Dendrochronology in the Blackwater Ecological Preserve

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INTRODUCTION

The Blackwater Ecological Preserve (BEP), located in southeastern Virginia, holds significant ecological importance as it contains the northernmost intact community of *Pinus palustris*, longleaf pine. At the BEP, we cored longleaf pine and recorded sample data including tree height and diameter at breast height (DBH). Two sites on the BEP, the 20's series and 40's series, were found to correlate within, but not between, sites. Statistical and qualitative analyses were conducted to find differences between the sites significant enough to affect correlation within a chronology. This data is being incorporated into a larger dendrochronology and climate analysis study on longleaf and other pine species on the BEP. This research is important for several reasons. Currently, no baseline master chronology exists for any tree species of the BEP, so the age of the pine populations is unknown. Additionally, there is a significant lack of research on climate related growth trends involving the longleaf pine near the northern range limit. The information produced from this study may have implications in the future management of the Preserve and its pine populations.

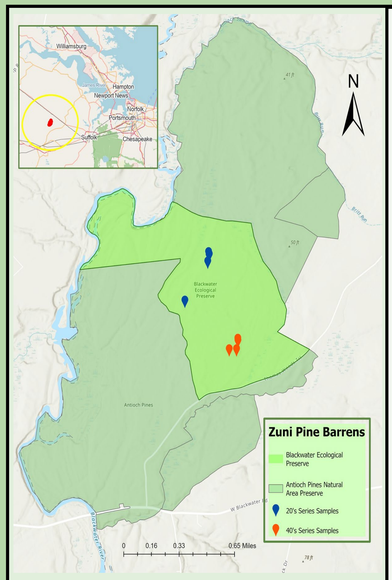

Figure 1. Sample locations on the BEP.

STUDY AREA

BEP (318 ac) is owned by Old Dominion University (Isle of Wight County, Virginia). It contains the northernmost longleaf pine community in the US (Frost and Musselman 1987). Antioch Pines Natural Area Preserve surrounds BEP and is managed by Virginia's Department of Conservation and Recreation. Both sites were heavily logged heavily since the colonial era for the naval stores and lumber industry. Tar kiln remnants and turpentine stumps are still present at both sites. BEP soils include include: Alaga fine sand, Chipley sand, Kenansville loamy sand, Kinston loam, Leon-Chipley sands, and Nawny loam (Soil Survey Staff, Web Soil Survey).

Figure 2 (Left). 40's series site. Vegetation is thicker, consists of a mixture of grasses and ferns in the understory.
Figure 3 (Right). Vegetation is thinner, leaving sand exposed in some areas. Vegetation for the most part consists of small shrubs, juvenile longleaf, and scattered prickly pear cactus (*Opuntia*).

METHODS

Five trees were sampled from the 20's series site and six trees were sampled from the 40's series site. For each sample tree, at least two cores were retrieved and data recorded includes DBH, tree height, and GPS location. Increment borer used was a Hagloff borer with a diameter of 5.15 mm. The GPS device used was a Garmin GPSMap.

Samples were processed in the lab, scanned, and analyzed using the programs CooRecorder and CDendro. The program Cofecha was used to statistically check validity of initial chronology. Statistical tests for normality and homogeneity were performed on the DBH and tree height values for both sites, followed by an unpaired t-test.

20's Series Master Bar Plot

Year Rel Val	Year Rel Value
1953----------K	1987--c
1954-----@	1988-e
1955-----@	1989-d
1956-------A	1990--------C
1957-----@	1991-------B
1958-d	1992----a
1959-d	1993--------C
1960e	1994---------D
1961---b	1995---------D
1962----------F	1996---------D
1963-------B	1997--d
1964------A	1998---b
1965----a	1999-------A
1966f	2000--------C
1967-e	2001---a
1968----a	2002-----@
1969----a	2003------A
1970--------C	2004----------G
1971---------D	2005g
1972---------E	2006---b
1973---------E	2007i
1974-------B	2008----a
1975--c	2009------A
1976---------D	2010---a
1977------A	2011----------L
1978------A	2012-------B
1979------A	2013------A
1980------A	2014--c
1981i	2015--c
1982---a	2016---b
1983-----@	2017-----@
1984f	2018---a
1985-------B	2019---b
1986f	2020---------F

40's Series Master Bar Plot

Year Rel Value	Year Rel Value
1959----------H	1990--------C
1960-----@	1991---b
1961---b	1992--c
1962--c	1993-----@
1963-d	1994---------D
1964----a	1995--------C
1965-----a	1996--------C
1966---------E	1997-------B
1967--------C	1998------A
1968---------D	1999---b
1969---------D	2000-------B
1970------A	2001f
1971--------C	2002----a
1972-------B	2003-d
1973----b	2004---------D
1974j	2005--b
1975----a	2006--c
1976-----@	2007-d
1977------@	2008-------A
1978-----@	2009--------C
1979-----a	2010e
1980e	2011----------L
1981-d	2012----------H
1982f	2013----b
1983-d	2014-d
1984-----@	2015--d
1985---b	2016--c
1986-------B	2017--------C
1987--c	2018-d
1988----------H	2019-----@
1989----------H	2020------A

Table 1. Cofecha output showing master bar plot for 20's and 40's series. Capital letters and longer lines indicate rings that are wider than the mean width, while shorter lines and lower case letters indicate rings that are narrower than the mean. The "@" symbol indicates a ring that is the similar in size to the mean.

RESULTS & DISCUSSION

Nine cores were used from the 20's series site, and eight cores were used from the 40's series site to create a chronology. After analyzing the chronology with the Cofecha program, it was determined that the cores from the 20's series site and the cores from the 40's series site correlate within, but not between, sites (**Table 1**). Mean correlation values are shown in **Table 3**. To determine if there were any significant differences between sites, we performed statistical tests on variables between the two sites. A Shapiro-Wilks test on the DBH and tree height values showed a normal distribution, while a Levene's test showed equal variances across samples. Results from an unpaired t-test on DBH and tree height between the 20's series and the 40's series sites were not quite significant (**Table 2**). Additionally, both sites consisted of the same type of soil, Leon-Chipley sands, though the 40's series site is located close to an area composed of Kinston loam. There may be some other factor, like elevation or micro-climatic variation that is influencing growth between the two sites, however we may combine cores from each site that have the better signals to evaluate against regional climate patterns. Research is still ongoing; we are developing a master chronology of the BEP for longleaf as well as pond pine (*P. serotina*), shortleaf pine (*P. echinata*), and loblolly pine (*P. taeda*). Finally, we will measure how climate affects growth in these species.

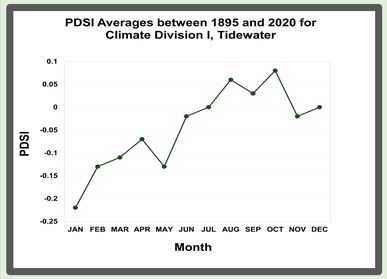

Figure 4. Monthly average PDSI averages between 1895 and 2020.

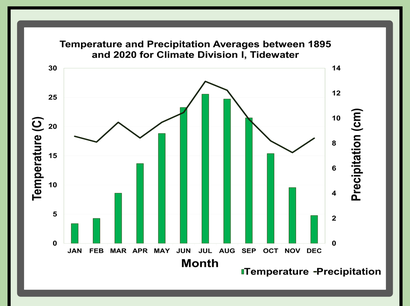

Figure 5. Monthly average temperature and precipitation averages between 1895 and 2020

	DBH	Height
Un-paired t-test α=.05	0.0966	0.0795

Table 2. Unpaired t-test between DBH and tree height between the 20's series and the 40's series sites

	20's Series	40's Series	Combined
Mean Correlation Value	0.677	0.581	0.506

Table 3. Mean correlation values for the 20's series, the 40's series, and both series combined.

Sources

Frost, C., and Musselman, L. (1987). History and vegetation of the Blackwater Ecologic Preserve. Castanea, 52(1), 16-46.

Soil Survey Staff, Natural Resources Conservation Service, United States Department of Agriculture. Web Soil Survey

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