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A Dendroarchaeological Study of Wood from Fort Lennox National Historic Site, Île-aux-Noix, Québec

Emilie Young-Vigneault, Louise Filion, and Allison Bain

*Samples of wood excavated from the Fort Lennox National Historic Site, on Île-aux-Noix in the Upper Richelieu River, were entrusted to Université Laval by Parks Canada for tree-ring analysis in 2004. These samples consisted primarily of coniferous species, namely 29 samples of white cedar (*Thuja occidentalis*), 18 of white pine (*Pinus strobus*), and a single sample of hemlock (*Tsuga canadensis*). Tree-ring and historical data suggest an alternative explanation for the use of this wood than that originally proposed by archaeologists. The wood originally was thought to have been part of a late 18th-century structure that was torn down, and the wood thrown into a water-filled ditch during site renovations in 1812–1814. In fact, the deposit may be associated with preparations for the construction of Fort Lennox in 1819.*

*Une collection de bois archéologique en provenance du lieu historique national du Canada de Fort Lennox à l'Île-aux-Noix dans le Haut-Richelieu a été confiée à l'Université Laval par Parcs Canada à des fins d'analyses dendrochronologiques en 2004. Cette collection comprenait surtout des bois de conifères, à savoir 29 échantillons de thuya occidental (*Thuja occidentalis*), 18 de pin blanc (*Pinus strobus*), et un de pruche du Canada (*Tsuga canadensis*). Les données dendrochronologiques et historiques permettent de proposer une explication alternative à celle mise de l'avant par les archéologues quant à l'utilisation de ces bois archéologiques qui auraient été jetés dans un fossé humide bordant la redoute ouest construite en 1782–1783. En effet, ce dépôt de bois pourrait être associé à la préparation du terrain pour la construction du Fort Lennox en 1819 plutôt qu'aux travaux de restauration survenus en 1812–1814.*

Introduction

In 2003, the excavation of several pieces of well-preserved wood at the Fort Lennox National Historic Site of Canada, on Île-aux-Noix in the Upper Richelieu Valley in Québec, Canada, presented the opportunity to conduct tree-ring analyses. This study had two objectives: (1) carry out dendrochronological analyses to identify and date the recovered wood, and (2) use the resulting tree-ring dating to reinterpret the fort's history, integrating archaeological and dendrochronological data with historical information on the use of wood by the British military.

Dendroarchaeology uses the growth-pattern matching of tree-ring series to determine felling dates of wood associated with historical and archaeological structures and, thereby, establish more precise construction dates (Stokes and Smiley 1968). The data represent an important means of testing archaeological interpretations. Samples for dendroarchaeological analyses must meet a number of criteria including the presence of sufficient numbers of samples with adequate ring counts (Baillie 1982). Several individual tree-ring sequences from samples of the same tree species and geographic region are measured, cross-dated, and compiled into chronologies. This compilation establishes local chronologies that are cross-dated with reference chronologies covering a larger geographic region to obtain a date range for the samples. A reference chronology is created from living trees, as well as historical and archaeological wood samples recovered from the same species. Living trees are an important part of the chronology, as they provide a fixed calendar date upon sampling, and they also provide a chronology with which to date historical and archaeologically recovered wood. Recent studies of military structures, such as forts and palisades (Mann 2002; Querrec et al. 2009), demonstrate that dendrochronological analyses can precisely date the construction of important structures or aid in interpreting significant historical events.

Tree-ring dating was employed here to date the main phases of Île-aux-Noix's expansion in the late 18th and early 19th centuries. The study was based on the hypothesis that the wood under examination was originally part of three British redoubts built in 1782 and a French fort built in 1759. This interpretation was suggested by previous Parks Canada archaeological excavations in 1995 and 2003 (Cloutier 1996; Guimont 2004). Furthermore, it was thought that specific woods were selected for different uses or functions. For example, white cedar (*Thuja occidentalis*) was chosen for the construction of palisades, while white pine (*Pinus strobus*) was used for building construction (Rousseau and Béthune 1977; Filion 1998; Paradis 2007). The possibility that some pieces of wood were reused also was considered. Wood reuse was common when palisades and forts, intended as temporary structures, were constructed in haste (Cloutier 1996; Querrec et al. 2009). The possibility that wood has been recycled could cause discrepancies in the tree-ring dates.

Historical Context

The French sought to secure New France along its main water courses, namely the St. Lawrence and Richelieu rivers (Kaufmann and Kaufmann 2007). The French constructed a series of forts along the Richelieu as it flows northward from Lake Champlain to the St. Lawrence and on islands in the river between 1665 and 1755. These forts included Fort Richelieu, Fort St. Louis (now Fort Chambly), Fort St. Thérèse, Fort l'Assomption, and Fort St. Anne. Throughout the 18th century, the island of Île-aux-Noix, just 11 km north of the Canadian-American border, occupied a strategic position on the Richelieu River (FIG. 1). The first fort on the island was built by the French in 1759–1760 (Piédalue 1993) and was destroyed during the British conquest. The British constructed a new fort to defend their newly acquired territory.

After a brief occupation by American forces, Île-aux-Noix became the headquarters of the British general John Burgoyne in August of 1776. He ordered the construction of barracks and storage buildings for food and ammunitions, including blockhouses (Guimont 2004). The first British fort was built in 1778 when Governor-General Frederick Haldimand decided to use the island as a forward operating base, and he constructed the new fort using the remains of the former French fort (FIG. 2). Between 1782 and 1791, three redoubts were added (FIG. 3). These consisted of a rampart with a ditch and glacis that protected storage and living quarters (FIG. 4), while a water-filled ditch surrounded each redoubt (Cloutier 1996). All buildings were abandoned between 1809 and 1812, when tensions between the

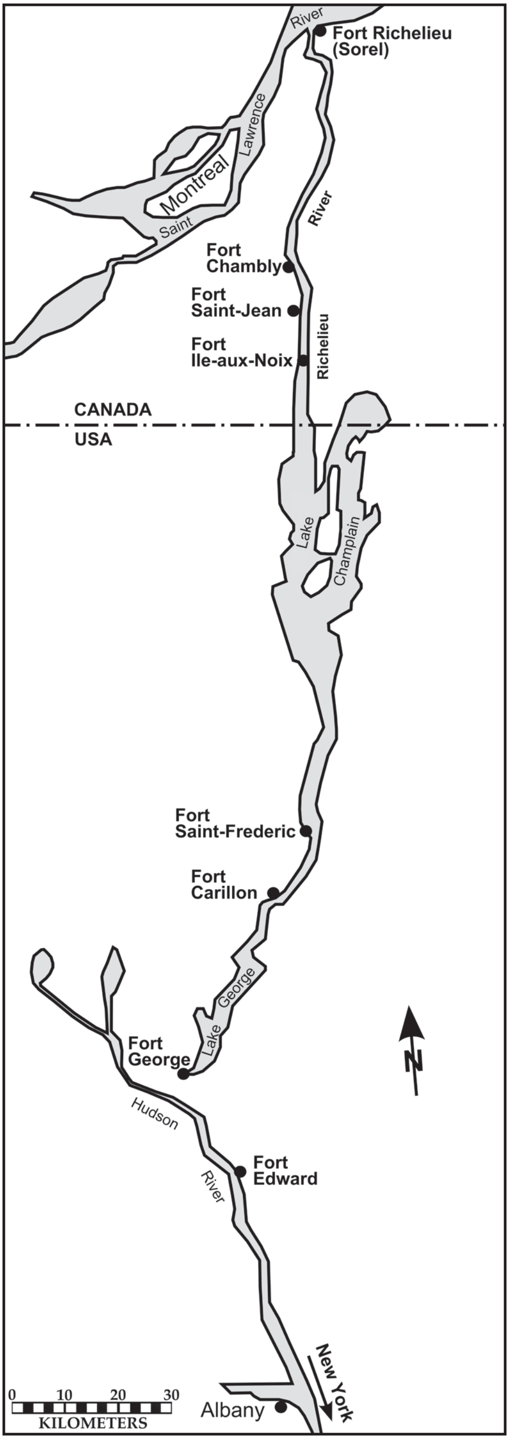

Figure 1. Map of French forts along Lake Champlain and the Richelieu River, including Île-aux-Noix. (Map by Stéphane Noël, 2013.)

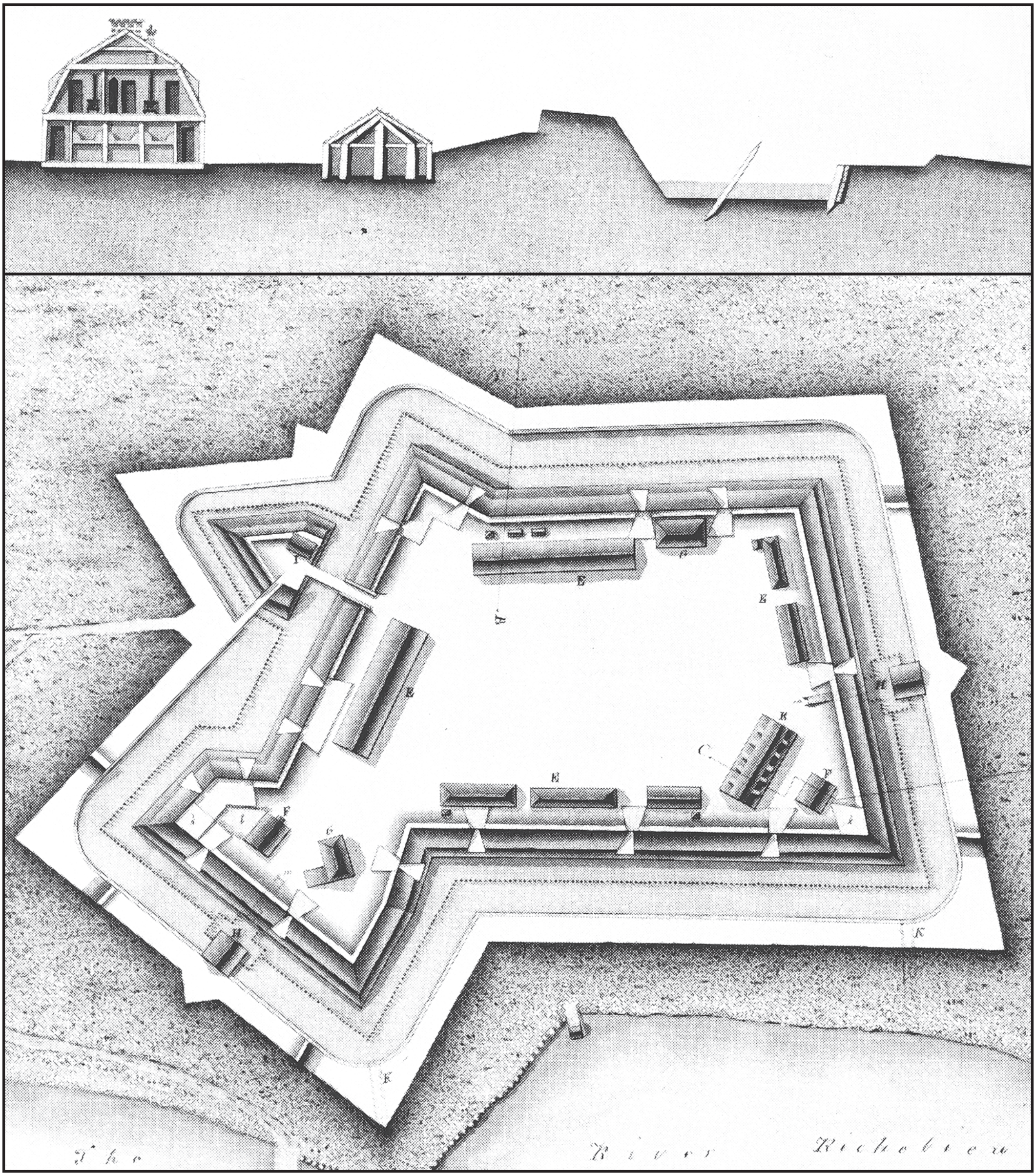

Figure 2. Detail of *Plan of the principal redoubt, on the Isle aux Noix; with sections,* by Thomas Walker (1760). Profile and plan of the first British fort built in 1778, which was built on the remains of the French fort dating to 1759–1760.

United States and the British government flared up once again (Charbonneau 1994).

In 1812, the British made the island their base of naval operations on Lake Champlain and constructed a shipyard. The northeast redoubt was demolished, and the back walls of the other two redoubts were replaced by wooden palisades, transforming them into advanced defensive works (Charbonneau 1994). The water-filled ditches surrounding the redoubts were filled, and fraises were added on the top of the scarp (FIG. 4). The 1815 peace treaty ended all building projects, and final changes to the site took place between 1819

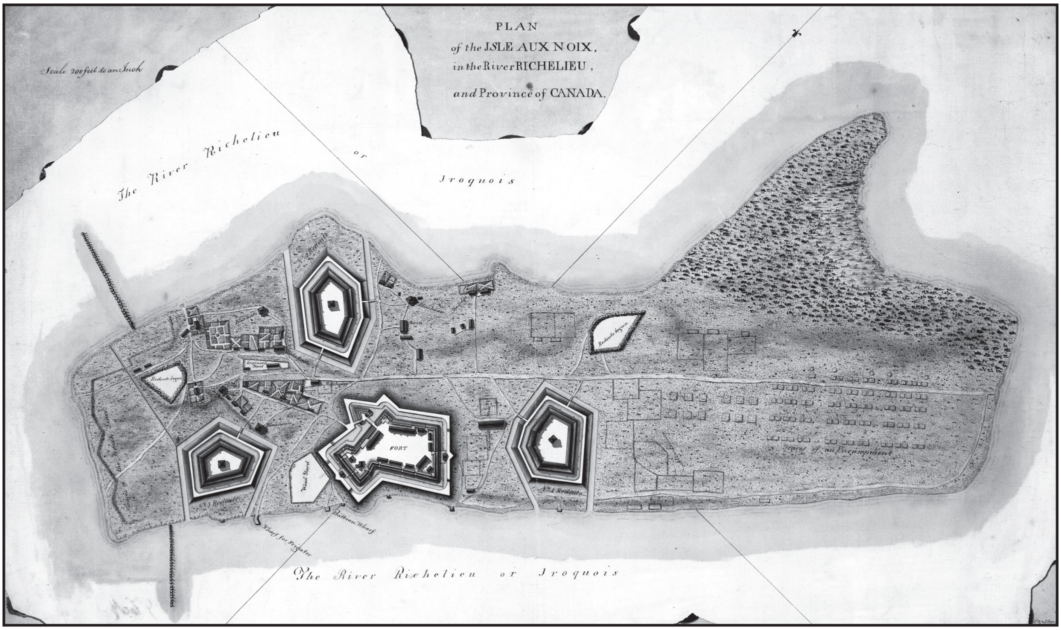

Figure 3. Detail of *Plan of the Isle aux Noix, in the River Richelieu, and Province of Canada. ca. 1760*, by Thomas Walker (ca. 1760). Plan of the 1778 British fort. Three redoubts surrounded by water-filled ditches were added in 1782–1783.

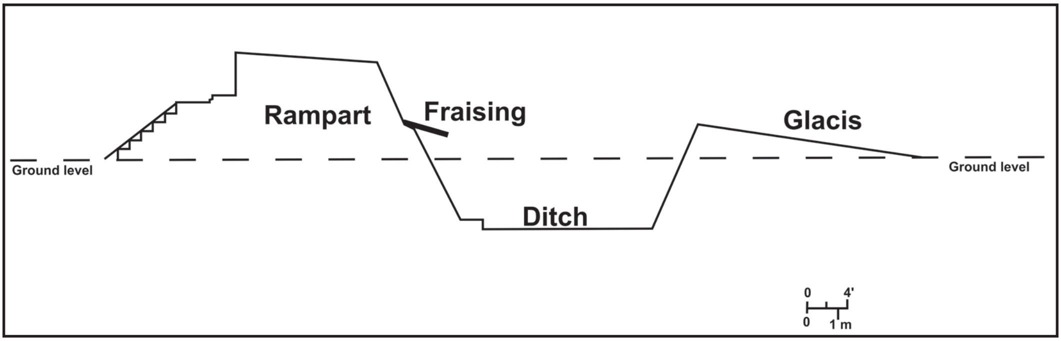

Figure 4. Example of a redoubt's rampart with the ditch and the glacis. Sometimes, fraises were added to increase the scarp defenses. Drawing adapted from Charbonneau (1994).

and 1826, when Fort Lennox was constructed in anticipation of an American attack that would never come.

Dendrochronology

Grange (1982) first studied the French fortifications, while Cloutier (1996) studied the British installations dating from 1760 to 1921. Dendrochronological analyses were undertaken after the 2003 excavations by Parks Canada (Guimont 2004). A total of 161 pieces of wood were initially recovered from what appeared to have been a water-filled ditch under the casern of Fort Lennox (FIGS. 5, 6, and 7). These pieces were primarily timbers and posts, and 104 were preserved for analysis. The anatomical structures of 75 samples were examined by the Canadian Conservation Institute in Ottawa. The results suggested that white cedar was associated with the first British fort and perhaps the French fort of 1759–1760, while white pine was used for the British redoubts of 1782–1783, and deciduous trees were used for the restoration work of 1812–1813 (Guimont 2004) (FIG. 8).

Tree-ring analyses were conducted on 67 pieces, including 44 cross-section disks and 27 cores (four pieces were sampled with both techniques). Core samples were collected from the maximum measurable diameters available. The samples were then sanded, and the growth rings cross-dated by matching ring-width patterns from the same species of tree. This step does not provide a firm calendar date, however, as the cross-dating at this stage is a visual examination

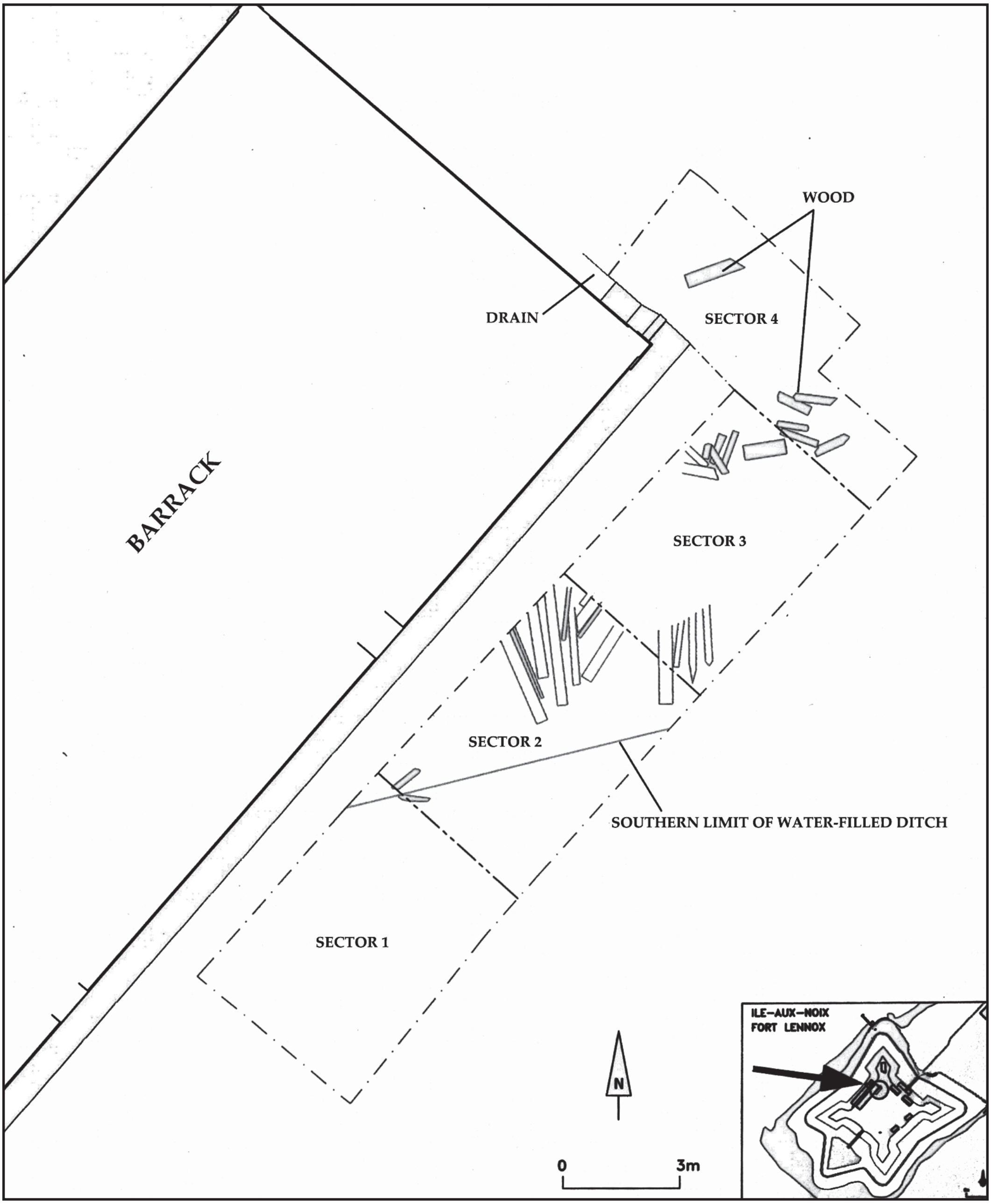

Figure 5. Plan of Parks Canada's excavations at Fort Lennox, showing where the analyzed wood was found. (Figure by Parks Canada (Plan #2003–5G–03), 2003.)

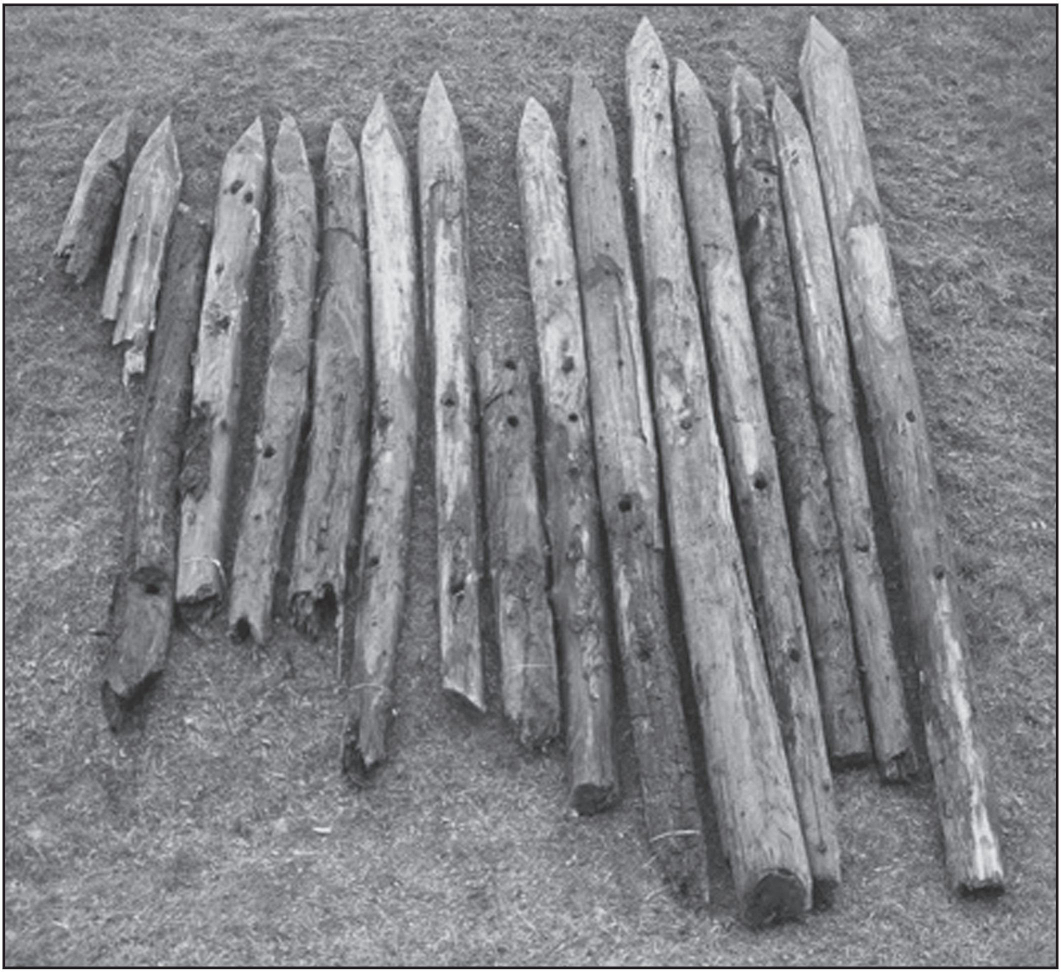

Figure 6. Wood samples (posts) from Parks Canada's 2003 excavations. (Photo by Parks Canada (5G03R6T-4), 2003.)

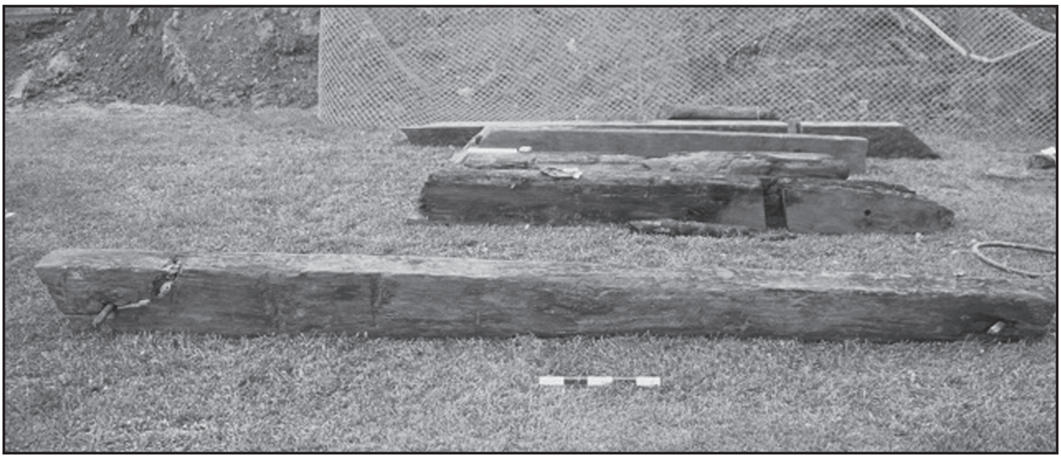

Figure 7. Wood samples (timbers) from Parks Canada's 2003 excavations. (Photo by Parks Canada (5G03R9T-19), 2003.)

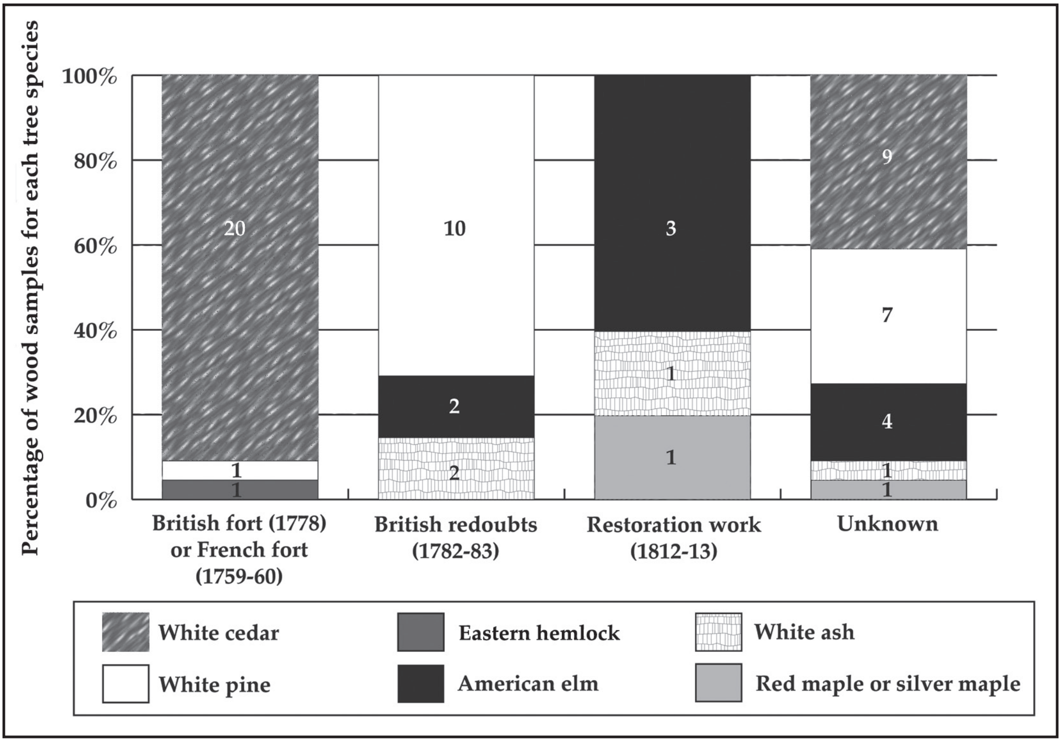

Figure 8. Distribution of wood sample for each archaeological context and species according to visual examination of samples and excavation reports by Parks Canada. White cedar is strongly associated with the 1778 British fort, while white pine is associated with the three redoubts built in 1782–1783 (Young-Vigneault 2010.)

to identify false or missing rings, as well as to match growth patterns. Ring widths were measured using a Velmex micrometer (precision: 2 μm), and measurements were recorded and transformed into skeleton plots in the DENDRO2009 software program (Young-Vigneault 2010). Cross-dating between individual series was tested visually and statistically using COFECHA software to detect any missing or false rings (Holmes 1983; Holmes et al. 1986; Grissino-Mayer 2001). COFECHA also was used to place the series in a relative sequence, and Pearson's r and t–tests were used to evaluate the correlation between these series. Each white pine and white cedar ring-width series was standardized using 32-year and 64-year spline functions with ARSTAN software (Cook and Holmes 1997). The expressed population signal (EPS) was used to assure homogeneity among the samples (Briffa and Jones 1989). The Fort Lennox white-pine series was then cross-dated and dated using the Champlain reference chronology (Delwaide and Filion 1999), while the white cedar series was compared to the St. Lawrence (Querrec et al. 2009) and Île d'Orléans (Dagneau and Duchaine 2007) reference chronologies. Historical data on the timber trade and forest management were also examined (Noël 1985; Charbonneau 1994; Paradis 2007).

Results

Wood identifications revealed that 48 samples (76%) were conifers, including white cedar (n=29), white pine (n=18), and one hemlock (*Tsuga canadensis*) sample. Other species (n=15) were hardwoods, including American elm (*Ulmus americana*), ash (*Fraxinus americana*), and maple (*Acer saccharinum* or *A. rubrum*).

The Fort Lennox White Cedar Series

The white cedar series from Fort Lennox spans 239 years, from 1574 to 1812, with a minimum number of ten samples for the period between 1659 and 1808, and a maximum number of samples dating to 1749 (n=24)

(APPENDIX 1: FIG. 9). The intercorrelation is 0.478 (APPENDIX 2: TAB. 1). The EPS (0.91) of the Fort Lennox chronology is over the significance level, which reflects a strong homogeneity among samples in the series. The St. Lawrence and Île d'Orléans chronologies date to 1489–2001 and 1530–2005, respectively. The period between 1659 and 1808 is covered by 20 to 80 samples for the St. Lawrence chronology, and 16 to 26 samples for the Île d'Orléans chronology. The *t*-value and Pearson's correlation coefficients (*r*) between the Fort Lennox series and Île d'Orléans and St. Lawrence chronologies also were over the significance level for a series of 150 years (TAB. 2, APPENDIX 1: FIG. 10). The high Gleichläufigkeit (GLK) index for both chronologies indicates that the growth variations of trees from both series are synchronous, which further validates cross-dating. The results of these tests confirm that the white cedar samples from Fort Lennox may be used as a reliable data source, as they are relatively homogenous and strongly correlated to the two reference chronologies.

The felling date of most white cedar samples was determined to be post-1783. The outermost ring dated to 1812 on five samples, while ten other samples did not have the outermost ring, but did have enough sapwood rings for an estimated date of within ca. 15 years (Young-Vigneault 2010) (APPENDIX 2: TAB. 3). On one sample, the last ring dated to 1714, while six samples did not have sapwood, so the felling date could not be determined.

The Fort Lennox White Pine Series and Hardwood Samples

The Fort Lennox white pine series remains a floating series, one that cannot be properly cross-dated with existing pine chronologies for southern Québec, as correlation coefficients were below the levels required for them to be considered significant. Cross-dating was attempted with the Champlain chronology, which includes wood from around Quebec City, but remains inconclusive, as all the samples had been squared or shaped to some extent, eliminating all sapwood and the possibility of determining felling dates. The resulting Fort Lennox white pine series spanned 224 years between 1504 and 1727, with at least 10 samples covering 1608 to 1696, and a maximum of 18 samples covering 1635 to 1659 (APPENDIX 1: FIG. 11). Furthermore, the hardwood samples could not be cross-dated due to the low number of suitable samples for tree-ring analysis and the lack of reference chronologies for the region.

Historical Documents

Historical documents and explorers' journals revealed that the Richelieu Valley contained rich mixed-hardwood forests composed of maple, oak, birch, beech, ash, and elm (Lamontagne et al. 2001). The botanist Pehr Kalm mentions hardwood forests along the shoreline of Lake Champlain in 1749, along with swamps intermingled with wood lots around Fort St. Jean, 20 km north of Fort Lennox (Rousseau and Bethune 1977). Temperate conifers, such as pine, cedar, and hemlock, were generally widespread at the outset of European settlement, but these populations were decimated, especially during the 19th and 20th centuries, as forests were exploited extensively for domestic and naval construction

After the British conquest, access to wood resources in the Richelieu region was one of the privileges of the seigneurs, the local, elite landowners (Noël 1985). However, due to

Table 2. Correlation between the white cedar chronology and the reference chronology. Significance level of Pearson's *r* attests to the concordance of patterns in ring width. The student *t*–test validates the Pearson's *r*. The Gleichläufigkeit index validates the similarity between series (Delwaide and Filion 2010; Young-Vigneault 2010.)

Series statistics	Île d'Orléans	St. Lawrence	Significance level
Adjusted *N*	141	180	—
T value	4.951	3.231	3.5
Pearson's *r* *(p<0.01)*	0.314	0.208	0.208
Gleichläufigkeit index	0.61	0.61	—

increasing tensions between the British authorities and American merchants, a commercial network developed at the beginning of the 19th century. The British army placed requests for wood in local newspapers, as it needed to refurbish the forts along the Richelieu River (Paradis 2007). Several major sales of wood to the British army by local merchants have been documented between 1812 and 1819 (Paradis 2007).

Discussion

In this study, white cedar felling dates provided by dendrochronology allow for a reinterpretation of when the excavated pieces of wood were originally harvested, how they were used, and when they were deposited into the ditch around the western redoubt. The initial interpretations of Parks Canada archaeologists suggested the wood was thrown into the water-filled ditch that encircled the western British redoubt during the 1812–1814 restorations. The contents were thought to be a mixture of wood from previous constructions, such as the British fort of 1778 or the 1782–1783 northeast redoubt, which had been discarded and covered with other debris to fill the ditch and level the surrounding terrain as new constructions were completed. The tree-ring data do not support these interpretations, however, as most white cedar felling dates are more recent than the 1778 and 1782 dates proposed by the Parks Canada archaeologists. In fact, 19 trees were cut after 1778. Consequently, the interpretation of the recovered wood needs to be reconsidered.

The original function of these wood timbers was misinterpreted. They were initially identified as palisade posts and fraises associated with either the first British fort or the French fort (Guimont 2004). However, there is no mention of fraises for any of these defensive structures. Fraises are only mentioned in reference to the restorations carried out in 1812–1813 (Charbonneau 1994).

The 1785 Walker Plan shows a water-filled ditch around the redoubt (FIG. 3). The ditch appears to have been filled after the 1812–1813 restorations, as suggested by the Hughes Plan, dating to 1814 (FIG. 12). According to historian

Figure 12. Detail of *A Plan of the Works at Isle aux Noix*, known as the Hughes Plan (1814), showing restoration work of 1812–1814. The northeast redoubt has been demolished, and back walls from the two remaining redoubts have been replaced by wooden palisades. Water-filled ditches surrounding the redoubts have disappeared.

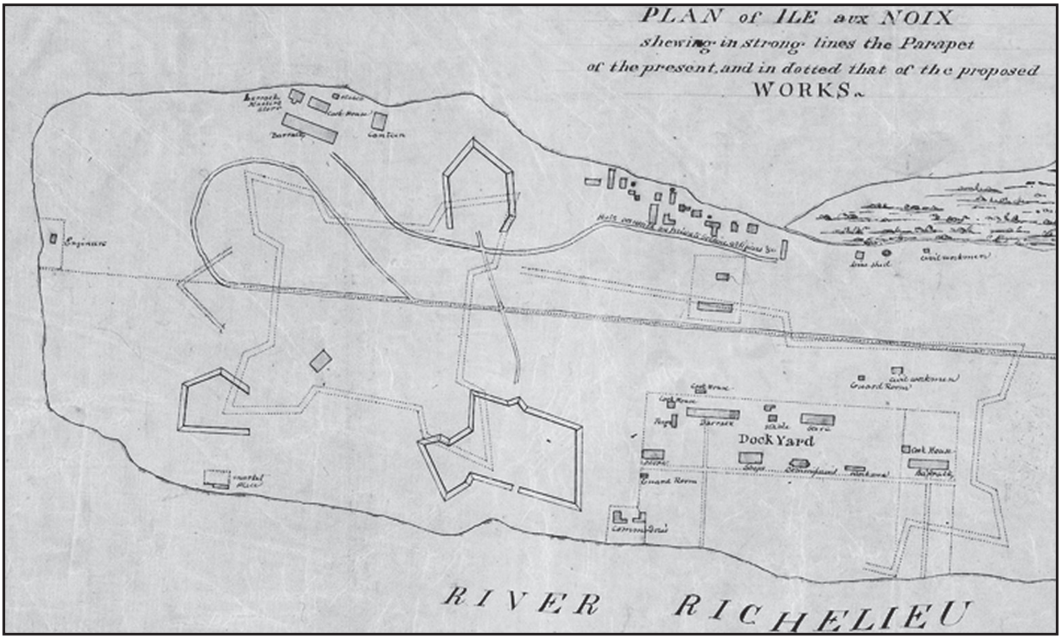

Figure 13. Detail of *PLAN of ILE aux NOIX showing in strong lines the Parapet of the present and in dotted that of the proposed WORKS ca. 1819*, known as the Romilly Plan (1819), showing a proposed plan for the construction of Fort Lennox.

André Charbonneau (1994), the redoubts' ramparts and glacis were improved during the 1812–1813 restorations, increasing the space between them. Those works were considered outdated in 1819, and the construction of Fort Lennox did not reuse any of the existing structures. We suggest, therefore, that the wood samples examined in this study were deposited in the ditch just before or during the construction of Fort Lennox in 1819. The 1819 Romilly Plan (FIG. 13) suggests that the whole area was leveled, which would confirm the creation of this wood deposit sometime before 1819. This early 19th-century date supports the interpretation that some white cedar timbers were used for fraises on the British fort in 1812–1813, as mentioned by Charbonneau (1994), rather than on the 1759 French fort.

While accurate dating of the white pine and hardwood samples was not possible during this analysis, their presence is not surprising. White pine has always been recognized as good timber for construction, while white cedar, highly resistant to decay, was suitable for structures such as palisades, where the logs were set directly in the ground. The presence of hardwoods among the timber samples may be associated with temporary buildings that were constructed quickly using resources at hand (Charbonneau 1994; Querrec et al. 2009). One possible means of obtaining construction materials was to dismantle unused or abandoned buildings, and to harvest the usable portions. For example, Fort St. Thérèse was dismantled to build Fort St. Jean in 1748, and His Majesty's Fort at Crown Point was built using wood materials from Île-aux-Noix (Charbonneau 1994).

Understanding the context of the 1812–1814 war is important to properly interpret the white cedar series. Because waterways were still the principal means of travel and transporation, Île-aux-Noix remained important to the British defensive strategy. The American fleet did not represent a significant threat, however, so only temporary fortifications were built—using minimal financial and material resources. The rapid improvement of the American fleet at the end of the summer of 1812 triggered the construction work on Île-aux-Noix later that same year. Moreover, the attacks of 1812, 1813, and 1814 convinced Great Britain of the necessity for strong fortifications within the colony, and specifically in the Richelieu Valley. The old fortifications on Île-aux-Noix were leveled, with wood timbers and debris likely buried in adjacent ditches, in anticipation of the construction of Fort Lennox in 1819.

Conclusion

The Fort Lennox white cedar series (1574–1812) will be useful for future dendroarchaeological analyses and tree-ring research in the Richelieu Valley and southern Québec, although further sampling is needed to strengthen the white pine series before it can be used as a dating tool. This tree-ring study yielded new information on the history of the Fort Lennox National Historic Site, as cross-dating of the Fort Lennox white cedar series permitted new interpretations of the way wood resources were used and discarded sometime between 1812 and 1819. While the initial archaeological interpretations suggested that the wood samples recovered from the excavations were used during the construction of British redoubts in 1782–1783, our tree-ring data reveals that it might be better associated with 1812–1813 restorations prior to the construction of Fort Lennox in 1819. These results reflect the choices made by the British authorities, who were coping with material and temporal constraints, as they needed to find new sources of wood, while enforcing a strategic line of defense close to the American border. This study argues for a careful interpretation of historical military contexts and for the integration of multiple forms of analysis whenever possible.

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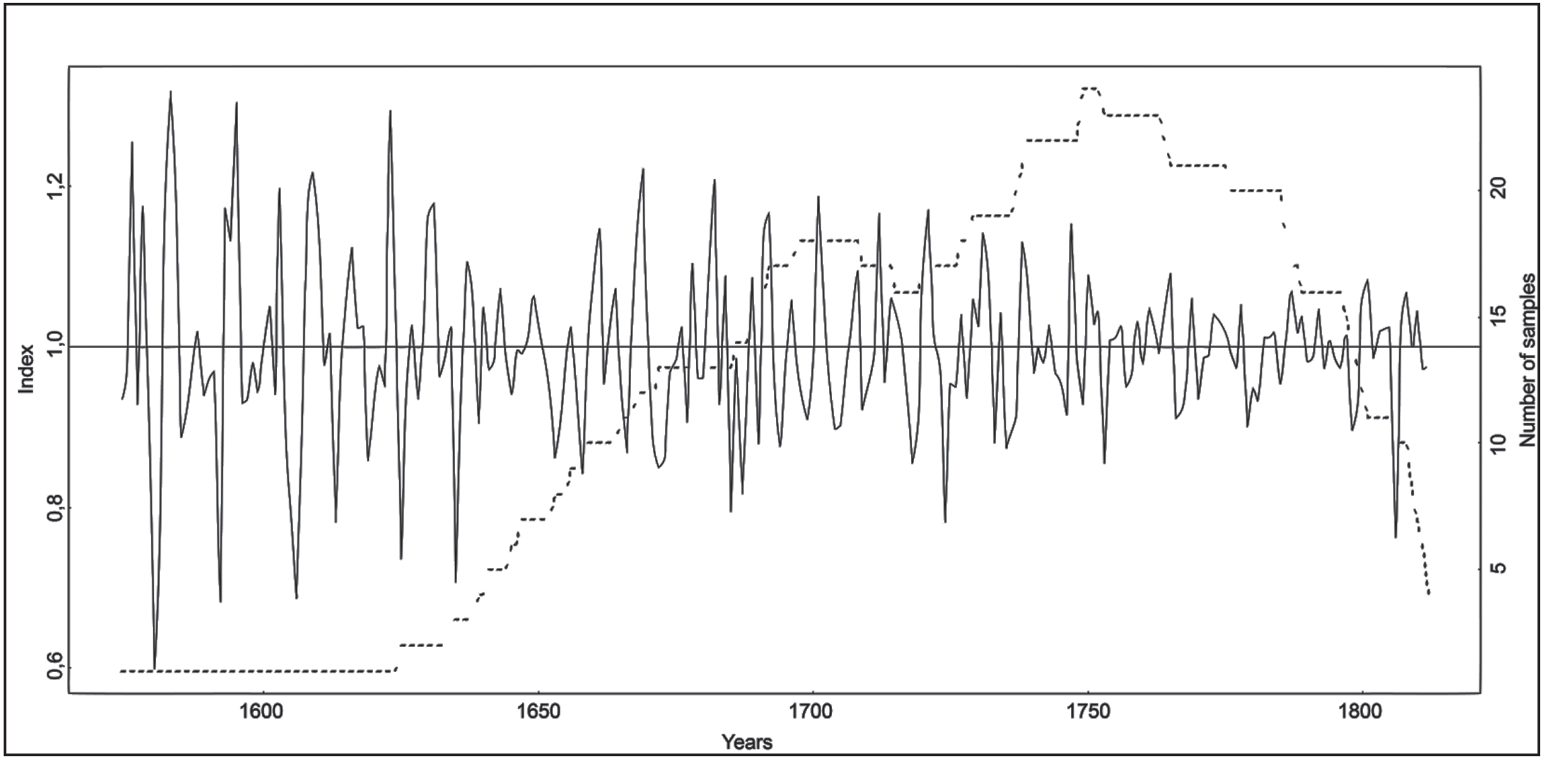
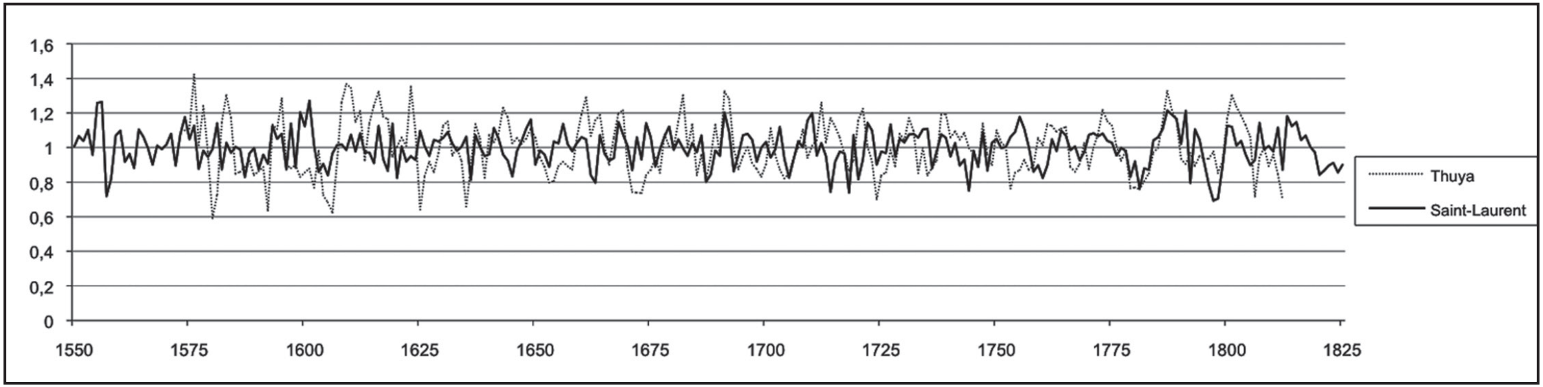
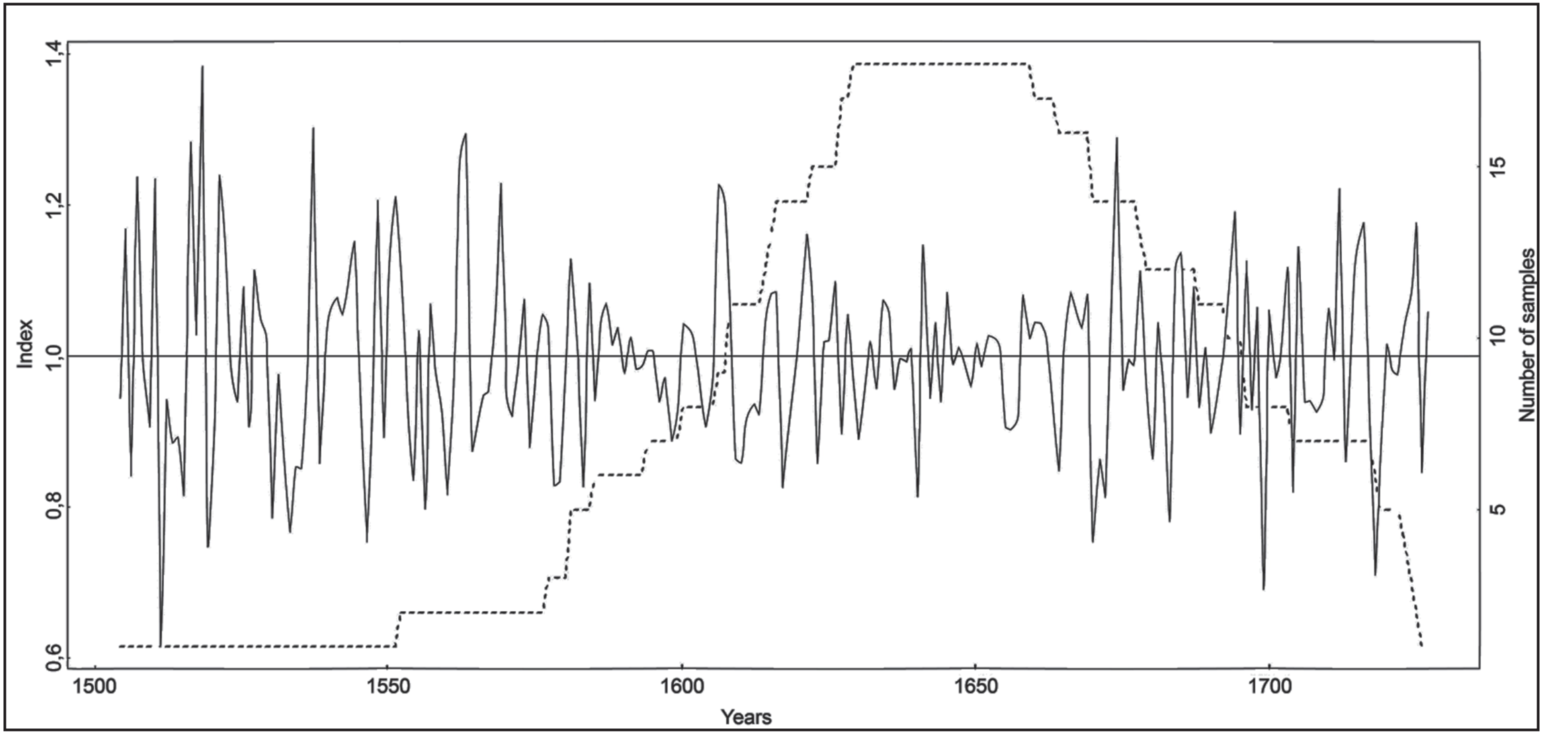
Appendix 1: Figure 9. Fort Lennox white cedar series (1574–1812) with the number of samples represented per year showing the strongest segments of the series. The series consists of at least 10 samples from 1659 to 1808, with a maximum of 24 samples for 1749 (Young-Vigneault, 2010.)



Appendix 1: Figure 10. Cross-dating between the Fort Lennox white cedar (Thuja) master dating chronology created by COFECHA (dotted line), and the St. Lawrence reference chronology (black line), from 1574 to 1812 (r=0.208, n=180 years, t=3.23, p<0.01) (Figure by Emilie Young-Vigneault, 2013.)



Appendix 1: Figure 11. Fort Lennox white pine series with the number of samples represented per year, showing the strongest segment of the series. The series spans from 1504 to 1727, although no outermost ring or sapwood was present, resulting in a floating chronology. The series consists of at least 10 samples from 1608 to 1696, with a maximum of 18 samples between 1635 and 1659 (Young-Vigneault, 2010.)



Appendix 2: Table 1. Correlation matrix from COFECHA, demonstrating the cross-dating in the tree-ring patterns from Fort Lennox white cedar samples.

				30-Yr Segment											
	Samples	Begin Year	End Year	1624-1653	1639-1668	1654-1683	1669-1689	1684-1713	1699-1728	1714-1743	1729-1758	1744-1773	1759-1788	1774-1703	1789-1818
1	5G100	1739	1797	—	—	—	—	—	—	—	0.39	0.44	0.44B	0.45	—
2	5G101	1754	1808	—	—	—	—	—	—	—	—	0.48	0.56	0.52	0.56
3	5G102	1729	1798	—	—	—	—	—	—	—	0.43	0.60	0.60	0.32A	—
4	5G103a	1720	1805	—	—	—	—	—	—	0.22B	0.42	0.36	0.04B	0.22B	0.26B
5	5G104	1697	1788	0.11B	0.21B	0.35	—	—	—	—	—	—	—	—	—
6	5G111	1749	1799	—	—	—	—	—	—	—	—	0.50	0.43B	0.53	—
7	5G112	1737	1812	—	—	—	—	—	—	—	0.45	0.57	0.58	0.48B	0.49
8	5G113	1645	1785	—	0.54	0.41	0.24B	0.36B	0.39B	0.43B	0.39B	0.21B	0.22B	—	—
9	5G122a	1672	1809	—	—	—	0.20B	0.48	0.66	0.87	0.82	0.74	0.58	0.44	0.34B
10	5G122b	1689	1808	—	—	—	—	0.45	0.55	0.80	0.86	0.80	0.45	0.31A	0.40
11	5G126	1738	1810	—	—	—	0.28A	0.12B	-0.08B	-0.20B	—	—	—	—	—
12	5G127	1659	1785	—	—	0.56	0.73	0.80	0.72	0.76	0.75	0.68	0.49	—	—
13	5G131	1653	1812	—	0.45	0.48	0.72	0.57	0.60	0.61	0.49	0.37	0.32B	0.55	0.60
14	5G138	1691	1775	—	—	—	—	0.25B	0.61	0.67	0.61	0.65	0.64	—	—
15	5G139	1665	1811	—	—	0.50	0.49	0.67	0.69	0.79	0.81	0.70	0.57	0.63	0.75
16	5G151	1749	1812	—	—	—	—	—	—	—	—	0.21B	0.47	0.60	0.69
17	5G155	1647	1763	—	0.38	0.44	0.53	0.72	0.74	0.76	0.52	0.47	—	—	—
18	5G158	1634	1811	0.59	0.51	0.60	0.71	0.68	0.61	0.50	0.56	0.56	0.22B	0.13B	0.36B
19	5G51	1641	1753	—	0.56	0.52	0.54	0.57	0.44B	0.50	0.58	—	—	—	—
20	5G57	1668	1812	—	—	0.58	0.58	0.62	0.55	0.55	0.51	0.60	0.71	0.42	0.56
21	5G84	1625	1796	0.50	0.48	0.58	0.74	0.61	0.47	0.46	0.63	0.67	0.54	0.48	—

Appendix 2: Table 1 (*continued*)

				30-Yr Segment											
	Samples	Begin Year	End Year	1624-1653	1639-1668	1654-1683	1669-1689	1684-1713	1699-1728	1714-1743	1729-1758	1744-1773	1759-1788	1774-1703	1789-1818
22	5G86	1692	1786	—	—	—	—	0.38	0.46	0.65	0.84	0.70	0.36B	—	—
23	5G92	1727	1800	—	—	—	—	—	—	0.33B	0.32B	0.23B	0.30B	0.35B	—
24	5G93	1656	1752	—	—	0.62	0.61	0.49	0.52	0.75	0.52	—	—	—	—
25	5G97	1639	1714	—	-0.16B	-0.07B	0.44	0.41	0.40	—	—	—	—	—	—
	Average Segment Correlation			0.40	0.37	0.47	0.52	0.52	0.53	0.56	0.57	0.53	0.45	0.43	0.50

An “A” or “B” in these columns indicates a 30-yr segment flagged by COFECHA, but no dating adjustment was necessary.

Appendix 2: Table 3. Lifespan of white cedar sample cross-dated with reference chronology and felling date according to outer-ring type.

Sample	Life span	Outer ring type	Inferred period of felling
5G2	1574–1708	a	Unknown
5G97	1639–1714	r	Cut sometime between summer 1714 and spring 1715
5G93	1656–1752	a	Unknown
5G51	1641–1753	v	Close to felling date, outermost ring likely missing
5G155	1647–1763	a	Unknown
5G85	1686–1763	a	Unknown
5G138	1691–1775	a	Unknown
5G127	1645–1785	v	Close to felling date, outermost ring likely missing
5G113	1659–1785	v	Close to felling date, outermost ring likely missing
5G86	1692–1786	a	Unknown
5G104	1697–1788	v	Close to felling date, outermost ring likely missing
5G84	1625–1796	v	Close to felling date, outermost ring likely missing
5G100	1739–1797	v	Close to felling date, outermost ring likely missing
5G102	1729–1798	v	Close to felling date, outermost ring likely missing
5G111	1749–1799	v	Close to felling date, outermost ring likely missing
5G92	1727–1800	v	Close to felling date, outermost ring likely missing
5G103a	1720–1805	v	Close to felling date, outermost ring likely missing
5G101	1754–1808	v	Close to felling date, outermost ring likely missing
5G122b	1689–1808	v	Close to felling date, outermost ring likely missing
5G122a	1672–1809	r	Cut sometime between summer 1809 and spring 1810
5G126	1738–1810	v	Close to felling date, outermost ring likely missing
5G139	1665–1811	v	Close to felling date, outermost ring likely missing

Appendix 2: Table 3 (*continued*)

Sample	Life span	Outer ring type	Inferred period of felling
5G158	1634–1811	r	Cut sometime between summer 1811 and spring 1812
5G57	1668–1812	r	Cut sometime between summer 1812 and spring 1813
5G131	1653–1812	r	Cut sometime between summer 1812 and spring 1813
5G112	1737–1812	r	Cut sometime between summer 1812 and spring 1813
5G151	1749–1812	r	Cut sometime between summer 1812 and spring 1813

r: sample with outermost ring (considered a felling date).
v: sample is missing the outermost ring, but sapwood is present (estimated felling date of within ca. 15 years.
a: sample without outermost ring nor sapwood (fail to give a felling date).