WEST VIRGINIA 2017 MOSQUITO SURVEILLANCE REPORT

WEST VIRGINIA Department of Health & Human Resources
BUREAU FOR PUBLIC HEALTH

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INTRODUCTION

The West Virginia Mosquito Surveillance Program (WVMSP) began in 2007 and involves the efforts of both state and local partners. WVMSP's objective is to identify mosquitoes that are infected with or are able to transmit mosquito-borne diseases. The secondary objective is to determine the geographic distribution of mosquitoes that are known to transmit diseases to humans and animals. Data collected on mosquitoes can guide mosquito control methods and activities. Monitoring for new, invasive mosquito species and species that are known to transmit emerging mosquito-borne diseases (e.g. chikungunya, Zika) is another function of the WVMSP.

Mosquito-borne diseases under surveillance in West Virginia are shown in Table 1. Mosquitoes collected through the season are tested for the following arboviruses: La Crosse Encephalitis (LAC), West Nile virus (WNV), St. Louis encephalitis (SLE), and Zika virus disease (ZIK), which replaced Eastern Equine Encephalitis (EEE) in 2017.

Table 1. Mosquito-borne diseases under surveillance in West Virginia and their vectors.

Disease	Vector
LAC	*Aedes triseriatus, Aedes japonicus, Aedes albopictus*
WNV	*Culex species*
Malaria	*Anopheles species*
Dengue/Chikungunya/ZIK	*Aedes aegypti*, Aedes albopictus*
EEE	*Aedes*, *Coquillettidia*, and *Culex species*
SLE	*Culex pipiens Culex quinquefasciatus**

*Species has not been found in West Virginia

LAC is the predominant mosquito-borne disease in West Virginia and has the highest incidence in the southern part of the state. The severe (neuroinvasive) form of LAC occurs in children who are under the age of 16. WNV was added to the mosquito surveillance system after an outbreak that started in New York in 1999. The highest number of WNV (N=9) was reported in 2012. Although no locally-acquired human cases of ZIK have occurred in West Virginia, ZIK could be established in the local mosquito population following mosquito blood feeding on human hosts who have the virus in their blood. Surveillance for arboviruses and other mosquito-borne diseases is important in understanding the public health impact of these diseases and monitoring for changes in disease activity, particularly because arboviral outbreaks are difficult to predict.

Mosquito surveillance involves use of different techniques to trap mosquitoes based on the species of interest, life stage, and other characteristics. *Culex* spp. mosquitoes are drawn to gravid traps while *Aedes* spp. are drawn to carbon dioxide emitting light traps and BG Sentinel traps. Attractants such as carbon dioxide (CO_2), chemical lures, and light are often used. Table 2 shows the types of mosquito traps used by WVMSP during 2017.

Table 2. Mosquito traps used by WVMSP during the 2017 mosquito surveillance season.

Type of Trap	Trap Characteristics	Mosquito Target
Gravid Trap / Frommer Trap / Reiter Trap	Collect gravid mosquitoes searching for site to deposit eggs	*Cx. pipiens*, *Cx. restuans*, *Ae japonicus*
Light Trap (with dry ice)	Light used to guide mosquitoes into trap. Dry ice (carbon dioxide) mimics vertebrate host.	*Ae. aegypti*, Ae. albopictus*, *Ae. triseriatus*, *Coquillettida perturbans*, *An. quadrimaculatus*, *An. punctipennis*
BG Sentinel Trap (with octenol or BG Lures)	Visual and olfactory; air convention currents mimic vertebrate host.	*Ae. aegypti*, Ae. albopictus*, *Ae.triseriatus*
Mosquito Ovitrap	Gravid container-breeding mosquitoes deposit eggs on substrate in water container	*Ae. aegypti**, *Ae. albopictus*, *Ae. japonicus*, *Ae. triseriatus,*

*Species has not been found in West Virginia

This report summarizes the combined efforts of state and local public health officials in West Virginia during the 2017 mosquito surveillance season.

METHODS

Local and state public health agencies were involved in mosquito surveillance activities from May to October. Four (4) local health departments (LHDs) were actively involved in mosquito surveillance in 2017: Berkeley County HD (one surveyor), Cabell-Huntington HD (two surveyors), Kanawha-Charleston HD (three surveyors), and Wheeling-Ohio HD (one surveyor).

The State Health Department (SHD) provided resources to participating LHDs (i.e. mosquito surveyors, surveillance equipment, mosquito identification expertise, and educational materials), served as a central depository for mosquito surveillance results, and conducted mosquito surveillance in counties not actively monitored by a LHD. State responsibilities were performed by the state public entomologist, five vector surveillance interns, and microbiologists in the West Virginia Office of Laboratory Services (WVOLS) who conducted arboviral disease testing on mosquito specimens.

Regular weekly mosquito trapping occurred in Fayette, Kanawha, Nicholas, Raleigh and Wood counties. Due to distance, semi-regular sampling was conducted in Greenbrier, Harrison, Jackson, Mercer, Marion, Monongalia, and Wetzel counties. LHD partners conducted mosquito trapping in Berkeley, Cabell, Jefferson, Kanawha, Lincoln, Morgan, Ohio, Putnam, and Wayne counties.

Adult mosquitoes were predominantly collected using gravid traps and CO_2 emitting light traps. Additional mosquito surveillance methods were employed to better monitor *Aedes albopictus* activity and reduce damage to mosquitoes caused by the collection process. Bio Gent Sentinel traps were utilized regularly throughout the surveillance season in Wood, Raleigh, Berkeley, Jefferson, and Morgan counties (and from late July through September in Cabell and Wayne counties). From late July through September, mosquito ovitraps were used in Wood, Raleigh, Berkeley, Jefferson, Morgan, Cabell, and Wayne counties to collect the eggs of *Ae. albopictus* and other container-breeding mosquitoes. Frommer traps and Reiter traps were used in Kanawha and Putnam counties to reduce damage to mosquito samples. In Kanawha County, tire traps were used to collect mosquito larvae.

Following collection from the field sites, adult mosquitoes were prepared for arboviral testing at WVOLS. Mosquitoes were identified and sorted into pools (groups) based on date of collection, collection location, and genus. Due to the recent concerns about ZIKV competent mosquitoes, the Asian tiger mosquito, *Ae. albopictus*, was tested separately from other mosquito species. LHDs regularly submitted mosquito samples with the associated collection information to the SHD throughout the summer. Geographic, temporal, collection method, identification, test result data were entered in an Epi Info 7 database.

Pools consisting of 10-50 adult female mosquitoes collected from May through September 2017 were tested by WVOLS (male mosquitoes do not actively transmit arboviral diseases) using real-time reverse transcription polymerase chain reaction (RT-PCR). This assay amplifies and detects arboviral ribonucleic acid (RNA). Mosquito pools were screened for WNV, SLE, LAC, and ZIKV.

Arboviral results were provided to the SHD and participating LHDs for their jurisdiction by WVOLS. Arboviral test results were reported to CDC through ArboNET, a national mosquito surveillance reporting system, within three days of confirmation, and later to CDC through MosquitoNET. Pooled infection rates were examined for each mosquito genus each week to relate incidence of infection with a population indicator. The WNV minimum infection rate (MIR) for *Culex* mosquitoes was determined weekly using the following equation:

$$MIR = \frac{virus\ positive\ mosquito\ pools}{total\ number\ of\ mosquitoes\ tested} \times 1{,}000$$

RESULTS

From May 17 to October 26, 2017, WVMSP conducted adult mosquito surveillance at 97 localities in 23 counties (Figure 1 and Appendix A). A total of 35,499 adult mosquitoes was collected during mosquito surveillance season.

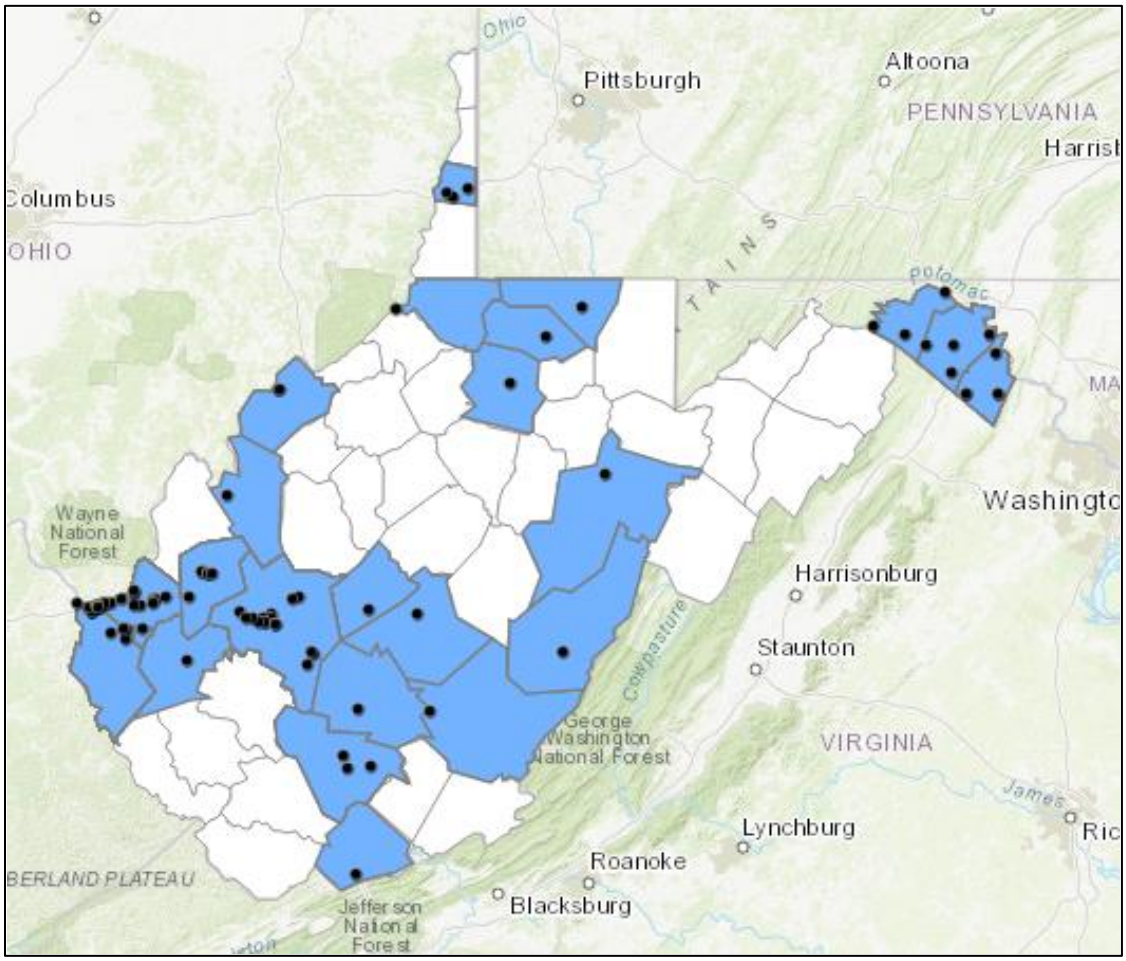

Figure 1. Locations under mosquito surveillance in West Virginia. Counties under surveillance are shown in blue and sites are represented as black dots.

Forty-nine (49) *Culex* spp., 12 *Aedes albopictus*, three *Aedes* spp., and one *Psorophora* spp. mosquito pool tested positive for WNV. The last WNV-positive mosquito pools were one *Aedes albopictus* sample and one pool containing *Culex restuans* and *Culex pipiens* active in Kanawha County on Sept. 22, 2017. Figure 2 and Table 3 show the distribution of WNV-positive mosquitoes. Figure 3 shows the WNV MIR in each county under mosquito surveillance. The first WNV-positive mosquito pool contained *Culex restuans* active in Cabell County on May 25, 2017.

In *Culex* mosquitoes, WNV activity began to increase during the middle of July (MMWR Week 28) with a WNV MIR value of 5.0 during the third week of July (MMWR Week 29). Although statewide the WNV MIR in the *Culex* mosquito population remained low and human risk of WNV infection was moderate from the middle of July through August, western and northeastern West Virginia experienced high WNV activity in the *Culex* mosquito populations (Figures 3 and 4). Across the state, WNV activity in *Culex* mosquitoes reached its peak in September (MMWR Weeks 34-39).

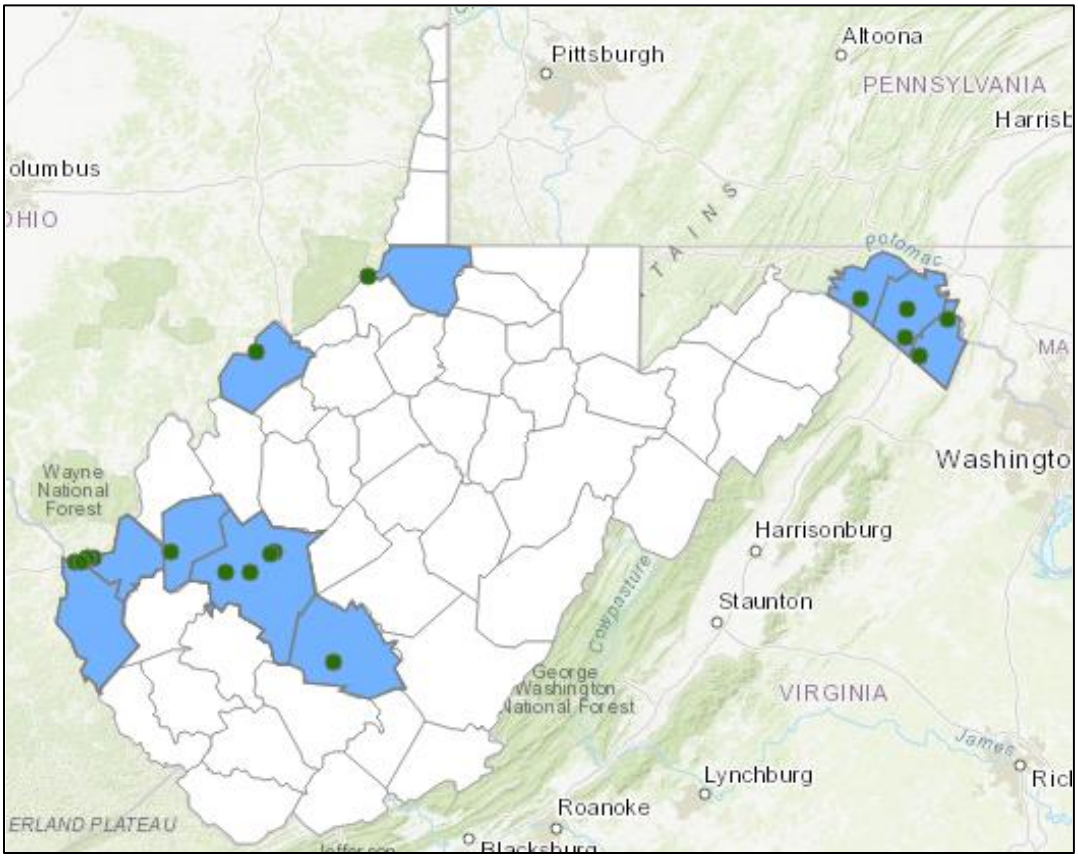

Figure 2. Location of WNV positive mosquitoes in West Virginia (counties shown in blue).

Table 3. 2017 WNV-positive mosquito pools by county, nearest populated location, and number of pools.

County	Nearest Populated Location	WNV+ Mosquito Pools
Berkeley	Bunker Hill	3
Berkeley	Martinsburg	3
Cabell	Huntington	27
Fayette	Oak Hill	1
Jefferson	Shepherdstown	3
Jefferson	Summit Point	1
Kanawha	Charleston	1
Kanawha	Elkview	5
Kanawha	South Charleston	11
Morgan	Berkeley Springs	1
Putnam	Hurricane	1
Wayne	Huntington	3
Wetzel	Paden City	3
Wood	Parkersburg	2

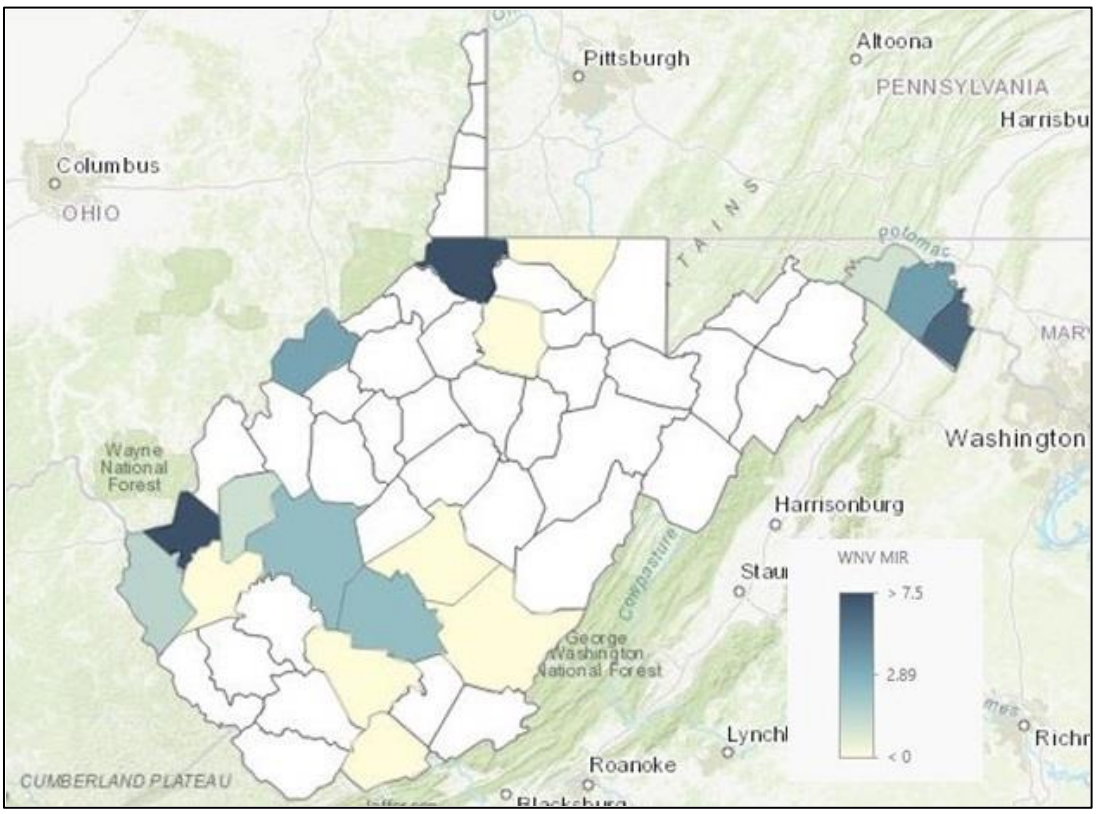

Figure 3. WNV minimum infection rate in *Culex* mosquitoes in each county under surveillance.

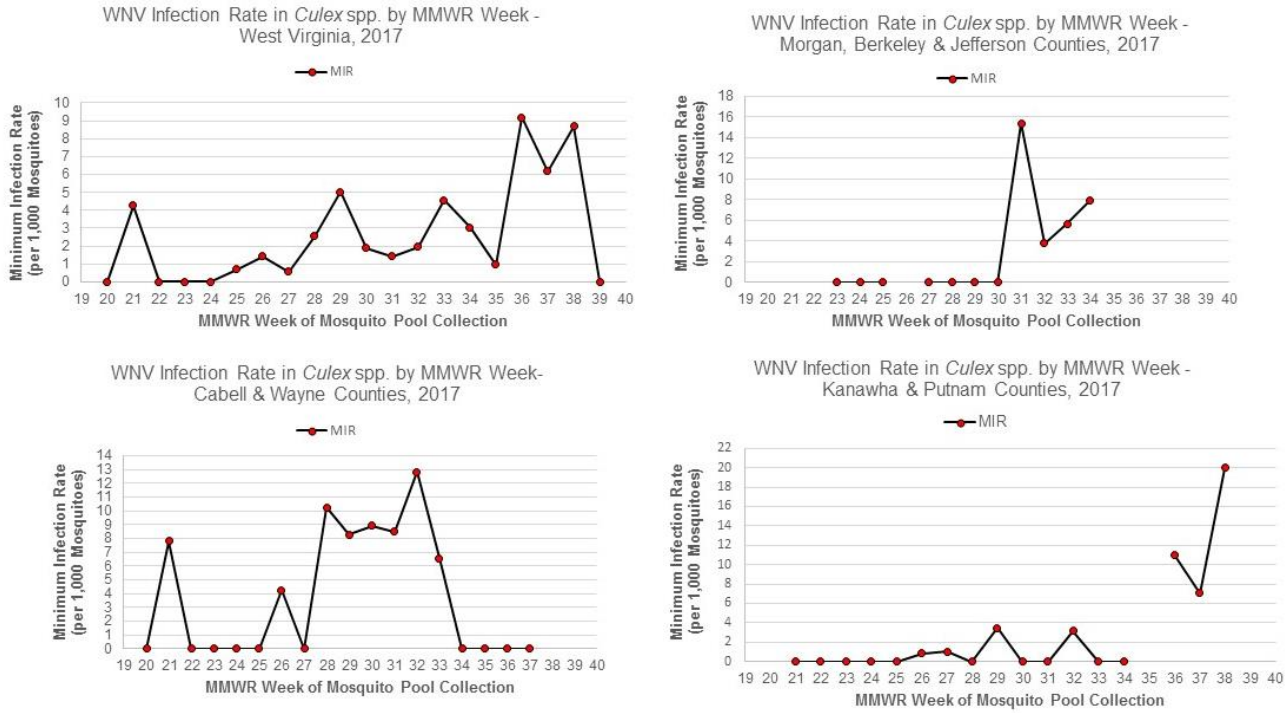

Figure 4. WNV minimum infection rate in *Culex* spp. by week in West Virginia and individual regions monitored by LHDs, 2017.

Two (2) *Aedes japonicus* mosquito pools and one *Culex* mosquito pool tested positive for LAC. LAC was first detected in *Aedes japonicus* collected in South Charleston, Kanawha County on June 26, 2017. LAC was also detected in *Aedes japonicus* collected from a different site in South Charleston, Kanawha County on September 22. *Culex erraticus* and *Culex restuans* collected from Berkeley Springs, Morgan County on August 11 were also infected with LAC. SLE and ZIK were not detected in any mosquito samples collected.

Aedes albopictus was detected in 69 localities in 21 counties surveyed (Figure 5) and was active throughout the mosquito surveillance season. Adult *Aedes albopictus* mosquitoes were first detected in Huntington, Cabell County on May 15, the first day mosquitoes were actively collected in the program. *Aedes albopictus* was last detected in Marlinton, Pocahontas County on October 26, the last day of active mosquito surveillance.

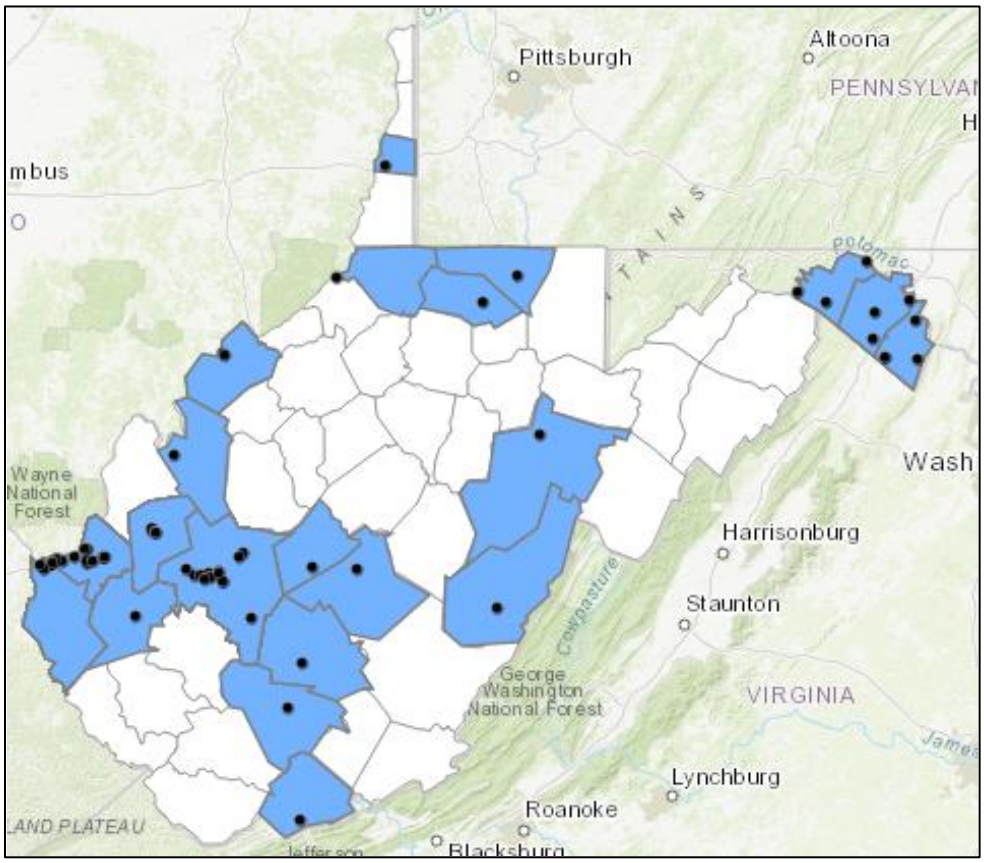

Figure 5. Location of *Aedes albopictus* pools in West Virginia (counties shown in blue).

DISCUSSION

The low arboviral disease activity in mosquitoes and the limited geographic distribution of infected mosquitoes resulted in few human arboviral cases in 2017. WNV infection rates in *Culex* species during the 2017 mosquito surveillance seasons were similar to the low rates from other years when human incidence of West Nile encephalitis was low (2008-2011, 2013-2016). Individual regions in western and northeastern West Virginia experienced high WNV activity in the *Culex* mosquito populations and resultant human cases of WNV virus infection. WNV activity in *Culex* mosquitoes was high from the middle of July through the middle of August in the Cabell and Wayne counties region (Figure 4). The first reported human case of WNV infection in Cabell County was preceded by three continuous weeks of WNV MIR > 5 in *Culex* mosquitoes in the Cabell/Wayne counties region.

Counties in the eastern panhandle (Morgan, Berkeley, Jefferson) experienced high WNV infection rates in *Culex* mosquitoes during August (Figure 4).

Aedes albopictus has a wide geographic distribution across the state (Figure 5), and adult mosquitoes are active from late spring through autumn. Due to the geographic distribution and temporal activity of this mosquito, mosquito transmission of established, endemic arboviral diseases (i.e. LAC) and local transmission of a non-endemic (dengue, chikungunya, Zika virus disease) arboviral disease from an *Aedes albopictus* mosquito feeding on an infected (viremic) human host is a concern for many counties in West Virginia.

Reducing the risk of mosquito-borne disease means reducing the risk of being bitten by mosquitoes:

- Wear protective clothing such as long sleeves, pants, and socks. Use insect repellant that contains DEET, picaridin, IR3535, or oil of lemon eucalyptus on exposed skin and clothing when outdoors.
- Be aware of the times of day when mosquitoes are most active. For many mosquitoes, peak hours are dusk and dawn. LAC-transmitting mosquitoes are active during the day.
- Ensure that window and door screens are intact to keep mosquitoes outside of homes. Remove breeding sites around the home (e.g. any containers that can accumulate water).
- Check with your healthcare provider when traveling abroad to learn more about mosquito-borne diseases found in that area of the world.

The Zoonotic Disease Program sincerely thanks the many public health partners who contributed to mosquito-borne disease surveillance across the state. Your efforts have provided much of the data summarized in this report. Mosquito surveillance partnerships with LHDs enhanced the collection duration, geographic surveillance area, mosquito collection abundance, and public health outreach in communities.

Appendix A. Number of mosquito pools collected in each county during the 2017 mosquito surveillance season.

County		AA	AE	AN	CO	CU	OR	PS	TO	UR
Berkeley		23	40	16	1	55	0	3	0	0
Cabell		80	36	10	1	111	1	12	0	0
Clay		1	0	0	0	0	0	0	0	0
Fayette		1	13	0	0	16	0	0	0	0
Greenbrier		0	1	0	0	1	0	0	0	0
Harrison		0	2	0	0	2	0	0	0	0
Jackson		2	2	0	0	2	0	0	0	1
Jefferson		13	25	14	0	36	0	1	0	1
Kanawha		55	59	16	4	175	4	0	0	9
Lincoln		8	9	0	0	5	0	0	0	0
Marion		2	1	1	0	1	0	1	0	0
Mercer		13	8	4	5	7	0	0	0	0
Monongalia		1	1	1	0	1	0	0	0	0
Morgan		14	19	4	0	38	0	0	0	1
Nicholas		1	9	10	2	102	0	4	0	2
Ohio		1	2	1	0	2	0	0	0	0
Pocahontas		1	1	0	0	1	0	0	0	0
Putnam		8	9	0	0	26	1	0	0	0
Raleigh		7	19	15	2	69	1	4	0	1
Randolph		1	2	0	0	0	0	0	0	0
Wayne		42	37	15	7	87	1	6	2	0
Wetzel		2	9	0	0	4	0	4	0	0
Wood		22	26	15	3	32	0	9	1	4
Total		298	330	122	25	773	8	44	3	19

AA=*Aedes albopictus*
AE=*Aedes* spp.
AN=*Anopheles*
CQ=*Coquillettidia* spp.
CX=*Culex*
OR=*Orthopodomyia*
PS=*Psorophora*
TX=*Toxorhynchites*
UR=*Uranotaenia*