WEST VIRGINIA 2018 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. The WVMSP's main objective is to identify mosquitoes that are infected with or are capable of transmitting 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 virus (LACV), West Nile virus (WNV), St. Louis encephalitis virus (SLEV), and Zika virus (ZIKV), which replaced Eastern Equine Encephalitis (EEE) virus in 2017.

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

Disease	Vector
La Crosse Encephalitis (LACV)	*Aedes triseriatus, Aedes japonicus, Aedes albopictus*
West Nile Virus Infection (WNV)	*Culex species*
Malaria	*Anopheles species*
Dengue/Chikungunya/Zika Virus Disease (ZIKV)	*Aedes aegypti,* Aedes albopictus*
Eastern Equine Encephalitis (EEE)	*Aedes*, *Coquillettidia*, and *Culex species*
St. Louis Encephalitis (SLEV)	*Culex pipiens Culex quinquefasciatus**

*Species has not been found in West Virginia

LACV 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 LACV occurs in children under the age of 16. WNV was added to mosquito surveillance after a nationwide 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 ZIKV have occurred in West Virginia, ZIKV 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. For example, *Culex* spp. mosquitoes are drawn to gravid traps while *Aedes* spp. are drawn to carbon dioxide emitting light traps and Bio Gent (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 2018.

Table 2. Mosquito traps used by WVMSP during the 2018 mosquito surveillance season.

Type of Trap	Trap Characteristics	Mosquito Target
Gravid Trap / Frommer Trap / Reiter Trap	Collects 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*

*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 2018 mosquito surveillance season.

METHODS

The West Virginia Department of Health and Human Resources, Bureau for Public Health (BPH) was involved in mosquito surveillance activities from May to October for arbovirus detection and *Aedes albopictus* monitoring. Four local health departments (LHDs) were actively involved in mosquito surveillance in 2018: Cabell-Huntington Health Department (4 surveyors), Kanawha-Charleston Health Department (1 surveyor), Monongalia County Health Department (3 surveyors), and Wheeling-Ohio Health Department (2 surveyors).

The BPH provided resources to participating LHDs (i.e., mosquito surveyors, surveillance equipment, mosquito identification training, mosquito identification expertise, 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 health entomologist, three vector surveillance interns, and two microbiologists in the West Virginia Office of Laboratory Services (WVOLS).

Regular, weekly mosquito trapping occurred in Fayette, Nicholas, and Raleigh counties and regular biweekly sampling occurred in Wood County. Due to distance, semi-regular sampling was conducted in Boone, Greenbrier, Hardy, Harrison, Jackson, Lewis, Marshall, Mercer, Mineral, Pleasants, Randolph, Ritchie, Tyler, and Wetzel counties. LHD partners conducted regular, weekly mosquito trapping in Cabell and Kanawha counties and semi-regular sampling in Harrison, Marion, Monongalia, Ohio, Taylor, 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, detect *Aedes aegypti*, and reduce damage to mosquitoes caused by the collection process. BG Sentinel traps with BG lure were utilized regularly throughout the surveillance season in Cabell and Wayne counties. To monitor *Aedes albopictus* activity, BG Sentinel traps with BG lure were also utilized opportunistically in Hardy, Mercer, Mineral, Ohio, and Randolph counties. To reduce damage to mosquito samples, Frommer traps and Reiter traps were also used in Kanawha County. LHDs regularly submitted mosquito samples with the associated collection information to the BPH throughout the summer. Geographic, temporal, collection method, identification, test result data were stored in an Epi Info™ 7 database.

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 recent concerns about ZIKV competent mosquitoes, the Asian tiger mosquito, *Ae. albopictus*, was tested separately from other mosquito species.

Pools consisting of 10-50 adult female mosquitoes collected from May through September 2018 were screened for WNV, SLEV, LACV, and ZIKV 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).

Arboviral results were provided to the BPH and participating LHDs for their jurisdiction by WVOLS. Arboviral test results were reported to the Centers for Disease Control and Prevention (CDC) by the BPH through ArboNET, a national mosquito surveillance reporting system, within three days of confirmation, and later to CDC through MosquitoNET. Pool infection rates were examined for each mosquito genus weekly 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 22 to October 18, 2018, WVMSP conducted mosquito surveillance at 49 localities in 25 counties (Figure 1 and Appendix A); a total of 22,879 adult mosquitoes was collected.

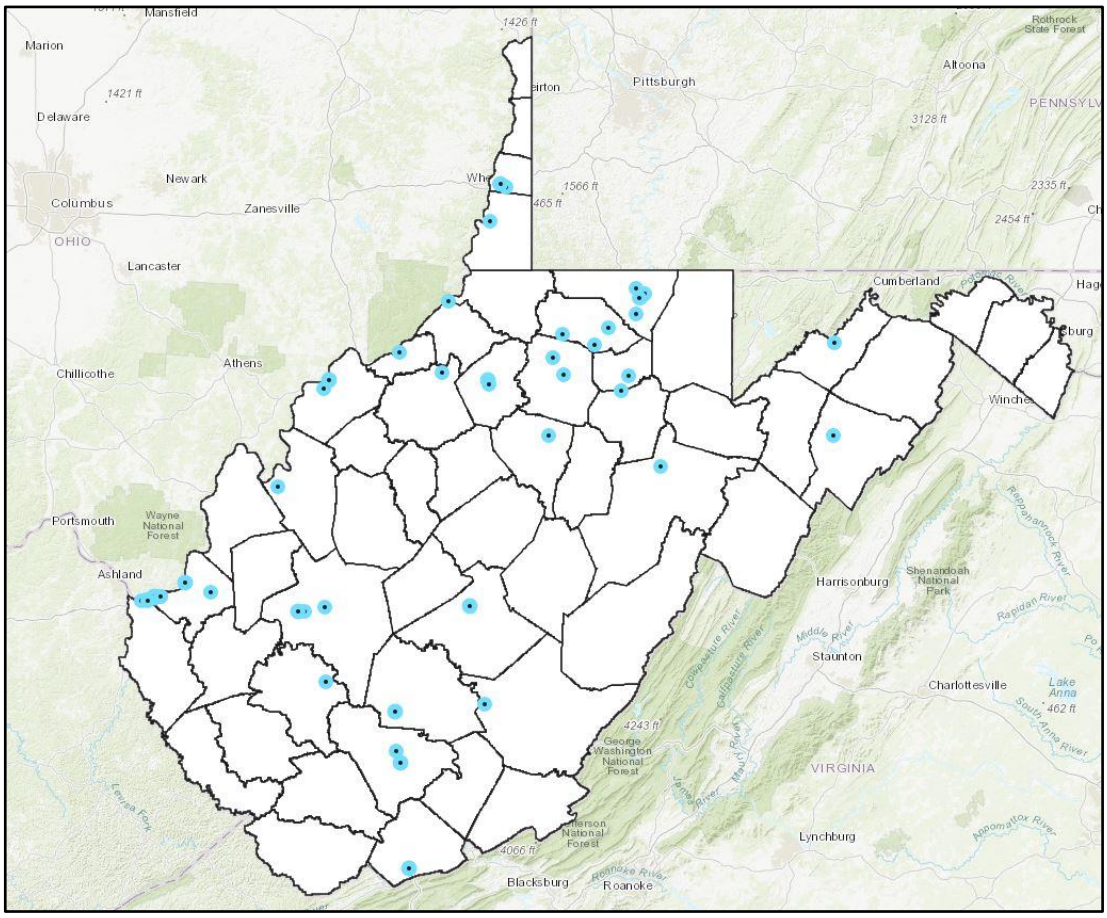

Figure 1. Locations under mosquito surveillance in West Virginia.

Fifteen *Culex* spp., 11 *Aedes albopictus*, 1 *Aedes* spp., and 1 *Psorophora*/*Aedes* spp. mosquito pools tested positive for WNV. The first WNV-positive mosquito pool contained *Culex restuans* active in Nicholas County on June 5, 2018. 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 September 22, 2018. Figure 2 and Table 3 show the distribution of WNV-positive mosquitoes.

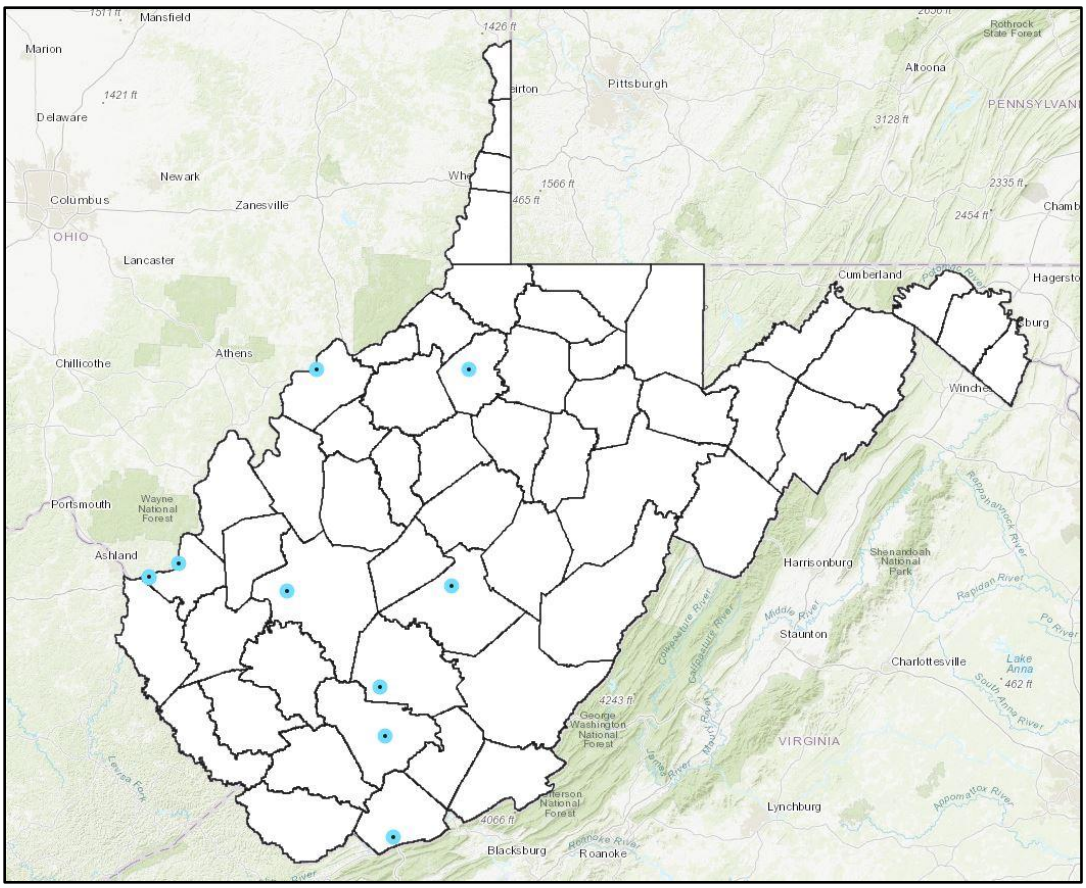

Figure 2. Location of WNV-positive mosquitoes in West Virginia.

Table 3. 2018 WNV-positive mosquito pools by county, nearest populated location, and number of pools.

County	Nearest Populated Location	WNV+ Mosquito Pools
Cabell	Huntington	15
Doddridge	West Union	1
Fayette	Pax	4
Kanawha	South Charleston	1
Mercer	Bluefield	1
Nicholas	Muddlety	2
Raleigh	MacArthur	3
Wood	Parkersburg	1

According to the West Virginia Mosquito Surveillance Protocol and historical mosquito surveillance results used to generate this protocol, there is a “moderate” human risk for WNV when mosquitoes exhibit WNV infection. However, the statewide WNV minimum infection rate (MIR) in *Culex* spp. is less than 5/1000 *Culex* mosquitoes or the statewide WNV MIR is greater than 5/1000 *Culex* mosquitoes for only one week. During July (MMWR weeks 27-31), the human risk for WNV across the state was considered “moderate” based upon the WNV MIR in *Culex* mosquitoes remaining below the 5/1000 *Culex* mosquito threshold (Fig. 3). WNV infection in *Culex* mosquitoes increased in August (MMWR weeks 31-35). The WNV MIR in *Culex* mosquitoes in MMWR week 32 (WNV MIR = 8.5) and MMWR week 34 (WNV MIR = 5.7) did exceed the 5/1000 *Culex* mosquito threshold but was not continuously

maintained. During September (MMWR weeks 35-40), the WNV MIR in *Culex* mosquitoes decreased from August values and the human risk of acquiring WNV was "moderate." LACV, SLEV, and ZIKV were not detected in any mosquito samples collected.

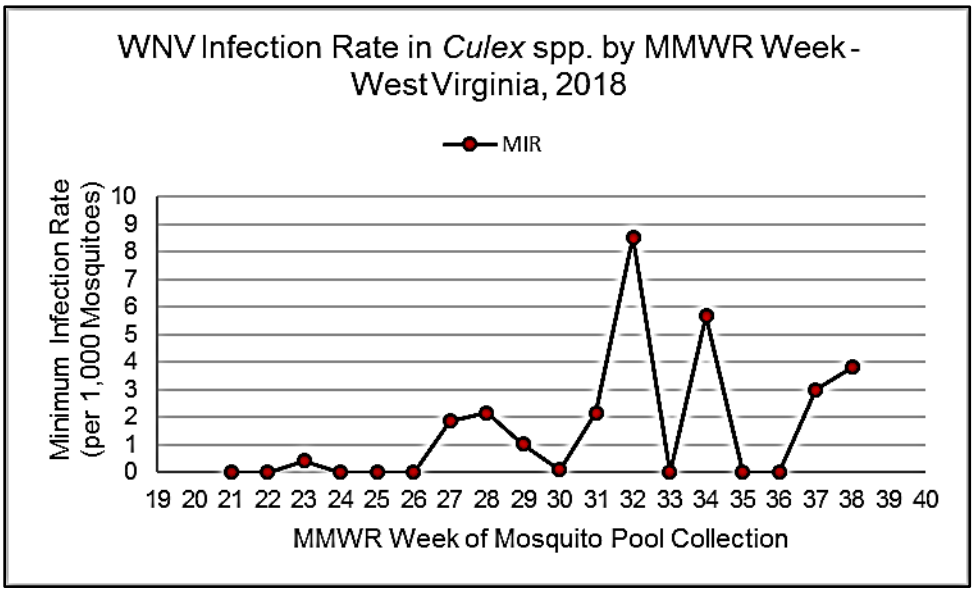

Figure 3. WNV minimum infection rate in *Culex* spp. by MMWR week in West Virginia, 2018.

Aedes albopictus was detected throughout West Virginia (Figure 4). New county records for *Aedes albopictus* include Doddridge, Hardy, Lewis, Marshall, Mineral, Pleasants, and Ritchie counties in northern West Virginia. In 2018, adult *Aedes albopictus* mosquitoes were first detected in Huntington, Cabell County on May 30. *Aedes albopictus* was last detected in Moorefield, Hardy County and Keyser, Mineral County on October 16, the last day of active mosquito surveillance in 2018. Conversely, *Aedes aegypti* was not detected in West Virginia in 2018.

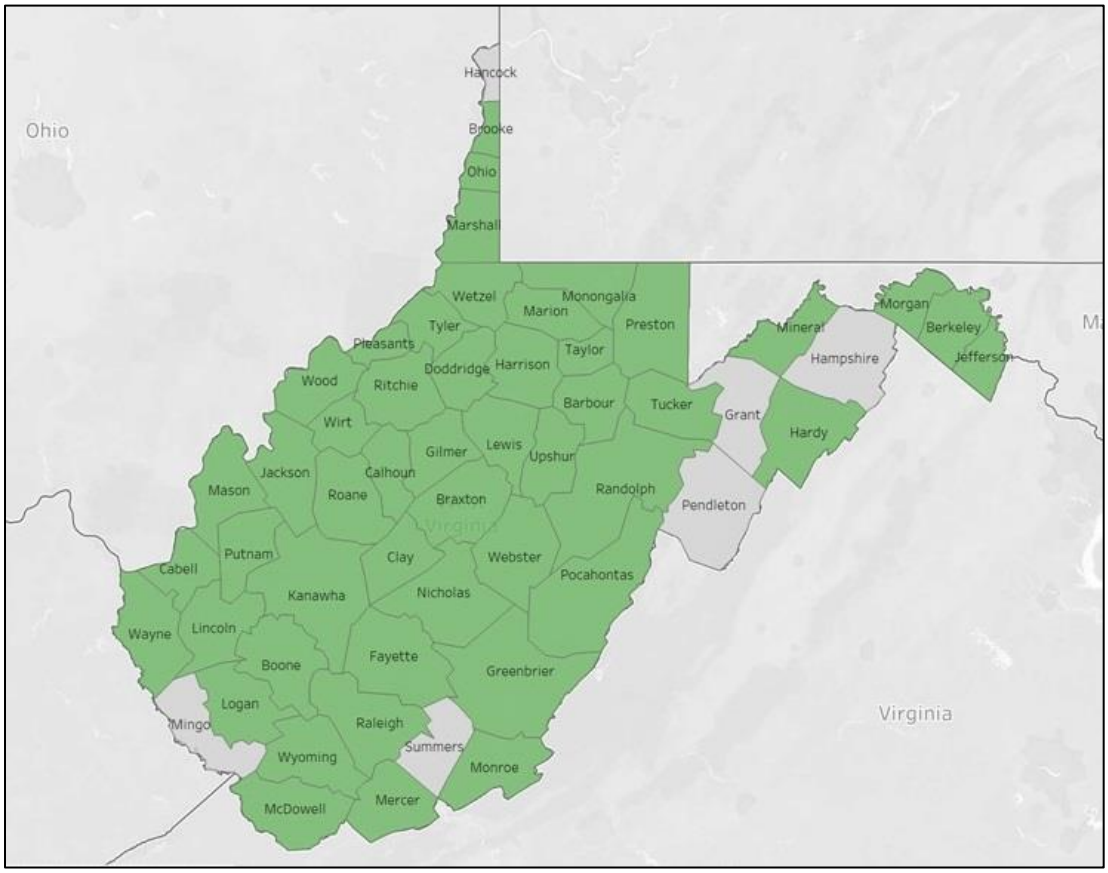

Figure 4. Counties where *Aedes albopictus* has been identified in West Virginia (counties shown in green).

DISCUSSION

Low arboviral infection rates in mosquitoes and the limited geographic distribution of infected mosquitoes resulted in few human arboviral diseases in 2018. Although some weekly WNV MIR did exceed the 5/1000 *Culex* mosquito threshold in August, these high values were not continuously maintained and the WNV MIR in *Culex* mosquitoes started to decrease in September. WNV infection rates in *Culex* species during the 2018 mosquito surveillance seasons were comparable to the low rates from other years when human incidence of West Nile encephalitis was low (2008-2011, 2013-2017). The number of WNV-positive mosquito samples from central and southern West Virginia were higher in 2018 than in previous years. A human case of WNV infection from Wyoming County in November and an equine case of WNV infection from Fayette County in October were preceded by high WNV infection rates in mosquitoes in neighboring Fayette, Raleigh, and Mercer counties in August and September. WNV activity in mosquitoes from West Virginia's eastern panhandle counties was not determined because mosquito surveillance was not conducted in this region in 2018. However, human disease surveillance showed a human case of WNV infection from Hardy County in September and an equine case of WNV infection from Berkeley County in September.

Aedes albopictus has a wide geographic distribution across the state (Figure 4) 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., LACV) and local transmission of a non-endemic arboviral diseases (dengue, chikungunya, ZIKV) 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. LACV-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 West Virginia whose efforts 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 2018 mosquito surveillance season.

County	AA	AE	AN	CO	CU	OR	PS	UR
Boone	1	1	1	0	1	0	1	0
Cabell	204	44	8	0	62	0	10	4
Doddridge	3	3	0	0	5	0	0	0
Fayette	1	9	5	7	36	0	0	0
Greenbrier	0	1	0	0	1	0	0	0
Hardy	1	1	1	0	1	0	1	0
Harrison	1	2	2	0	2	0	1	0
Jackson	0	1	1	0	1	0	0	0
Kanawha	21	19	0	0	48	0	0	0
Lewis	1	1	0	0	1	0	0	0
Marion	3	3	0	0	2	0	0	0
Marshall	1	1	1	0	3	0	1	0
Mercer	1	6	1	0	4	1	0	0
Mineral	1	1	1	0	0	0	0	0
Monongalia	1	5	1	0	6	0	0	0
Nicholas	0	12	11	8	104	0	7	1
Ohio	0	4	3	0	4	0	0	0
Pleasants	1	1	0	0	1	0	0	0
Raleigh	1	13	10	1	57	0	4	0
Randolph	0	1	1	1	1	0	0	0
Ritchie	1	2	1	0	2	1	1	0
Taylor	2	2	0	0	3	0	0	0
Wayne	3	1	0	0	2	0	0	0
Wetzel	1	1	0	0	1	0	1	0
Wood	11	27	8	3	24	1	12	2
Total	260	162	56	20	372	3	39	7

AA=*Aedes albopictus*
AE=*Aedes* spp.
AN=*Anopheles* spp.
CO=*Coquillettidia* spp.
CU=*Culex* spp.
OR=*Orthopodomyia* spp.
PS=*Psorophora* spp.
UR=*Uranotaenia* spp.