Factors driving success of the invasive herb layer species *Microstegium vimineum*

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Abstract

Microstegium vimineum is an invasive grass invading suburban forests. Like many invasive species, general factors that contribute to success are known. We constructed a structural equation model to determine how *M. vimineum* percent cover can be explained by some of these factors in differing environments. Using data from a deer-exclusion study of 225 plots in six forests in varying deer-pressure levels, we investigated what best explained the variation seen in *M. vimineum* cover. Native cover negatively affected *M. vimineum* cover, suggesting physical niche availability as a driving factor, but nonnative cover also positively affected *M. vimineum* cover. This suggests support for invasional meltdown; with more nonnative cover, species richness tended to lower, potentially opening more niches for exploitation by new invaders. Furthermore, deer access had only an indirect negative effect on *M. vimineum* cover, indicating that deer hunting is not the only factor that should be used for *M. vimineum* management.

Background

- *Microstegium vimineum* is an invasive C_4 grass in northeast American suburban forests, decimating native plant populations, potentially irreparably
- To see causal relationships between factors that might affect its success, we made a **structural equation model** (SEM)
- Data from 6-year, 225-plot deer-exclusion study in 6 forests, across a gradient of ambient deer pressure

Methods

Data

- 6 forests in suburban New Jersey; 225 plots; half deer-fenced in spring 2013; seeds of *M. vimineum* added in fall 2012
- Native + nonnative herb layer cover in fall 2018: 16 0.25 m^2 subplots per plot, scored as +, 1, 2, 3, etc. for 10% cover categories, then averaged per plot
- Soil pH: 4 soil cores per plot and pooled; measured Sept. 2018
- PAR: AccuPAR from Decagon Devices, 5 readings per plot and averaged; measured in summer 2016

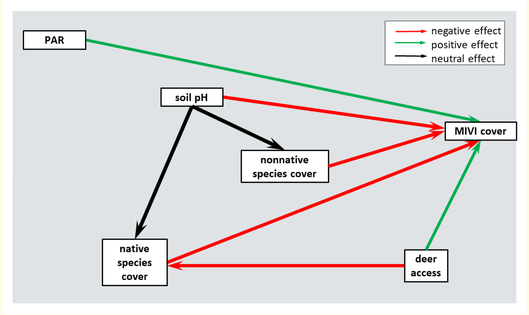
SEM

- Initial conceptual model as in **Figure 1**
- Paths were removed and added in an iterative process to explain the most variation in *M. vimineum* percent cover

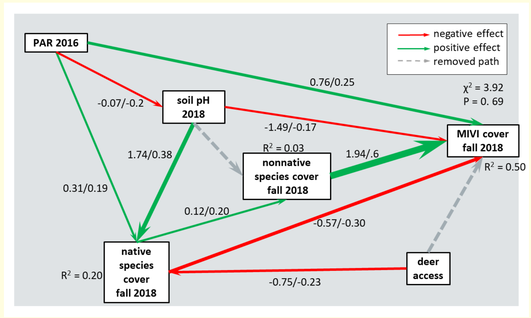
Developing an SEM

As a C_4 grass, we hypothesized that *M. vimineum* would depend on PAR, and it is known to prefer acidic soils, so we expected an effect of soil pH. Furthermore, we thought non-native and native species cover would negatively affect *M. vimineum*, as it physically cannot take up space that is not available. We also thought soil pH would affect both native and non-native species cover. Additionally, we predicted that deer access would negatively affect native species cover, as we already know that white-tailed deer (*Odocoileus virginianus*) are at high density in the region, and they notoriously eat the leaves and young stems of native species, ultimately diminishing native species cover. Deer are also thought to facilitate *M. vimineum* invasion.

The initial conceptual model:



Results



The final iteration of the SEM. Grey, dotted arrows indicate paths from the conceptual model that turned out to be nonsignificant. Values on arrows indicate unstandardized/standardized path coefficients.

Microstegium vimineum plant (left); invaded herb layer (right)

Discussion

- *M. vimineum* was not dependent on physical availability
- Invasional meltdown theory: More nonnative species in an area made it easier for the new species, *M. vimineum*, to invade
- This study used percent cover rather than species richness:
  - In plots with more nonnative than native cover, a few nonnative species dominated
  - Implies more open niches for *M. vimineum* to exploit
- Deer-mediated disturbance positively affected *M. vimineum* success via a reduction of native cover
  - Managed deer hunting may offer ecosystem-level management by its positive effect on native species
  - R^2 for nonnative species was very small → other factors should be considered
- Nonnative species may have wider tolerance of soil pH variation, with native species more dependent on higher pH

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