

# Lyme Disease in New England

## Correlation Between Lyme Disease Prevalence and Land Use

### Introduction

Over the past few decades, there has been an increase in the population density of blacklegged ticks (*Ixodes scapularis*) in New England (Khatchikian, 2012). These ticks are vectors for the *Borrelia* bacteria, which causes Lyme disease in humans (Minkhoff, 2016). The reason for the increase in Lyme disease is still being debated, but one hypothesis is that the deciduous forests where black-legged ticks reside in are expanding (CDC, 2019). The purpose of this study is to see if there is a correlation between the number of Lyme disease cases and the number of ticks positive with *Borrelia* bacterium that were found via passive surveillance for the years of 2000, 2010 and 2018. Additionally, this was compared to New England land usage data in 2001, 2011 and 2016 to see if there is a correlation between the number of Lyme disease cases with areas that are deciduous forests. The goal is to see if changes in land use explains the increase of Lyme disease cases in New England.

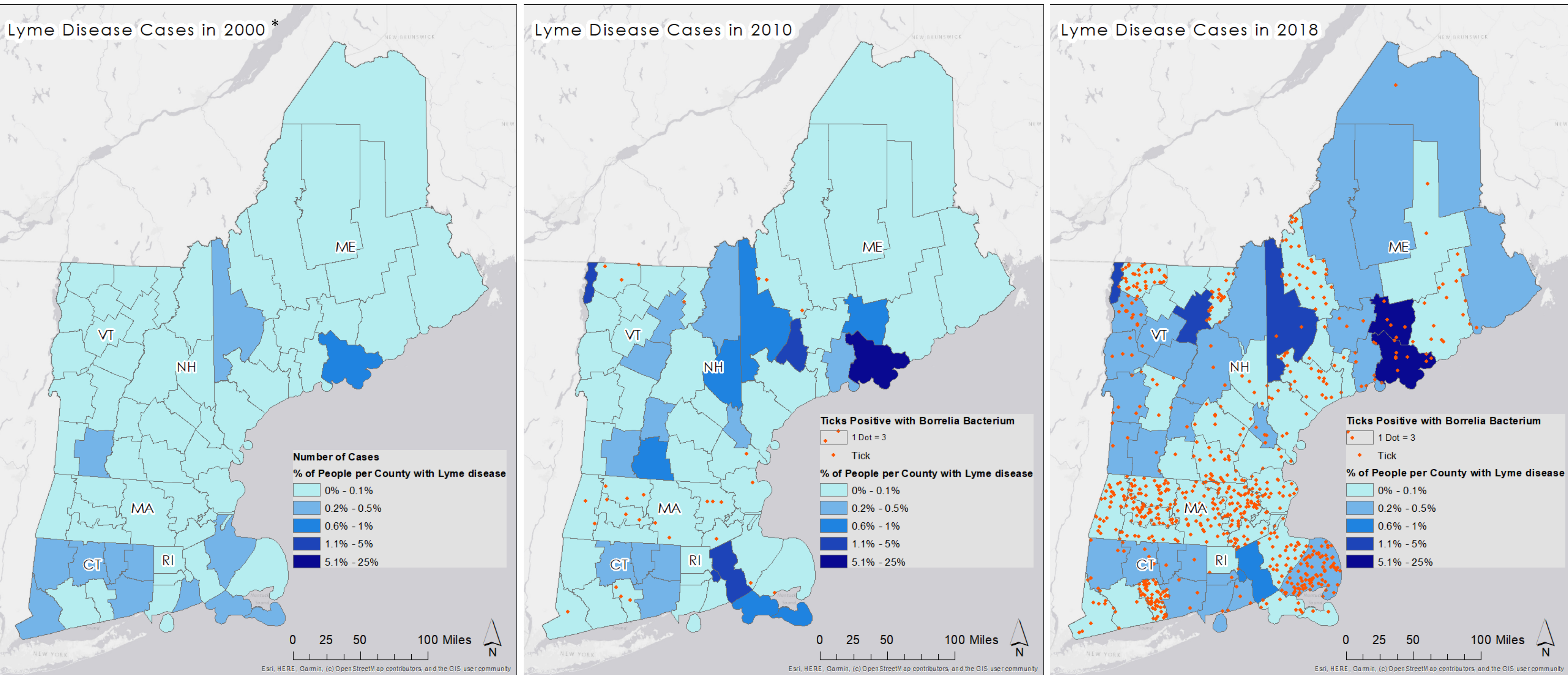
### Methods

Publicly available Lyme disease data was obtained from the CDC. The dataset included Lyme disease cases from 2000 to 2018; only the data for 2000, 2010 and 2018 was used. This data was joined to a shapefile from the U.S Census that contained the counties for the New England states of Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island and Vermont. The number of Lyme disease cases was spatially analyzed by normalizing the count with the population of each county. The resulting rate was displayed on the county level using choropleth maps. Data from tickreport.com is comprised of ticks found by people residing in the United States that were sent to the Laboratory of Medical Zoology at the University of Massachusetts-Amherst for testing. The ticks are tested for all types of pathogens that give rise to tick-borne diseases. For this project, the data was narrowed down to *I. scapularis* ticks that tested positive for the *Borrelia* bacterium from the years of 2010 and 2018. Tick testing started in 2006, so data prior to 2006 is not available. This data was also joined to the shapefile containing New England counties. A thematic map of ticks was created using dot density and this data was superimposed over the choropleth maps showing Lyme disease cases. Data for land use was obtained from the National Land Coverage Data (NLCD) for 2001, 2011 and 2016. Only data for deciduous forest was selected for analysis. The results of this map was compared to Lyme disease to see if there is a correlation. Additionally, temporal analysis was done to see the changes in New England land use over the span of 15 years.

### Results

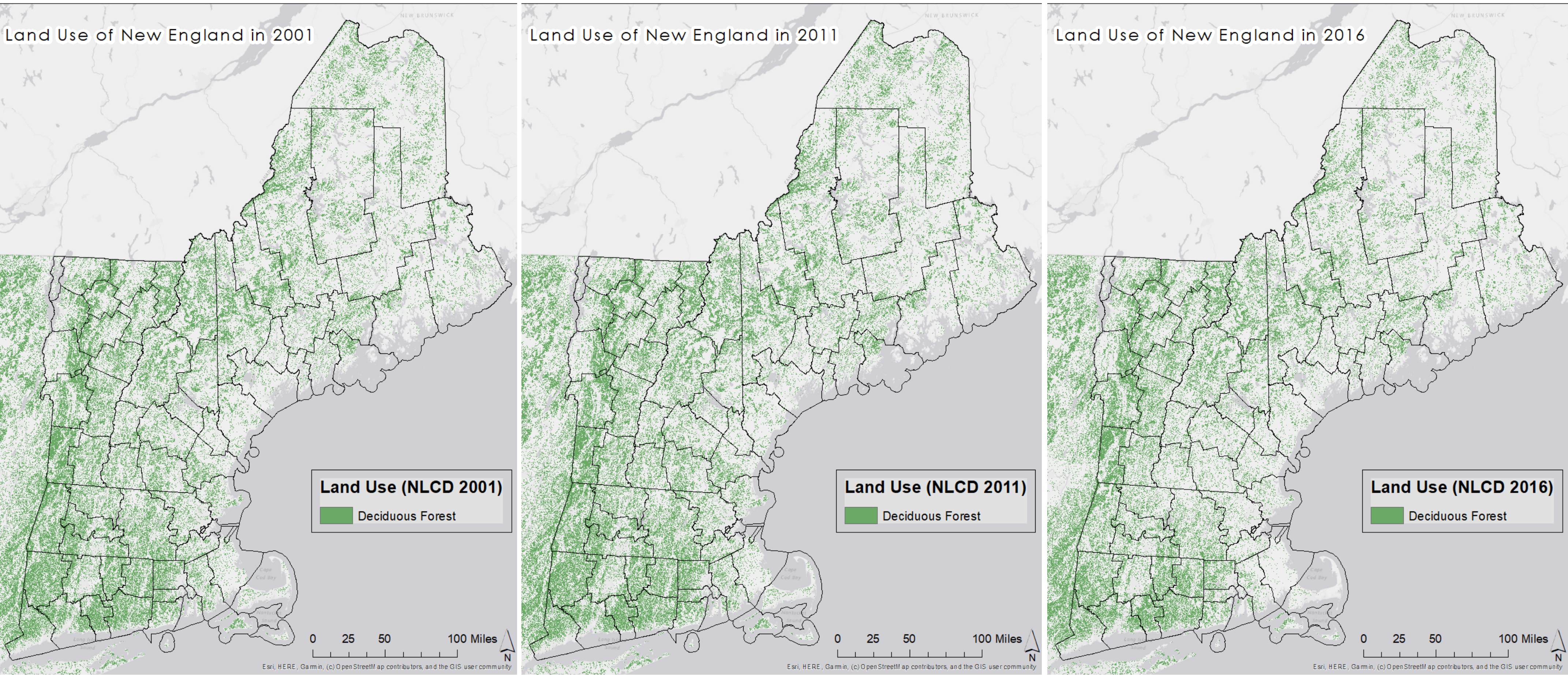
As shown in the choropleth maps, there has been an increase in the prevalence of Lyme disease in New England from 2000 to 2018. The choropleth map shows that out of all of the states in New England, Maine has seen the highest increase in prevalence. Data from tickreport.com shows that there has also been a large increase in the number of *I. scapularis* ticks positive with *Borrelia* bacterium. There is an unclear correlation between the prevalence

Figure 1. Cases of Lyme Disease in 2000, 2010 and 2018



\*No data recorded from Tick Report prior to 2006.

Figure 2. Land coverage for 2001, 2011, 2016



of *Borrelia* bacterium positive ticks and areas that have a high prevalence of Lyme disease. Looking at areas of land use in New England, there does not appear to be a great discrepancy from 2001 to 2016, but there are areas that have seen deforestation, such as in Massachusetts. Furthermore, there seems to be a slight correlation between land use and Lyme disease prevalence; in north-western New Hampshire, there appears to be more deciduous forests than the southern part and in 2018, there is a higher prevalence of Lyme disease.

### Discussion

The lack of correlation between ticks found and Lyme disease prevalence can be explained by the fact that the ticks that tested positive for *Borrelia* bacterium doesn't necessarily indicate that a person was infected with Lyme disease. Additionally, the tick data may be skewed because the lab that tests the ticks is at University of Massachusetts-Amherst, so there is a greater number of ticks that are positive for *Borrelia* bacterium in Massachusetts compared to other New England states. The lack of correlation between land use and Lyme disease prevalence goes against previous research; results show that there has been deforestation occurring in New England while the CDC states that the increase in Lyme disease is due to expansion of habitat. A limitation of this study is that comparison between Lyme disease prevalence and land use is done by visual examination. For future research, mathematical modeling should be completed to see if the relationship between Lyme disease, *Borrelia* positive ticks and land use is statistically significant and if there are confounders affecting the associations. A strength of this study is showing the choropleth map as a rate instead of a count. Showing the data as a rate takes into account the population of the counties and gives a more accurate depiction of Lyme disease prevalence. The goal of this study is to inform public health by showing which areas of New England have a high prevalence of Lyme disease and which areas have dense forests, indicating a high abundance of *I. scapularis*. This will inform public health professionals the areas of New England that need to be targeted for primary prevention, so that the public can prevent themselves from being in contact with black-legged deer ticks that may be infested with *Borrelia* bacterium.

### References

(1) CDC. (2019, April 22). Prevention is key in fight against Lyme and other tickborne diseases. Centers for Disease Control and Prevention. <https://www.cdc.gov/ticks/>

(2) Khatchikian, C. E., Prusinski, M., Stone, M., Backenson, P. B., Wang, I.-N., Levy, M. Z., & Brisson, D. (2012). Geographical and environmental factors driving the increase in the Lyme disease vector *Ixodes scapularis*. *Ecosphere* (Washington, D.C.), 3(10). <https://doi.org/10.1890/ES12-00134.1>

(3) Minkoff, D. I. (2016). Lyme disease: Prevalence, diagnosis, and comprehensive treatment. *Townsend Letter*, 391-392, 76-. Gale Academic OneFile. Data Sources: Centers for Disease Control and Prevention (CDC), tickreport.com, USGS, U.S. Census

(4) University of Rhode Island. (2018). TickEncounter Resource Center > Tick Identification > *Ixodes scapularis* (Blacklegged tick or Deer tick). [https://tickencounter.org/tick\\_identification/deer\\_tick#top](https://tickencounter.org/tick_identification/deer_tick#top)