Preliminary Tree Regeneration and Browsing Patterns Following Various Silvicultural Treatments in Northern Hardwood Forests

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INTRODUCTION

Many managed northern hardwood forests in northern Michigan contain low densities of desirable tree regeneration, while often simultaneously containing relatively high densities of undesirable tree species (e.g., *Fagus grandifolia* Ehrh., *Ostrya virginiana* Mill. K. Koch). Limited light availability that favors shade-tolerant species and a lack of viable germination substrate for many desirable tree species following harvest—as well as selective deer-browsing effects—likely contribute to this pattern. As a result, managers and researchers alike have been interested in testing alternative silvicultural practices that may achieve more sustainable regeneration layers. In 2017, a long-term, landscape-scale research project was established to examine how a wide range of silvicultural prescriptions (and site-level factors such as deer usage) may affect tree seedling regeneration and recruitment. Selective browsing patterns, particularly in the first few years following harvest, may play an outsized role in future tree species composition. While regeneration surveys are planned for 5 and 10 years post-treatment, earlier post-harvest surveys may elucidate patterns, particularly in browsing damage, that otherwise might have been missed. We set out to examine (1) early post-harvest stem counts and (2) interspecific deer-browsing intensity following four unique harvest types (also receiving one of two possible understory treatments) proposed for managed northern hardwood forests in Michigan. Understanding these browsing patterns may prove critical to the successful application of future harvests over a deer usage gradient.

METHODS

Data were collected on 140 30-acre research sites located in northern hardwood forests managed by the state of Michigan (~85 percent) or private industry (~15 percent) and were distributed throughout the northern Lower and Upper Peninsulas of Michigan. All sites were harvested between August 2017 and March 2018, with each site receiving one of four overstory treatments (i.e., seed tree, shelterwood, large-group selection/patch cut, or single-tree/small-group selection harvests). Mature, felled tree crowns were retained on half of the sites in order to test their effect on site-level deer usage. Seedling stem counts and data on browse availability/damage (i.e., total twigs/stem, plus total twigs browsed/stem) were collected (nine 50.24-m^2 plots per site) on trees >50 cm and <137 cm tall at each research site on 2-year-old seedling growth. This size class was chosen due to its importance in future stand composition and its current presence in the browsing zone. Pellet counts, a proxy for winter deer usage, were collected in early spring 2019 in linear transects that covered approximately 2 percent of each site.

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Generalized linear regression models with a negative binomial distribution were used to predict stem counts and total twigs browsed by species for the 15 most common species found in the study. Plot level data were aggregated to obtain a stand level estimate. Predictor variables for stem counts 2 years post-harvest included overstory treatment, understory treatment (i.e., mature felled tree crowns retained vs. removed), and preharvest stem counts (collected in 2017). Predictor variables for the total number of browsed twigs by species included overstory and understory treatments, as well as deer use (pellets/acre), available twigs of the species being modeled, and the sum of available twigs of generally palatable browse species.

RESULTS

Stem Count Results

Stem counts varied widely. Seed tree or shelterwood treatments contained higher stem counts than the single tree/small group selection treatment—the predominant silvicultural system used in this cover type—for 10 of 12 species that showed significant differences. Further, higher stem counts were found on sites in which mature, felled tree crowns had been retained following harvest (i.e, seven of eight species). Preharvest stem counts were a significant predictor for 13 of 15 species; unsurprisingly, shade intolerant *Populus* spp. and *Prunus pensylvanica* L. did not conform to this pattern.

Browsing Results

Interspecific browsing rates and browsing rate differences across silvicultural treatments were apparent. *Quercus rubra* L. experienced higher browsing rates following large-group selection/ patch cut harvests, while *P. pensylvanica* experienced higher browsing rates following seed-tree harvests; both species experienced more browsing damage on sites where mature-felled tree crowns had been removed. Six species experienced increased browsing damage as deer usage estimates increased, including *Prunus serotina* Ehrh. and *Q. rubra*. *F. grandifolia* and *O. virginiana* were browsed less as the availability of palatable twigs increased.

Across the study, conifers such as *Picea glauca* (Moench) Voss, *Pinus strobus* L., and *Abies balsamifera* (L.) Mill, as well as the deciduous *F. grandifolia* were generally avoided; all experienced browsing rates under 6 percent. *O. virginiana*, *P. pensylvanica*, and *Q. rubra* twigs were browsed at rates less than 25 percent, while a large group of species were browsed at 30 to 35 percent, including *Acer rubrum* L., *P. serotina*, and *Acer saccharum* Marsh. *Betula alleghaniensis* Britton., *Tilia americana* L., and *Ulmus americana* L. were browsed at higher rates.

MANAGEMENT IMPLICATIONS

Preliminary results suggest the implementation of alternative silvicultural systems may lead to increased densities of many desirable tree species, particularly mid-tolerant species such as *B. alleghaniensis* and *Q. rubra*, as well as other desirable tolerant (e.g., *A. saccharum*) and intolerant (e.g., *P. serotina*) species. However, recruitment rates in the face of browsing damage and competing vegetation mean that further data collection and analysis will be necessary. While *P. strobus* was not generally abundant on study sites, it is a potentially beneficial structural component of future northern hardwood forests (particularly on drier sites) that does not seem to experience high levels of browsing. *A. saccharum*, the predominant economically valuable northern hardwood, experienced relatively moderate browsing intensity, along with many other hardwoods; it remains to be seen how these browsing rates will affect interspecific tree recruitment.

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