

What is the Effect of the Spotted Lanternfly on Red Maple Reproductive Success in Pennsylvania?

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Background

- Spotted Lanternflies are a novel invasive species from Asia that were recently introduced in Eastern Pennsylvania in 2014. With no native predators, their growth and spread have been widespread across the Mid-Atlantic. In response to their spread, quarantines have been enacted in counties across the state (Urban, 2020; Figure 2).
- The Spotted Lanternfly feeds on the sap of over 90 tree species in Pennsylvania. This is particularly unique because it feeds on herbaceous plants and woody plants and trees, unlike other generalist invasive species (Urban, 2020). One of these species is the Red Maple which is the most common tree species in Pennsylvania, and listed as one of the Top 10 Most Important Hardwood Trees in Pennsylvania by Penn State University (Smith 2020). The Spotted Lanternflies can induce great stress on mature trees, which could affect their ability to reproduce

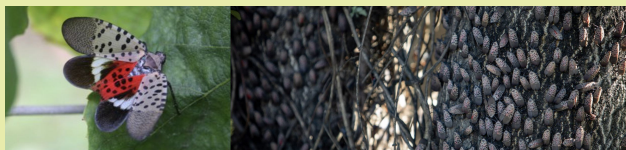


Figure 1. Photo source: Tim Weigle and Bernard Brown
The Spotted Lanternfly (*Lycorma delicatula*) reaches maturity in Late Summer (July/August). They feed on the saps of various trees, and secrete honeydew, often hundreds at a time. The honeydew attracts other pests and grows mold, causing harm to the host tree. Because of the novelty of these invaders, the long term effects of these secretions are still unknown (Urban, 2020).

Motivation

- The Spotted Lanternfly has the potential to induce harm on multiple industries in the U.S. The forest industry is especially at risk of degradation due to this invasive pest (Antolos, 2019). In Pennsylvania alone, SLF has the potential to destroy their \$17 billion hardwood industry (Duke, 2020).
- The full extent of economic and environmental damage due to the Spotted Lanternfly is unknown because it is such a new threat. There is clearly a high risk, so it is vital to research its long-term effects on the forestry industry. Since the red maple is one of the most abundant tree species in Pennsylvania, it is crucial to protect this species (Figure 1).
- We propose to evaluate how the presence of the Spotted Lanternfly influences the reproductive success of the Red Maple.

Hypothesis

We hypothesize that there is a relationship between spotted lantern fly presence and red maple reproductive success.

Predictions

We predict that the reproductive success of red maples will decrease over time given the increased effect of the spotted lantern flies in Pennsylvania old growth forests. This is because the lantern flies greatly affect mature red maples in Pennsylvania, and the stress from these invasive pests may cause these trees to have less reproductive success as a result.

Study Design

- This experiment will be conducted at two different locations of Appalachian oak forests within the state of Pennsylvania (Block & Rhoads). Lake Nockamixon State Park, located in the east of the state, has been exposed to the presence of the spotted lantern fly for the entire duration of their presence, six years. Laurel Hill State Park will be analyzed as a control, located on the western side of the state that has not yet been affected by the fly (Figure 2).
- Within each park, 200 randomly selected two square meter quadrants will be analyzed. To do this, GIS will be used to randomly generate coordinates for each plot, which will be located on foot. Each quadrant will be marked off and any red maple saplings under six years old will be identified and recorded. This follows an observational study as systems are being observed and not manipulated.

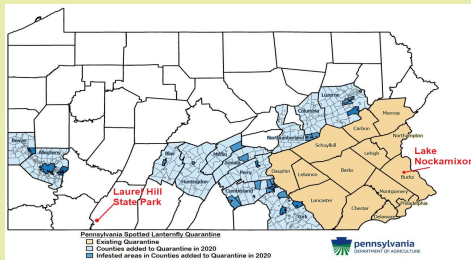
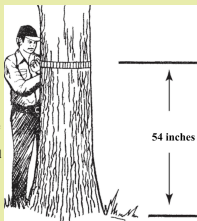


Figure 2. Photo Source: PA Department of Agriculture
This map visualizes the spread of the Spotted Lanternfly in Pennsylvania. It was initially introduced in Bucks County in the East, before slowly spreading West by means of translocation of egg masses by vehicle. In order to slow the spread of the SLF, quarantines were enacted by the Dept. of Agriculture. Counties in orange show areas with the longest and most severe disturbances, which had quarantines enacted Pre-2020. Counties in blue show newly affected areas recently added to the registrar in 2020.

Fig 3. Photo Source: IN department of Natural Resources. To determine the age of the saplings, the circumference of the tree will be analyzed at 54 inches from the ground surface. Saplings under this height can be assumed and recorded as under three years of age. Trees with a circumference of over 4.18 inches can be assumed over six years of age, and therefore not taken into consideration. The qualifying saplings will have their circumference at 54 inches recorded, divided by pi, and multiplied by 4.5 to obtain their predicted age in years.



- The recordings at each park will be categorized into number of individuals and assumed age (<3, 4, 5, 6), in order to complete an analysis (Figure 3). This study will be occurring during the fall to consider mass sapling germination in the spring months and the end of the lanternfly lifecycle in the fall.

Intended Analysis

- Given this is an observational study, the independent variable is not being manipulated. It can be defined as the presence of the fly in only two categories: present or not present (predictor variable). The dependent variable is the number of red maple saplings found in each location, a continuous and response variable. This indicates that our study will be analyzed using a T-test.
- Looking further into our analysis, we can use our results to determine if the invasive spotted lantern fly is affecting the reproductive success of red maples in Pennsylvania, and if there is a more prominent effect over time. Our inferences will be limited to the red maples found in two specific parks containing Appalachian Oak Forests in Pennsylvania, as we are limited to selecting one of the only areas affected by the spotted lantern fly for a prolonged period of time. Our analysis will also consider external variables such as climate differences between both years and the different plots of land.

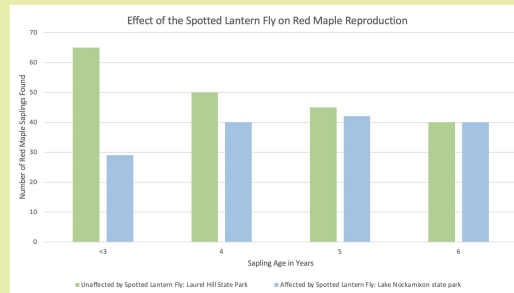


Figure 4. Our prediction about the trends in red maple germination in relation to spotted lanternfly impacts, assuming that one tree would be found in each plot for the control. In the unaffected region, saplings will be found in a higher quantity the younger they are, as more saplings will sprout and die off within the first few years of life as a result of selection. In the affected region, the lanternflies will have had a greater impact on mature trees over time, so the germination success of seeds will decrease, resulting in fewer saplings in more recent years.

Expected Benefits

Given that red maple is one of the most widespread species in eastern North America that occupies a wide range of habitats and successional stages (Sakai, 1990), it is necessary to understand the future success of the species. If Spotted Lanternflies are not contained, they are predicted to cause \$554 million in annual losses in Pennsylvania alone (Duke, 2020). Our study will inform the forest industry of the long-term effects of SLF on red maple reproductive success, thus proving why it is crucial to control this invasive species for the sake of the industry.