A Dendrochronological Analysis of Canadian Prairie Shelterbelts: Gust Farm.

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Table of Contents

Abstract

As a part of the Agricultural Greenhouse Gases Program, which seeks to determine the carbon sequestration capabilities of shelterbelt trees and their response to climate and climate change, the Mistik Askiwin Dendrochronology Lab conducted a tree-ring analysis on shelterbelt trees throughout Saskatchewan. Using dendrochronological cross-dating techniques and climate analysis, radial growth chronologies were established, and the relationship between tree growth and climate was assessed. At Gust Farm, white spruce (*Picea glauca*) and Scots pine (*Pinus sylvestris*) samples were collected from 20 and 20 trees. The oldest tree sampled from white spruce was 50-years old and the overall average age of sampled trees was 44 years. The oldest tree sampled from Scott's pine was 38-years old and the overall average age of sampled trees was 32 years. The climatic variables exerting a positive affect on white spruce radial growth at this site include March temperature from the current growing season (year = n), and a positive relationship to spring precipitation from the past growing season (year = n-1. The climatic variables exerting a positive affect on Scots pine radial growth at this site include March temperature from the current growing season (year = n), and a positive relationship to spring precipitation from the past growing season (year = n-1).

Introduction

The Mistik Askiwin Dendrochronology Lab (MAD Lab) located at the University of Saskatchewan, is currently involved in a project for the Agricultural Greenhouse Gases Program (AGGP), which is investigating the capability of shelterbelt trees to store carbon. The carbon storage capability of these trees will inform their ability to offset carbon emissions and potentially act as carbon credits. The objective of the larger project is to determine the current and future capacity of carbon sequestration in these shelterbelt trees.

In the summer of 2015, samples for this project were collected across most of Saskatchewan. These samples were used as a part of the larger study, looking at shelterbelt tree growth over time since the trees were planted. As a landowner, and therefore a stakeholder in this project, we would like to provide you with the results from our findings on your property.

Site Information

MAD Lab Site Code: 15BLS00 & 15BL200	Date: May 25th, 2015
Site Name: Gust Farms	Site Contact Info: Stephen and Lorraine Gust
Latitude: 51° 16’ 10.5”	Longitude: -106° 54’ 54.26”
UTM: 6436689 5580200	UTM Zone: 13U
MASL (m above sea level): 622m	
Satellites: 8	Precision: ± 15m

Species Common Name: Scots Pine & White Spruce

MAD Lab Species Code: S00 & 200

Methods

The MAD Lab sampled 20 Scots pine trees and 20 white spruce trees using a 5.1 mm increment borer to take two core samples from each tree at approximately breast height. These samples were stored in plastic straws and taken back to the MAD Lab in Saskatoon, Saskatchewan for analysis. The samples were glued into slotted mounting boards and labeled with the appropriate site code. The samples were sanded with progressively finer sandpaper (60 to 600 grit) and then buffed in order to reveal the cell structure of the tree rings. The annual-growth rings were measured under a microscope using a Velmex stage system with a precision of 0.001 mm. The measurements from each core create a growth pattern, which could then be matched against that from the other cores taken from that site. The combination of all radial growth records extracted from cores taken from a single site allows for the creation of a site-

specific master growth chronology representing the overall average tree growth through time. The master chronology was then standardized to remove age related and biological growth trends, providing a cleaner signal.

The resulting standardized growth chronology was then used to determine the environmental factors influencing the tree's growth. Annual tree-ring measurements were compared to historical climate data from the Davidson weather station, using the program DendroClim. The program provides statistical correlations, which allow us to identify which climate variables most significantly influence the growth of the trees at each site.

Results and Discussion

The oldest tree was found for Scott's pine was 38-years old and the overall average age of sampled trees was 32 years. The oldest tree sampled from white spruce was 50-years old and the overall average age of sampled trees was 44 years. The average raw ring-width measurement for Scott's pine was determined to be 2.99 mm (see Figure 1 for the standardized growth of the tree over time). The average raw ring-width measurement for white spruce was determined to be 2.70 mm (see Figure 2 for the standardized growth of the tree over time).

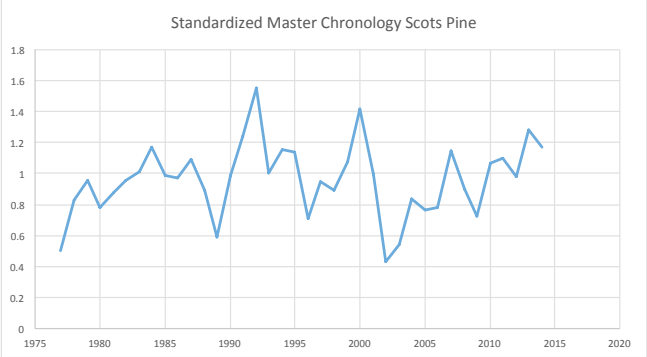


Figure 1: Master chronology for scots pine at the Gust Farm site. Standardized measurements of 1.00 indicate an average year of growth (in this case, associated with a raw ring-width of 2.99 mm), while any value above or below 1.00 indicate a year of growth that deviates from the average.

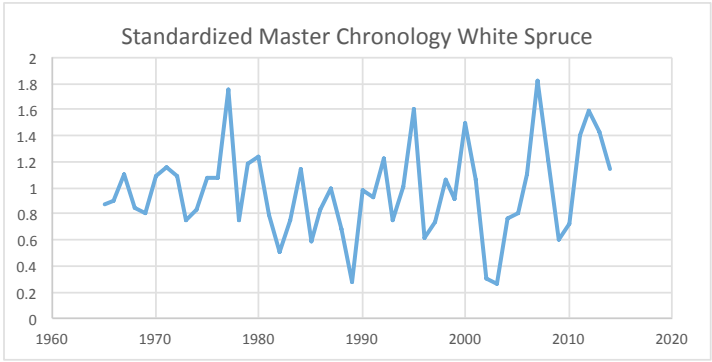
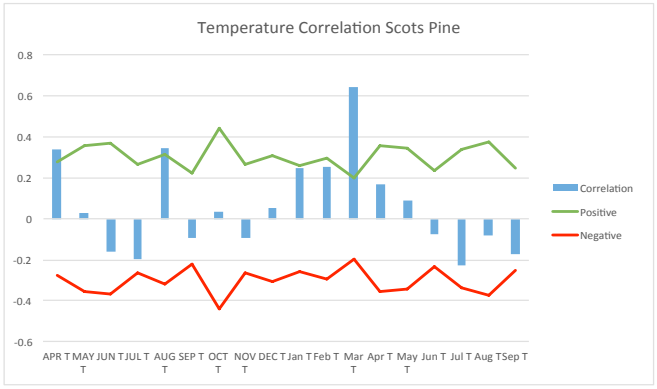


Figure 2: Master chronology for white spruce at the Gust Farm site. Standardized measurements of 1.00 indicate an average year of growth (in this case, associated with a raw ring-width of 2.70 mm), while any value above or below 1.00 indicate a year of growth that deviates from the average.

For Scots pine, May, June and July precipitation from the past growing season (year = n-1) had a positive affect, and July precipitation from the current growing season (year = n) had a positive affect. For white spruce, April, May, June precipitation from the past growing season (year = n-1) has a positive affect, and September precipitation from the current growing season (year = n) has a negative affect (see Figures 3, 4, 5 and 6).



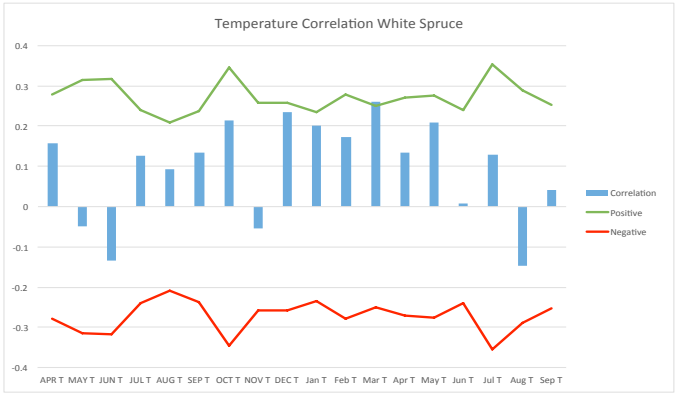
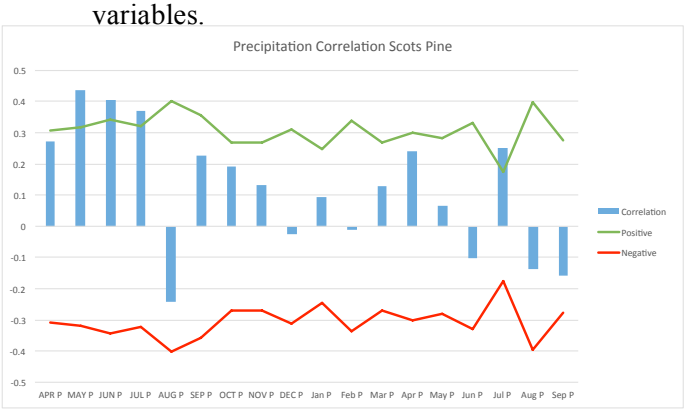


Figure 3 and 4: Results of the climate analysis comparing annual tree-ring growth to historical temperature variables from Davidson, SK. The bars represent the degrees of correlation between the tree growth and the climate variable. The places where the bars cross the linear threshold are considered significantly correlated. The uppercase letters (ie., APR) label the previous years' variables.



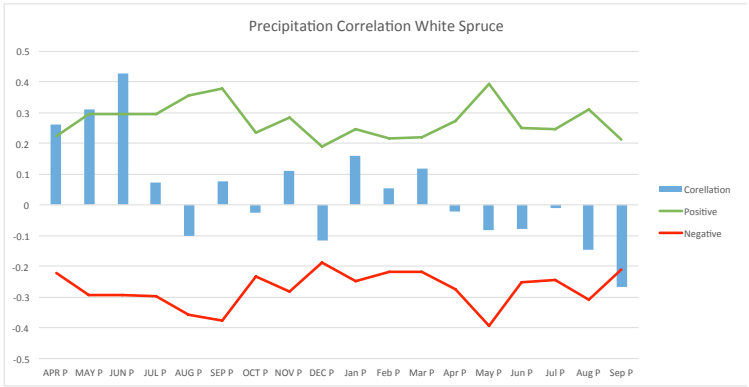


Figure 5 and 6: Results of the climate analysis comparing annual tree-ring growth to historical precipitation variables from Davidson, SK.

Conclusion

The results of this analysis help to strengthen our record of Scots pine and white spruce growth over time within Saskatchewan's south-central region. They also provide us with an understanding of the important climate variables driving tree growth in south-central Saskatchewan, in this case spring precipitation. The data collected from this site will be used in future studies, which will attempt to determine future growth trends and the amount of carbon sequestered by Scots pine and white spruce to determine its potential and viability for ongoing carbon sequestration.

This research was conducted at the MAD Lab in Saskatoon, Saskatchewan, and funded through the AGGP. Any questions regarding the findings of this report should be directed to:

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