Deer Browse, Pennsylvania Sedge, and Silviculture Strategies to Enhance Tree Regeneration

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Abstract.—Complex interactions between heavy deer browse and plant response have resulted in structural and compositional changes in forest ecosystems. Sedge dominance and poor tree recruitment have been documented in northern hardwood stands across Wisconsin and Michigan. This study explores interactions of Pennsylvania sedge dominance and deer-browse impacts in northern hardwood forests with adaptive management strategies designed to enhance tree regeneration. We evaluated the immediate effects of several common silviculture site preparation techniques implemented in a recently harvested northern hardwood stand managed by Oneida County Forestry in Wisconsin. In 2004, we compared data characterizing this forest community before harvest and up to 15 growing seasons after implementation of the silvicultural treatments. Data collection included tree regeneration, herbaceous plants, and Pennsylvania sedge cover.

INTRODUCTION

Land use, deer management practices, mild winters, and other factors have contributed to unprecedented high deer densities in Wisconsin. Sustained deer browsing has significant negative impacts on forest herbs, tree recruitment, and forest vertical structure. However, there are some species that deer avoid, such as certain ferns, grasses and sedges, and some shrubs. The native Pennsylvania sedge (*Carex pennsylvanica*) has increased dramatically in some northern Wisconsin and Upper Michigan forest stands as deer browse pressure increases. The absence of northern hardwood regeneration with the dominance of Pennsylvania sedge is a growing concern among forestry professionals in Wisconsin.

Pennsylvania or yellow sedge is a native, low-growing, rhizomatous sedge occurring in clustered, persistent tufts. It is found in almost every state within the eastern United States. Pennsylvania sedge is readily found in northern Wisconsin and commonly present in northern hardwood understory. In some forest stands, it dominates the understory while hardwood regeneration and most other forest herbs are absent. There are very few studies on the complex interaction of sedge dominance, though some have documented possible causes including deer herbivory, exotic-earthworm invasion, and past forestry practices (Powers et al. 2009).

This study observes the silvicultural treatments used to control sedge dominance in an 80-acre northern hardwood stand in the Oneida County Forest. Past management history in this 90-year-old stand consisted of previous intermediate harvest treatments. The terrain is rolling moraine with sandy loam soils. The stand composition is predominately sugar maple (*Acer saccharum*), basswood (*Tilia americana*), white ash (*Fraxinus americana*), and northern red oak (*Quercus rubra*) with some hemlock (*Tsuga canadensis*), balsam fir (*Abies balsamea*), white pine (*Pinus strobus*), white birch (*Betula papyrifera*), and aspen (*Populus* spp.). There are two to three size classes and average tree diameter is approximately 15 inches with pole timber and very few tree

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seedling, saplings, and understory herbs. Pennsylvania sedge was the dominant understory vegetation. During winter of 2004–2005, an even-aged thinning with gaps was implemented leaving a residual basal area of 90 square feet and included 60-foot canopy gaps, one per acre throughout the stand. In early summer 2005, a variety of site preparation treatments were conducted in the gaps. Approximately 10 or more gaps per treatment were selected. Herbicide treatment was implemented using a variety of herbicide combinations to control the sedge (i.e., Oust® [Bayer Environmental Science], Velpar® [Bayer Environmental Science], Diuron [Alligare], and Plateau® [BASF]). The prescribed fire treatment was attempted in early spring but the sedge's resistance to ignition made burning difficult. Blade scarification was implemented in the gaps with a bulldozer. The ground was carefully scraped to set back the sedge mat and expose mineral soil. The last treatment was a combination of blade scarification and herbicide in the gaps. Five deer exclosures were also established by installing an 8-foot plastic fence placed along the periphery of each 60-foot gap, one per treatment.

The sedge cover was evaluated in each gap before and after treatment. Sedge cover was estimated on each plot per treatment and assigned a value from 0 to 4 (i.e., 0 = no sedge cover; 1 <25 percent cover; 2 = 25 to 50 percent cover; 3 = 51 to 75 percent cover; 4 = 76 to 100 percent cover). These results were assessed for the adequacy of the treatment. In this study, we observed that a sedge cover rating of 50 percent or more is significant coverage, eventually dominating the site. All plots had 75 percent or more sedge cover before treatment.

Tree regeneration data were collected in each gap to assess the species and adequacy of established regeneration. Erdmann's recommendation (i.e., having a minimum of 2,000 to 5,000 seedlings per acre where above 3 feet tall; Erdmann 1986) was used to gauge regeneration adequacy in this project.

RESULTS

The results in this report represent vegetation response after harvest and site preparation treatments monitored from 2005–2021.

Sedge Cover

The herbicide and herbicide/scarification treatments were the most successful by initially reducing the sedge to less than 50 percent cover. Although several herbicide combinations were tested, the herbicide Oust XP (1 oz/acre) was the most successful at reducing the sedge mat. The prescribed burning treatment was not successful since the sedge is somewhat fire resistant. The blade scarification treatment was not successful since it was difficult to break up the sedge mat. When we returned to the site in 2021 (15 years after the treatment) all sedge cover had returned to >75 percent throughout the stand.

Tree Regeneration

The results indicate that over half of herbicide and herbicide/scarification treatment plots initially had good to very good regeneration (>2,000 stem/acre). More white ash (*Fraxinus americana*) stems established on the control plot and more sugar maple (*Acer saccharum*) on the herbicide plots. By spring of 2010, most established regeneration in the plots surpassed browse height of 5 feet. However, the 2021 inventory data indicated lower stocking densities across all treatments (Fig. 1). Deer herbivory on seedlings and saplings was evident.

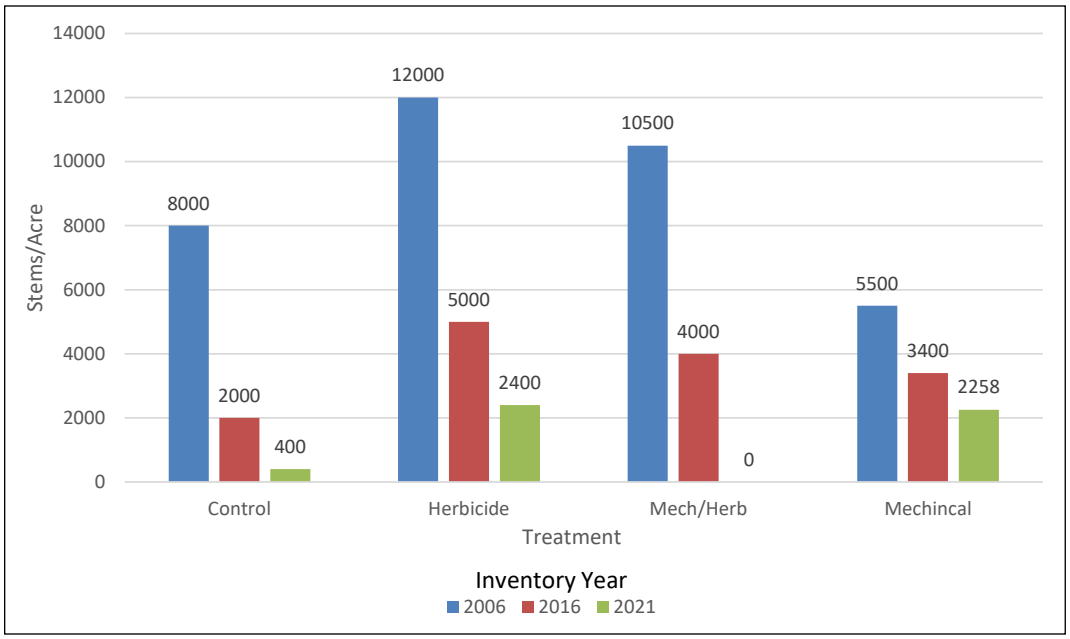

Figure 1.—Tree regeneration by treatment and year.

Deer Exclosures

Each of the five deer exclosures represented a different treatment including control, fire, herbicide, blade scarified, and no treatment/no harvested canopy gap. The herbicide treatment was most successful at reducing the sedge and had the most seedlings (i.e., 18,000 seedlings per acre). All fenced treatments had more than adequate regeneration (i.e., >5,000 seedlings per acre). The herbicide treatment had predominantly sugar maple and white ash seedlings. The blade scarification treatment had abundant white birch (*Betula papyrifera*) seedlings, however, many weedy species such as raspberry, mullein, and thistle were present. By 2010, seedling height in all fenced areas ranged from 5 to 8 feet for sugar maple and white ash. In the area that was not fenced, tree seedlings remained 1 to 2 feet high and were heavily browsed. By 2015, fences were removed, and most saplings previously fenced exceeded 20 feet high. When we returned in 2021, the established tree regeneration in the gaps surpassed browse height but surrounding vegetation was browsed.

DISCUSSION

Our results in this project suggest an interaction between deer herbivory contributing to a reduction in tree regeneration. Two years after harvest, tree regeneration in the fenced gaps was abundant and successfully grew through the sedge. This observation suggests deer browse is a significant factor in reducing tree regeneration, understory herbs, and indirectly allows sedge dominance. Under high browse, deer can exclude understory vegetation while some species such as ironwood and sedge flourish.

Though observation continues, our results suggest that the herbicide treatment was effective at hastening sedge in the short term while allowing the establishment of tree regeneration. One recommendation is to apply a fall herbicide application to minimize mortality of understory plants and optimize plant diversity. Broadscale application of herbicide might be logistically and economically difficult. Instead, small patch treatment would allow opportunity for regeneration to establish a good tree-seed crop.

Ensuring adequate levels of regeneration in northern hardwood forests may require development of strategies that address complex interacting factors. Adopting silviculture systems that consider thorough site assessments, structural considerations, limiting deer densities, and reducing Pennsylvania sedge may be necessary to meet management objectives. More experimental silviculture trials are needed to determine how these factors continue to alter structural and compositional changes in northern hardwood forest ecosystems.

ACKNOWLEDGMENTS

Labor, logistics, and support for this project was provided by Oneida County Forestry and Wisconsin Department of Natural Resources–Division of Forestry. Special thanks to Emanuel Oradei, Paul Feine, Joe Renik, Tom Piikkila, Michael Ard, Michigan Technological University graduate student Matt Powers, and forestry Professor Linda Nagel.

LITERATURE CITED

Erdmann, G.G. 1986. **Developing quality in second-growth stands**. In: Mroz, G.D.; Reed, D.D., eds. A conference on the northern hardwood resource: management and potential [conference proceedings]; 1986 August 18-20. Houghton, MI: Michigan Technological University: 206–222.

Powers, M.D.; Nagel, L.M. 2009. **Pennsylvania sedge cover, forest management and deer density influence tree regeneration dynamics in a northern hardwood forest.** Forestry: An International Journal of Forest Research. 82(3): 241–254. https://doi.org/10.1093/forestry/cpp003.

CITATION: Matula, Colleen; Feine, Paul; Oradei, Emanuel. 2023. **Deer Browse, Pennsylvania Sedge, and Silviculture Strategies to Enhance Tree Regeneration.** In: Kern, Christel C.; Dickinson, Yvette L., eds. Proceedings of the first biennial Northern Hardwood Conference 2021: Bridging science and management for the future. Gen. Tech. Rep. NRS-P-211. Madison, WI: U.S. Department of Agriculture, Forest Service, Northern Research Station: 61–64. https://doi.org/10.2737/NRS-GTR-P-211-paper15.