Canopy Assessment & Niche Modeling of Populations of *Microstegium vimineum* (Trin.) A. Camus in Lilley Cornett Woods

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Introduction

Invasive species are a threat to native plant diversity in a wide array of plant communities, including intact old-growth forests. Invasions may alter the ecosystem dynamics for species that rely on edible herbaceous material and pollinators access to variety of nutrition sources. *Microstegium vimineum* (Poaceae), is native to China and was introduced to Tennessee in 1919. Since then, it has invaded much of the eastern United States. *Microstegium vimineum* is of particular concern to land managers because it is both shade tolerant, allowing it to persist in forest understories, and more tolerant to hot sunny conditions than most native vegetation due to its use of the C4 photosynthetic pathway. In this study, efforts were focused on assessing the canopy conditions of populations in an old-growth forest due to field observations of higher coverage of *M. vimineum* in canopy gaps and findings in Cole 2003. Following data collection, preliminary outputs on the niche modeling program Maximum Entropy (MexEnt) were created to access the current habitat suitability for *M. vimineum* in the Northeastern United States.

Methods

In June and July of 2019, research was conducted in the Shop Hollow portion of Lilley Cornett Woods, an old-growth, mixed mesophytic forest in Letcher County, Kentucky. The area was first scouted to identify 41 areas infested with *M. vimineum*. We then established four meters by four meters ($16m^2$) plots in these locations to measure the percent coverage of *M. vimineum*. All plots were split into 16, 1 meter by 1 meter subplots for more accurate assessment. The cover classes used were a modified Braun-Blanquet scheme and were the following: <1%, 1-4%, 5-9%, 10-25%, 26-50%, 51-75%, 76-91%, 92-96%, 97-99%, >99% (Adams & Engelhardt 2009). To measure canopy openness, the DX ED Fisheye lens was equipped to a Nikon D7200 and then the picture was taken at the center point of each subplot that had the highest coverage class. When there were two or more subplots with an equal coverage class, canopy openness over each subplot was averaged to create a single coverage value for each plot. The picture was then processed using ImageJ with the Hemispherical 2.0 plugin, which calculates a ratio between non-sky and sky pixels. At the end of the field assessments, *M. vimineum* at fourteen of the plots was hand removed for a biomass analysis.

When completing the preliminary niche models, 1824 GPS coordinates of occurrence data of *M. vimineum* from GBIF and iDigBio were used along with the GPS coordinates of the plots used in this study. The environmental variables used were: temperature seasonality, elevation, precipitation of warmest quarter, mean temperature of coldest quarter, slope, precipitation of driest month, mean temperature of direst quarter, and soils. These were selected from previous models ran and removing variables that had less than a 1% affect on the overall output.

All data analyses and linear regressions (except for the niche modeling) were processed in R (Version 3.6.1) and RStudio (Version 1.2.1335).

Results & Discussion

The average percent coverage over all 41 plots was 25.0% and the average percent openness of the canopy was 10.989%.The average per plot biomass of *M. vimineum* was 45.1g. Three linear

regressions were fit between the three measured field variables (percent coverage, canopy openness, and biomass). The two linear regressions between canopy openness vs. biomass and canopy openness vs. percent coverage were both not significant ($p<0.05$). This result, however not statistically significant, is biologically significant because based on the aforementioned results, canopy openness does not have an impact on the growth of *M. vimineum*. These results add to the previous studies that have deemed the species shade tolerant. The relationship between the percent coverage and biomass was, highly significant ($p=0.002$, Figure 1).

Figure 1. Graphical representation of linear regression between percent coverage (%) and biomass (g).

The niche model shows that in general, the distribution concurs with previous studies and research on the distribution of *M. vimineum* (Figure 2).

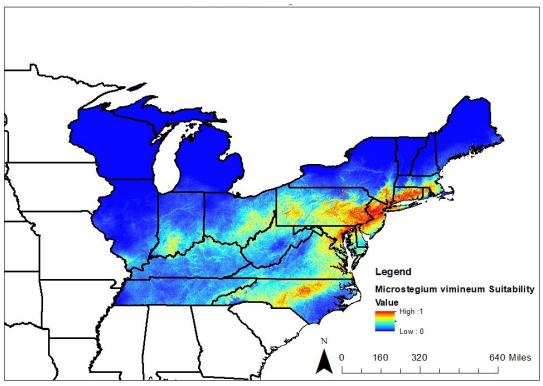

Figure 2. Ecological niche model of *M.vimineum* in the Northeastern United States.

However, nearly all the counties in Kentucky and Tennessee have documented records of *M. vimineum* and the niche model does not reflect this. This may be due to the lack of occurrence data from the areas. To address this, more models will be run on the state level so there can be a more accurate representation of the actual habitat suitability of the species and to take in account the sampling biases (Elith et. al. 2011).

Conclusions

Field assessments support the categorization of *M. vimineum* as a shade tolerant species. This should encourage land managers to enforce measures to decrease or eliminate *M. vimineum* from the area. The niche model, while only looking at presence data, implies a larger distribution and spread of the invasive grass especially in states with few counties lacking a documented presence of *M. vimineum*. In the future, a distance between the plots and a means of dispersal (stream, road, trail) will be conducted to see if the recreation in the forest is having an effect on the current distribution in the forest, which was found in Cole & Weltzin 2004. Also more models on MaxEnt will be run to calibrate and create a more precise output especially for Kentucky.

References

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