Effects of legacy forest structure on regeneration in irregular shelterwoods in oak-hardwood forests

Forest Stand Development Through Time

Abstract
Forest managers are tasked with meeting a variety of societal demands such as wildlife habitat and aesthetic considerations, while still providing monetary value to landowners through timber harvest. Adaptive strategies such as irregular shelterwoods can offer alternatives to traditional regeneration methods that help to meet these goals. These techniques often involve diversifying age classes and leaving more standing structure in the form of legacy trees, which allows less light to the forest floor, and thus often promotes growth of shade tolerant tree species over shade intolerant species. This study examines a 25-year chronosequence of 34 irregular shelterwoods, varying in amount of structure, designed to regenerate oak in southern New England. In each shelterwood we measured all legacy trees in a 50 m radius overstory plot, and measured seedling and sapling regeneration in 18 subplots. We analyzed regeneration of the three most common species: red maple (*Acer rubrum*), black birch (*Betula lenta*), and red oak (*Quercus rubra*). We used ANOVA to compare the differences in species abundance and height across age classes, as well as to compare differences in regeneration growth based on variation in overstory basal area. Over time, self-thinning occurred in all focus species, but at different rates. Black birch thinned most drastically through time and the saplings that survived retained a high position in the canopy. Red oak self-thinned most slowly and by its third decade (19+years since harvest) began to increase in height growth above the other 2 species. As legacy basal area increased, growth of red oak slowed, with 5 m^2/ha of basal area as a limiting density. These results suggest that resource managers should consider the tradeoff between increasing legacy trees and decreases in growth of oak regeneration, as well as long-term effects of increased structure post-timber harvest.

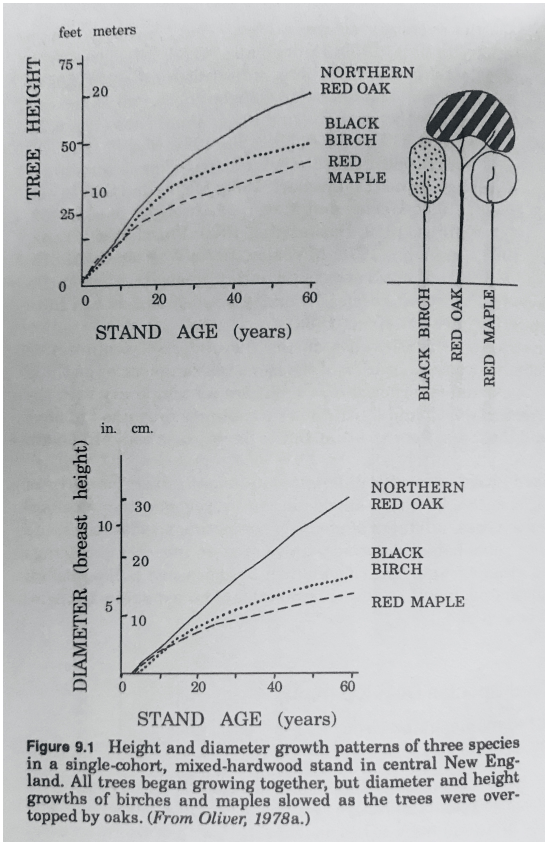

Figure 9.1 Height and diameter growth patterns of three species in a single-cohort, mixed-hardwood stand in central New England. All trees began growing together, but diameter and height growths of birches and maples slowed as the trees were overtopped by oaks. (*From Oliver, 1978*a.)

As described in *Stand Dynamics* (Oliver and Larson 1996), based off of Oliver's prior research, as the current second growth hardwood stands developed, oak outcompeted and overtopped black birch and red maple, by the time the stand was about 20 years in age.

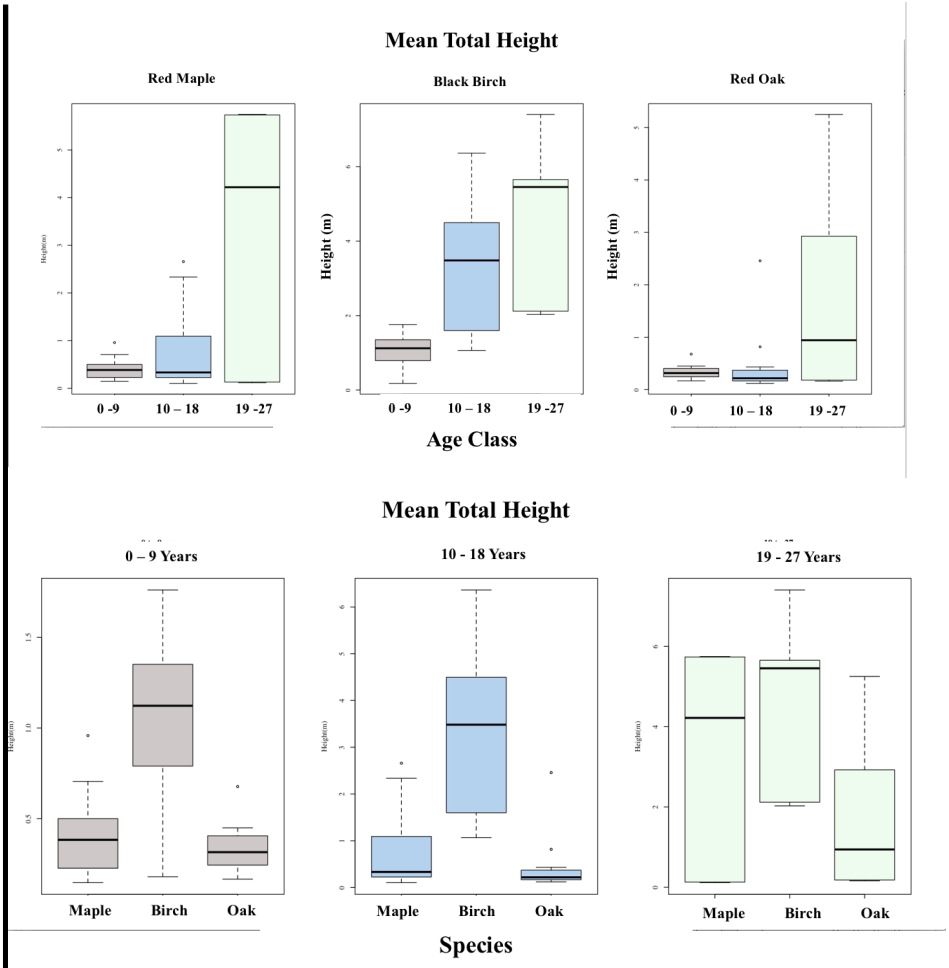

Fig. 1. Total height in meters of three dominant regenerating species in irregular shelterwood harvests. Categories are are time since shelterwood harvest, broken down as 0 - 9 years, 10 - 18 years, and 19 - 25 years. Categories approximate stand development phases of early stand initiation, late stand initiation, and early stem exclusion.

Effects of Legacy Trees on Regeneration

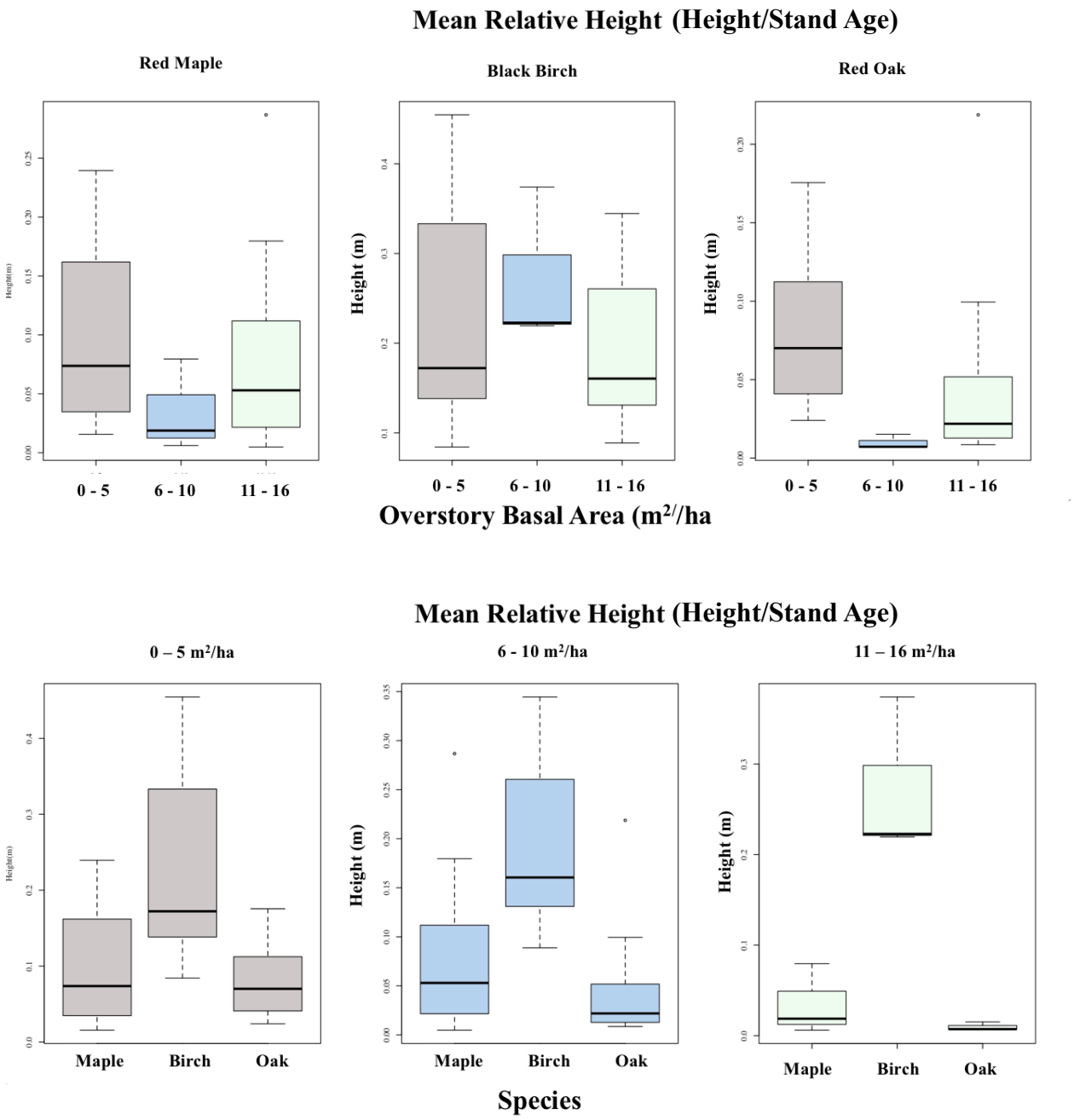

Fig. 2. Relative height (height/stand age) in meters of three dominant regenerating species in irregular shelterwood harvests. Categories are overstory basal area of legacy trees in sq. m/ha, broken down as 0 - 5 sq. m, 6 - 10 sq. m, and 11 - 16 sq. m. Relative growth rate of red oak is significantly higher in harvests with 0 - 5 sq. m/ha (0 - 22 sq. ft./ac), than in the categories with higher overstory basal area.

References:

Oliver, C.D., Larson, B.C., 1996. Forest stand dynamics, Update ed. ed. Wiley, New York.

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