Disease-spreading ticks keep marching north as weather stays warmer

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Ticks are among nature's most hardy survivors. They've been around for at least 100 million years and used to feast on dinosaur blood. Their bodies contain anti-freeze to help them survive cold weather and their two front legs have carbon dioxide and infrared sensors to help detect when a warm-blooded mammal is approaching. Tiny hairs on their legs increases friction and allows ticks to latch onto animals that brush by. And blacklegged ticks, which spread the most disease in the U.S., are notoriously un-picky eaters, happy to ingest the blood of numerous mammals and birds, making them perfect for spreading disease from one species to the next.

Blacklegged ticks and their counterparts abroad used to be confined to certain climates, especially milder and humid temperate zones such as coastal New England. Now, they're present in places farther north where they didn't use to appear.

Researchers in Sweden were astonished when, in the 1990s, they discovered ticks creeping up the Baltic Coast and into the sparsely populated Northland. The disease-ridden prehistoric creatures brought north new cases of Lyme disease and other ailments. By 2009, the critters had reached the edge of the Arctic Circle.

In the mountains of the Czech Republic, ticks are now present above 1,100 meters of elevation; prior to the 1980s they apparently hadn't been able to survive much above 700 meters. In the U.S., they have spread north and west from their strongholds in southern New England and Upper Midwest to the far northern reaches of Minnesota and northern New England.

And from there, they've just kept going. In eastern Canada, government researchers have found that ticks are encroaching north at a rate of up to 50 kilometers a year, bringing disease with them.

The relentless northward march is closely linked to mild winters and warming summers that gave ticks more opportunity to find hosts. Understanding ticks' migration and their concurrent climb to ever higher latitudes and altitudes has grown from a passing curiosity to an obsession for Richard Ostfeld, a 65-year-old disease ecologist at the Cary Institute of Ecosystem Studies in Millbrook, New York. He's immersed himself in the study of ticks for almost three decades—and has spent the last decade looking at how climate affects tick survival.

"We should all be very worried," says Ostfeld, about the long-term risks of tick-borne disease. "This is a growing public health threat that we need to get under control because the longer it is allowed to spread unabated, the harder it is to reign back in."

While broad correlation between ticks' spread and global warming is clear, predicting where they will go next as the climate changes is surprisingly daunting, as is proving cause and effect. Little is known about the precise details of what weather conditions kill ticks in the field, and, complicating matters, tick populations bounce up and down naturally for a plethora of reasons, such as the abundance of acorns that their rodent hosts feed on. Predicting where ticks will spread next, "is super important," says Ostfeld, "because where ticks go so too goes tick-borne illness."

In the U.S., those illnesses have more than doubled in recent years, to more than 47,000 cases in 2018 from 22,000 cases in 2004. Lyme Disease accounts for the bulk of this, but numerous lesser-known tick ailments are on the rise as well, including flu-like anaplasmosis and babesiosis, a malaria-like infection of red blood cells. Ticks can also transmit Powassan virus, the rare microbe that killed former North Carolina Senator Kay Hagan last year. The U.S. Centers for Disease Control and Prevention lists 16 bacterial, viral and protozoan diseases that are transmitted by ticks in the U.S. alone, with several more that are mainly present in other parts of the world. And more are being discovered all the time.

In the woods just beyond Ostfeld's office, a team of six researchers is conducting one of the first-ever rigorously controlled field experiments designed specifically to investigate ticks and climate change. They are artificially warming plots of soil and, over the next year, ticks are being placed at various life stages inside fabric bags to see at what temperatures and in which environments they are able to thrive and under which conditions they tend to start dying off. The number of variables is immense—everything from snow-cover, to relative humidity, to the activity of host mammals can affect tick survival.

The complexity of it all keeps Ostfeld up a night. But if this, and other experiments in North Carolina and two other locations in upstate New York succeed, it will provide some of the first reliable data that climate modelers can use to predict where tick-borne diseases are going to pop up in the future.

Ticks' reclusive lifestyle make them hard to study. They eat just three times in their lifespan of two years but spend as much 20% of their lives looking for meals. This process, called questing, involves standing on the edge of a leaf or blade of grass and sticking two hairy legs out ready to grab onto any mammal that happens to brush by. But most of the time, as far as researchers can tell, ticks spend their existence "doing pretty much nothing," says Ostfeld.

Perhaps a tick's most brilliant arsenal is how it renders its victim oblivious to its bite. When a tick sinks its pincerlike jaws and a barbed needle-like appendage called a hypostome into animal flesh, it releases a hospital-style drip of substances, including analgesics to stop the pain, antihistamines and anti-inflammatories to make sure it doesn't itch or swell, and anticoagulants to keep the blood flowing for days. The blacklegged tick, the primary disease-spreading tick species in the Northeast and Midwest, is especially good at undetected gorging.

Not so long ago, Lyme disease was rarely seen in Canada. Now, there are around 2,000 cases a year. Tick populations are "expanding northward all the time" in a pattern consistent with climate change being a driver, says Nicholas Ogden, a research scientist at the Public Health Agency of Canada. Longer warm seasons are giving ticks better chances to find hosts and complete their life cycle, he says "We are going to see more and more of Canada become suitable for ticks," he predicts.

While most research has focused on the blacklegged tick and its European relative, other species of ticks are also roaming into previously colder climes, including the so-called lone star tick, which is linked to red-meat allergy and can spread rare but potentially deadly Heartland virus as well as ehrlichiosis, a flu-like bacterial illness. Long thought of as a southeastern tick, it has made big inroads into Long Island and southern New England in recent years. In July, researchers at the University of Illinois found to their surprise that lone star ticks harboring the Heartland virus had inched north and become established within 60 miles of Chicago, according to research published in *Emerging Infectious Diseases*.

There's more to the spread of tick habitat and tick diseases than climate, of course. Forest fragmentation, growing deer populations, natural adaptation to colder climates, and ever-expanding suburbs all play a role, making the impact of climate change difficult to parse out. Some researchers argue the role of climate is overstated and that the northern spread is mostly explained by these other factors. "We have no idea what the changes in the weather might do to ticks," says Sam Telford, and epidemiologist and tick researcher at Tufts University. And warming could be neutral or good for some hard-hit regions now, if ticks are driven north out of population centers. "The data isn't really there."

That's where Ostfeld's work comes in. His field experiment on tick survival and climate change, designed with researchers at New York University and Washington State University, doesn't look like much at first glance. It sits in an unassuming patch of leafy woods a few yards behind the parking lot at the Cary Institute of Ecosystem Studies, 80 miles north of New York City. There, two patches of leaf-covered-soil, each roughly one square meter in size, have been divided into 90 squares like a big outdoor checkerboard. Thirty-eight of the squares are covered with tick-containing nylon fabric bags that extend down into soil cores scooped out with a golf hole cutting tool. Other squares contain a variety of temperature, relative humidity and soil moisture sensors that log the precise environmental conditions at all times.

The two patches are exquisitely designed to be essentially identical except for one thing: in one of the patches, the soil is heated with 110 evenly spaced heat probes in buried in the soil and connected to a 24-volt-solar powered battery. That will bring the temperature of the soil up by 2.5 degrees Celsius, about as much as this part of the country is expected to warm in the next 50 years.

"We know almost nothing about whether the ticks get killed outright by cold snaps in winter, hot spells in summer flooding events, or drought," says Ostfeld.

Even though ticks can't be eliminated, knowing where they are likely to spread diseases next could help public health authorities to alert local residents and doctors. Lyme disease is easily treatable with antibiotics if detected early, but if it's missed, the bacterium can spread throughout the body and cause complications ranging from arthritis to neurological complications. And this worst-case scenario is more likely to occur in locales that haven't experienced much Lyme disease or other tick-borne ailments.

"That is one of the consequences of climate change. It spreads in communities that have never experienced it before," Ostfeld says.