Deer pressure in suburban/exurban forests and its relation to deer browse on invasive plants

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Introduction

Increasing levels of anthropogenic activity over the last century have led to dramatic changes in land use. Farmlands and large forests have transformed into residential/commercial areas, resulting in the proliferation of small, fragmented forests. Combined with the loss of natural predators and limited hunting this has resulted in overabundant populations of white-tailed deer. Additionally, invasions of non-native plants have redefined these small-forest plant communities.

Deer may avoid unpalatable invasive plants, which may help account for their success. However, some research also suggests that deer do eat these plants when other vegetation is scarce. In this case, deer may even disperse invasive plants’ seeds. It is important to better understand the relationship of overabundant deer populations and invasive plants in order to prevent and halt further forest degradation.

We investigated whether deer feed on two important invasive species of the eastern temperate deciduous forest, garlic mustard (Alliaria petiolata, ALPE) and Japanese stiltgrass (Microstegium vimineum, MIVI). We conducted the study in 12 second-growth, small forests in central New Jersey, where we related the level of deer herbivory to the species’ abundances and the intensity of deer pressure.

To be able to do this, we first investigated three methods of measuring deer pressure, since accurate quantitative measures of deer density and pressure are difficult to make within fragmented forests in suburban/exurban landscapes.

Methods

Deer Pressure

Deer density (per group) = (deer count during the group survey) / (length of survey time (in min))

Deer browse (per group) = (deer count during the browse survey) / (length of survey time (in min))

Deer herbivory (per group) = (deer count during herbivory observations) / (length of survey time (in min))

To estimate deer density, species' abundance and herbivory, we conducted surveys in 12 small, second-growth forests in central New Jersey. The study was conducted in the spring, summer, and fall of 2010.

Deer density was estimated using the per group survey method, which involved counting the number of deer in each group for 5 min.

Deer browse was estimated using the per group browse survey method, which involved counting the number of deer browsing in each group for 5 min.

Deer herbivory was estimated using the per group herbivory survey method, which involved counting the number of deer browsing in each group for 5 min.

Results

Deer density was estimated using the per group survey method, which involved counting the number of deer in each group for 5 min.

Deer browse was estimated using the per group browse survey method, which involved counting the number of deer browsing in each group for 5 min.

Deer herbivory was estimated using the per group herbivory survey method, which involved counting the number of deer browsing in each group for 5 min.

Discussion

Deer density, species' abundance and herbivory were all positively correlated with each other.

Conclusion

Deer density, species' abundance and herbivory were all positively correlated with each other.

References

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Fig. 1: Example small, invasive species growing by roadside. The characteristic fringed end of the leaf is due to a defect resulting from the shoot bending and passing through the leaf stalk at various heights.

Fig. 2: A group of deer feeding on Microstegium vimineum (MIVI) and Alienled Petal Group Survey (FAR) in the forest.

Fig. 3: A group of deer feeding on Japanese stiltgrass (Microstegium vimineum, MIVI) and Alienled Petal Group Survey (FAR) in the forest.
The six forests exhibited a high degree of variation in deer pressure, but the patterns among the forests were not identical across the three types of measures. For example, the FPR proxy for deer density indicated that Eames and Baldpate had the highest deer densities (Fig. 4), but they differed greatly in the percent cover of foliage in the shrub layer (Fig. 6). Also, it may be expected that forests with high deer density should have higher browse intensity, comparison of the pellet data of Fig. 4 with the browse data of Fig. 5 show the opposite pattern.

Discussion

Assessment of deer pressure measures – Forests with high levels of historical deer browse generally also exhibited high levels of current deer browse. The deer pellet surveys did not mirror this pattern, and our calculated estimates of deer density based on pellet group surveys were much lower than those using larger-scale methods such as aerial counts. Thus, we conclude that deer pressure estimates based on pellet surveys in small suburban forests are not accurate. Shrub cover reflects chronic deer pressure, is similar to the pattern shown for current browse, and also yielded the greatest variation among forests that had clearly visible browse lines (Fig. 10). For these reasons, we chose it for the study of deer browse on MIVI and ALPE.

Deer herbivory on MIVI and ALPE – Forests within the suburban matrix are differentially affected by deer. In 12 forests, mean vertical shrub cover ranged from 0.57% to 9.83%. These forests typically also harbor large populations of multiple invasive species such as garlic mustard (ALLP) and Japanese stiltgrass (MIVI). We observed deer herbivory on both in all forests, which challenges the assumption that deer avoid these species.

Herbivory was more common and intensive in MIVI stands than ALPE stands. MIVI stands were also more abundant. Both species possess characteristics that should repel herbivores (ALPE’s plant chemistry and MIVI’s tough, fibrous tissue), but deer appear to be deterred more by ALPE. This suggests a possible role for deer during co-invasion; with a more negative effect on stilt-grass they may promote garlic mustard invasion.

A simple model that includes the inter-related effects of shrub cover and ALPE and MIVI abundance explained a much greater amount of the variation in ALPE herbivory among forests than did it variation in MIVI herbivory. The models show that deer more readily turn to ALPE where native plant biomass is scarcest and ALPE is more abundant. For MIVI herbivory, the models suggest the opposite: the information why is there a positive path from ALPE abundance to deer herbivory on MIVI, and what other, yet unexplained factors are also important?