North Carolina Endemic Mosquito-Borne Disease Annual Report 2024

NC DEPARTMENT OF HEALTH AND HUMAN SERVICES
Division of Public Health

Endemic Mosquito-borne Diseases Reported in North Carolina, 2024

Preventing and controlling mosquito-borne diseases requires consistent and coordinated efforts of health care providers, state and county health agencies, and local mosquito control agencies. Surveillance for human infections, animal infections, and infected mosquitoes helps to identify areas where there is a risk of transmission, while local efforts to control mosquito populations, as well as personal protective measures such as applying EPA-registered insect repellents, are crucial for prevention of bites from infected mosquitoes. Transmission of mosquito-borne diseases involves interactions between mosquitoes, humans, weather patterns, and animal hosts (e.g., birds, chipmunks, deer). Therefore, case numbers can vary significantly from year to year and decade to decade. This annual surveillance report summarizes three mosquito-borne diseases – West Nile virus (WNV), La Crosse virus (LACV), and eastern equine encephalitis (EEE) – that are transmitted locally in NC. Detailed statistics and surveillance data for each of these diseases are presented on subsequent pages. While a fourth mosquito-borne disease caused by Jamestown Canyon virus (JCV) is also transmitted in NC, a detailed report of this disease is not presented here because only a single case has ever been reported and no cases were identified in 2024.

2024 Surveillance Highlights

- 27 neuroinvasive WNV cases were reported in 2024 – the highest case count since WNV first entered the state in 2002.
- Reported cases of neuroinvasive LACV returned to typical rates in 2024 after several years with lower-than-average numbers.
- Consistent with previous years, WNV cases were geographically distributed throughout the state, while LACV cases were concentrated in western NC.
- One EEE case was reported in 2024, which is typical for the state.
- WNV, LACV and EEE cases all peaked earlier in the year compared to their historical averages.
- Consistent with previous years, the vast majority of WNV, LACV and EEE cases in 2024 were hospitalized, emphasizing the severity of these infections. Three deaths due to WNV infection were also reported.

Important Mosquito Vectors of North Carolina

Mosquito Species	Disease(s)	Primary hosts	Adult Habitat	Larval Habitat	Flight range	Biting Time	Distribution in NC
Eastern Treehole Mosquito *(Aedes triseriatus)*	LACV	Small mammals, Humans	Hardwood Forest & Residential	Treeholes & small man-made containers	0.5 to 1 mile	Daytime	Statewide; Primarily Western
Asian Tiger Mosquito *(Aedes albopictus)*	WNV & LACV	Humans, Birds, Mammals & Other (Opportunistic)	Thick vegetation; Urban to Rural	Small natural and man-made containers	0.25 to 0.5 mile	Daytime	Common Statewide
Northern and Southern House Mosquito *(Culex pipiens complex)*	WNV	Birds, Mammals, and Humans	Urban; Suburban; Homes	Small stagnant pools; Man-made containers	0.25 to 1 mile	Dusk & Night	Common Statewide
Florida SLE Mosquito *(Culex nigripalpus)*	WNV	Birds, Mammals, Humans, & Reptiles	Thick vegetation; Urban to Rural	Large stagnant vegetated pools	<1 to 2 miles	Dusk to Dawn	Statewide, primarily Southeastern
Unbanded Saltmarsh Mosquito *(Culex salinarius)*	WNV & EEE	Birds, Humans, Mammals & Other	Lowland forest, Open marshes; Homes	Large fresh to brackish pools and marshes	0.25 to 5 miles	Sunset to early night	Statewide; Primarily Eastern
Culex erraticus	WNV & EEE	Birds in spring; Mammals and Humans in late summer and fall	Thick vegetation; Urban to Rural	Large stagnant pools with heavy vegetation	0.9 to 1.4 miles	Dusk & Dawn	Statewide
Black-tailed Mosquito *(Culiseta melanura)*	WNV & EEE	Passerine Birds	Hardwood Swamps	Acidic stagnant pools in swamps or bogs	0.5 to 1 mile	Sunset to sunrise	Primarily eastern coastal plain; Isolated swamps west to foothills

Endemic Mosquito-borne Diseases Reported in North Carolina, 2024

Number of Cases of Mosquito-Borne Diseases Reported in North Carolina, 2014-2024													
Disease	*2014*	*2015*	*2016*	*2017*	*2018*	*2019*	*2020*	*2021*	*2022*	*2023*	*Previous ten-year average*	*2024*	*Significant Change*
WNV	0	4	2	8	10	1	1	8	12	15	*6*	27	⇧
LACV	23	11	8	21	24	6	21	10	2	5	*13*	15	--
EEE	0	1	2	0	0	1	0	1	0	0	*1*	1	--
JCV	0	0	0	1	0	0	0	0	0	0	*0*	0	--

⇧=significant increase *(≥ 2 standard deviations above average)* ⇩*=significant decrease (≥ 2 standard deviations below average)* *-- = no significant change*

Report Specifications. Notable information about this report includes:

- In North Carolina, only neuroinvasive disease caused by West Nile virus, eastern equine encephalitis virus or La Crosse encephalitis virus is reportable. Therefore, total case numbers cannot be directly compared with other states that also report non-neuroinvasive disease.
- Cases include those classified as confirmed or probable, per the surveillance case definitions, and are only among North Carolina residents.
- County data are based on the patient's home address at the time of reporting, not necessarily the county or state where they were infected.
- Cases are counted using the earliest date of illness identification. This is most frequently the symptom onset date. Therefore, case counts in this report may differ slightly from those published in national summaries or state dashboards, which can be based on other dates such as date of initial report or the date when cases were closed and reported to the Centers for Disease Control and Prevention (CDC).
- Ages are based on the date the case was entered in the North Carolina Electronic Disease Surveillance System (NCEDSS).
- Incidence rates are based on data obtained from the U.S. census population estimates project. Note that estimates of rates based on a small number of cases are unstable and can fluctuate widely. Therefore, these estimates should be interpreted with caution.
- Only mosquito-borne diseases that are transmitted in North Carolina are included in this report. Data for tickborne diseases in North Carolina are summarized in a separate report, and data for travel-associated mosquito-borne diseases can be found on the North Carolina Disease Data Dashboard (NCD3).
- Please note that case classification criteria are subject to change and counts may fluctuate based on these changes.

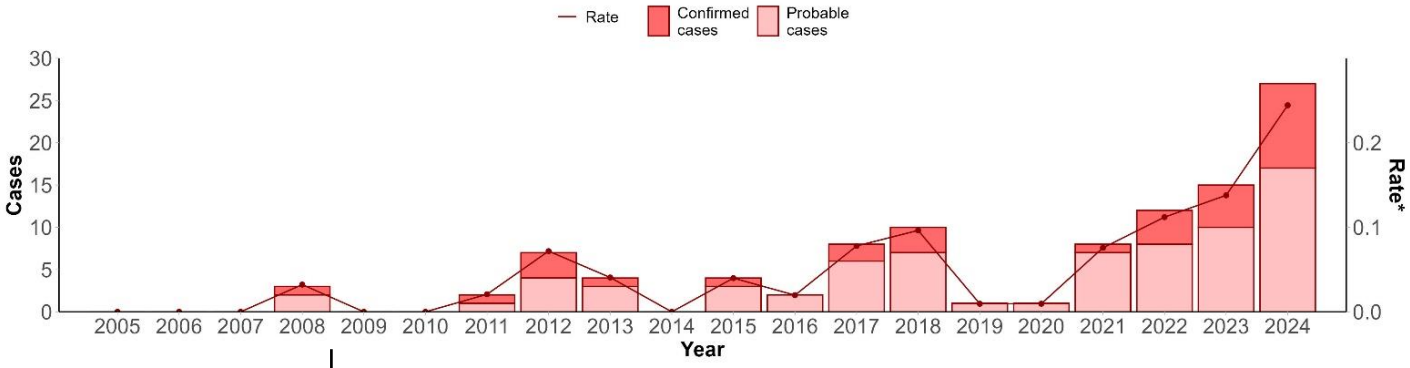
West Nile Virus (WNV)

2024 Key Points

- 27 human neuroinvasive WNV cases were reported in 2024, which is the highest in the state's history.
- WNV cases were reported across all regions of the state in 2024.
- WNV can cause severe disease. Over 88% of cases in 2024 were hospitalized, and 11% died.

West Nile virus (WNV) is an arthropod-borne virus (arbovirus) in the genus Flavivirus that arrived in NC in 2002 through migrating birds. WNV is spread to humans and other mammals (e.g., horses) by the bite of a mosquito after it is infected by a wild or domestic bird. WNV has been rarely transmitted through blood transfusions, organ transplants, breastfeeding and during pregnancy from mother to baby. Most people infected with WNV will have no clear symptoms, but approximately 20% of infected people will experience fever, headache, body aches, vomiting, diarrhea and/or rash. Approximately 1% of infected people will develop a serious neuroinvasive form of the disease that can include high fever, convulsions, paralysis, lasting neurological effects, and death. There are no vaccines available for WNV in humans, but a vaccine is available for horses.

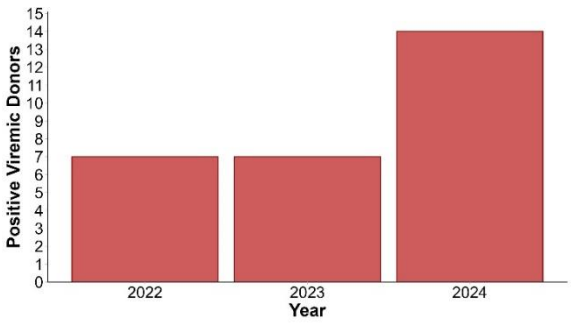
Confirmed and probable cases of WNV neuroinvasive disease and rates of per 100,000 residents, NC, 2005-2024



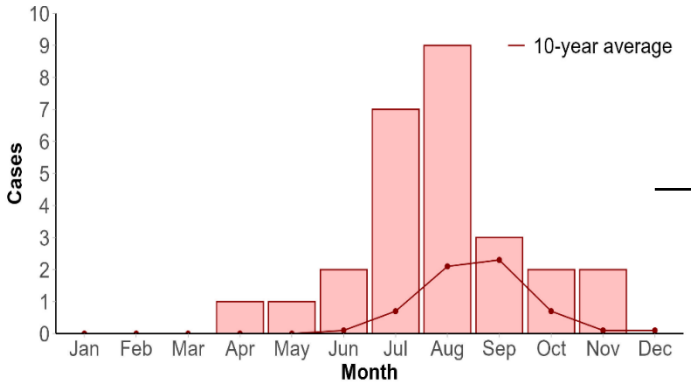
Neuroinvasive WNV reported cases reached a 20-year peak in 2024. A general upward trend has been observed over the last four years.

The FDA recommends WNV screening for all blood and blood components intended for transfusion. Since 2022, the NCDHHS Division of Public Health has required reporting of WNV-positive blood donors by blood donation centers. In 2024, 14 WNV-positive donors were reported, compared to seven donors in both 2022 and 2023.

Reported WNV-positive viremic blood donors, NC, 2022-2024



2024 NC WNV cases by month of illness onset, compared to previous 10-year average monthly case count

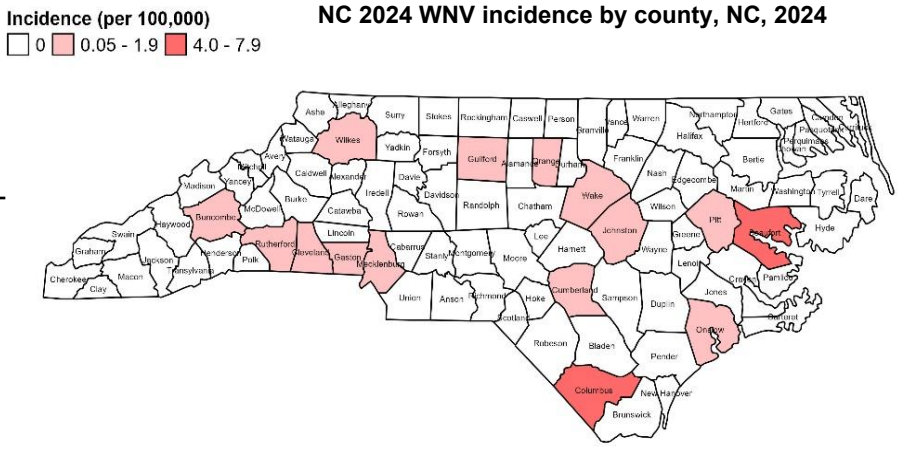


WNV neuroinvasive cases were reported from April through November in 2024 – four months longer than normal. WNV neuroinvasive cases peaked in August instead of September – approximately one month earlier than normal.

*Rate calculated per 100,000 residents

West Nile Virus (WNV)

WNV neuroinvasive cases occurred all over the state in 2024. This is typical for the disease because the several mosquito species that transmit WNV are found in abundance throughout NC.



Annual Summary					
	2020	2021	2022	2023	2024
Cases	1	8	12	15	27
Rate*	0.01	0.1	0.1	0.1	0.2
Case Statistics, 2024					
Sex	**Category**		**Cases**	**%**	
	Male		17	63.0%	
	Female		10	37.0%	
	Unknown		0	0.0%	
Age Group	**Category**		**Cases**	**%**	
	<5		0	0.0%	
	5-17 yrs		0	0.0%	
	18-24 yrs		0	0.0%	
	25-34 yrs		2	7.4%	
	35-44 yrs		0	0.0%	
	45-64 yrs		10	37.0%	
	65-84 yrs		14	51.9%	
	85+ yrs		1	3.7%	
	Unknown		0	0.0%	
Race	**Category**		**Cases**	**%**	
	White		21	77.8%	
	Black or African American		4	14.8%	
	American Indian/Alaskan Native		0	0.0%	
	Asian or Pacific Islander		0	0.0%	
	Multiple Races		1	3.7%	
	Other or Unknown		1	3.7%	
Hispanic Ethnicity	**Category**		**Cases**	**%**	
	Yes		0	0.0%	
	No		19	70.4%	
	Unknown		8	29.6%	
Hospitalization	**Category**		**Cases**	**%**	
	Yes		24	88.9%	
	No		3	11.1%	
	Unknown		0	0.0%	
Death	**Category**		**Cases**	**%**	
	Yes		3	11.1%	
	No		21	77.8%	
	Unknown		3	11.1%	

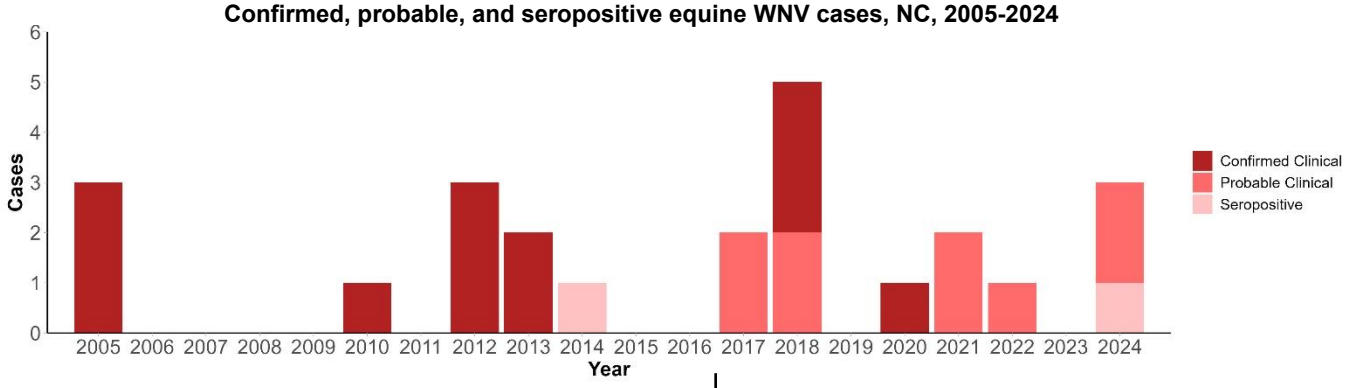
Annual Summary Key Points

- The incidence of WNV more than doubled in 2024 compared to the previous four years.
- Roughly two-thirds of reported cases occurred in males, which is typical for WNV in NC.
- WNV was only reported among adults age 25 years and older in 2024, with over half of cases reported among those between the ages of 65 and 84. Older individuals (>55 years of age) tend to be at higher risk of severe illness when infected with WNV.
- Approximately 78% of cases were reported among white residents and 15% of cases were reported among Black/African American residents, demonstrating a moderate overrepresentation and underrepresentation, respectively, of these racial groups among WNV cases compared to the population of NC as a whole. This may be due to differences between racial groups in risk factors for exposure, access to health care, recognition of WNV by health care providers, or other factors.
- Over 70% of reported cases were of non-Hispanic ethnicity. However, Hispanic ethnicity was unknown in the remainder of cases.
- 11% of cases resulted in fatalities, highlighting the severity of neuroinvasive WNV infections.

*Rate calculated per 100,000 residents

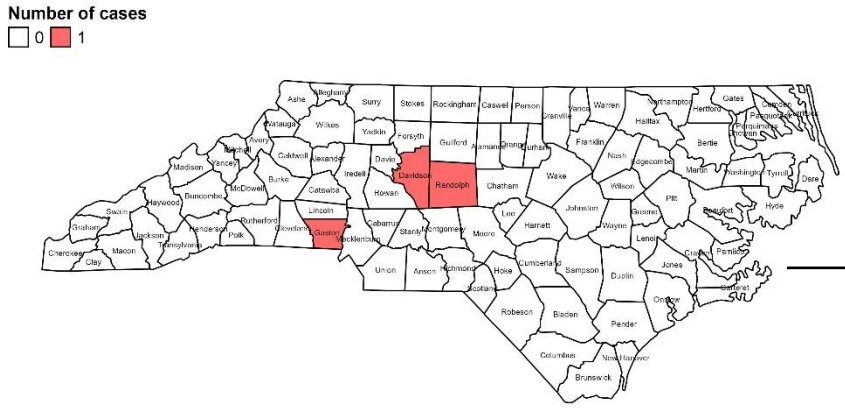
West Nile Virus (WNV)

Confirmed, probable, and seropositive equine WNV cases, NC, 2005-2024



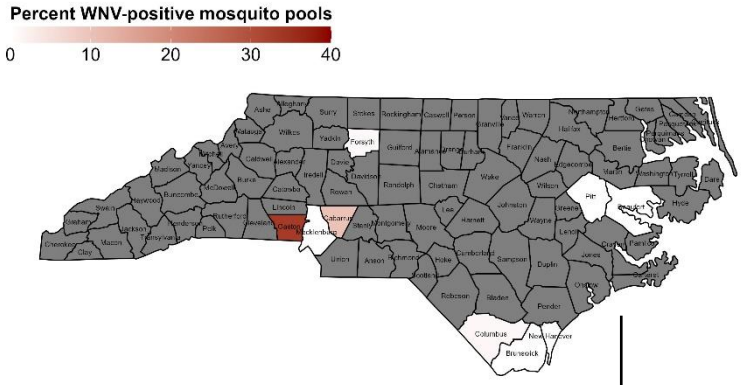
WNV infections in horses are reportable to the NC Department of Agriculture & Consumer Services. Few cases are reported each year, but 2024 saw the highest number of reported cases since 2019, including two probable clinical cases and one horse that was seropositive but non-clinical. The highest number of cases seen in the past 20 years was five in 2018.

Number of reported equine WNV cases by county, NC, 2024



Historically, most WNV-positive equines are reported from unvaccinated horses in the eastern third of the state. It is unusual that all three positive horses in 2024 were in the central part of the state. This may reflect local vaccination rates more than the distribution of WNV-infected mosquito vectors.

Percent positivity among mosquito pools tested for WNV by county, NC, 2024



County	Total Number of Samples Submitted	% Positive
Beaufort	20	0%
Brunswick	43	0%
Cabarrus	10	10.0%
Columbus	90	1.1%
Forsyth	794	0.7%
Gaston	3	33.3%
Mecklenburg	57	0%
New Hanover	288	0%
Pitt	16	0%
Total	**1321**	**0.7%**

Local vector control programs from select counties collect, identify and submit mosquitoes to the NC State Laboratory of Public Health for WNV testing. Each sample submitted to the lab was comprised of 1-50 mosquitoes. In 2024, 0.7% of all mosquito pools submitted tested positive for WNV. This is below the threshold of 1% that indicates outbreak potential. While mosquitoes submitted from Gaston County had a disproportionately high percent positivity compared to other counties, this is likely due to the relatively small number of mosquitoes submitted and does not reflect the true infection rate among mosquitoes in Gaston County.

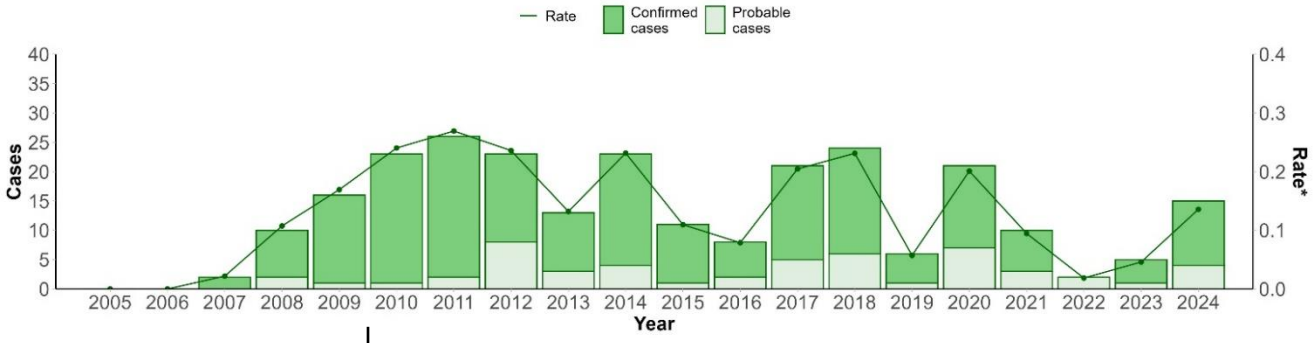
La Crosse Virus (LACV)

2024 Key Points

- Case counts returned to average after 2 years of abnormally low reports.
- The 5-9 year-old age range had considerably higher cases than average.
- All cases occurred in counties that typically report cases.

La Crosse virus (LACV) is the most common arbovirus in North Carolina. It is a member of the genus *Orthobunyavirus* and is most commonly transmitted by the eastern treehole mosquito. LACV infections occur primarily in the western part of North Carolina. Most people who are infected with the virus do not experience any symptoms, but it can cause severe disease, including inflammation of the brain (encephalitis). Symptoms may include fever, fatigue, headache, nausea, and vomiting, and may progress to more severe symptoms including seizures, paralysis, and coma. Children under the age of 16 are at highest risk for severe disease.

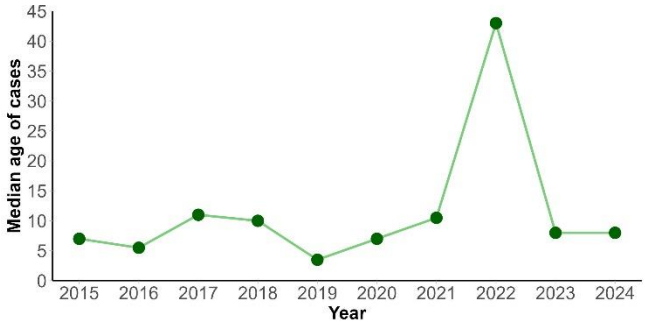
Confirmed and probable cases of LACV neuroinvasive disease and rates per 100,000 residents, NC, 2005-2024



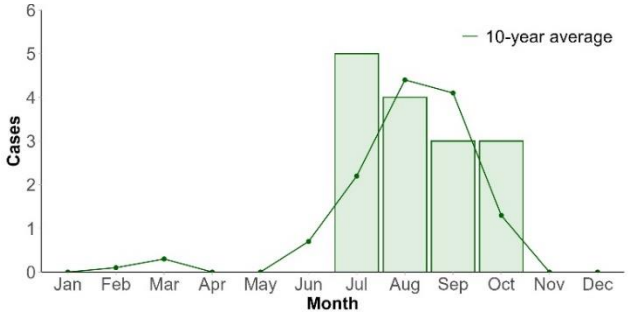
Fifteen neuroinvasive LACV cases were reported in 2024, an increase from the lower case counts observed in 2022 and 2023. The highest annual case count observed in the past 20 years was in 2011 (24 cases). As in previous years, the majority of reported LACV cases in 2024 were confirmed.

Median age of reported LACV cases, NC, 2015-2024

In 2024, the median age among reported cases of neuroinvasive LACV was 8 years. This is consistent with previous years, with the exception of 2022, when an unusually high median age was observed among the two reported cases.



2024 NC LACV cases by month of illness onset, compared to previous 10-year average monthly case count



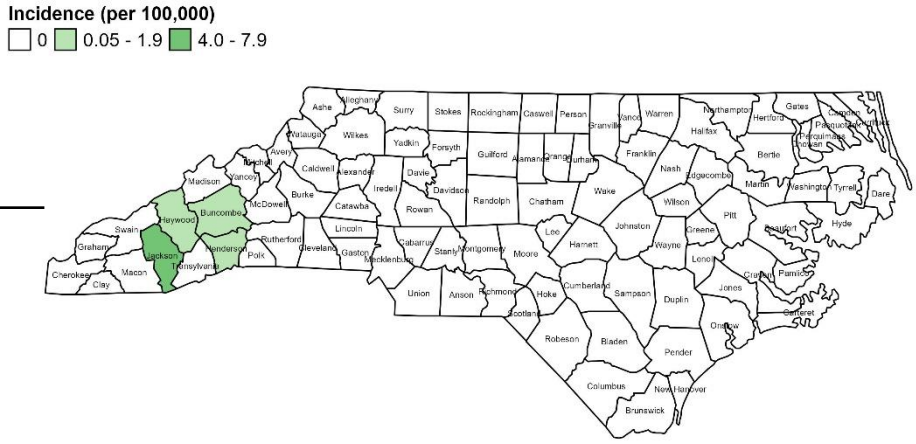
The highest monthly LACV case count was observed in July 2024, a month earlier compared to the previous 10-year average.

*Rate calculated per 100,000 residents

La Crosse Virus (LACV)

Over the last 22 years, six western North Carolina counties (Buncombe, Jackson, Transylvania, Haywood, Henderson and Swain) accounted for 19% of all LACV cases in the United States. In 2024, Buncombe County alone accounted for 14% of all cases in the U.S.

LACV incidence by county, NC, 2024



Annual Summary					
	2020	2021	2022	2023	2024
Cases	21	10	2	5	15
Rate*	0.2	0.1	0.02	0.1	0.1
Case Statistics, 2024					
Sex	**Category**		**Cases**	**%**	
	Male		11	73.3%	
	Female		4	26.7%	
	Unknown		0	0%	
Age Group	**Category**		**Cases**	**%**	
	<5		2	13.3%	
	5-17 yrs		11	73.3%	
	18-24 yrs		1	6.7%	
	25-34 yrs		0	0%	
	35-44 yrs		0	0%	
	45-64 yrs		0	0%	
	65-84 yrs		0	0%	
	85+ yrs		1	6.7%	
	Unknown		0	0%	
Race	**Category**		**Cases**	**%**	
	White		7	46.7%	
	Black or African American		0	0%	
	American Indian/Alaskan Native		2	13.3%	
	Asian or Pacific Islander		2	13.3%	
	Multiple Races		4	26.7%	
	Other or Unknown		0	0%	
Hispanic Ethnicity	**Category**		**Cases**	**%**	
	Yes		1	6.7%	
	No		14	93.3%	
	Unknown		0	0%	
Hospitalization	**Category**		**Cases**	**%**	
	Yes		15	100.0%	
	No		0	0%	
	Unknown		0	0%	
Death	**Category**		**Cases**	**%**	
	Yes		0	0%	
	No		15	100.0%	
	Unknown		0	0.0%	

Annual Summary Key Points

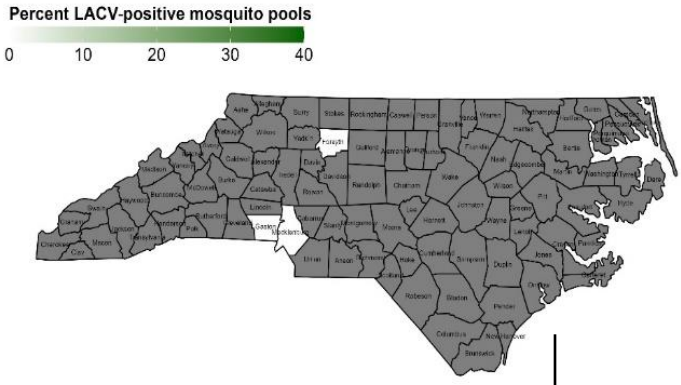
- In 2024, 73% of cases were in males.
- Over 85% of cases were reported among children under the age of 18, with nearly three-quarters of all cases occurring among children between the ages of 5 and 17.
- Native American residents are disproportionately affected by LACV. In 2024, this population comprised over 13% of all LACV cases in NC, while American Indians/Alaskan Natives make up less than 2% of the population of NC. From 2014 to 2023, 8% of all reported LACV cases were American Indians/Alaskan Natives (range: 0-22% per year). This is likely in part attributable to the location of the Qualla Boundary in high incidence counties.
- Fewer than 7% of reported LACV cases occurred among residents of Hispanic ethnicity.
- No deaths due to LACV were reported in 2024.

*Rate calculated per 100,000 residents

La Crosse Virus (LACV)

Note: *LACV does not infect horses, so equine surveillance data are not presented for this disease.*

Percent positivity among mosquito pools tested for LACV by county, NC, 2024



County	Total Number of Pools Submitted	% Positive
Forsyth	16	0%
Gaston	3	0%
Mecklenburg	63	0%
Total	82	0%

A total of 82 mosquito pools from three counties were tested for LACV at the NC State Laboratory of Public Health. The virus was not detected among these mosquitoes. Mosquitoes are not routinely collected and submitted for LACV testing from the western NC counties with the highest rates of LACV due to a lack of county-level vector surveillance programs in this region.

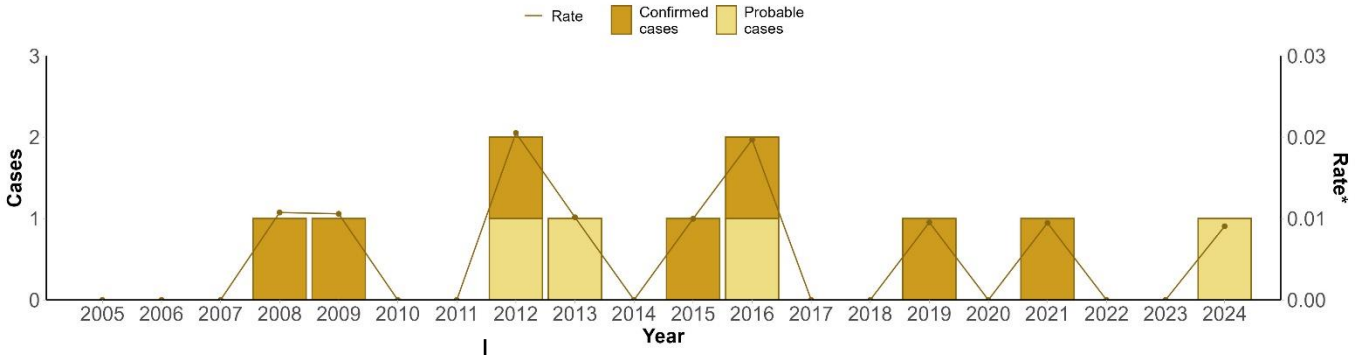
Eastern Equine Encephalitis (EEE)

2024 Key Points

- Neuroinvasive EEE is uncommon in NC with only one case reported in 2024
- There were five reported EEE cases in horses in four separate counties in 2024, indicating widespread transmission between birds and mosquitoes.

Eastern equine encephalitis (EEE) is caused by an arbovirus in the genus Alphavirus. EEE is transmitted within wild bird populations by the black-tailed mosquito (*Culiseta melanura*). While birds serve as the main host of the virus, the black-tailed mosquito and other mosquito species can also transmit the virus to other mammals, such as humans and horses. Most people who are infected with the virus do not experience any symptoms, but a small proportion of people develop severe disease, which may include swelling of the brain that can be fatal. Symptoms may include fever, headache, vomiting, seizures, and coma. About one-third of severe cases result in death. There is no vaccine for EEE in people, but a vaccine is available for horses.

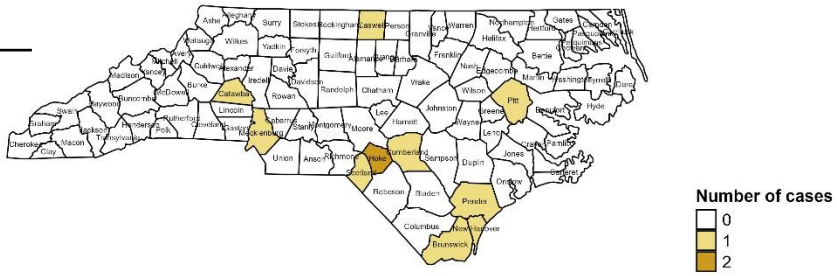
Confirmed and probable cases of EEE neuroinvasive disease and rates per 100,000 residents, NC, 2005-2024



Neuroinvasive EEE has been reported intermittently in NC over the past 20 years, with 0-2 cases identified per year. In 2024, a single case was identified after two years of no observed cases in 2022 and 2023.

Over the past 20 years, most EEE cases have been reported within the Coastal Plains region of NC, with fewer cases occurring in the Piedmont, and none reported in the Mountains region of western NC. In 2024, the only reported EEE case occurred in Caswell County, which may not be where the disease was acquired.

Number of reported EEE cases by county, NC, 2005-2024



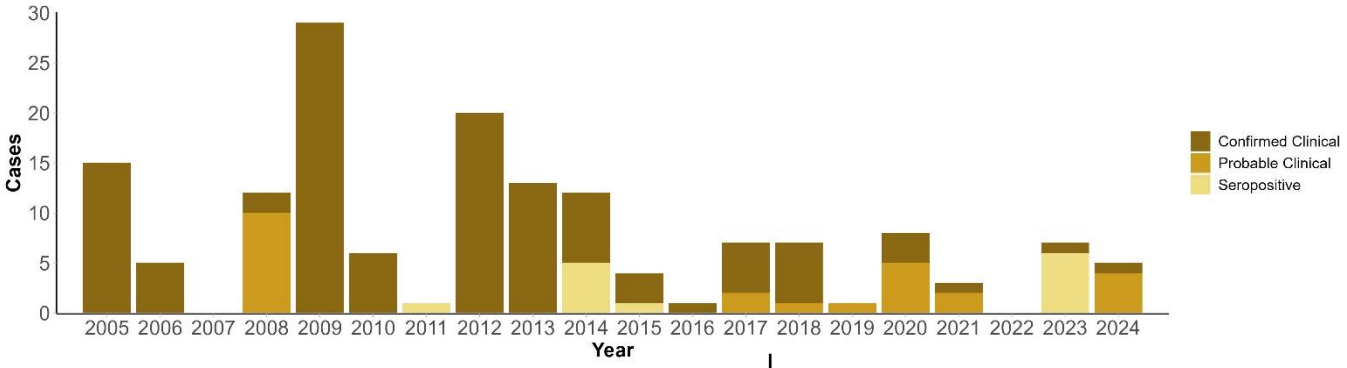
Annual Summary Key Points

- Rates of EEE in NC have remained consistently low in recent years, including 2024, with a maximum of 0.01 cases reported per 100,000 residents.
- The only reported case of EEE in 2024 occurred in April in a Caswell County resident.

*Rate calculated per 100,000 residents

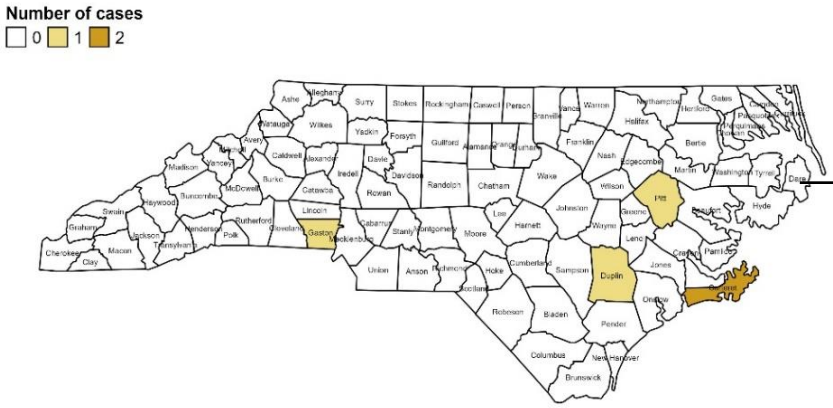
Eastern Equine Encephalitis (EEE)

Confirmed, probable, and seropositive equine EEE cases, NC, 2005-2024



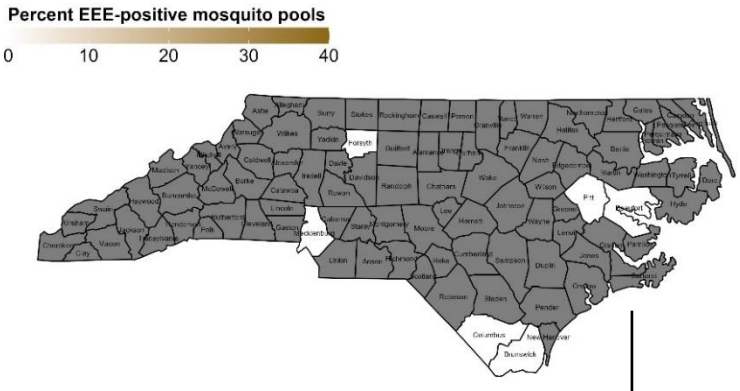
EEE cases in horses have generally decreased over the last 20 years. This is more likely caused by increased levels of vaccination by horse owners than by an overall decrease in EEE virus in the state.

Number of reported equine EEE cases by county, NC, 2024



Three of the four EEE cases in horses occurred in the eastern third of the state, which is typical. The single case in Mecklenburg is unusual but may not reflect where the disease was acquired (e.g., due to movement of horses for shows and other purposes).

Percent positivity among mosquito pools tested for EEE by county, NC, 2024



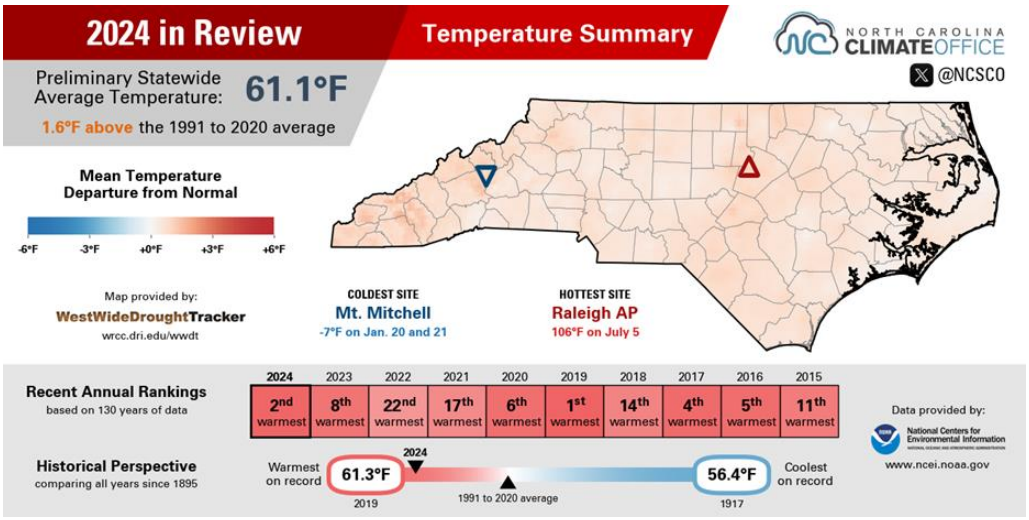
County	Total Number of Samples Submitted	% Positive
Beaufort	10	0%
Brunswick	43	0%
Columbus	90	0%
Forsyth	283	0%
Mecklenburg	63	0%
Pitt	34	0%
Total	**523**	**0%**

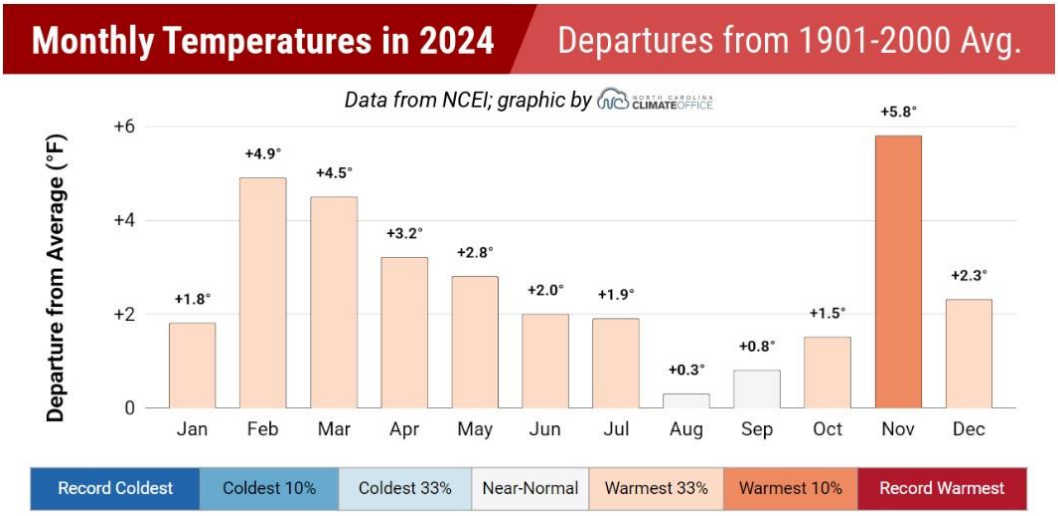
A total of 523 mosquito samples (each consisting of between 1-50 mosquitoes) were submitted by local vector programs in six counties to the State Laboratory of Public Health for EEE testing. No infected mosquitoes were identified in 2024.

Environmental Conditions Impacting Transmission, 2024

Temperature

In 2024 temperatures were well-above average across much of the Southeast. Most locations were 1 to 2 degrees F above average. Temperatures for much of eastern North Carolina were near average for the year, whereas Asheville, NC and the Raleigh-Durham area of NC observed their warmest year on record. For example, the Raleigh-Durham area (1887-2024) recorded its all-time highest maximum temperature of 106 degrees F on July 5.





Precipitation

Annual precipitation totals were above average across much of the Southeast in 2024. The wettest locations were found across the central and western portions of the Carolinas and southern portions of Virginia. In contrast, the driest locations were in the eastern portions of the Carolinas, where annual precipitation totals were 4 to 8 inches (102 to 203 mm) below average. On September 13, a low-pressure system formed off the Southeast coast and later became Potential Tropical Cyclone (PTC) Eight. A few days later, the storm brought heavy rainfall to southeastern North Carolina, with some areas receiving over 20 inches. The combination resulted in high mosquito populations (including *Culex nigripalpus*, a WNV vector), and aerial adulticide spraying in Brunswick County, NC. At the end of September, Hurricane Helene resulted in the greatest annual total rainfall in the mainland Southeast, 100.69 inches at Lake Toxaway, NC, at 3,000 feet (914 m) elevation. This storm hit North Carolina after the typical La Crosse encephalitis season. No unusual patterns of LACV were observed in 2024.

Environmental Conditions Impacting Transmission, 2024

Drought

Hot and dry weather in mid-June led to a rapid resurgence of drought, particularly in Virginia and North Carolina. Between June 18-25, drought coverage expanded by more than 30%, with over half of the region in drought by mid-July. Severe (D2) drought was found across northern parts of the region, while extreme (D3) drought affected northern Virginia, and eastern portions of the Carolinas. Above-average rainfall later in July, combined with the rain from Hurricane Debby, eliminated much of the drought by mid-August. By early September, Hurricane Helene near the end of September further reduced drought across the region. Moderate (D1) drought developed in parts of the Carolinas. By December, abnormal dryness (D0) had spread across the large portions of North Carolina. Sequential patterns of drought followed by heavy precipitation, in combination with warm temperatures, have been associated with WNV outbreaks.