MAD Lab Report 2005-01

Tree Ring Dating of a Submerged Tree Stump from Ilse Madame, Cape Breton Island, NS

By

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Introduction

The Mount Allison Dendrochronology Lab (MAD Lab) was contacted to process a tree stump that was collected by Eric Force in a small bay along Lennox Passage between Cap Ronde and Gull Cape on Ilse Madame, Cape Breton Island, NS. The tree stump was reported to be the largest and most sound of a series of wooden pieces at the site, and was believed to be a stump judging by the vertical orientation of the bole and probable *in situ* rooting. The stump is of interest because if it can be dated, the rate of erosion at the site may be able to be approximated.

For this reason, the MAD Lab processed the sample using standard dendrochronological methods to determine a kill date for the sample. The process was broken into three steps, 1) determining the species of the sample, 2) extracting a ring pattern of radial growth for the sample, and 3) pattern matching (crossdating) the sample's ring record into an existing base chronology for the region.

Sample Preparation and Analysis

The sample arrived at the MAD Lab after being in cold storage at the Bedford Institute of Oceanography in Dartmouth, NS, and was assigned the MAD Lab sample number 05AA001. The sample was broken and saturated with water, but each of the pieces was of sufficient size that the whole of the sample could be carefully reassembled. The sample was then held together in its proper position with duct tape and slowly dried in a drying oven for 48 hours at 50° C.

The sample was examined under a microscope to try to discern the anatomical characteristics of the wood, but due to mastication and degradation of the surface of the sample, conventional microscope analysis failed to positively identify the species. It was therefore decided that a more detailed anatomical analysis was needed to establish the sample's species.

SEM Analysis

A Scanning Electron Microscope (SEM) analysis was conducted in conjunction with the Digital Microscopy Facility at Mount Allison University (http://www.mta.ca/dmf/). Tiny fragments of the sample were used to establish cellular level views of the transverse, radial, and tangential sides of the wood, as a detailed view of the anatomical structures of wood allows identification to the species level in most cases.

Measurement Preparation

To prepare the sample for ring measurement, the disc was sawn flat and sanded with progressively finer sanding paper until a smooth polished finish was obtained. The sample was then buffed to remove any sanding dust and a final polish was applied to prepare the sample for scanning in a WinDendro™ analysis.

Results

SEM Results

MAD Lab sample 05AA001 was identified as balsam fir (*Abies balsamea*) on the basis of the following criteria:

- resin ducts are absent (Figure 1) which would eliminate the pine, spruce and larch species.
- transverse tracheids on the rays are absent (Figure 2) which would eliminate the hemlock species.
- pits on the ray parenchyma cells are of the cupressoid and piceoid type (Figure 3), and the height of the rays on the tangential view are higher than in the cedar species (Figure 1) which would eliminate the cedar species.
- Therefore the only species that all of the characteristics agreed with were balsam fir (*Abies balsamea*), a species common to that region of Cape Breton.

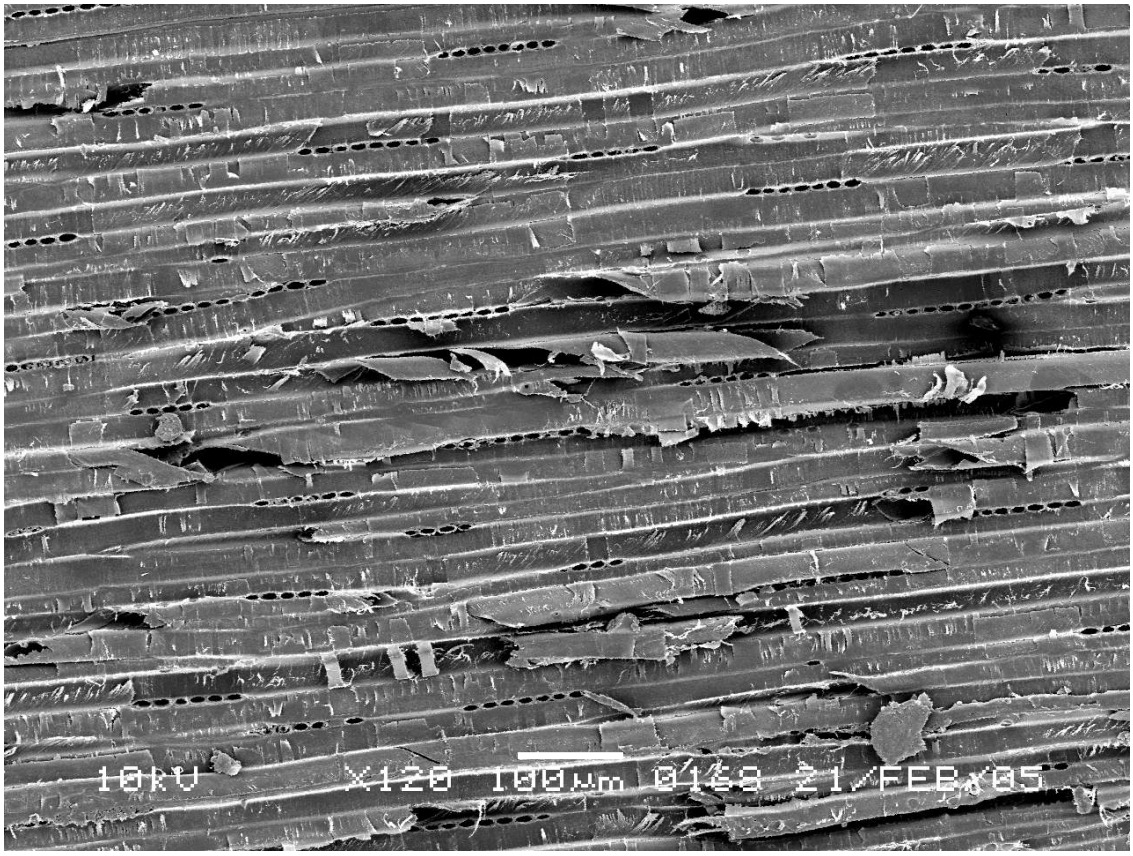

Figure 1 - Tangential view magnified at 120 X. Resin ducts are absent and the height of the rays (here from 4 to 12 cells, but we counted some up to 16) are greater than in cedar which are generally less than 6).

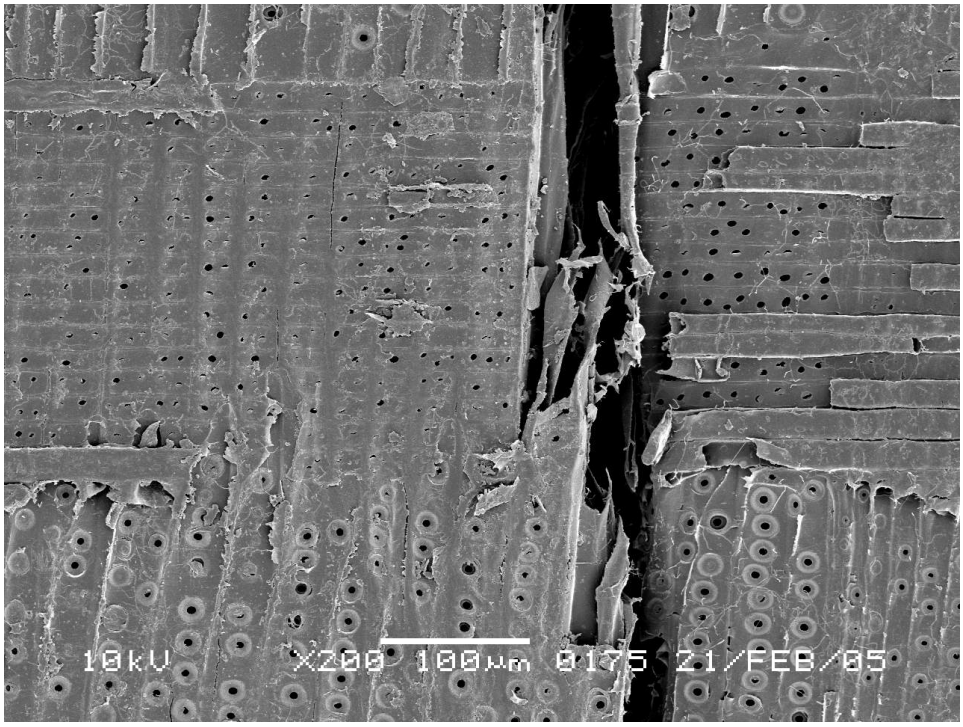

Figure 2 - Radial view magnified at 200 X.. The rays shown here have no transverse tracheids, as all of the other rays that we looked at do. Pits on the rays cells are of the cupressoid and piceoid type. Figure 3 displays a closer view of the pits.

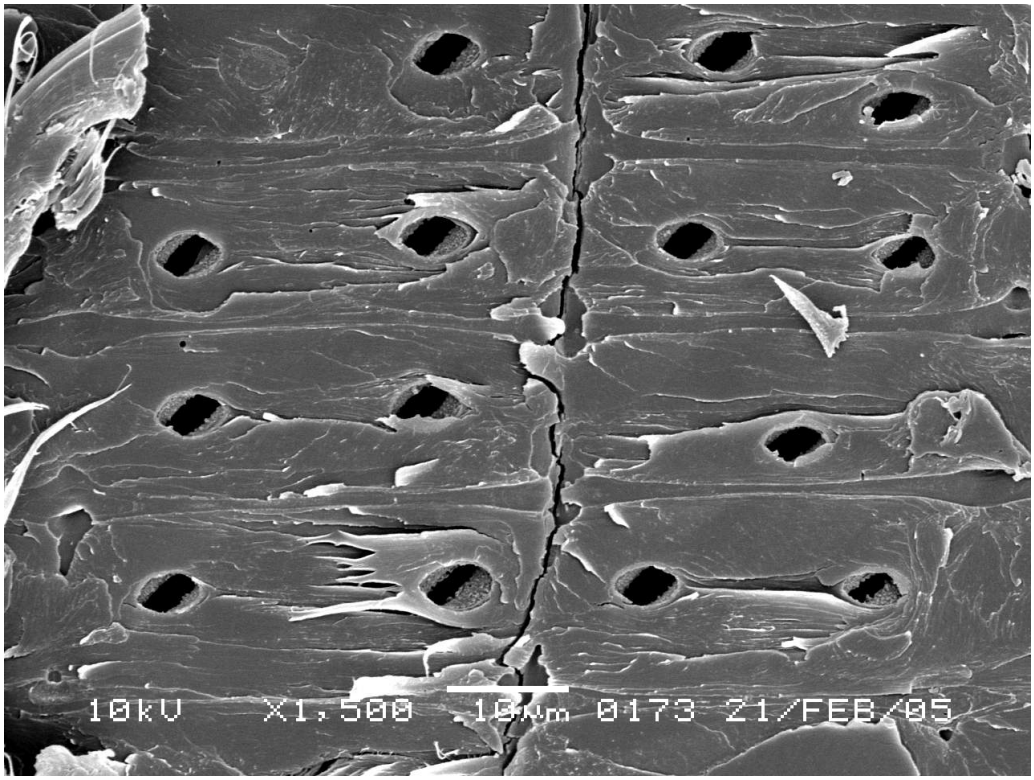

Figure 3 - Radial view magnified 1500 X. Pits on the rays cells are of the cupressoid and piceoid type.

Ring Measurements

Radial growth was measured using a WinDendro™ (Version 2004a) system which is a semi-automated image analyzing system, consisting of a high-resolution scanner and a computer algorithm that is capable of determining ring boundaries on the scanned image of a sample. Since the sample's rings were not unusually small, the sample was scanned a relatively low resolution of 400 dpi. Four paths (radii) were measured that tried to take in the most rings possible on the sample. The four paths were able to distinguish slightly different numbers of rings: Path A - 62 rings, Path B - 64 rings, Path C - 64 rings, Path D - 60 rings (Figure 4a-d).

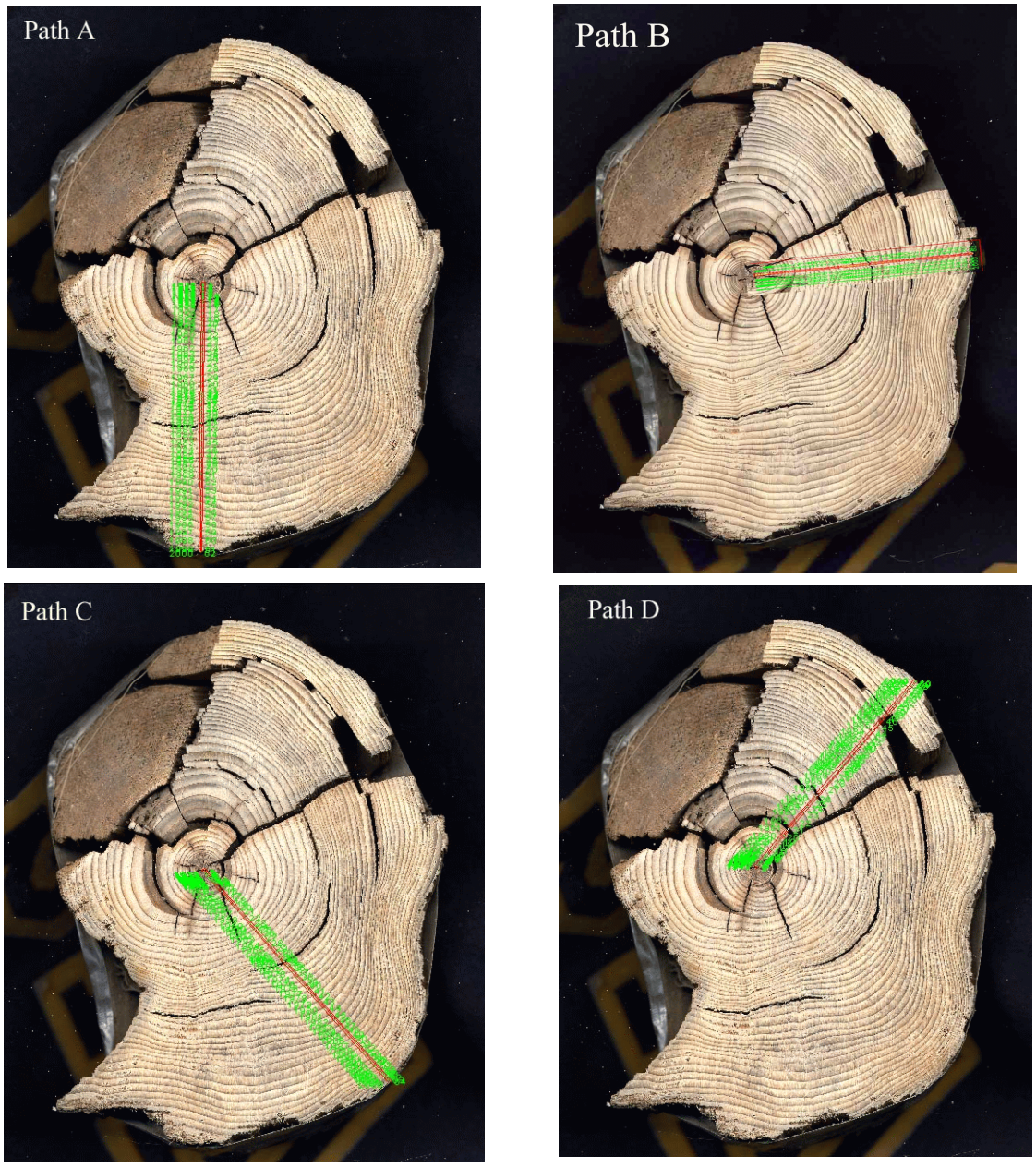

Figure 4 - The direction of the four paths measured on the 05AA001 sample to establish the highest number of rings present.

The ring-width measurements of each paths were pattern matched with each other to determine if the ring widths were showing the same general configuration within the sample. The analysis established this fact (Figure 5) and the measurements were deemed robust enough to attempt crossdating with a living chronology of balsam fir trees from within the region.

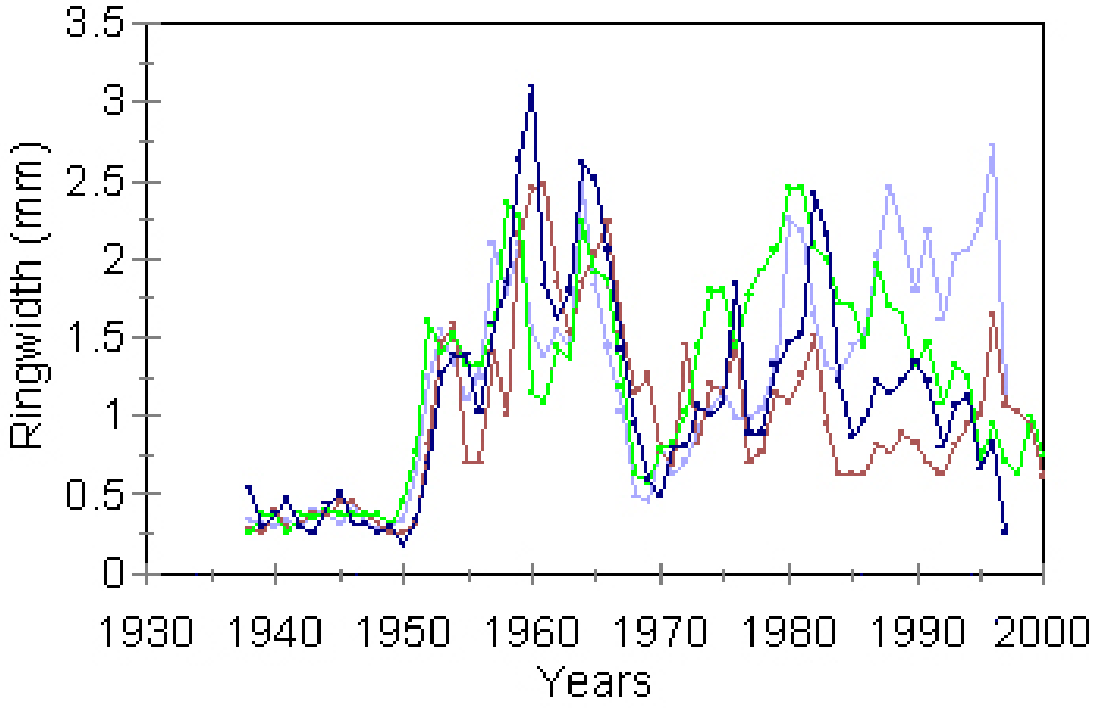

Figure 5 - Ring-width measurements of the four paths establishing a common growth pattern that will be able to be cross-dated into a regional master chronology of balsam fir from Nova Scotia. Note: for this analysis, each path was arbitrarily assigned a final date of approximately 2000.

Cross-dating

The closest living chronology of balsam fir from Nova Scotia in the MAD Lab archives was from Horse Lake, Nova Scotia in the Harmony Lake area of southwestern Nova Scotia. The master chronology (MAD Lab 04AHL300) has a strong common growth signal (r = 0.503 for 50 year segments, with values higher than 0.3281 significant at the 99% confidence interval). The four paths from the unknown Ilse Madame sample crossdated into the master chronology, giving a statistical match with the living chronology of Path A - 0.243, Path B - 0.332, Path C - 0.322, and Path D - 0.418. Again all values over 0.3281 are statistically significant at the 99% confidence interval. It is felt that the patterns of the undated samples reliably fit into the pattern of the master chronology. Some of the individual path's correlations are weak, but since the overall patterns of the four paths of the undated sample illustrate a close similarity to each other, it is thought that overall the samples is well placed in time. It was hoped that a stronger correlation between the master chronology and the paths of the undated sample would have been found, but the distance from the Cape Breton site to the southwestern Nova Scotia site, probably reduces the overall ability of the patterns to match.

The kill dates of each of the paths are displayed in Table 1. Final calendar kill dates of the paths range from 1975 to 1979.

Table 1 - The length of each path and the cross-dated kill date of each of the four paths in the study.

Path	Age	Calendar Date
A	62	1916-1977
B	64	1916-1979
C	64	1916-1979
D	60	1916-1975

Conclusion

All evidence points to this tree dying in or slightly after 1979. The exact year will always be inconclusive though, as there is no bark remaining on the masticated outer edges of the bole section. If there was bark remaining, or anatomical structures such as beetle galleries (that are produced between the last growth ring and the actively growing bark), one could conclude that the exact kill date was the last remaining ring or 1979. In this case though, with the condition of the outside of the stump stripped of its bark, probably by the wave action in the littoral zone where the stump was found, an exact date of death will never be conclusively obtained.

It is in our estimation though, that the death date is probably close to the 1979 date because of the shape and condition of the wood. With this in mind, our best guestimate puts the death date at approximately 25 years ago, which should help in at least establishing a rough range of dates to help calculate shoreline recession rates in the area.