Analysis of a pole structure from the Grande Cache area, Alberta

Amanda B. Young and Colin P. Laroque
MAD Lab Report 2009-11
Mount Allison Dendrochronology Laboratory,
Department of Geography and Environment,
Mount Allison University

Analysis of a pole structure from the Grande Cache area, Alberta

Table of Contents

Table of Contents 2
Abstract 2
Introduction 3
Methods 4
Results and Discussion 6
Conclusion 10
References 10

Abstract

A pole structure from the Grande Cache area in Alberta was sampled by the Turtle Island Cultural Resource Management Inc. during the summer of 2009. This study investigates the age of the wood used to construct the pole structure and the type of wood used. Six cross-sections from poles and three cores from nearby living trees were sent to the Mount Allison Dendrochronology (MAD Lab). Samples were processed and cross-dated with regional chronologies. Samples from the pole structure are probably white spruce (*Picea glauca*) while those from the living trees are lodgepole pine (*Pinus contorta*). The wood from the pole structure was killed in 1903/04 and span from 1759 to 1904. The living wood samples established between 1895 and 1909 during the time that the wood for the pole structure was killed. The coincidence of these events is most probable due to a wild fire that swept through the area killing the white spruce and creating an environment suitable for today's lodgepole pine forest to thrive.

Introduction

During the summer of 2009 a pole shelter was identified by the Turtle Island Cultural Resource Management Inc. (Figure 1). The structure is located north of Grande Cache at NAD 83 11 U 358056/ 5985697 at an elevation of 1,567 metres above sea level (Figure 2). Local elders believe that the poles are snags killed by a wildfire, before being used to construct the pole shelter. Cross-sections of six of the poles used in the shelter were sent to the Mount Allison Dendrochronology Laboratory (MAD Lab) for analysis and dating. Dendrochronology is the scientific field that uses patterns in the annual growth rings of trees to establish a chronology against which samples can be compared and subsequently dated.

Figure 1 – Pole shelter identified by the Turtle Island Cultural Resource Management Inc. (photo provided by Gareth Spicer).

Figure 2 – A map of the Grande Cache area in Alberta, Canada, (NAD 83 11 U 358056/ 5985697) noted with an A (Google Maps, 2009).

Methods

The cross-sections that were taken from six of the poles from the shelter were given the MAD Lab code of 09ALS000. Additionally, three cores were taken from lodgepole pine trees (*Pinus contorta*) adjacent to the structure. These cores were given the corresponding code of 09ALL600.

Once at the Lab, the cores were mounted into slotted boards in order to stabilize the cores. Cores and cross-sections were then sanded with progressively finer sanding paper (80-400 grit) to bring out the cellular structures and annual rings of the wood. Rings were counted and measured from the bark towards the center of each sample using a Velmex measuring system with an accuracy of 0.001mm. Rings were counted and measured along two paths from the bark to the pith (center) of each disc. Measurement paths were run through the most structurally sound portions of the sample.

Time series of measurements from the pole structure samples were correlated to each other thereby creating floating chronologies (chronologies that are not attached to a specific period of time). The floating chronologies were then cross-dated to previously established master chronologies that were locked in time from the region. Cross-dating is the practice of taking the pattern of growth from one sample of an unknown age and comparing it to that of another of known age (Figure 3).

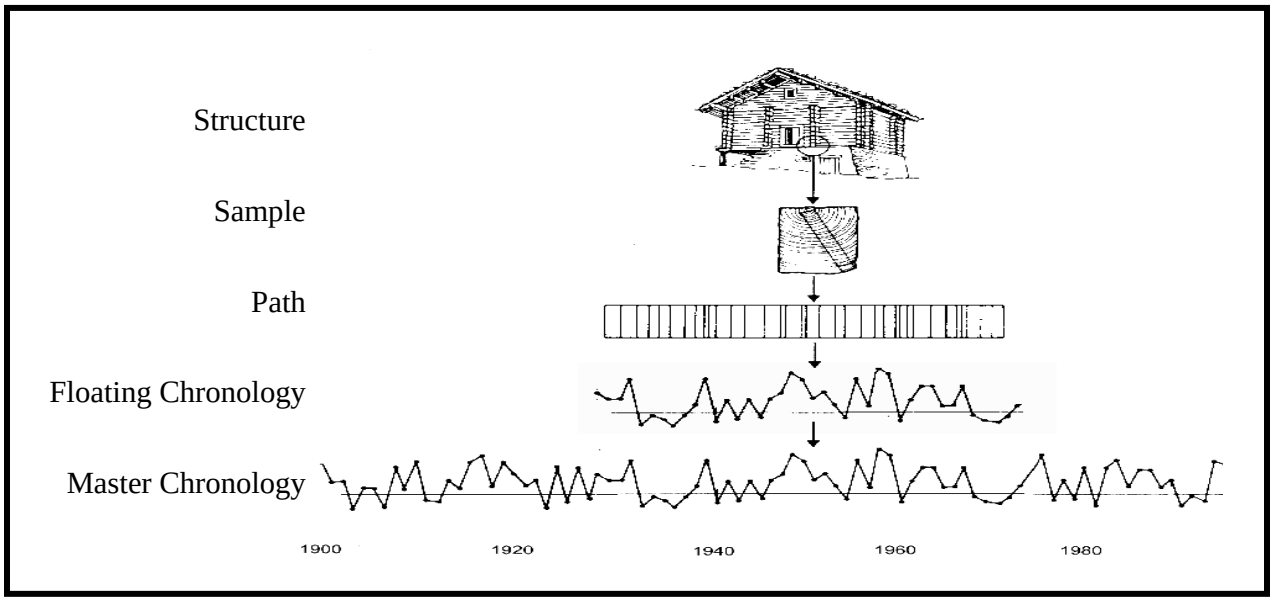

Figure 3 - Example of cross-dating by using patterns from a structure (floating chronology) compared to a master chronology.

To assist in the cross-dating procedure we used the statistical cross-dating program COFECHA (Holmes, 1986a). COFECHA uses correlation values to assist in accurately dating samples. Higher correlation values indicate that the floating chronology corresponds well to the master chronology. Lower correlation values can indicate a variety of things such as ecological or climatic variation from the norm or that the sample is inaccurately dated. COFECHA calculates how many years the floating chronology needs to move forwards or backwards in time to have the highest correlation.

The species of wood used in the pole structure was uncertain, thus the floating chronologies were run against a variety of chronologies from the MAD Lab archives from the Jasper region: including two spruce chronologies (Spruce 99 and WS), a lodgepole pine (Pine), and the living lodgepoles adjacent to the structure (09ALL600) (Table 1). This insured that the patterns found in the floating samples could be referenced to one of the chronologies locked in time. Wood morphology was analyzed to help determine the species of wood.

Table 1 - Correlation values and time spans of the four master chronologies used to date the 09ALS000 pole structure samples.

Chronology	**Interseries Correlation**	**Time Span**
Spruce99	0.607	1699-1999
WS	0.645	1820-2004
Pine	0.487	1735-2006
09ALL600	0.346	1895-2009

Each of the floating and master chronologies was standardized to have a mean of one by using a negative exponential curve in the program ARSTAN (Holmes,1986b). Standardization allows samples of different ages to be compared, by removing growth variation that is due to the age of the trees rather than the environment. A correlation matrix was then constructed to help determine which of the master chronologies best matched that of the pole structure.

Results and Discussion

Information to determine the species of the pole structure was gained by examining the wood in detail. None of the samples displayed pitch cells, which are characteristics of pine and Douglas-fir. The late wood definition was not similar to that of larch. Removing pine, Douglas-fir and larch as possibilities left only spruce and fir as options. Due to the earlywood to latewood transitions, the wood displayed much more similarly to spruce. Due to the elevation of the pole structure, and the type of habitat that it was located in, using the anatomical evidence we believe it is most likely that the pole shelter was constructed of white spruce (*Picea glauca*).

Fifteen paths were taken from the six pole structure cross-sections. The overall correlation for the floating chronology of these 15 paths is 0.550 (Table 2). The pole structure dated to five different time periods depending on which master chronology it was compared against (Table 3). The correlation between these dates and the chronologies differs greatly, and helps in the identification of the year of death of the pole structure (Table 4).

Table 2 – Sample identifier, time span, number of years, and correlation for 09ALS00 and 09ALL600.

Sample	Time Span	# of Years	Correlation
09als01a	1832-1903	72	0.348
09als01b	1832-1893	62	0.287
09als02a	1760-1891	132	0.724
09als02b	1760-1900	141	0.671
09als03a	1771-1888	118	0.463
09als03b	1771-1894	124	0.480
09als03c	1769-1892	124	0.499
09als04a	1780-1890	111	0.602
09als04b	1780-1904	125	0.648
09als05a	1797-1904	108	0.611
09als05b	1797-1890	94	0.604
09als05c	1795-1897	103	0.441
09als06a	1767-1900	134	0.492
09als06b	1767-1889	123	0.566
09als06c	1769-1901	133	0.574
09all607	1903-2009	107	0.336
09all606	1895-2009	115	0.417
09all609	1909-2009	101	0.281
Average		112.6	0.502

Table 3 - Years indicated as the possible death year of the pole structure from the master chronologies.

Master Chronologies	End year
Spruce99	1879, 1959, 1904
WS	1958
Pine	1903
09ALL600	none

Table 4 - Correlations values between the pole structure and master chronologies. The larger positive values have the highest correlations, thus more similar growth. (Statistically significant values are displayed in yellow highlight).

	Master Chronologies			
End Year	**Spruce99**	**WS**	**Pine**	**09ALL600**
1876	-0.011	0.061	0.060	-0.057
1903	0.222	-0.011	0.413	0.215
1904	0.238	-0.158	0.300	0.018
1958	-0.069	-0.053	0.051	0.084
1959	-0.125	-0.107	0.159	0.014

The highest significant correlation values are present in 1903 against the pine chronologies, and in 1904 against the spruce99 chronology (Table 4, Figure4A). Both years register high correlation values with the master chronologies. Because of this, we deemed 1904 as the last possible year that growth occurred in the sample poles. The sample pole floating chronology was therefore locked into time from 1760 to 1904. Visual pattern matching also indicates that the end year of 1904 is reliable, especially with the patterns between the pole structure and Spruce99 (Figure 4A) and the pine master chronologies (Figure 4C).

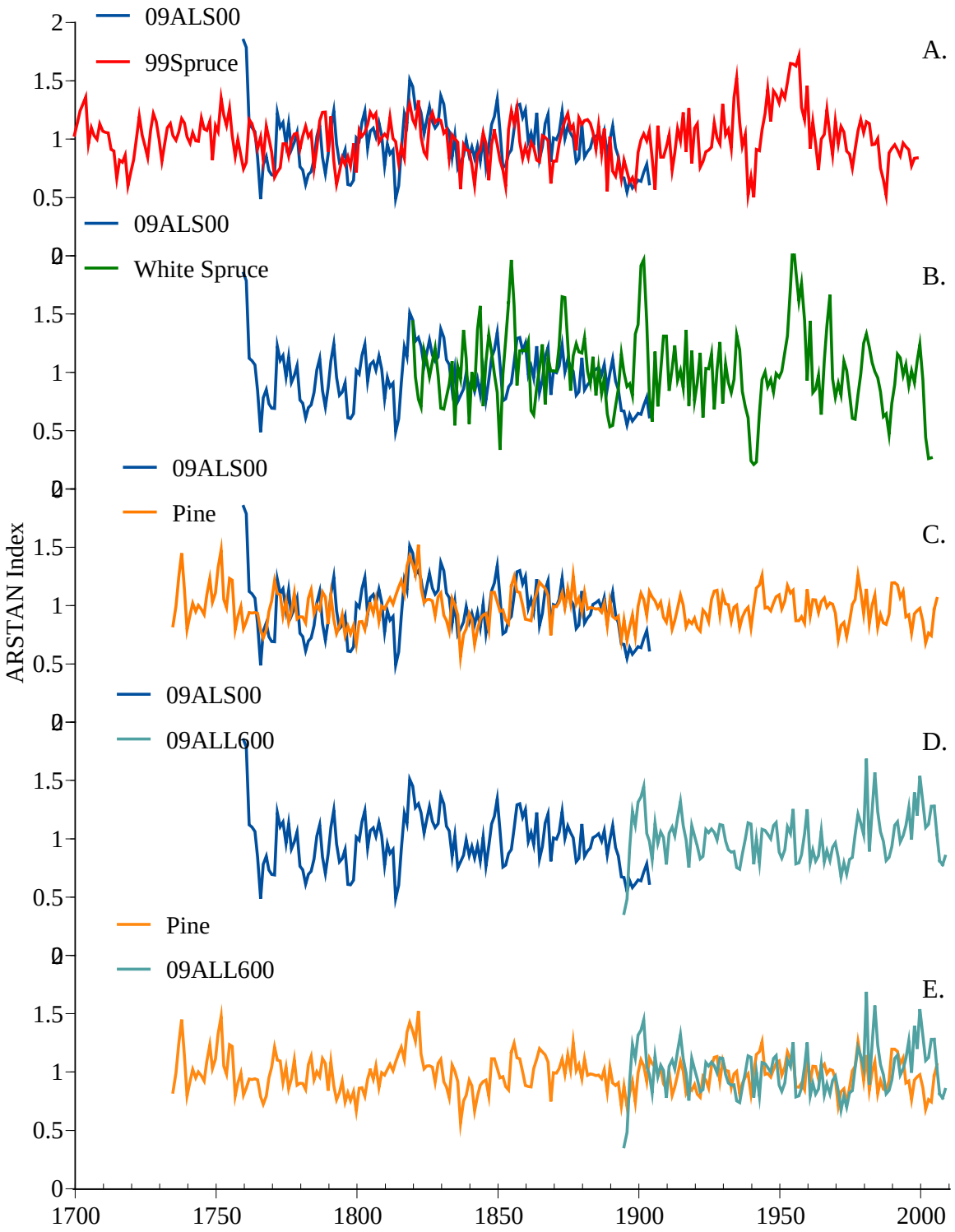

Figure 4 – Comparison of standardized chronologies of the pole structure 09ALS00 and A. Spruce chronology, B. White spruce chronology, C. Lodgepole pine chronology, and D. 09ALL600 with an end year of 1904. E. Comparison of the standardized chronologies of the lodgepole pine master chronology and 09ALL600.

Not all of the samples paths illustrate the outer year of growth, only 2-3 samples go to the year 1903-04 (Figure 5). These samples may still have a ring or two missing on the outer edge due to perimeter loss of the degenerating wood. The lodgepole pine adjacent to the pole structure established between 1895 and 1909 (Table 2, Figure 4E, Figure 5). The oldest of the living cores is the only one that was cored through the pith, while the other two were close to the pith, likely missing only a few rings. The three lodgepole pine samples all established over a 15-year period in which the pole samples died. It is documented that elders believe that the trees used to construct the pole shelter were standing snags that were a result of a past fire. Thus, it is highly probable that the white spruce pole samples died during a fire in the early 1900's.

For undetermined reasons this fire did not kill the very young lodgepole pine, while killing off the white spruce trees in the area. One potential reason for this is that a crown fire may have swept through the area killing the canopies while leaving the understory relatively untouched. Currently the forest where the pole structure is found is primarily a lodgepole pine dominated forest (Spicer, 2009 personal communication). The opening of the canopy during an early 1900's fire would have potentially altered the environment by exposing the soils to more light and drying them out to create a better growing environment for lodgepole pine. This would be especially important for a fire regenerated species such as lodgepole pine.

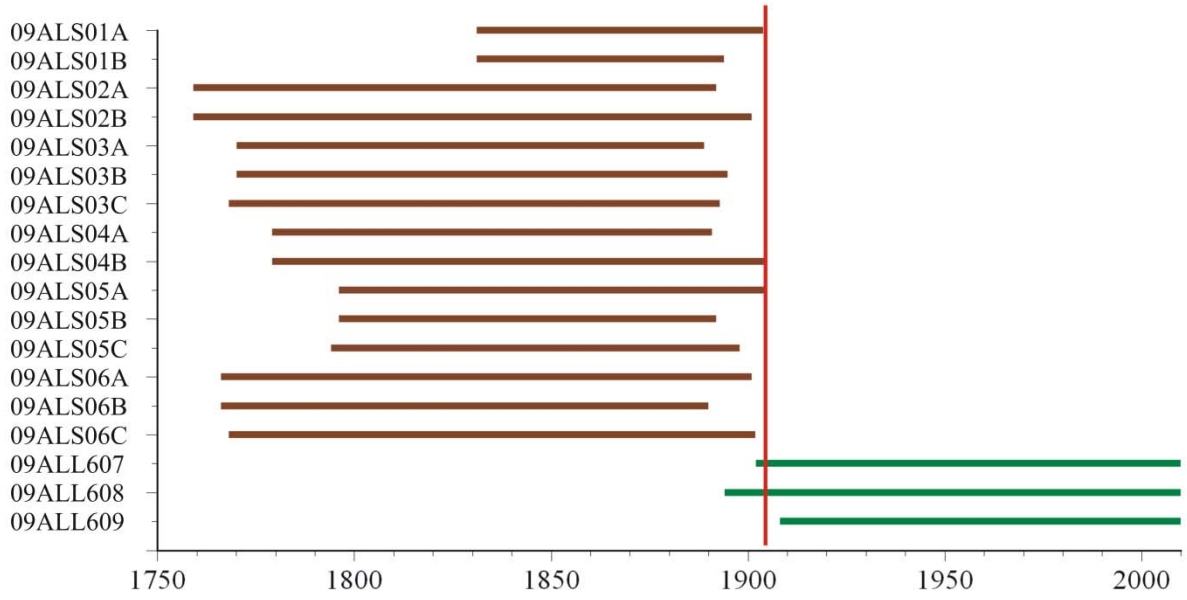

Figure 5 – Time span of each of the paths from the pole structure (brown) and the three living lodgepole pine cores (green). The red line represents the approximate time frame of the stand replacing fire that occurred in ~1904 which killed the white spruce and opened the canopy for the lodgepole pine.

Conclusions

The pole structure wood spans the time period from 1760 to 1904 and correlates well to the regional spruce and pine chronologies. After careful investigation of the wood morphology it was determined that the pole structure is probably composed of spruce poles. The three lodgepole pine cores covered the time period of 1895 to 2009. The coincidence of year of death of the white spruce and the establishment of lodgepole pines in the area tends to corroborate the belief of elders that a wildfire swept through the area killing the trees used in the pole structure. Though the spruce died in 1904, there is no dendrochronological evidence of when the structure was erected.

References

Holmes, R.L. (1986a). Users manual for program COFECHA. In *Tree-ring chronologies of western North America: California, eastern Oregon, and northern Great Basin* (eds R.L. Holmes, R.K. Adams & H.C. Fritts), pp. 41-49. Laboratory of Tree-Ring Research, University of Arizona, Tucson.

Holmes, R.L., Adams, R.K., & Fritts, H.C. (1986b) Users Manual for Program ARSTAN. In *Tree-ring chronologies of western North America: California, eastern Oregon, and northern Great Basin* (eds R.L. Holmes, R.K. Adams & H.C. Fritts), pp. 50-65. Laboratory of Tree-Ring Research, University of Arizona, Tucson.