Alternative Silviculture Treatments and the Influence on White-tailed Deer Behavior

M.D. Starking and G.J. Roloff[1]

INTRODUCTION

Conflicts between herbivores and forest management vary depending on region and forest type. In northern hardwood forests of the north-central United States, high herbivore abundances, specifically white-tailed deer (*Odocoileus virginianus*), often cause problems by limiting tree stocking and regeneration of diverse tree species. Beginning in 2017, a collaboration between the Michigan Department of Natural Resources, Michigan State University, and forest industry partners began testing alternative silviculture in northern hardwood forest types across the state. Foresters and wildlife biologists developed a long-term, large-scale manipulative research project. We compartmentalized Michigan into three regions: eastern Upper Peninsula (EUP), northern Lower Peninsula (NLP), and western Upper Peninsula (WUP). We randomly assigned overstory (i.e., shelterwood, seed tree, larger group/patch cuts, and single tree/small group selection) and understory treatments (i.e, herbicide/scarification, and leaving treetops) to 12.14 ha forest stands (n = 140). A randomly chosen subset of these stands (n = 48) were used for detailed wildlife monitoring with a focus on white-tailed deer occupancy, residence time, and behavior such as movement. Questions we asked included (1) how does leaving piles of treetops (i.e., leave tops) as an understory treatment influence deer movement and browsing behavior, and (2) how well do these leave tops act as a barrier to herbivory. To promote regeneration of diverse northern hardwood species in areas with high-deer impacts, it is vital to understand the effects of silviculture methods on deer behavior and how interactions between forest management and wildlife management can work together toward sustainable ecosystem management.

METHODS

Deer movements were recorded through sites with leave top treatments December 2020 to March 2021 using snow-tracking surveys. A pair of observers would navigate the edge of the 12.14 ha treatment site until they walked the entire perimeter. If they encountered deer tracks in the snow, they would record a GPS track following the deer trail. Observers would follow the deer trail through the site until it was lost or until the deer exited the site. Along the route, observers collected depth of snow (cm) at the beginning, at any leave top encountered, and at the end of the trail. When a deer encountered a leave top, observers recorded the height (cm) of the tallest piece of wood if the deer traveled through the leave top or if the deer changed direction. A change in movement direction indicated a leave top successfully altered the movement path, potentially prohibiting deer from accessing browse within the leave top.

Generalized linear regression models with a negative binomial distribution predicted variables that influenced whether deer moved over or through leave tops or resulted in a change of direction. Variables included leave top height (cm), region (EUP, NLP, WUP), snow depth (cm), and overstory treatment. Because some sites were visited more than once, we included an offset

[1] PhD Candidate (MDS), and Professor (GJR), Michigan State University, East Lansing, MI 48824. MDS is corresponding author: to contact, email szyman87@msu.edu.

in the model to account for number of visits to each site. We produced 10 candidate models and identified the top-ranking using Akaike information criterion (AIC). We deemed model parameter estimates with 95 percent confidence intervals that did not include 0 as significant.

RESULTS

Four different observers visited 26 leave top sites with an average of three visits per site over the winter of 2020–2021. Each observer recorded an average of three deer trails per site visit. Along recorded deer trails, observers recorded 546 leave tops encountered by deer. The average snow depth during site visits was 20 cm. Average leave top height was 68.9 cm with average deer movements going over or through tops that were ≤50 cm tall; taller tops served as barriers to movement and caused a change in movement direction.

Our top model included leave top height (cm), region, and snow depth (cm). Leave top height significantly affected deer movements, and this effect was different between the NLP and EUP. Snow depth was not significant. In the Upper Peninsula of Michigan (i.e., EUP and WUP), leave tops ≤ 50 cm tall have a ≥75 percent chance of deer going over or through them. Also in the Upper Peninsula, leave tops ≥100 cm tall have ≤25 percent chance of deer moving over or through them. In the northern Lower Peninsula leave tops needed to be ≤70 cm to have a 75 percent chance or greater for deer to move over or through them. Additionally, in the NLP, leave tops ≥120 cm had a ≤25 percent of deer moving through them. Thus, taller leave tops were needed in the NLP to deter deer movements, likely corresponding to areas with higher deer abundances compared to most sites we studied in the Upper Peninsula.

MANAGEMENT IMPLICATIONS

Our results show that structure of individual leave tops influence deer movements and as a result, leave tops may prove an effective strategy for deterring deer herbivory on regenerating trees. We found that tops with more volume (i.e., >50 cm tall but <~100 cm tall) appeared to act as movement barriers. We recommend that leave tops be left intact, not be feller-bunched, and not be crushed by logging equipment to function as deer barriers. Additionally, we mapped the spatial distribution of leave tops across each site using drone imagery to understand how leave tops function across space. Preliminary results indicate that leave tops can be used to control deer movements at the site level, potentially funneling them away from tree regeneration areas like harvest gaps.

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