Impacts of Invasive *Ailanthus altissima* on Woody Plant Communities in an Old Growth Forest of Southeastern Kentucky

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Introduction

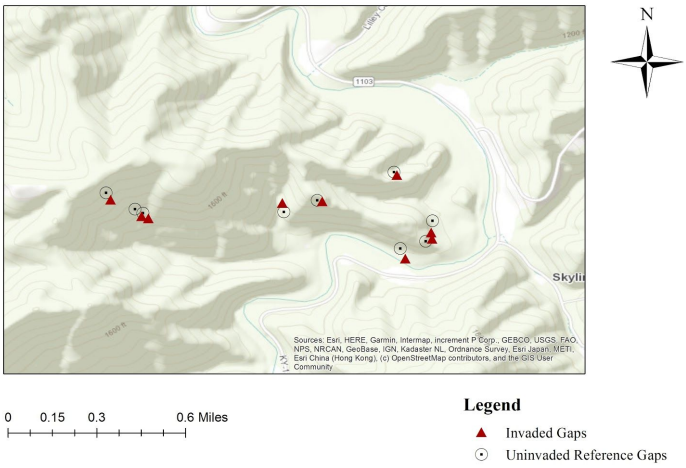
Alongside issues of climate change, the introduction and spread of invasive species is a critical threat to native species and natural communities. The non-native tree *Ailanthus altissima* (Simaroubaceae), or Tree-of-Heaven, is a competitive invasive species in the United States and one of the most widespread. Once established it is intensive to remove and prolific samaras allow it to spread far, and quickly. This tree grows rapidly and produces powerful herbicidal compounds that halt the germination and growth of possible native competitors (Knapp and Canham, 2000) as well as alters soil chemistry -- particularly increasing the soil pH.

Although this species is alarmingly tolerant of most growing conditions, it does require high light conditions to germinate. Because of this light requirement, urban habitats, roadways, and forest gaps have been shown to be crucial points of the introduction and spread of *Ailanthus* (Motard *et. al.*, 2011). Numerous studies have worked to assess the subsequent changes and reduction of native species diversity that occurs around points of invasion (Knapp and Canham, 2000; Motard *et. al.*, 2011). To further examine these impacts on native plant communities, the current study looks at how this trend appears in regards to woody plant compositions in forested areas.

Methods

To determine if *Ailanthus* is as detrimental to the woody species composition in forested areas as it has been for the herbaceous layer of forests elsewhere, invaded and uninvaded canopy gaps of an old growth forest in Southeastern Kentucky were compared. At the study site, Lilley Cornett Woods in Letcher County, nine out of 30 invaded areas were compared to nine nearby univaded gaps.

Canopy Gaps Invaded and Univaded by Ailanthus altissima



Measurements of canopy gap size, age, and openness were taken for each gap, along with description and position of the site. A belt-transect, 6M long by 4M wide, was run in each gap. Woody species within each transect were identified and their position in relation to a central *Ailanthus* was recorded. For individuals over 30cm tall their diameter at breast height was taken, and pH was measured every 3M along the centerline of the transect.

For comparison between the species present at invaded or uninvaded sites a system of Ecological Indicator Values (EIV's) were used. Species were ranked one through three on their tolerance to high pH, successional status, and gap-response. The numerical values were compared to describe patterns in the characteristics of species that were most common at either invaded or uninvaded gaps. This can be a useful tool for interpreting patterns in species assembly (scherrer and Guisan, 2019).

Results

Sites were assessed on the species richness, Shannon diversity, and assembly of the native species within the transects. Despite the sample size being somewhat limited, the results show some trends consistent with previous work on the herbaceous layer around *Ailanthus*. The richness ($F_{1,16}$=3.633, p=0.0748) Shannon diversity ($F_{1,16}$=3.55, p=0.0778) of species were not significantly different, but the data show a reasonably significant trend that the richness and diversity were higher at invaded sites. Species evenness was even less significant ($F_{1,16}$=0.067, p=0.799). However, trends in the data showed that although invaded sites had higher richness and diversity, they also had marginally lower evenness of the species present.

When the sites were paired there was a trend for the soil directly under *Ailanthus* to have a higher pH than soil at the equivalent place in univaded gaps (log likelihood ratio test, χ = 3.535, p = 0.060).

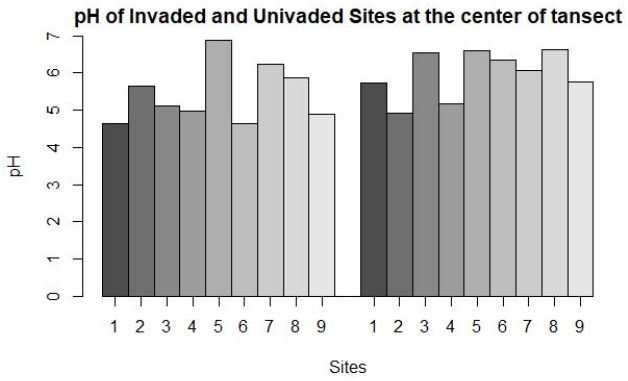


Figure 1. *Higher soil pH at invaded sites (right), than paired uninvaded sites (left).*

Differences in all of the species at invaded or invaded sites was not statistically significant either (p=0.538), but also was not entirely null. Anecdotal observations of species composition did offer insights as to the types of species peristing and being suppressed by *Ailanthus*. Species that consistently appeared higher or exclusively in uninvaded sites include: *Acer rubrum*, *Asimina triloba*, *Oxydendrum arboreum*, and *Rhododendron maximum*. EIV's for these species indicated that these are primarily slow growing species that can be present in a variety of successional stages (as is expected in the variously aged gaps surveyed), and which prefer very to slightly acidic soil. Alternatively, species with an increased presence in the invaded plots included: *Magnolia tripetala*, *Acer saccharum*, and *Fagus grandifolia*. EIV's for these species indicated these were more generalist species capable of tolerating shade and higher soil pH.

Conclusion

The data collected here supports trends observed with *Ailanthus* invasion in the herbaceous layer and in open areas; there is little change in overall richness but meaningful observations about species compositions. However, this trend still appears less severe amongst the woody species, and is confined to canopy gaps in forested settings. Even though tolerant generalist species appear to increase in invaded gaps, the decrease of more selective and gap-obligate species has implications for the future of the native communities that we recognize in the old growth. Additionally the data herein did lack statistical significance, possibly from the small sample size, so future studies are needed to confirm these observations. The resilience of old growth forests to invasion by non-natives may be due to its great heterogeneity of native species, which allows communities to better compete with invasive species.

References

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