A Preliminary Analysis of Climatic Controls on *Pinus taeda* L. (Loblolly Pine) in the Turkey Creek Unit of the Big Thicket National Preserve, Texas

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Objectives

The recent devastation from Hurricane Rita in southeastern Texas has created an unprecedented sampling opportunity for the collection of stand-age structure and disturbance history in the Big Thicket National Preserve. This preserve was the first to be established by the National Park Service and was designated an International Biosphere Reserve by the United Nations, Education, Scientific, and Cultural Organization (UNESCO) in 1981 for extraordinary biological diversity in North America. Many of the plant associations in the Big Thicket National Preserve are disturbance maintained through fire and wind throw. Hurricanes are a relatively common occurrence in this area and may be particularly important in maintaining these forests and their diversity. The data in this presentation are preliminary results from a much larger project which will analyze how various forms of disturbance have helped to shape the structure of this unique area. The objective of this research was to determine what climatic variables are controlling the growth of *Pinus taeda* L. (Loblolly pine) in the sand hill pine area of the Turkey Creek Unit of the Big Thicket National Preserve. Additionally some inferences are made with regards to further environmental controls which may effect the species growth.

Study Site

The Turkey Creek Unit (Figure 1) is located approximately 5km east of Highway 69 north of Kountze, TX. This unit of the Big Thicket National Preserve is located between Tyler and Hardin Counties, Texas, and is comprised of approximately 7,800 acres. Sampling for this project occurred in the sand hill pine area in the southeast portion of this unit, an area which is dominated by Loblolly pine with various other species of pine and oak in the understory. The substrate is composed of a dry, sandy soil which drains rapidly.

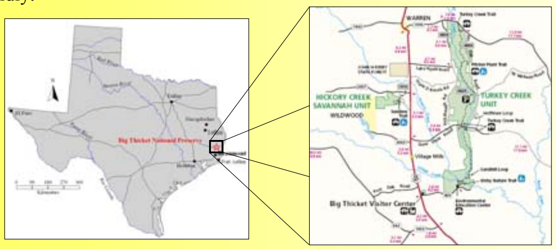

Figure 1: Location of study site within the Big Thicket National Preserve

Methods

Field Sampling and Laboratory Analysis

Two increment cores were taken from each tree on opposite sides of the bole and perpendicular to the slope at breast height (approximately 120cm above the forest floor) using a Haglof 600mm increment bore with a 5.15mm interior core diameter. After extraction, each core was placed in paper straws, labeled at the bark end of the straw, and transported to the laboratory for analysis.

In the laboratory, standard dendrochronological techniques were used to prepare each sample. Cores were then sanded with progressively finer grit sandpaper (150, 240, 320, and 400) and finished with 30 micron finishing paper (Orvis and Grissino-Mayer 2002). After sanding, the cellular structure of each sample was visible at 10X magnification making each individual ring series apparent (Stokes and Smiley 1968).

Ring Width Analysis and Statistical Analysis

After the cores were dated, each sample was measured using a Velmex measuring system capable of measuring to 0.01mm accuracy. The measurements of each sample were then compared in COFECHA (Holmes 1983, Grissino-Mayer 2001) to statistically verify the accuracy of each core and develop a site chronology. Once the site chronology was developed, ARSTAN (Cook 1985) was used to standardize the ring width indices. While various standardization techniques were explored, a conservative standardization technique (negative exponential curve) was chosen in order to preserve low-frequency climatic variability. Finally the standard chronology, was then compared to various types of climatic data.

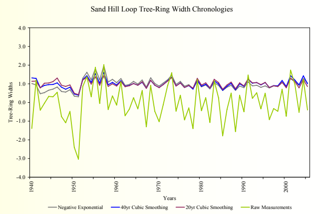

Figure 2: Comparison of standardization techniques

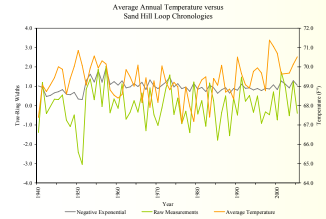

Figure 3: Comparison of ring width indices and temperature

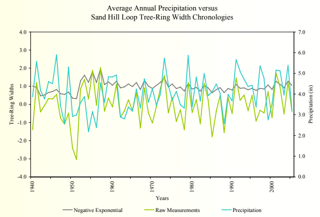

Figure 4: Comparison of ring width indices and precipitation

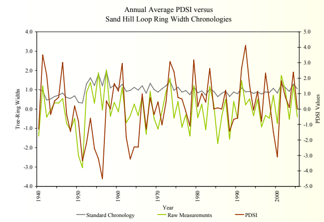

Figure 5: Comparison of ring width indices and PDSI

Results

A total of 21 series with a continuous time span of 67 years (1939 to 2005) were visually and statistically cross-dated. The interseries correlation was 0.549 with an average mean sensitivity of 0.316. Cross-dating revealed distinct narrow marker rings and periods of suppressions in the following years: 1940, 1947-1951, 1976-1978, 1985, 1996-1998, and 2000. Ring width indices were created using a negative exponential curve, a 40-year cubic smoothing spline and a 20-year cubic smoothing spline. These indices were then plotted against the raw tree-ring widths to determine the most appropriate standardized chronology (Figure 2). The more conservative negative exponential curve was chosen to help retain the climatic variability.

The standardized chronology was then plotted against various types of climatic data to analyze the effect of each on growth of Loblolly pine in the sand hill region (Figures 3-5). Additionally, correlation matrices were developed of each climatic variable and lagged variables to determine the temporal effect of each climatic variable on growth (Figures 6-9).

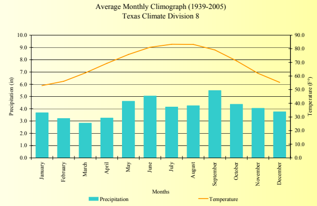

Figure 6: Climograph for Texas Climate Region 8

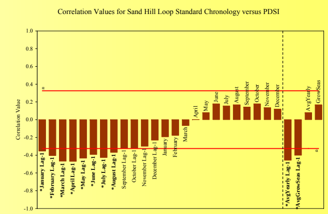

Figure: 7: Standard Chronology and PDSI

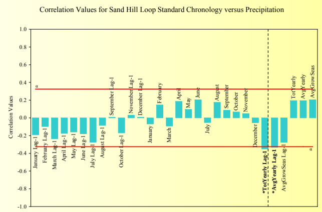

Figure 8: Standard Chronology and Precipitation

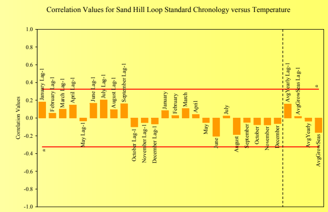

Figure: 9: Standard Chronology and Temperature

Conclusions

Correlation analysis of the climate variables showed some surprising results when compared to growth of Loblolly pines in the Turkey Creek Unit. A significantly negative relationship was found between previous years PDSI and current years growth. This effect could be do to a washing of the nutrients from the sandy soil in the previous year which limits the amount of below ground nutrients available to the trees during the current years growth. Additional analysis of the climatic controls on this site and other sites in SE Texas will help further the understanding of how climate and disturbance shape these forests.

Acknowledgments

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