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

Qi Yao and Zhaofei Fan, Mississippi State University; Daniel C. Dey, USFS Northern Research Station, Columbia, MO
Martin A. Spetich, USFS Southern Research Station, Hot Spring, AR

Introduction

In the Ozark Highlands of Missouri, widespread oak decline and failure of regeneration has plagued the oak forests due to the long-term fire suppression and low-intensity timber management that has relatively little impact on the overstory The Missouri Ozark Forest Ecosystem Project (MOFEP) initiated in 1989 by Missouri Department of Conservation is a long-term, landscape-level experimental study. The objective of MOFEP is to evaluate the effects of timber treatments on oak forest ecosystems. In this study we use the1990-2006 MOFEP monitoring data to evaluate the impact of five timber harvest methods on oak regeneration, in terms of the change of understory oak seedlings and saplings.

Data and Methods

MOFEP data were collected in 648 plots in 9 sites that range from 772 to 1271 acres, primarily within the Current River Oak Forest Breaks and the Current River Oak-Pine Woodland Hills land type associations in the Ozark Highlands, southeast Missouri. The study design includes three timber management alternatives: even-aged, uneven-aged and no management treatment (control), each with three replications. Live and dead trees (>4.5 inches diameter at breast height (dbh)) were sampled in the 0.5-ac circular plot; saplings (1.5 inches<dbh<=4.5 inches) were sampled in four 0.05-ac circular subplots; and seedlings (<1.5 inches dbh but >1.0 m tall) were sampled in four 0.01-ac circular subplots nested within the 0.05-ac circular subplots.

Seedling density (tree per acre (TPA)) and the basal area (BA) of saplings, overstory live trees and snags of white oak group and red oak group species were calculated by inventory year (1992,1995,1998,2002,2006) and treatment (clearcut, intermediate clearcut, single-tree selection, group selection, and no harvest).

The effects of treatments on oak seedling and sapling density were compared using the analysis of covariance through the generalized linear model (GLM) procedure of SAS.

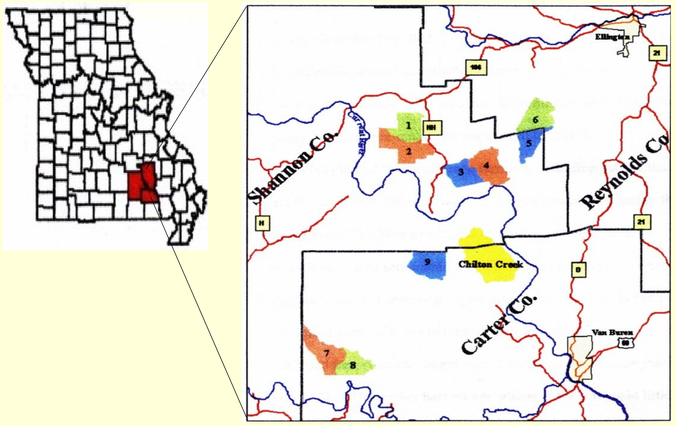

Figure 1. Location of the nine MOFEP experimental sites.

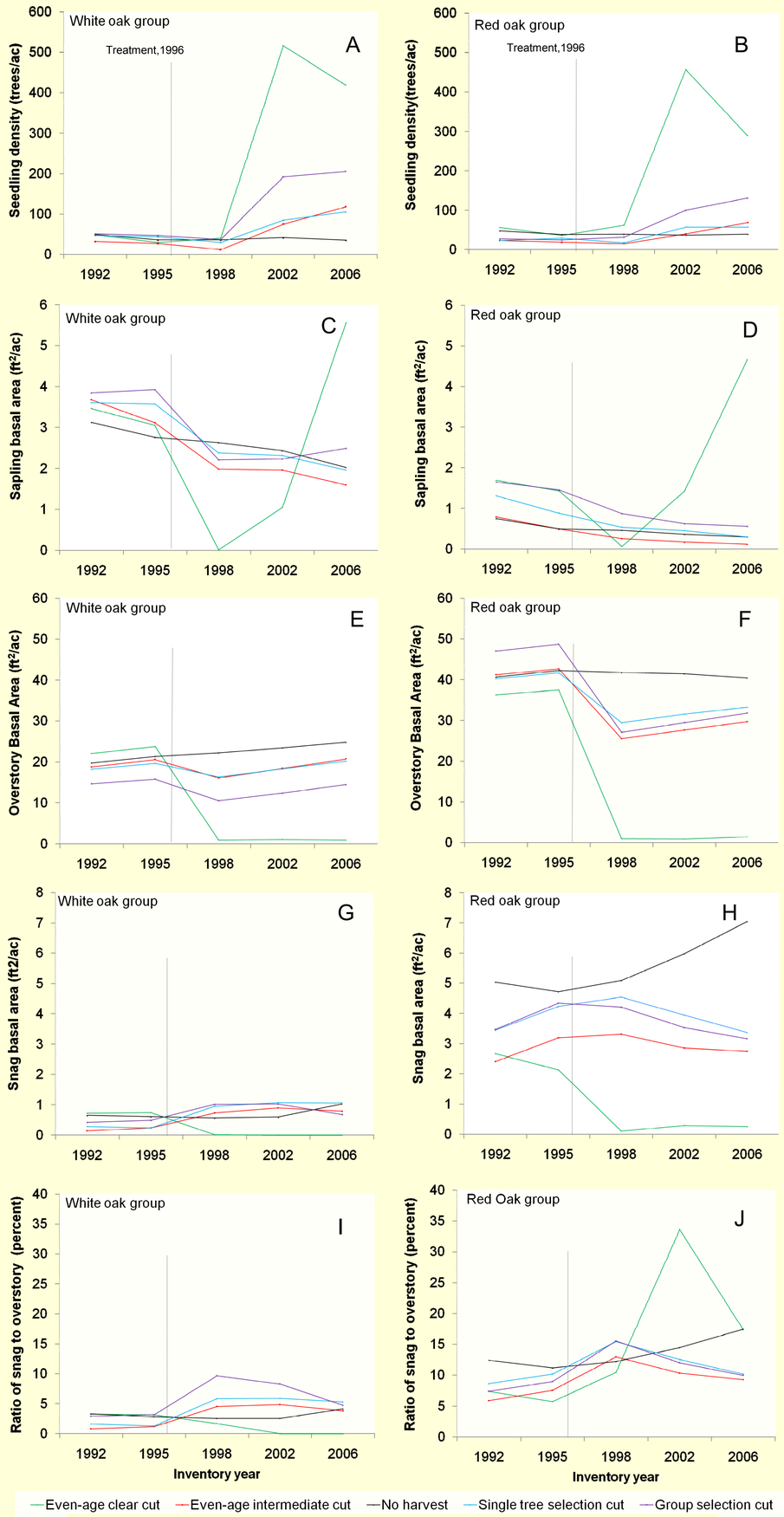

Figure 2. Change of oak seedling and sapling density and live tree and snag basal area by inventory year and timber treatment in the MOFEP study sites.

Results and Discussion

Compared to the no harvest treatment (control), oak seedling density increased on all treated sites. Particularly on the clearcut sites, by year 2002 white and red oak seedling density had reached up to 17 times and 13 times greater than that of year 1995 (pre-harvest) (Figure 2, panels A and B). After then seedling density started to decrease because of competition-caused mortality.

Sapling basal area gradually decreased following the treatments (Figure 2, panels C and D) except the clearcut treatment. On the clearcut sites, oak sapling basal area dramatically dropped to the lowest level within the first two years and then quickly increased. By 2006 (10 years after the treatment) white and red oak sapling basal area increased 82% and 225%, respectively, compared to that of year 1995.

Change of live and dead oak basal area following the treatments was displayed (Figure 2, panels E through J). Decrease of live tree basal area varied by the treatments, but dead tree (snag) basal area treated with group selection, single-tree selection and intermediate clearcut maintained a relatively stable level over the whole inventory period (1992-2006). However, red oak snag basal area continually built up on the no harvest sites due to red oak decline and mortality. Accordingly, the ratio of live verse dead tree basal area increased to certain extent.

The results suggest clearcut and group selection are more effective than other harvest treatments to regenerate oaks in the Ozarks. We will further test how these treatments and resultant overstory change will affect oak regeneration and decline in the future.

Major References

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