DATING THE GRAND-PRÉ ABOITEAU WITH THE USE OF DENDROARCHAEOLOGY

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MAD Lab Report 2008-03

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Abstract

An aboiteau found at Grand-Pré Nova Scotia in May 2006 was dated by dendrochronological methods. Two sections from the aboiteau were analysed: the sluice and one of the support logs. The sluice is made of white pine and has a cutting date of 1686. The log is red spruce and was cut in 1682.

Introduction

In May 2006, an aboiteau was excavated by chance during the digging of a drainage ditch in the Grand-Pré marshes. This remarkable find made it the object of an archaeological research led by Jonathan Fowler of which a full account is given in a report (Fowler, 2006) (Figure 1). An important issue about the site is how old is it exactly? For sure, it was in one of the earliest areas to have been dyked by the Acadians who arrived around 1682. According to Dr Sherman Bleakney (Bleakney, 2004, and personal communication, 2006) who mapped various features of the Grand-Pré marshes, the aboiteau is within an enclosure made by the Acadians that was completed by 1693, but it also could be as old as the mid-1680s, not long after the Acadians started to build the dykes in the marshes. In an attempt to have a more precise date or even a confirmation of the period within which it was constructed, the Mount Allison Dendrochronology Laboratory was approached to use its expertise in tree-ring research and dating old wooden structures to investigate the aboiteau in question.

Figure 1: A view of the aboiteau remains during the archaeological excavation. *(Photo: Jonathan Fowler)*

Sampling

The excellent preservation of the structure made it possible to analyze not only the sluice but also an associated log that served as a support structure. Sampling was

carried out the 9th of June 2006 at the Grand-Pré national Historic site where the recovered portions of the sluice were being processed for preservation. We took core samples using a manual increment borer (Figure 2), two on the sluice and two on the log. Both artifacts seemed to have the last growth rings: the log had bark and the sluice had the smooth curved surface typical of the wood under the bark. Cores were carefully placed in plastic straws, labeled and taken back to the lab to slowly air dry.

Figure 2: Extraction of a core form the log. *(Photo: Jonathan Fowler)*

Laboratory analysis and results

Wood identification

Excess wood fragments taken from cores were cut with a razor blade on a wooden bloc under a dissecting microscope to expose the tangential and radial sections of the wood. The best pieces were glued on a metal stub and taken to the Mount Allison Digital Microscopy Facility where they were prepared for viewing under a Scanning Electron Microscope (SEM). The SEM enables precise wood identification through the recognition of species-specific cell features and structures. The identification of the wood is important because different species have different growth reactions to climatic variables. When the species is known, it allows us to crossdate the samples with the proper reference chronology with more accurate results. Additionally, it informs us on the type of wood used in the aboiteau construction.

Anatomical features revealed characteristics typical of pine for the sluice (Figure 3). Observations on the cross section from sanded cores show that the early wood/late wood transition is gradual which further suggests that it is white pine (*Pinus strobus*). SEM analysis on the log revealed that it is red or black spruce (Figure 4). Bark remnants suggest that it is red spruce (*Picea rubens*).

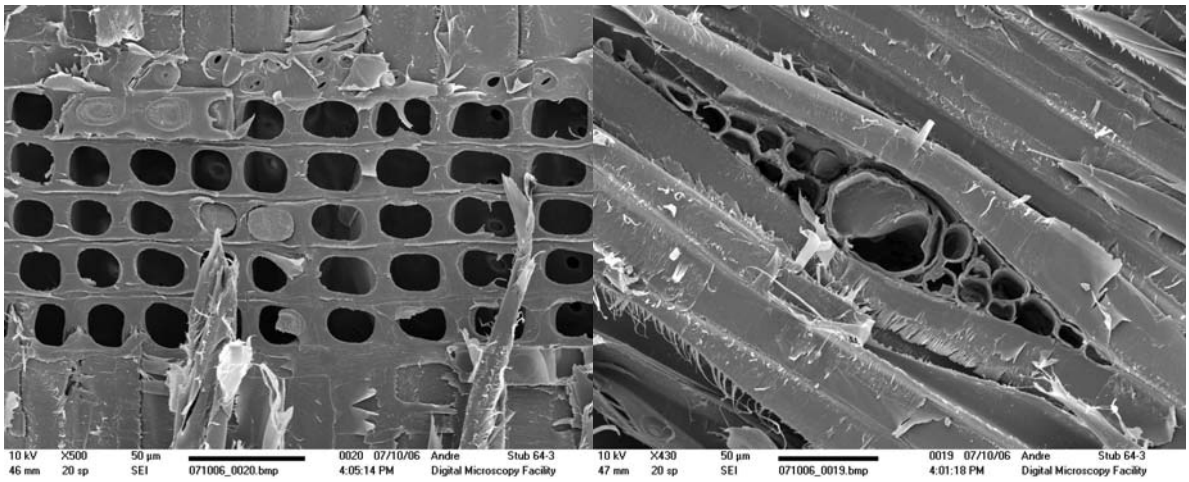

Figure 3: A) Radial view of a wood fragment from the sluice. Close-up view of a ray showing large pinoid pits typical of some pine species. B) View of a large resin canal, also typical of some pine species.

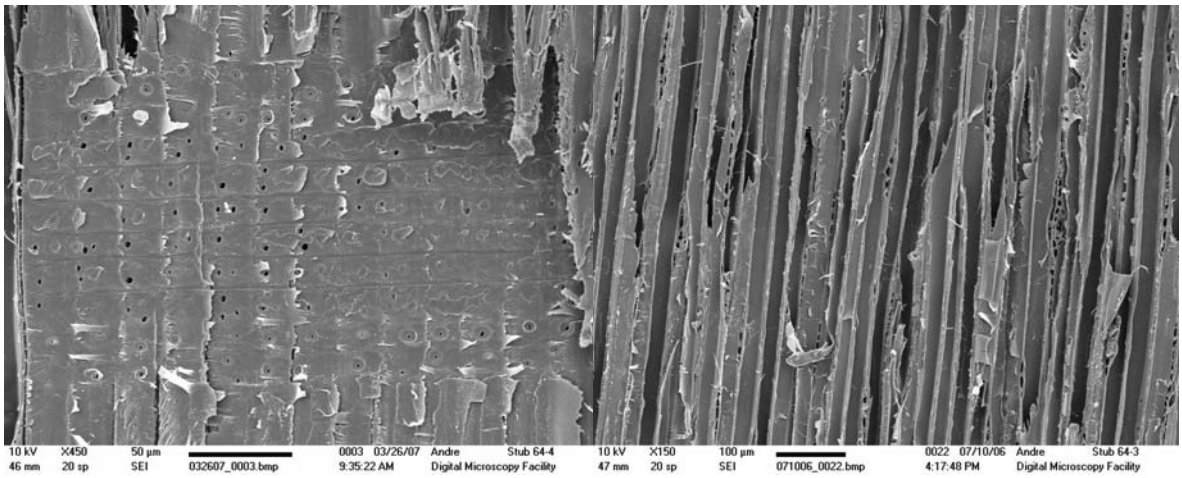

Figure 4: A) Radial view of a wood fragment from the log. Ray cells display piceoid pits and are fringed by several rows of transverse tracheids. B) Tangential view showing rays and a small resin canal at the right. Both features are common in red spruce.

Dating of the structure

The cores brought back to the lab were glued on grooved wooden mounting canes after drying. Mounted cores were progressively sanded with sandpaper of increasingly fine grain to expose the annual ring-growth patterns. The annual rings were measured using a 24 inch movable Velmex Stage hooked up to a digital encoder to an accuracy of a 1/1000 mm. Raw data was captured by J2X software and put into standard tree-ring decadal format and then standardized with the use of ARSTAN software (Holmes *et al*., 1986).

The data from the sluice and the log were visually compared using the graphic software DeltaGraph® and showed remarkable similarities in patterns (Figure 5). Comparison of different species sometimes gives positive significant correlations or similar growth curves like in this case. Relative curve placement also suggests that the two pieces of wood are nearly the same age (four years difference).

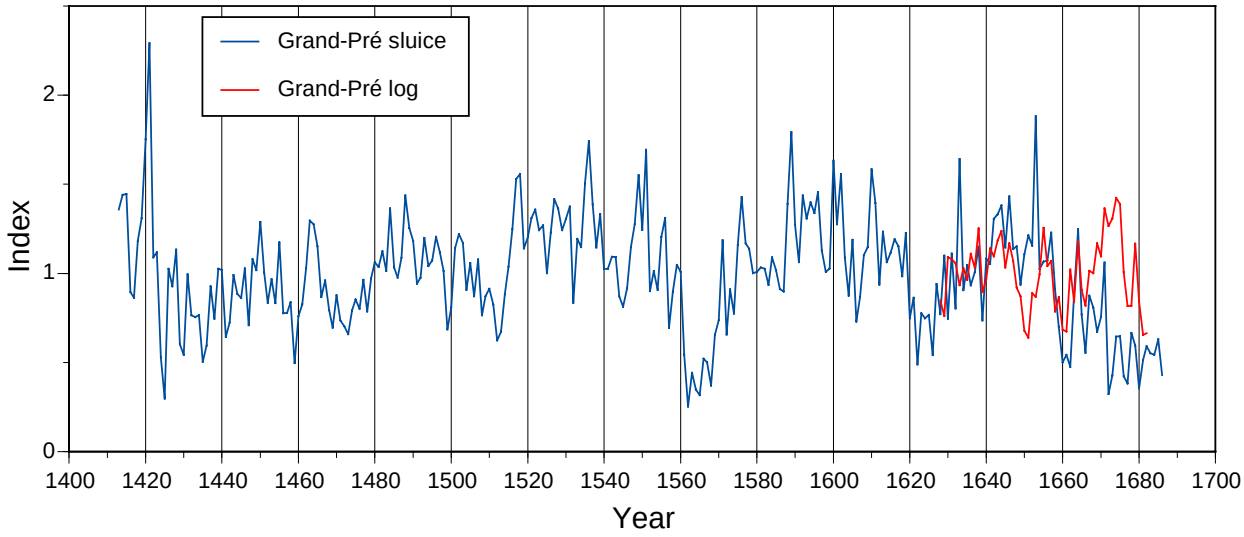

Figure 5: The Grand-Pré sluice and log standardizes growth curves plotted against each other. Visual curve fitting suggest a four years difference between the two artifacts.

The average ring width of the sluice was also relatively low (1.46 mm) which suggest the tree was living in stressful environmental conditions such as very humid or poor soils and/or in a dense perhaps old-growth forest. The latter is further supported by the relatively large number of rings counted in the sample (274) with possibly many more since the pith of the tree was missing from the sluice.

Ring-width data from both samples was also crossdated against regional reference chronologies using the software COFECHA (Holmes *et al*., 1986). We also visually tested pattern matches of the line graphs of the series with the reference chronologies to verify all crossdating outputs from COFECHA.

The best fit for the log was with the Soullard local red spruce chronology from Annapolis Royal (Robichaud and Laroque, 2008) and gave a cut date of 1682 (Figure 6). As for the sluice, the best fit was made with the Halifax Government House white pine chronology developed recently (Robichaud *et al*., 2008). A cut date of 1686 is suggested (Figure 7) and is consistent with the four years difference between the sluice and the log.

An important point to make is that the last 15 rings of the sluice were extremely narrow. Although great care was taken to measure the rings accurately (we used a razor blade in that zone to expose the ring cells), it is potentially possible that a ring or two might be missing in that area,

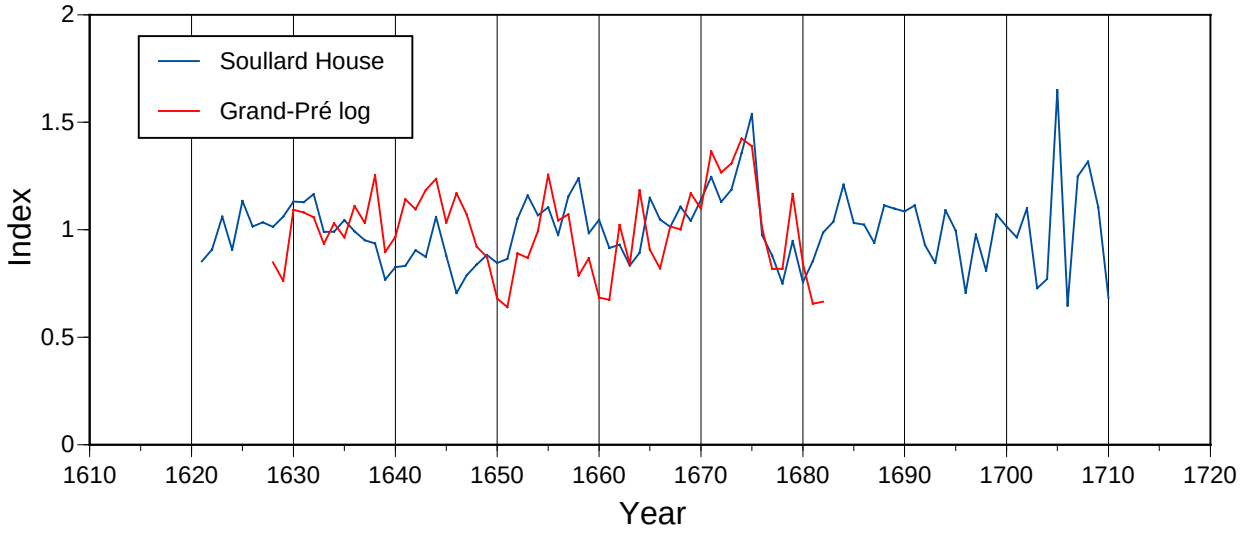

Figure 6: Mean standardized ring-width curve of the Grand-Pré log (in red) compared to a red spruce master chronology from Annapolis Royal. The end date of the log sample is 1682.

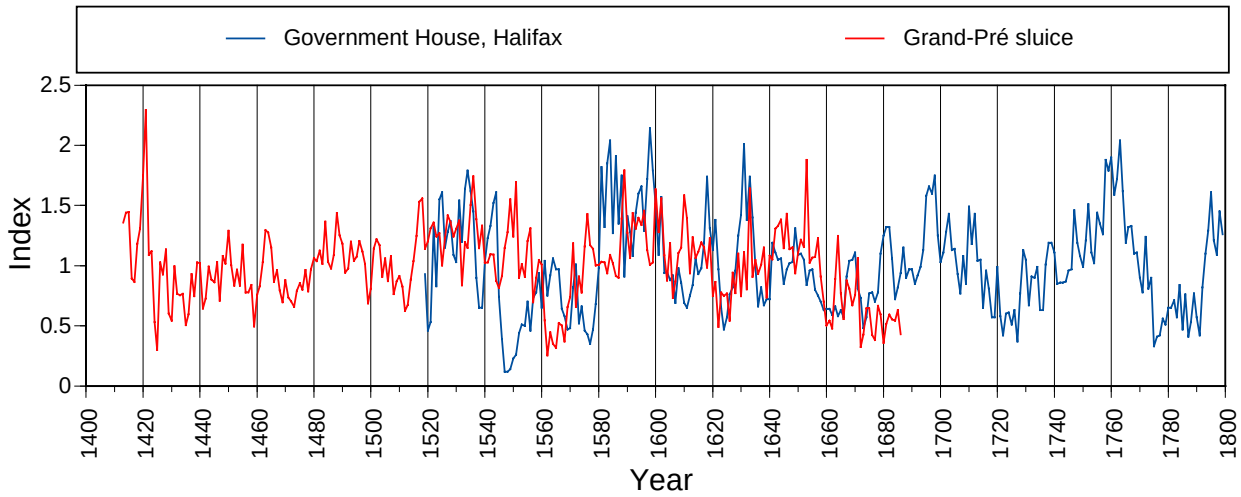

Figure 7: Mean standardized ring-width curve of the sluice (in red) compared to a white pine master chronology from Halifax. The end date of the sluice sample is 1686.

Conclusion

The dendroarchaeological investigation of the Grand-Pré aboiteau exhibited the following results:

Aboiteau part	Cut date	Wood type
Sluice	1686	White pine
Log	1682	Red spruce

The cut date represents the year when the tree was felled and is sometime used as a minimum construction date. In buildings, the wood is usually left to dry for a season to a few years so that the wood doesn't distort after being incorporated in the structure. That might not have been necessary for the construction of the aboiteau as by design it was meant to be waterlogged in place. We suggest that the construction of the aboiteau was most likely conducted soon after the cutting of the trees, in this case 1686 which is the youngest date of the two artifacts. Caution must still be made with the cutting date of the sluice because of potentially missing rings in the area of very low growth observed on the core. This being said, the dendroarchaeological study of the sluice confirms earlier assessments of it being made after the mid-1680s and before 1693, with the possibility for a construction date as early as 1686.

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