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Status of Arboviral Disease Surveillance in Georgia, 2001-2012

Three arboviral diseases are currently endemic in Georgia: LaCrosse Encephalitis, Eastern Equine Encephalitis, and West Nile virus.

Eastern equine encephalitis virus (EEE) is transmitted to humans by the bite of any number of different infected mosquitoes. This virus is maintained in birds and is endemic is South Georgia. Eastern equine encephalitis (EEE) only rarely causes illness in humans due to its somewhat complex life cycle. Infection with EEE virus begins with the sudden onset of headache, high fever, chills, and vomiting. The illness may then progress into disorientation, seizures, or coma. EEE is one of the most severe mosquito-transmitted diseases in the United States with approximately 33% mortality and significant brain damage in most survivors. There is no specific treatment for EEE; care is based on symptoms.

The primary vector for La Crosse encephalitis virus (LAC) is *Ochlerotatus triseriatus*, the treehole mosquito. This virus is maintained in small mammals such as chipmunks and squirrels. Many people infected with LAC have no apparent symptoms. Among people who become ill, initial symptoms include fever, headache, nausea, vomiting, and tiredness. Some of those who become ill develop severe neuroinvasive disease (disease that affects the nervous system). Severe LAC disease often involves encephalitis and can include seizures, coma, and paralysis. Severe disease occurs most often in children under the age of 16. In rare cases, long-term disability or death can result from La Crosse encephalitis. Children who have had LAC often fall behind in school.

West Nile virus (WNV) is a mosquito-borne viral pathogen that was introduced into the United States in 1999. Within four years following its initial detection in New York, WNV was detected in states from the East and West coasts as well as in Mexico and Canada.

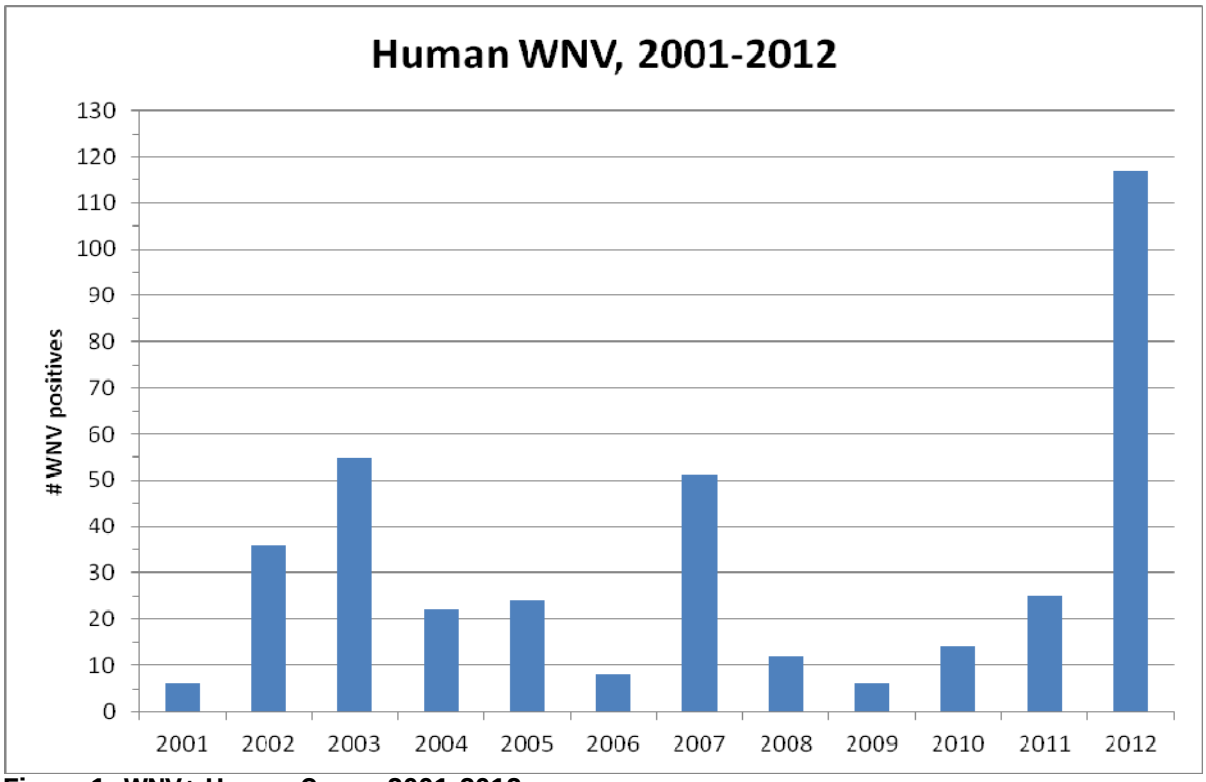

Figure 1: WNV+ Human Cases, 2001-2012

West Nile virus is maintained in birds. It occasionally infects humans who are bitten by mosquitoes that have been feeding on birds. Most people (approximately 80%) infected with WNV do not develop symptoms. About one in five infected people experiences a mild illness, often termed "West Nile Fever" (WNF), characterized by fever, headache, muscle weakness or myalgia, arthralgia, and sometimes rash. Less than one percent of persons infected with WNV develop neurologic illness ("West Nile Neurologic Disease" or WNND) in the form of meningitis, encephalitis, or possibly acute flaccid paralysis. Approximately three to fifteen percent of WNND cases are fatal. Risk of WNND is associated with increasing age and the presence of underlying medical conditions.

The presence of WNV in Georgia was first confirmed in July 2001 when an American crow from Lowndes County tested positive for the virus. In 2001, 322 WNV-positive birds were found in 55 of the 127 counties that submitted birds for testing; 7 birds tested positive for Eastern Equine Encephalitis virus (EEE). Two counties conducted mosquito surveillance in 2001; one of these counties had WNV-positive mosquitoes detected. There were 64 WNV-positive horses reported from 25 counties. Six human cases of WNV were reported, with one death.

In 2002, 934 WNV-positive birds were found in 93 of the 113 counties that submitted birds for testing. Twelve counties conducted mosquito surveillance in 2002, and 7 of these counties had WNV-positive mosquitoes detected; over 90% of the positive mosquitoes were *Culex quinquefasciatus*, the southern house mosquito. There were 175 WNV-positive horses reported from 69 counties. There were 44 WNV human cases, with 7 deaths.

In 2003, 479 birds tested positive for WNV from 65 of 114 counties that submitted birds for testing. Nineteen birds from 12 counties tested positive for EEE. Some level of mosquito surveillance was done in 28 counties, with 7 counties detecting WNV-positive mosquitoes. Again, the majority of the mosquitoes found positive for WNV were *Culex quinquefasciatus*. EEE was found in 4 mosquito pools from 3 counties. There were 60 cases of WNV reported in horses, and 81 cases of EEE reported. This number was well above our mean of 5 EEE-positive horses per year. In 2003, Georgia reported 55 verified cases of West Nile virus infection, including 4 deaths. Five of these cases were asymptomatic, 29 experienced WNV neurologic disease, and 21 were diagnosed with WN fever. Two cases of EEE were reported as well, with one death.

In 2004, 105 WNV-positive birds were found in 24 of the 71 counties that submitted birds for testing. Five hundred and eighty-one birds were submitted for testing. Sixty counties conducted some level of mosquito surveillance in 2004, and 7 of these counties had WNV-positive mosquito pools detected; over 90% of the positive mosquitoes were *Culex quinquefasciatus*, the southern house mosquito. Two EEE-positive mosquito pools were detected. There were 3 WNV-positive horses and 7 EEE-positive horses reported. There were 23 human cases of WNV, with 1 death. One of these cases was asymptomatic, 14 experienced WNV neurologic disease, and 7 were diagnosed with WN fever. In one case, the symptoms were unknown. Five cases of LaCrosse Encephalitis were reported, with no deaths.

In 2005, 310 birds were submitted for testing from 51 counties; 23 tested positive for WNV. EEE was also detected in a flock of quail in South Georgia in 2005. Some level of mosquito surveillance was done in 59 counties, with WNV-positive mosquitoes detected in 5 counties. Intensive mosquito surveillance was conducted in fewer than 10 counties. Ninety-six percent of all WNV-positive mosquito pools consisted of *Culex quinquefasciatus*, the southern house mosquito. EEE was isolated from 8 mosquito pools from 2 counties. There were 20 EEE-positive horses detected in 2005, as well as one WNV-positive horse, and one horse that was determined to be both WNV and EEE positive. Twenty-four verified human cases of WNV were reported, with 2 deaths. Fifty percent of these cases experienced neurologic illness, 4 cases were viremic donors who never developed disease. One case of LaCrosse and one case of EEE were also reported. There were 5 cases of internationally-acquired dengue fever.

In 2006, 282 birds were submitted for testing from 38 counties; 15 (from 7 counties) tested positive for WNV. Pigeon paramyxovirus was detected in one bird. Some level of mosquito surveillance was done in 27 counties, with WNV-positive mosquitoes detected in 5 counties. All WNV-positive mosquito pools

consisted of *Culex quinquefasciatus*, the southern house mosquito. There were 4 EEE-positives horses detected in 2006; no WNV-positive horses were detected. Eight confirmed cases of human disease were reported, including one death. One positive viremic blood donor was also identified. Twenty-five percent of these cases developed neurologic symptoms, while 63% were diagnosed with West Nile fever. One case of LaCrosse and one case of EEE were also reported. There was 1 case of internationally-acquired dengue fever reported.

In 2007, 99 birds were submitted for testing from 21 counties; 12 (from 5 counties) tested positive for WNV. Some level of mosquito surveillance was done in 28 counties, with WNV-positive mosquitoes detected in 7 counties. All WNV-positive mosquito pools consisted of *Culex quinquefasciatus*, the southern house mosquito. No WNV+ horses were reported in 2007, but 6 horses were reported positive for EEE. Fifty-two confirmed human cases of WNV infection, including 1 death were reported. Three positive viremic blood donors were also identified. A fourth blood donor went on to develop WNV symptoms and was counted as one of the 52 confirmed cases. Twenty five (48%) of the 52 cases experienced WNV neurologic illness (altered mental status, encephalitis, and/or meningitis) and 25 (48%) were diagnosed with WNV fever. The remaining two cases (4%) were asymptomatic. Three viremic blood donors were lost to follow up and symptoms were never recorded. In addition to WNV, two confirmed cases and one suspect case of LaCrosse Encephalitis were reported in Georgia in 2007. One suspect case of Eastern Equine Encephalitis was also reported. There were 11 internationally-acquired Dengue cases and 1 case of internationally-acquired Chikungunya reported.

In 2008, 20 birds were submitted from 10 counties; 5 (from 2 counties) tested positive for WNV. Some level of mosquito surveillance was done in 28 counties with WNV-positive mosquitoes detected in 5 counties. Mosquitoes found WNV+ were *Cx quinquefasciatus, Cx restuans, and Ochlerotatus triseriatus;* the mosquitoes most commonly found positive were *Cx quinquefasciatus*. No WNV+ horses were reported in 2008, but 23 horses and 1 dog were reported positive for EEE. Eight confirmed human cases of WNV infection were reported. Four positive viremic blood donors were also identified, but are not counted as part of the 8 confirmed cases. Five (62%) of the 8 cases experienced WNV neurologic illness (altered mental status, encephalitis, and/or meningitis) and 3 (38%) were diagnosed with WNV fever. The four viremic blood donors remained asymptomatic. In addition to WNV, two confirmed cases of LaCrosse Encephalitis were reported in Georgia in 2008. Two internationally-acquired cases of Dengue were also reported.

In 2009, 21 birds were submitted for testing from 7 counties; 1 bird tested positive for WNV. Some level of mosquito surveillance was done in 27 counties with WNV-positive mosquitoes detected in 4 counties. Mosquitoes found WNV+ were *Cx quinquefasciatus* and *Cx restuans;* the mosquitoes most commonly found positive were *Cx quinquefasciatus*. One horse and 2 dogs tested positive for WNV in 2009, and 44 horses, 1 calf, and 1 dog were reported positive for EEE. Four confirmed human cases of WNV infection were reported. Two positive viremic blood donors were also identified, but are not counted as part of the 4 confirmed cases. All of the WNV+ cases experienced WNV neurologic illness (altered mental status, encephalitis, and/or meningitis). The two viremic blood donors remained asymptomatic. In addition to WNV, two confirmed cases of LaCrosse Encephalitis were reported in Georgia in 2009. Five internationally-acquired cases of Dengue were also reported.

In 2010, 9 birds were submitted for testing from 3 counties; 4 birds tested positive for WNV. Some level of mosquito surveillance was done in 24 counties with WNV-positive mosquitoes detected in 5 counties. Mosquitoes found WNV+ were *Aedes albopictus, Culex quinquefasciatus* and *Cx restuans;* the mosquito species most commonly found positive (96%) was *Cx quinquefasciatus*. Two horses tested positive for WNV in 2010, and 11 horses were reported positive for EEE. Thirteen confirmed human cases of WNV infection were reported. One positive viremic blood donor were also identified, but is not counted as part of the 13 confirmed cases. Nine of the cases were fever case, while 4 experienced WNV neurologic illness (Guillian Barre Syndrome, encephalitis, and/or meningitis). The viremic blood donor remained asymptomatic. In addition to WNV, two confirmed cases of LaCrosse Encephalitis were reported in Georgia in 2010. Nine internationally acquired cases of Dengue were also reported, as were 2 cases of Dengue Hemorrhagic Fever and one case of Chikungunya.

In 2011, 6 birds were submitted for testing from 3 counties; 1 bird tested positive for WNV in DeKalb County. Some level of mosquito surveillance was done in 18 counties with WNV-positive mosquitoes detected in 7 counties. Mosquitoes found WNV+ were *Aedes albopictus, Culex quinquefasciatus* and *Cx restuans;* the mosquito species most commonly found positive was *Cx quinquefasciatus*. Four hundred and thirty-eight WNV+ mosquito pools were reported. Three horses tested positive for WNV in 2011, and no horses were reported positive for EEE. Eight confirmed and 14 probable human cases of WNV were reported in 2011. Three positive viremic blood donors were also identified, but are not counted as any of the 22 cases.

In 2012, only the six counties and one city holding independent contracts with SCWDS were able to send birds and mosquitoes in for testing. Ten birds were submitted for testing from 3 counties; 1 bird, sent in for testing by the veterinarian, tested positive for WNV in Mitchell County. The six counties and one city sent mosquitoes in for testing in 2012, and WNV-positive mosquitoes were detected in 5 counties. One hundred and twenty-five WNV+ mosquito pools were reported. Mosquitoes found WNV+ **were** *Culex quinquefasciatus* **and** *Cx nigripalpus;* **the mosquito species most commonly found positive** was *Cx quinquefasciatus*. Eleven horses tested positive for WNV in 2012, and 10 horses were tested positive for EEE. One hundred human cases of WNV were reported in 2012, with 6 deaths. Seventeen positive viremic blood donors were also identified, but are not counted as any of the 100 cases. Forty-seven (47%) of the 100 cases experienced WNV neurologic illness (altered mental status, encephalitis, and/or meningitis) and 50 (50%) were diagnosed with WNV fever. Three cases were lost to follow-up. The viremic blood donors remained asymptomatic. The average age of cases was 55 years (range 11-87). The average age of those with WNV neurologic illness was 59 years (range 11-87). Sixty-six (66%) of the 100 cases were male. The majority of cases were reported in August and September, although there was a peak in number of cases in July. In addition to WNV, one confirmed case of EEE was reported in Georgia in 2012. Thirteen internationally acquired cases of Dengue were also reported.

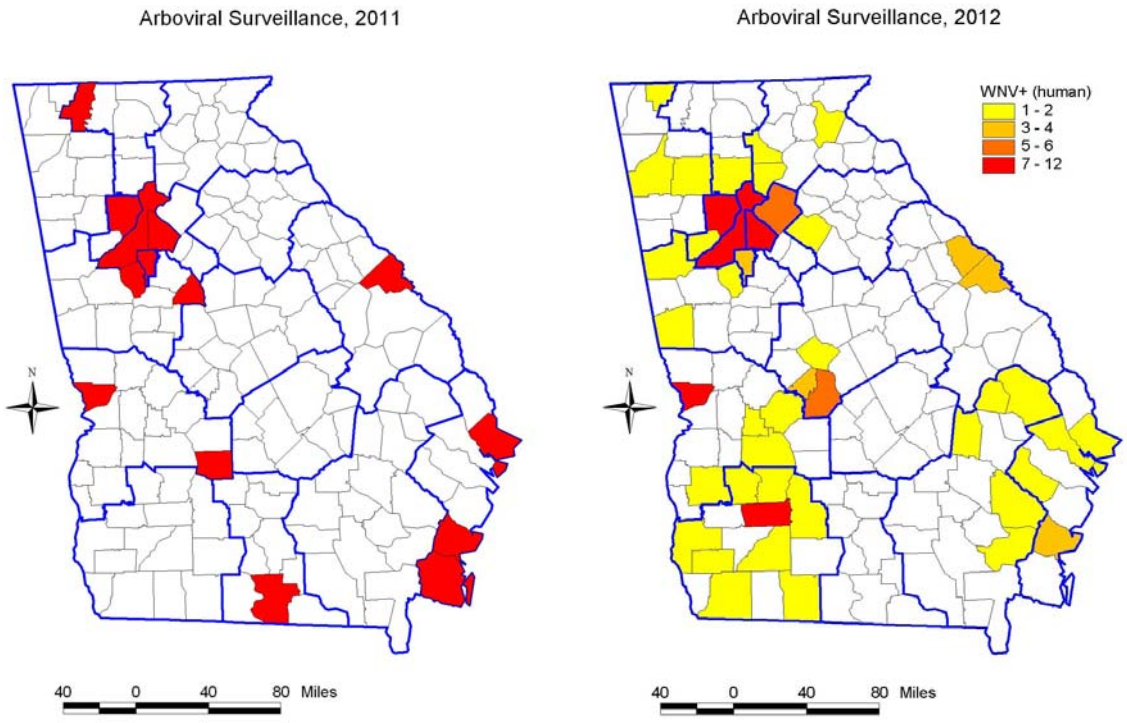

Figure 2: WNV in Georgia, 2011 and 2012

Of the 5387 WNV cases reported to the CDC, 2734 (51%) were reported as neuroinvasive disease cases and 2653 (49%) were reported as nonneuroinvasive disease cases. Five hundred and ninety seven (597) WNV presumptive viremic blood donors (PVDs) have been reported.

West Nile virus (WNV) Neuroinvasive Disease Incidence reported to ArboNET, by state, United States, 2012 (as of December 11, 2012)

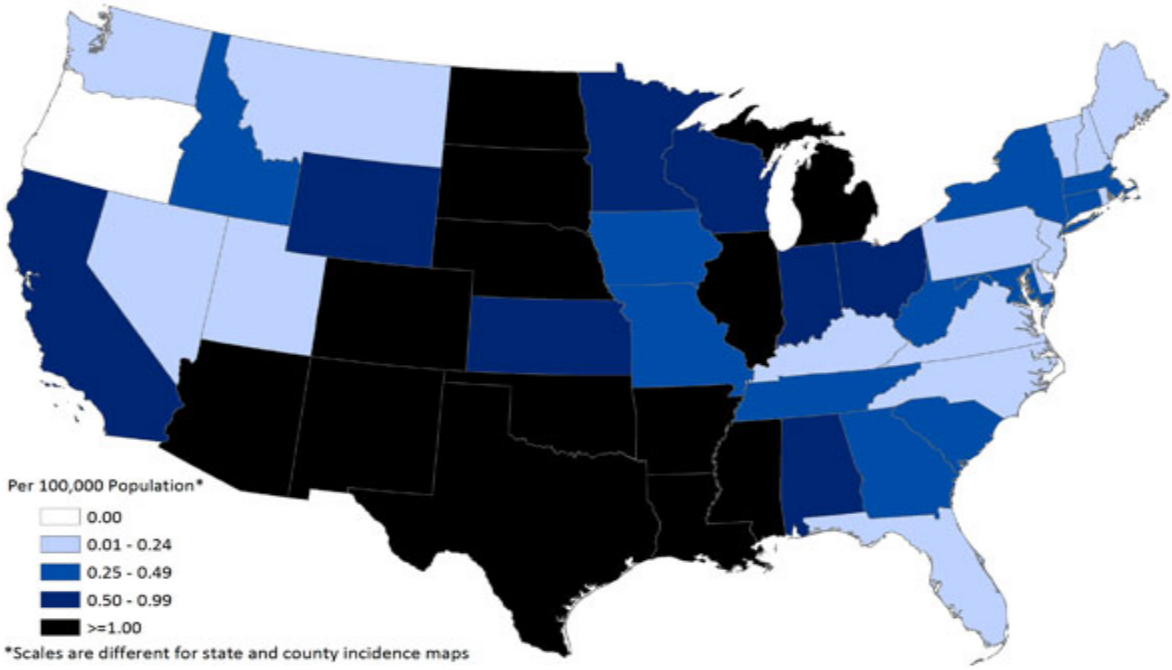

Figure 3: 2012 West Nile Virus Activities in the United States

Arbovirus Surveillance during the Winter Months:
Although cold winter temperatures will reduce mosquito activity in Georgia, some mosquitoes will fly and blood feed when temperatures rise above 50° F. However, cooler temperatures generally mean a lower risk of mosquito-borne disease transmission because mosquitoes are less active and virus does not replicate well. Also, people tend to spend less time outdoors during winter months, and typically wear more clothing or heavier clothing while they are outdoors.

Testing of dead birds for arboviruses is no longer being offered at the Southeastern Cooperative Wildlife Disease Study (SCWDS), unless you have a contract with SCWDS**.** Birds are no longer considered good indicators of human risk, especially where mosquito surveillance is being done. If no mosquito surveillance is being done, dead bird testing may provide the only evidence that WNV is active in an area.

District or county health departments that are able to collect and identify mosquitoes may also submit sorted and identified mosquitoes to SCWDS for arbovirus testing **if they have a contract with SCWDS**. Mosquito pools should be shipped on dry ice and should include the following information: date of collection, collection location, collection method, and mosquito species. The submission form and instructions may be downloaded from the GDPH website (MOSQUITO SUBMISSION FORM). Information on identifying Georgia mosquito species can be found at http://www.GAmosquito.org.

What to Expect During 2013:
Due to our wet winter and to the storms hitting many areas of Georgia, both nuisance and vector species of mosquitoes will be in abundance this year. Eastern equine encephalitis horse cases have been on the

rise for the last few years, so the risk of EEE transmission to humans should be considered to be high this year. Frequent heavy rains may serve to reduce WNV vectors, so West Nile virus risk will likely be low initially.

Equine surveillance and human disease surveillance will continue to be conducted in 2013. Some mosquito surveillance will also occur. All these are important components of an arbovirus surveillance and control program. By boosting our efforts to detect WNV, we had improved our ability to detect and respond to other arboviruses in Georgia, including eastern equine encephalitis (EEE) and LaCrosse encephalitis (LAC) viruses. **Information obtained from these surveillance efforts should lead to responsible and informed decisions about mosquito control as well as public education about elimination of mosquito breeding habitats and prevention of mosquito bites.**

Our past experiences in Georgia do point out the need for mosquito surveillance and testing to reduce the impact of arboviral diseases. For example, three times the number of WNV+ mosquitoes was detected in 2011, and a majority of these were collected in Chatham County, where no virus transmission had been detected since 2007. Although mosquito control is not based on the presence of virus, finding virus in the mosquito pools in an area does increase the mosquito control response. This increase in response was likely responsible for reducing the risk of transmission in these areas of high viral transmission.

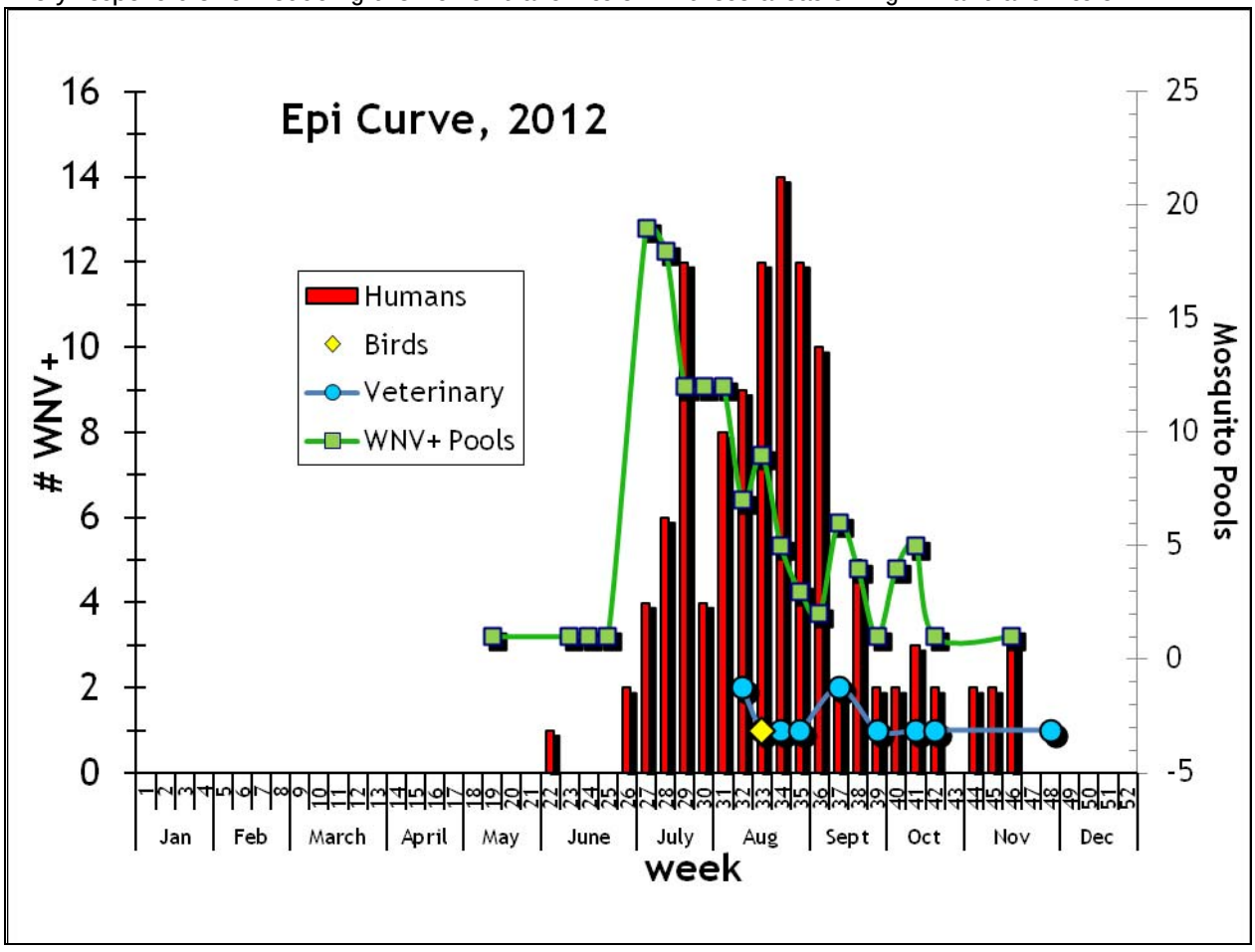

FIG 4: Epi Curves for 2012 WNV Season

We do not yet know the extent of virus transmission from year to year (WNV activity might be yearly, cyclical, or sporadic), but to-date WNV activity has been a yearly occurrence and is considered endemic throughout the state. Surveillance is useful as a trigger for public education messages reminding people to wear repellent and to dump out standing water.

Continued bird surveillance and mosquito surveillance also make it much more likely that the next new virus introduced into the area will be identified before human cases occur. However, funding for arboviral testing is no longer available. Where mosquito control is available, data should be shared between public health and mosquito control. Mosquito control targeting vector species will reduce the risk of disease transmission.

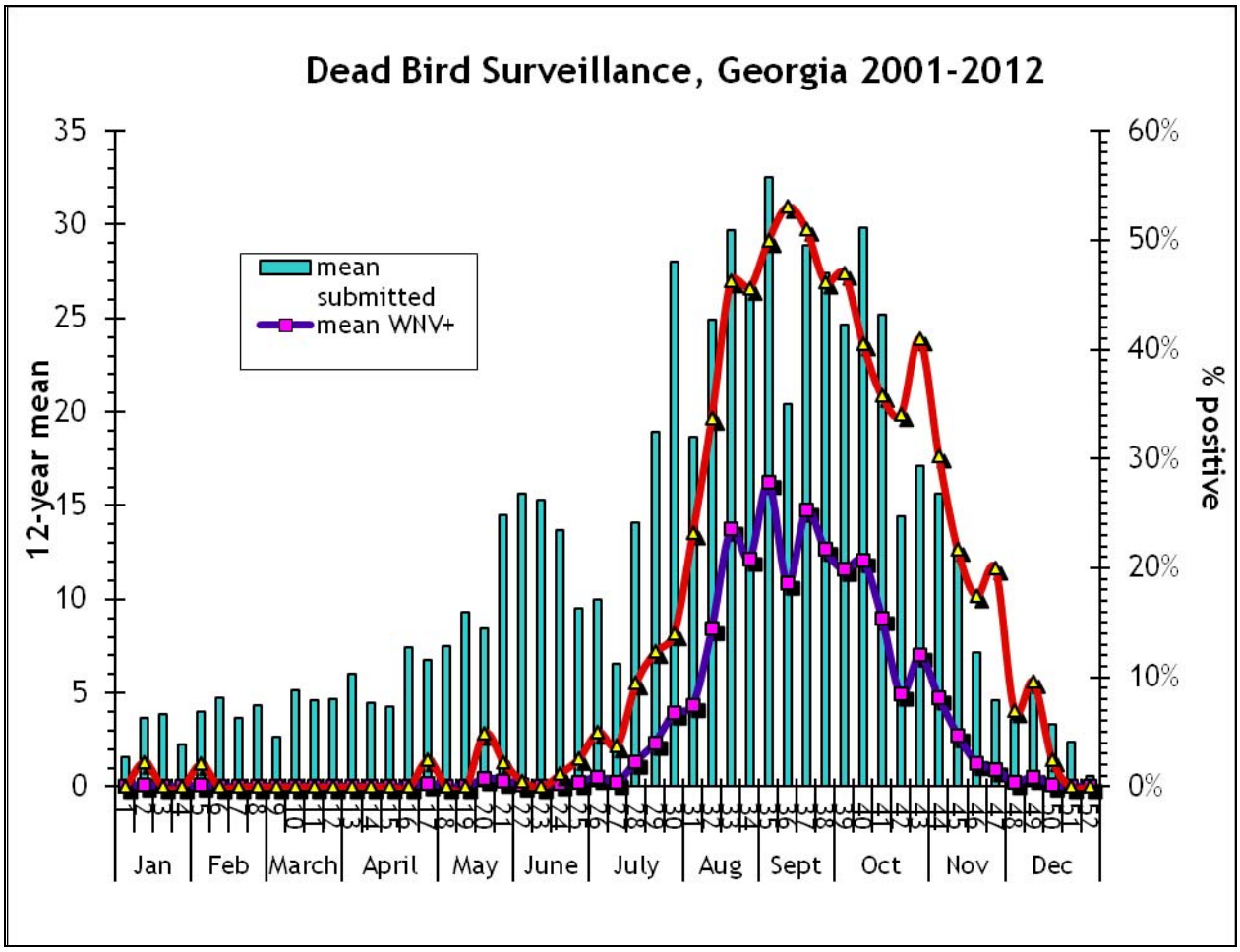

Figure 5: Dead Bird Surveillance, 2001-2012. Dead bird surveillance determines when WNV is circulating through bird populations, and indicates a potential for increased risk of human disease.

Equine surveillance will continue throughout 2013 in cooperation with the Georgia Department of Agriculture and the University of Georgia Veterinary Diagnostic Laboratories. Equine arbovirus surveillance has traditionally been an important indicator of EEE activity in Georgia and has been used as an indicator of human risk. Equine surveillance plays an important role in determining the risk of WNV activity, especially in rural areas where bird surveillance data may not be as available, but because reported cases of WNV in horses continue to decrease, strengthening relationships with local veterinarians will provide better information on horse cases locally. Because clustering of human cases around positive horse sites indicates that these are sites of high human risk, education of horse owners plays an important role in reducing the risk of mosquito-borne diseases.

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. Providers are requested to use commercial laboratories for arboviral testing, although the Georgia Public Health Lab may offer the arboviral panel during 2012 to healthcare providers in cases of extreme need. Although specific treatments are unavailable, testing humans for arboviral infection is useful in that it helps guide public health education and prevention programs. An arboviral encephalitis case report form (CRF) will still be required before testing will be performed. Clinical criteria for testing, specific instructions, required forms, and updates may be found on the GDPH website under Information for Healthcare Providers. GDPH does mandate that **all arboviral infections, REGARDLESS OF DISEASE STATUS, must be reported immediately to public health.**

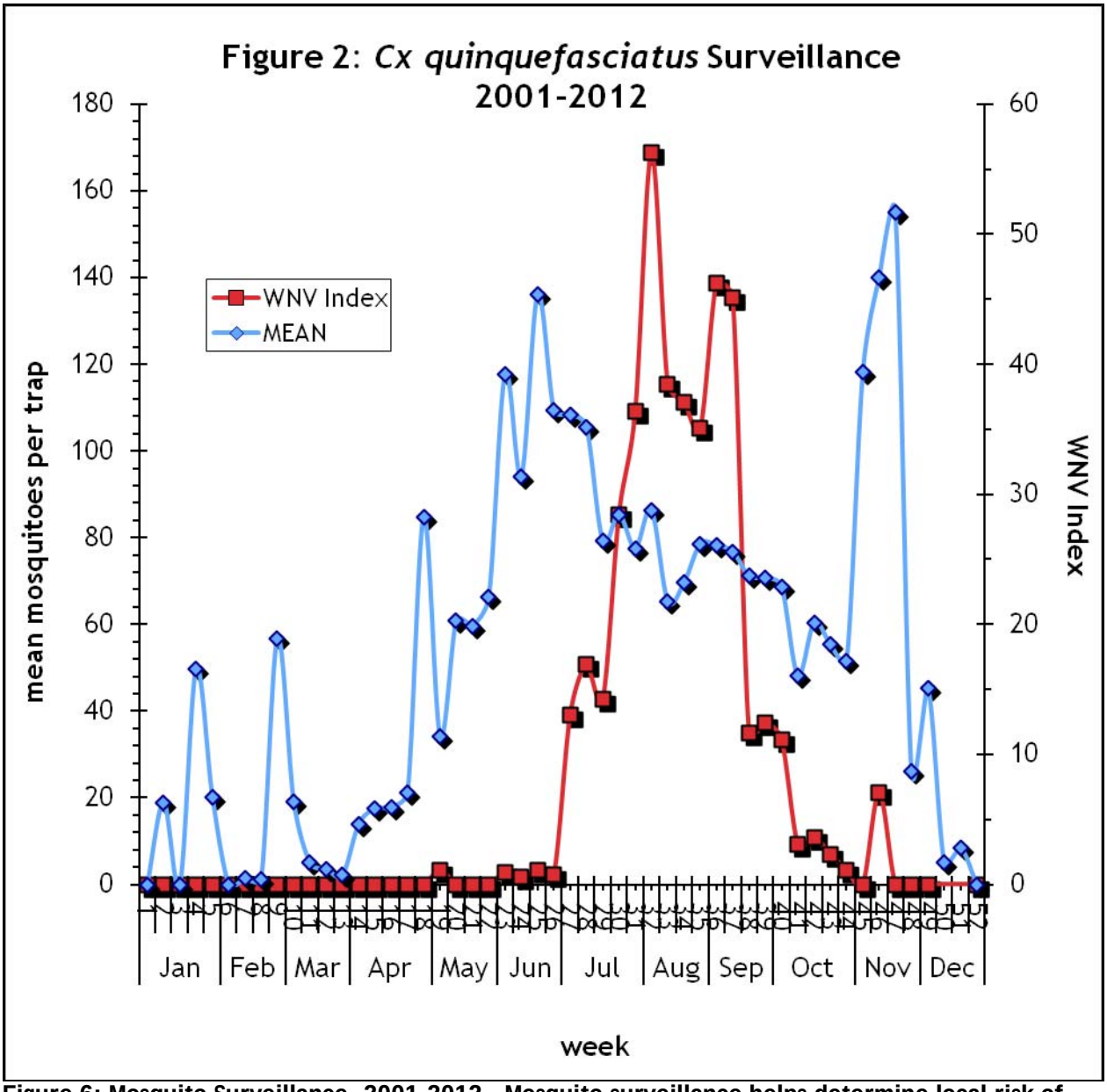

Figure 6: Mosquito Surveillance, 2001-2012. Mosquito surveillance helps determine local risk of vector-borne diseases such as WNV. Detection of WNV in mosquitoes indicates an increased risk of human disease locally.

As Georgia begins its 14th year of WNV transmission, surveillance for the sake of locating and responding to increases in vector populations through community education and mosquito control

continues to be an important tool in reducing human risk of disease. Currently, it is recommended that mosquito surveillance start in April (or earlier) to determine baseline vector populations and continue through October (or later). Mosquito surveillance traps can be placed where human cases, or positive horse, birds, or mosquito pools have been found previously, where mosquito complaints occur, where at-risk populations live, or where public use areas are located. *Culex quinquefasciatus*, the mosquito most associated with WNV in Georgia, has an average flight range of approximately one half mile from its site of breeding habitat.

Integrated mosquito management (IMM) practices for mosquito control include education, surveillance, source reduction, larviciding, and adulticiding as the means to reduce mosquito populations below a threshold amount. Reminding the public at the start of mosquito season that wearing repellent reduces the risk of WNV is important. It is also important to remind people of their role in reducing mosquito populations by eliminating mosquito-breeding areas in their yards and in their neighborhoods. Applying larvicide to catch basins and other locations starting in March or April will help reduce populations of *Culex* spp mosquitoes. Additional larviciding and education in response to positive birds or increased numbers of vector species undoubtedly has the effect of minimizing the risk of human disease in areas where virus is actively circulating. When adult mosquito populations begin to rise, it is important to consider adulticiding in an effort to reduce mosquito populations. Where nuisance mosquito control is already being conducted, coordinating these activities with bird and mosquito surveillance may aid in further reducing human risk. Communication between agencies and with the public is an essential part of the arboviral disease risk reduction effort. Mapping of surveillance and control activities provides additional information that can be used to direct activities to make the best use of resources. Education should occur whenever anyone talks to a member of the public, be it answering the phone, larviciding, or setting a mosquito trap. It is important to do as many of these activities simultaneously as is possible to use worker time more efficiently.

Thank you for your hard work in making Georgia's arbovirus surveillance program successful. Please visit the GDPH website (http://health.state.ga.us/epi/vbd/mosquito.asp) often for maps, updates, presentations, guidance documents, forms, and summaries.