

Woody Plant Expansion in the Chautauqua Hills, KS: A Regional Assessment of Historical Change

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Abstract. Woody plant expansion into grasslands and savannas is a globally occurring phenomenon that has considerable economic and socio-cultural impacts. I use a multi-site historical study to quantify age structures of *Quercus marilandica* (Blackjack Oak) and *Quercus stellata* (Post Oak) from four discrete Cross Timbers stands in the Chautauqua Hills Region of southeast Kansas. My objectives are to determine when expansion occurred and from which landscape position oaks have expanded. Finally, I examine how timing and spatial patterns of expansion differ between species in the White and Red Oak subgenera. Preliminary data from the first site indicates an even-aged stand structure, represented by a normal distribution among age classes. Mean age for Post and Blackjack oak are 34 and 42 respectively and, maximum ages are 70 and 82 respectively. The relationship between tree age and landscape position was assessed by using slope position categories (mid-slope, ridge, and drainage) and slope steepness (degrees). There was no significant relationship between these two categories and tree age. However, sampling three more sites will provide further insight into the effect of landscape position on the two oak species in the Chautauqua Hills, KS. and should reveal any regional patterns that exist.

1. Introduction

Woody plant expansion (WPE) is a globally occurring phenomenon, found in a diverse array of grassland and savanna ecosystems [2]. WPE has increased substantially within the last 50-300 years [1] and can have profound economic and ecological impacts including reduced forage production for livestock, declines in biodiversity and changes in hydrological and biogeochemical processes [1]. Virtually every region in the United States has been affected by WPE, but particularly montane grasslands, savannas of the desert Southwest, and the Great Plains [3].

Land managers in southeast Kansas have become increasingly aware of WPE and many are contemplating or have already begun savanna “restoration” projects [5] These projects usually include reintroducing fire, and mechanical tree thinning. Attempts to restore historical tree communities should use dendrochronological data to define the restoration goals. Stahle et al. [4] found that some Post oaks in the Chautauqua Hills are older than 250 years. However, this data was collected for the purpose of climate reconstruction, and sampling was focused on older larger trees. In my study, I quantify age structures of Blackjack Oak and Post Oak to determine when oak populations expanded, to identify possible causes of oak expansion and to determine landscape position of old trees and, hence, from where oak populations expanded.

2. Experiment, Results, Discussion, and Significance

The criteria used to select study sites were 1) presence of both *Q. marilandica* and *Q. stellata* and 2) lack of dense tree cover in GLO records from the 1800's. Four sites were selected: Cross Timbers State Park, Fall River State Lake, Woodson State Fishing Lake and Stotts' Ranch. The point-quarter method of sampling will be used to sample trees in one woodland at each site. My sample size at each site will be 80 trees per species.

For each tree sampled, I measured the diameter of each tree at its base and at breast height (dbh); extracted an increment core from the base of trees ≥ 10 cm dbh; recorded GPS coordinates, and slope position category (ridge-top, mid-slope, or drainage); measured slope steepness at the base of each tree using a clinometer, and recorded the compass direction (aspect) that each slope is facing. All of these steps enable me to create age and size structures for each oak species in individual woodland patches, and to examine correlations between tree age or size and topographic variables (e.g., slope steepness, aspect and slope position).

Increment cores were allowed to dry for >96 hrs whereupon they were mounted and sanded. Cores were analyzed using visual cross-dating techniques and checked using the computer programs CDendro and COFECHA. These programs are used to eliminate age specific growth rates and to detect missing or false rings. Cross-dated cores will be used to create age structures at the four respective sites, which will translate into a master chronology providing useful reference information for future conservation and restoration efforts in the region.

To this point, one site (Stotts' Ranch) has been completely sampled and analyzed. Age structures (Fig. 1) for both species appear to be even-aged, represented by a normal distribution. Mean ages for Blackjack and Post Oak are 45 (SE 2.1) and 40 (SE 2.1), respectively; the oldest individual of each species was 82 and 74, respectively. The majority of recruitment of both species occurred 40- 50 years ago. This recruitment episode coincides with the drought of 1962-1972 which was followed by unusually high precipitation in 1973. McPherson (1997) suggested that periods of drought followed by large precipitation events, leads to the increased recruitment of woody plants. This is particularly true of Blackjack and Post Oak, the two most drought tolerant species of all the oaks. Further, the Stotts family heavily grazed their ranch until approximately 1970. Years of heavy grazing, coupled with a regional fire suppression strategy, and large fluxes in precipitation are believed to be the primary causes of WPE at this site. Two-way ANOVA will be used to determine the effects of landscape position on tree species and tree age, and it will provide further insight into the conditions that are historically correlated with WPE.

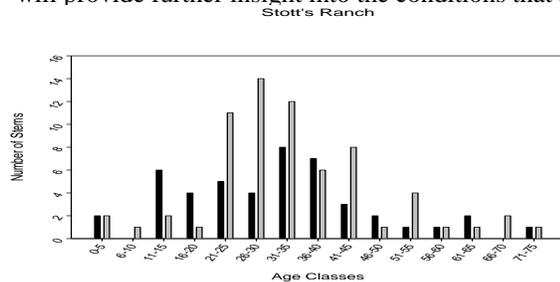


Fig. 1 Age-structure of Blackjack Oaks (Black) and Post Oaks (Grey) at the Stotts' Ranch Elk, Co. Kansas

The Stotts' ranch is one of four sites to be sampled in the Chautauqua Hills in southeast Kansas. Although this stand appears to be even-aged for both Post Oak and Blackjack Oak species, I believe that stands at other sites will be uneven, indicated by an over representation of older age classes as compared to a normal distribution. Stahle [6] found Post oaks ≥ 250 yrs. within the region. I believe these older trees are savanna remnants which, through autogenic succession, served as the points of WPE following European settlement in the mid- 1800's.

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