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Northern Trek: The Spread of *Ixodes scapularis* into Canada

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For a decade Nicholas Ogden, a researcher at the National Microbiology Laboratory of the Public Health Agency of Canada, has tracked the northern expansion of the deer tick (*Ixodes scapularis*), the vector for Lyme disease. He has found a strong correlation between rising winter temperatures and the spread of the tick population.[1,2] Now Ogden has collaborated with Hugo Beltrami, Canada Research Chair in Climate Dynamics at St. Francis Xavier University, and other researchers to forecast the range expansion of *I. scapularis* under a greater number of possible climate scenarios.[3]

Lyme disease was first identified in coastal Connecticut in 1976, and the bacterium that causes it, *Borrelia burgdorferi*, was isolated in 1982.[4] Eastern Canada's first infected ticks were found on the Ontario shore of Lake Erie in the early 1990s.[5] The ticks have since expanded their range farther north into Ontario and parts of Manitoba, Quebec, New Brunswick, and Nova Scotia, Ogden says. The number of reported Lyme disease cases in Canada is rising steadily, from 144 in 2009 to 917 in 2015.[6]

The inference that temperature thresholds have a strong impact on tick survival fits with a growing body of evidence showing that the ranges of *Ixodes* ticks in Europe are limited by cold temperatures.[7] In a 2014 study, Ogden and his colleagues used a single climate model to forecast the spread of the tick into Canada.[1] They concluded that climatic conditions suitable for *I. scapularis* populations to expand steadily northward would likely occur during the coming century.

The basic needs of *I. scapularis* include woodland habitat and an assortment of vertebrate hosts to bite. After hatching, ticks pass through three life stages and require a blood meal to fuel their development from one to the next. As larvae and nymphs, the ticks most often obtain these meals from white-footed mice or other small rodents, although they occasionally latch onto other creatures—a raccoon, a bird, or an unfortunate human. Adult ticks feed primarily on white-tailed deer.[8]

Deer are growing in numbers and expanding their range to the north, as are white-footed mice.[9] In addition, Ogden says, recent warming has occurred in southern Canadian regions with new influxes of ticks, which are moving in a geographic pattern consistent with temperature being an important factor in their becoming established.

Under even the most optimistic scenario, in which the increase in global average temperature is limited to 1.5°C above preindustrial temperatures, the authors' models showed Lyme disease continuing to spread in Canada. They conclude that people in Nova Scotia and in southern Ontario—home to more than 85% of the provincial population—will need to be aware of and adapt to the risk of bites from infected ticks. Under the worst-case scenario modeled, in which global greenhouse gas emissions are not curtailed, the authors estimate *I. scapularis* will spread into northern Ontario, a region not yet colonized by deer ticks.

"This study is an extension of previous work published in 2014[1] showing the predicted expansion of the distribution of the Lyme disease tick vector into Canada," says Maria Diuk-Wasser, a professor at Columbia University who focuses on the emergence of vector-borne diseases. "Although the results are not qualitatively different, it represents an improvement on the previous study by incorporating the full range of and most up-to-date climate models and emission scenarios." Importantly, she says, the new study accounts for the inherent uncertainty in such models and scenarios but also indicates that an increased risk can be expected in any event.

Ticks do not jump, fly, or drop onto passersby. Instead, they wait on vegetation with their front legs raised in a "questing" pose. When an appropriate host brushes past, the tick hitches a ride and attaches itself for a blood meal.

Canada's public health officials track the leading edge of the tick's range expansion in several ways: through laboratory identification of ticks found on patients by doctors and veterinarians; by conducting surveys in which a large cloth is dragged across a woodland floor, picking up any ticks that are questing for a host to bite; and by compiling data on reported cases of human infection. The Canadian government has provided information on how to avoid tick bites and identify the symptoms of Lyme disease.[10] "We'll all need to participate in adapting to the tick's arrival," says Ogden.

Sharon Levy based in Humboldt County, CA, has covered ecology, evolution, and environmental science since 1993. She is at work on the book *The Marsh Builders: Wetlands in the Fight for Clean Water*.

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