

# Arboviral Surveillance and Control Annual Report: Pennsylvania, 2016

Arbovirus  
Surveillance  
Program

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**pennsylvania**  
DEPARTMENT OF HEALTH

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# Introduction

Arthropod-borne viruses (arboviruses) negatively impact the health of millions around the world. Arboviral outbreaks are difficult to predict and control due to complex transmission cycles, increasing globalization and environmental impacts related to climate change. Arboviruses originating domestically (e.g., West Nile virus [WNV]) or introduced through international travel (e.g., Zika virus, dengue virus and chikungunya virus) constitute a potential public health threat to Pennsylvania by causing human morbidity and mortality, as well as agricultural and other economic impacts. The Pennsylvania Department of Health (DOH) leads a multi-agency team that includes the Pennsylvania Department of Environmental Protection (DEP) and the Pennsylvania Department of Agriculture (PDA) and is tasked with reducing the impact of WNV and other arboviruses in Pennsylvania through a coordinated arboviral surveillance and control program. DOH is responsible for surveillance and investigation of human arboviral infections, as authorized by the Disease Prevention and Control Law of 1955 (35 P. S. § § 521.1—521.21). DEP is responsible for mosquito surveillance and control activities, responding to and coordinating testing of deceased avian specimens and maintaining the public WNV website (<http://www.westnile.state.pa.us/>). The actions taken by DEP are authorized by and conducted in accordance with the following: Section 1917-A of the Act of April 9, 1929 (P.L. 177, No.175), as amended, known as the Administrative Code of 1929, 25 PA Code, Chapter 243. PDA facilitates testing of equine (and other veterinary) specimens for WNV and other arboviruses. In general, arboviral testing is conducted by each agency's own laboratory. This report provides a summary of arboviral surveillance and control activities in Pennsylvania from Jan. 1, 2016, through Dec. 31, 2016. For more information on arboviral diseases, please follow the following links to the DOH website: [West Nile virus](#), [Zika virus](#), [dengue virus](#) and [chikungunya virus](#).

## Overview

During 2016, sixteen human WNV disease cases were recorded along with two asymptomatic WNV presumed viremic donors (WNV-PVD). Of the 16 clinically apparent WNV infections, 11 were neuroinvasive, 15 were hospitalized and two deaths were reported. Mosquito sampling and testing yielded 1,457 WNV-positive pools (8.6 percent of those collected). Sixteen deceased avian specimens were WNV-positive (26.2 percent of those submitted), and six equine specimens tested positive for WNV. WNV activity among humans during 2016 was slightly higher than expected compared with previous non-epidemic years. National WNV epidemics, which also impacted Pennsylvania, occurred during the years 2002–2003 and 2012.<sup>1</sup>

In addition to human WNV disease cases, several confirmed or probable travel-associated arboviral infections were recorded among Pennsylvania residents during 2016, including 21 dengue virus cases and five chikungunya virus disease cases. No evidence of local mosquito-borne transmission of these viruses was identified during this time. The year 2016 was notable for the global emergence of Zika virus. Following an outbreak of Zika virus in Brazil in 2015, several additional countries in the Americas and Caribbean began to report locally acquired cases of mosquito-borne transmission (2). As more cases were reported, it became apparent that Zika virus was linked to neurological disorders such as microcephaly among newborns and Guillain-Barré syndrome (2). Although local mosquito-borne transmission in the United States was limited to Florida and Texas, over 200 Zika virus cases were identified among Pennsylvania residents in 2016.

Mosquito WNV activity was detected in 41 of 67 counties. In response, a collaborative network of mosquito control services conducted over 3,000 control events covering more than 50,000 acres across Pennsylvania during 2016. In addition to these events, over 70,000 urban catch basins, which are important breeding sites for mosquitoes, were treated in Pennsylvania cities.

# Surveillance Summary

## Human Case Surveillance

In Pennsylvania, all human arboviral infections are reportable to DOH by clinicians and laboratories (28 Pa. Code § 27.21a, 28 Pa. Code § 27.22). Reports are submitted electronically to DOH through Pennsylvania's National Electronic Disease Surveillance System (PA-NEDSS) and assigned to public health investigators for follow-up based on the location of the patient's residence. The most frequently reported domestic arboviral infection among Pennsylvania residents is WNV. Over the past 10 years, infections due to Powassan encephalitis virus, Jamestown Canyon virus and St. Louis encephalitis virus have also been reported; however, none of these less-common domestic arboviruses were reported in 2016 (Table 1).

All human case data were obtained from ArboNET, the national electronic surveillance system for arboviral diseases administered by the Centers for Disease Control and Prevention (CDC). Arboviral disease cases are initially reported into PA-NEDSS and then entered into the ArboNET Web application once preliminary investigation determines the case to meet the probable or confirmed case classification of the current applicable national case definition (other than WNV-PVDs, which are considered non-cases but are still reported for surveillance purposes). ArboNET designates the reporting year for each reportable case based on the year in which illness onset occurred.

WNV and chikungunya virus disease cases were classified according to the updated 2015 arboviral neuroinvasive and non-neuroinvasive disease case definitions (Council of State and Territorial Epidemiologists [CSTE] position statement number 14-ID-04). Dengue cases were classified using the 2015 dengue case definition (CSTE position statement number 14-ID-10). Zika virus disease cases were classified using the 2016 case definition (CSTE position statement 16-ID-01). Case definitions can be reviewed at: <http://wwwn.cdc.gov/nndss/conditions/search/>.

**Table 1 – Confirmed or Probable Arboviral Infections Reported to ArboNET by Arbovirus and Year– Pennsylvania, 2001–2016**

**Note: Non-WNV arboviruses were not added to ArboNET until 2003.**

Year	No. Cases									
	West Nile virus (WNV)	Eastern equine encephalitis virus (EEEV)	Jamestown canyon virus (JCV)	La Crosse encephalitis virus (LACV)	Powassan virus (POWV)	St. Louis encephalitis virus (SLEV)	Dengue virus (DENV)	Chikungunya virus (CHIKV)	Zika virus (ZIKV)	Unspecified flavivirus
2001	3	-	-	-	-	-	-	-	-	-
2002	59	-	-	-	-	-	-	-	-	-
2003	240	0	0	0	0	1	0	0	0	0
2004	15	0	0	0	0	0	0	0	0	0
2005	25	0	0	0	0	0	0	0	0	0
2006	9	0	0	0	0	0	3	2	0	0
2007	10	0	0	0	0	0	15	1	0	0
2008	14	0	0	0	0	1	3	0	0	0
2009	0	0	0	0	0	0	5	0	0	0
2010	28	0	0	0	0	0	21	0	0	0
2011	6	0	0	0	1	0	16	1	0	0
2012	60	0	0	0	0	0	21	0	0	0
2013	11	0	1	0	0	0	24	0	0	0
2014	13	0	0	0	0	0	8	97	0	0
2015	30	0	0	0	0	0	23	8	1	1
2016	16	0	0	0	0	0	21	5	206	0
<b>Total</b>	<b>539</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>1</b>	<b>2</b>	<b>160</b>	<b>114</b>	<b>207</b>	<b>1</b>

Source: ArboNET.

## A. WNV

Sixteen WNV disease cases and two asymptomatic WNV-PVD were recorded during 2016 (Table 2). Almost half of WNV disease cases were neuroinvasive infections affecting adults 60 years of age or older. All cases except one required hospitalization, and two fatalities were reported (Table 2). WNV disease cases were recorded among residents of 10 counties, including: Philadelphia (4), Bucks (2), Delaware (2), Montgomery (2), Chester (1), Indiana (1), Lancaster (1), Lebanon (1), Northampton (1) and York (1) [Figure 1].

The first WNV disease cases of the 2016 season experienced symptom onset during the week ending June 4, 2016 (epidemiologic week 22). Most human cases were clustered the week ending Sept. 3 (epidemiologic week 35) and the week ending Sept. 24 (epidemiologic week 38). The timing of human cases is consistent with previous years.

Based on the number of cases recorded during 2001–2015, a median of 11 WNV-ND cases, 5 WNV-NND cases and 1 WNV-PVDs are expected annually. Overall, 2016 WNV case counts were slightly higher than expected compared to previous non-epidemic years (i.e., years other than 2002–2003 and 2012) [Table 3].

**Table 2 – Characteristics of WNV Cases Reported to ArboNET by Infection Type – Pennsylvania, 2016**

Characteristic	Value	No. Cases (Percent)		
		WNV-ND <sup>a</sup>	WNV-NND <sup>b</sup>	WNV-PVD <sup>c</sup>
<b>Age group (in years)</b>	0 – 19	0 (0.0)	0 (0.0)	0 (0.0)
	20 – 39	1 (9.1)	2 (40.0)	0 (0.0)
	40 – 59	3 (27.3)	1 (20.0)	1 (50.0)
	60+	7 (63.6)	2 (40.0)	1 (50.0)
<b>Sex</b>	Female	4 (36.4)	3 (60.0)	1 (50.0)
	Male	7 (63.6)	2 (40.0)	1 (50.0)
<b>Hospitalized</b>	Yes	11 (100.0)	4 (80.0)	-
	No	0 (0.0)	1 (20.0)	-
<b>Fatality</b>	Yes	2 (18.2)	0 (0.0)	-
	No	8 (72.7)	5 (100.0)	-
	Unknown	1 (9.1)	0 (0.0)	-
<b>Case classification</b>	Confirmed	6 (54.5)	1 (20.0)	-
	Probable	5 (45.5)	4 (80.0)	-
<b>Total cases</b>		11 (100.0)	5 (100.0)	2 (100.0)

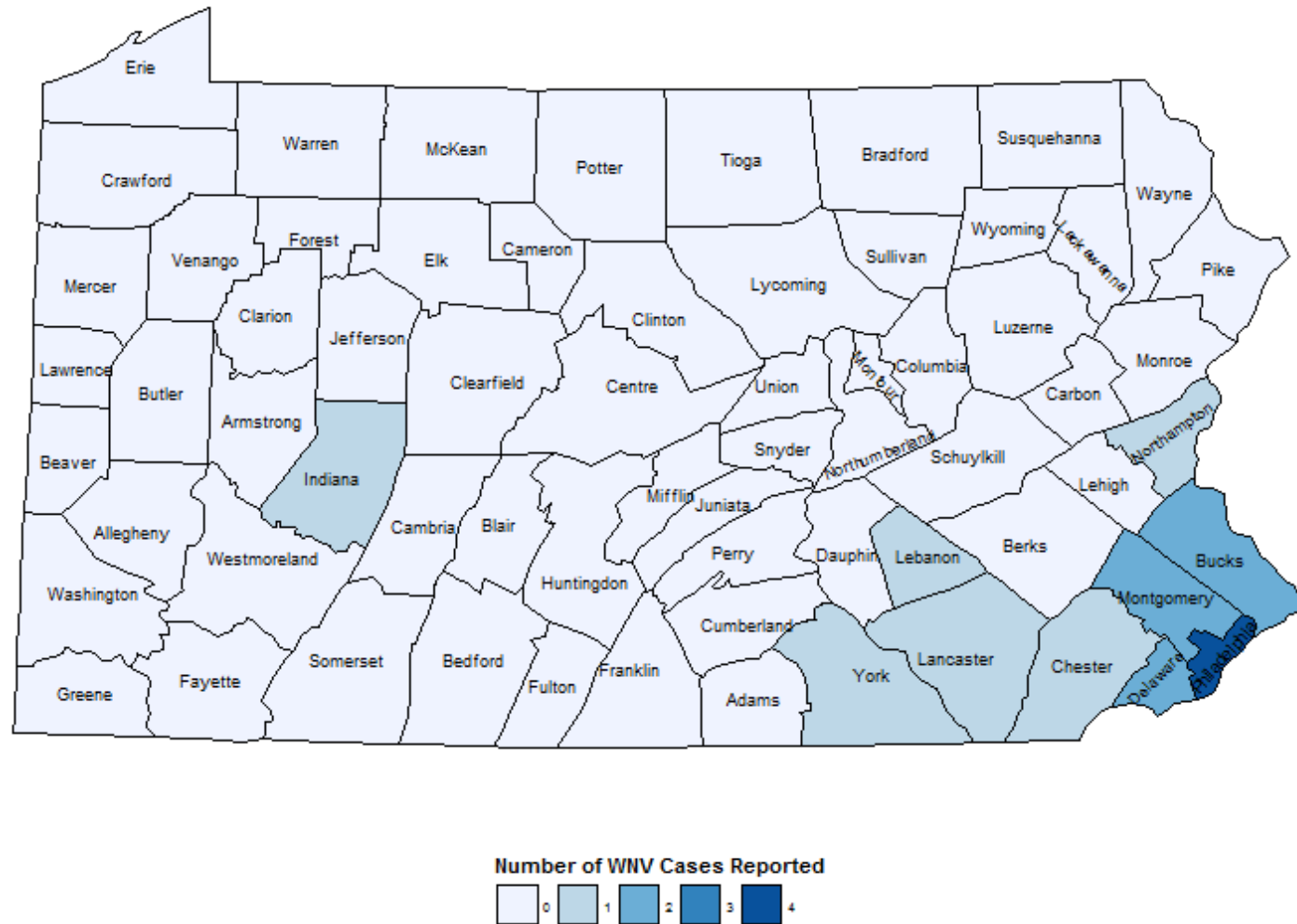
Source: ArboNET.

<sup>a</sup>West Nile virus neuroinvasive disease (i.e., encephalitis, meningitis, acute flaccid paralysis, etc.)

<sup>b</sup>West Nile virus non-neuroinvasive disease (i.e., West Nile fever)

<sup>c</sup>West Nile virus presumptive viremic donor (asymptomatic; detected via blood donor screening)

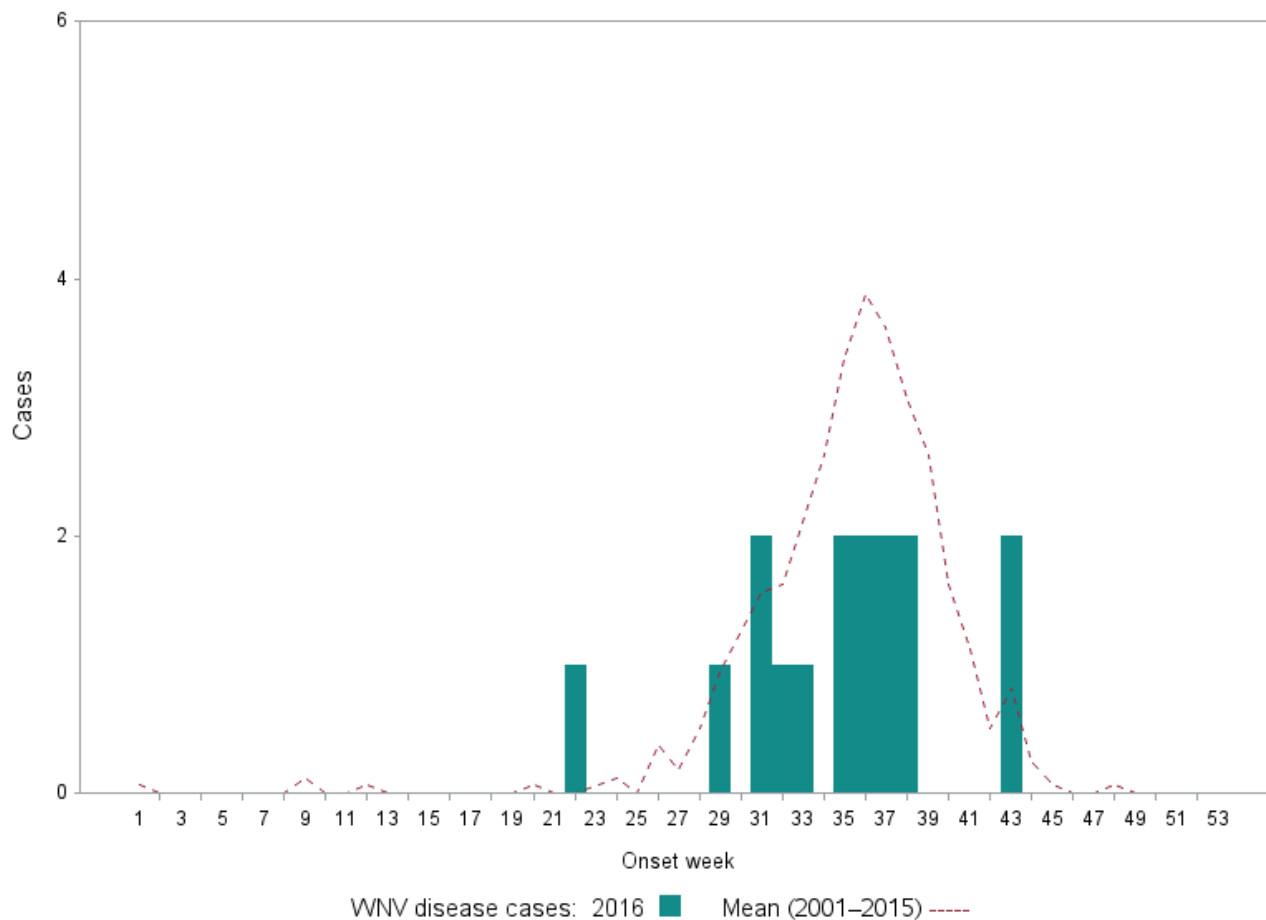
**Figure 1 – WNV Disease Cases Reported to ArboNET by County of Case Residence – Pennsylvania, 2016**  
**Note: WNV-PVDs are not depicted**



Source: ArboNET.



**Figure 2 – WNV Disease Cases Reported to ArboNET by Epidemiologic Week of Onset in Comparison to Historic Average – Pennsylvania, 2016**  
**Note: WNV-PVDs are not depicted.**



Source: ArboNET.

**Table 3 – Number of WNV Cases Reported to ArboNET by Infection Type – Pennsylvania, 2001–2016**

Year	No. Cases		
	WNV-ND	WNV-NND	WNV-PVD
2001 <sup>a</sup>	3	0	0
2002	59	0	0
2003	148	92	10
2004 <sup>a</sup>	9	6	1
2005	14	11	3
2006	8	1	1
2007	5	5	2
2008	12	2	0
2009	0	0	0
2010	19	9	0
2011 <sup>a</sup>	5	1	0
2012	33	27	4
2013	6	5	0
2014 <sup>a</sup>	11	2	4
2015 <sup>a</sup>	17	13	1
2016	11	5	2

<sup>a</sup>A change in the national case definition for WNV took effect beginning this year.

Source: ArboNET.

## B. Dengue

Twenty-one travel-associated cases of dengue were recorded during 2016 (Table 4). Most cases occurred in adults, the majority were not hospitalized, and no deaths were reported. None of the dengue cases reported in 2016 were classified as severe dengue (Table 5). To date, no locally-acquired mosquito-borne dengue cases have been identified in Pennsylvania.

Dengue cases recorded during 2016 were residents of the following Pennsylvania counties: Allegheny (5), Bucks (2), Centre (1), Chester (3), Indiana (1), Lancaster (2), Lehigh (1), Monroe (1), Montgomery (2) and Philadelphia (3). Cases were exposed through travel from the following locations: Costa Rica (3), Dominican Republic (1), Guatemala (1), India (3), Jamaica (3), Mexico (1), Paraguay (1), Puerto Rico (2), Saint Martin (2) and Thailand (3). One case had a travel history that included more than one international destination and is not included in the above counts.

Dengue cases reported symptom onset dates ranging from the week ending Jan. 9, 2016 (epidemiologic week 1), through the week ending Nov. 5, 2016 (epidemiologic week 44).

Based on the number of cases recorded during 2010–2015, a median of 21 dengue cases and 0 severe dengue cases are expected annually. No record of Pennsylvania dengue cases prior to 2006 exists in ArboNET. In comparison to the reported cases for the last several years, 2016 case counts were at expected levels (Table 5).

**Table 4 – Characteristics of Dengue Cases Reported to ArboNET – Pennsylvania, 2016**

Characteristic	Value	Dengue Cases (Percent)
<b>Age group (in years)</b>	0 – 19	3 (14.3)
	20 – 39	9 (42.9)
	40 – 59	4 (19.0)
	60+	5 (23.8)
<b>Sex</b>	Female	9 (42.9)
	Male	12 (57.1)
<b>Hospitalized</b>	Yes	4 (19.0)
	No	14 (66.7)
	Unknown	3 (14.3)
<b>Fatality</b>	Yes	0 (0.0)
	No	19 (90.5)
	Unknown	2 (9.5)
<b>Case classification</b>	Confirmed	9 (42.9)
	Probable	12 (57.1)
	<b>Total cases</b>	<b>21 (100.0)</b>

Source: ArboNET.

**Table 5 – Dengue Cases Reported to ArboNET by Year and Infection Type – Pennsylvania, 2006–2016**

Year	No. Cases	
	Dengue fever	Severe dengue
2006	3	0
2007	15	1
2008	2	1
2009	6	0
2010 <sup>a</sup>	21	0
2011	16	0
2012	21	0
2013	24	0
2014	8	0
2015 <sup>a</sup>	23	0
2016	21	0

<sup>a</sup>A change in the national case definition for dengue took effect beginning this year.

Source: ArboNET.

### C. Chikungunya Virus Disease

Five travel-associated non-neuroinvasive chikungunya virus disease cases were recorded in Pennsylvania during 2016. All cases occurred among females older than 40 years. Hospitalization occurred in one case, and no deaths were reported (Table 6). To date, no locally-acquired mosquito-borne chikungunya virus disease cases have been identified in Pennsylvania.

Chikungunya virus disease cases recorded in 2016 were residents of the following Pennsylvania counties: Allegheny (2), Bradford (1), Cumberland (1) and Lancaster (1).

Of the five recorded chikungunya virus disease cases in Pennsylvania in 2016, all cases except one was acquired while traveling in India. The fifth case was acquired from traveling in Venezuela.

Chikungunya virus disease cases reported symptom onset dates ranging from the week ending June 4, 2016 (epidemiologic week 22), through the week ending Nov. 12, 2016 (epidemiologic week 45).

Prior to 2013, only four chikungunya virus disease cases had been reported in Pennsylvania. During 2013-2014, a large outbreak of chikungunya virus affected the Americas (including the Caribbean islands, Central America and South America), resulting in >1 million infections in the affected areas, as well as thousands of imported cases (via travel) in the United States and limited local mosquito-borne transmission in Florida (3,4). During 2014, the outbreak in the Americas resulted in 97 chikungunya virus disease cases being recorded among Pennsylvania residents (all imported from travel outside the continental United States).

Based on the number of cases recorded during 2006–2015, a median of 0 chikungunya virus disease cases are expected annually. In comparison to the history of reported cases per year, 2016 case counts were higher than expected but much lower compared to the unprecedented number of cases documented during 2014 (Table 7).

**Table 6 – Characteristics of Chikungunya Virus Disease Cases Reported to ArboNET – Pennsylvania, 2016**

<b>Characteristic</b>	<b>Value</b>	<b>Chikungunya Virus Disease Cases (Percent)</b>
<b>Age group (in years)</b>	0 – 19	0 (0.0)
	20 – 39	0 (0.0)
	40 – 59	3 (60.0)
	60+	2 (40.0)
<b>Sex</b>	Female	4 (80.0)
	Male	1 (20.0)
<b>Hospitalized</b>	Yes	1 (20.0)
	No	4 (80.0)
	Unknown	0 (0.0)
<b>Fatality</b>	Yes	0 (0.0)
	No	5 (100.0)
	Unknown	0 (0.0)
<b>Case classification</b>	Confirmed	2 (40.5)
	Probable	3 (60.0)
	Total cases	5 (100.0)

Source: ArboNET.

**Table 7 – Chikungunya Virus Disease Cases Reported to ArboNET – Pennsylvania, 2003–2016**

<b>Year</b>	<b>Chikungunya Virus Disease Cases</b>
<b>2006</b>	2
<b>2007</b>	1
<b>2008</b>	0
<b>2009</b>	0
<b>2010</b>	0
<b>2011</b>	1
<b>2012</b>	0
<b>2013</b>	0
<b>2014<sup>a</sup></b>	97
<b>2015<sup>a</sup></b>	8
<b>2016</b>	5

<sup>a</sup>A change in the national case definition for Chikungunya took effect beginning this year.

Source: ArboNET.

#### **D. Zika Virus Disease**

Prior to 2015, no cases of Zika virus infection had been recorded in Pennsylvania. One Zika virus disease case and one unspecified flavivirus infection were recorded in Pennsylvania during late 2015. The unspecified flavivirus infection case had evidence of neutralizing antibodies to Zika and dengue viruses, and the identity of the infecting virus could not be determined. Both cases acquired infection during travel to locations in the Americas experiencing active transmission of Zika virus, which emerged in Brazil as early as 2014. Zika virus rapidly spread throughout South America, Central America and the Caribbean during 2015 and 2016. There was also limited local mosquito-borne transmission in the United States during 2016 in Florida and Texas.

In total, 206 Zika virus cases were recorded in Pennsylvania in 2016 in the following categories: 175 non-congenital Zika virus disease cases, 30 non-congenital Zika virus infection cases and one congenital Zika virus infection case. Hospitalization occurred in six cases, and no deaths were reported (Table 8). Zika virus cases were reported from 36 counties, but most commonly among residents in southeastern Pennsylvania. DOH identified thirteen Zika virus case clusters in five counties. Clusters were defined as an occurrence of two or more Zika virus cases with residence less than one mile apart, with either onset date or specimen collection date less than 14 days apart. As part of a collaborative approach to prevent local mosquito-borne transmission, DEP responded to the clusters with preventive measures, such as habitat assessment and, if warranted, surveillance testing of mosquito pools, as well as control of the associated vector population for Zika virus. To date, no locally-acquired mosquito-borne Zika virus disease cases have been identified in Pennsylvania.

Of the 206 identified cases, 198 were acquired outside the continental U.S. from the following regions: 163 from the Caribbean, 27 from Central America, seven from South America and one from Southeast Asia (Figure 3). Eight Zika virus cases were acquired in the U.S. This includes two following travel to affected areas in Florida, four acquired through sexual transmission, one from perinatal transmission and one occupational laboratory exposure.

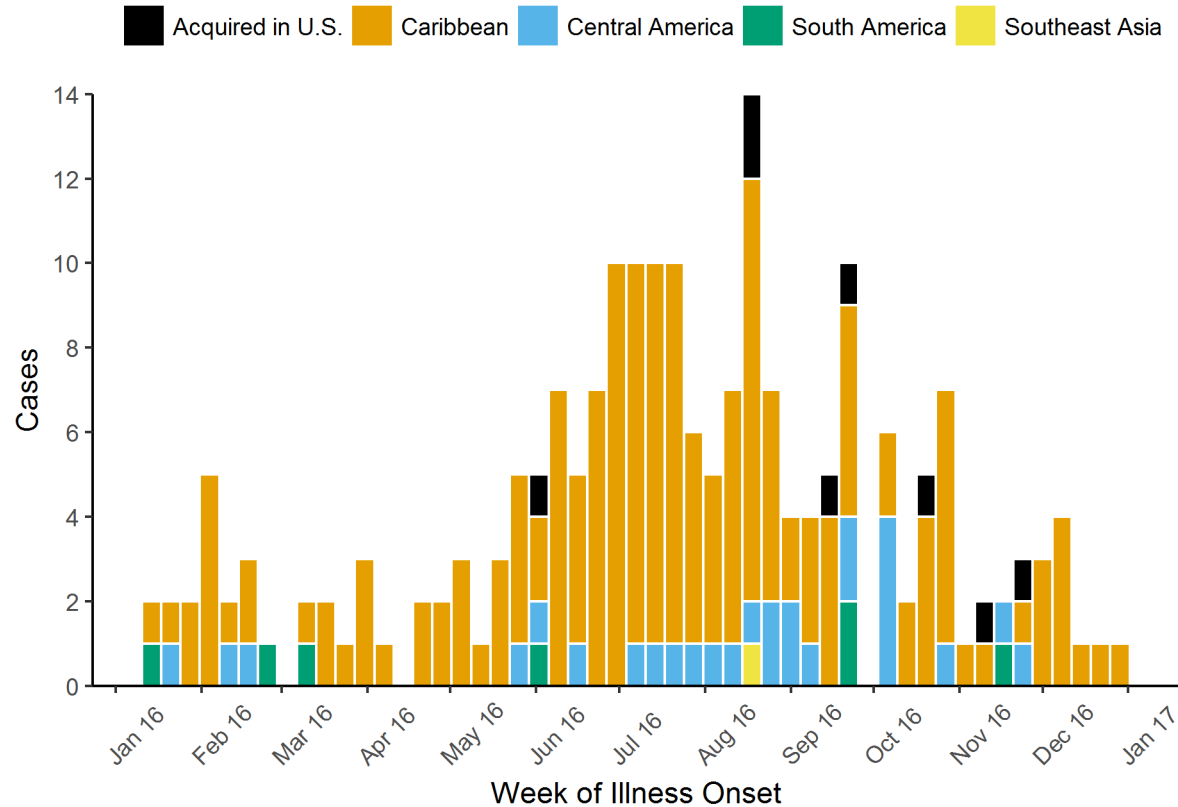
Zika virus cases reported symptom onset dates ranging almost the entire year, except the first week (epidemiologic week 1), ending Jan. 9, 2016. Almost half (49.5 percent) of all cases occurred June through August.

**Table 6 – Characteristics of Chikungunya Virus Disease Cases Reported to ArboNET – Pennsylvania, 2016**

Characteristic	Value	No. Cases (Percent)			
		Zika virus disease, congenital	Zika virus disease, non-congenital	Zika virus infection, congenital	Zika virus infection, non-congenital
<b>Age group (in years)</b>	0 – 19	0 (0.0)	25 (14.3)	1 (100.0)	6 (20.0)
	20 – 39	0 (0.0)	74 (42.3)	0 (0.0)	23 (76.7)
	40 – 59	0 (0.0)	52 (29.7)	0 (0.0)	1 (3.3)
	60+	0 (0.0)	24 (13.7)	0 (0.0)	0 (0.0)
<b>Sex</b>	Female	0 (0.0)	121 (69.1)	0 (0.0)	29 (96.7)
	Male	0 (0.0)	54 (30.9)	1 (100.0)	1 (3.3)
<b>Hospitalized</b>	Yes	0 (0.0)	6 (3.4)	0 (0.0)	0 (0.0)
	No	0 (0.0)	158 (90.3)	1 (100.0)	29 (96.7)
	Unknown	0 (0.0)	11 (6.3)	0 (0.0)	1 (3.3)
<b>Fatality</b>	Yes	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
	No	0 (0.0)	167 (95.4)	1 (100.0)	29 (96.7)
	Unknown	0 (0.0)	8 (4.6)	0 (0.0)	1 (3.3)
<b>Case classification</b>	Confirmed	0 (0.0)	135 (77.1)	0 (0.0)	9 (30.0)
	Probable	0 (0.0)	40 (22.9)	1 (100.0)	21 (70.0)
<b>Total cases</b>		0 (0.0)	175 (100.0)	1 (100.0)	30 (100.0)

Source: ArboNET.

**Figure 3 – Zika Virus Cases Reported among Pennsylvania Residents by Week of Illness Onset and Exposure Location, 2016**



Source: ArboNET.



## Non-human Surveillance Summary

All non-human arbovirus surveillance data were obtained from a WNV specimen database maintained by DEP. This database serves as a single portal to collect DOH, DEP and PDA arboviral data, which are regularly summarized on the public WNV website throughout the active mosquito surveillance season (April – October). These data are also uploaded to ArboNET via xml file on a weekly basis. Mosquito and avian specimens are tested via polymerase chain reaction (PCR), and veterinary specimens are tested via IgM antibody capture enzyme-linked immunosorbant assay (ELISA), immunohistochemistry (IHC) or PCR, depending on the specimen type. The only arbovirus detected through non-human arbovirus surveillance during 2016 was WNV. However, WNV is normally the only arbovirus for which testing is done except during special surveillance projects based on the known distribution of domestic arboviruses in Pennsylvania.

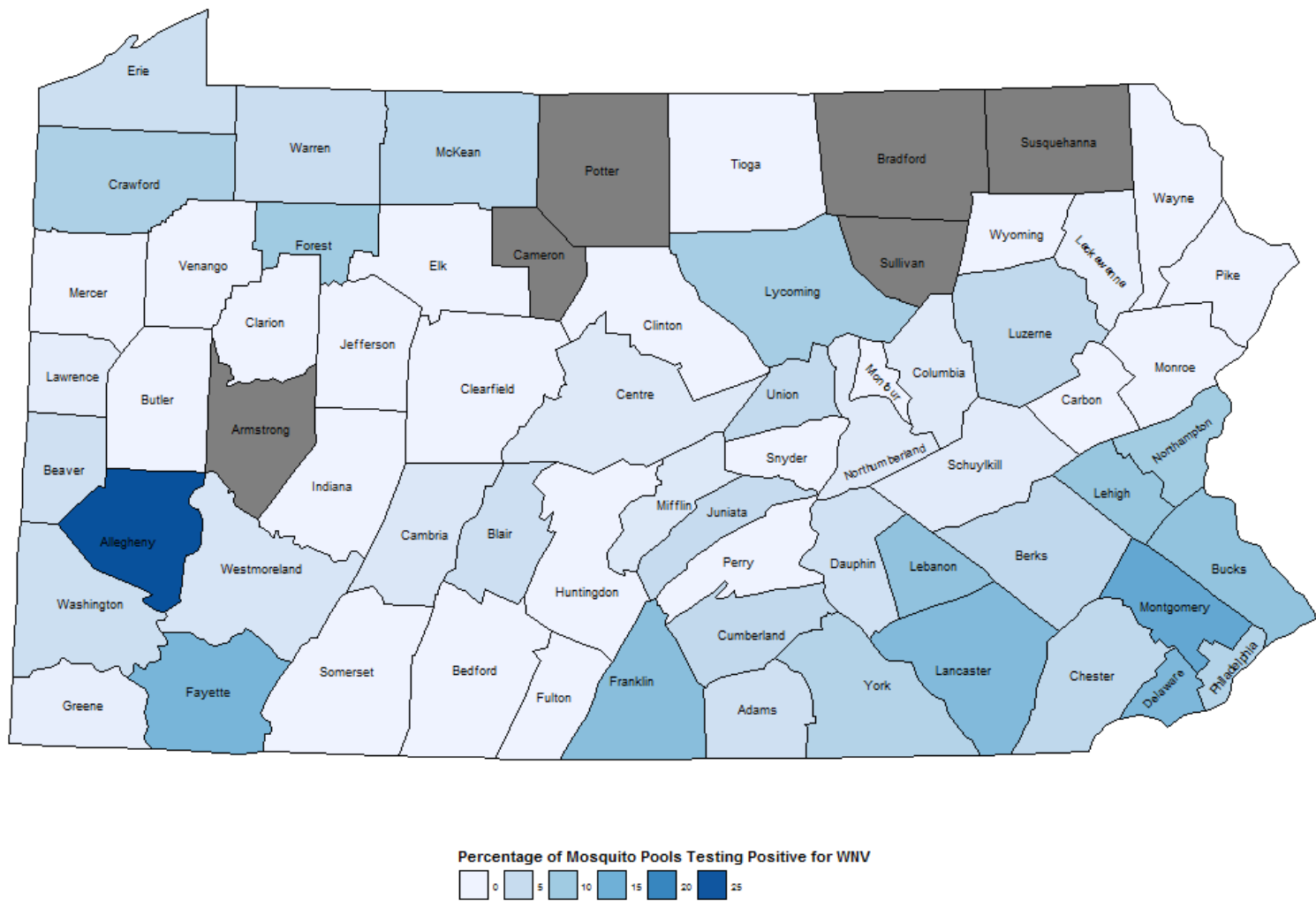
### A. WNV

Program staff collected 16,931 pools of mosquitoes from 61 counties during 2016 (Figure 4). Of these, WNV was detected in 1,457 (8.6 percent) pools collected from 39 counties (Table 8). The first positives were detected the week ending May 24, 2016 (epidemiologic week 21). Statewide WNV pool positivity peaked at 34 percent during the week ending Aug. 20, 2016 (epidemiologic week 33). No positive pools were detected after the week ending Oct. 22, 2016 (epidemiologic week 42), and no additional samples were collected after the week ending Nov. 26, 2016 (Figure 5). Based on *Culex* species mosquitoes collected by gravid trap with a pooled sample size of at least 25, overall weekly pool positivity was consistently higher than the average weekly positivity of prior years (2001–2015). Additionally, the overall percentage of WNV-positive pools observed during 2016 was higher than expected compared to previous non-epidemic years (i.e., years other than 2002–2003 and 2012).

A total of 61 deceased avian specimens were collected, and WNV was detected in 16 of these specimens (26.2 percent) [Table 8]. Positive avian specimens were collected from the following counties: Erie (6), Lancaster (3), Centre (2), Franklin (1), Fayette (1), Blair (1), Clinton (1) and Indiana (1). Collection dates of positive specimens ranged from the week ending May 7, 2016 (epidemiologic week 18), to the week ending Oct. 22, 2016 (epidemiologic week 42). The percentage of WNV-positive avian specimens observed during 2016 was about average compared to previous non-epidemic years (i.e., years other than 2002–2003 and 2012).

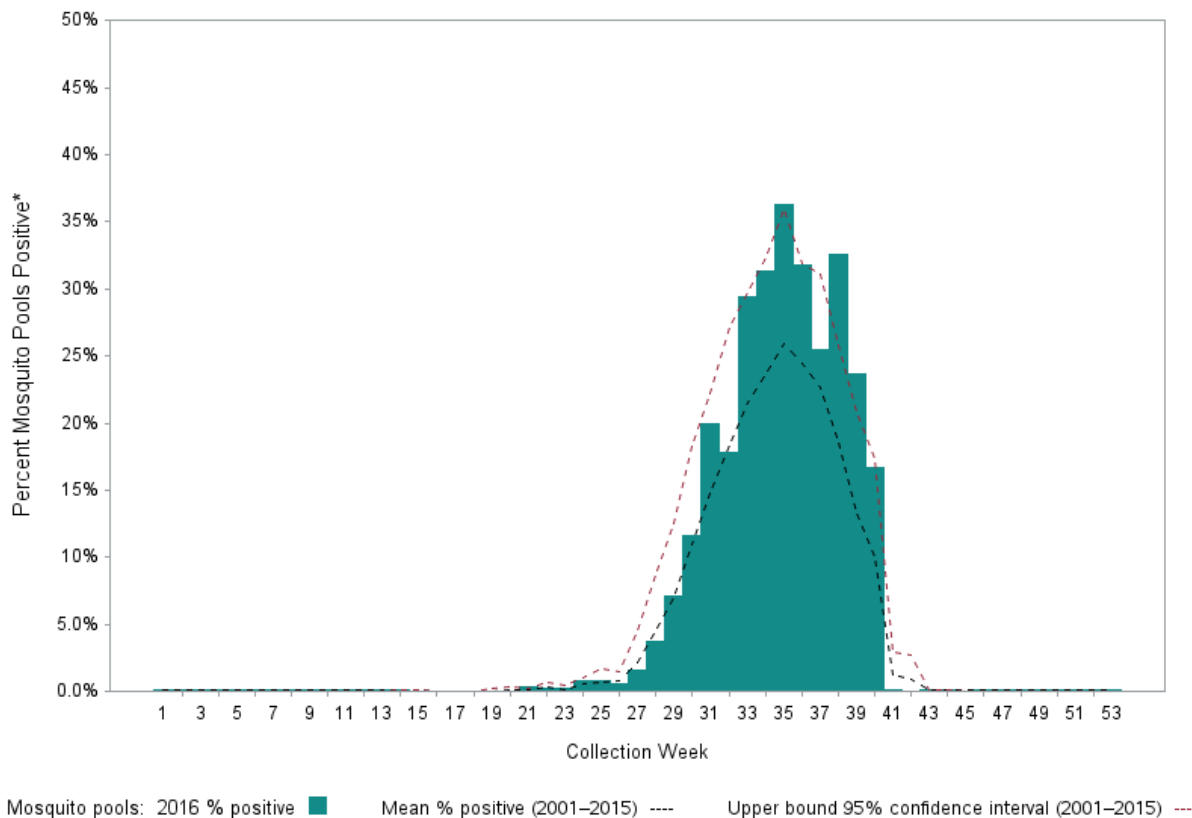
Six veterinary specimens tested positive for WNV IgM antibodies during 2016 from the following counties: Lancaster (3), Centre (2) and Mifflin (1). The first equine tested positive the week ending Sept. 10, 2016 (epidemiologic week 36), and the sixth equine tested positive the week ending Oct. 15, 2016 (epidemiologic week 41). The number of WNV-positive veterinary specimens was slightly higher than average during 2016 compared to previous non-epidemic years (i.e., years other than 2002–2003 and 2012) [Table 8].

**Figure 4 – WNV-positive Mosquito Pools Collected during 2016 by Pennsylvania County**



Source: ArboNET/The Pennsylvania West Nile Virus Control Program (DEP).

**Figure 5 – Percentage of WNV-positive Mosquito Pools Collected by Epidemiologic Week in Pennsylvania during 2016 in Comparison to the Average Weekly Percentage Positive from 2001–2015**



\*Percent positive is based on Culex species collected by gravid trap with a pooled sample size of at least 25.

Source: ArboNET/The Pennsylvania West Nile Virus Control Program (DEP).

**Table 8 – Summary of Non-human WNV Surveillance Activity in Pennsylvania by Year, 2000–2016**

Year	Mosquito Pools				Deceased Avian Specimens			Veterinary Specimens
	No. collected	No. positive	Percent positive	Adjusted percent positive*	No. collected	No. positive	Percent positive	No. positive
2000	2,273	46	-	-	1,346	37	2.7	1
2001	12,465	53	0.4	0.8	990	361	36.5	6
2002	30,530	769	2.5	14.0	2,449	1,410	57.6	97
2003	29,415	1,243	4.2	15.0	873	546	62.5	545
2004	22,531	228	1.0	4.8	174	45	25.9	9
2005	22,660	428	1.9	7.9	181	23	12.7	0
2006	27,516	272	1.0	3.8	626	55	8.8	2
2007	25,301	249	1.0	3.7	97	10	10.3	1
2008	26,622	638	2.4	5.1	73	14	19.2	2
2009	23,024	311	1.4	2.5	58	10	17.2	2
2010	25,572	1,295	5.1	8.8	56	20	35.7	7
2011	27,402	1,490	5.4	7.8	108	49	45.4	12
2012	23,914	4,302	18.0	26.0	260	135	51.9	50
2013	25,405	1,505	5.9	8.4	80	28	35.0	2
2014	17,156	1,435	8.4	11.0	74	17	23.0	1
2015	18,503	2,689	14.5	14.9	78	31	39.7	2
2016	16,931	1,457	8.6	8.6	61	16	26.2	6

\*To facilitate comparability between years, the percent positive for mosquito pools is based only on *Culex* species mosquitoes collected by gravid trap with a pooled sample size of at least 25.

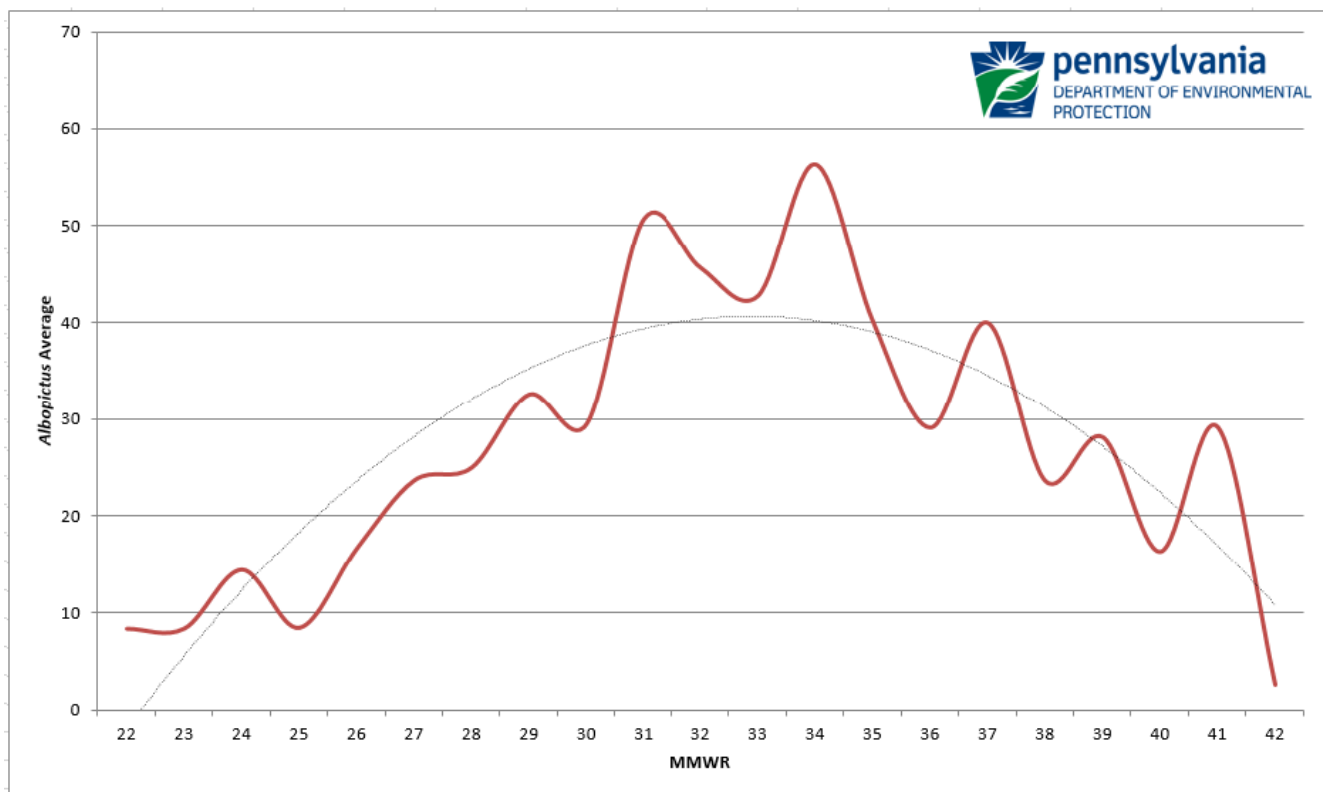
Source: ArboNET/The Pennsylvania West Nile Virus Control Program (DEP).

## B. Zika

DEP staff conducted 495 trapping events in 42 counties from June through October, including weekly density surveys at 167 fixed sites in 25 counties. Program staff collected 100,533 *Ae. albopictus* mosquitoes, a vector of Zika, dengue and chikungunya virus, in 33 of the 67 Pennsylvania counties. Twenty-two of these counties (66.7 percent) reported at least one human Zika virus case. *Ae. albopictus* density peaked during August, averaging 47.7 specimens collected per trap per week during this period (Figure 6). DEP tested 65,374 *Ae. Albopictus* mosquitoes for presence of Zika virus RNA, and all were negative. There was no evidence of *Ae. aegypti* mosquitoes in any of the trapping events.

**Figure 6 – Average Number of *Ae. albopictus* Collected per Trap at Sites Included in the Weekly *Ae. albopictus* Density Survey Conducted by DEP.**

**Note: Only traps collecting at least one specimen were included in the graph.**

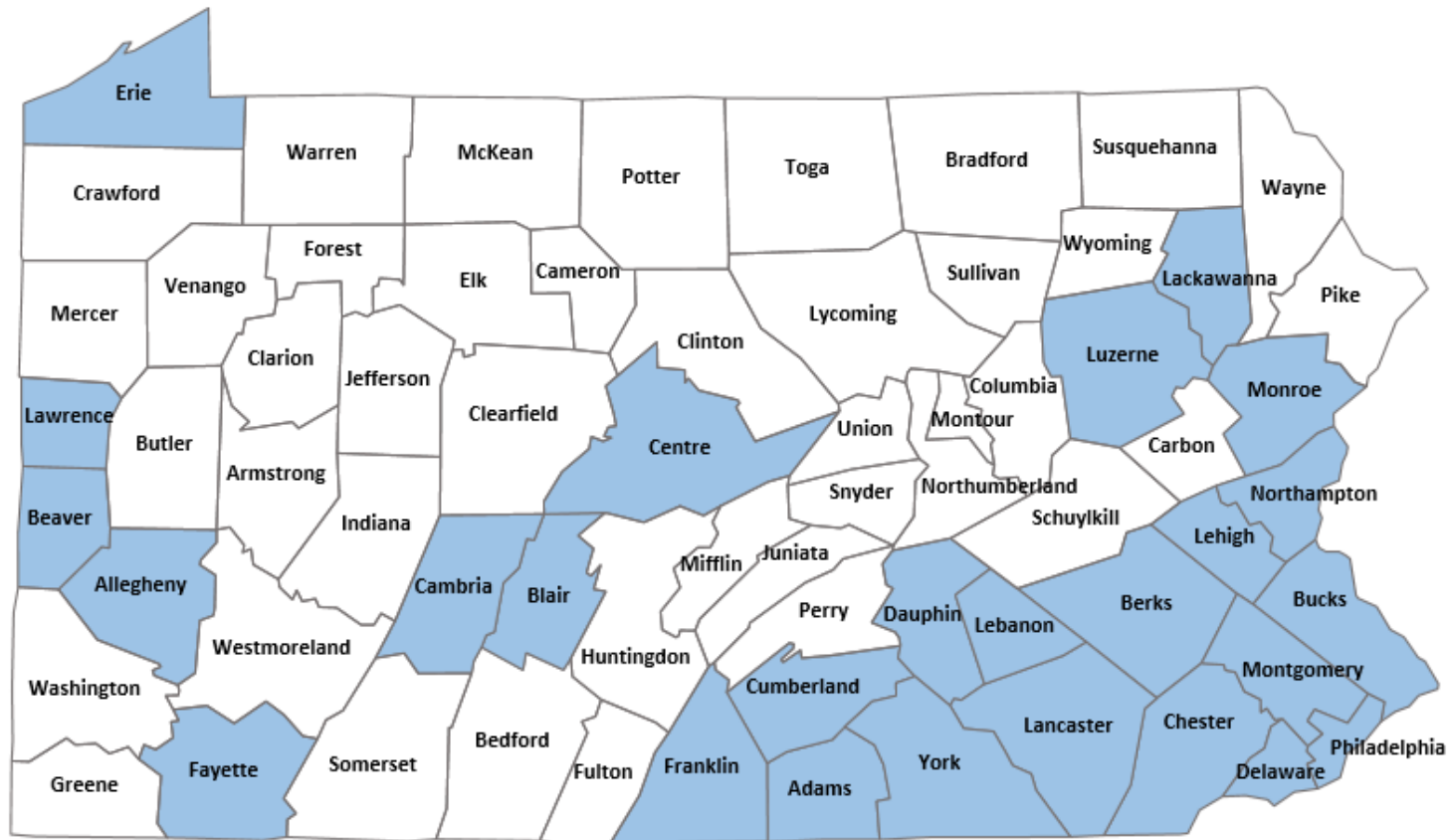


## Mosquito Control Summary

In addition to surveying both human and non-human populations for arboviral disease, Pennsylvania has taken measures to minimize arboviral disease impact in the commonwealth. The goal of the initiative is to limit the scope and intensity of outbreaks of disease; this is done through a collaborative network of local and state mosquito control experts operating an integrated pest management program. DEP organizes the network and partially funds mosquito control services in the 26 counties that have historically displayed the highest risk of endemic WNV disease and imported mosquito-borne diseases such as Zika, dengue, chikungunya, and malaria (Figure 7). In 2016, the commonwealth provided \$2,564,050 in grant funding to these counties. DEP provides reactive surveillance and control services for the remaining 41 counties that do not receive grant funding.

In 2016, this collaborative network of mosquito control services conducted 3,382 mosquito control events covering 50,690 acres. In addition to these events, a total of 70,538 catch basins, which are significant breeding sites for mosquitoes, were treated in Pennsylvania cities. The majority (97 percent) of these treatments were used to control larval sources of mosquitoes.

Figure 7 – Counties Receiving DEP Grant Funding for Mosquito Control Activities in 2016\*



\*DEP funded counties are highlighted in blue.  
Source: The Pennsylvania West Nile Virus Control Program (DEP).

## Acknowledgments

The data summarized in this document represent the combined efforts of numerous disease surveillance and control professionals across Pennsylvania employed at the municipal, county and state levels of government, all of which are committed to protecting the health of all Pennsylvanians.



## Citations

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