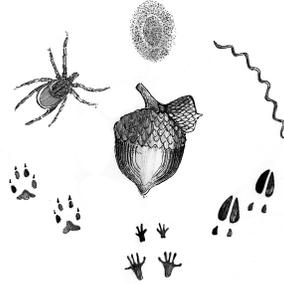


Lyme Disease Spreading Due to Climate Change and Human Activities

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Lyme Disease is Spreading Globally - Lyme disease is a vector-borne illness rapidly advancing in response to human activities, particularly climate change. In the U.S. alone, there are up to an estimated 440,000 cases of commercial laboratory evidence of Lyme disease annually, making it one of the most common infectious disease tracked by the CDC. The disease is difficult to detect, largely tolerant to antibiotics, and is spread mainly by *Ixodid* ticks carried by abundant hosts such as deer, mice, and migratory birds. A warming climate and human-caused habitat alterations are increasing survivability and spread of ticks and hosts, especially in northern latitudes where the pace of climate change is most rapid.

Since the recognition of Lyme disease, its incidence has increased dramatically across much of North America, Europe, and Asia. It is now been reported in more than 80 countries, is the most common tick-borne disease in the northern hemisphere, and is spreading rapidly in countries like the U.S (Fig. 1). It has been reported in temperate, rural areas of Asia, in northwestern, central and Eastern Europe and West Africa.

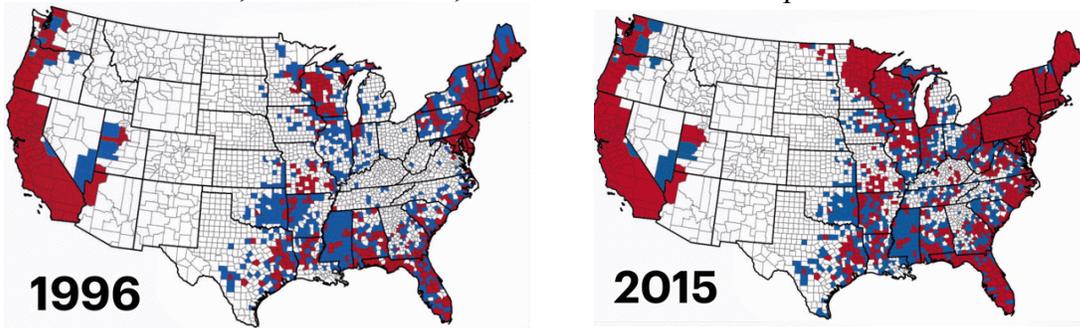


Figure 1. Counties in the United States where Lyme disease has been established (red) or reported (blue) in 1996 vs. 2015¹.

Climate Change is Triggering Lyme Disease Spread - An unprecedented accumulation of greenhouse gases in the atmosphere caused mainly by burning of fossil fuels and deforestation/forest degradation is as a growing risk of Lyme disease spread. Notably, the *Borrelia burgdorferi*, the bacteria that causes Lyme, has been projected to expand its

¹Graphic provided by Katharine Walker reprinted from Eisen et al. (2016) cited in DellaSala et al. in press.

range northward in Canada some ~250-500 km by mid century. Lyme disease spread is projected for higher latitudes and altitudes in Europe. In the U.S., cases of Lyme disease may occur up to nearly two weeks earlier by 2065–2080.

Climate Change is Triggering Host Spread - Since the 1980s, ticks have increased in density and have spread into higher latitudes and altitudes due, in part, to climate change. By the end of this century, the range of ticks and Lyme disease may occur as far north as Scandinavia. Northward expansion of ticks has been noted or anticipated for Sweden, Russia, Eurasia, and Canada. Temperature and humidity conditions in early spring and autumn are important drivers of tick increases. For instance, projected temperature increases in Canada are anticipated to double tick populations and trigger a range expansion northward of 200 km by the 2020s and 1,000 km by 2080s. Tick habitat in Canada is also expected to increase northward by a whopping 213 percent by 2080s.

Mice and several migratory bird species serve as reservoir hosts from which ticks acquire Lyme disease and other infectious agents. As their distribution and ranges shift in response to climate change, so will infectious disease rates. Both ticks and their host, white-footed mouse, are projected to expand northward in Canada at a rate of 3.5-11 km per year by the 2050s. Lyme spirochetes also have been detected in other arthropods that may expand with climate change.

Lyme Disease is Costly - The impact of the chronic debilitating and disabling form of Lyme disease can destroy human potential, especially for children, young adults and those vulnerable persons and communities living on the edge of poverty and in resource scarce environments most vulnerable to climate change. The US health care system alone spends up to \$1.3 billion a year (about \$3000/patient) on Lyme disease and costs will escalate without a concerted global response to climate change. Costs to individuals can include loss of income, pain and suffering, transportation problems, relocation and dependency on family or other caregivers. Immeasurable is the loss of an ability to pursue a normal education, career and personal life trajectory. Societal costs include increasing welfare, loss of productivity, loss of tax revenue to local and national governments, and the breakup of families due to emotional and financial stress.

Solving for Lyme Disease Must Involve Global Climate Change Remediation and Long-term Care – Climate change is a growing problem of human, environmental, and social injustice requiring immediate actions to reduce greenhouse gases from fossil fuels and forest losses, and a shift to clean, renewable energy sources. Governments and health care providers need to recognize the alarming threat of Lyme disease by providing long-term care for persistent cases.