Effects of timber harvesting on oak regeneration in the upland oak forests in the Missouri Ozarks

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Introduction

Oak regeneration is a vital process to sustain upland oak forests. However, lack of enough oak seedlings and saplings has been a concern in the upland oak forests in the Missouri Ozarks. Widespread fire suppression and lack of active timber management that regulate overstory are believed to be one of the major causes of oak regeneration failure (Hicks 1998).

The Missouri Ozark Forest Ecosystem Project (MOFEP) was initiated in 1989 by the Missouri Department of Conservation to examine vegetation dynamics including oak regeneration under a set of predetermined timber management scenarios. In this study we used the1990-2006 MOFEP monitoring data to evaluate the impact of timber harvesting on the composition and size structure of oak seedlings and saplings on treated sites.

Data and Methods

Three treatments: even-aged (including clear cut, intermediate cut), uneven-aged (single tree and group selection) and no harvest (control) with three replications (sites) each were included in the long-term, landscape level experimental study. In total, 648 half-acre monitoring plots were installed and measured every 3-5 years (1990, 1995,1998, 2002,2006) across the nine study sites (Figure 1). All treatments were implemented in 1996.

Reproduction population was classed into three classes: size 1 (ht>1m, dbh<1.3 cm), size 2 (1.3 cm ≤dbh<3.8 cm), and size 3 (3.8 cm ≤ dbh< 11.4 cm). Trees per hectare (TPH) of 3 sizes were calculated by inventory year (1995,1998, 2002, 2006) and 5 harvesting methods. Percentage change of reproduction of four oak species (white oak, scarlet oak, black oak, post oak) were compared between the pre-harvest (1995) and the post-harvest (1998, 2002 and 2006). MANOVA (multivariate analysis of variance) and ANOVA (analysis of variance) were used to analyze treatment effects at p = 0.05 significance level.

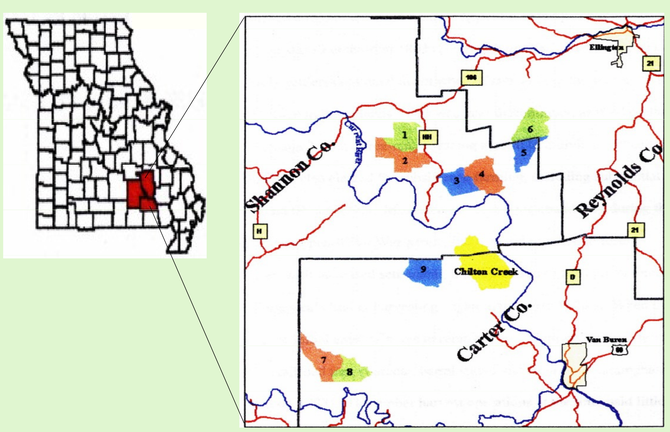

Figure 1. Location of the nine MOFEP experimental sites.

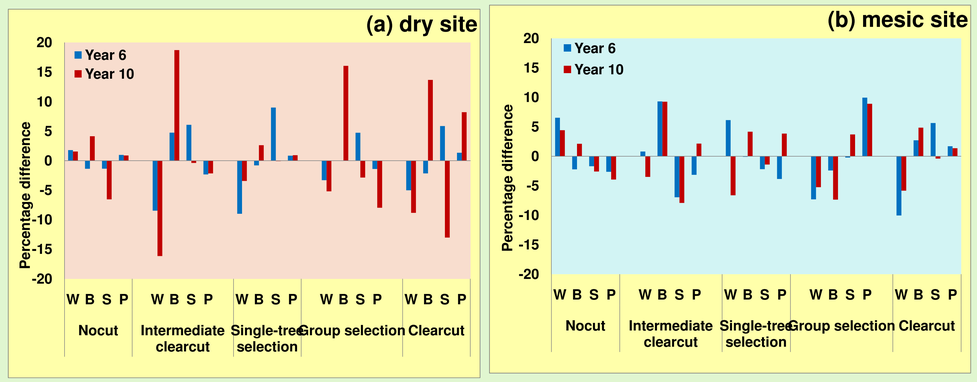

Figure 2. Difference of reproduction proportion between pre- and post-harvest of four species (white (W), black (B), scarlet (S), and post (P) oak) by year 6 and 10 in the MOFEP sites.

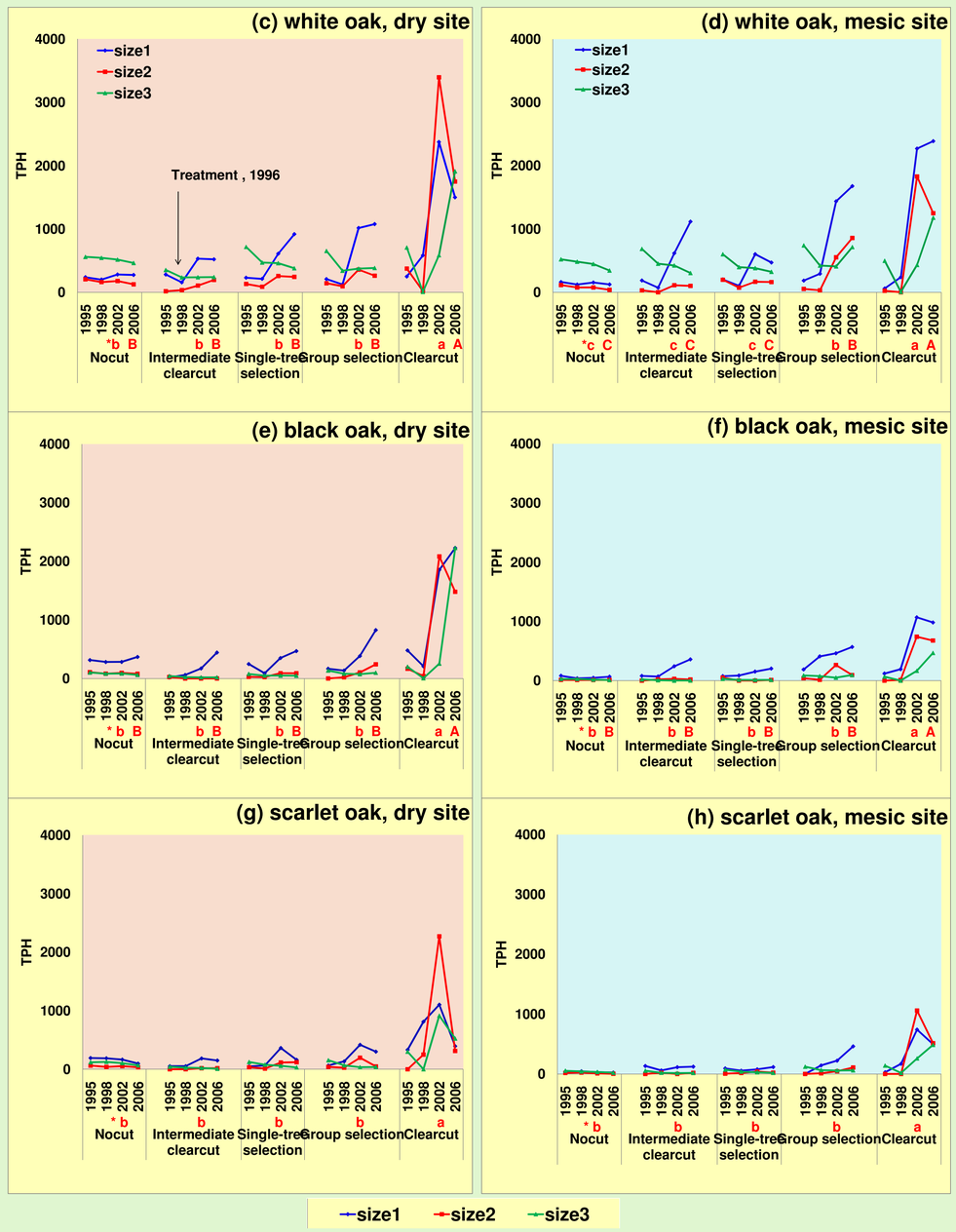

Figure 3. Change of oak reproduction density of three sizes by inventory year and regeneration methods in the MOFEP sites.

* Same lower-case letters represent means of total reproduction (sum of sizes 1, 2 and 3) density of a given species are not significantly different by year 6. Same capital letters represent that by year 10.

Results and Discussion

Compositional shift among four oak species (Fig. 2): In dry sites, indicate intermediate cut, group selection and clear cut will cause a compositional shift from white oak to black oak since each of these three methods induced a decrease to white oak but an increase to black oak. In mesic sites, intermediate cut and single-tree selection induced a shift from scarlet oak to black oak. Group selection was the only method that increased scarlet oak proportion by both year 6 and 10. Group selection also favors post oak. Clear cut led to a compositional shift from white oak to black and scarlet oak. Overall, the composition change in mesic sites was not as distinct as that in dry sites.

Change of size distribution of oak reproduction (Fig. 3) MANOVA revealed significantly different density change under the five regeneration methods among three reproduction sizes of both white oak and black oak by year 6 and year 10. For scarlet oak, a significant difference existed only by year 6 (2002). There is no significant difference for post oak all the time (not presented). For a given reproduction size of an oak species, ANOVA also suggested there exist significant differences among the five treatments.

Clearcut increased total reproduction density of white oak and black oak significantly by year 10. Compared to the no harvest treatment, intermediate cut, single-tree selection and group selection increased the proportion of size 1 seedlings of black and scarlet oak. This is true with white oak in mesic sites with either group selection or clearcut. Even though seedling and sampling density increased dramatically following the clearcut, mortality due to competition was very intensive. Six years after the treatment, seedling and sapling (sizes 1 and 2) density started to decrease.

A study is underway to examine how the five treatments will interact with other factors like residual/removed basal area and pre-treatment stand conditions to affect the composition and size structure of oak regeneration.

Major References

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