The Effects of Land Cover Change on the Spatial Distribution of Lyme Disease in Northern Virginia Since 2005

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Introduction:

-Lyme disease has been an increasing problem in the U.S. over the last few decades

-Previous research has focused on similar correlations, but none have looked at the northern Virginia region

-Northern Virginia saw an increase in human Lyme disease cases in the early 2000s and case totals have remained relatively high

Research Questions:

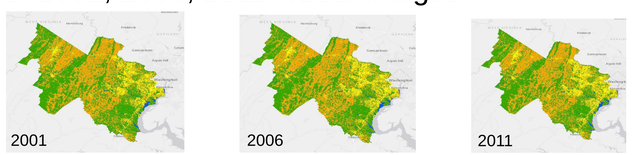
-What land cover characteristics are related to the emergence of Lyme disease in Northern Virginia 2005?

-Which suburban communities are more at risk for Lyme disease when considering their land cover types and the increasing spatial distribution of Lyme disease?

Data:

-Virginia Department of Health (VDH): human Lyme disease case information for the years 2005-2017

-MLRC: 2001, 2006, 2011 NLCD images



-U.S. Census Bureau: Tiger GIS data for state, county, and census tract shapefiles

-American Factfinder: county and census tract population totals data

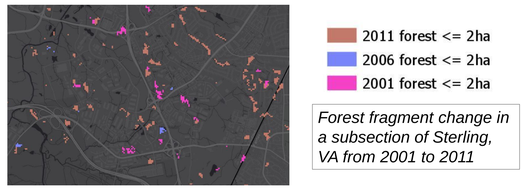
Methods:

-GIS was used to map the Lyme disease cases.

-The case incidence rates were calculated in ArcGIS Pro using yearly population estimates and the VDH yearly case totals

-The NLCD images were reclassified in ArcGIS Pro to consist of four land cover types: forest, developed, herbaceous/agriculture, and water.

-The forest classification was further analyzed to calculate the total and size of forest fragments.



Forest fragment change in a subsection of Sterling, VA from 2001 to 2011

-A publicly available program, Geospatial Modelling Environment (GME), will be used to calculate information about the forest fragments within the study area. GME provides land cover edge information that will be helpful in determining which combination of land cover edges potentially correlate to a higher incidence rate.

-Poisson regression model will be run with PCA due to multicollinearity within the variables. The purpose of running a Poisson regression model is to see which variables, if any, have a statistically significant relationship to the incidence rate of human Lyme disease cases in northern VA.

Anticipated Results:

-We are predicting there to be a correlation between forest fragment size and Lyme disease incidence rates.

-We are also predicting that land cover edge combinations will have negative and positive correlations to Lyme disease incidence rates depending on the land cover type that shares an edge with forest fragments.

Anticipated Results (cont.):

-We expect to see higher incidence rates in areas where the land cover edge combinations include forest and lawn due to the likely increased prevalence of human interaction with nature.

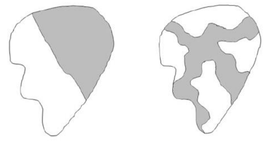


Figure 3 Hypothetical landscapes comprising 50% forest (dark shading), but with low (left) and high (right) interspersion with herbaceous cover

This image shows the way in which a forest is fragmented can vary and have an impact on Lyme disease prevalence. The assumption is that more forest-herbaceous edges increases the risk of human Lyme disease incidence.

Image from: Jackson, L. E., et al. (2006). "Towards landscape design guidelines for reducing Lyme disease risk." International Journal of Epidemiology 35(2): 315-322.

Limitations:

-Potential limitations of this research could arise due to:

-case locations are based on where the patients lives, which may not be where the infection occurred

-there is the chance of reporting errors or areas where physicians were over/under reporting cases

-in 2008 the case definition for Lyme disease was changed in an attempt to discourage over-reporting of cases

-the NLCD images could be misclassified or over-generalized

Applied Contributions:

-The purpose of this research is to contribute to the knowledge base of Lyme disease, as well as; impacts of land cover use/change on disease spread.

-The goal is for the research findings to provide useful information on how to reduce the risk of human Lyme disease in developed areas.

-This research hopes to be applicable to other regions with similar land cover sprawl and for the information presented to be helpful in addressing infectious disease risks associated with land use change.