



**Mount Allison
Dendrochronology Lab**

Mad Lab Report 2006-30

A Dendroarcheological Analysis of Zion Baptist Church:
Yarmouth, Nova Scotia

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Abstract

Twenty tree-ring samples were taken from beams in Zion Baptist Church in Yarmouth, 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*) 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 1894-1895, supporting the records that the church was built in 1895.

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.

Zion Baptist Church in Yarmouth, Nova Scotia (MAD Lab #06QS000) 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 1895. 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: Zion Baptist Church, Yarmouth, N.S.

Research Methods

Samples were taken from a total of twenty 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 church's basement, 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. Although the bark on the samples collected gave some indication that beams were red spruce (*Picea rubens*), four samples were examined using a scanning electron microscope (SEM) to

confirm the identification. All samples were confirmed as to be red spruce, and it was inferred from this that all twenty beams were of the same species.

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 a red spruce chronology constructed by the MAD Lab from live trees and historical structures in New Brunswick and Nova Scotia.



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 ranged from 1894-1895 (Figure 3, Table 1). This suggests that the trees used in the construction of the church were cut down with the last growing years being 1894-95, approximately a year before 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 year before construction began. This fact confirms the parishioners' records of Zion Baptist Church being constructed in 1895.

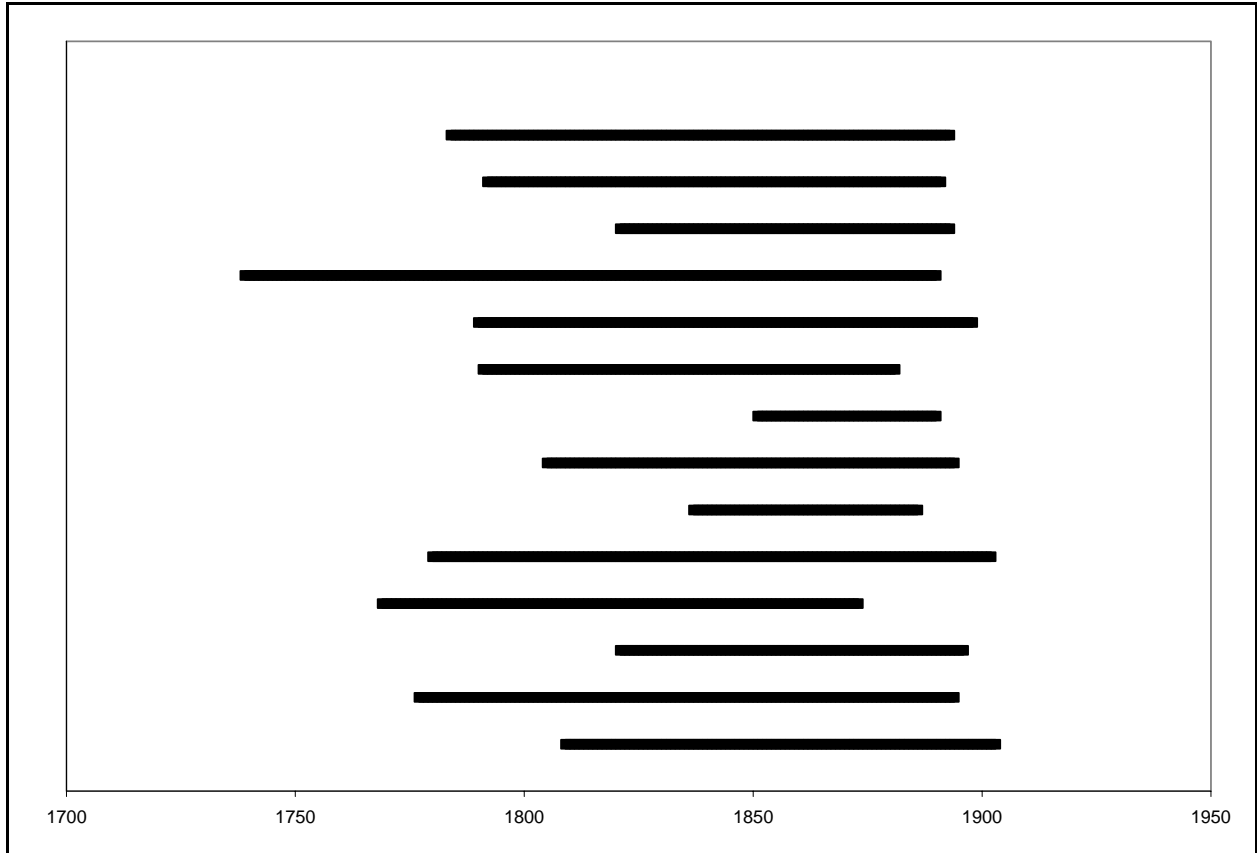


Figure 3: Life-spans of trees within beams in Zion Baptist Church.

<i>Sample Number</i>	<i>Location</i>	<i>Bark Condition</i>	<i>Species</i>	<i>Crossdated Interval</i>
06QS001	basement	bark present	Red spruce	1809-1903
06QS002	basement	bark present	Red spruce	1777-1894
06QS003	basement	bark present	Red spruce	1821-1896
06QS004	basement	bark present	Red spruce	1769-1873
06QS007	basement	no bark present	Red spruce	1780-1902
06QS009	basement	no bark present	Red spruce	1837-1886
06QS010	basement	bark present	Red spruce	1805-1894
06QS014	basement	no bark present	Red spruce	1851-1890
06QS015	basement	no bark present	Red spruce	1791-1881
06QS016	basement	no bark present	Red spruce	1790-1898
06QS017	basement	bark present	Red spruce	1739-1890
06QS018	basement	bark present	Red spruce	1821-1893
06QS019	basement	bark present	Red spruce	1792-1891
06QS020	basement	bark present	Red spruce	1784-1893

Table 1: Data on samples collected from beams within Zion Baptist Church.

Once the cut years of the trees were determined, it was possible to create a floating chronology for the “stand” (Figure 4). This shows the average growth patterns for all of the red spruce samples within the beams of the church.

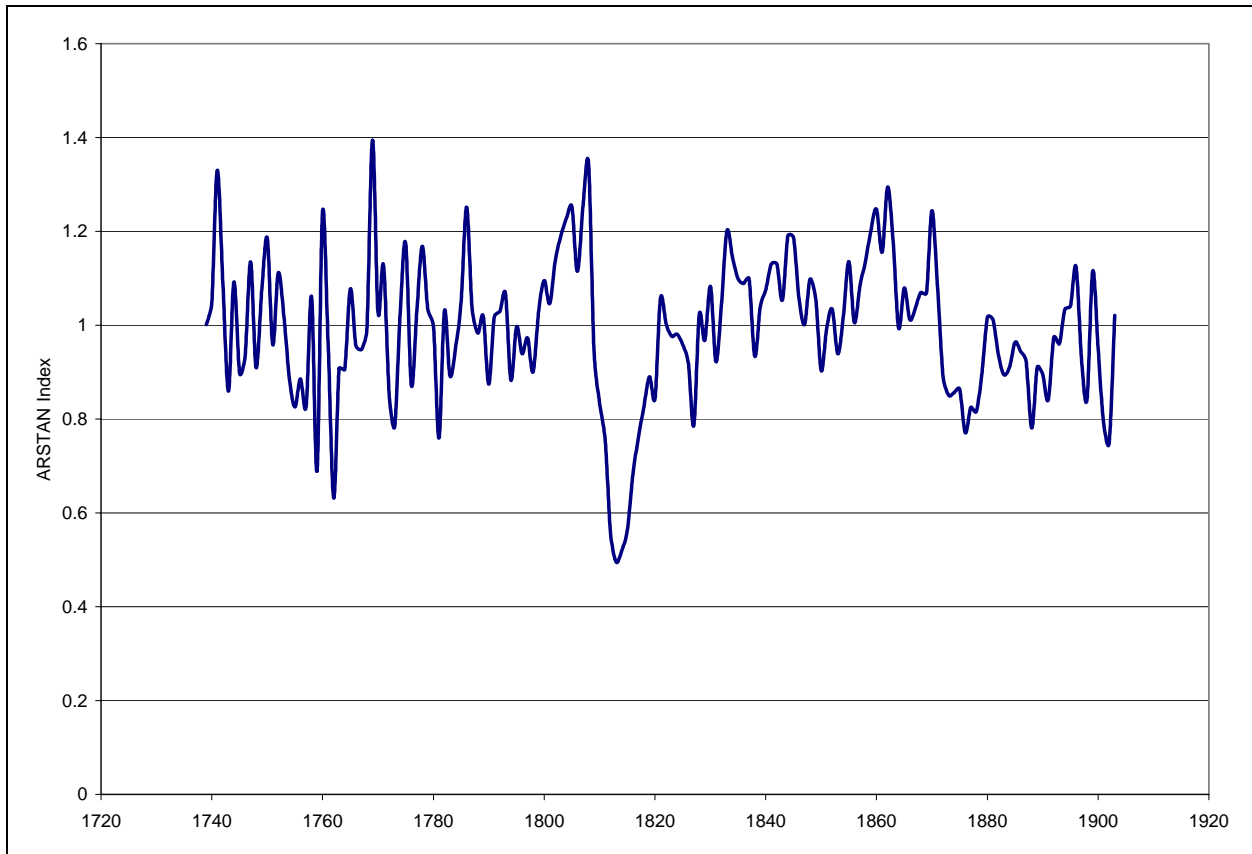


Figure 4: Floating chronology for red spruce in Zion Baptist Church.

The beams from this church effectively contribute to the two of the project’s objectives which are to increase red spruce sample depth in Nova Scotia and to create a master chronology specific to southwestern Nova Scotia (Figure 5). All beams crossdate into the live chronology with a significance ranging from 0.133-0.378 (90% confidence of significance at 0.21). Out of the fourteen samples, nine achieve 90% significance or higher, with correlations to the live chronology above 0.21. The reason that the significance levels are not higher than 90% is likely that the live chronology is 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.

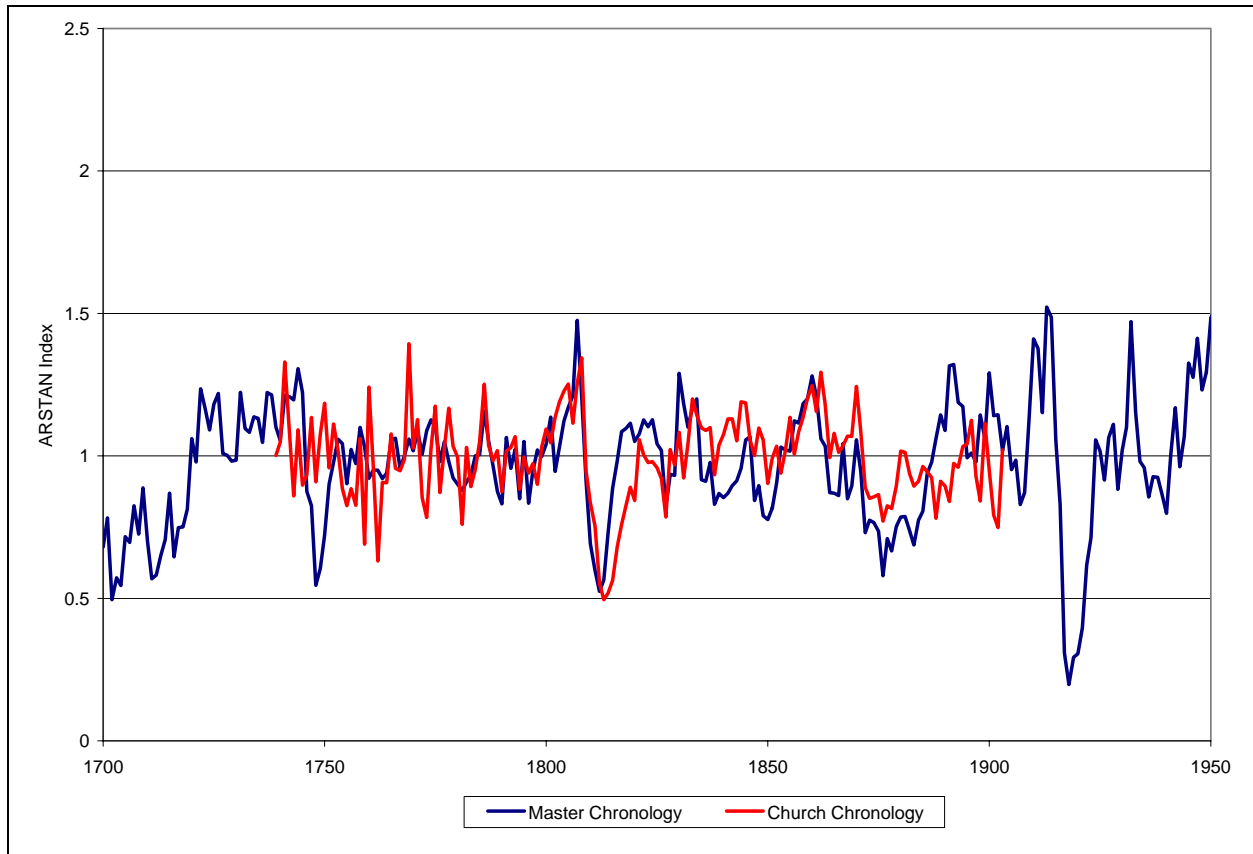


Figure 5: Overlap of the master and church chronologies shows similar growth patterns.

By combining the master and church chronologies, it was possible to develop a master chronology for red spruce in New Brunswick and Nova Scotia (Figure 7). The overall correlation of this chronology is 0.479, which is much higher than the 0.3281 required for 99% confidence of significance.

From the church chronology constructed from Zion Baptist Church as well as the chronologies constructed from the other churches sampled in southwestern Nova Scotia, it was possible to make a master chronology specific to the region (Figure 8).

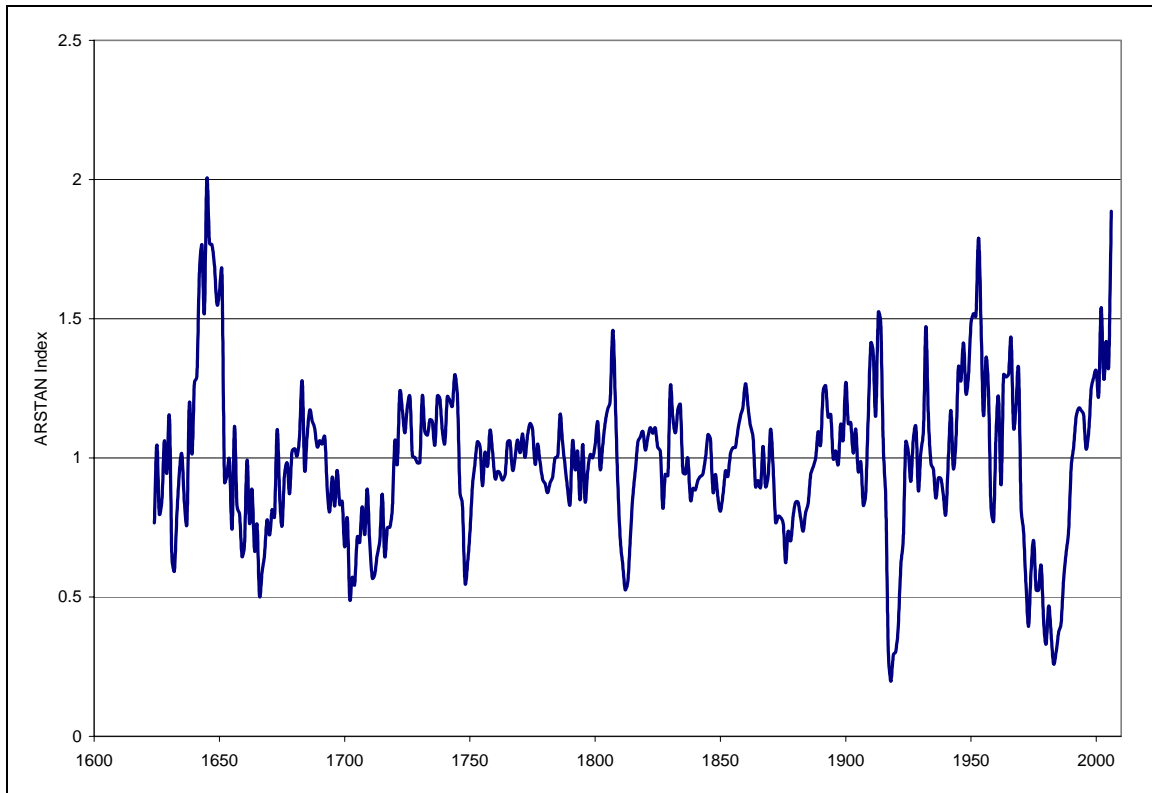


Figure 6: Combined master chronology for red spruce in New Brunswick and Nova Scotia.

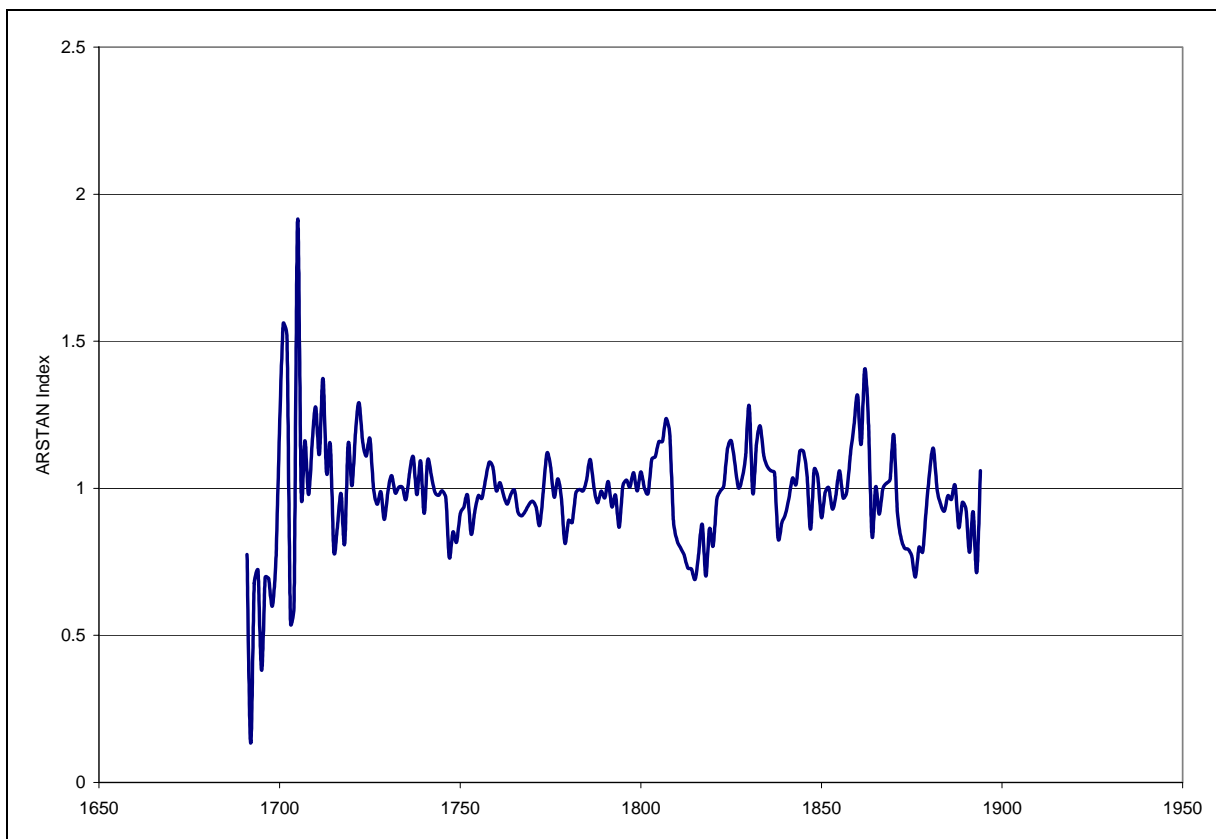


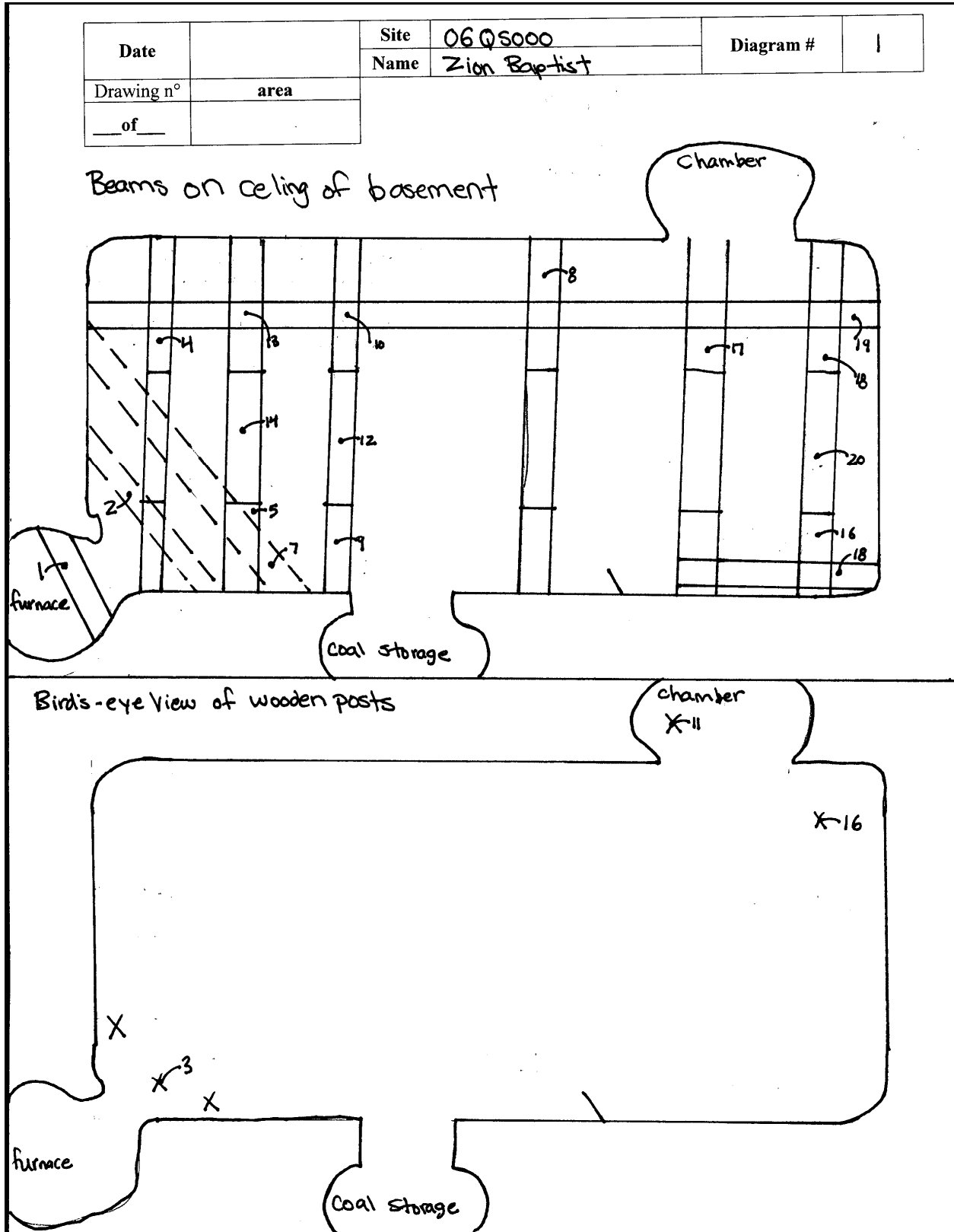
Figure 7: Master chronology for red spruce in southwestern Nova Scotia.

Conclusion

The master chronology for red spruce in southwestern Nova Scotia will have a number of uses. If red spruce samples from another structure in the region are found, it will be possible to place them in this chronology and thus determine the construction date of the structure. As well, this chronology 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 the this church dated to the end of the growing season of 1894-1895 and this means that the construction date of the church of 1895 given by the parish records, is confirmed.

Appendix



Appendix A: Diagram of Zion Baptist Church basement.