GEORGIA DEPARTMENT OF PUBLIC HEALTH

# 2021—Arbovirus Final Report

## Summary of Human West Nile Virus and Other Arboviral Infections, Georgia 2021

West Nile virus (WNV) is a mosquito-borne disease of birds. Humans are occasionally infected with WNV through mosquito bites. Approximately 1 in 5 people infected with WNV develop symptoms of "West Nile Fever", which is often characterized by fever, headache, fatigue, and muscle pain or weakness. Less than 1% of people infected with WNV develop neurologic disease such as meningitis, encephalitis, or flaccid paralysis.

West Nile virus was first recognized in Georgia in July 2001. That year, there were 6 human cases of WNV encephalitis reported in Georgia, including one death. Since then cases have been reported each year with varying numbers of human deaths.

To improve identification of Georgians infected with WNV, surveillance for WNV illness in humans was expanded for the 2003 transmission season to include all acute infections of WNV. In addition, routine screening of the nation's blood supply began in 2003, resulting in the identification of persons infected with WNV prior to the development of symptoms, if symptoms developed at all.

While the majority of human infections with arboviruses have resulted from bites by infected mosquitoes, other rare modes of transmission have been identified, including blood transfusion and organ transplantation.

Historical data on arboviral diseases in Georgia 2002-2020 are available upon request.

In 2021, Georgia reported 4 cases of WNV and 1 WNV presumptive viremic donors (PVD), with 1 death. Presumptive viremic donors (PVDs) are people who had no symptoms at the time of blood donation or other testing, but tested positive for the presence of select arboviruses. Although we track and report PVDs to the CDC for epidemiological purposes, we do not count these as cases in our state.

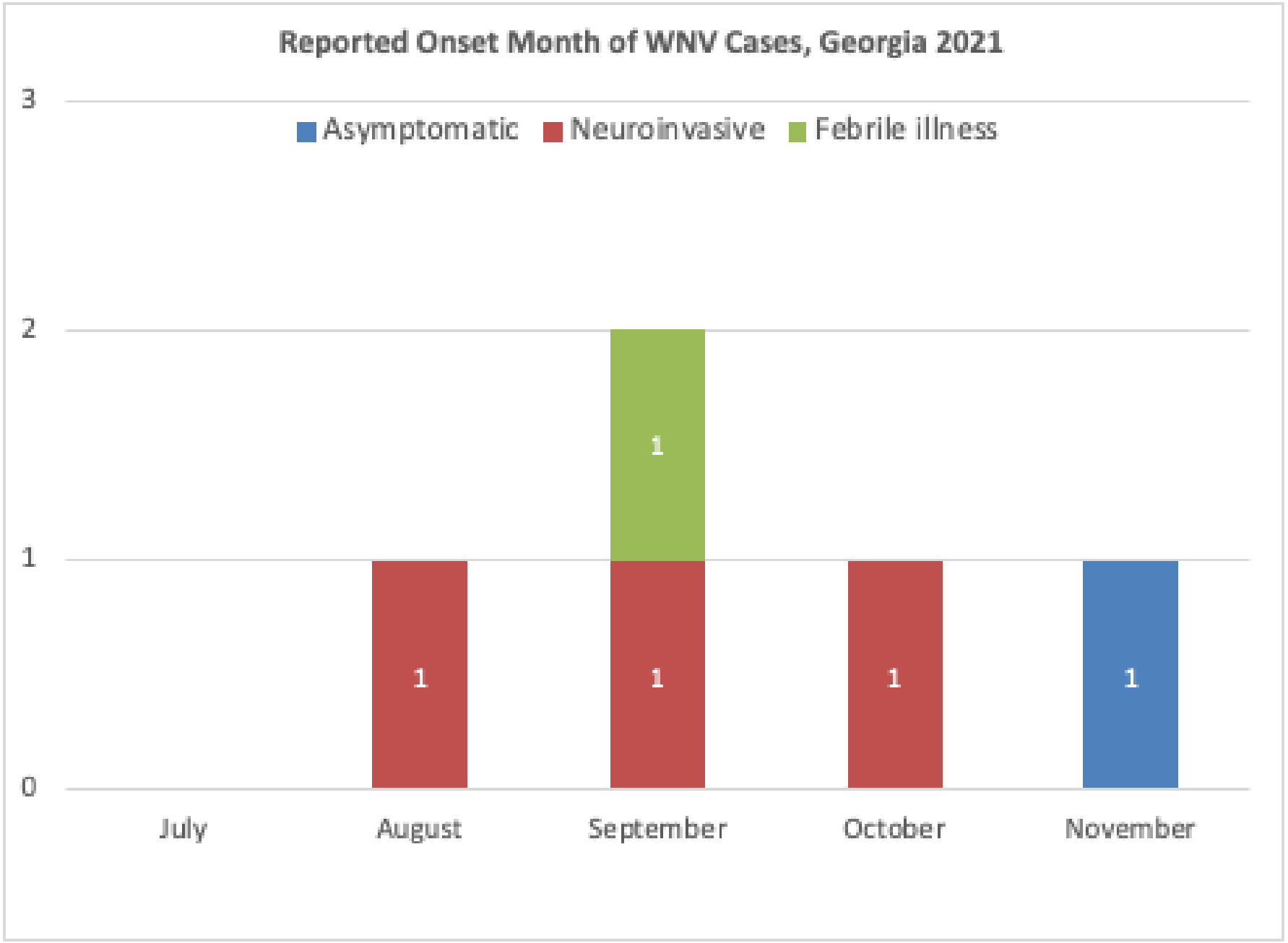
To date, 4 WNV disease cases were reported from 4 counties in 3 public healthdistricts. Among these cases, 3 (75%) were neuroinvasive, all patients had ill-ness onset during Aug-Oct and 3 (75%) cases were male. The average patient age of all WNV disease cases was 54 (range: 43-71) and the average patient age of all neuroinvasive cases was 57.7 (range: 47-71). Cases were reported between August and October, with a peak in August. The PVD, reported in November, was a 17 year old male.

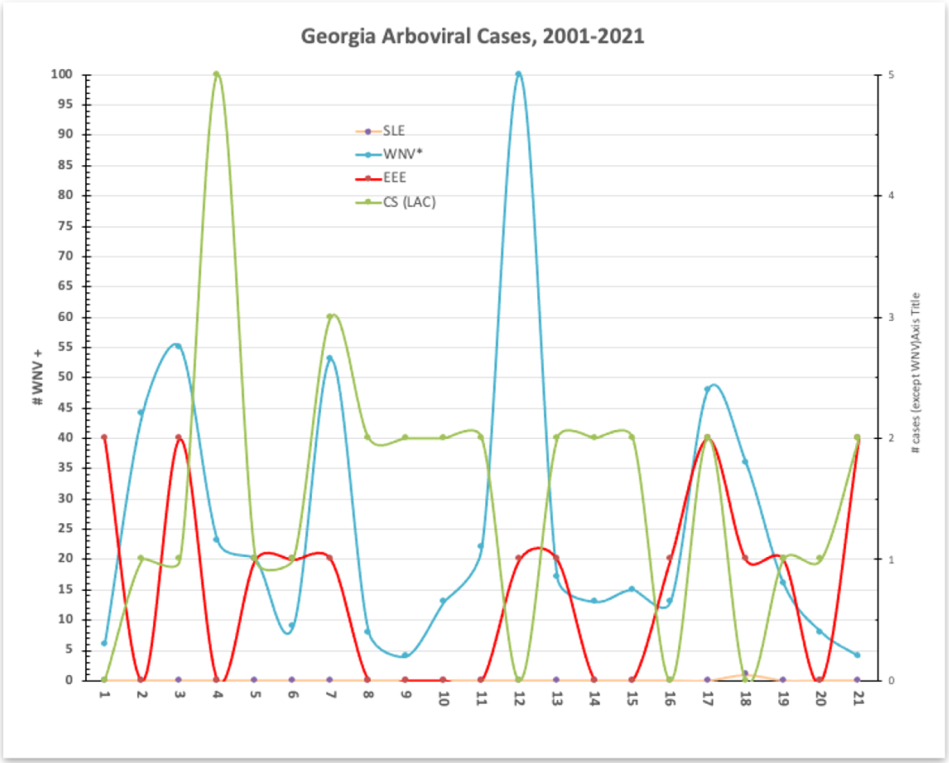
California serogroup (CS) viruses, including California encephalitis, Keystone, La Crosse, Jamestown Canyon (JCV), snowshoe hare, and trivittatus, belongs to the Bunyaviridae family of viruses. In the United States, La Crosse virus (LACV) is the most common of the California serogroup viruses. There were two cas-es of California Serogroup, non-specified reported in Georgia in 2021.

Saint Louis encephalitis virus is related to WNV and is a member of the Flaviviridae subgroup. Until recently, SLE had not been reported in Georgia since the 1970s. In 2018, one case of SLE was reported in Georgia. There were no SLE cases reported in Georgia in 2021.

Two cases of Eastern Equine Encephalitis (EEE) were reported in 2021, with one death. One case is presumed to have been infected in Florida.

The first travel-associated case of Zika was reported in Georgia in December 2015. In 2016, there were 113 travel-associated cases reported in Georgia. In 2017, there were a total of 11 travel-associated cases, 8 of which were asymptomatic. In 2018, a total of 2 asymptomatic travel-associated ZIKV cases were reported. In 2019, there were 5 travel-related ZIKV cases reported, 4 of which were asymptomatic. There was also 1 case of occupationally-acquired ZIKV. In 2020 and 2021, no travel-related cases of ZIKV were reported. To date there have been no locally transmitted (mosquito to human) cases of Zika in Georgia. No travel-associated Dengue cases were reported in 2021, nor were any locally - acquired cases reported. No travel-related cases of CHIK were reported in 2021; no locally-acquired cases of CHIK have ever been reported in Georgia.


Reported Onset Month of WNV Cases, Georgia 2021
Asymptomatic
Neuroinvasive
Febrile illness
3
2
1
0
1
1
1
1
1
July
August
September
October
November




| | # cases (including asymptomatic) | | | |
|---|---|---|---|---|
| **District** | **CS (LAC)** | **EEE** | **WNV** | **TOTAL** |
| 1-1 | 1 | | | 1 |
| 1-2 | | | | 0 |
| 2-0 | | | | 0 |
| 3-(1,2,3,4,5) | 1 | | 2 | 3 |
| 4-0 | | | 1 | 1 |
| 5-1 | | | | 0 |
| 5-2 | | | 1 | 1 |
| 6-0 | | | 1 | 1 |
| 7-0 | | | | 0 |
| 8-1 | | | | 0 |
| 8-2 | | | | 0 |
| 9-1 | | 2 | | 2 |
| 9-2 | | | | 0 |
| **TOTAL** | 2 | 2 | 5 | 9 |

*Does not include asymptomatic cases

Table 3: Age Ranges, WNV 2021

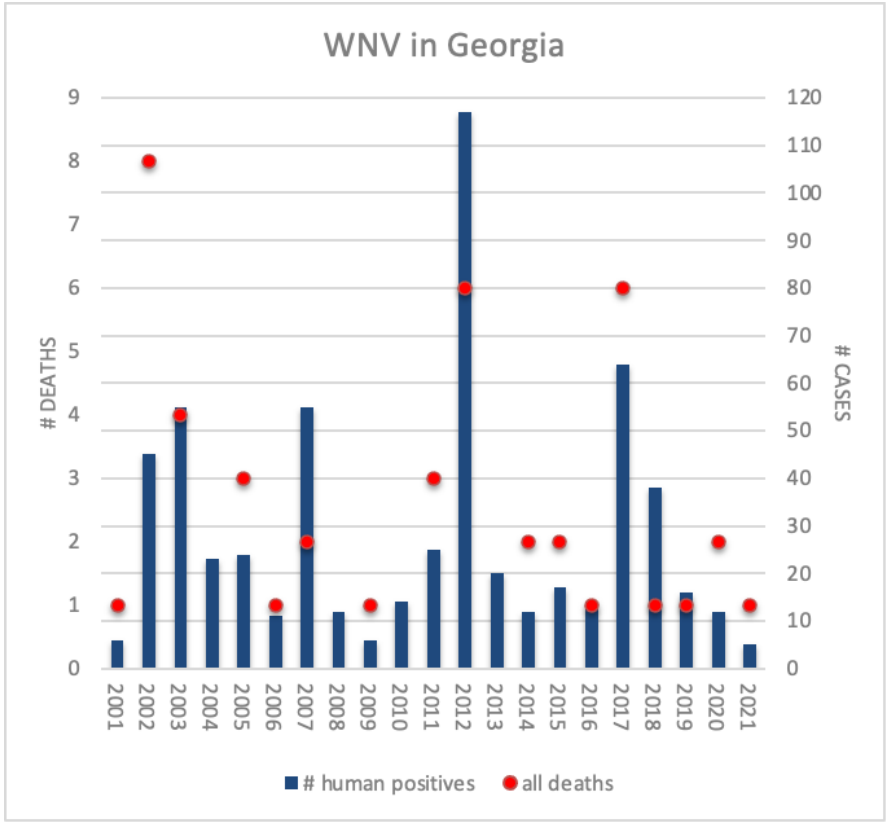
| age range | WNND/other neurological | WNF | Asymptomatic |
|---|---|---|---|
| 0-10 | | | |
| 11-20 | | | 1 |
| 21-30 | | | |
| 31-40 | | | |
| 41-50 | 1 | 1 | |
| 51-60 | 1 | | |
| 61-70 | | | |
| 71-80 | 1 | | |
| >80 | | | |
| **TOTAL** | **3** | **1** | **1** |

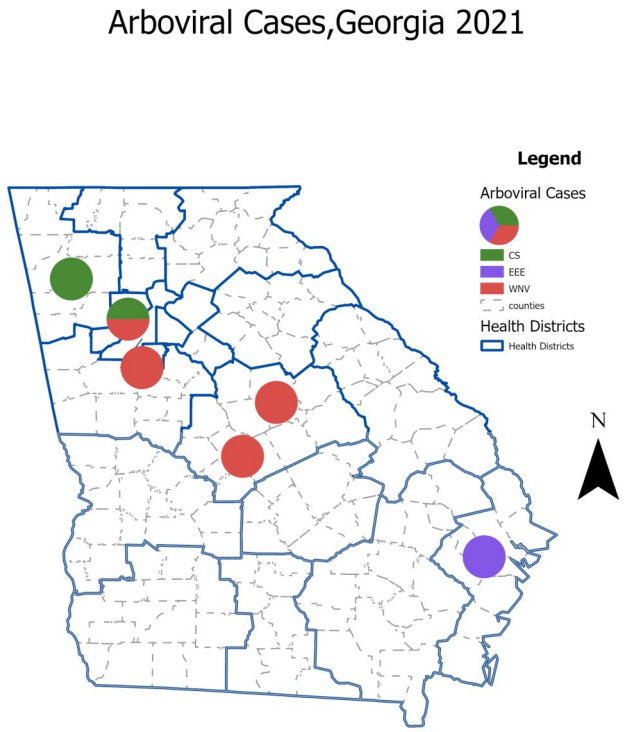
Table 2: Clinical Syndromes, 2021

| | **Virus** | | |
|---|---|---|---|
| **Diagnosis** | **EEE** | **CS(LAC)** | **WNV** |
| Asymptomatic | | | 1 |
| Encephalitis | 2 | 1 | 3 |
| Fever | | | 1 |
| Meningitis | | | |
| other, neuroinvasive | | 1 | |
| other, clinical | | | |
| | 2 | 2 | 5 |

Table 1: Clinical Syndromes, 2021

| Arbovirus | Month of Onset | County of Residence | Clinical Syndrome | Fatality | # cases |
|---|---|---|---|---|---|
| CS (LAC) | September | Cobb | Encephalitis | No | 1 |
| | September | Paulding | Other Neuroinvasive | No | 1 |
| EEE | July | Liberty | Encephalitis | Yes | 1 |
| | August | Camden (Florida) | Encephalitis | No | 1 |
| WNV | August | Fulton | Encephalitis | Unknown | 1 |
| | September | Cobb | WNF | No | 1 |
| | September | Houston | Encephalitis | Yes | 1 |
| | October | Richmond | Encephalitis | Unknown | 1 |
| | November | Carroll | Asymptomatic | No | 1 |



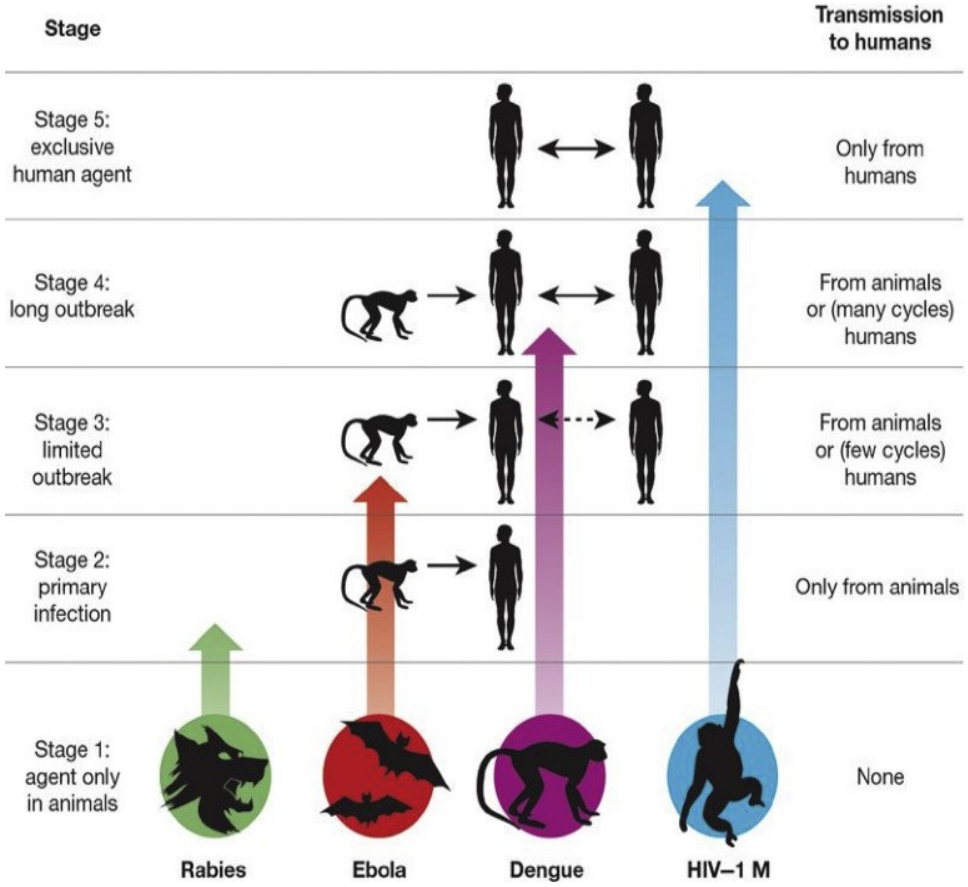



| Cases by Year (includes asymptomatic cases*) | | | | |
|---|---|---|---|---|
| Year | EEE | SLE | CS (LAC) | WNV |
| 2001 | 2 | | | 6 |
| 2002 | | | 1 | 45 |
| 2003 | 2 | | 1 | 55 |
| 2004 | | | 5 | 23 |
| 2005 | 1 | | 1 | 24 |
| 2006 | 1 | | 1 | 11 |
| 2007 | 1 | | 3 | 55 |
| 2008 | | | 2 | 12 |
| 2009 | | | 2 | 6 |
| 2010 | | | 2 | 14 |
| 2011 | | | 2 | 25 |
| 2012 | 1 | | | 117 |
| 2013 | 1 | | 2 | 20 |
| 2014 | | | 2 | 13 |
| 2015 | | | 2 | 15 |
| 2016 | 1 | | | 13 |
| 2017 | 2 | | 2 | 63 |
| 2018 | 1 | 1 | | 38 |
| 2019 | 1 | | 1 | 16 |
| 2020 | | | 1 | 12 |
| 2021 | 2 | | 2 | 5 |
| Grand Total | 16 | 1 | 32 | 588 |

**Zoonotic Diseases**

Zoonotic diseases are those diseases transmitted from animals to humans through direct contact or through food, water, or the environment, contributing to 61% of infectious organisms affecting humans. Zoonotic diseases may be categorized by their ability to spread among humans through 5 stages ranging from only spread among animals (stage 1) to fully human pathogens (stage 5). Fig. 1 illustrates the stages through which pathogens of animals evolve to cause human diseases.

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7096727/

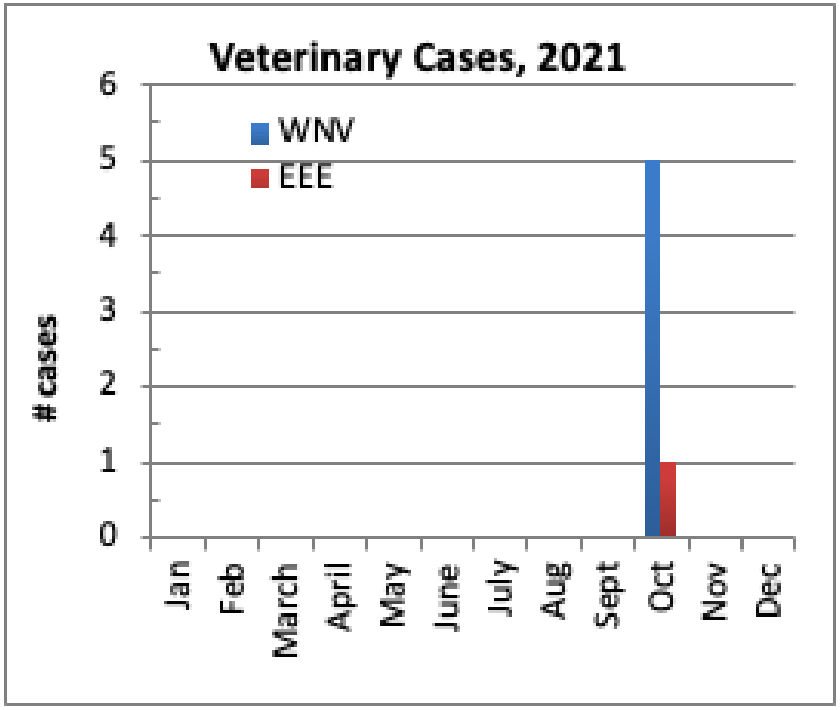


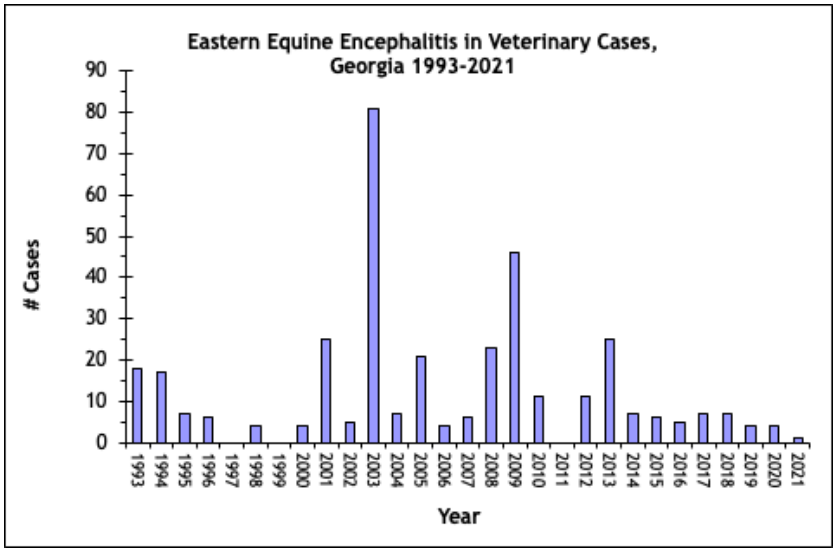
**Veterinary Data**

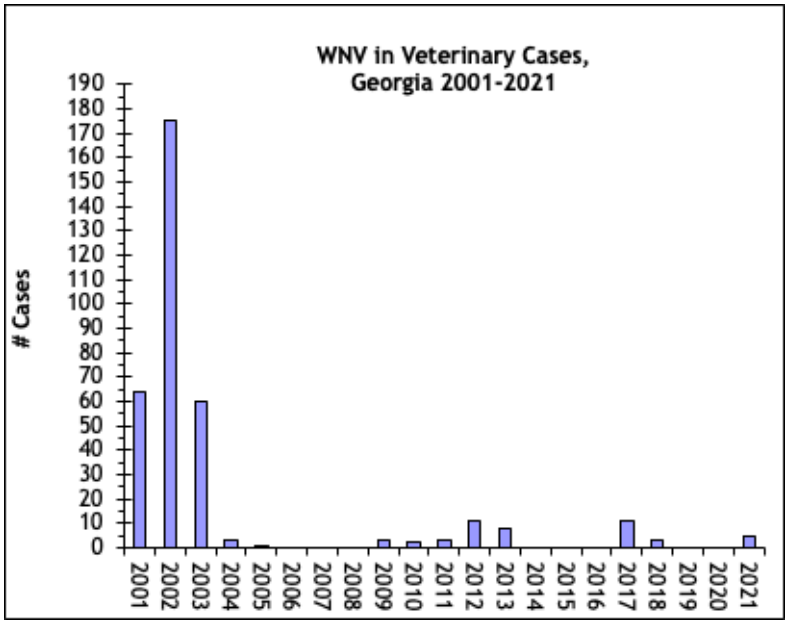
No horses tested positive for WNV in 2021. The number of reported cases of WNV in horses decreased rapidly after 2002, likely due to increased immunity, increased vaccination, and/or decreased testing, but had lately begun to increase again, although somewhat sporadically. However, 5 alligators did test positive for WNV. This is of public health importance as alligators can act as amplifiers of the virus (https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3323409/).

One horse tested positive for EEE in 2021. Eastern equine encephalitis is endemic in the Coastal and Coastal Plains areas of Georgia. During an average year, four or five EEE+ horses are reported from these areas. The true number of horse cases is probably higher, and lack of reporting is due primarily to undertesting, although subclinical infections can occur with EEE.

Vaccinating at the proper time of the year against EEE and WNV is critical to protecting horses from the potentially fatal mosquito-borne diseases.



**Alligators and WNV**

A crocodile farm or alligator farm is an establishment for breeding and raising of crocodilians in order to produce crocodile and alligator meat, leather from crocodile and alligator skin, and other goods. West Nile virus (WNV) is known to affect captive populations of alligators and, in some instances, cause significant mortalities. Alligators have been shown to amplify the virus, serve as a reservoir host, and even represent a source of infection for humans. West Nile virus (WNV) primarily affects birds, but can also infect bats, horses, cattle, cats, dogs, chipmunks, skunks, squirrels, domestic rabbits, alligators, and humans.

Mosquitoes, primarily *Culex quinquefasciatus* in Georgia, acquire the virus from infected birds and transmit it to susceptible horses, humans, and other animals. Many of these are dead-end hosts that do not produce a high enough viremia for mosquitoes to pick up virus from them from feeding to transmit to other hosts. WNV has been detected in over 150 species of birds in the United States, many of which do not develop outward disease. Corvids, such as the American crow and blue jays, along with other birds such as the house finch, are likely efficient hosts. WNV transmission corresponds to the mosquito feeding and life cycle. In Georgia we primarily see WNV transmission from late June through October, with peaks in August and September.

| | EEE Vaccination Status | | |
|---|---|---|---|
| **County** | **unknown** | **unvaccinated** | **vaccinated** |
| Long | 1 | | |
| **Grand Total** | **1** | **0** | **0** |

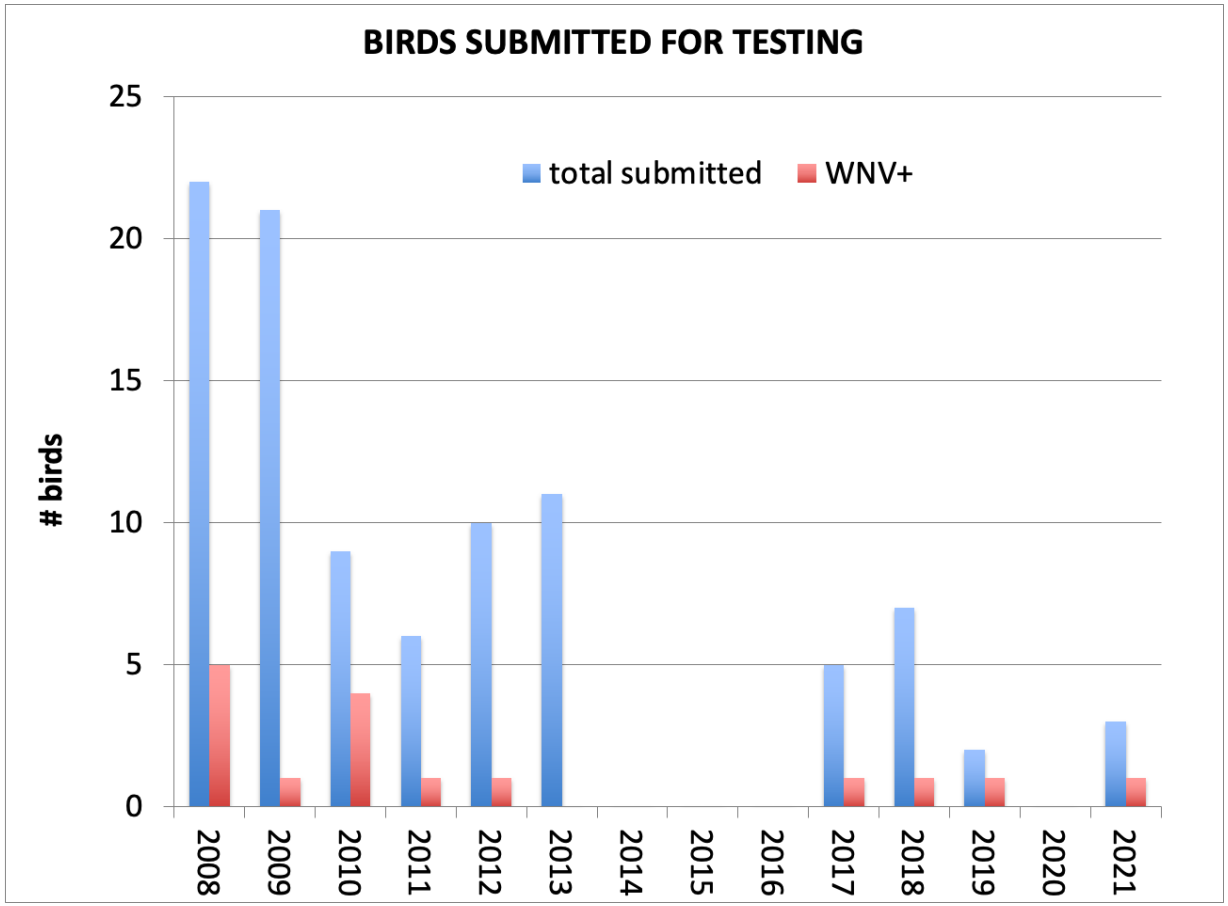
| | WNV Vaccination Status | | |
|---|---|---|---|
| **County** | **unknown** | **unvaccinated** | **vaccinated** |
| Mitchell | | 5 | |
| **Grand Total** | **0** | **5** | **0** |

Infection with West Nile Virus does not always lead to signs of illness in people or animals. Horses are a species that is susceptible to infection with the virus. In horses that do become ill, the virus infects the central nervous system and may cause symptoms of encephalitis. Most clinically affected horses exhibit general loss of appetite, depression and fever along with neurological signs such as ataxia (stumbling, staggering, wobbly gait, or incoordination) and any combination of the following:

- circling
- hind limb weakness
- recumbence or inability to stand
- multiple limb paralysis
- muscle fasciculation (twitching)
- altered mental state
- impaired vision
- lip droop
- inability to swallow
- hyper excitability

It is important to note that not all horses with clinical signs of encephalitis have West Nile encephalitis. Other infectious and non-infectious diseases, including EEE, can cause a horse to have symptoms similar to those resulting from infection with WNV.

## Dead Bird Surveillance

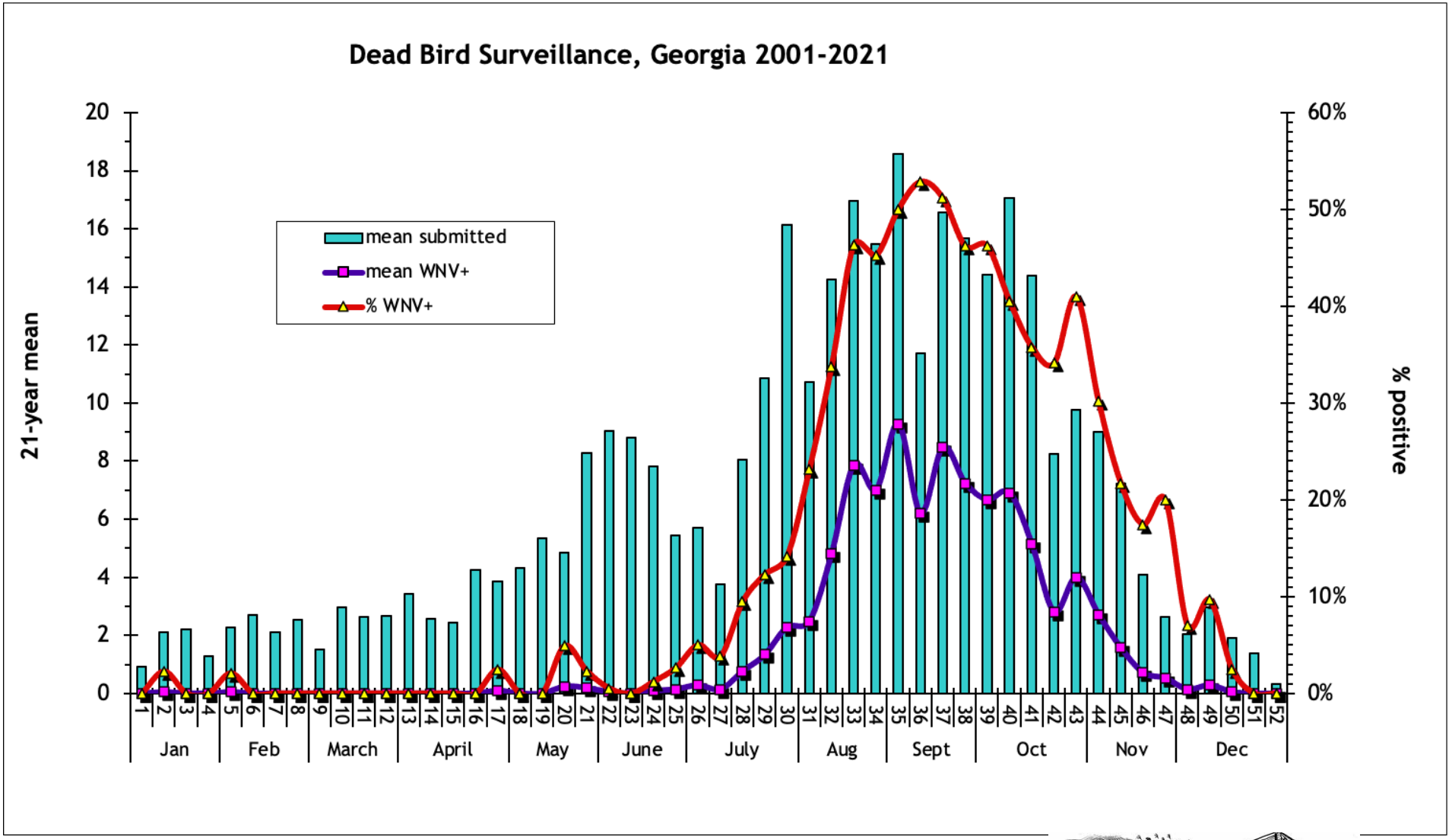



| Species | NEG | WNV+ | EEE+ | TOTAL | % WNV+ |
|---|---|---|---|---|---|
| Tufted titmouse | | 1 | | 1 | 100% |
| American goldfinch | 1 | | | 1 | |
| Cooper's Hawk | 1 | | | 1 | |
| **TOTAL** | 2 | 1 | 0 | 3 | 33.3% |

As of 2012, federal funding was no longer available to test birds. Submission of dead birds had already decreased from a high of 2421 birds submitted to SCWDS for testing in 2002 to 6 birds submitted in 2011.

In 2021, 3 birds were reported as submitted for testing; one bird tested positive for WNV.

Dead bird surveillance continues to lose ground as a surveillance tool, and even more so now when no funding is available at the State level to support testing; most counties do not have the resources to pick up and ship birds for testing in any case. Bird testing does continue to have some utility however, esp where mosquito surveillance data are not available. In addition, positive dead bird reports can be used to trigger public education messages reminding people to wear repellent and to dump out standing water.




2021 Dead Bird Surveillance

| DATE | Week | Species | City | Zip | Virus Isolation |
|---|---|---|---|---|---|
| 7/14/21 | 29 | Cooper's hawk | Decatur | 30032 | NEG |
| 9/9/21 | 37 | Tufted titmouse | Stone Mt | 30083 | WNV |
| 10/25/21 | 44 | American goldfinch | Decatur | 30030 | NEG |

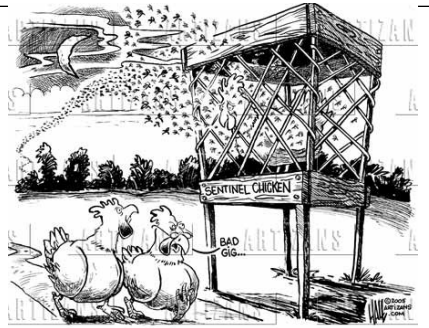
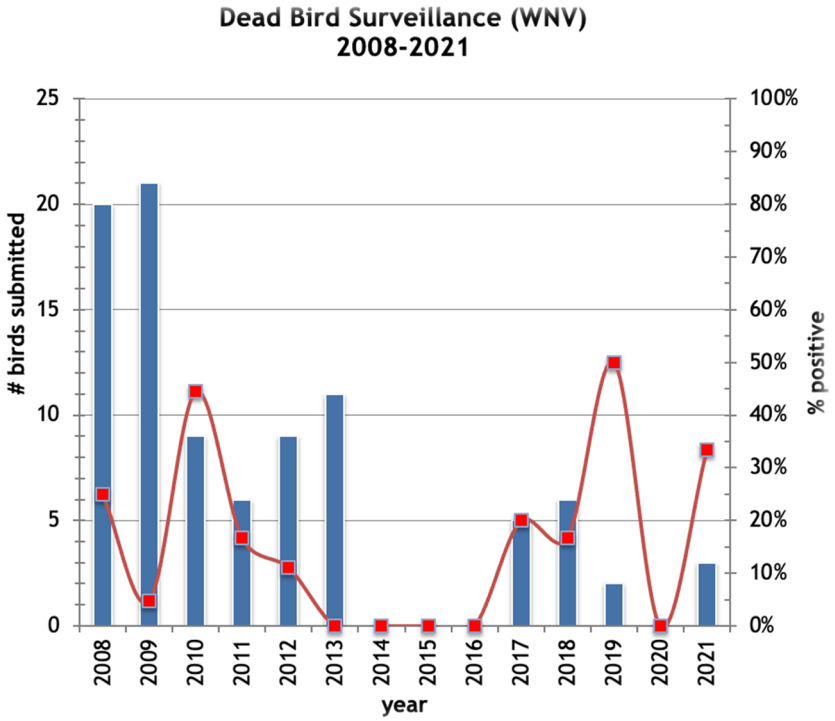
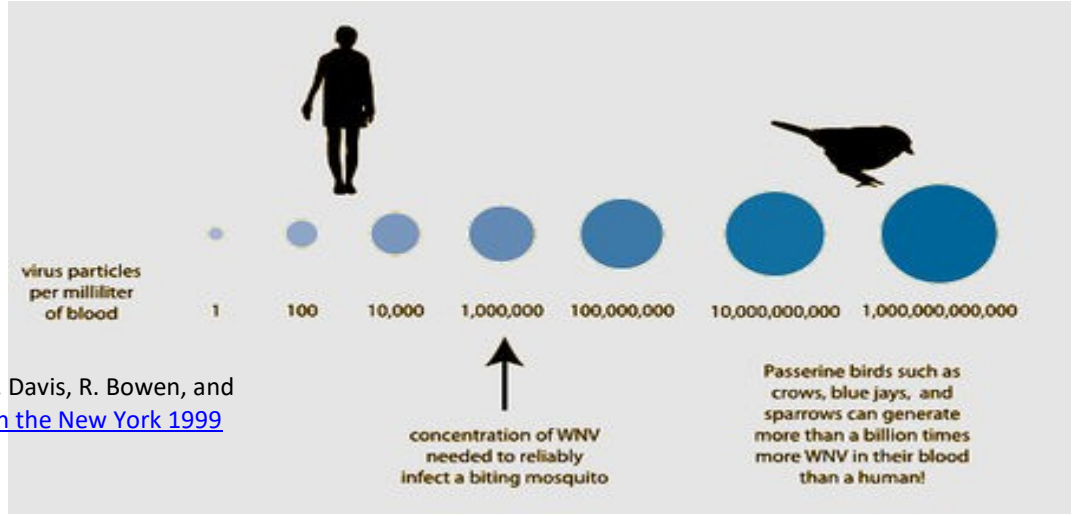


Table of West Nile Virus host competency of 23 species of birds. A larger index number correlates to higher amounts of viral load in concurrence with long durations of viremia. Data adapted from Komar et al. 2003.

| Species | Reservoir Competence Index |
|---|---|
| Blue Jay | 2.55 |
| Common Grackle | 2.04 |
| House Finch | 1.76 |
| American Crow | 1.62 |
| House Sparrow | 1.59 |
| Ring-billed Gull | 1.26 |
| Black-billed Magpie | 1.08 |
| American Robin | 1.08 |
| Red-winged Blackbird | 0.99 |
| American Kestrel | 0.93 |
| Great Horned Owl | 0.88 |
| Killdeer | 0.87 |
| Fish Crow | 0.73 |
| Mallard | 0.48 |
| European Starling | 0.22 |
| Mourning Dove | 0.19 |
| Northern Flicker | 0.06 |
| Canada Goose | 0.03 |
| Rock Dove | 0 |
| American Coot | 0 |
| Ring-necked Pheasant | 0 |
| Monk Parakeet | 0 |




Komar, N., S. Langevin, S. Hinten, N. Nemeth, E. Edwards, D. Hettler, B. Davis, R. Bowen, and M. Bunning. 2003. Experimental Infection of North American Birds with the New York 1999 Strain of West Nile Virus. Emerging Infectious Diseases 9(3): 311-322.

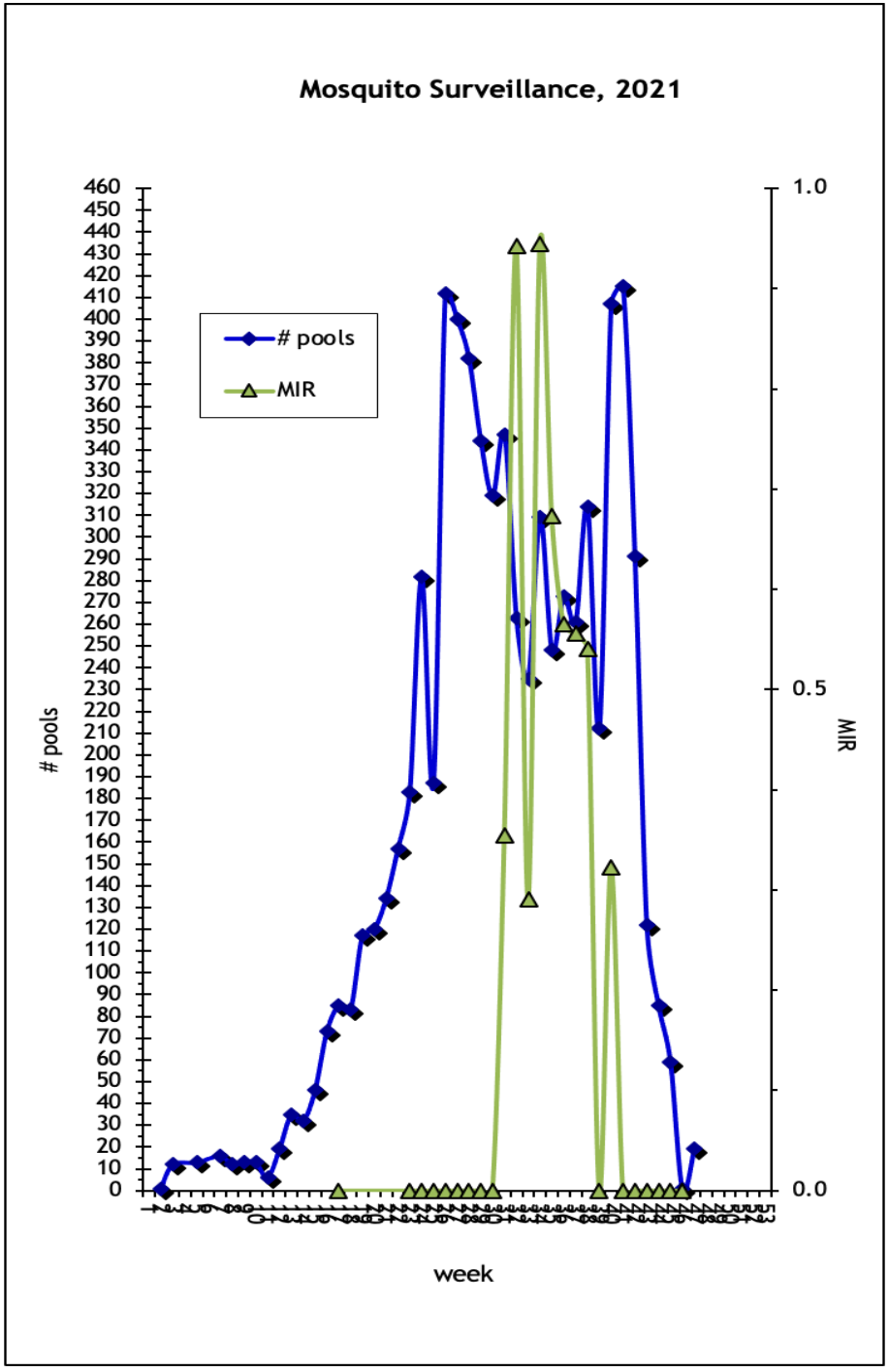
## Mosquito Surveillance

In 2012, due to funding cuts, mosquito testing was no longer supported by the State Department of Public Health. Counties holding independent contracts with SCWDS, or other labs, for testing continued doing mosquito surveillance and shared some of the test results with the GDPH. Sixteen counties sent mosquitoes for testing in 2021. Unfortunately, data submitted to the GDPH are likely to be incomplete, making data analysis difficult and results suspect.

A total of 7357 pools of mosquitoes (170917 individuals) were sent for testing in 2021, with results reported to the GDPH. Two species were found to be WNV+, *Culex nigripalpus* (1 pool) and *Cx quinquefasciatus* (30 pools).

2021 WNV+ pools

| County | # mosquitoes submitted | # WNV+ pools | MIR |
|---|---|---|---|
| Camden | 5711 | | |
| Chatham | 81411 | 3 | 0.04 |
| Columbia | 4 | | |
| DeKalb | 12091 | 15 | 1.24 |
| Fulton | 5972 | 11 | 1.84 |
| Glascock | 4 | | |
| Glynn | 31744 | 1 | 0.03 |
| Jefferson | 27 | | |
| Jenkins | 2 | | |
| Lincoln | 9 | | |
| Lowndes | 33583 | 1 | 0.03 |
| McDuffie | 2 | | |
| Richmond | 325 | | |
| Taliaferro | 10 | | |
| Warren | 4 | | |
| Wilkes | 18 | | |
| **TOTAL** | **170917** | **31** | |



In 2021, the first WNV+ mosquitoes were detected in DeKalb County in late July. The last WNV+ pools were collected in Chatham & DeKalb in late September. Peaks in numbers of WNV+ pools occurred in August and September. One WNV+ pool was collected from a CDC light trap. The rest (30) of the WNV+ mosquitoes were caught in gravid traps.

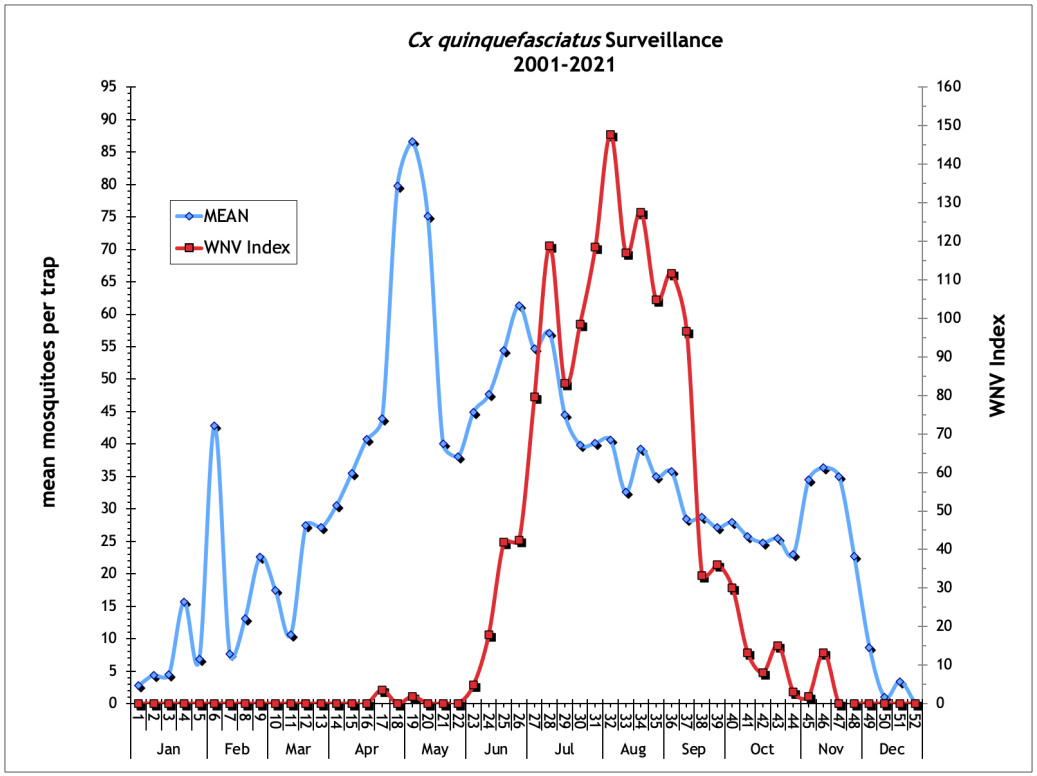
The Vector Index (VI) equals the MIR times the number of vectors per trap night . It is a Measure of infectivity that takes into account the following information:

- **Vector species composition** – Key species carrying West Nile virus in our region.
- **Vector species population density** – Vector abundance relative to trapping effort (vectors per trap night).
- **Vector species infection rate** – Proportion of vector population infected with WNV (MIR).

The VI is an objective method of following trends in mosquito infection rates, adjusted for mosquito abundance in the area.

The Minimum Infection Rate or MIR = (# WNV+ Pools/Total # Mosquitoes Tested) X 1000. The WNV Index is the MIR multiplied by the number of mosquitoes per trap night. An MIR of 0 suggests that there is no viral activity in the area. An MIR of 0.1 to 3.9 indicates that some viral activity is present, and increased vigilance and testing are needed. An MIR of 4.0 or above means that a high level of viral activity is present, human infections are imminent (if not already present), and prompt action is required.

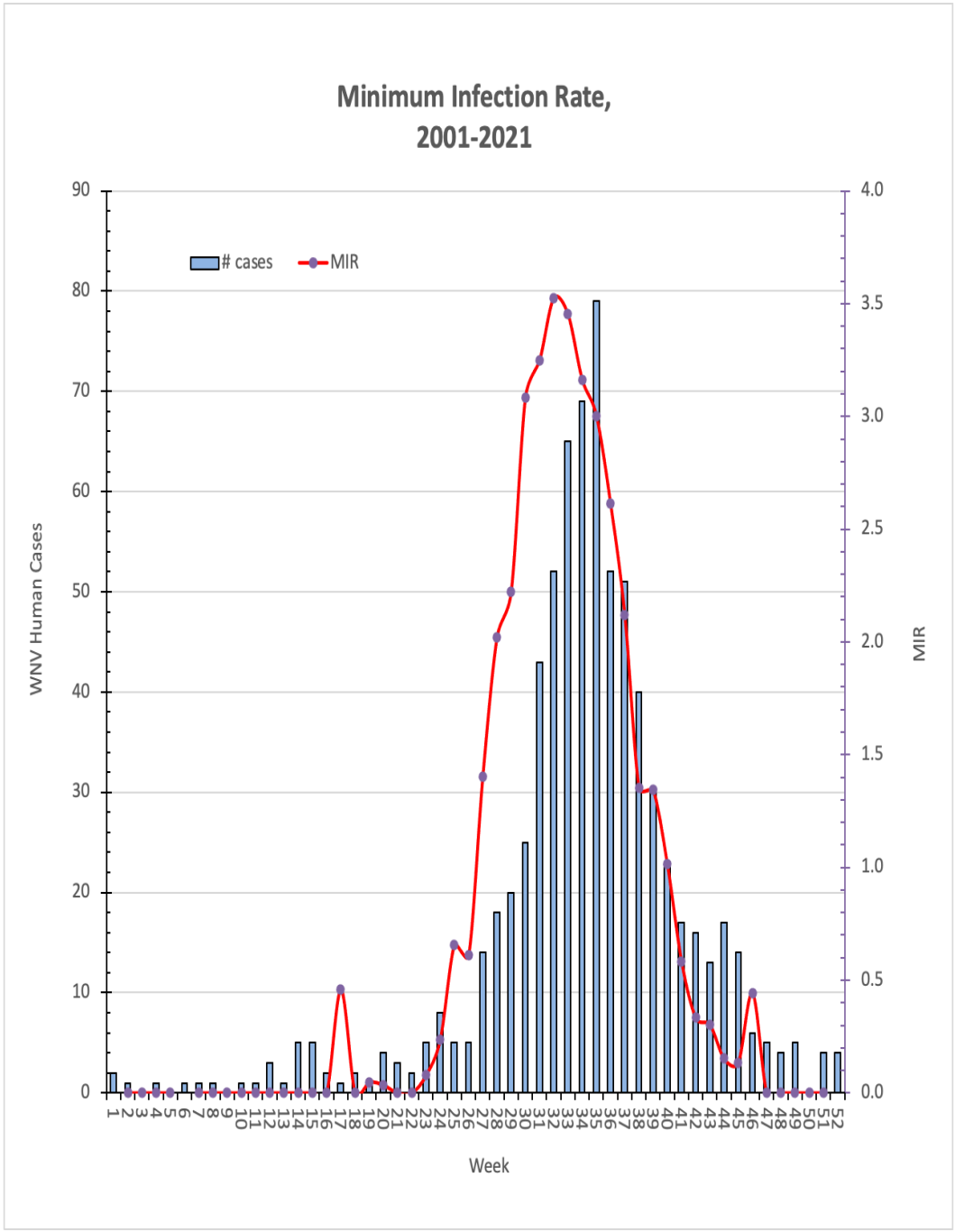
The monthly MIR for Georgia in 2021 ranged from 0.05 to 0.65, with an average of 0.18.




| year | WNV Index | WNV+ Pools | human cases |
|---|---|---|---|
| 2001 | 146.3 | 31 | 6 |
| 2002 | 106.6 | 57 | 37 |
| 2003 | 50.7 | 105 | 60 |
| 2004 | 40.7 | 126 | 24 |
| 2005 | 17.7 | 67 | 24 |
| 2006 | 31.5 | 81 | 10 |
| 2007 | 29.9 | 75 | 60 |
| 2008 | 25.3 | 50 | 12 |
| 2009 | 13.7 | 24 | 6 |
| 2010 | 47.7 | 99 | 14 |
| 2011 | 179.6 | 397 | 26 |
| 2012 | 64.3 | 125 | 117 |
| 2013 | 72.0 | 150 | 20 |
| 2014 | 43.6 | 56 | 13 |
| 2015 | 37.00 | 40 | 17 |
| 2016 | 22.80 | 36 | 13 |
| 2017 | 148.00 | 276 | 64 |
| 2018 | 202.30 | 310 | 38 |
| 2019 | 113.40 | 243 | 16 |
| 2020 | 24.60 | 59 | 12 |
| 2021 | 11.50 | 31 | 5 |

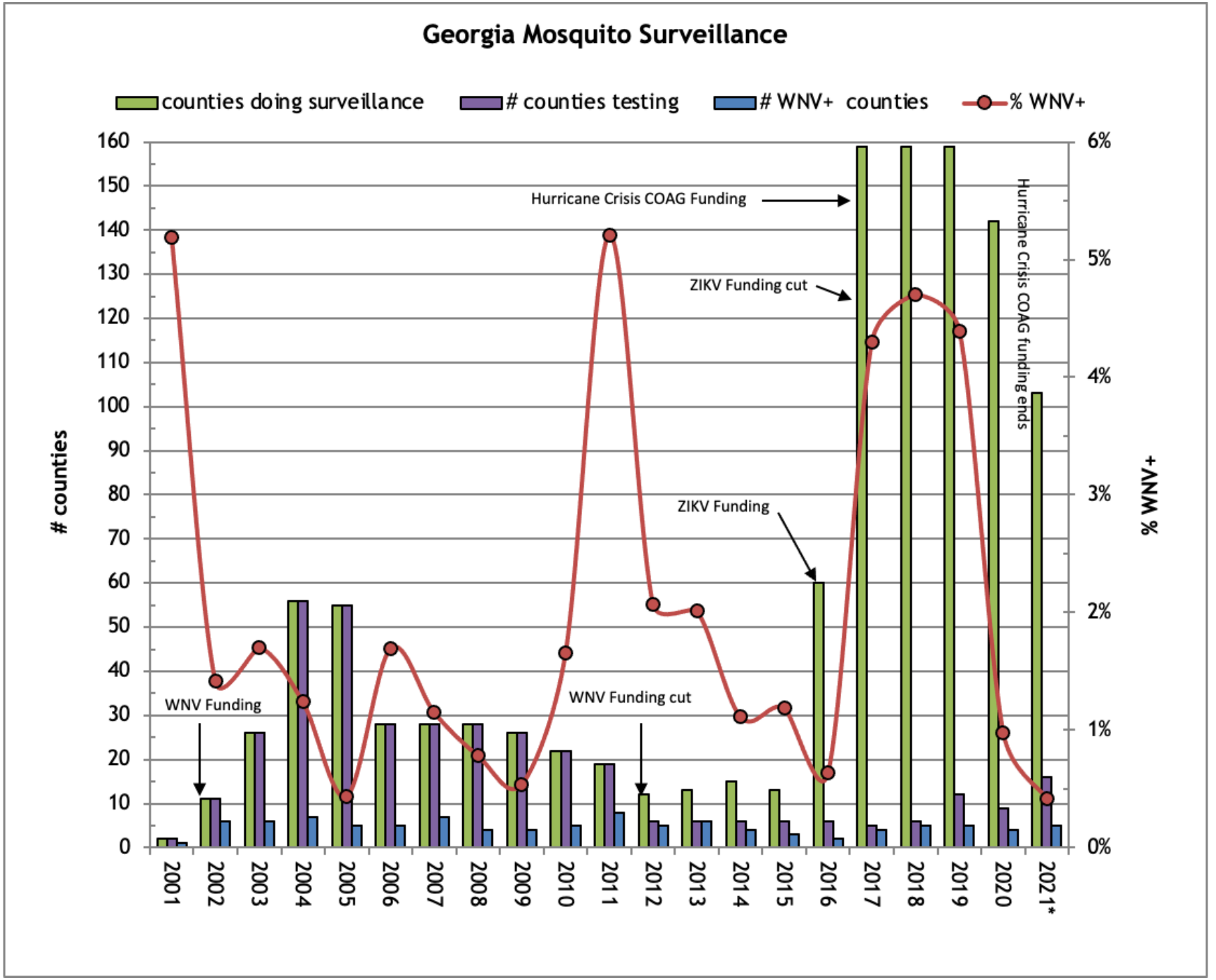
| 2001-2021 | human cases | WNV+ mosquito pool | veterinary case | positive bird |
|---|---|---|---|---|
| total | 589 | 2595 | 349 | 1904 |
| mean/year | 28.0 | 123.6 | 16.6 | 90.7 |

| year | total pools | WNV+ | % WNV+ | human cases |
|---|---|---|---|---|
| 2001 | 597 | 31 | 5.2% | 6 |
| 2002 | 4032 | 57 | 1.4% | 37 |
| 2003 | 6177 | 105 | 1.7% | 60 |
| 2004 | 10161 | 126 | 1.2% | 24 |
| 2005 | 15248 | 67 | 0.4% | 24 |
| 2006 | 4785 | 81 | 1.7% | 10 |
| 2007 | 6513 | 75 | 1.2% | 60 |
| 2008 | 6383 | 50 | 0.8% | 12 |
| 2009 | 4446 | 24 | 0.5% | 6 |
| 2010 | 5990 | 99 | 1.7% | 14 |
| 2011 | 7622 | 397 | 5.2% | 26 |
| 2012 | 6042 | 125 | 2.1% | 117 |
| 2013 | 7453 | 150 | 2.0% | 20 |
| 2014 | 5038 | 56 | 1.1% | 13 |
| 2015 | 3366 | 40 | 1.2% | 17 |
| 2016 | 5620 | 36 | 0.6% | 13 |
| 2017 | 6419 | 276 | 4.3% | 64 |
| 2018 | 6599 | 310 | 4.7% | 38 |
| 2019 | 5532 | 243 | 4.4% | 16 |
| 2020 | 6015 | 59 | 1.0% | 12 |
| 2021 | 7375 | 31 | 0.4% | 5 |
| | | | | |
| **MEAN** | 6257.8 | 116.1 | 0.0 | 28.3 |
| **TOTAL** | 131413 | 2438 | 42.8% | 594 |



| year | WNV+ pools | EEE+ pools | counties doing surveillance | # counties testing | # WNV+ counties | total mosquito pools tested | % WNV+ | Human WNV+ |
|---|---|---|---|---|---|---|---|---|
| 2001 | 30 | | 2 | 2 | 1 | 597 | 5.2% | 6 |
| 2002 | 91 | | 11 | 11 | 6 | 4032 | 1.4% | 36 |
| 2003 | 106 | 1 | 26 | 26 | 6 | 6177 | 1.7% | 55 |
| 2004 | 126 | 2 | 56 | 56 | 7 | 10161 | 1.2% | 23 |
| 2005 | 67 | 8 | 55 | 55 | 5 | 15248 | 0.4% | 24 |
| 2006 | 81 | | 28 | 28 | 5 | 4785 | 1.7% | 11 |
| 2007 | 75 | | 28 | 28 | 7 | 6513 | 1.2% | 55 |
| 2008 | 51 | 1 | 28 | 28 | 4 | 6383 | 0.8% | 12 |
| 2009 | 24 | | 26 | 26 | 4 | 4446 | 0.5% | 6 |
| 2010 | 99 | 3 | 22 | 22 | 5 | 5990 | 1.7% | 14 |
| 2011 | 438 | | 19 | 19 | 8 | 7622 | 5.2% | 25 |
| 2012 | 125 | 3 | 12 | 6 | 5 | 6042 | 2.1% | 117 |
| 2013 | 166 | 1 | 13 | 6 | 6 | 7453 | 2.0% | 20 |
| 2014 | 56 | 2 | 15 | 6 | 4 | 5038 | 1.1% | 13 |
| 2015 | 40 | | 13 | 6 | 3 | 3366 | 1.2% | 15 |
| 2016 | 36 | | 60 | 6 | 2 | 5620 | 0.6% | 13 |
| 2017 | 276 | 2 | 159 | 5 | 4 | 6419 | 4.3% | 63 |
| 2018 | 310 | 3 | 159 | 6 | 5 | 6598 | 4.7% | 38 |
| 2019 | 243 | | 159 | 12 | 5 | 5532 | 4.4% | 16 |
| 2020 | 59 | | 142 | 9 | 4 | 6025 | 1.0% | 12 |
| 2021* | 31 | 1 | 103 | 16 | 5 | 7357 | 0.4% | 5 |

*to date


Georgia Mosquito Surveillance
counties doing surveillance
# counties testing
# WNV+ counties
% WNV+
# counties
% WNV+
Hurricane Crisis COAG Funding
ZIKV Funding cut
ZIKV Funding
WNV Funding
WNV Funding cut
Hurricane Crisis COAG funding ends
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
0%
1%
2%
3%
4%
5%
6%
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021*

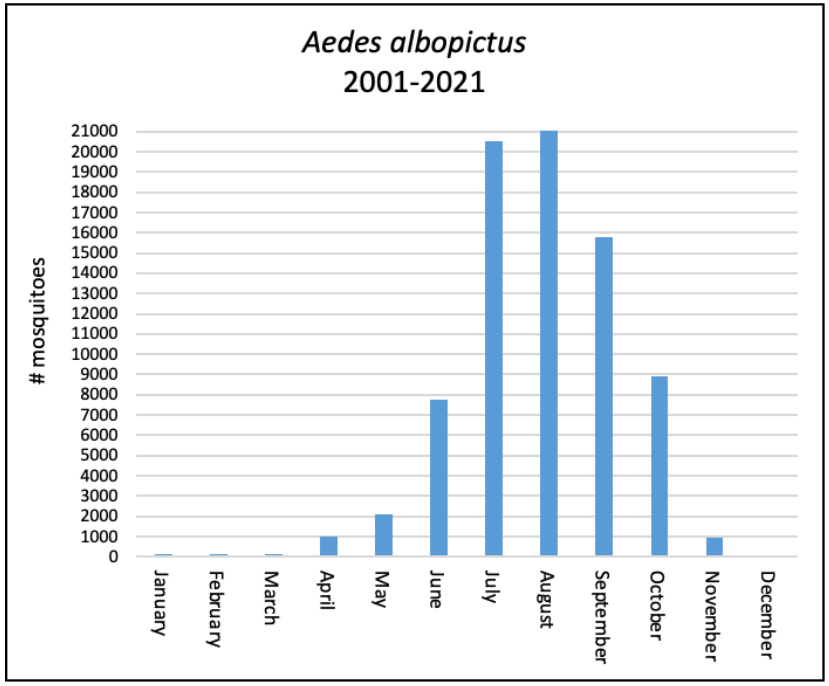
**Mosquito Surveillance: Untested Mosquitoes**

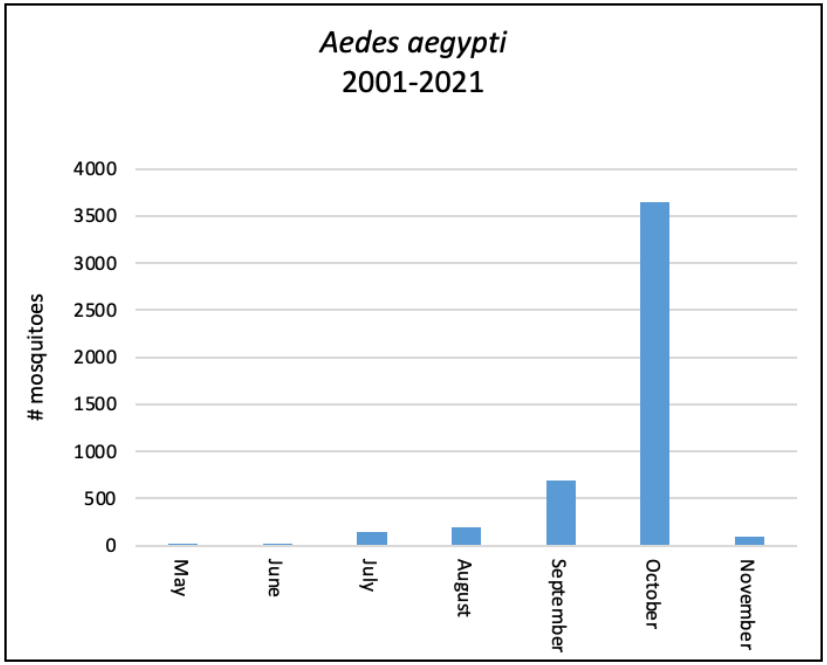
After the loss of WNV funding, mosquitoes collected during surveillance by the GDPH were no longer sent for testing. These mosquitoes are identified and the data are shared with the county mosquito control agency to assist with control efforts. ZIKV funding, followed by Hurricane Crisis CoAg funding allowed GDPH to create 5 Vector Surveillance Coordinator positions and hire a second entomologist in order to increase our ability to do surveillance and to respond to mosquito complaints and arboviral disease issues. Between 2017-2019, some level of surveillance was done in every county in Georgia. Due to loss of funding resulting in the loss of the Vector Surveillance Coordinators in August 2020, and to the COVID-19 response, surveillance was only done in 103 counties in 2021.

| Month | # mosquitoes |
|---|---|
| January | 123 |
| February | 215 |
| March | 1422 |
| April | 2874 |
| May | 2858 |
| June | 4507 |
| July | 3549 |
| August | 1824 |
| September | 1765 |
| October | 5096 |
| November | 648 |
| December | |
| Grand Total | 24881 |

| Month | # trap nights |
|---|---|
| January | 21 |
| February | 20 |
| March | 29 |
| April | 108 |
| May | 94 |
| June | 155 |
| July | 90 |
| August | 69 |
| September | 58 |
| October | 45 |
| November | 26 |
| December | |
| Grand Total | 715 |

| Month | # mosquitoes/trap night |
|---|---|
| January | 5.86 |
| February | 10.75 |
| March | 49.03 |
| April | 26.61 |
| May | 30.40 |
| June | 29.08 |
| July | 39.43 |
| August | 26.43 |
| September | 30.43 |
| October | 113.24 |
| November | 24.92 |
| December | |
| Mean | 35.11 |



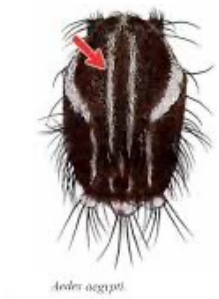




## Mosquito Surveillance

| Year | earliest report | earliest surveillance |
|---|---|---|
| 2001 | late Aug | late Aug |
| 2002 | late April | late Jan |
| 2003 | early April | early Jan |
| 2004 | early April | late Feb |
| 2005 | mid March | early Jan |
| 2006 | late April | early March |
| 2007 | mid May | late March |
| 2008 | mid June | late March |
| 2009 | mid July | mid Feb |
| 2010 | mid June | late Feb |
| 2011 | mid June | late Feb |
| 2012 | mid April | early Jan |
| 2013 | early May | early Jan |
| 2014 | mid May | mid Feb |
| 2015 | late May | early March |
| 2016 | late March | early Jan |
| 2017 | mid April | early Jan |
| 2018 | early Jan | early Jan |
| 2019 | early Feb | early Feb |
| 2020 | early May | early May |
| 2021 | mid January | early Jan |

*Aedes aegypti*

*Aedes albopictus*

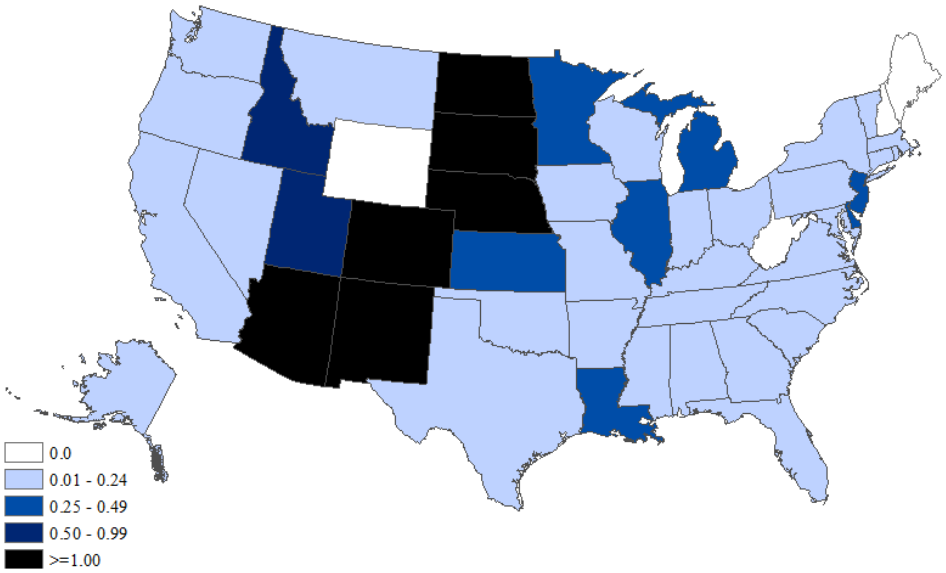


| Year | earliest report | earliest surveillance |
|---|---|---|
| 2005 | late Oct | mid July |
| 2006 | early Sept | late July |
| 2011 | early Sept | early Sept |
| 2012 | mid July | mid July |
| 2013 | mid Aug | early July |
| 2014 | early July | early July |
| 2015 | early July | early July |
| 2016 | late July | late July |
| 2017 | early June | early June |
| 2018 | early May | mid Feb |
| 2019 | Late July | Late July |
| 2020 | early May | early May |
| 2021 | early Sept | early Sept |

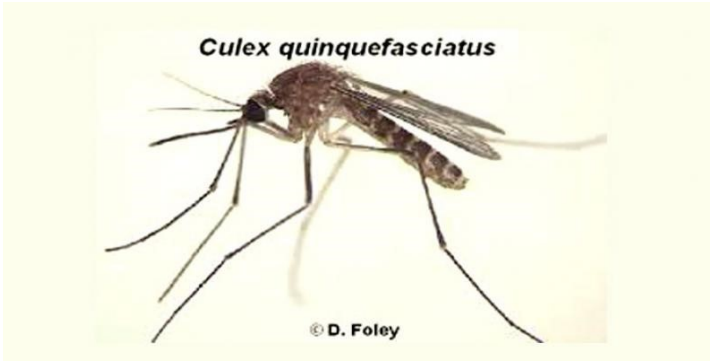
| Species | # mosquitoes |
|---|---|
| *Ae. aegypti* | 18 |
| *Ae. albopictus* | 2685 |
| *Ae. cinerius* | 1 |
| *Ae. vexans* | 1466 |
| *An. crucians* | 736 |
| *An. punctipennis* | 502 |
| *An. quadrimaculatus* | 284 |
| *Cq. perturbans* | 901 |
| *Cs. inornata* | 26 |
| *Cs. melanura* | 33 |
| *Cx. coronator* | 1357 |
| *Cx. erraticus* | 942 |
| *Cx. nigripalpus* | 1546 |
| *Cx. peccator* | 2 |
| *Cx. pilosus* | 1 |
| *Cx. quinquefasciatus* | 4200 |
| *Cx. restuans* | 623 |
| *Cx. salinarius* | 3351 |
| *Cx. territans* | 46 |
| *Oc. atlanticus* | 1924 |
| *Oc. canadensis* | 151 |
| *Oc. dupreei* | 1 |
| *Oc. fulvus pallens* | 17 |
| *Oc. hendersoni* | 1 |
| *Oc. infirmatus* | 131 |
| *Oc. japonicus* | 265 |
| *Oc. sollicitans* | 5 |
| *Oc. sticticus* | 80 |
| *Oc. taeniorhynchus* | 86 |
| *Oc. thibaulti* | 12 |
| *Oc. triseriatus* | 94 |
| *Oc. trivittatus* | 4 |
| *Or. signifera* | 10 |
| *Ps. ciliata* | 223 |
| *Ps. columbiae* | 201 |
| *Ps. cyanescens* | 1139 |
| *Ps. ferox* | 617 |
| *Ps. horrida* | 140 |
| *Ps. howardii* | 160 |
| *Tx. rutilus* | 20 |
| *Ur. lowii* | 4 |
| *Ur. sapphirina* | 43 |

## WNV Activity Map

This map shows the incidence of human West Nile virus neuroinvasive disease (e.g., meningitis, encephalitis, or acute flaccid paralysis) by state for 2021 with shading ranging from 0.01-0.24, 0.25-0.49, 0.50-0.99, and greater than 1.00 per 100,000 population.

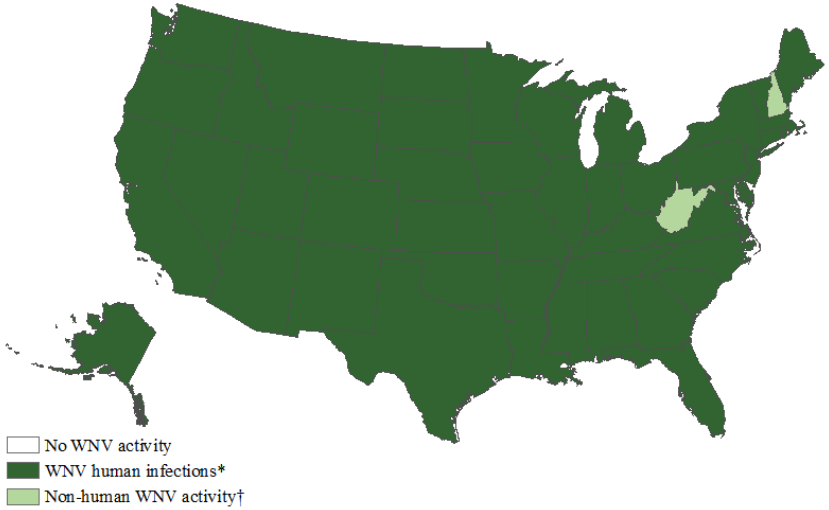



**West Nile Virus Neuroinvasive Disease Incidence by State – United States, 2021 (as of January 11, 2022)**

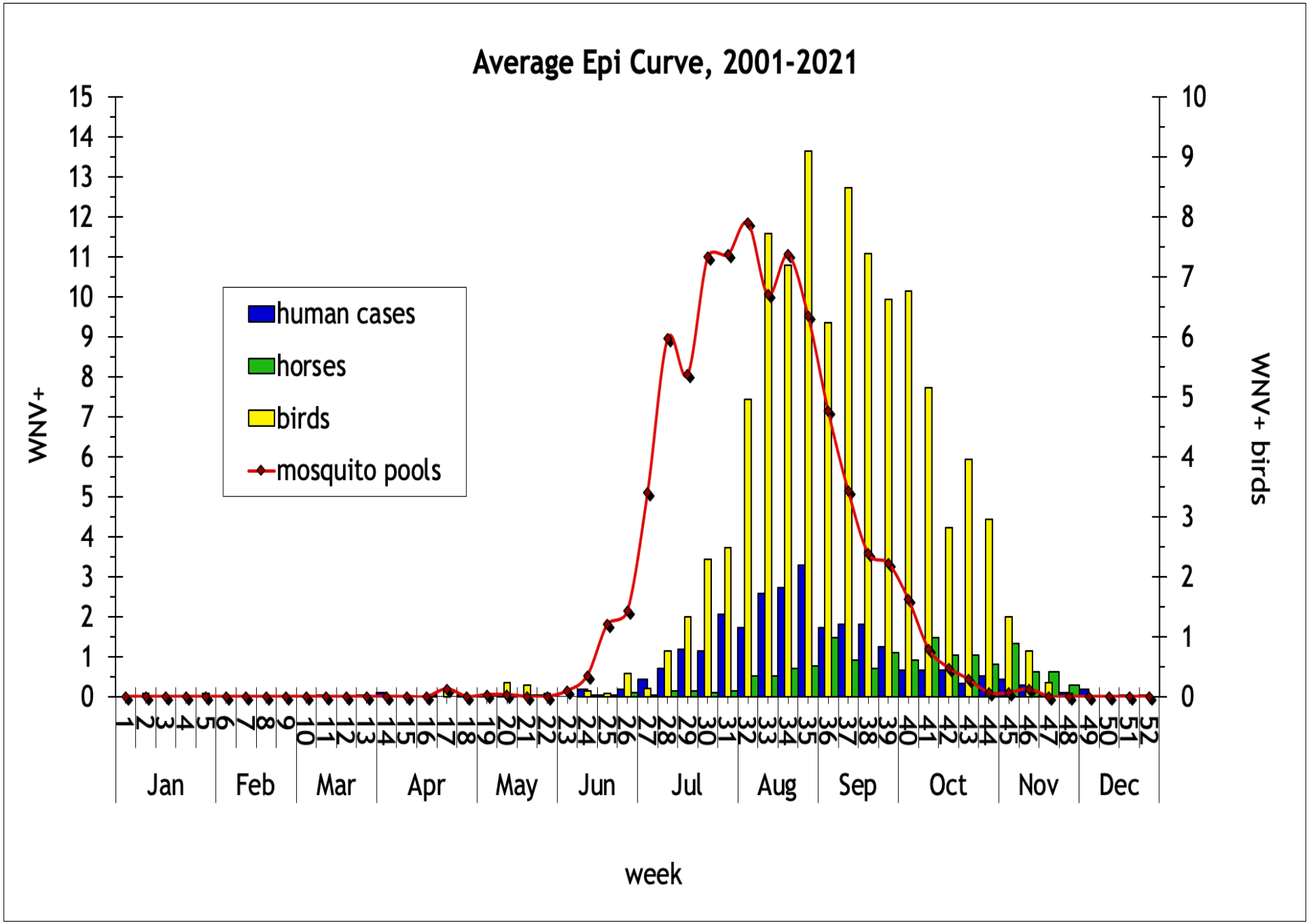


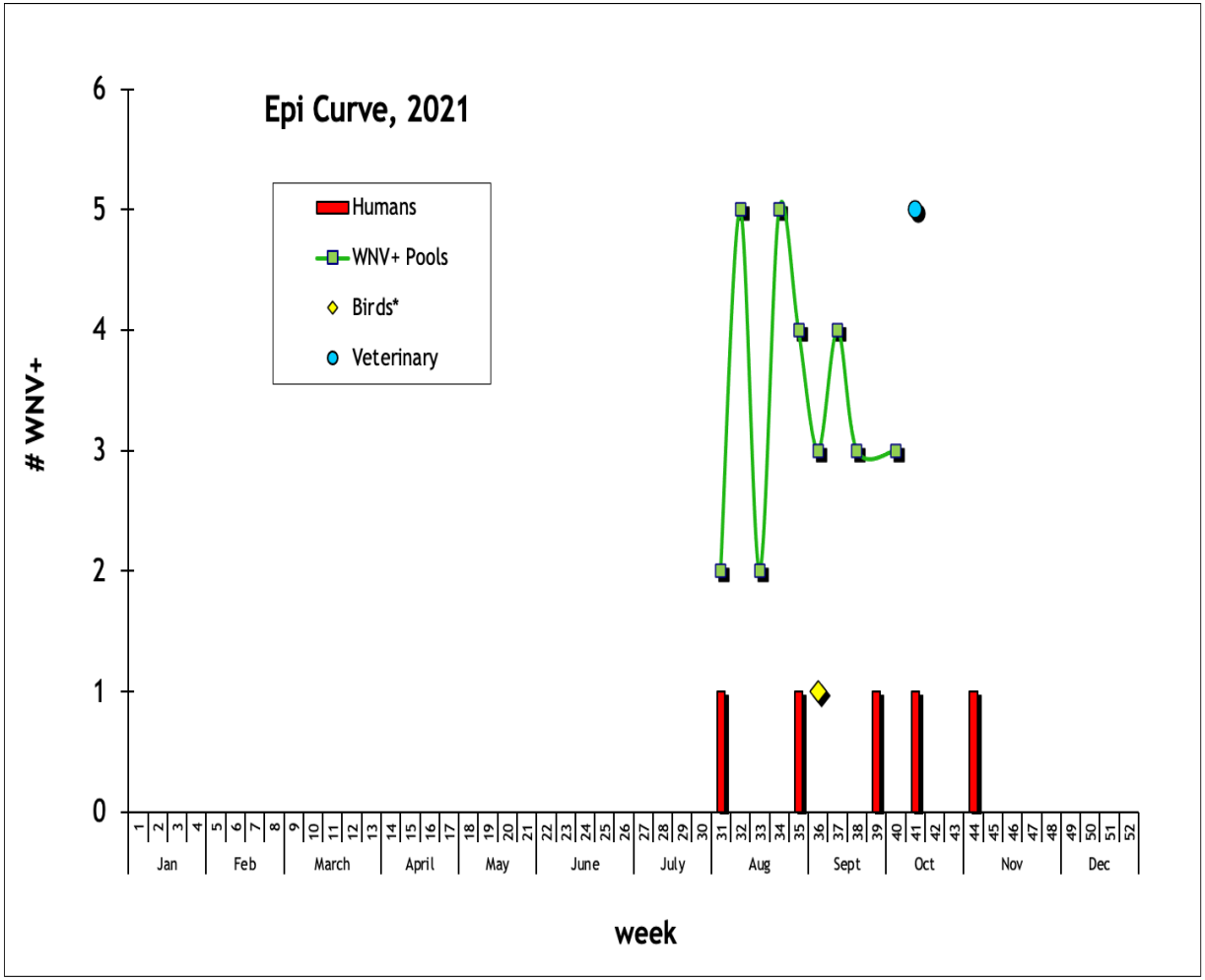

*WNV human disease cases or presumptive viremic blood donors. Presumptive viremic blood donors have a positive screening test which has not necessarily been confirmed.

†WNV veterinary disease cases, or infections in mosquitoes, birds, or sentinel animals.




**West Nile Virus Activity by State – United States, 2021 (as of January 11, 2022)**


Average Epi Curve, 2001-2021
WNV+
WNV+ birds
human cases
horses
birds
mosquito pools
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
week




The epidemic curve (epi curve) shows the progression of an outbreak over time.

THANK YOU to the district and county public and environmental health employees, mosquito control workers, veterinarians, and healthcare providers who collected much of the data summarized in this document.

GDPH Vector-Borne & Zoonotic Diseases Team

- Rosmarie Kelly, PhD (Entomologist)
- "Tiffany" Thuy-Vi Thi Nguyen, PhD (Entomologist)
- Shawna Stuck (Epidemiologist)
- Julie Gabel, DVM


Constructing epidemic curves is a common and very important practice in epidemiology. Epidemic curves are used to monitor disease occurrence, to detect outbreaks, to generate hypotheses about the cause of an outbreak, to monitor the impact of intervention efforts, and to predict the course of an epidemic.