TREE-RING RESEARCH, *Vol. 65(1), 2009, pp. 37–45*

THE HISTORICAL DENDROARCHAEOLOGY OF THE HOSKINS HOUSE, TANNENBAUM HISTORIC PARK, GREENSBORO, NORTH CAROLINA, U.S.A.

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ABSTRACT

The Hoskins House is a two-story, single pen log structure located in Tannenbaum Historic Park, Greensboro, North Carolina. The house is thought to have been built by Joseph Hoskins, who lived in Guilford County from 1778 until his death in 1799. Previous archaeological testing of soil around the house yielded over 1000 artifacts, and the ceramics of these gave a Mean Ceramic Date (MCD) of 1810 as a possible initial year of construction. Our objective was to date the outermost rings on as many logs as were accessible in the Hoskins House to determine the year or range of years when the house was likely built. We compared 37 ring-width measurement series from 28 white oak group logs with a composite reference chronology created from three oak reference chronologies from Virginia. We found that the logs were cut over a 3-year period from 1811 to 1813, lending credence to the initial MCD of 1810. Joseph Hoskins had already passed away in 1799 and the property was deeded to his two sons, Joseph and Ellis. Ellis Hoskins eventually was later deeded sole possession of the property. The two-story log house located at Tannenbaum Historic Park may be more correctly called the "Ellis Hoskins House" rather than the "Joseph Hoskins House."

Keywords: Tree rings, dendrochronology, historical dendroarchaeology, Hoskins House, North Carolina, southeastern U.S.

INTRODUCTION

Dendroarchaeological research on historic structures in the Southeastern U.S. is only now beginning to gain acceptance by historians, archaeologists, and architects. The earliest (though unsuccessful) attempt to date historic buildings in the Southeast was conducted by Bowers and Grashot (1976) who analyzed structures at President Andrew Jackson's First Hermitage plantation just outside Nashville, Tennessee. Later, Stahle (1979) formalized methods and techniques used in dendroarchaeology in the southeastern U.S. by evaluating the construction histories of numerous log buildings throughout Arkansas. Mann (2002) was one of the first to combine techniques commonly employed in historical archaeology (assessing the range of years associated with recovered ceramics, nails, and window glass) with tree-ring dating techniques to accurately date the year of construction of a supposed historic blockhouse in eastern Tennessee. Likewise, Pulice (2000) combined an analysis of historical architecture, archaeology, and dendrochronology to date a slave cabin on the Virginia Tech campus in Blacksburg, Virginia. Such studies are proving invaluable because many agencies charged with managing historical sites wish to authenticate the reported dates of construction on these log structures. Occasionally, the accepted dates of construction are questionable (*e.g.* Mann 2002; Brogden *et al.* 2007; Grissino-Mayer and van de Gevel 2007) and many structures throughout the Southeast require verification using dendrochronological techniques

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that use reference tree-ring chronologies currently in existence for much of the southeastern U.S. One such structure in the U.S. National Park Service's Guilford Courthouse National Military Park, Guilford County, North Carolina, is the focus of this paper.

The Battle of Guilford Courthouse took place on March 15, 1781 (Baker 2005), and is considered "… the largest, most hotly-contested action of the Revolutionary War's climactic Southern Campaign" (National Park Service (NPS) 2006). Approximately 1,900 British soldiers marched up New Garden Road toward the small, log-house style courthouse that formed the judicial seat of the county, and faced a much larger army of 4,500 American militia made up of companies from neighboring states. A two-and-a-half hour battle eventually forced the American militia, led by General Nathaniel Greene, into retreat. Today, the battle site is preserved and maintained by the National Park Service (NPS 2006). Adjacent to this park, Tannenbaum Historic Park preserves the place where the Battle of Guilford Courthouse began (Greensboro Parks and Recreation (GPR) 2006).

This 7.5-acre (3.0 ha) park is dedicated to sharing the story of the Hoskins family and colonial life before, during, and after this pivotal battle in the American Revolution. Joseph Hoskins, his wife Hannah, and their family left Chester County, Pennsylvania, in the spring of 1778, mainly to escape the difficulties brought on by the Revolutionary War as their home was located in close proximity to Valley Forge, Pennsylvania (GPR 2006). The main structures in the historic park currently consist of a two-story, single-pen, 18 × 24 ft (5.5 × 7.3 m) log house (Figure 1), a renovated kitchen (called the "cookhouse" in the original Register of Historic Places registration form, NPS 1988) placed adjacent to this house, and an impressive double-pen cantilever barn known as the "Coble Barn" (NPS 1988). The kitchen structure was brought in from a location outside the park, whereas the barn was relocated from southern Guilford County (NPS 1988; Stine *et al.* 2003). Only the two-story log house (the "Hoskins House") is original to the property. The year of construction of the Hoskins House is the object of this study.

Figure 1. The Joseph Hoskins House, located at Tannenbaum Historic Park, Greensboro, North Carolina. The log structure was currently covered with clapboard siding. The house was believed to date to the Revolutionary War period (*ca.* 1781), but earlier archaeological testing suggested a later date of construction (Stine 2005).

In 1999, three 5 × 5 ft (1.5 × 1.5 m) test units were excavated around the log house, which yielded 1,435 artifacts ranging from the Revolutionary War era through the 20th Century (Stine *et al.* 2003; Stine 2005). Many of these artifacts were wire nails (n = 185) that dated post-1830 and machine cut nails (n = 94) that dated between *ca.* 1790 to 1830. Curiously, no 18th Century hand-wrought nails (*ca.* pre-1790) were located in any surveys, suggesting that a date of construction for the log house contemporary with the Revolutionary War was not supported. Most important, however, were the ceramics. The ranges of years for the manufacture of specific ceramic types can be averaged to provide a Mean Ceramic Date (MCD; see South 1977). The ceramics in the 1999 collection of artifacts provided a MCD of 1810 (Stine 2005).

Previous dendrochronological research on the Hoskins House reported an 1857 construction date (Heikkenen and Egan 2000) based on alignment of "key-year patterns" between the Hoskins House tree-ring patterns and those from the Chesapeake Bay (Maryland) area (Stine *et al.* 2003). Curiously, reference oak tree-ring chronologies from nearby locations in Virginia were not used to derive cutting dates of trees in the Hoskins House, even though these chronologies have been archived in the International Tree-Ring Data Bank (ITRDB) for many years. Based on the architecture of the house, previous archaeological

Figure 2. Extracting a core from the rounded portion of a log in the interior of the Hoskins House with a hollow tubular drill bit attached to a 0.5 inch (1.3 cm) variable speed drill.

testing, and family archives, the 1857 date appeared to be too young. Our primary objective was to determine the exact year or years when logs were cut and eventually used to build the two-story log structure known as the Joseph Hoskins House at Tannenbaum Historic Park.

METHODS

Field Methods

On October 29, 2005, we extracted at least one core from all accessible logs in the cabin using a custom-made 0.5 inch (1.3 cm) hollow drill bit attached to a 0.5 inch (1.3 cm) variable-speed power hand drill (Figure 2). Cores were taken from both the first and second floors. Cores were labeled by building code (HOS), compass direction of the side of the house (1 letter), log number (beginning with the bottom log = "01" and numbering sequentially upward), and core letter. By convention, "A" is a core taken from the left side of the log and "B" is a core taken from the right side of log, as one faces the log. Cores extracted in intermediate locations are assigned letters "C" and higher, and their locations marked on standard forms. For example, "HOSW04A" represents a core taken from Hoskins House, West side, log 04, core A (left side).

Cores were taken primarily from the lower curved surfaces of the white oak (*Quercus alba* L.) logs, although some cores were taken from the upper curved surface on logs in the second floor. These lower and upper curved surfaces are preferred because often complete sapwood is present, but has been removed from the hewn sides of the log. In addition, the mud chinking placed in between the logs to insulate the structure helps preserve the sapwood and therefore the outermost rings. On logs with clearly defined outer surfaces, we drilled into the log approximately 0.25 inch (0.64 cm), then removed the bit and marked the outer surface of core with indelible ink to verify that the outermost rings remained intact after coring. We then reinserted the drill bit and drilled until we reached the center portion of the log based on visual assessing alignment with the pith that was obvious on the log end. The core was then separated from the log using a cutting tool inserted alongside the core, extracted, and immediately fastened with wood glue to wooden core mounts. The mounted cores were appropriately labeled and allowed to dry several days before sanding with progressively finer grit sandpaper (Orvis and Grissino-Mayer 2002) back in the laboratory.

Internal Crossdating

Absolute dating was accomplished by first dating each series of tree rings against all others ("internal crossdating") using both graphical and statistical crossdating techniques to create an undated (or "floating") tree-ring chronology (Swetnam *et al.* 1985; Stokes and Smiley 1996; Grissino-Mayer 2001; Grissino-Mayer and van de Gevel 2007). Once the tree-ring series had been temporally placed relative to each other and a chronology developed, this floating chronology was crossdated against a set of anchored regional oak tree-ring chronologies ("external crossdating"). The internal crossdating process began by assigning the innermost complete ring on each core the relative year "1" and marking every subsequent tenth ring with mechanical pencil. We then created skeleton plots (Stokes and Smiley 1996) of all cores to relatively crossdate the tree rings of each series against all others. Finally, we measured the widths of all tree rings to 0.001-mm accuracy with a Velmex measuring stage coupled with MEASURE J2X software.

Statistical Verification of External Crossdating

Absolute ("external") crossdating was accomplished by using COFECHA to compare the undated master chronology with a composite chronology created by averaging together the indices from three regional oak chronologies from Virginia, archived in the ITRDB. All three chronologies were collected and created by Dr. Edward R. Cook of the Lamont-Doherty Earth Observatory at Columbia University:

1. VA009, Blue Ridge Parkway, chestnut oak (*Quercus montana* Michx.), located at 37°33′ N, 79°27′ W, spanning 1587 to 1982;
2. VA016, Watch Dog, Massenhutten Mountain, chestnut oak, located at 38°30′ N, 78°21′ W, spanning 1642 to 1981;
3. VA017, Patty's Oaks, Blue Ridge Parkway, white oak, located at 37°55′ N, 79°48′ W, spanning 1569 to 1982.

We confirmed the graphical crossdating and relative placements of all tree-ring series using COFECHA, a quality-control program that uses segmented time-series correlation techniques to confirm the temporal placements of all tree rings (Holmes 1983). Because crossdating is essentially a "high-frequency" process (pattern matching of sequences of individual rings), COFECHA removed all low-frequency trends using both spline-fitting algorithms and autoregressive modeling (Grissino-Mayer 2001). COFECHA tested consecutive 40-yr segments (with 20-yr overlaps) on each series with a temporary master chronology created from all other series. Crossdating was verified when the correlation coefficient for each tested segment exceeded 0.37 ($p < 0.01$), although coefficients were usually much higher (for example, $r > 0.55$, $p < 0.0001$). The final placement made by COFECHA had to be convincing graphically (similar patterns in wide and narrow rings) and statistically. Once confirmed, we assigned absolute years to all individual rings in each measurement series.

Cutting Dates for Logs

Cutting dates for logs were obtained by noting the outermost ring on all cores extracted from logs that had intact outer surfaces. By convention, symbols are assigned to help evaluate the possible year of cutting (Bannister 1962; Nash 1999):

B: bark is present, indicating the outer ring is fully intact (certainly a cutting date);
r: outermost ring is continuous and intact around a smooth surface, but no bark is present (considered a cutting date);
v: the date is within a few years of the cutting date, based on presence of sapwood (near cutting date);
vv: impossible to determine how far the outer ring is from the true outer surface (no sapwood and rings in the heartwood could also be missing).

RESULTS

Descriptive Statistics

The average mean sensitivity was 0.21 (lowest = 0.12 for core HOSS07A; highest = 0.33 for core HOSE10B; Table 1), higher than the average reported for 16 other white oak chronologies from the eastern and central U.S. (average of 0.16, with upper 95% confidence limit of 0.20; Dewitt and Ames 1978). The average interseries correlation for the 37 cores was 0.65 (lowest $r = 0.29$ for core HOSW06B, $n = 105$ years; highest $r = 0.86$ for core HOSN09B, $n = 41$ years, Table 1). This value is exceptional by dendrochronological standards, especially considering that hardwood species generally have lower interseries correlations than do conifer species.

Internal Crossdating

Most logs sampled were cut from species in the white oak group, most likely white oak. Of 53 cores extracted from the cabin, 37 cores representing 28 logs could be conclusively crossdated. Of 105 40-yr segments tested by COFECHA in these 37 measurement series, only 8 segments were flagged by the COFECHA software because of possible errors (Table 1), but inspection of these segments indicated correct temporal placements. Such flagged segments occasionally arise because

Table 1. Descriptive statistics for 37 crossdated cores extracted from 28 logs from the Hoskins House.

Core Number	Core Ident	Begin Year	End Year	Total Rings	Segments Tested	Segments Flagged	Series Intercorrelation	Mean Sensitivity
1	HOSN03A	1755	1800	46	3	0	0.835	0.253
2	HOSN03B	1754	1813	60	3	0	0.751	0.250
3	HOSN04A	1763	1803	41	2	0	0.741	0.172
4	HOSN06B	1761	1810	50	2	0	0.609	0.275
5	HOSN07A	1735	1785	51	3	0	0.585	0.210
6	HOSN08A	1750	1796	47	2	0	0.656	0.222
7	HOSN08B	1749	1813	65	3	0	0.750	0.228
8	HOSN09A	1759	1812	54	3	0	0.748	0.190
9	HOSN09B	1767	1807	41	2	0	0.863	0.208
10	HOSN11A	1743	1812	70	3	0	0.745	0.197
11	HOSN12B	1736	1813	78	4	0	0.692	0.225
12	HOSE04B	1723	1811	89	4	0	0.568	0.194
13	HOSE05A	1732	1812	81	4	0	0.667	0.202
14	HOSE07A	1772	1807	36	1	0	0.704	0.232
15	HOSE08A	1739	1805	67	4	0	0.644	0.203
16	HOSE08B	1751	1812	62	3	0	0.708	0.205
17	HOSE09A	1755	1812	58	3	0	0.759	0.195
18	HOSE10B	1761	1797	37	1	0	0.655	0.325
19	HOSS03A	1761	1813	53	2	0	0.787	0.196
20	HOSS05A	1733	1813	81	4	1	0.491	0.202
21	HOSS05B	1733	1795	63	3	1	0.540	0.199
22	HOSS06A	1742	1812	71	3	0	0.752	0.224
23	HOSS06B	1752	1802	51	3	0	0.826	0.243
24	HOSS07A	1745	1812	68	3	1	0.433	0.124
25	HOSS07B	1752	1812	61	3	1	0.405	0.177
26	HOSS08A	1760	1812	53	2	0	0.752	0.199
27	HOSS09A	1749	1806	58	3	0	0.724	0.197
28	HOSS09B	1744	1811	68	3	0	0.758	0.212
29	HOSW06A	1760	1812	53	2	0	0.805	0.222
30	HOSW06B *	1727	1831	105	4	2	0.293	0.207
31	HOSW06C	1760	1812	53	2	0	0.777	0.184
32	HOSW07C	1747	1813	67	3	0	0.723	0.163
33	HOSW09A	1750	1813	64	3	0	0.548	0.176
34	HOSW10A	1763	1812	50	2	0	0.793	0.174
35	HOSW11A	1745	1811	67	3	2	0.310	0.203
36	HOSW12A	1728	1812	85	4	0	0.613	0.239
37	HOSW14A	1742	1800	59	3	0	0.470	0.207
Total or Mean					**105**	**8**	**0.647**	**0.207**

*HOSW06B is not similar in length or appearance to cores HOSW06A and HOSW06C, suggesting to us this could be a core extracted from a (partial) replacement log.

of erratic ring sequences caused by local disturbances (such as wildfires and windthrow) that affect the ring patterns, rather than the result of misdated ring segments. Sixteen cores could not be crossdated, either internally against other cores or externally against the reference chronologies, and were excluded from further analysis. These cores usually had too few rings (less than 30) to be convincingly crossdated, or contained injuries that caused erratic ring sequences. One core was extracted from a tulip poplar (*Liriodendron tulipifera* L.) log but was not processed.

External Crossdating

Comparison of the standard index chronology created from the Hoskins House measurement series graphically with the composite reference

Table 2. Cutting or outermost dates for the 28 logs sampled from the Hoskins House.

Log Number	Log Identification	Inner Ring	Last Measured Ring	Outer Ring	Outer Ring Type	Interpretation
1	HOSN03	1754	1813	1813	r	Cutting date
2	HOSN04	1763	1803	1813	r	Outer rings crossdated, not measured. Cutting date.
3	HOSN06	1761	1810	1810	v	Near cutting date
4	HOSN07	1735	1785	1812	r	Outer rings crossdated, not measured. Cutting date.
5	HOSN08	1749	1813	1813	r	Cutting date
6	HOSN09	1759	1812	1812	r	Cutting date
7	HOSN11	1743	1812	1812	r	Cutting date
8	HOSN12	1736	1813	1813	r	Cutting date
9	HOSE04	1723	1811	1811	r	Cutting date
10	HOSE05	1732	1812	1812	r	Cutting date
11	HOSE07	1772	1807	1812	r	Outer rings crossdated, not measured. Cutting date.
12	HOSE08	1739	1812	1812	r	Cutting date
13	HOSE09	1755	1812	1812	r	Cutting date
14	HOSE10	1761	1797	1806	vv	Outer rings unclear, not measured.
15	HOSS03	1761	1813	1813	r	Cutting date
16	HOSS05	1733	1813	1813	r	Cutting date
17	HOSS06	1742	1812	1812	r	Cutting date
18	HOSS07	1745	1812	1812	r	Cutting date
19	HOSS08	1760	1812	1812	r	Cutting date
20	HOSS09	1744	1811	1811	r	Cutting date
21	HOSW06A	1760	1812	1812	r	Cutting date
22	HOSW06B *	1727	1831	1831	r	Cutting date, likely a portion of replacement log.
23	HOSW07	1747	1813	1813	r	Cutting date
24	HOSW09	1750	1813	1813	r	Cutting date
25	HOSW10	1763	1812	1812	r	Cutting date
26	HOSW11	1745	1811	1811	r	Cutting date
27	HOSW12	1728	1812	1812	r	Cutting date
28	HOSW14	1742	1800	1811	r	Outer rings crossdated, not measured. Cutting date.

*HOSW06B is not similar in length or appearance to cores HOSW06A and HOSW06C, suggesting this could be a core extracted from a (partial) replacement log.

chronology created from the three oak chronologies in Virginia revealed a strong agreement (Figure 3). This graphical agreement was verified statistically using COFECHA by comparing the undated chronology created from the Hoskins House with the composite reference chronology. We found that all 40-yr segments (lagged 10 yrs) tested significantly (average $r = 0.51$, $n = 40$, $t = 3.65$, $p < 0.001$) against the composite chronology with a dating adjustment of +1723, suggesting that our chronology for the Hoskins House was now anchored from 1723 to 1831. The correlation between the two data sets was statistically significant over the period 1723 to 1813 ($r = 0.45$, $n = 91$, $t = 4.8$, $p < 0.0001$). This shorter period was used for statistical testing because only one sample (HOSW06B, likely a replacement log)

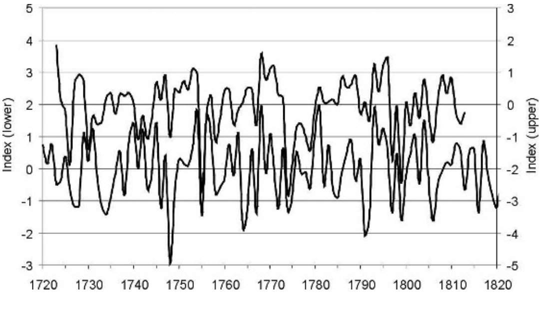

Figure 3. Comparison of the Hoskins House master chronology (upper graph) with the composite created from the three oak chronologies located in Virginia (lower graph) ($r = 0.45$, $n = 91$, $t = 4.8$, $p < 0.0001$, from 1723 to 1813). Index values were converted to standard deviation units to highlight extreme wide and narrow rings.

extended the chronology between 1814 and 1831. Several of the samples in our data set are short (less than 50 rings), and dating short samples should be viewed with a degree of caution. However, we believe that enough 60 to 80-year samples were used to make conclusive dating possible.

DISCUSSION

The trees that were harvested to construct the Hoskins House were cut within a three-year period in the years 1811, 1812, and 1813. Four oak trees had outermost dates of 1811, which indicated the initial cutting of trees, but the majority of trees used in the log structure were cut in the year 1812 (13 trees). Eight trees in our final sample of 28 logs were then harvested in the year 1813. Closer inspection of the 1813 tree rings on these eight logs suggest that the 1813 ring may be a partial ring. The earlywood is clearly formed on all eight logs, but the latewood on all eight appears narrower than on preceding rings, suggesting the latewood is partial. This suggests that these eight oak trees were likely harvested in the late spring or early summer of the year 1813. No earlywood vessels for the year 1814 were found on any core. We propose that the Hoskins House was constructed no earlier than the summer or fall of 1813.

Only three logs had outermost dates other than the 1811 to 1813 range of years. One log (HOSN06) had an outermost ring of 1810, which occurred because the outer rings disintegrated during sampling (no ink mark was visible on the outer ring on the core). Another log (HOSE10) had an outermost ring in the year 1806, but the additional outer rings that were present were too indistinct to measure and crossdate because of decay. Finally, one log (HOSW06B) curiously had an outermost ring of 1831. We believe this core may have been extracted from a partial log (number 6 on the west wall) that had been inserted as a replacement log, as partial replacement logs were common in the structure. To support this, the log was also the oldest of any log sampled in the Hoskins House, suggesting that it was not part of the original log structure. The rings in this log also had a lower than average interseries correlation with the other logs (0.29), which further suggests this tree came from a different stand of trees than those used in the log structure. However, because the series of rings in this log still has a statistically significant correlation, despite it being lower, we believe this tree came from the immediate vicinity of the region.

The early 1800s construction date is also supported by the number of rings found in each log. We have found that log structures built from the oldest trees in a region that had not witnessed considerable settlement-era logging often display a considerable number of rings in the logs. For example, 30 oak logs at the Rocky Mount historic site in northeastern Tennessee had an average of 99 rings per log (Grissino-Mayer and van de Gevel 2007). Ring counts on logs from Abraham Lincoln's Boyhood Cabin, located just north of Hodgenville, Kentucky, showed 150 rings per log (H.D. Grissino-Mayer, *unpublished data*), suggesting the cabin was constructed from old-growth trees. Alternatively, the number of rings on logs used to reconstruct Abraham Lincoln's (supposed) Birthplace Cabin in downtown Hodgenville, Kentucky, averaged only 40 rings (H.D. Grissino-Mayer, *unpublished data*), indicating this structure could not date to the year 1809, the year of Lincoln's birth. Thus, Lincoln's Boyhood Cabin is more likely to be authentic, whereas the Birthplace Cabin is not.

The average number of rings found in the 28 logs in the Hoskins House was 61, suggesting that these trees had not grown in an old-growth stand of trees when harvested. Instead, these oak trees could have been come from a second-growth forest in the vicinity. Alternatively, these trees could represent residual trees left over from the initial cutting that took place on the property during the early phases of settlement, assuming that a growth release occurred in these trees because of the reduction in competition. The property was believed settled as early as 1762 by Robert Mitchell, who at one time was thought to be the builder of the Hoskins House (NPS 1988).

After the death of Joseph Hoskins in 1799, the property was passed to his two sons, Joseph and Ellis (Stine *et al.* 2003). The will stipulated that the portion of the property with the house go to his son Joseph, but the property must have eventually passed into the hands of his son Ellis (Stine *et al.* 2003), who was likely at the point in his life between 1812 and 1814 when he needed to build a cabin of his own. Therefore, the log house located at Tannenbaum Historic Park may be more correctly called the "Ellis Hoskins House" rather than the "Joseph Hoskins House" (Adrienne Byrd, *personal communication*, 3 April 2006).

The correspondence of the 1811–1813 cutting dates for the logs in the Hoskins House with the Mean Ceramic Date (MCD) of 1810 (Stine *et al.* 2003) is a testament to the efficacy of archaeological dating techniques based on the assessment of recovered artifacts. The MCD is obtained by taking the sum of the artifacts making up the median date for the manufacturing date range for each ceramic shard and then multiplying by the total frequency, or the count in any given interval, and dividing the sum by the number of shards in the total population (South 1977). Using these techniques, Mann (2002) obtained a MCD of 1852 for the Swaggerty Blockhouse in eastern Tennessee. Tree-ring dating of 13 logs from this historic structure in eastern Tennessee revealed the last trees had been cut in the spring of 1860, and not in 1787 as was once believed. Mann (2002) and Stine *et al.* (2003) clearly demonstrate the importance of using complementary techniques from both historical archaeology and dendrochronology to establish (1) construction dates of historic structures, (2) the duration of occupation of historical sites, and (3) how such historic sites were used by their occupants.

The erroneous 1857 date for the construction of the Hoskins House supplied to Tannenbaum Historic Park by Heikkenen and Egan (2000) is particularly troubling because errant dates can have adverse repercussions for the historical and architectural interpretations of any structures and their sites. Many sites of regional and national historical significance are listed in the National Park Service's National Register of Historic Places, and dates of construction that are too young could diminish the importance of a site being considered for possible inclusion in the register. Furthermore, dendrochronology provides dates that are repeatable—any laboratory or individual should give the same result (Baillie 1982)—and dates for tree rings should never be released unless the dendrochronologist is absolutely certain of the dates provided. The errant 1857 date highlights the need for better documentation of methods used to derive the date.

ACKNOWLEDGMENTS

We thank the personnel of Tannenbaum Historic Park, the City of Greensboro Parks and Recreation Facility, and the Guilford Battleground Company for providing funds, logistical support, and welcome advice needed to conduct this research. Adrienne Byrd, Director of Tannenbaum State Park, and Linda Stine, Professor of Archaeology at the University of North Carolina Greensboro, were extremely helpful in providing copies of past unpublished studies and reports, relevant journal articles, maps, and related documents. We were assisted in the field by laboratory assistants Pamela Dalal and Tim Green. Tim Green also measured the hundreds of tree rings from these samples. Daniel Miles of the Oxford Dendrochronology Laboratory provided critical tree-ring data that verified the crossdating of the tree rings obtained from the Hoskins House cores. The project benefited greatly from the many contributors of tree-ring data to the ITRDB (National Climatic Data Center in Asheville, North Carolina), especially Dr. Edward R. Cook of the Lamont-Doherty Earth Observatory at Columbia University. S.L. van de Gevel and J.L. Hart were partially supported by NSF grant number DGE-0538420.

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Received 17 July 2007; accepted 23 February 2008.