White-tailed deer and landscape effects on forest structure and species composition [DRAFT]

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Managing forests for multiple uses including sustained timber yield is an ecologically complex task. In northern hardwood forests over much of the eastern United States including Michigan, white-tailed deer have a huge impact on sustained yield because of browse impacts on forest regeneration.

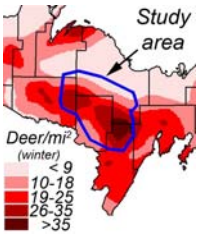

Figure 1. The study area encompasses a gradient in average winter deer density observed between 1981 and 2000. Data from MDNR spring fecal pellet counts.

Many studies have shown that when deer are excluded from forests, tree seedlings establish, grow, and become part of the forest canopy more quickly than in similar forests with deer. In exclosures (fenced areas designed to exclude deer), tree species such as eastern hemlock (*Tsuga canadensis*) and northern white cedar (*Thuja occidentalis*) survive, while they are stunted or killed by deer browse outside exclosures. Most exclosure studies contrast areas of high deer density with areas of zero deer (the exclosures), but they cannot answer the question of *how many* deer are "too many" for a number of purposes, including maintaining plant species diversity and high forest regeneration rates in managed forests. Similarly, exclosure studies are expensive, and thus limited to few exclosures and small areas. These studies are able to address detailed questions about how deer affect particular forest stands, but are less effective in explaining how highly mobile deer herds affect forest regeneration across a larger land area of hundreds of square miles.

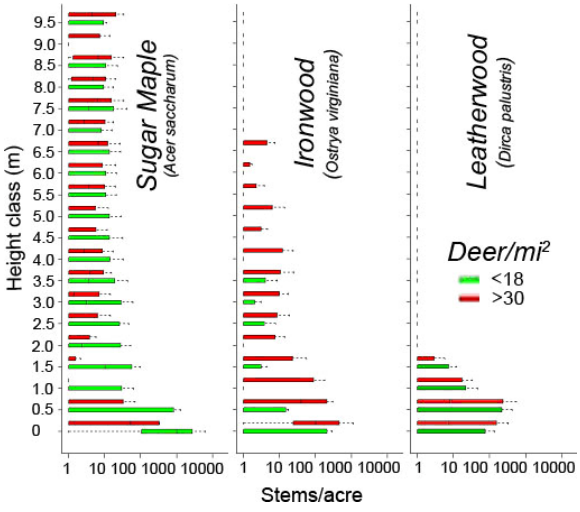

Figure 2. Stem density by height class in low vs. high deer density plots for three common understory species.

For northern hardwood stands, our study addressed the questions: 1) How does the distribution of height classes and density of tree seedlings change as deer densities change, and 2) How does the surrounding landscape affect how deer browse?

We measured vegetation structure and composition, including all vascular plants, in 453 vegetation plots across a study area in the central Upper Peninsula of Michigan (Figure 1). Northern hardwood stands accounted for 234 plots. The study area has a strong gradient in deer density, from <9 deer/mi^2 in the north to >35 deer/mi^2 in the south. We related our vegetation information to deer density information.

Our preliminary analyses indicate lower sugar maple sapling density and higher ironwood sapling density in areas that experienced high winter deer populations between 1981 and 2000 (Figure 2). Height classes that are within the reach of deer in the winter (0.25m to 1.5m tall) were the most heavily affected, with ironwood replacing sugar maple as the dominant understory sapling in high deer density plots. We also found a legacy effect of past high deer densities: In areas that have had high deer density for the past 20 years, there is a lower density of larger height classes that are above the immediate effects of deer (>2m tall). Thus, forest

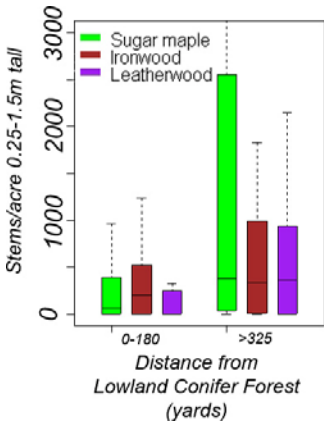

Figure 3. Stem density of 3 species in plots grouped by distance from lowland conifer forest.

structure and composition may be affected for decades by deer browse effects on young seedlings and saplings. Not all understory shrubs and trees showed as strong a response to deer density as did sugar maple and ironwood. Leatherwood, for example, showed little change in stem density in any height class (Figure 2).

The landscape surrounding northern hardwood stands also impacted stem density, presumably by providing winter habitat for deer. In particular, the distance from a northern hardwood stand to the nearest lowland conifer stand affects sapling density. As the distance from lowland conifer stands increases, the sugar maple sapling class increases nearly tenfold in density, and ironwood and leatherwood also increase (Figure 3). This may be because northern hardwood food sources nearest thermal cover habitat are exploited more heavily by deer than food sources far from thermal cover.

Finally, for the herb layer we are finding evidence of a shift in plant community composition and a decrease in plant diversity with increasing deer density. For example, median percent ground cover of sedges and grasses, which may compete with young tree seedlings for resources, approximately doubles in high deer density areas over low deer density areas (Figure 4). Median percent cover of other herbaceous species that are more palatable to deer decreased slightly over the same increase in deer density.

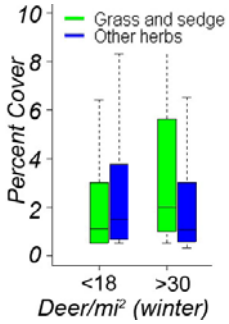

Figure 4. Herb layer cover in low- vs. high-deer-density stands.

Management Considerations

It will surprise no one that deer reduce northern hardwood regeneration rates and remove seedlings and saplings of economically valuable species. But the exact density of deer that forests can maintain without compromising plant diversity and adequate forest regeneration of desirable species is unknown. Despite the preliminary stage of our data analysis, we can offer some suggestions for forest managers. When considering a plan for harvest and regeneration:

Forest managers should be aware of local winter-time deer densities. In addition to regional estimates based on DNR pellet count analyses (e.g., Hill 2001), managers can use vegetation and location to help guide them. In areas that have been actively managed by selection methods, clues that deer densities may be high in a particular stand include some combination of low densities of trees 0.25 to 1.5 m tall, and high densities of ironwood, spruce and other less palatable species 0.25 to 1.5 m tall, *relative to* sugar maple, ash and other more palatable species. Seedling densities <0.25m can be high or low, but often most of the taller individuals will show evidence of browse. High sedge and grass ground cover under canopy or in a recent clear-cut is also an indicator of high deer density over the last 10-20 years. Finally, close proximity (<200 m) to either upland or lowland conifer forests, and especially cedar swamps, may also indicate relatively high wintertime deer densities.

In areas of high deer densities and if merchantable tree characteristics are appropriate, alternatives to single tree and small group selection systems could be considered. Larger openings, including large group selection and patch cuts often result in high densities of regeneration that “saturate” the forage demand of local deer populations. Due to greater resource availability in larger openings, regeneration grows quickly through the height range susceptible to deer (~0.25-1.5 m tall) and thus has a greater likelihood of escaping deer browsing. However, in the highest winter deer density areas even very aggressive canopy removal may not be sufficient to allow advance regeneration to escape deer browse.