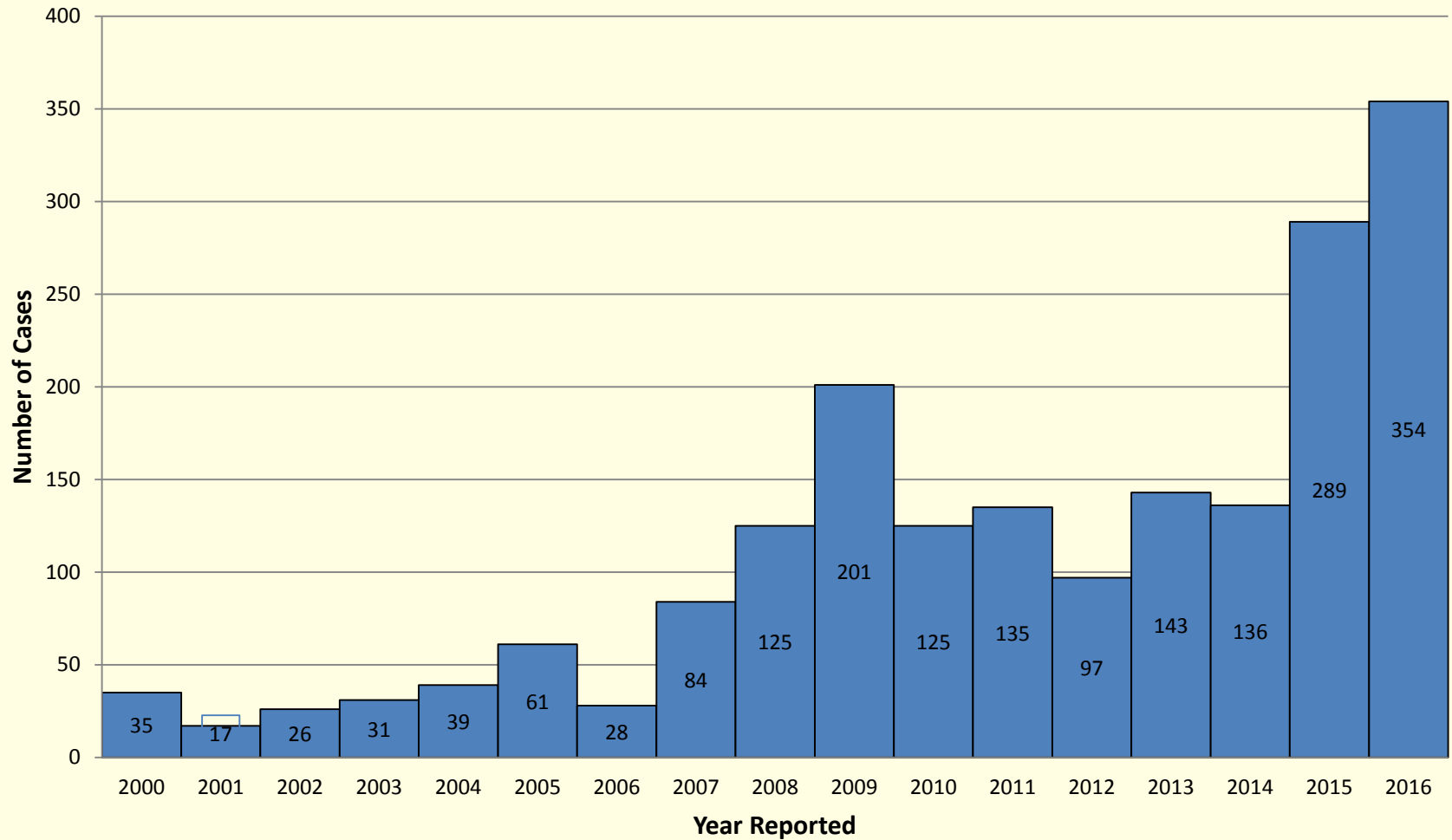
Tick-borne Diseases by Causative Organism(s) and Presence of Tick Vectors in West Virginia

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

*This tick-borne disease has not been detected in West Virginia.

Tick-borne Disease Surveillance (cont.'d)

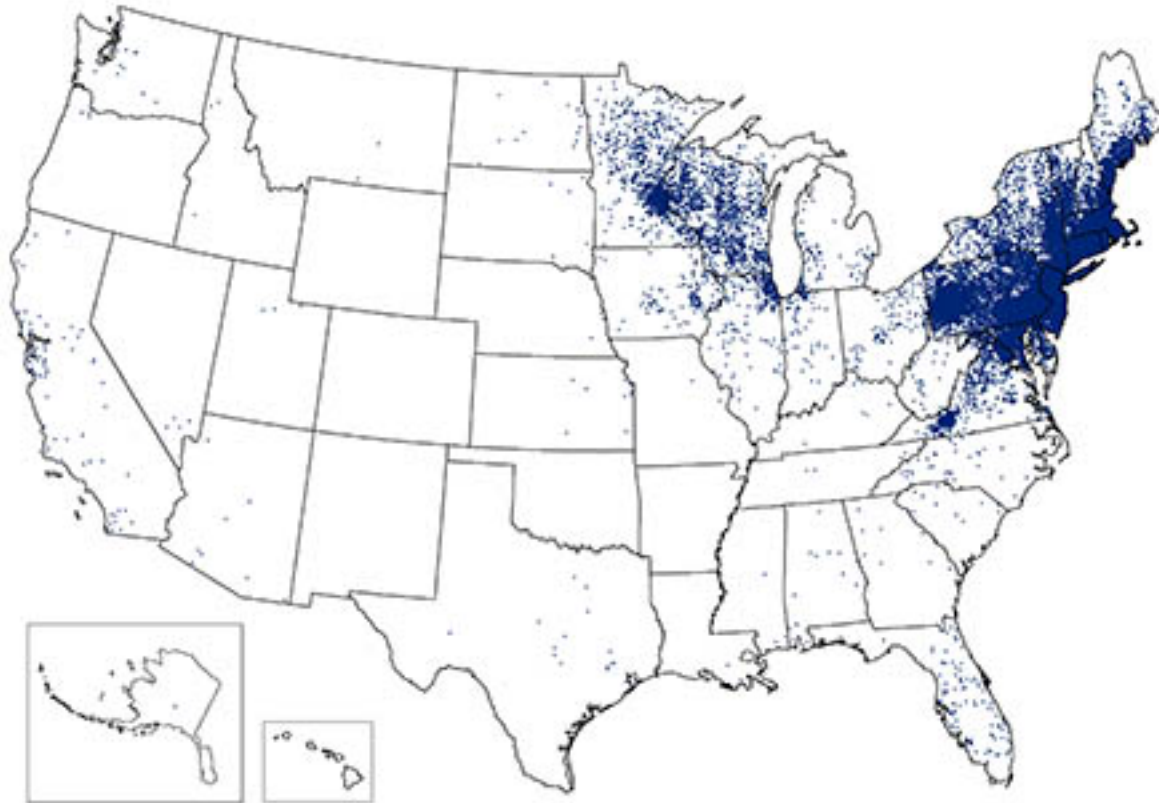
Reported Cases of Lyme Disease by Year - West Virginia, 2000-2016*



*Updated as of January 9, 2017

Tick-borne Disease Surveillance (cont.'d)

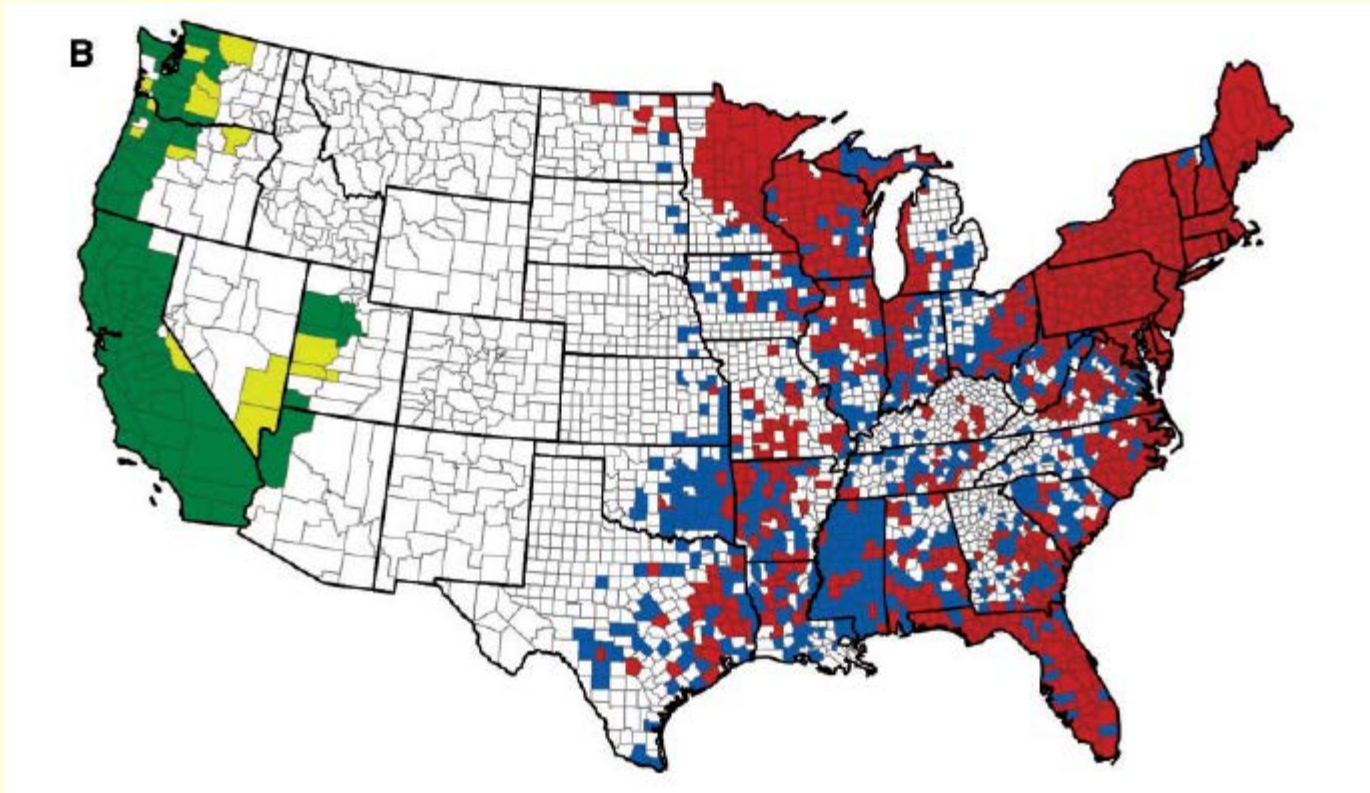
Reported Cases of Lyme Disease -- United States, 2015



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

Tick Surveillance

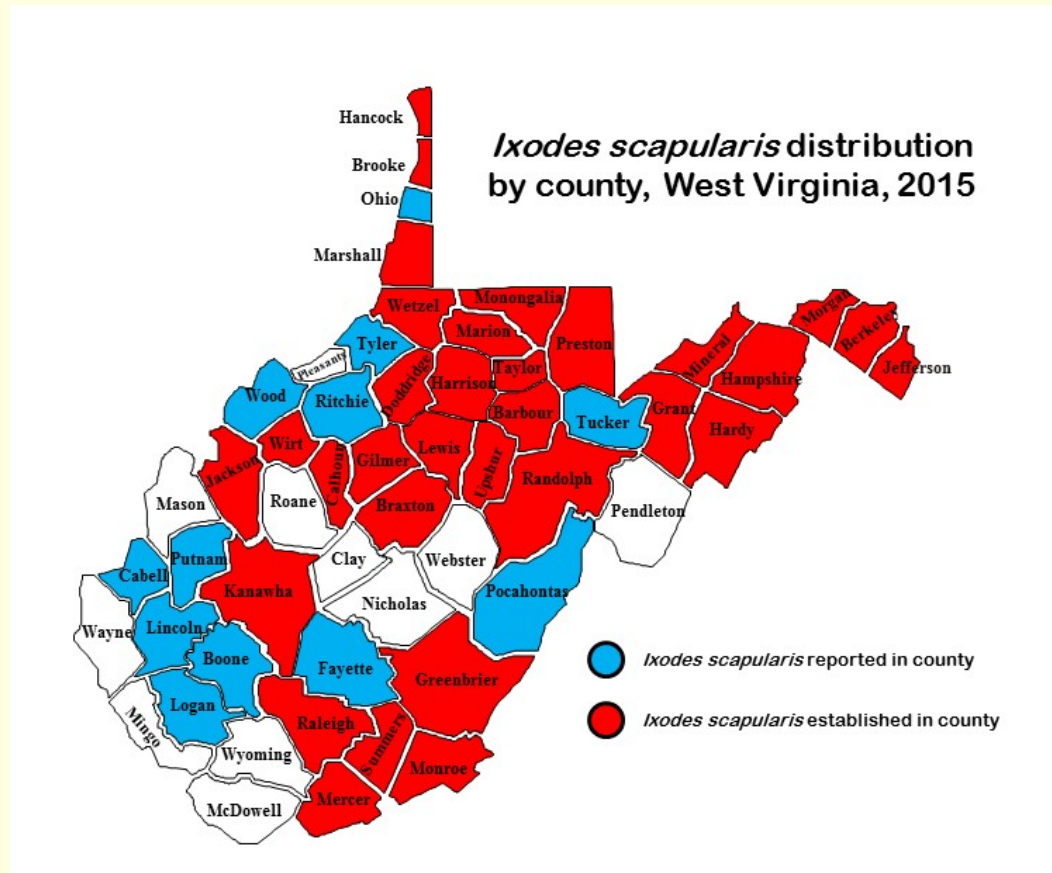
Lyme Disease Vector Distribution 1907-2015



- *Ixodes scapularis* reported (blue) or established (red) in county
- *Ixodes pacificus* reported (yellow) or established (green) in county

Eisen, R. J., L. Eisen & C. B. Beard. 2016. County-scale distribution of *Ixodes scapularis* and *Ixodes pacificus* (Acari: Ixodidae) in the continental United States. *Journal of Medical Entomology* 53 (2): 349-386.

Tick Surveillance (cont.'d)



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

Eisen, R. J., L. Eisen & C. B. Beard. 2016. County-scale distribution of *Ixodes scapularis* and *Ixodes pacificus* (Acari: Ixodidae) in the continental United States. *Journal of Medical Entomology* 53 (2): 349-386.

West Virginia Veterinary Tick Submission Project

Tick Species	# of ticks submitted and identified (2013)	# of ticks submitted and identified (2014)	# of ticks submitted and identified (2015)	# of ticks submitted and identified (2016)
<i>Dermacentor variabilis</i> ¹	470	998	677	723
<i>Amblyomma americanum</i> ²	5	16	85	109
<i>Ixodes scapularis</i> ³	121	179	410	171
<i>Ixodes cookei</i> ⁴	7	18	86	27
<i>Haemaphysalis leporispalustris</i> ⁵	1	8	0	3
<i>Amblyomma maculatum</i> ⁶	0	1	0	1
<i>Rhipicephalus sanguineus</i> ⁶	0	0	4	119

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

¹Vector of tularemia and Rocky Mountain spotted fever

³Vector of Lyme disease, anaplasmosis, babesiosis, and Powassan encephalitis

⁵Vector of tularemia in rabbits

²Vector of ehrlichiosis, tularemia, STARI, and spotted fever rickettsioses

⁴Vector of Powassan encephalitis

⁶Vector of spotted fever rickettsioses

Summary

- 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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