Quantifying Changes in Herb Layer Diversity as *Microstegium vimineum* Invades an Old Growth Forest in Eastern Kentucky

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Introduction

Ecological disturbance is when an ecosystem experiences an influential change that alters the living community or how that community functions. Disturbances are often classified as natural or anthropogenic. Anthropogenic disturbances are those that occur due to the activities of humans and in the context of a forest, examples include mining, logging, climate change, and farming. Examples of natural disturbances can include earthquakes, ice storms, fires, and tree falls.

Invasive species are species which have been introduced to an area outside of their native range and have become aggressive weeds in this new area, outcompeting natives and having an economic impact in the area they invade. In the vast majority of cases, these species are spread by the aid of humans and can be viewed through the lens of anthropogenic disturbance.

Japanese stiltgrass (*Microstegium vimineum* (Trin.) A.Camus) is an annual grass which was introduced from Japan into North America in 1919 it has since established itself as an aggressive invasive species in the deciduous forests of Eastern North america, being listed as invasive or banned in three states (USDA NRCS 2018).

Previous research (Adams & Engelhardt 2009; Oswalt et al. 2007) has found that herbaceous layer diversity declines in areas with high *stiltgrass* populations. However, these studies used secondary growth forests with many disturbances besides stiltgrass. This study observed an old growth forest where invasive species and climate change are some of the only anthropogenic disturbances.

Methods

Lilley Cornett Woods (LCW) in Letcher Co. KY. was used as the study location due to it being relatively undisturbed compared to most forest in KY, especially in the areas of old growth forest, here defined as forest that has not been logged or significantly disturbed by humans for over 150 years. Previous research discovered several invasive species established in the old growth forest, including multiflora rose (*Rosa multiflora*), Japanese stiltgrass, tree of heaven (*Ailanthus altissima*), princess tree (*Paulownia tomentosa*), and autumn olive (*Elaeagnus umbellata*).

Eighteen sites were established at LCW after a thorough scouting of the old growth forest, each site consisted of a 2x2m plot invaded by stiltgrass and another 2x2m plot which is not or minimally invaded by stiltgrass (Figure 1). Each plot was divided into 4 $1m^2$ subplots. At each site a checklist of plants in each subplot and their cover was estimated using Braun-Blanquet cover class system. At each plot, soil moisture, canopy closure, pH, leaf litter depth, and soil nitrogen were measured.

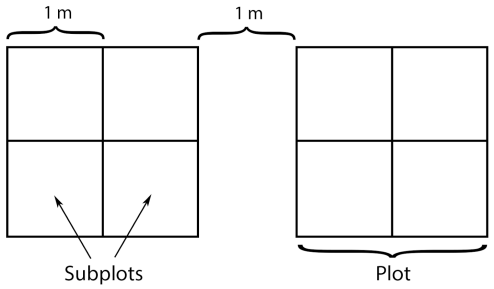

Figure 1: Site design, one plot has at least 50% cover by stiltgrass and the other with less than 10%

Using program R, all the cover values for each subplot were averaged together to get one cover

value per plot. Shannon diversity was calculated based on this average cover. The results of mean Shannon diversity and species richness per plot were fit with general linear mixed models (block design) with invasion status as a fixed factor and site as a random factor.

Results

During scouting, 11 out of 18 stiltgrass patches were discovered in treefall gaps. Plots invaded with stiltgrass had lower Shannon diversity than the uninvaded plots (t_1 = 6.136, p < .001, Figure 2). There was no difference in species richness between the invaded and uninvaded plots (t_1 = 1.663, p = 0.096, Figure 3).

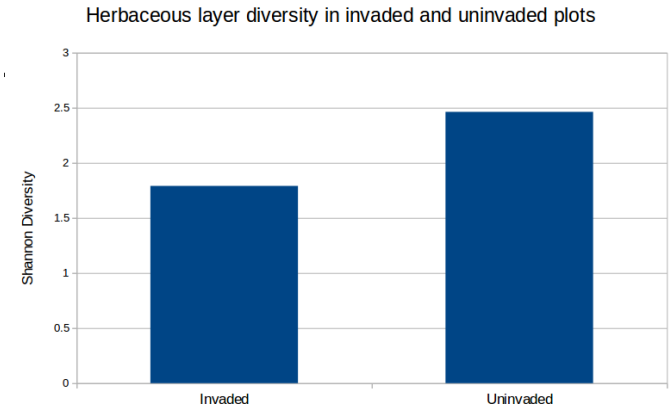

Figure 2: Diversity in the herbaceous layer was lower in stiltgrass invaded plots.

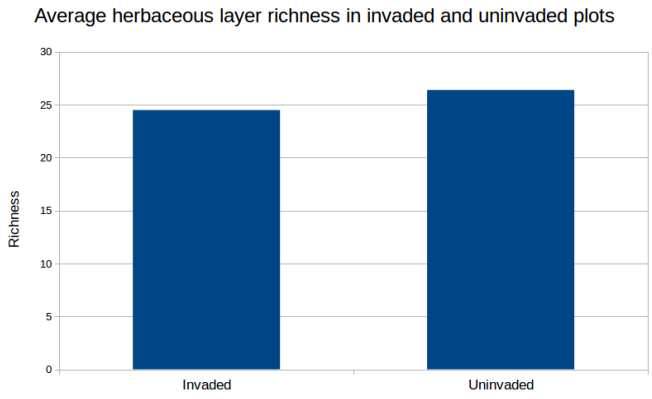

Figure 3: The number of species present in stiltgrass invaded and uninvaded plots did not differ.

Conclusions

Stiltgrass appears to be using the natural disturbance of treefall gaps to gain a foothold in the old-growth forest. Many of those treefall gaps were caused by fallen hemlock trees. More gaps can be expected due to the invasive hemlock woolly adelgid (*Adelges tsugae*), although the pest is being actively managed by LCW staff.

One consequence of intensive disturbance in forests is the loss of the herbaceous layer diversity. The diversity of LCW is higher than that of a second growth forest, but the conserservation of this diversity is at risk due to the invasion of the forest with invasive species such as stiltgrass.

This study may not perfectly model the effects of stiltgrass invasions into second growth forests which are the vast majority in the eastern deciduous forests, it gives a view of what happens when stiltgrass one of the only disturbances affecting a forest.

References

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