Mount Allison
Dendrochronology Lab

Crossdating the Davin Lake, Saskatchewan Cores

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Abstract

As part of an analysis conducted by Ken Van Rees and Doug Jackson at Davin Lake, Saskatchewan, twenty trees were cored and sent to the Mount Allison Dendrochronology Lab. Eighteen cores were identified as jack pine and the remaining two were from a black spruce and a white birch tree. The MAD Lab was contacted in order to assist in ages and crossdating of the samples. The results indicate that the jack pine cores correlate significantly (above the 99% confidence interval) to one another (0.430 using 50-year increments), whereas the white birch and black spruce did not correlate well against the jack pine master chronology (0.223 and 0.122 correlation, respectively). The results were then standardized and represented both graphically and numerically in a chronology for the region extending from 1883-2010.

Introduction

In the spring of 2011, twenty trees were cored at Davin Lake, Saskatchewan, Canada. These samples were sent to the MAD Lab to process for aging, crossdating, and then to standardize and graph them to help illustrate the data. The purpose of the study was to identify the ages of the trees. Standard dendrochronological procedures were conducted on the data as described below.

Methods

The samples were taken from twenty trees, at breast height, at Davin Lake, Saskatchewan, on June 1st and 2nd, 2011 by Ken Van Rees and Doug Jackson. One core was taken from each tree; eighteen of these trees were determined to be jack pine (*Pinus banksiana*), while one core was taken from a white birch (*Betula papyrifera)* and one from a black spruce (*Picea mariana*) (see Appendix 1). The samples were sent to the MAD Lab and were given the lab code MAD Lab 11NL000.

In the lab, all of the samples were glued into slotted mounting boards, and then sanded with progressively finer sanding paper (40-800 grit) to bring out the cellular structures and annual rings of the wood. The rings were counted and measured along the centre of each sample, starting at the bark, using a Velmex measuring system with an accuracy of 0.001 mm, producing a time series of measurements.

Using the program COFECHA, this data was statistically analyzed and crossdated. COFECHA uses a Pearson's correlation procedure to relate how well each individual core relates to the overall group, which is made up of all other cores present in a series. All cores which correlate to the group at a value higher than 0.3281 are considered to be similar enough to pass the 99% confidence interval. Two sets of data were analyzed - one containing only the 18 jack pine measurements (lab code 11NLA00), and one containing all twenty samples.

The program ARSTAN was used in order to create a jack pine master chronology for the project. In order to remove the biological growth trend, each core was detrended using ARSTAN and the jack pine cores were then averaged together into a master chronology for the site.

Results

The initial measuring of the tree samples provided a ring count for each core. As some samples did not extend right to the pith of the tree, these can be taken only as approximate ages. The results of the jack pine crossdating are represented in Table 1. However, because of the low mean sensitivity and high auto-correlation of the species, as well as the individual growth pattern of the trees and low sample depth of the other species, the jack pine did not correlate well with

the white birch and black spruce samples. Table 2 illustrates the correlation values of the white birch (0.223) and black spruce (0.122), which were very low, and so which were not included in the standardized master chronology. The jack pine samples, dating between 1883-2010, had a series intercorrelation of 0.430, which is relatively strong. Individuals which stand out as probable outliers are 11NLA14A (0.298), possibly due to its proximity to the lake (see Appendix 1), and 11NL08A (0.313), based on their lower correlations with the master.

Table 1: A crossdating COFECHA summary table for the jack pine data in the study.

Series	Interval	No. Rings	No. of 50-year segments	No. Flags	Correlation with Master	Auto Correlation	Mean sensitivity
11NLA01A	1944-2010	67	3	0	0.435	0.852	0.226
11NLA02A	1942-2010	69	3	2	0.338	0.737	0.197
11NLA03A	1938-2010	73	3	1	0.328	0.925	0.171
11NLA04A	1941-2010	70	3	0	0.492	0.911	0.229
11NLA05A	1936-2010	75	3	1	0.380	0.968	0.211
11NLA06A	1944-2010	67	3	0	0.466	0.787	0.165
11NLA07A	1945-2010	66	3	0	0.447	0.889	0.198
11NLA08A	1978-2010	33	1	1	0.313	0.939	0.155
11NLA09A	1977-2010	34	1	0	0.620	0.943	0.163
11NLA10A	1945-2010	66	3	0	0.507	0.885	0.196
11NLA11A	1883-2010	128	5	1	0.468	0.877	0.205
11NLA12A	1896-2010	115	5	1	0.485	0.918	0.179
11NLA13A	1903-2010	108	4	3	0.352	0.920	0.205
11NLA14A	1938-2010	73	3	1	0.298	0.917	0.158
11NLA15A	1977-2010	34	1	0	0.554	0.822	0.184
11NLA16A	1977-2010	34	1	0	0.486	0.765	0.201
11NLA17A	1923-2010	88	4	1	0.545	0.816	0.234
11NLA18A	1922-2010	89	4	2	0.356	0.827	0.299
Total or mean:		1289	53	14	0.430	0.875	0.203

Table 2: Crossdating summary Table for white birch (11NLC01A) and black spruce (11NL101A) data.

Series	Interval	No. Rings	No. of 50-year segments	No. Flags	Correlation with Master	Auto Correlation	Mean sensitivity
11NLC01A	1945 2010	66	3	3	0.223	0.762	0.307
11NL101A	1942 2010	69	3	3	0.122	0.541	0.207

The overall growth pattern was attained by standardizing each jack pine series with a single detrending of either a negative exponential curve, a straight line through the data, or a cubic smoothing spline. The result of the analysis is illustrated in Figure 1.0. A comparison of the raw measurements of the white birch (11NLC01A) and black spruce (11NL101A) to the raw measurements of the jack pine are displayed in Figure 2.0.

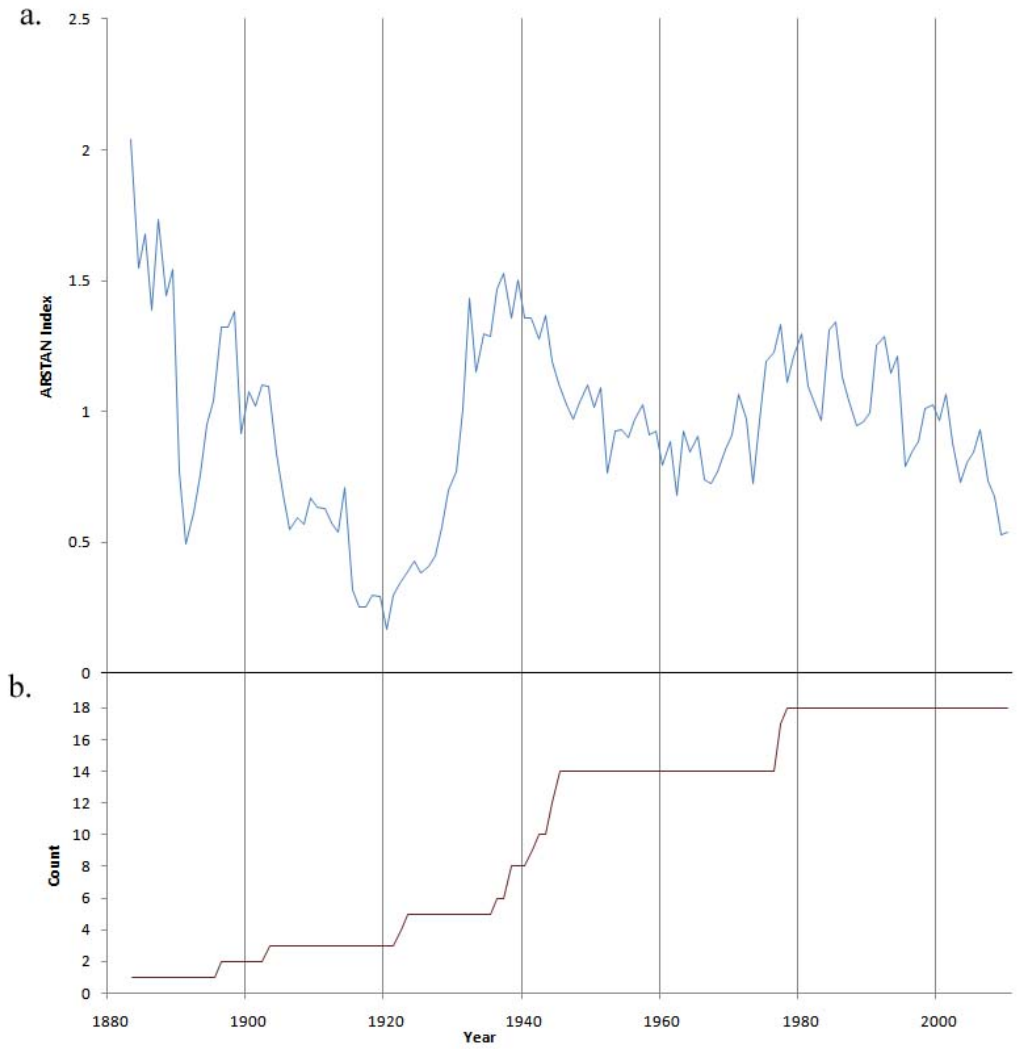

Figure 1a: The standardized ARSTAN curve for all of the jack pine cores in the analysis; 1b: Sample depth for jack pine chronology.

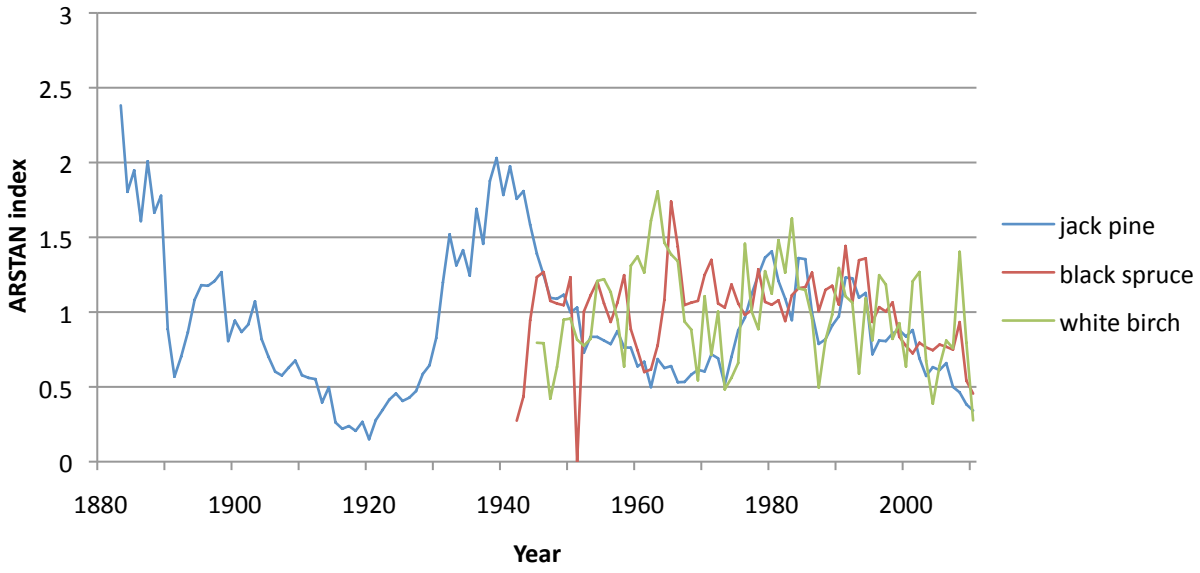

Figure 2.0: The ARSTAN index for the white birch and black spruce in comparison to the jack pine master chronology.

Conclusion

The analysis of the samples not only provided the approximate ages of the trees sampled, but it was also able to produce a chronology of jack pine, revealing a shared regional growth signal. Despite the inability to include the white birch and black spruce in the master chronology, our analysis of these cores did reveal the age of the tree to breast height.

Appendix 1. Sample codes with accompanying GPS locations and field notes.

Site Code	Species	UTM	Easting	Northing	Notes
11NLA01A	jack pine	13V	585933	6309305	
11NLA02A	jack pine	13V	585904	6304311	
11NLA03A	jack pine	13V	585893	6304343	June 1/2011
11NLA04A	jack pine	13V	585892	6304341	June 1/2011
11NLA05A	jack pine	13V	585893	6304353	June 1/2011
11NLA06A	jack pine	13V	585921	6304351	June 1/2011
11NLA07A	jack pine	13V	585976	6304329	June 1/2011
11NLA08A	jack pine	13V	585739	6304246	Davin machine shop, June 1/2011
11NLA09A	jack pine	13V	585739	6304264	Davin machine shop, June 1/2011
11NLA10A	jack pine	13V	585750	6304297	old growth firescar, June 1/2011
11NLA11A	jack pine	13V	585744	6304308	firescar, June 1/2011
11NLA12A	jack pine	13V	585752	6304319	firescar, June 1/2011
11NLA13A	jack pine	13V	585769	6304304	firescar, June 1/2011
11NLA14A	jack pine	13V	585694	6304092	down by lake, June 1/2011
11NLA15A	jack pine*	13V	585722	6304206	Davin machine shop site, June 1/2011
11NLA16A	jack pine*	13V	585725	6304215	Davin machine shop, June 1/2011
11NLA17A	jack pine*	13V	587567	6245926	Southern, June 2/2011
11NLA18A	jack pine*	13V	587567	6245924	Southern, June 2/2011
11NLC01A	white birch	13V	585895	6304379	June 1/2011
11NL101A	black spruce	13V	585889	6304331	June 1/2011

*indicates that the sample was not labeled, but was later identified as pine in the lab