

The effect of deer exclosure on juvenile native tree cover in northeastern American suburban forests



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Abstract

Increased deer pressure decreases abundance of native vegetation in forest plant communities. Additionally, generalist herbivores such as white-tailed deer can change the composition of woody species. These effects may be enhanced when deer are present at high densities. Fragmentation of forests in suburban areas has consequences for deer populations as well as the structure of the plant communities. Juvenile tree cover is an important indicator of the health of a forest, as it will eventually occupy the future canopy. We examined the change in percent cover from 2012 to 2018, with and without deer exclosures, in forests with higher and lower deer pressure, to determine if these factors had an interactive effect on native juvenile tree recruitment. In Rosedale Park, a forest with higher deer pressure, the fenced plots experienced a 12-fold increase in native juvenile tree cover compared to the open plots. However, in Nayfield Preserve, a lower deer pressure forest, the difference between the open and fenced plots was negligible. Analysis of the four other study sites showed variation in their responses to the fencing treatment due to other factors besides deer pressure.

Introduction

White-tailed deer (*Odocoileus virginianus*) browse many native plant species. Previous studies have shown that by excluding deer and therefore minimizing herbivory, native species can flourish over time (e.g. Tanentzap et. al. 2009; Bourg et. al. 2017). Deer populations have been curbed by hunting in some forests, however, due to eradication of their natural predators and very limited hunting, deer populations are typically very large in suburban woodlands. Using data from a six-year deer exclosure study, we investigated the native juvenile tree community to determine its percent cover change over time with prolonged deer exclusion. We hypothesized that the change in native tree cover from 2012 to 2018 would decrease more in forests with higher deer pressure, and would increase in exclosures due to protection from deer herbivory. The fate of native juvenile communities is central to maintaining forest health and conserving biodiversity across an increasingly urbanizing region.

Methods

This project is part of a six-year experiment in six suburban forests in central New Jersey with varying levels of ambient deer pressure. We investigated three forests with lower deer pressure - Herrontown Woods Arboretum, Nayfield Preserve, Baldpate Mountain - and three with higher deer pressure - Eames Preserve, Rosedale Park, and Curlis Lake Woods. These forests each had 32 - 40 16 m² plots, and half of the plots were randomly assigned to a deer exclosure fencing treatment in early 2013. Percent cover of all juvenile tree species in the herbaceous layer was measured in the late summer/early fall of 2012, prior to treatment, and then at the same time of year in 2018. Percent cover was estimated for each species in 16 0.25 m² quadrats per plot, which was then used to calculate the plot average. We compared fenced and nonfenced plots for the change in total tree species cover from 2012 to 2018 in the six forests with a two-way factorial ANOVA (done in SAS 9.4).

Results

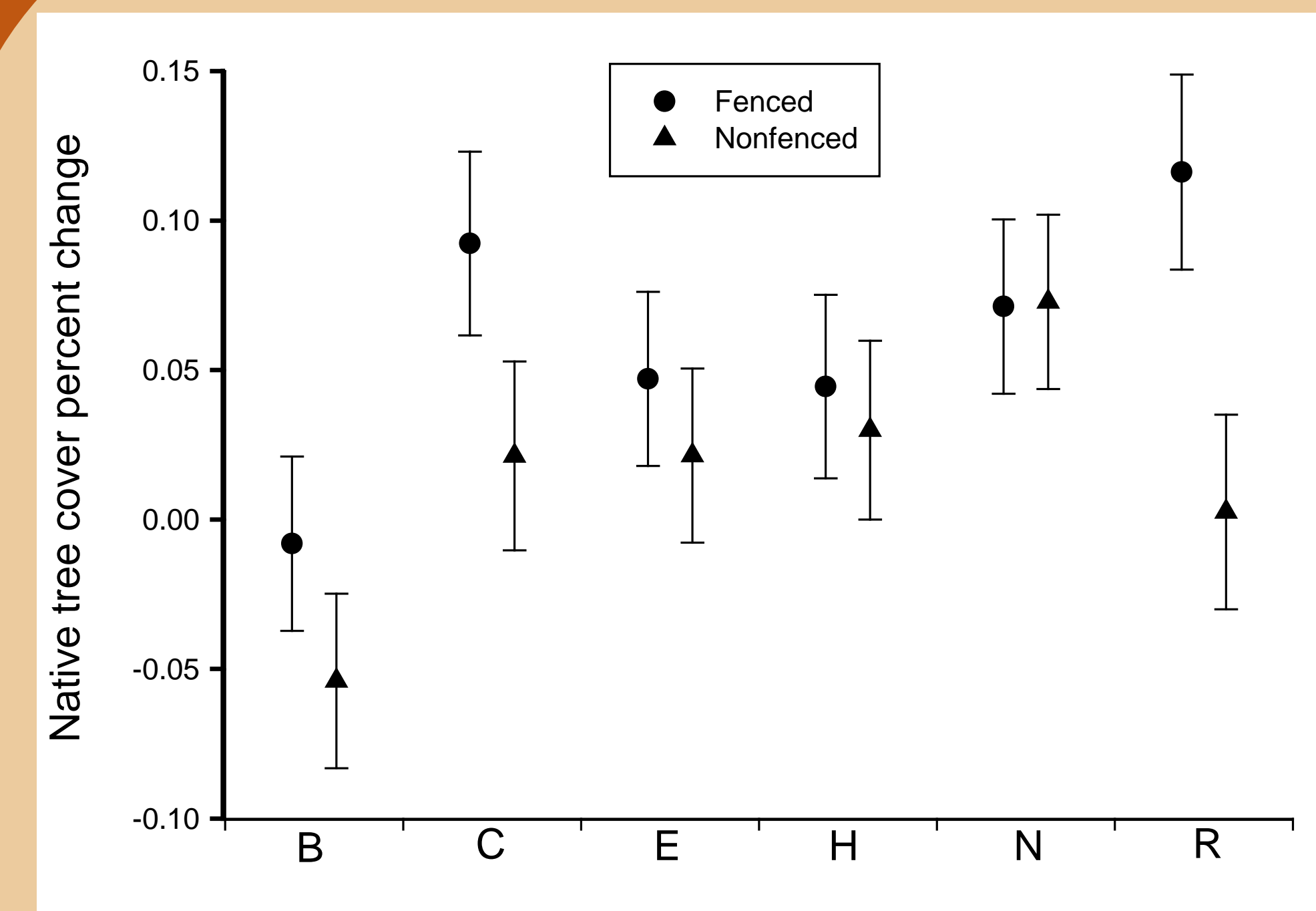


Figure 1. Change of native tree cover in 2012 and 2018 in fenced and nonfenced plots (n = 16 to 20) in Baldpate, Curlis, Eames, Herrontown, Nayfield, and Rosedale.

| source of variation | DF | MS | F | P |
|--------------------------------|-----|-------|-------|----------|
| forest site | 5 | 0.265 | 12.15 | < 0.0001 |
| fencing (fenced vs. nonfenced) | 1 | 0.112 | 25.59 | <0.0001 |
| forest x fencing | 5 | 0.015 | 3.53 | 0.0044 |
| error | 212 | | | |

Table 1. Two-way analysis of variance of change in proportion juvenile tree cover from 2012 to 2018 in fenced and nonfenced plots, in six forest sites in suburban New Jersey.

- There was a significant interactive effect on the change of native tree cover between fencing and study site
- Across the six forests, the effect on juvenile native tree cover consisted of an increase of growth after treatment or remained unchanged.
- Rosedale and Curlis had a larger change in native tree growth after treatment with deer exclosure.
- Rosedale had a 12-fold increase in the change of native tree due to the exclosure of deer.
- The change of native tree cover between fenced and open plots in Nayfield and Herrontown was negligible

Discussion

Imposing a fencing treatment strongly increased the change in native juvenile tree cover in several of the forests, but not all. These forested parcels are within only 2.3 - 21 km of each other, in a region with a high deer density of 32/km², yet they exhibited a wide range of responses to protection from deer. This variation appeared to be only partially explained by deer pressure. We had hypothesized that the forests we had identified as having higher deer pressure would exhibit greater increase in juvenile tree cover with fencing, and this was clearly the case in two of those three forests, Rosedale and Curlis; however, Eames failed to show a prominent change. In fact, juvenile tree cover appeared to increase more in a lower deer-pressure forest that also has the longest history of managed hunting, Baldpate, than it did in higher-pressure Eames. As expected, the exclusion of deer from lower-pressure Nayfield and Herrontown had minimal influence on the success of native juvenile trees. This suggests that deer, though an important driver of tree species success, are only one of the factors that need to be considered to help explain the variation in change of native juvenile tree cover over time. The results point to the need to for more complex models that include seed sources, the other herb layer vegetation, light levels, soil factors (pH, moisture), and non-deer natural enemies.



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