



**Mount Allison
Dendrochronology Lab**

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A Dendroarcheological Analysis of St. Paul's Lutheran Church:
Bridgewater, Nova Scotia

By

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Abstract

Ten tree-ring samples were taken from beams in St. Paul’s Lutheran Church in Bridgewater, Nova Scotia. The sampling was conducted in efforts to extend the Mount Allison Dendrochronology (MAD) Lab chronologies for southwestern Nova Scotia using historic structures. Statistical analysis was conducted on the red spruce (*Picea rubens*) and white pine (*Pinus strobus*) samples to deduce the tree-ring growth patterns of the species for the region. Based on analysis, it was determined that the trees used in the construction of the church were felled in the years leading up to 1854, supporting the records that the church was built in 1854.

Introduction

Churches in Nova Scotia are the pride of many communities and as such have been maintained for many centuries by their parishioners. Southwestern Nova Scotia has a wealth of churches that have been built and cared for by the earliest settlers. Not only are these churches rich in cultural history, the wood used to construct them holds a wealth of information on the environment of the region up to the time of initial settlement.

Dendroarcheology is the study of tree rings taken from beams in historical structures. The purpose of this project is to understand how several tree species were growing in southwestern Nova Scotia at the time of settlement. Samples were taken from eight historical churches in the region to accomplish this goal. Master chronologies of radial growth from each tree species, at each church, were constructed, with the ultimate goal of adding growth patterns to existing regional chronologies to extend radial growth records for each tree species in the region. This method of collecting tree-rings is used in southwestern Nova Scotia because the majority of the region's old-growth forests have been cut down, and therefore shortening the length of the record accessible from live trees. Beams from historic churches provide records of tree-ring growth of what would be the region's old-growth forests, if they were standing today.

St. Paul's Lutheran Church in Bridgewater, Nova Scotia (MAD Lab #06NS000) was one of the eight churches the Mount Allison Dendrochronology (MAD) Lab sampled in the summer of 2006 (Figure 1). According to church records, the church was constructed in 1854. Due to its age, there was potential for the tree-rings in the church beams to extend quite far into the past. With the support of the church's parishioners, sampling was conducted.



Figure 1: St. Paul's Lutheran Church, Bridgewater, N.S.

Research Methods

Ten samples were taken from a total of nine beams using an increment borer (see Appendix A). The diameter of each sample is 4.3 mm, approximately the size of a pencil (Figure 2). The sampling process has no negative effects on the structural integrity of the building. All of the beams sampled are located in the basement of the church, where they have not been altered since the initial construction of the church. Beams were selected for sampling according to their integrity (the absence of rot) and the presence of bark (indicating the last tree-ring has not been removed in the construction of the church).

Samples were stored in plastic straws and were transported back to the lab to be prepared for analysis. Each core was glued into a slotted mounting board. The cores were sanded using up to 600 grit sandpaper in order to ensure a clear cross-section of the rings. The cores were then measured using a 63x light microscope and the Velmex measuring system. This process produced measurements indicating the annual growth rates of the individual trees to 0.001 mm.

Prior to further analysis, it was important to determine the tree species used in the construction of the church. As all tree species have different growth responses to climatic factors, to compare growth patterns of a set of samples they must be of the same species. Three samples were examined using a scanning electron microscope (SEM) to determine the species of

the samples. Two samples were confirmed as to be red spruce (*Picea rubens*) and one was confirmed to be white pine (*Pinus strobus*). It was inferred from this that six samples are red spruce and four are white pine.

The process of analyzing archeological data requires two steps. The first is to crossdate the samples within the church to each other. This ensures that there is a significant correlation between the growth patterns of the trees within the building (representing a stand of trees that was growing together and thus should have similar growth trends). Once this was completed, the church beams were crossdated into two chronologies: a red spruce chronology constructed by the MAD Lab from live trees and structural samples obtained from New Brunswick and Nova Scotia and a white pine chronology constructed by the MAD Lab from live trees obtained from the Tobetic Wilderness Area, NS sampled in the summer of 2006.



Figure 2: Sample extracted with an increment borer.

Results and Discussion

Based on an analysis using COFECHA, it was determined that the last year of growth of the trees within the church beams was in the years leading up to 1854 (Figures 3 and 4, Table 1). This suggests that the trees used in the construction of the church were cut down with the last growing year in the late 1840s and early 1850s near to the date the building was constructed. Based on construction and logistical schedules of the time, it is reasonable to believe that the

trees were felled in the fall/winter of the years before construction began. This fact confirms the parishioners' records of St. Paul's Lutheran Church being constructed in 1854.

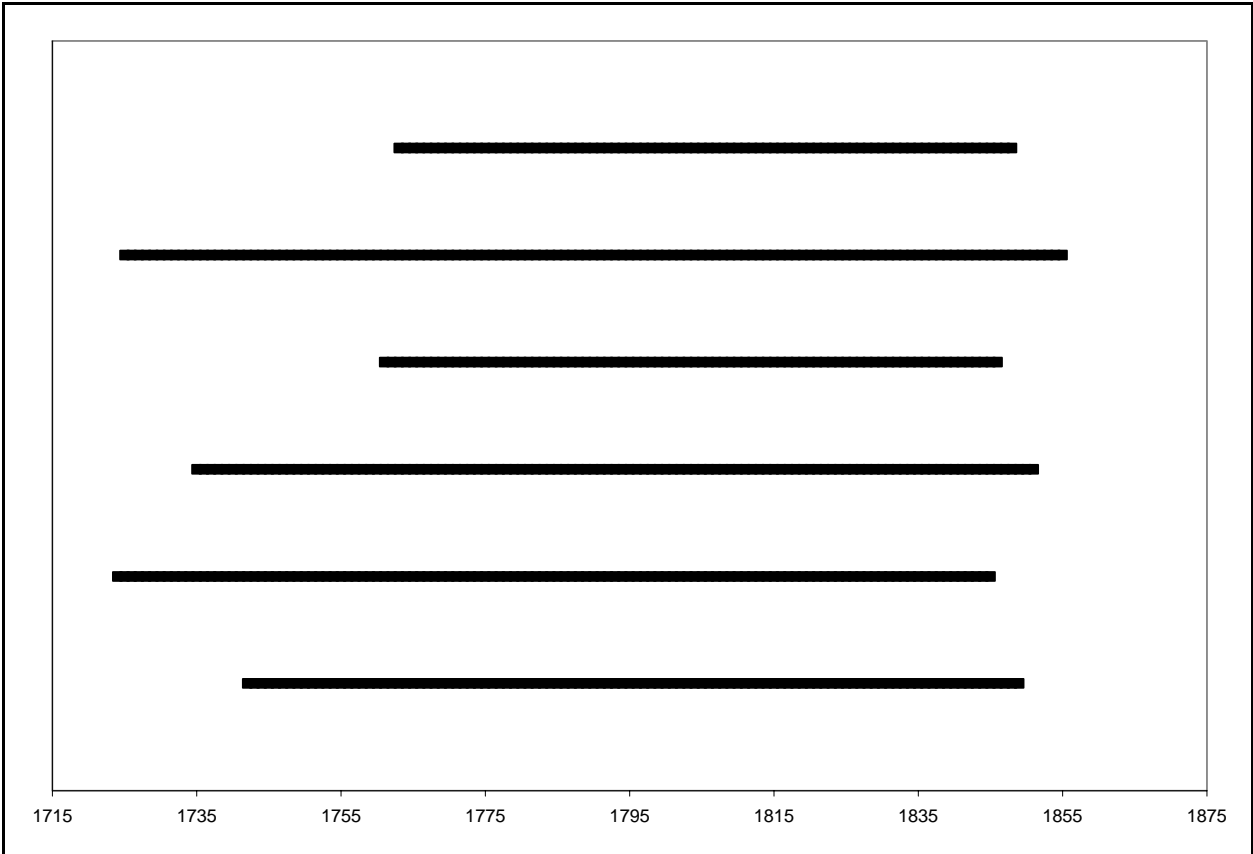


Figure 3: Life-spans of red spruce trees within beams of St. Paul's Lutheran Church.

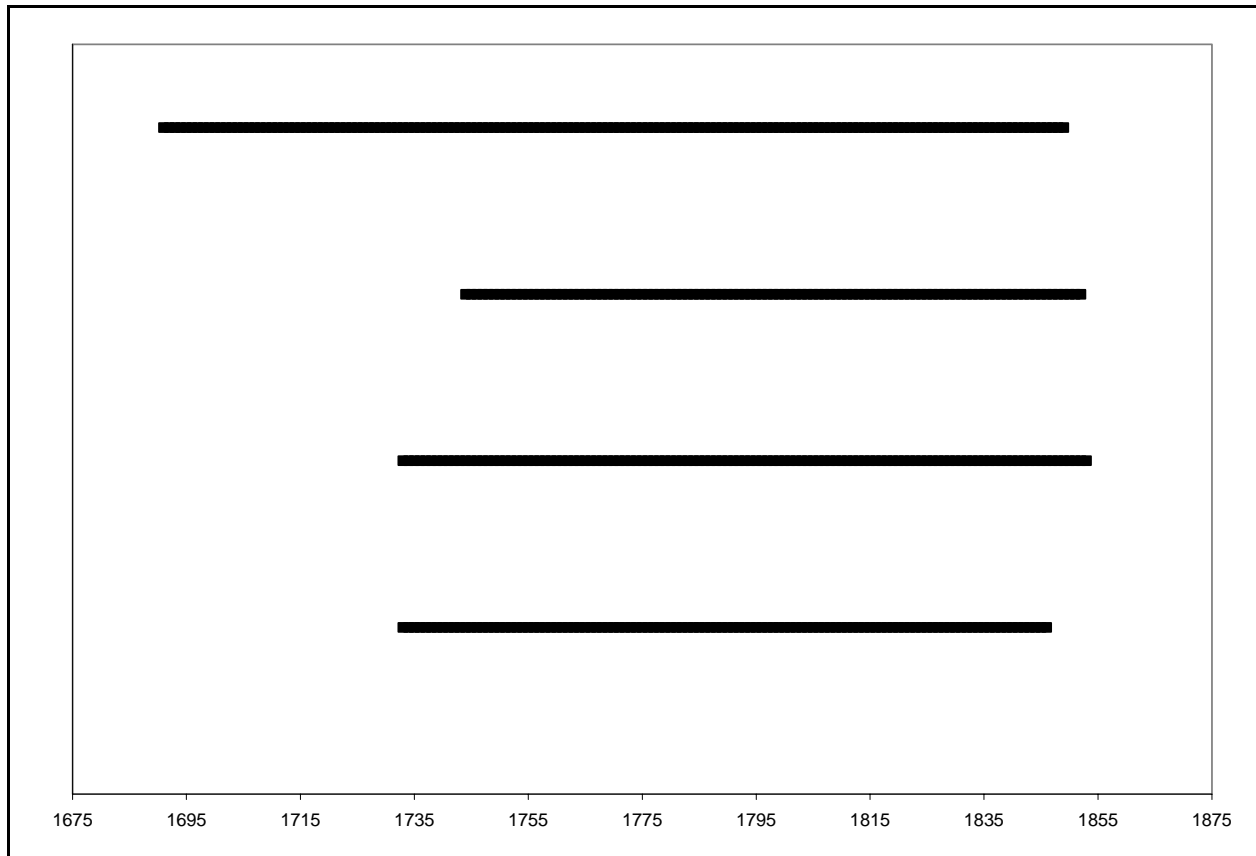


Figure 4: Life-spans of white pine trees within beams of St. Paul's Lutheran Church.

<i>Sample Number</i>	<i>Location</i>	<i>Bark Condition</i>	<i>Species</i>	<i>Crossdated Interval</i>
06NS001	basement	no bark present	White pine	1733-1846
06NS002	basement	bark present	White pine	1733-1853
06NS003	basement	bark present	Red spruce	1742-1849
06NS004	basement	no bark present	White pine	1744-1852
06NS005a	basement	bark present	Red spruce	1724-1845
06NS005b	basement	bark present	Red spruce	1735 -1851
06NS006	basement	bark present	White pine	1691-1849
06NS007	basement	bark present	Red spruce	1761-1846
06NS008	basement	bark present	Red spruce	1725-1855
06NS009	basement	no bark present	Red spruce	1763-1848

Table 1: Data on samples collected from beams within St. Paul's Lutheran Church.

Once the cut years of the trees were determined, it was possible to create a floating chronology for the two “stands” (Figures 5 and 6). This shows the average growth patterns for all of the red spruce and white pine samples within the beams of the church.

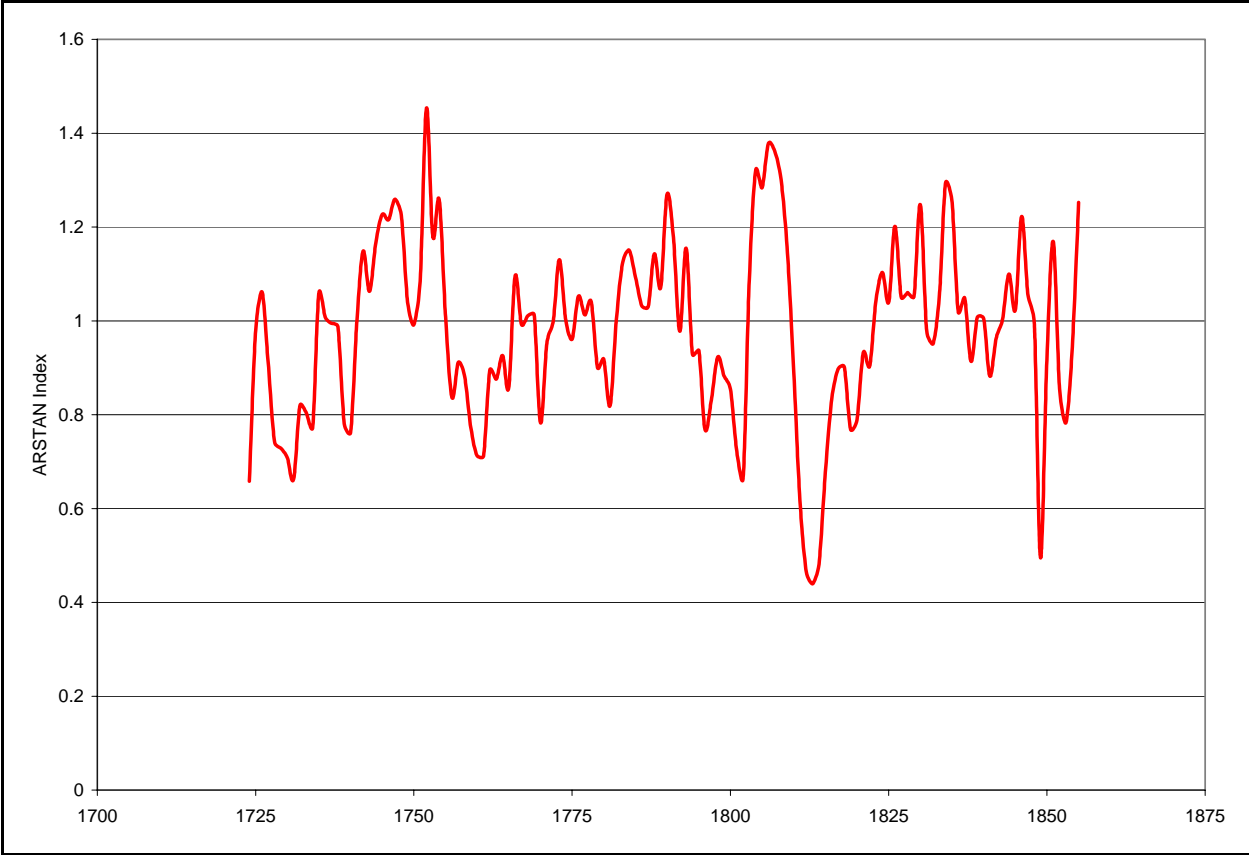


Figure 5: Floating chronology for red spruce in St. Paul's Lutheran Church.

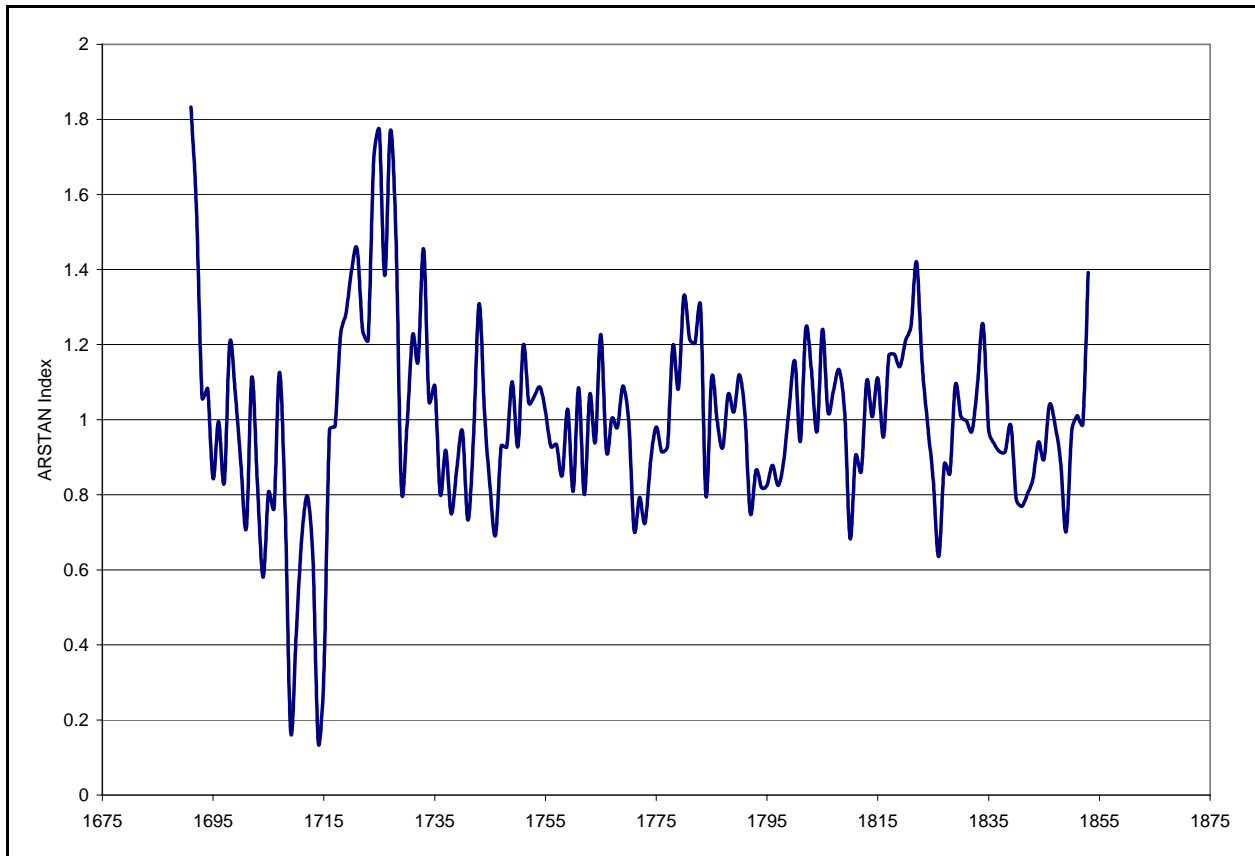


Figure 6: Floating chronology for white pine in St. Paul's Lutheran Church.

The beams from this church effectively contribute to two of the project's objectives which are to increase red spruce and white pine sample depth in Nova Scotia and to create a master chronology specific to each species in southwestern Nova Scotia (Figures 7 and 8). All red spruce beams crossdate into the master chronology with a significance ranging from 0.108-0.291 (90% confidence of significance at 0.21). Out of the six red spruce samples, three achieve 90% significance or higher, with correlations to the master chronology above 0.21. The reason that the significance levels are not higher than 90% is that the live chronology is likely based predominately on red spruce trees growing in New Brunswick. The distance between the habitats of the live chronology and the stand that made up the church chronology may be the reason for this discrepancy.

All the white pine beams crossdate into the live chronology with a significance ranging from 0.015-0.242 (90% confidence of significance at 0.21). Out of four white pine samples, only one achieves 90% significance or higher, with correlations to the live chronology above 0.21.

This has to do with difference in growth patterns at the site of the live stand and the site where the church beams were cut. If the trees used in the church were constructed with local wood, their growth patterns would probably reflect near-ocean habitat, whereas the live stand in the Tobeatic Wilderness Area is much further inland and thus would experience somewhat different growing conditions. Another possibility is that the white pines in the church are not from a nearby forest. The church was constructed at a time when Nova Scotia's white pines were given the "King's Mark," and were therefore reserved for shipment to England only. Thus, the trees may have been shipped in from afar, explaining the weak correlations between them and the live stand.

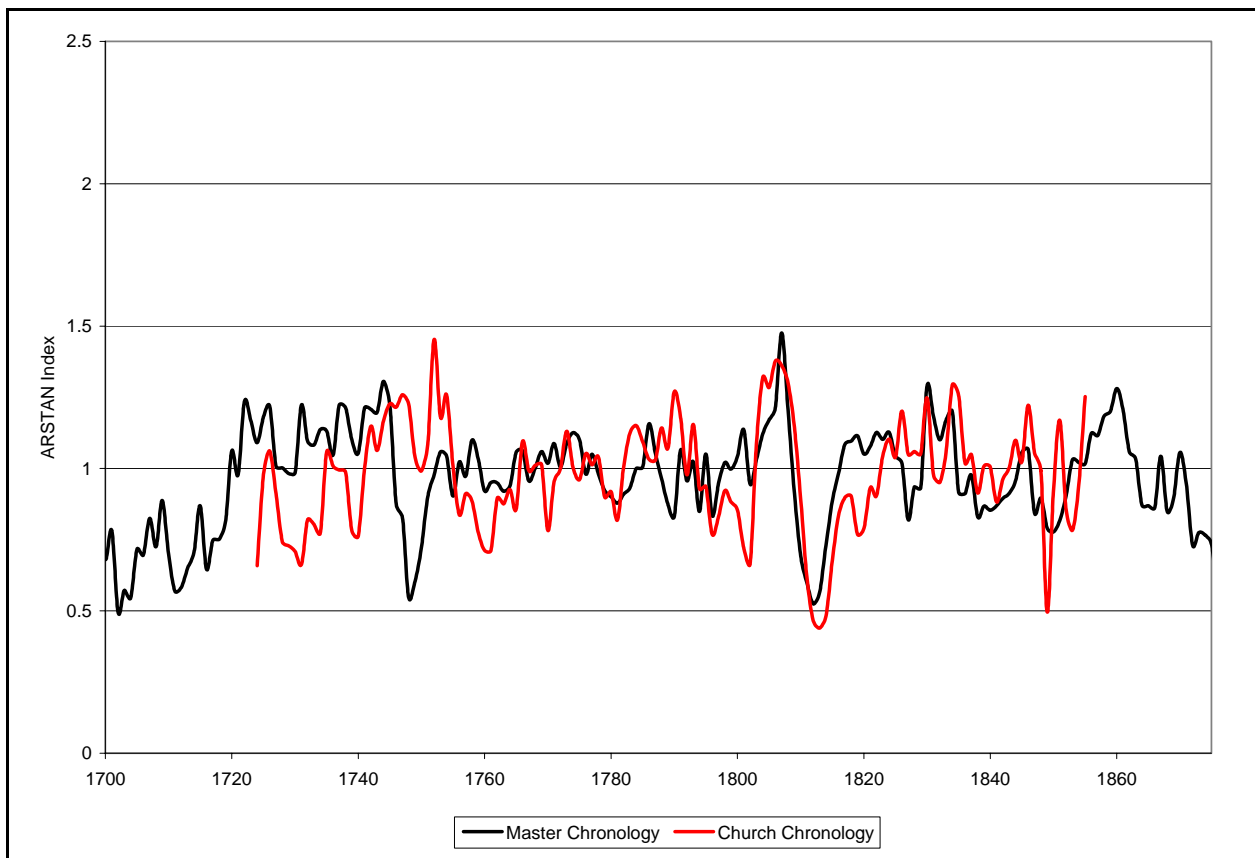


Figure 7: Overlap of the master and church red spruce chronologies shows similar growth patterns.

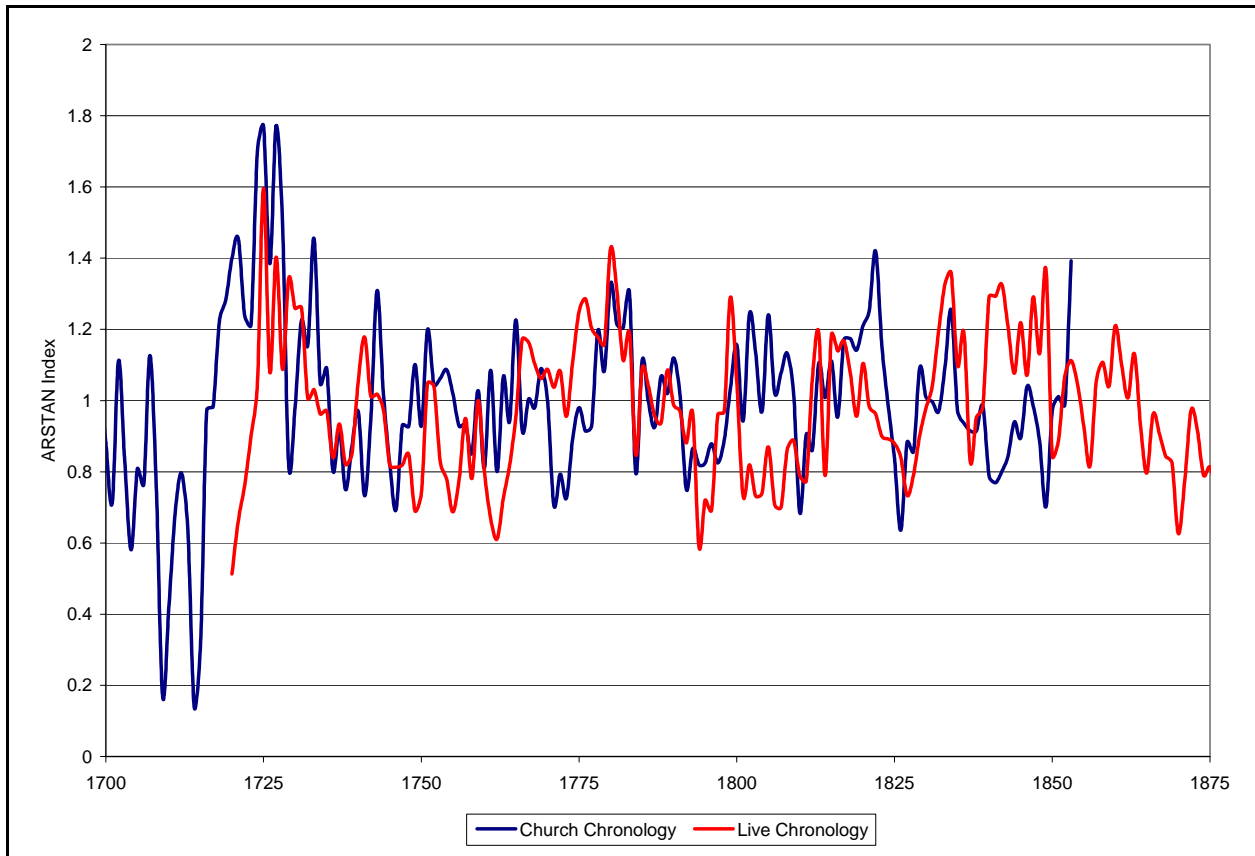


Figure 8: Overlap of the living and church white pine chronologies shows similar growth patterns.

From this it was possible to develop a master chronology for red spruce and white pine in southwestern Nova Scotia (Figures 9 and 10). The overall correlations of the red spruce and white pine chronologies are 0.488 and 0.454 respectively, which is much higher than the 0.3281 required for 99% confidence of significance.

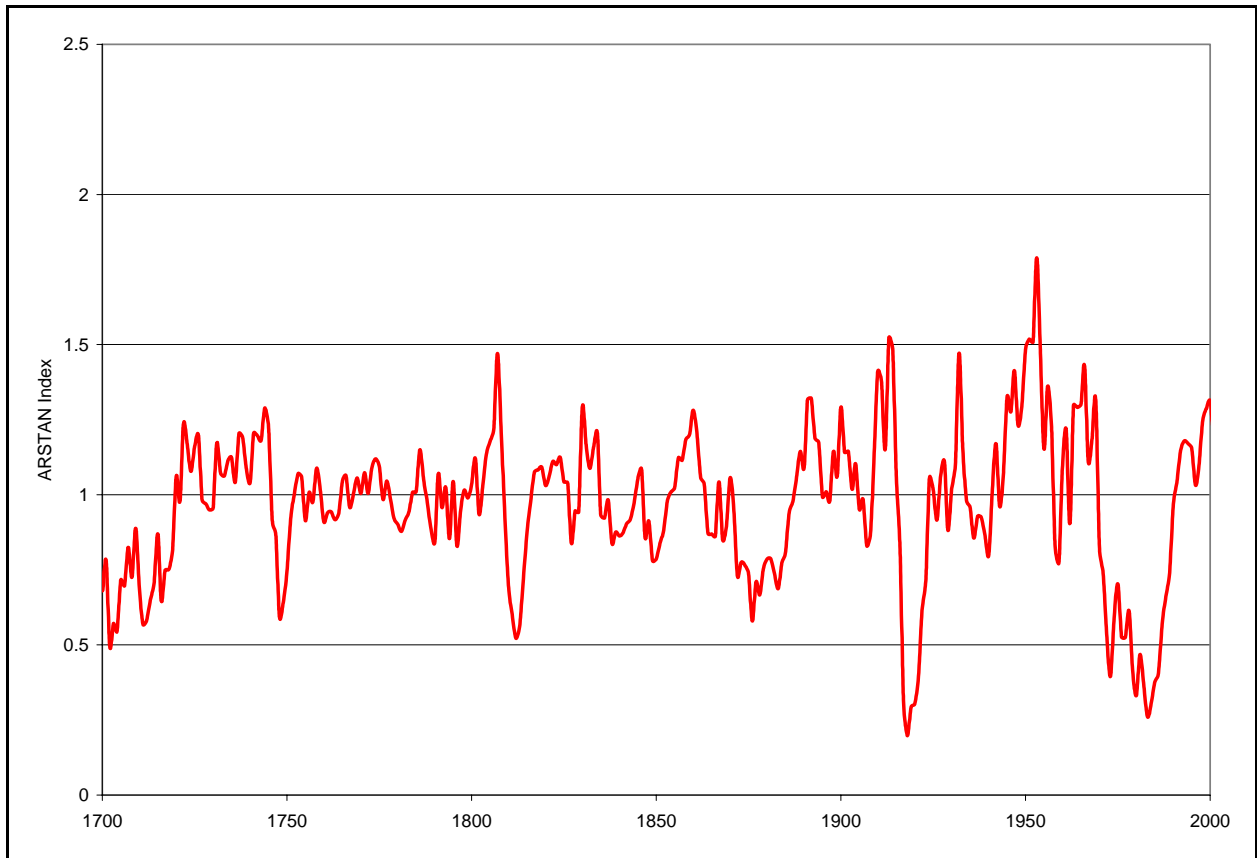


Figure 9: Combined master chronology for red spruce in New Brunswick and southwestern Nova Scotia.

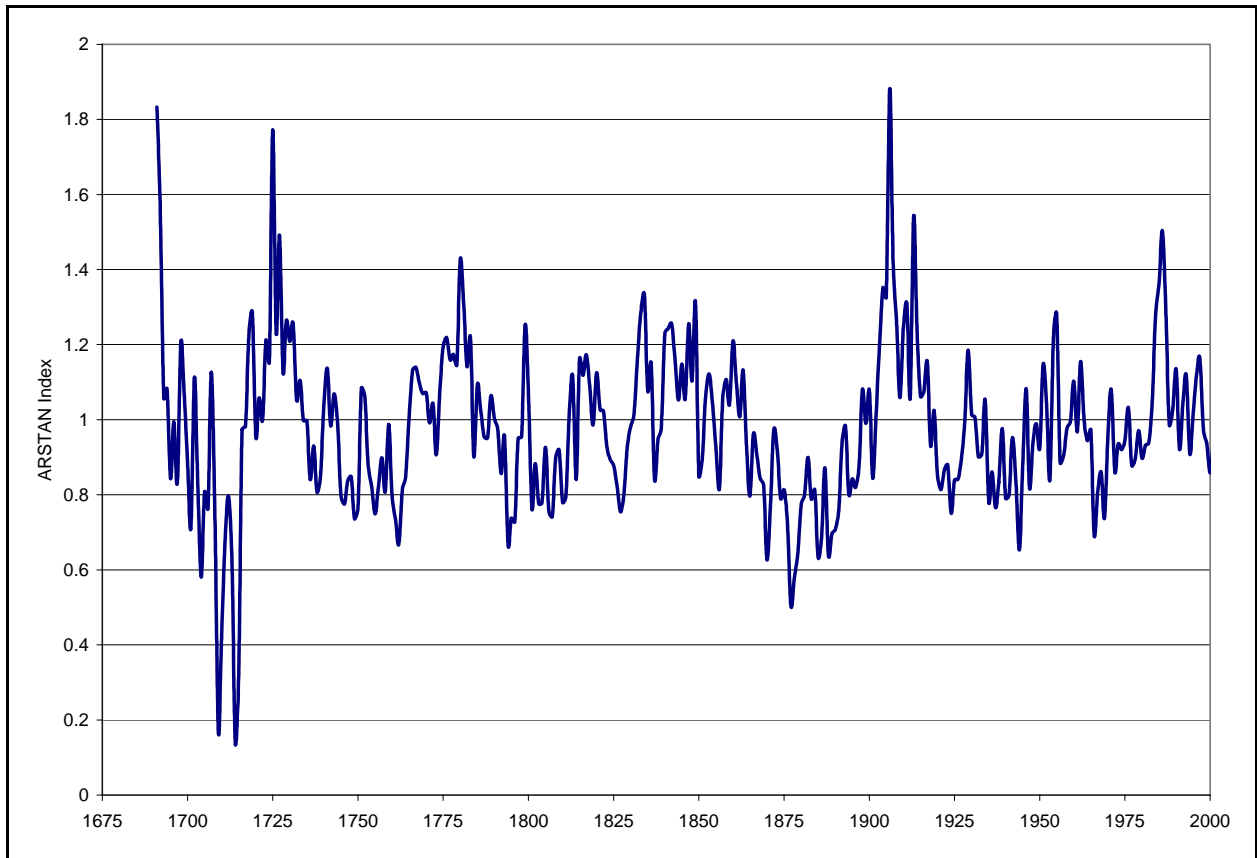


Figure 10: Master chronology for white pine in southwestern Nova Scotia.

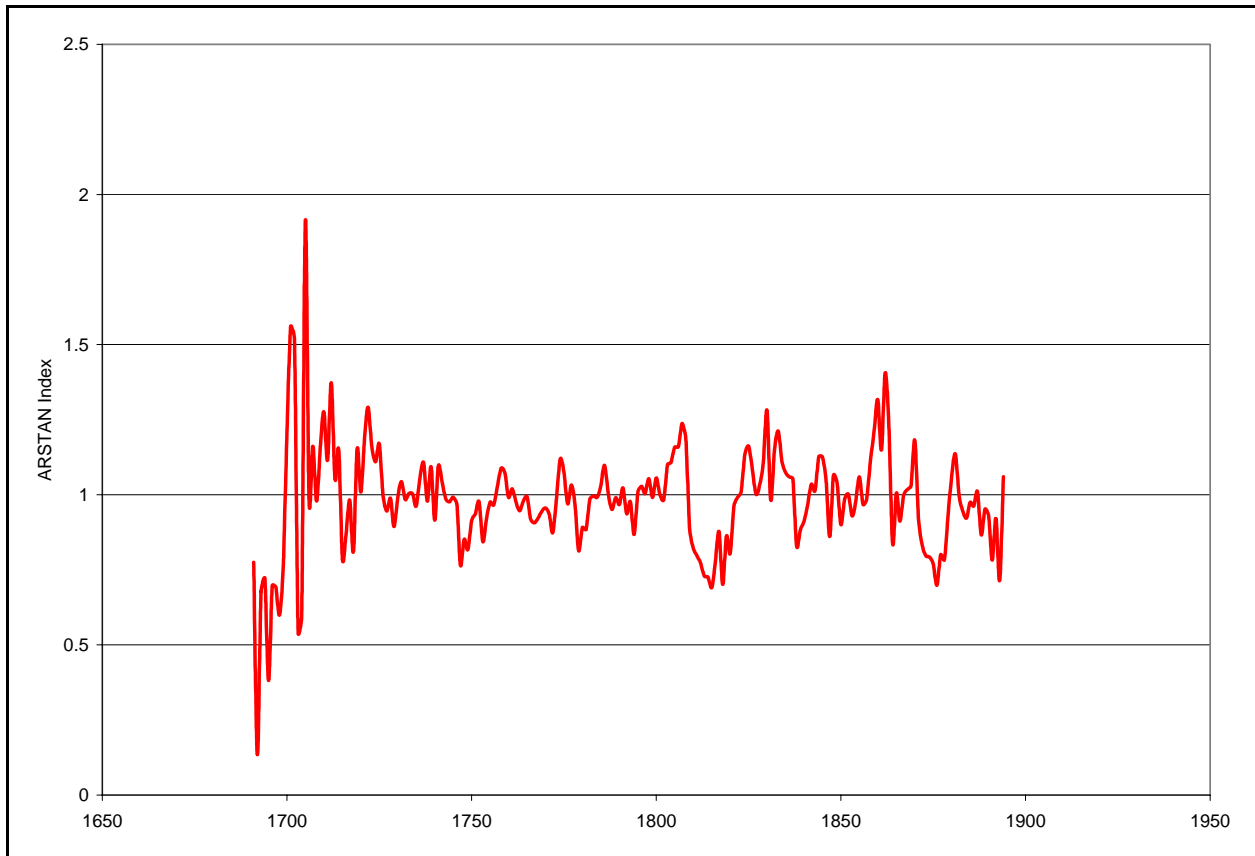


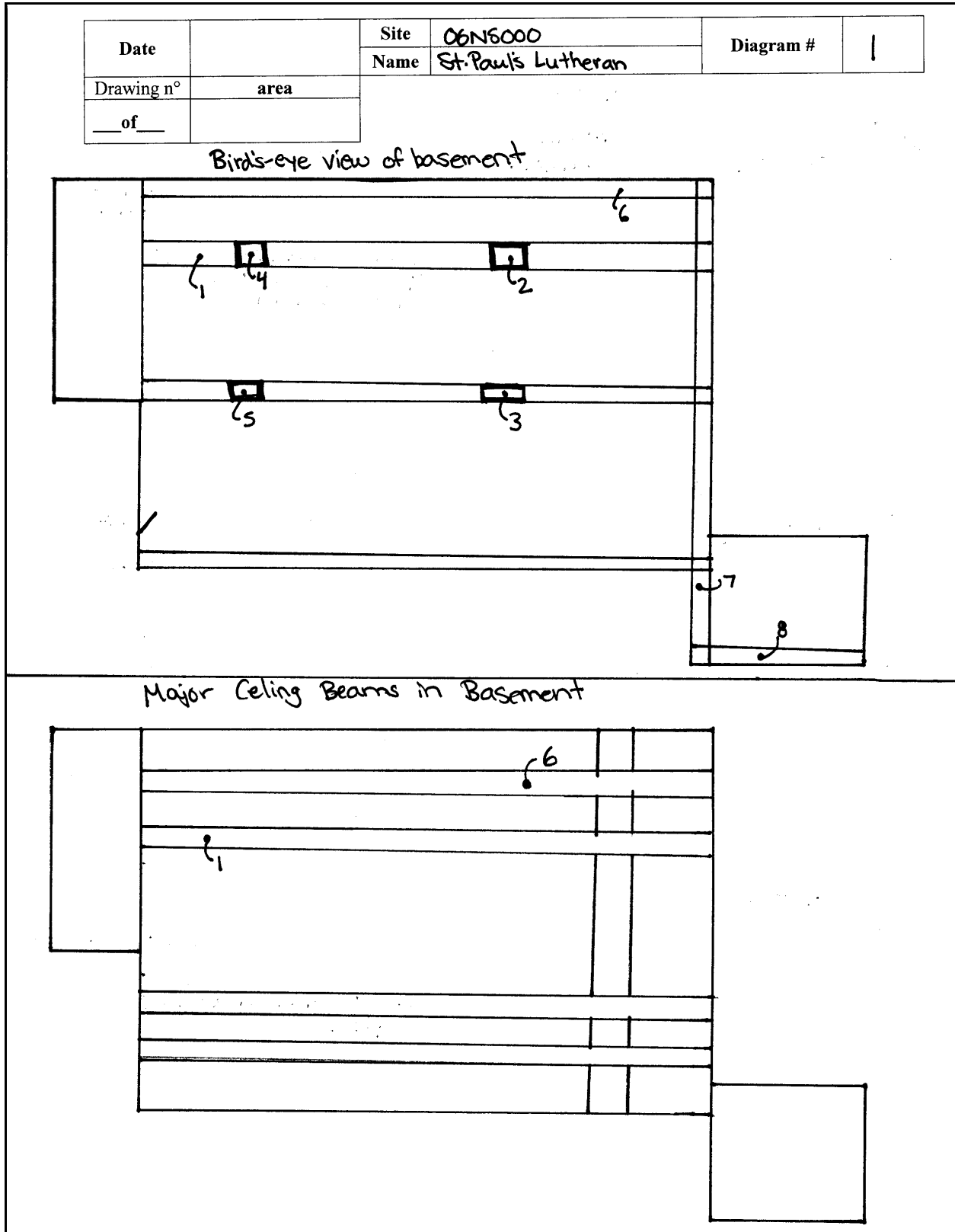
Figure 11: Master chronology for red spruce in southwestern Nova Scotia.

Conclusion

The master chronologies for red spruce and white pine in southwestern Nova Scotia will have a number of uses. If samples of these species from other structures in the region are found, it will be possible to place them into their respective chronology and thus determine the construction date of the structure. As well, these chronologies can be used to learn about climatic trends in the past, enabling us both to have a better understanding about past climates and to compare these trends to the current Atlantic climate.

We found that the wood in this church dated to the end of the growing seasons close to the construction date of the church of 1854 given by the parish records. Therefore, this record is confirmed.

Appendix



Appendix A: Diagram of St. Paul's Lutheran Church basement.