The effects of deer and Microstegium vimineum invasion on native woody and herbaceous plants Elizabeth Matthews, Scott Eckert, and Janet A. Morrison Department of Biology, The College of New Jersey

Abstract

Suburban forests are necessary for biodiversity and offer access to nature for many people. However, native plant communities in these forests may be altered by deer overpopulation, as well as by invasive species - possibly acting together. Both forces can affect growth and diversity of natives, and may do so differently for herbaceous and woody species. One common non-native plant species in suburban forests of the eastern U.S. is Japanese stilt-grass, *Microstegium vimineum*. In three forests in central New Jersey (deer density ca. 20/km²), we set up plots under all combinations of including or excluding deer and stiltgrass, in 4 x 4 m plots (32-40 plots per forest). We documented percent cover of native herbaceous and woody plants from pre-treatment (early Fall 2012) to two seasons post-treatment (early Fall 2014). Percent cover of native herbaceous plants increased overall, but was not significantly different among any factorial treatments. In contrast, percent cover of native woody plants increased in fenced plots without deer (from an average of 8.25% to 10.68%) but decreased in unfenced plots (from 12.63% to 7.72%). Woody plant cover decreased in plots with added stilt-grass (from 11.50% to 8.24%), but not in plots without stilt-grass. The effects on woody plants were more pronounced in the two forests with greater ambient deer pressure. We detected no interaction effect between deer exclusion and stilt-grass addition. Woody plants – which provide important physical structure in a forest – appear to be particularly vulnerable to overabundant deer and stilt-grass invasion.

Introduction

Suburban forest ecosystems are subject to non-native plant invasion at a high rate, such as by *Microstegium vimineum* (Japanese stilt-grass), because of their high levels of disturbance and proximity to seed sources. In addition, the fragmentation of forests in the suburban landscape provides ideal edge habitat for deer, and the proximity to human communities results in little hunting, so suburban forest communities also are subject to deer overpopulation.

Microstegium vimineum is a commonly studied, invasive annual grass. It can negatively affect communities of native plants, and is seldom eaten by deer. Deer herbivory also negatively affects the growth of native plants, but because deer feed selectively, their effects can differ among species or types of species – such as herbaceous versus woody species.

We aim to understand how deer overpopulation combined with an invasive competitor influences the herb layer plant community in suburban forests.

Methods

- Three forests in central New Jersey Curlis, Herronton, Rosedale. In each: - 4 x 4 m plots (32-40 plots per forest)
- all combinations of *M. vimineum* added/not X deer excluded/not
- Early fall 2012 pre-treatment, baseline percent cover of all species: - estimated to 10% intervals in 16 0.25 m² sub-plots per plot
- Nov. 2012 2.95 g *M. vimineum* seeds added to randomly selected plots
- March 2013 Fences built around half the plots for deer exclusion
- Early fall 2014 percent cover of all species, again

Results

Across all three forests, after 18 months of protection from deer by fencing, native woody plant cover in the herb layer increased, while in unfenced, deer-access plots it decreased. So, by fall 2014, native woody cover was significantly greater in fenced plots (Fig. 1A; ANOVA, $F_{(1.91)} = 9.11$, P=0.003). The effect from deer exclosure was particularly strong in Rosedale (Fig. 2A, 3A, 4A).

Native woody cover also was lower in plots with added stilt-grass, across all forests, compared to the plots without stilt-grass (Fig. 1B; ANOVA, $F_{(1.91)} = 4.57$, P=0.035), but the effect varied among forests. It was apparent only in the two forests with higher deer pressure (Curlis, Fig. 2B, ANOVA, $F_{(1.31)} = 5.96$, P=0.02; Herronton, Fig. 3B, ANOVA, $F_{(1,33)} = 0.04$, NS; Rosedale Fig. 4B, ANOVA, $F_{(1,27)} = 14.41$, P=0.0008).

Percent cover of native herbaceous plants increased overall by 2014, but deer access and stilt-grass addition had no significant effect (Figure 1C, 1D).





Discussion

Deer herbivory: Excluding deer from the plots had a significant, positive effect on the growth of native woody plants, across all three forests, after just 18 months, but did not affect herbaceous plants. In 2012, the native plant community was not at carrying capacity, and the populations were likely limited by deer. Release from deer browsing allowed the extant woody plants in the plots to increase growth, and also allowed new recruits (such as seedling offspring of the canopy trees) to survive; both processes add to the percent cover of woody plants. In contrast, herbaceous plants' capacity for increased size when released from deer is more limited, so their increase in cover would need to be caused mostly by new recruitment. Given the paucity of the herb layer in these deer-ridden forests, it will take more time for protected plots to become populated by new herbaceous recruits from external seed sources.

Non-native invasion: *Microstegium vimineum* can be a competitive invader in suburban forest communities. Its addition in 2012, to stage novel invasions, has already been detrimental for native woody plants in the two most deer-affected forests. The dense stands of living *M. vimineum* and its persistent senescent tissue may both act as barriers to light for woody juveniles, potentially preventing them from emerging above the herb layer. This same mechanism should apply to herbs as well, but we did not observe and negative effect by *M. vimineum* on herbaceous plant species.

Interactive Effect: One purpose of the study was to investigate if there was a greater effect on the native plant community due to simultaneous deer pressure and stiltgrass invasion. There was no significant interactive effect between deer herbivory and *M*. vimineum invasion.

Further Investigation: This study will continue for at least two more years to determine the longer-term effects that deer pressure and M. vimineum invasion have on native plants in suburban forest ecosystems.

Acknowledgements

For field assistance: Morrison lab students, friends, and family – too numerous to name – but thanks to all! For research permits: Mercer County Parks, Friends of Hopewell Valley Open Space. Undergraduate Summer Experience. For travel support: TCNJ School of Science.

