A Dendrochronological Analysis of White Spruce in Prairie Shelterbelt Systems: "Rude Birds"

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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 Mount Allison Dendrochronology Lab conducted a tree-ring analysis on white spruce across latitudinal and longitudinal gradients in Saskatchewan. Using dendrochronological cross-dating techniques and climate analysis, patterns in tree growth were revealed and a relationship to climate variables was established. At the "Rude Birds" site, white spruce samples were collected from twenty trees, and the oldest samples were 42 years old.

Introduction

The Mount Allison Dendrochronology Lab is currently involved in the Agricultural Greenhouse Gases Program, in conjunction with the University of Saskatchewan, which is investigating the capability of shelterbelt trees to store carbon. The carbon storage capability of these trees will inform their ability to off-set 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 2012, samples for this project were collected across most of Saskatchewan. These samples were used for three separate studies which used dendrochronological (tree-ring) analysis, with the intention of investigating whether the sensitivity of the trees (in this study, white spruce (*Picea glauca*)) to major climate factors changed depending on their location. In order to do so, the ages and growth patterns of white spruce at each site were determined, and their sensitivity to climate factors was compared to those established at other sites.

Site Information

MAD Lab Site Code:12AEL200

Date: July 12, 2012

Site Name: Rude Birds

Site Contact Info:

Latitude: N 49° 08’ 42.7”

Longitude: W 104° 18’ 01.7”

UTM: 0551020 5443829

UTM Zone: 13U

MASL (m above sea level): 724 m

Satellites: 7

Species Common Name: White Spruce

MAD Lab Species Code: 200

Methods

The MAD Lab sampled 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 Mount Allison Dendrochronology Lab in Sackville, New Brunwsick, for analysis. The samples were glued onto 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 and tree-rings. The annual growth rings were measured under a microscope using a Velmex staging system with a precision of

0.001 mm. The measurements from each core created a growth pattern which could then be matched against the other cores from that site, in order to create a standardized chronology which would demonstrate the overall tree-growth patterns through time.

In order to determine the environmental factors influencing the tree's growth, annual tree-ring measurements were compared to historical climate data from the Estevan weather station, using the program DendroClim. The program provides statistical correlations which allow us to identify which climate variables influence the growth of the trees at each site.

Results and Discussion

The oldest samples were determined to be 42 years old at breast height. This suggests they were planted no later than 1969. The average ring-width measurement was determined to be 3.13 mm (see Figure 1 for the standardized growth of the trees over time). The climate data from the Estevan station indicated that the temperature of the previous October and the precipitation of the previous May were the strongest climate variables affecting the tree growth (see Figures 2 and 3).

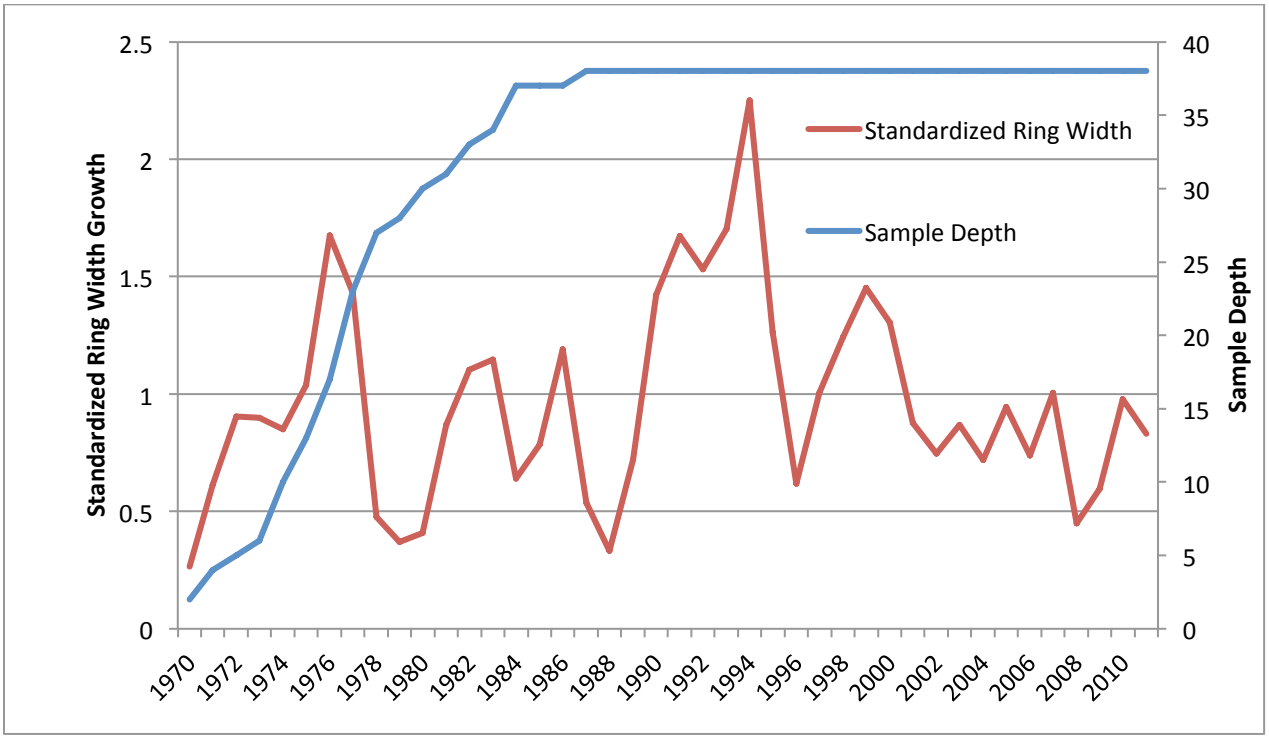

Fig. 1 Master chronology for white spruce at the Rude Birds site. Standardized measurements of one indicate an average year of growth (in this case, 3.13 mm), while any value above or below one indicate a year of above or below average growth. Sample depth is the number of samples averaged to produce the ring measurement for that year.

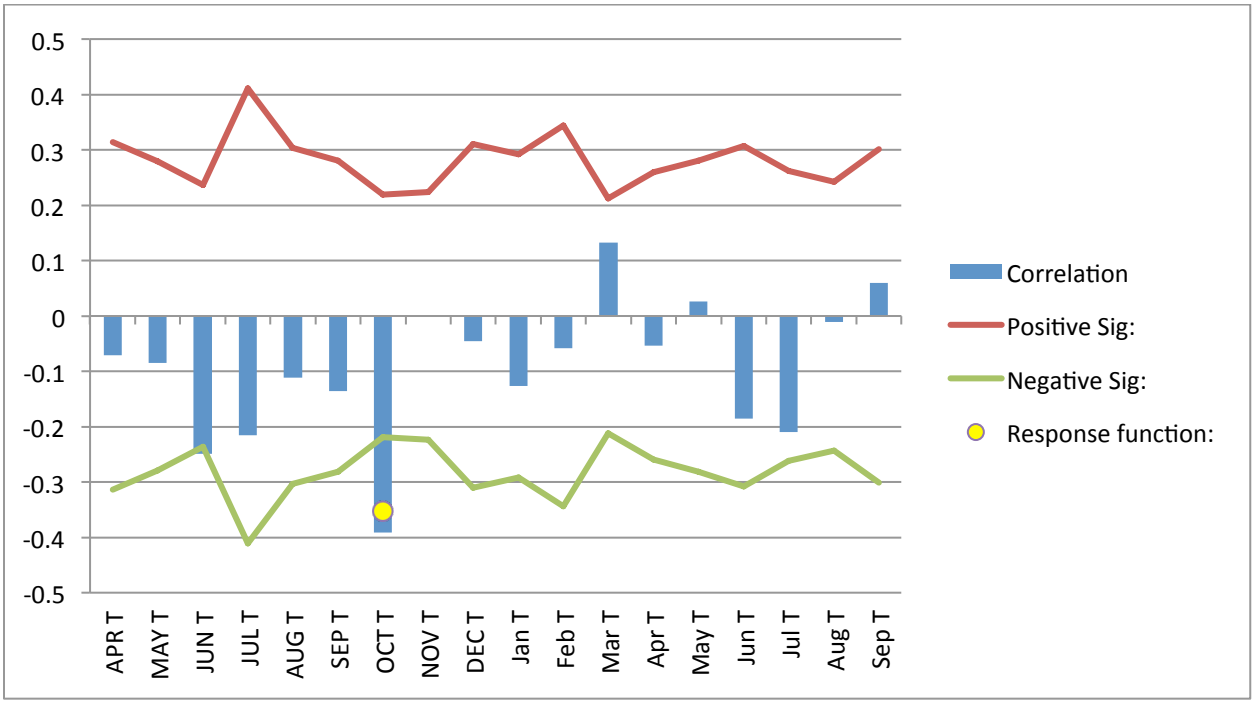

Fig. 2 Results of the climate analysis comparing annual tree-ring growth to historical temperature variables from Estevan, SK. The bars represent the degrees of correlation between the tree growth and the climate variable. The places where the bars cross the linear threshold are considered significantly correlated, marked by the response function circle. The uppercase letters (ie. APR) label the previous years' variables.

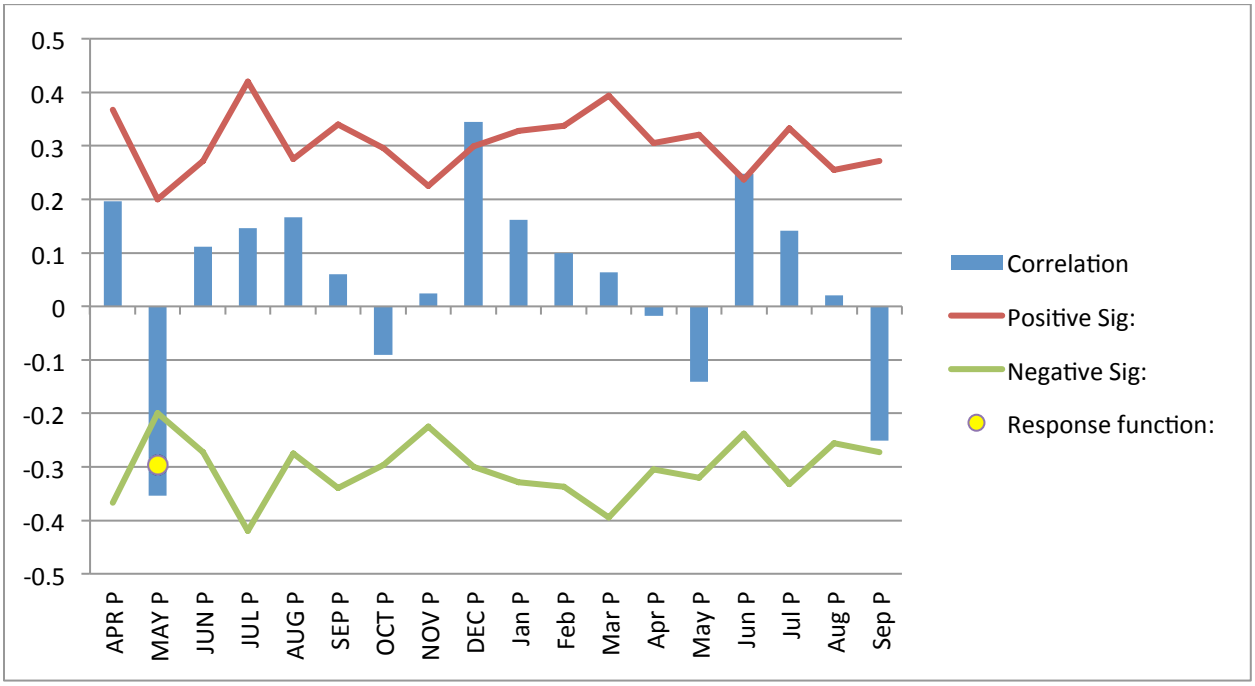

Fig. 3 Results of the climate analysis comparing annual tree-ring growth to historical precipitation variables from Estevan, SK.

Conclusion

The results of this analysis give a strong indication of the important climate variables in south-east Saskatchewan. For example, the importance of previous May precipitation in influencing tree-growth seems to change along a north-south gradient. At this site, the relationship to previous May precipitation is negative (more precipitation is associated with less growth), while at sites located further north, the relationship becomes positive (more precipitation is associated with more growth). The data used from this site will be used in future studies, which will attempt to determine future growth trends and the amount of carbon sequestered by white spruce to determine its potential and viability in carbon sequestration.

This research was conducted at the Mount Allison Dendrochronology Lab in Sackville, New Brunswick, and funded through the Agricultural Greenhouse Gases Program and NSERC-USRA (Jennings). Any questions regarding the findings of this report should be directed to:

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