



Vulnerability assessment of forests to invasion by the Asian Longhorned Beetle: a pilot study of Worcester County, MA

by: Brynna Bolger

About the Project

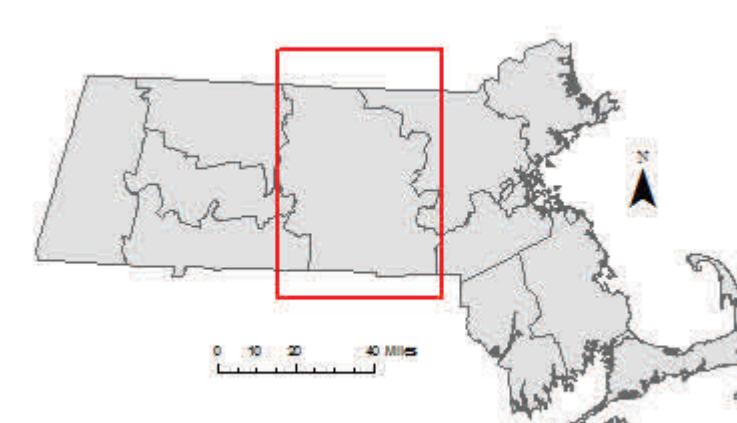
One of the biggest threats to Massachusetts' trees in both urban and forested areas is the destruction by invasive pests. The Hemlock Woolly Adelgid (HWA) has already decimated Massachusetts' hemlocks. Our ash, maple, birch, elm, willow and many others will be next if pests like the Emerald Ash Borer (EAB) and the Asian Long-horned Beetle (ALB) are allowed to spread into the state. Massachusetts has already had 2 close encounters with the Asian Long-horned Beetle – in Worcester and Boston. The only real option for eradication of the ALB is cutting down and destroying the infested trees. Unfortunately, this is not a viable solution in large forests, but only in urban and residential areas. Therefore, prevention or early detection is the best hope of saving Massachusetts' forests.

One of the most common ways invasive pests spread to new areas is through firewood or other wood material. For example, both ALB

and EAB initially spread to North America from Asia in wooden shipping materials. Despite campaigns promoting "burn it where you buy it" many people either do not realize the level of threat or are not exposed to the message. In addition, the areas where the largest number of out of state firewood is coming in is to campgrounds, state parks, etc. which are commonly surrounded by large stands of trees, and so the job of controlling an infestation would be extremely difficult. Therefore, making sure that the message of limiting the movement of firewood is a high priority, but especially in areas where the presence of host trees coincides with a large influx of out of state wood.

In this pilot study I worked to create a method of identifying forested areas at highest risk of invasion by the ALB. I chose to focus on Worcester County for this initial analysis because it is centrally located in the state and because it contains a city that already has a known infestation. For the scope of this project I am focusing on Massachusetts forests and not trees in residential-

and urban areas because infestations in forests are much harder to initially identify and then to eliminate. This project is meant to be a pilot study – to design a method of identifying at risk areas in Massachusetts or the Northeast by using Worcester County as an initial test.



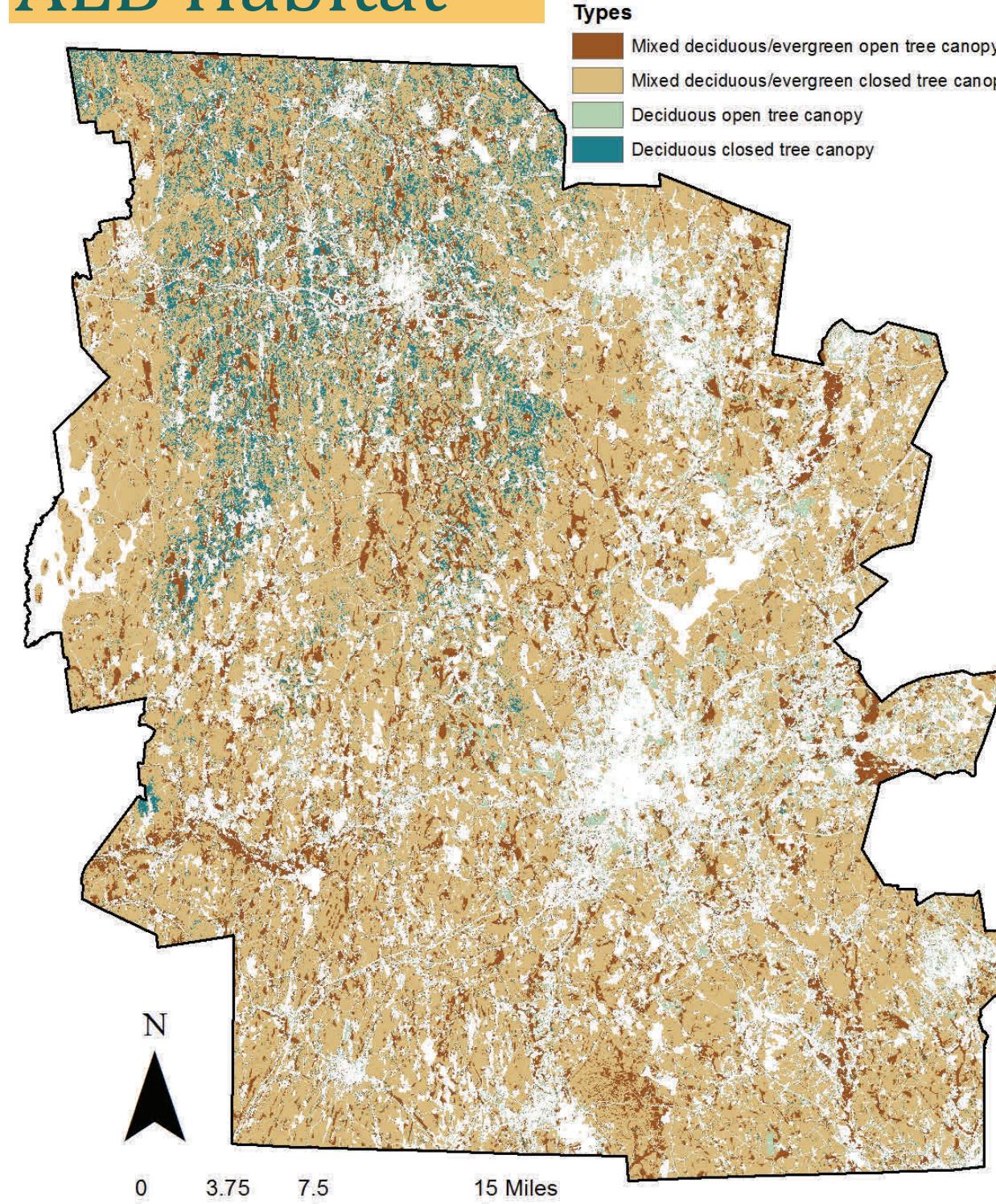
Worcester County, MA

density of areas adjacent to forested areas because studies have found that introduction and success of invasives is correlated with human population density. Another important aspect to consider is that invasives typically thrive in disturbed habitats or edge habitats, so I selected for forested areas around roads because these forests are both disturbed and have large edges. Lastly, I located plant nurseries and campgrounds adjacent to the selected forest types.

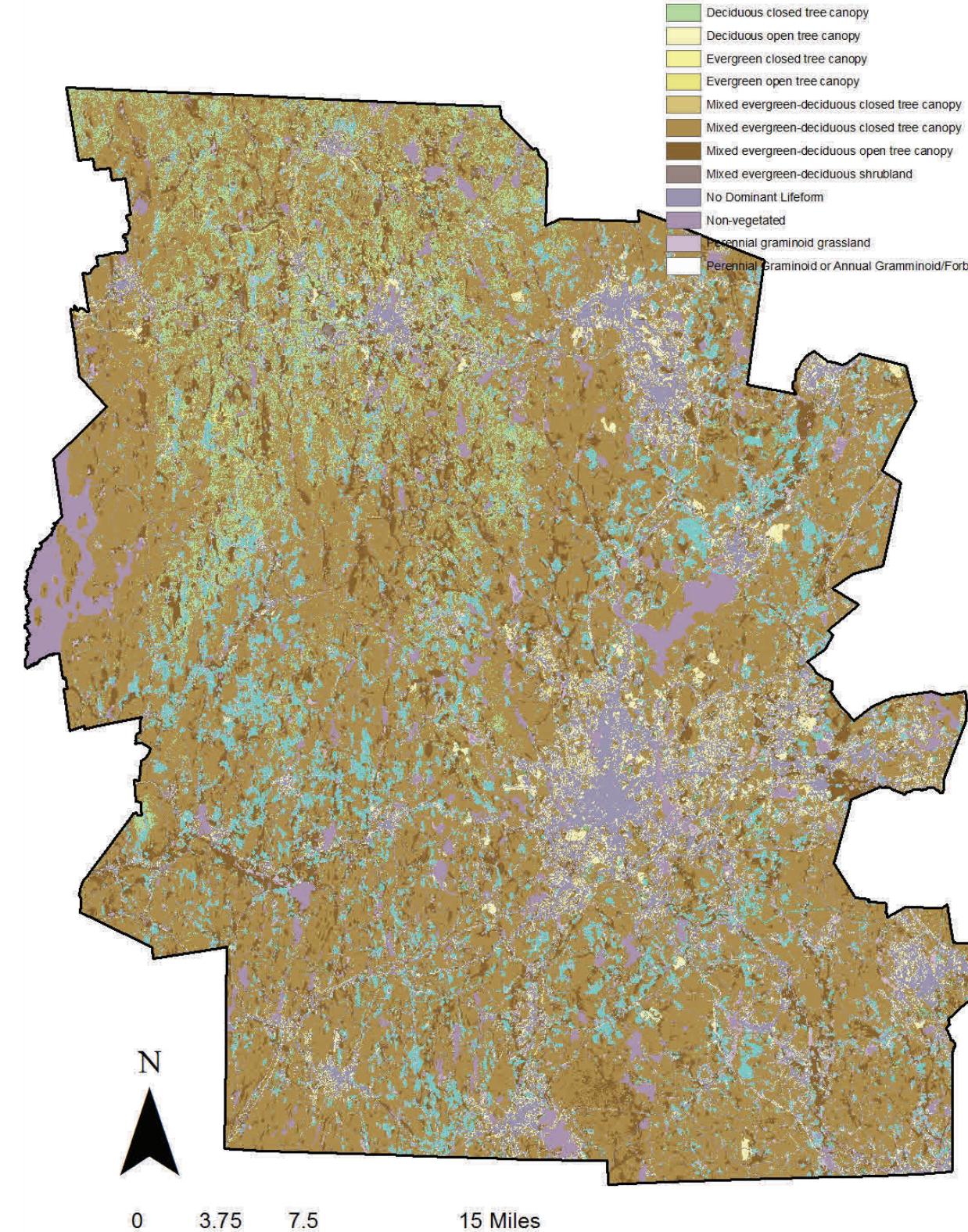
then used the Raster Calculator tool to create 2 vulnerability maps – one types were classified by suitability combining the risk factors layer of habitat for ALB, most to least: with a reclassified raster layer of all deciduous closed, deciduous open, mixed closed, mixed open, all others.

Using raster analysis I determined which areas have the most overlap of these factors as a method of assessing risk. While the vegetation data was already in raster form, I used the Euclidean Distance tool to rasterize the 4 risk factor layers. I then reclassified each layer individually so that 200 m=1, 400 m=2, 600 m=3, >600 m=1, with the assumption that closest to the areas of introduction would be at highest risk. I used research on the biology of the species to determine annual migration of adult ALB of their own volition. I combined these 4 layers, using the Raster Calculator tool to create a "risk factors" raster layer. I

ALB Habitat



Vegetation Types



Tufts Cartographer: Brynna Bolger
Class: Intro to GIS, Fall 2012

Map Projection: NAD 1983 State Plane MA Mainland FIPS 2001,
Meters; Data: MassGIS from Tufts GIS server 2000 data, Landfire
raster data 2008, Google Maps .kml data, US Census data from
2012 TIGER Line/Shapfile data and Factfinder table 2010

Methods

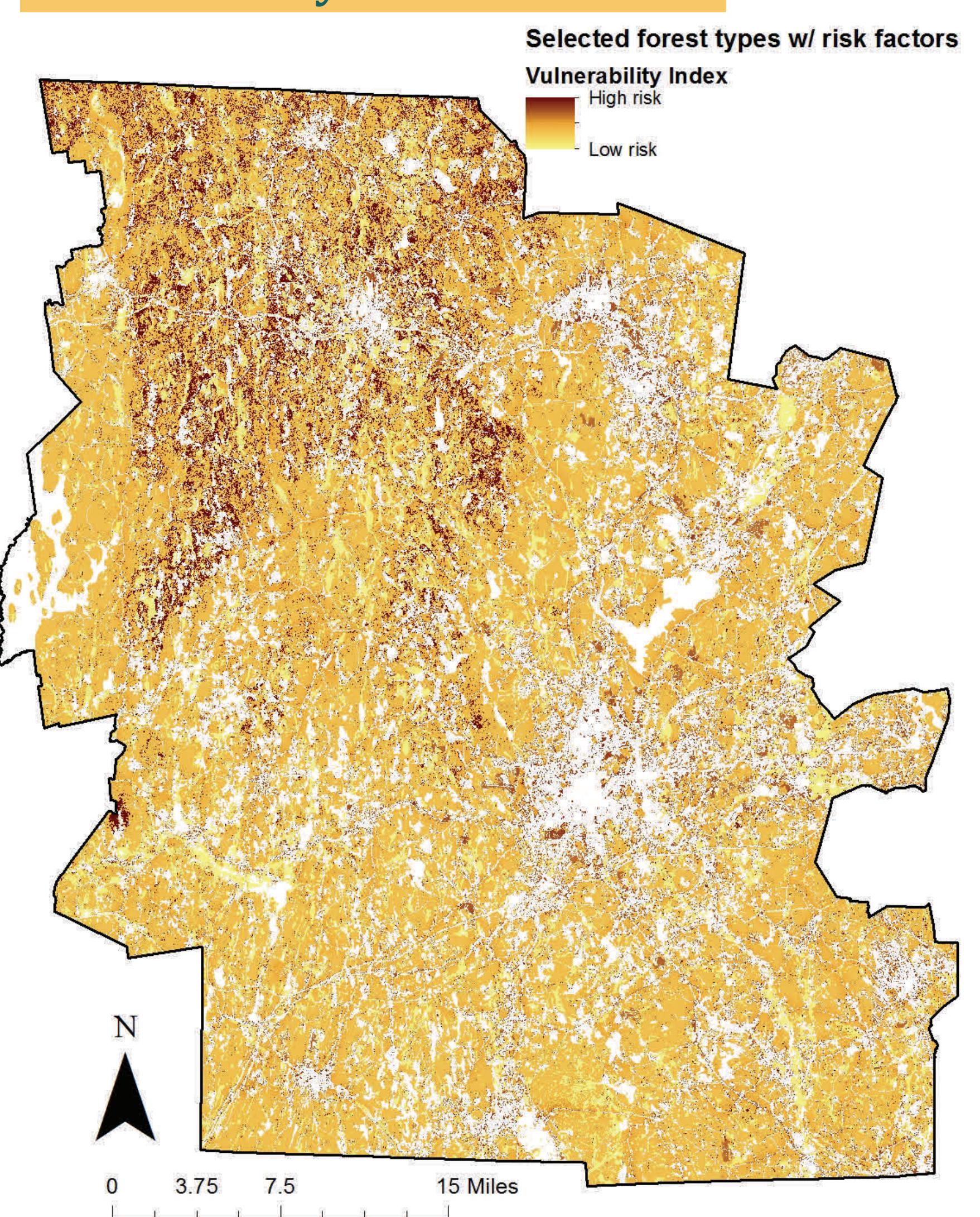
In order to assess the vulnerability of forests in Massachusetts to ALB, I built 2 raster data layers – one showing the existing vegetation types and another combining several factors that may increase the risk of invasion. This included campgrounds, plant nurseries, roads, and areas of high population densities. I looked only at forested areas – deciduous and mixed evergreen and deciduous – because the host trees of ALB are of this type. Additionally, I looked at population

density of areas adjacent to forested areas because studies have found that introduction and success of invasives is correlated with human population density. Another important aspect to consider is that invasives typically thrive in disturbed habitats or edge habitats, so I selected for forested areas around roads because these forests are both disturbed and have large edges. Lastly, I located plant nurseries and campgrounds adjacent to the selected forest types.

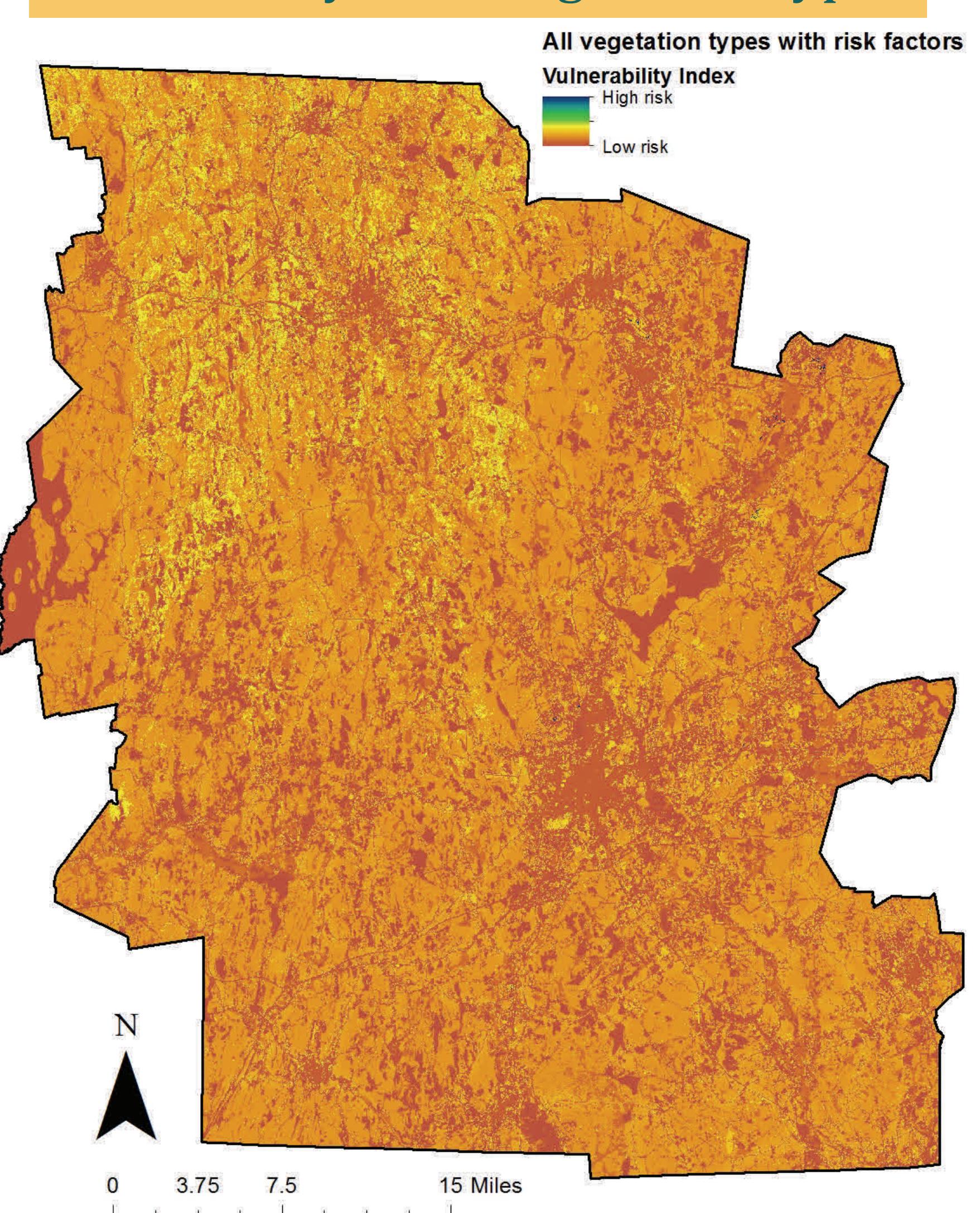
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Vulnerability in ALB habitat



Vulnerability in all vegetation types



Results

Based on this initial analysis, it appears that there are several areas throughout the county where the risk factors (campgrounds, plant nurseries, roads, and highest population density) are concentrated (Risk Factors). For the most part these areas are around high population densities. The largest area of high risk is the Worcester area. However, when vegetation type and habitat are taken into account, the area of highest vulnerability appears to be the Northwestern region of the state. Furthermore, although there are small areas of vulnerability, the areas shown to be at highest risk by the human-related factors are no longer of concern once vegetation type is taken into consideration.

Limitations

A major limitation of this pilot study is that I concentrated on forested areas, however, as is clear by the risk factors map, human activities in non-forested areas provide many opportunities for introduction. Furthermore, there are additional factors that increase the risk of introduction, such as have enabled me to better determine points where industrial or commercial risk products are brought to the county (airports, train stations, etc.) I was also limited by the specificity of the vegetation data. There is a wide variety of tree types ALB inhabit, but they do so with varying degrees of preference and success. Additionally, forests with increased heterogeneity are less susceptible to invasion. Therefore, knowledge of tree species would

Conclusion

The risk factors map shows that it may not be necessary to combine all of the risk factors – simply using highest population density may be sufficient. This has been shown historically in the state, as the two areas of infestation have been Boston and

Worcester, two major cities and thus areas of high human density. On the other hand, the vulnerabilities maps show that these areas of highest influence by human-related risks are not as important once vegetation type is considered. This exhibits the interaction of anthropogenic and ecological factors in determining where pests are introduced but also where they can become established.