

Is climate change to blame for New England's EEE outbreak?

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The question shadows the current outbreak of Eastern equine encephalitis in Southern New England: Is the high number of human cases of the mosquito-borne virus this year part of a natural cycle, or is it linked to the changing climate?

Scientists have long predicted that global warming would abet the spread of mosquitoes and other parasites that transmit diseases to humans. Studies attribute the rise in illnesses carried by ticks, such as Lyme disease, in part to milder winters that are failing to kill off the tiny creatures.

For mosquitoes, too, warmer winters help more of them survive into the spring. But for the swamp-loving species that is primarily responsible for the spread of EEE, it may be that wetter weather is the key in creating more pools of water for its larvae to overwinter.

Higher rainfall in the spring and summer may also help create better conditions for the mosquito to breed and increase its numbers.

And finally, longer summers are extending the period of time for the [virus](#) to make its way from its host population of birds to humans.

Conditions are already changing in the region in a way that could benefit the EEE-carrying mosquito known as *Culiseta melanura*. Annual precipitation in Rhode Island has increased by about half an inch a decade since 1895, and more of it is falling in the winter and spring. Meanwhile, the average annual temperature in the state has climbed 3.8 degrees over the same time period, outstripping the global rate of change.

Scientists caution that it is difficult to draw a definitive connection between climate change and the spread of EEE because human infections are relatively rare and outbreaks are influenced by a complex set of circumstances. But they say it's conceivable that changes in temperature and rainfall could lead to more outbreaks of EEE.

"I think it is likely, if those conditions are met, with a longer period of time when mosquitoes are active and if we have more precipitation in

the region," said Philip Armstrong, a medical entomologist with the Connecticut Agricultural Experiment Station. "That would definitely favor EEE."

The numbers illustrate that this year is highly unusual for the spread of the virus.

So far in Rhode Island, three people have been infected. One of them, a person in their 50s from West Warwick, died. Two others, a 6-year-old Coventry girl, and a person in their 50s from Charlestown, are, according to the Department of Health, recovering.

They are the first cases in the state since 2010. In no other year since the health department started tracking EEE have there been this many human cases in Rhode Island.

Similarly, in Massachusetts, the 12 human cases, including three deaths, are the most in recent memory. Those who have died include a Fairhaven woman, 59, and a Freetown man, 78. Since the virus was first identified in the state in 1938, there have been fewer than 100 cases there.

In Connecticut, two people diagnosed with the virus have died. They were the first cases in the state since 2013.

Over the last decade, the nation has averaged only seven cases of the virus per year, according to the Centers for Disease Control and Prevention. In Southern New England alone this year, there have been 17 cases already.

In addition, there have been eight cases in Michigan, including three deaths, as part of what health authorities have described as the biggest outbreak in that state in more than a decade. There have also been three

cases in New Jersey and one in North Carolina, according to authorities in those states.

The last time the country had a spike in cases was 2012, when 15 people were infected.

That was at the tail end of an outbreak in Massachusetts that started in 2010 and, over three summers, resulted in nine people getting infected and four of them dying.

Outbreaks usually occur in Southern New England every 10 to 20 years. In most years, the virus is confined to hardwood, freshwater swamps, such as Chapman Swamp, in Westerly, where the virus has most frequently been found in Rhode Island; the swamps that dot the Taunton River watershed in Massachusetts; and wetlands complexes in southeastern Connecticut.

Songbirds that migrate north from Florida, the only state where EEE is present year-round, and other parts of the Southeast spend their summers in and around these swamps, where *C. melanura* mosquitoes feed on them. Many types of birds can carry the virus without suffering any ill effects, and they eventually pass it on to the mosquitoes, which in turn transmit it to other birds.

The virus spreads when an infected bird is bitten by any one of several different types of mosquitoes that also feed on mammals. One of these mosquitoes can then act as the "bridge vector," infecting horses, deer or humans.

Because it takes time for the virus to become widespread in the bird population to the point that it will jump to mammals, the highest chance of infection in humans typically doesn't begin until August.

The risk continues until the first hard frost of the season, which can occur as late as the end of October or early November. Global warming could extend the time of risk by pushing back that first frost that kills mosquitoes.

"Lengthening the summer can have that effect," said Alan Gettman, mosquito abatement coordinator with the Rhode Island Department of Environmental Management.

Nationwide, the number of cases of illness caused by mosquito, tick and flea bites doubled from 2004 to 2015, to more than 50,000 cases. In 2016, the number spiked to 96,000 cases, according to the CDC, which attributed the trend, in part, to mosquitoes and ticks increasing in numbers and moving into new areas.

Temperature can also be a factor. The season when mosquitoes are active has grown longer across much of the United States as temperatures have risen. According to Climate Central, the number of mosquito "disease danger days"—days when the temperature falls between 61 and 93 degrees Fahrenheit—increased in nearly all of the 244 cities it analyzed data for going back to 1970. Providence has seen an increase of 13 days in that period.

In a 2013 article in the *New England Journal of Medicine*, Armstrong and co-author Theodore Andreadis, director of the Connecticut Agricultural Experiment Station, pointed to a pair of EEE cases in 2012 in Vermont, the first human infections in the state on record, and seven cases in New Hampshire in 2005 to show how the virus appeared to be migrating north. Their data also included cases in northern Massachusetts and northern New York.

"EEE infections in humans have become more frequent and have extended northward in New England over the past 10 years," they wrote.

Since their study, there have been seven more cases in New Hampshire, five more in New York and two in Maine.

Because EEE is so rare, there hasn't been a lot of research into its transmission. Until more work is done, there will be more questions than answers about outbreaks like the current one.

Sadie Ryan, a professor of medical geography at the University of Florida, co-authored a study released this year that projected a shift northward as temperatures rise in the range of Zika, dengue and other tropical mosquito-borne viruses. But she said in an interview that making predictions about EEE is more difficult.

"That isn't to say that there isn't a climate signal," she said. "But it's a very complex ecology with this occasional eruption."

It may be that the climate in the Northeast is becoming more conducive to the spread of the virus, but she said that cases could also be increasing as development encroaches on wetlands habitats. It's a point that Armstrong and Andreadis also raised in their paper.

Howard Ginsberg, an insect ecologist with the U.S. Geological Survey, agrees that the changes caused by [global warming](#) in New England could create conditions that are favorable to the spread of EEE, but he is loath to draw conclusions.

He listed certain factors that may be at play. More winter precipitation, like the region had last winter, would prevent pools holding mosquito larvae from drying up and may lead to greater numbers of adults in the spring. Rainfall that continues through the early summer—again, like the region had this year—could also promote the production of more generations of [mosquitoes](#).

"It's been over 20 years in Rhode Island since we had significant (EEE) activity. That's why it's difficult to make statements about virus transmission," said Ginsberg, who is based at the University of Rhode Island. "With more evidence, we may be able to better predict these outbreaks."

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