



Arboviral Surveillance and Control Annual Report: Pennsylvania, 2015

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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, chikungunya virus, etc.) 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 January 1, 2015, through December 31, 2015.

Overview

During 2015, WNV activity was detected in 56 of 67 counties. Thirty human WNV disease cases were recorded along with one asymptomatic WNV presumed viremic donor (WNV-PVD). Of the 30 clinically apparent WNV infections, 25 were neuroinvasive, 21 were hospitalized and one death was reported. Mosquito sampling and testing yielded 2,689 WNV-positive pools (14.5 percent of those collected and tested). Thirty-one deceased avian specimens were WNV-positive (38.8 percent of those submitted and tested), and two equine specimens tested positive for WNV. No domestic arboviruses other than WNV were reported in Pennsylvania in 2015. WNV activity during 2015 was higher than expected compared with previous non-epidemic years. National WNV epidemics, which also impacted Pennsylvania, occurred during the years 2002–2003 and 2012 (1).

In addition to human WNV disease cases, several confirmed or probable travel-associated arboviral infections were recorded among Pennsylvania residents during 2015, including 23 dengue cases, eight chikungunya virus disease cases, one Zika virus disease case, and one unspecified flavivirus infection. No evidence of local transmission of any of these viruses was identified within Pennsylvania during 2015.

In response to the detection of WNV activity, a collaborative network of mosquito control services conducted over 4,000 control events covering more than 80,000 acres across Pennsylvania during 2015. In addition to these events, nearly 67,000 urban catch basins, which are important breeding sites for mosquitoes, were treated.

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 (PANEDSS) 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 2015 (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 PANEDSS 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 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 2015 arboviral diseases case definition (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 an interim case definition (CSTE position statement 16-ID-01 Interim). Unspecified flavivirus infections were classified based upon unpublished guidance from CDC. 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, 2001–2015

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	0	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	0	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
Total	539	0	1	0	1	0	162	112	1	1

Source: ArboNET.

A. WNV

Thirty WNV disease cases and one asymptomatic WNV-PVD were recorded during 2015 (Table 2). The majority of WNV disease cases were neuroinvasive infections affecting adults 40 years of age or older. Twenty-one cases required hospitalization, and one fatality was reported (Table 2). WNV disease cases were recorded among residents of 14 counties, including: Allegheny (3), Beaver (1), Bucks (3), Chester (2), Cumberland (1), Dauphin (2), Delaware (2), Erie (2), Lancaster (1), Lebanon (1), Luzerne (1), Montgomery (3) and Philadelphia (6) and York (2) (Figure 1).

The first two WNV disease cases of the 2015 season experienced symptom onset during the week ending July 25, 2015 (epidemiologic week 29). Case activity peaked during the week ending August 22, 2015 (epidemiologic week 33) (Figure 2). Compared with previous years, human WNV case activity peaked approximately four weeks earlier than expected during 2015.

Based on the number of cases recorded during 2001–2014, a median of 10.0 WNV-ND cases, 3.5 WNV-NND cases and 0.5 WNV-PVDs are expected annually. Overall, 2015 WNV case counts were 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, 2015

Characteristic	Value	No. Cases (percent)		
		WNV-ND ^a	WNV-NND ^b	WNV-PVD ^c
Age group (in years)	0 – 19	0 (0.0)	0 (0.0)	0 (0.0)
	20 – 39	3 (17.7)	2 (15.4)	0 (0.0)
	40 – 59	7 (41.2)	6 (46.2)	1 (100.0)
	60+	7 (41.2)	5 (38.5)	0 (0.0)
Sex	Female	11 (64.7)	2 (15.4)	0 (0.0)
	Male	6 (35.3)	11 (84.6)	1 (100.0)
Hospitalized	Yes	17 (100.0)	4 (30.8)	-
	No	0 (0.0)	9 (69.2)	-
Fatality	Yes	1 (5.9)	0 (0.0)	-
	No	15 (88.2)	13 (100.0)	-
	Unknown	1 (5.9)	0 (0.0)	-
Case classification	Confirmed	10 (58.8)	9 (69.2)	-
	Probable	7 (41.2)	4 (30.8)	-
Total Cases		17(100.0)	13 (100.0)	1 (100.0)

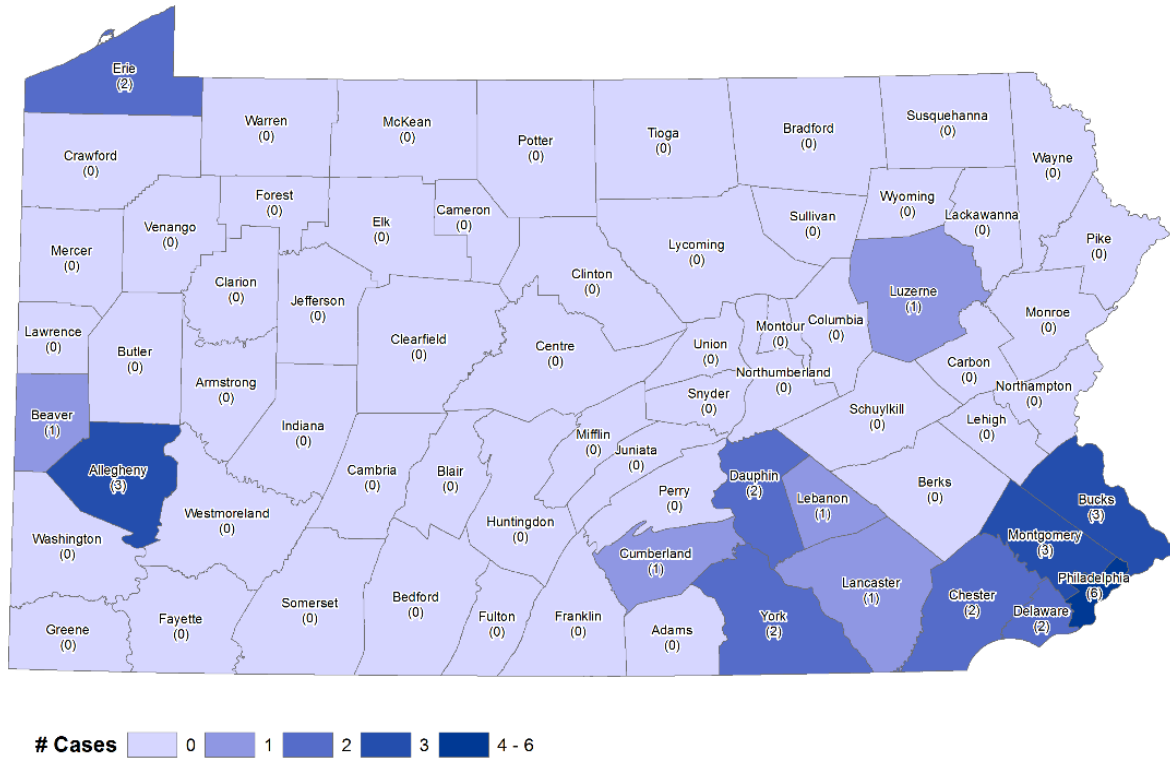
Source: ArboNET.

^aWest Nile virus neuroinvasive disease (i.e., encephalitis, meningitis, acute flaccid paralysis, etc.)

^bWest Nile virus non-neuroinvasive disease (i.e., West Nile fever)

^cWest Nile virus presumptive viremic donor (asymptomatic; detected via blood donor screening)

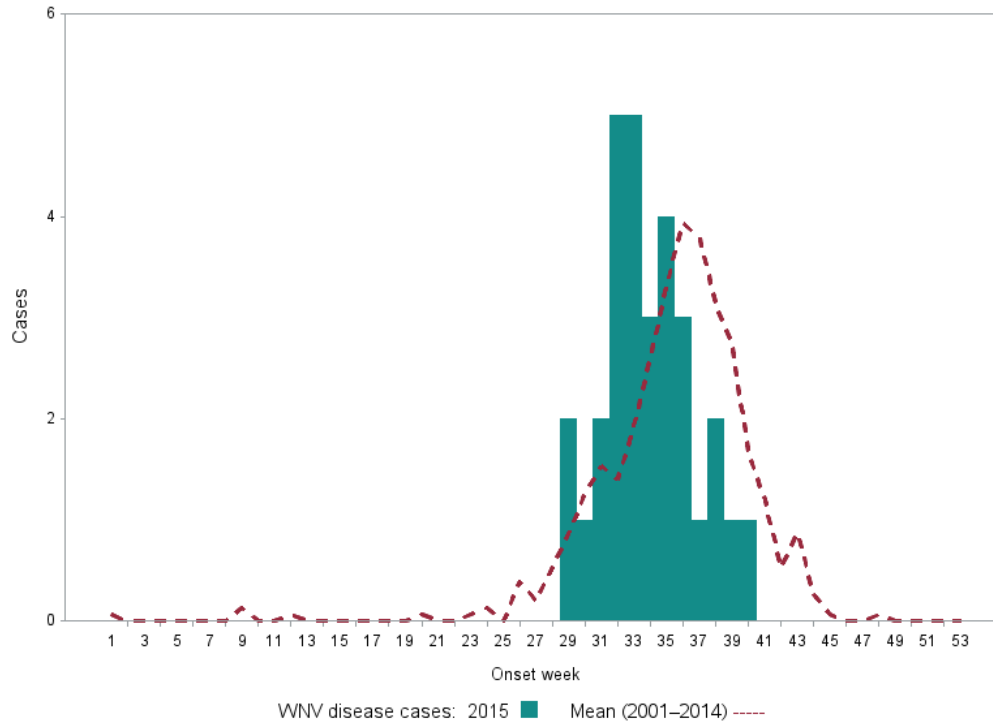
Figure 1: WNV disease cases reported to ArboNET by county of case residence—Pennsylvania, 2015
 Note: WNV-PVDs are not depicted



Source: ArboNET.

Figure 2: WNV disease cases reported to ArboNET by epidemiologic week of onset in comparison to historic average—Pennsylvania, 2015

Note: WNV-PVDs are not depicted



Source: ArboNET.

Table 3: Number of WNV cases reported to ArboNET by infection type—Pennsylvania, 2001–2015

Year	No. Cases		
	WNV-ND	WNV-NND	WNV-PVD
2001 ^a	3	0	0
2002	59	0	0
2003	148	92	10
2004 ^a	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 ^a	5	1	0
2012	33	27	4
2013	6	5	0
2014 ^a	11	2	4
2015 ^a	17	13	1

^aA change in the national case definition for WNV took effect beginning this year.

Source: ArboNET.

B. Dengue

Twenty-three travel-associated cases of dengue were recorded during 2015 (Table 4). Most cases occurred in adults; the majority were hospitalized and no deaths were reported. None of the dengue cases reported in 2015 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 2015 were residents of the following Pennsylvania counties: Allegheny (2), Berks (2), Bucks (1), Butler (1), Centre (2), Chester (1), Columbiana (1), Cumberland (1), Delaware (2), Monroe (1), Montgomery (3), Montour (1) and Philadelphia (5). Cases were exposed through travel from the following locations: Brazil (2), Myanmar (1), Costa Rica (1), Dominican Republic (3), El Salvador (1), Haiti (4), Guatemala (1), India (4), Jamaica (1), Mexico (1) and Nicaragua (1). Three cases had travel histories that included more than one international destination, and are not included in the above counts.

Dengue cases reported symptom onset dates ranging from the week ending March 14, 2015 (epidemiologic week 10) through the week ending November 28, 2015 (epidemiologic week 47).

Based on the number of cases recorded during 2006–2014, a median of 15 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 history of reported cases per year, 2015 case counts were higher than expected (Table 5).

Table 4: Characteristics of dengue cases reported to ArboNET–Pennsylvania, 2015

Characteristic	Value	Dengue Cases (percent)
Age group (in years)	0 – 19	3 (13.0)
	20 – 39	11 (47.8)
	40 – 59	9 (39.1)
	60+	0 (0.0)
Sex	Female	17 (73.9)
	Male	6 (26.1)
Hospitalized	Yes	12 (52.2)
	No	10 (43.5)
	Unknown	1 (4.4)
Fatality	Yes	0 (0.0)
	No	22 (95.7)
	Unknown	1 (4.4)
Case classification	Confirmed	15 (65.2)
	Probable	8 (34.8)
	Total cases	23 (100.0)

Source: ArboNET.

Table 5: Dengue cases reported to ArboNET by year and infection type—Pennsylvania, 2003–2015

Year	No. Cases	
	Dengue fever	Severe dengue
2003	0	0
2004	0	0
2005	0	0
2006	3	0
2007	15	1
2008	2	1
2009	6	0
2010 ^a	21	0
2011	16	0
2012	21	0
2013	24	0
2014	8	0
2015 ^a	23	0

^aA change in the national case definition for dengue took effect beginning this year.

Source: ArboNET.

C. Chikungunya Virus Disease

Eight travel-associated non-neuroinvasive chikungunya virus disease cases were recorded in Pennsylvania during 2015. Most cases occurred in older adult females. 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 2015 were residents of six different Pennsylvania counties: Allegheny (1), Bucks (2), Cumberland (1), Delaware (1), Philadelphia (2), and Somerset (1).

Of the eight recorded chikungunya virus disease cases in Pennsylvania in 2015, all but two were related to exposures in the Americas, where an outbreak of chikungunya began late 2013. Cases were exposed through travel from the following locations: Colombia (1), Honduras (1), India (2), Mexico (1), Nicaragua (1) and Puerto Rico (2).

Chikungunya virus disease cases reported symptom onset dates ranging from the week ending January 31, 2015 (epidemiologic week 4) through the week ending October 31, 2015 (epidemiologic week 43).

Prior to 2014, only four chikungunya virus disease cases had been reported in Pennsylvania. During 2014, a large concurrent 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 2006–2014, a median of 0 chikungunya virus

disease cases are expected annually. In comparison to the history of reported cases per year, 2015 case counts were higher than expected but much lower compared to the unprecedented number of cases documented during 2014 (Table 7). 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 (2,3).

Table 6: Characteristics of chikungunya virus disease cases reported to ArboNET–Pennsylvania, 2015

Characteristic	Value	Chikungunya Virus Disease Cases (percent)
Age group (in years)	0 – 19	0 (0.0)
	20 – 39	2 (25.0)
	40 – 59	5 (62.5)
	60+	1 (12.5)
Sex	Female	5 (62.5)
	Male	3 (37.5)
Hospitalized	Yes	1 (12.5)
	No	4 (50.0)
	Unknown	3 (37.5)
Fatality	Yes	0 (0.0)
	No	6 (75.0)
	Unknown	2 (25.0)
Case classification	Confirmed	3 (37.5)
	Probable	5 (62.5)
	Total cases	8 (100.0)

Source: ArboNET.

Table 7: Chikungunya virus disease cases reported to ArboNET–Pennsylvania, 2003–2015

Year	Chikungunya Virus Disease Cases
2003	0
2004	0
2005	0
2006	2
2007	1
2008	0
2009	0
2010	0
2011	1
2012	0
2013	0
2014^a	97
2015^a	8

^aA change in the national case definition for WNV took effect beginning this year.

Source: ArboNET.

D. Zika Virus Disease and Unspecified Flavivirus Infection

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 and rapidly spread throughout South America, Central America and the Caribbean during 2015 and 2016. Prior to 2015, no cases of Zika virus disease had been recorded in Pennsylvania. To date, no locally-acquired mosquito-borne Zika virus disease cases have been identified in Pennsylvania.

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 2015 was WNV; however, WNV is normally the only arbovirus that is tested for, except during special surveillance projects based on the known distribution of domestic arboviruses in Pennsylvania.

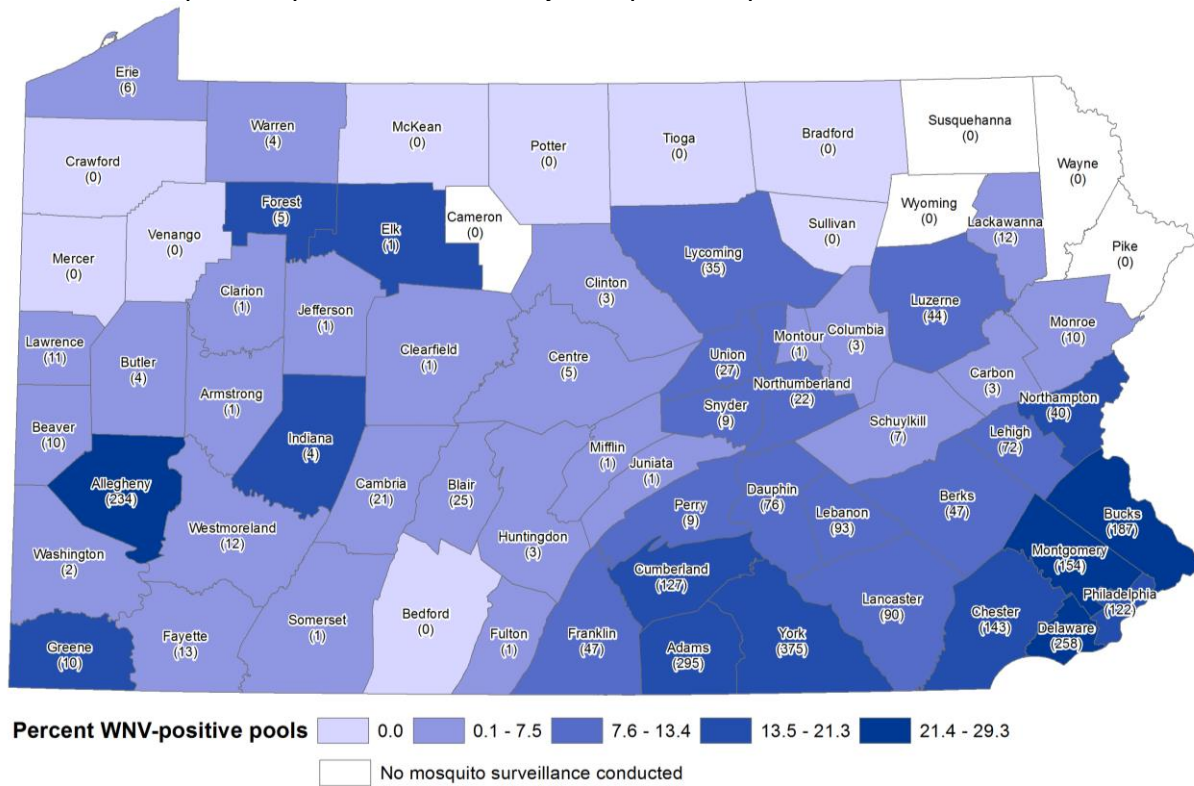
A. WNV

Program staff collected 18,503 pools of mosquitos from 62 counties during 2015 (Figure 6). Of these, WNV was detected in 2,689 (14.5 percent) pools collected from 53 counties (Table 8) . The first positives were detected the week ending June 20, 2015 (epidemiologic week 24). Statewide WNV pool positivity peaked at 34 percent during the week ending September 5, 2015 (epidemiologic week 35). No positive pools were detected after the week ending October 3, 2015 (epidemiologic week 39), and no additional samples were collected after the week ending October 10, 2015 (Figure 7). Based on *Culex* species mosquitos 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 (2001–2014). Additionally, the overall percentage of WNV-positive pools observed during 2015 was higher than expected compared to previous non-epidemic years (i.e., years other than 2002–2003 and 2012).

A total of 78 deceased avian specimens were submitted for WNV testing. Of these, WNV was detected in 31 specimens (39.7 percent) (Table 8). Positive avian specimens were collected from the following counties: Allegheny (3), Bedford (1), Centre (4), Crawford (1), Cumberland (4), Dauphin (2), Delaware (3), Erie (1), Huntingdon (1), Lancaster (3), Mifflin (1), and York (7). Collection dates of positive specimens ranged from the week ending May 30, 2015 (epidemiologic week 21), to the week ending October 3, 2015 (epidemiologic week 39). The percentage of WNV-positive avian specimens observed during 2015 was higher than expected compared to previous non-epidemic years (i.e., years other than 2002–2003 and 2012).

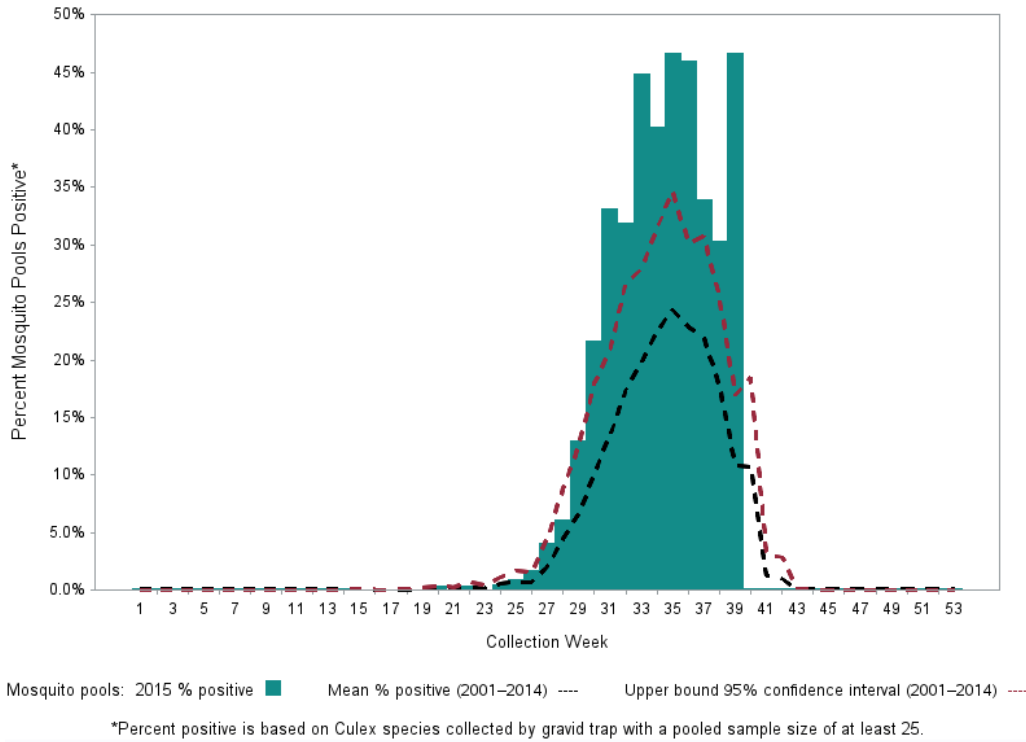
Two veterinary specimens, an equine in Chester County and an equine in McKean County, tested positive for WNV IgM antibodies during 2015. The McKean County equine tested positive the week ending August 15, 2015 (epidemiologic week 32). The Chester County equine tested positive the week ending September 19, 2015 (epidemiologic week 37). The number of WNV-positive veterinary specimens was average during 2015 compared to previous non-epidemic years (i.e., years other than 2002–2003 and 2012) (Table 8).

Figure 6: WNV-positive mosquito pools collected during 2015 by Pennsylvania county. The number of WNV-positive pools in each county is depicted in parentheses.



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

Figure 7. Percentage of WNV-positive mosquito pools collected by epidemiologic week in Pennsylvania during 2015 in comparison to the average weekly percentage positive from 2001–2014



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

Table 8: Summary of non-human WNV surveillance activity in Pennsylvania from 2000–2015, by year

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

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

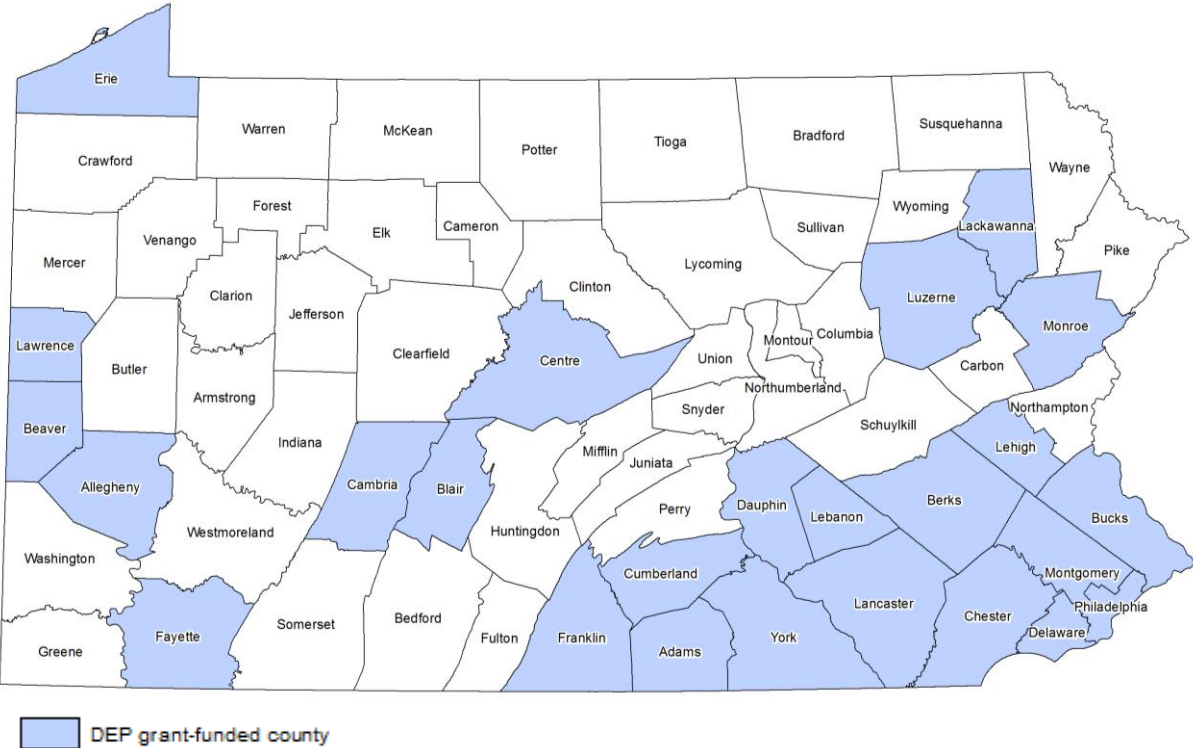
Source: ArboNET/The Pennsylvania West Nile Virus Control Program (DEP).

Mosquito Control Summary

In addition to surveying both human and non-human populations for arboviral disease, Pennsylvania has taken the initiative to control it. 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 25 counties that have historically displayed the highest risk of WNV disease (Figure 8). In 2015, the commonwealth provided \$2,033,880.00 in grant funding to these counties. DEP provides limited surveillance and control services for the remaining 42 counties that do not receive grant funding.

In 2015, this collaborative network of mosquito control services conducted 4,105 mosquito control events covering 83,896 acres. In addition to these events, a total of 66,911 catch basins, which are significant breeding sites for mosquitos, were treated in Pennsylvania cities. The majority (93 percent) of these treatments were used to control larval sources of mosquitoes.

Figure 8: Counties receiving DEP grant funding for mosquito control activities in 2015



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 who are committed to protecting the health of all Pennsylvanians.

Citations

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2. Pan-American Health Organization (PAHO). Number of reported cases of Chikungunya Fever in the Americas – EW 52 (December 29, 2014). Available at http://www.paho.org/hq/index.php?option=com_docman&task=doc_download&Itemid=270&gid=28697&lang=en. Accessed 22 Dec 2016.
3. CDC. 2014 final data for the United States – Chikungunya virus. Available at <https://www.cdc.gov/chikungunya/geo/united-states-2014.html>. Accessed 22 Dec 2016.