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Dendrochronology reveals the construction history of an early 19th century farm settlement, southwestern Virginia, USA

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ABSTRACT

The McDonald Farm (also called the Anderson-Doosing Farm) in Catawba Valley, Virginia dates to 1789 and is registered with the National Register of Historic Places maintained by the National Park Service. According to written accounts, oral histories, and architectural analyses, the construction of four structures (a collapsed cabin, a standing cabin, a barn, and a smokehouse) at the farm likely occurred in the early to mid-19th century. To verify and refine the construction dates of the four structures, we absolutely dated the tree rings in logs used in their construction by comparing their ring patterns with a composite reference tree-ring chronology created from four regional locations. We used established graphical and statistical techniques used in dendrochronology to ensure that all tree rings were dated absolutely with 99.99% certainty. We found cutting dates for the collapsed cabin ranged from 1809 to 1810, making the likely builder Samuel Myers and not Joseph Anderson, who is currently given credit for its construction. The logs in the barn had cutting dates ranging from 1830 to 1831, confirming the 1830 construction date estimated by the historical documents and confirming the builder was Joseph Anderson. The logs from the standing cabin and smokehouse had cutting dates ranging from 1838 to 1840, refining the "mid-19th century construction" listed in the register nomination. Furthermore, the nomination gave credit of the construction of these latter two structures also to Joseph Anderson, but the builder was actually John Gish who owned the farm from 1837 to 1845. Our study demonstrates the benefit and reliability of using dendrochronology to verify and refine construction dates and ownership histories of historic structures in the Southeastern U.S.

1. Introduction

Many structures exist in the southeastern United States with "historic" designations from federal agencies, local historical societies, or oral accounts, many of which do not have well-documented construction years or periods (Henderson et al., 2009; Grissino-Mayer, 2009). Dendrochronology can provide and has provided an objective method for determining the construction dates of historic structures by obtaining the cutting dates of logs and beams used in the structures. Techniques of this science have been increasingly used within the past few decades to successfully date structures throughout the eastern U.S. (Bonzani et al., 1991; Fuener and Taylor, 2008; Flynt, 2009) and the southeastern U.S. in particular (Stahle, 1979; Bortolot et al., 2001; Reding, 2002; Blankenship et al., 2009), advancing the historic understanding of these structures. Such studies are gaining acceptance by historians, historical architects, and archaeologists in the southeastern U.S. Of primary concern are structures with considerable historical

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significance but unverified and sometimes questionable construction dates. Subsequent dendrochronological analyses demonstrated that some structures were not what they were purported to be (Grissino-Mayer and van de Gevel, 2007; Mann et al., 2009; Slayton et al., 2009), with histories likely distorted over the generations that made the structures considerably older (Grissino-Mayer, 2009).

The first attempt at using tree rings to determine the construction date of historic structures in the southeastern U.S. can be attributed to Lassetter (1938) who successfully dated four cabins that had to be dismantled due to flooding caused by the construction of the nearby Norris Dam in eastern Tennessee. After nearly a 40-year hiatus in such studies, Bowers and Grashot (1976) attempted to determine the construction period of President Andrew Jackson's First Hermitage plantation outside Nashville, Tennessee, but were unsuccessful. Finally, Stahle (1979) developed the initial dating methods for historical dendroarchaeology in the Southeast by examining and dating numerous log structures throughout the state of Arkansas. Later studies by Pulice (2000) and Mann (2002) were the first to combine archaeological dating methods (e.g., ceramic assemblages, window glass thickness, nail typology) with dendrochronological dating techniques to determine accurate construction dates of historic structures and provide a more meaningful understanding of the land-use history associated with the structures. Later studies by DeWeese Wight and Grissino-Mayer (2004), Grissino-Mayer and van de Gevel (2007), Grissino-Mayer et al. (2009), van de Gevel et al. (2009), Grissino-Mayer et al. (2010), and Garland et al. (2012), among many others, proved the veracity for absolute dating of tree rings from beams and logs from a variety of historic structures, from Spanish missions in Florida to crib dams in North Carolina.

The McDonald Farm is located in Catawba Valley, Virginia and consists of 675 acres located near the headwaters of both Catawba Creek and the north fork of Roanoke River (Pezzoni, 2009). A historical and architectural examination of the structures on the farm complex was conducted in July 2009 by J. Daniel Pezzoni of Landmark Preservation Associates who subsequently nominated the McDonald Farm with the National Register of Historic Places (NRHP), maintained by the National Park Service. In the nomination, the farm is termed by its historical name of the "Anderson-Doosing Farm." The earliest ownership record showed the property belonged to William Sampson, dating back to 23 September 1789. Sampson later separated parcels on the property and sold 150 acres to Samuel Myers in 1809. In 1814, Myers sold 152 acres to Joseph Anderson. He and his family are traditionally credited with building the current structures on the property because tax records indicate that he built at least one structure on the property by 1820 (Pezzoni, 2009). Anderson later sold the property to John Gish in 1837. In 1845, Gish sold the farm to Jacob Doosing, which by then consisted of 278 acres on both sides of Catawba Creek. Jacob Doosing owned the farm until his death in 1868. His nephew, John Doosing, purchased the farm around 1870 and built a large farmhouse in 1882. John Doosing sold 240 acres to J.W. McNeil in 1916. The McNeil family built a barn and operated a dairy farm from 1940 to 2007. In 2007, the farm was purchased by current owners Jack and Mary McDonald.

The farm complex today consists of three intact log structures (Fig. S1): a standing cabin, a double-pen cantilever barn, and a smokehouse (but called a "meat house" in the nomination report). Pezzoni (2009) stated that the cabin dates to the "mid-19th Century," the smokehouse to the "early to mid-19th Century," and the barn to "ca. 1830." The current landowners found a tax deed that stated the barn on the property was built in 1814, thus bringing into question the "ca. 1830" date. The 1830 construction date likely came from a carving in one log of the barn that states "A A 1830" (Fig. 1) (we can infer that the last "A" stands for Anderson, but presume the first "A" may represent the name of a relative). Finally, a collapsed cabin lies across the road from the farm complex, where only the chimney remains standing surrounded by rotting oak log beams.

These four log structures represented a unique opportunity to investigate and hopefully refine the construction and ownership history of the farm complex. We had two specific objectives: (1) determine the construction dates of the four log structures on the farm complex using dendrochronological techniques to assign precise calendar years to all tree rings of the logs incorporated into the four structures, and (2) compare these dates to the known documentation to evaluate the veracity of prior historical and architectural assessments, especially concerning ownership history.

2. Materials and methods

2.1. Field methods

All four structures contained logs that were not fully squared and still maintained the natural curvature of the felled tree, some of which contained bark. For the three standing buildings (barn, standing cabin, and smokehouse), we chose logs that appeared to have a high number of rings to help ensure successful crossdating, and sampled only the basal end of logs that still maintained a natural curvature where the bark or sapwood appeared to be present. We used a 25 cm long hollow drill bit with 12 mm diameter drill tip attached to a variable-speed electric hand drill, taking extra care to not damage the outermost ring. Sampling locations were marked on sketches and coded. Cores extracted from the standing cabin and smokehouse were labeled based on letter assignment of the structure (e.g., MC = "McDonald Cabin"), the cardinal direction of the wall where the log was present, and log number, beginning with "01" for the sill (bottom) log and increasing sequentially upward (e.g., the third log from ground level on the north facing wall of the cabin would be assigned "MCN03"). Logs with noticeable sapwood decay required a second core to be extracted and these cores were assigned sequential letters following the core number starting with "A" to distinguish cores from the same log. Most cores were extracted from inside the structures because log surfaces outside the structure displayed significant erosion that would have hindered our ensuring the outermost rings were kept intact. All cores were taken from the lower curved surfaces of the logs because this location often has complete sapwood and gravity aids in removing dust from the borehole.

The barn presented a unique challenge because it consisted of two separate structures (called "pens"), each with four walls that extended for two floors, but also consisted of accessible logs that were part of individual rooms and separate walls in the lower portion of the barn. Cores extracted from the barn were labeled either "NP" (North Pen) or "SP" (South Pen), followed by cardinal direction, whether the log was located in the lower ("L") or upper

Fig. 1. Carving in one log of the cantilever barn, stating (likely) "A A 1830."

("U") floor, and log number for that floor level. Several cores were extracted from walls not associated with the two pens and were labeled "CW" ("Center Wall") followed by cardinal direction and log number. We also obtained cores from four *ex situ* logs outside the north pen and labeled these "NPX."

We obtained cross-sections of logs from the collapsed cabin using a chainsaw, relying on a visual assessment of logs we deemed to be in the best condition. In addition, the owners of the structure had previously salvaged some of the less weathered logs and put them in storage, and the owners kindly allowed us to cut sections from these logs. We carefully wrapped each log with shrink-wrap to prevent sapwood from crumbling and labeled each sample "CC" (Collapsed Cabin) followed by a sequential number as cardinal directions and sequential log numbers based on wall position were not possible. Similar to the three standing structures, when we took two samples from one log, we appended each label with an "A" or "B."

2.2. Data processing

The cores and cross-sections were sanded to a high polish using progressively finer sand paper so that the cells on all rings were clearly identifiable under standard 7–10X magnification (Orvis and Grissino-Mayer, 2002). The innermost complete ring for each core was then assigned the number "1" and every tenth ring marked in pencil with a single dot, every 50th ring with two dots, and every 100th ring with three dots to assist in the measuring and dating phases (Stokes and Smiley, 1996). Tree-ring widths on all cores were measured with a Velmex measuring stage at 0.001 mm precision using MEASURE J2X software (Voortech Consulting, 2012), while ring widths on cross-sections were measured using WinDENDRO software (Regent Instruments, 2012).

2.3. Reference chronologies

We used four regional oak tree-ring chronologies to create a composite reference chronology to assist in dating rings from the undated individual series (Fig. 2). This combined reference chronology for the region helps filter out any non-climate signals and improves our ability to successfully crossdate our samples. The reference chronologies (Cook, 1982; Copenheaver, 2001) obtained from the International Tree-Ring Data Bank (Grissino-Mayer and Fritts, 1997) included:

1. Blue Ridge Parkway, Virginia: chestnut oak (*Quercus montana* Michx.), 37° 33′N, 79° 27′W, AD 1587–1982
2. Patty's Oaks, Blue Ridge Parkway, Virginia: white oak (*Quercus alba* L.), 37° 55′N, 79° 48′W, AD 1569–1982
3. Lilley Cornett Tract, Kentucky: white oak, 37° 05′N, 83° 00′W, AD 1660–1982
4. VA029, Craig Creek, Virginia: white oak, 37° 21′N, 80° 22′W, AD 1722–2001

2.4. Crossdating

We used the software program COFECHA to perform the initial crossdating of the undated cores by crossdating each series against the composite reference chronology. COFECHA uses segmented time-series correlation techniques to confirm the temporal placement of each tree-ring series (Holmes, 1983; Grissino-Mayer, 2001). We verified crossdating using both graphical and statistical crossdating. We used $r = 0.37$ ($p < 0.01$) as the critical segment correlation coefficient value (Holmes, 1983; Grissino-Mayer, 2001) although correlations are usually much higher ($r > 0.50$). We tested consecutive 40-yr segments (with 20-yr overlap) on each series against the reference chronology, and the majority of segments tested for the undated series had to surpass the critical value for crossdating to be confirmed. In addition, the majority of segments being dated had to suggest similar dating adjustments (e.g., "+1755," which indicated 1755 years had to be added to the first measured ring = ring "1") (Grissino-Mayer, 2001). Once dated with a high degree of statistical confidence (usually > 99.9%), we created an index chronology for each structure using ARSTAN (Cook, 1985) to detrend the individual series using conservative linear models or

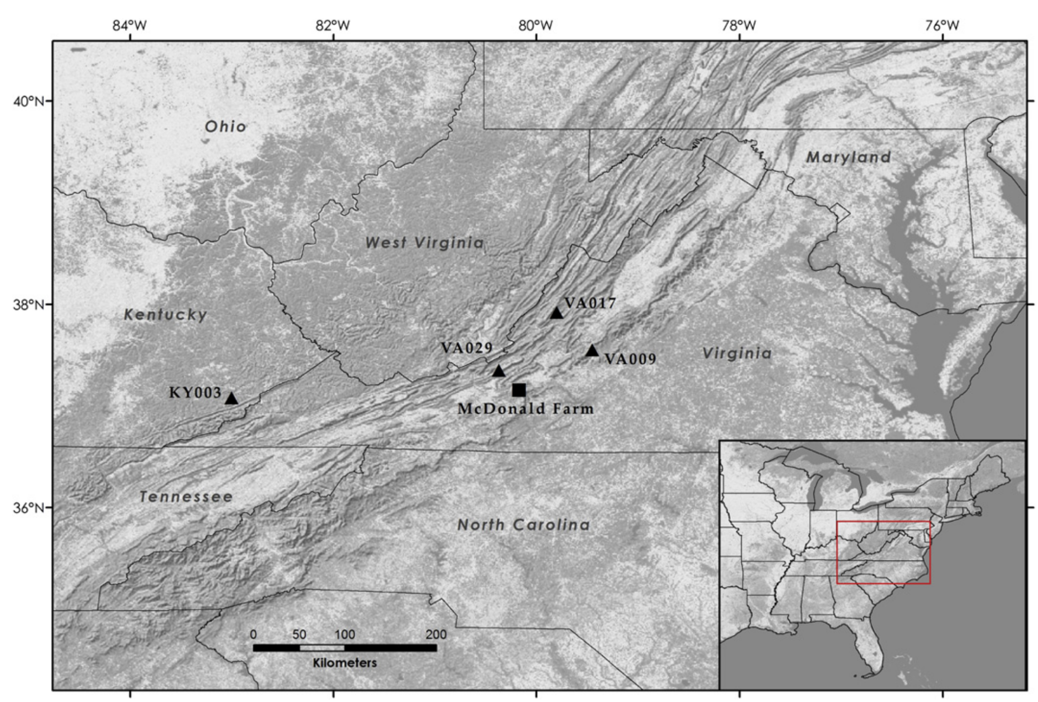

Fig. 2. Map showing the study site and locations of the reference chronologies obtained from the International Tree-Ring Data Bank (ITRDB) used in this project.

negative exponential curves to remove age-related trends and other trends arising from internal stand dynamics when the trees were living. The chronology for each structure was then input into COFECHA as an undated series and tested against the composite reference chronology. If crossdating was accurate, COFECHA assigned a dating adjustment of "0" which indicated the series required no shifting and thus was absolutely dated. Finally, we graphically compared via line plots the newly dated chronologies with the composite reference chronology to further ensure that the tree rings were dated absolutely in time. The comparisons had to be convincing both statistically and graphically before we considered the structures dated (Grissino-Mayer, 2001).

2.5. Establishing cutting dates

The outermost ring ever formed by the tree, if intact, indicates the year (cut during the growing season) or years (cut during the dormant season) the tree was felled to eventually be placed in the structure. Once trees were felled, they were often immediately incorporated into the structure (Grissino-Mayer and van de Gevel, 2007; Grissino-Mayer, 2009; Henderson et al., 2009). A partial outermost ring indicated a log that was most likely harvested during the growing season (i.e., between March and October), while a complete outermost ring signified a harvest date during the dormant season (i.e., between October and March). Cores taken from logs provide either the exact year (growing season cut) or years (dormant season cut) the tree was harvested based on visual evidence that the outermost ring formed was present and intact (cutting date), an outermost ring several years from harvest date based on the presence of sapwood (near cutting date), or an outermost ring many years from harvest date based on the absence of sapwood (non-cutting date). To help evaluate the possible cutting dates, we used the following nomenclature (Bannister, 1962; Nash, 1999):

B: Bark was present, indicating the outer ring was fully intact (a certain cutting date);

r: The outermost ring is intact and continuous but incomplete across the surface of the log as all logs were hand-hewn (considered a cutting date). These logs often displayed additional supporting evidence that the outermost ring was intact: a smooth surface displaying patination, beetle galleries, and sometimes discontinuous but fragile bark. Patination on wood occurs at the interface of xylem and phloem, just underneath the bark, as do beetle galleries;

v: The date is within a few years of the cutting date, based on presence of sapwood (a near cutting date);

vv: A cutting date is not possible because we cannot determine how far the outer ring is from the true outer surface (a non-cutting date). Either sapwood was not present or rings were missing due to an incomplete core (usually from extensive decay);

++: A ring count was necessary on a small section of outer portion of the core because a break, rot, or obscured rings kept the rings from being measured.

The latter symbol increased the accuracy of possible cutting dates. A segment containing the outermost rings occasionally separated from the rest of the core, which was usually caused by normal decay and extensive beetle galleries in the more fragile sapwood. While the detached segments contained too few rings for crossdating and measuring, they were valuable in determining the outermost calendar dates. The rings in the detached segment were counted and added to the outermost measured and crossdated ring to obtain a more accurate outermost date for the sample.

3. Results

The four reference chronologies used to create the composite regional chronology had statistically significant correlations for nearly all 40-year segments tested ($n = 69$) (Table 1). Seven of the 40-year segments tested were flagged by COFECHA as being problematic (falling below the threshold for statistical significant at the 0.01 level, $r < 0.37$), but re-evaluation of the flagged segments showed correct temporal placements. Such flags often occur in earlier segments of chronologies where sample depths decrease to only a few trees in each (Grissino-Mayer, 2001). Interseries correlations (the correlation of one chronology against a composite created from the other three) ranged from 0.43 (KY003) to 0.53 (both VA009 and VA017). Chronology VA029 had an interseries correlation of 0.47. The average interseries correlation was 0.49 over the full periods represented in each chronology, but was slightly higher (0.51) for the period in common (1722–1982, $n = 261$, $t = 8.21$, $p < 0.0001$), suggesting a strong regional climate signal that could be used to date the ring patterns of logs used to build the four structures.

3.1. Crossdating

We sampled a total of 56 logs, eight from the collapsed cabin, 24 from the barn, and 12 each from the standing cabin and smokehouse. Tree-ring patterns in logs obtained from all four structures displayed statistically significant internal (within structure) crossdating with interseries correlations ranging from 0.55 to 0.61 (Table 2). Values of average mean sensitivity ranged from 0.19 to 0.21, values identical for other eastern U.S. oak chronologies (*Q. alba*, *Q. montana* (= *Quercus prinus*), and *Quercus rubra*) in the International Tree-Ring Data Bank (ITRDB, 2012). Correlations for the final chronology from each structure revealed statistically significant values with the regional composite chronology, ranging from 0.53 to 0.59 ($p < 0.0001$). The collapsed cabin tree-ring chronology was absolutely dated from 1698 to 1828 (but only one log dated past 1810) with $r = 0.53$ ($n = 131$, $t = 7.08$, $p < 0.0001$), the standing cabin was dated from 1691 to 1839 with $r = 0.57$ ($n = 149$, $t = 8.43$, $p < 0.0001$), the smokehouse from 1706 to 1840 with $r = 0.53$ ($n = 135$, $t = 7.26$, $p < 0.0001$), and the barn from 1692 to 1920 (but only one log dated past 1835) with $r = 0.59$ ($n = 229$, $t = 8.73$, $p < 0.0001$) (Table 2). Finally, graphical comparisons supported the strong statistical relationships between the structure chronologies and the regional composite chronology (Fig. 3).

COFECHA flagged any segments with correlations that (1) did not meet the established level for statistical significance ($p < 0.01$), or (2) indicated an alternate dating adjustment with a higher correlation. For all four structures, the flagged segments were no greater than 10% (Table 2). We evaluated all flagged segments from all cores in all structures (Tables 3–6) and determined the temporal placements were correct. Most often, flagged segments occurred in the innermost ring segments where the climate signal is generally not strong during juvenile growth years, or in the outermost ring segments where decay and beetle galleries make accurate ring measurements difficult (Grissino-Mayer, 2001).

3.2. Cutting dates

The collapsed cabin log cross-sections yielded two conclusive cutting dates (Table 3). Log CC07 had an outermost ring of 1809 that may or may not have been fully formed, suggesting this tree was felled anytime from the mid- to late growing season of 1809 to the dormant season (winter) of 1809/1810. Both cores from log CC05 had bark intact and the ring for 1810 may have been fully formed, indicating the tree was felled anytime from the latter part of the

Table 1
Results from the COFECHA correlation analysis conducted on the four regional chronologies used to construct the regional composite for crossdating the individual structure.

Series	Years	40-Year segment tested																			
		1580–1619	1600–1639	1620–1659	1640–1679	1660–1699	1680–1719	1700–1739	1720–1759	1740–1779	1760–1799	1780–1819	1800–1839	1820–1859	1840–1879	1860–1899	1880–1919	1900–1939	1920–1959	1940–1979	1960–1999
VA009	1587–1982	0.42	0.33[a]	0.43	0.57	0.54	0.49	0.30[a]	0.54	0.76	0.66	0.61	0.67	0.71	0.52	0.40	0.45	0.55	0.60	0.58	0.59
VA017	1569–1982	0.42	0.33[a]	0.43	0.41	0.46	0.68	0.51	0.63	0.61	0.54	0.71	0.59	0.59	0.54	0.46	0.50	0.49	0.51	0.62	0.63
KY003	1660–1982					0.19[a]	0.23[a]	0.30[a]	0.46	0.51	0.48	0.51	0.48	0.57	0.59	0.50	0.48	0.46	0.45	0.47	0.42
VA029	1722–2001								0.14[a]	0.39	0.52	0.67	0.48	0.38	0.47	0.43	0.61	0.70	0.53	0.54	0.58
Average correlation		0.42	0.33	0.43	0.49	0.40	0.47	0.37	0.44	0.57	0.55	0.62	0.56	0.56	0.53	0.45	0.51	0.55	0.52	0.55	0.55

[a] Indicates a segment flagged by COFECHA (low correlation).

growing season of 1810 to the dormant season (winter) of 1810/1811. The proximity of these two dates suggests that a common year of 1810 for cutting is possible. One log (CC01) had a cutting date near 1829 that suggested this log was likely a replacement log, or could have been a later addition to the structure from a tree cut during the same period as trees cut to construct the barn. Logs CC08, CC03, and CC04 had near cutting dates of 1808, 1805, and 1799, respectively, based on presence of sapwood. Two logs had non-cutting dates.

Eleven logs from the standing cabin provided cutting dates (Table 4). Two logs (MCW04 and MCX25, the latter being an *ex situ* log found in the barn that was likely an original log from the standing cabin) revealed a cutting date based on what appears to be a complete ring for the year 1838 (based on its ring width relative to surrounding rings), indicating the tree was felled anytime from the latter part of the growing season in 1838 to the dormant season (winter) of 1838/1839. Logs MCE03, MCE06, MCN03, MCN05, MCS04, MCS07, MCW03, and MCW05 all had the 1839 ring which may or may not have been completely formed, indicating cutting in the middle to latter portion of the growing season of 1839 to the dormant season (winter) of 1839/1840. One log, MCS04, had an outermost ring formed in 1840, which may or may have been complete, indicating the tree was felled anytime from the latter part of the growing season of 1840 to the dormant season (winter) of 1840/1841. Based on these cutting dates, the trees used to construct the standing cabin could have been felled anytime from late 1838 to early 1841, but the majority of logs indicate the standing cabin likely was initially constructed in 1838–1839 and completed a few years later.

Of the 24 logs cored from the barn, 18 provided cutting dates (Table 5). Eleven of these 18 logs had an outermost ring dated at 1830 that may or may not have been completely formed, indicating felling of the trees in the middle to latter part of the growing season for that year, or possibly in the dormant season (winter) of 1830/1831. Four logs, however (CWE01, SPNU03, SPEU04, and CWE03), had outermost rings that had formed in 1831 only, and these rings appeared to have been completely formed or nearly so based on the ring widths relative to previous ring widths. If so, then these trees were felled in the latter part of the growing of 1831 or as late as the dormant season of 1831/1832. Curiously, one log (SPWU07) had an outermost ring of 1829, indicating felling anytime from the middle of the growing season for that year to the dormant season of 1829/1830. This may represent the earliest year when trees were felled to construct the barn. Two logs had cutting dates later than the 1829–1831 period. Sample CWW01 had an outer ring date of 1836, perhaps representing a replacement or addition to the structure, while sample NPX02 had an outer date of 1920. This latter log was collected from a pile of logs stacked in the barn that obviously were cut to replace logs that had likely deteriorated and needed replacement early in the 20th century. Based on these cutting dates, the trees used to construct the barn were felled during the period 1829 to 1832, with 1830 and 1831 being the most likely years when the majority of trees were felled.

Ten logs from the smokehouse provided cutting dates (Table 6). Four logs (MSE08, MSS05, MSW07, and MSW08) had an outermost tree ring that dated to the year 1838 and we could determine only that these trees were cut sometime during the growing season of 1838. Four logs (MSE09, MSS07, MSS08, and MSW06) had an outermost ring present that dated to the year 1839, and the incomplete ring (based on the relative ring width) suggested again cutting during the growing season of 1839. One log (MSN08) clearly had an outermost ring with wood formed in 1841. Its topmost position on the north wall of the smokehouse could indicate it was one of the last trees felled to construct the smokehouse, or could suggest the smokehouse walls were elevated a few years after

Table 2
Descriptive statistics from COFECHA for the tree-ring chronologies from each structure.

Structure	Interval	Dated logs	Segments tested	Flagged segments	Interseries correlation	Mean sensitivity	Corr. w/Reference	Student's t[b]
Collapsed cabin	1698–1828	8	47	3	0.61	0.22	0.53	7.08
Barn	1692–1835[a]	24	136	10	0.61	0.21	0.59	8.73
Standing cabin	1691–1839	12	75	7	0.60	0.21	0.57	8.43
Smokehouse	1706–1840	12	61	4	0.55	0.19	0.53	7.26

[a] One series extended from 1836 to 1919 from a replacement log.
[b] All values $p < 0.0001$.

initial construction. One log (MSW05) had an outermost tree ring dating to 1834 (with bark present) and also likely was cut during the growing season. The wide range of cutting dates for logs on this structure may suggest that either (1) construction proceeded slowly over a number of years, or (2) logs were stockpiled before eventual construction, but the majority of trees felled indicated that 1838 and 1839 were the major years of construction.

4. Discussion

The sequence of cutting dates of all the structures on the compound revealed that the collapsed cabin was built first, likely completed in and livable by 1810. The NRHP nomination did not assign an approximate period of construction for the collapsed cabin because nothing remained standing to assist the visual assessment. The nomination noted, however, that

"It seems likely that a log house that formerly stood across Blacksburg Road from the present farm, and known as the Jacob Doosing House after the mid-nineteenth-century owner, was [Joseph] Anderson's residence and was built before 1820, presumably shortly after Anderson purchased the property in 1814" (Pezzoni, 2009).

Our findings suggest that Samuel Myers, who purchased the property in 1809, likely constructed the now-collapsed cabin which had cutting dates of 1809 and 1810. This cabin therefore should be renamed the "Samuel Myers Cabin." The nomination further stated that "An 1864 map of Roanoke County suggests the Doosings lived in the former log house across the road from the present Anderson-Doosing Farm" (Pezzoni, 2009). This is possible given that the cabin likely would still have been standing in 1864, but the Doosing family (who bought the farm from John Gish in 1845) likely lived in the more recently constructed (1838–1839) current standing cabin.

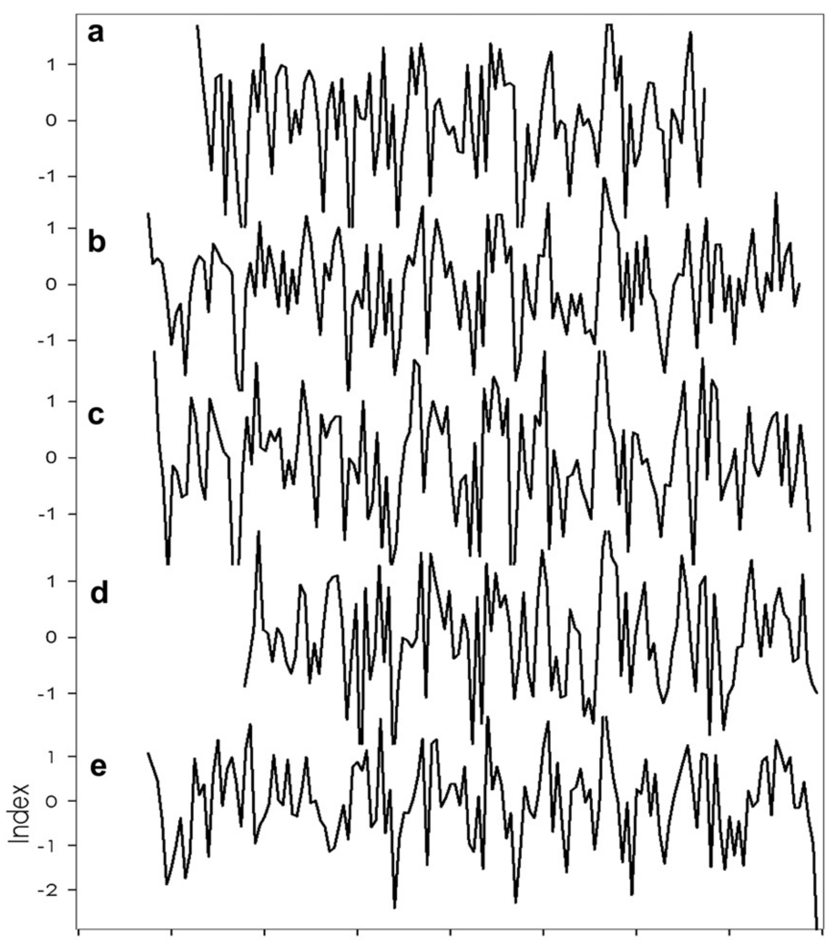

Fig. 3. Time series comparisons showing agreements in crossdating: (a) collapsed cabin, (b) barn, (c) standing cabin, (d) smokehouse, and (e) The composite regional reference chronology.

Table 3
Results from the COFECHA correlation analysis conducted for tree-ring measurements from the Collapsed Cabin, with outermost ring date and cutting date type.

Series	Years	40-Year segment tested					Outer ring	Date type[b]
		1700–1739	1720–1759	1740–1779	1760–1799	1780–1819		
CC01A[c]	1726–1828		0.64	0.70	0.63	0.46	1829v	Near CD
CC01B[c]	1728–1814		0.71	0.51	0.45[a]	0.33[a]	1815v	Near CD
CC02A	1716–1786	0.80	0.80	0.45	0.30[a]		1787vv	Non-CD
CC02B	1714–1783	0.82	0.79	0.62	0.64		1784vv	Non-CD
CC03A	1726–1804		0.58	0.64	0.53	0.54	1805v	Near CD
CC04A	1721–1798		0.72	0.59	0.47		1799v	Near CD
CC05A	1710–1809	0.67	0.63	0.75	0.73	0.54	1810B	CD
CC05B	1709–1809	0.59	0.58	0.62	0.76	0.69	1810B	CD
CC06A	1710–1792	0.63	0.62	0.82	0.68		1793vv	Non-CD
CC07A	1698–1808	0.76	0.64	0.67	0.76	0.72	1809r	CD
CC08A	1705–1807	0.66	0.58	0.70	0.72	0.69	1808v	Near CD
Average correlation		0.70	0.66	0.64	0.61	0.57		

[a] Indicates a segment flagged by COFECHA (low correlation).
[b] CD = Cutting date.
[c] Indicates a log that likely came from the cantilever barn.

The nomination further stated that the now-collapsed cabin later served as a “wash house,” substantiating that this cabin was perhaps of secondary importance on the Doosing Farm of the mid-to late 1800s.

The nomination, however, was very accurate for the construction date for the barn (“ca. 1830”), a date that likely came from the graffiti found on one of the logs (Fig. 1). We found cutting dates for the barn between 1829 and 1832 (more likely cut in 1830 and 1831), which confirmed the barn was perhaps functional around 1830 (i.e., one pen of the two required for the double cantilever barn had been completed) while construction continued until the barn was complete by the winter of 1831/1832. According to the NRHP nomination, tax records indicated that Joseph Anderson, who owned the property from 1814 to 1837, had buildings on the property, and thus was given credit for building all four structures (Pezzoni, 2009). However, the barn is the only structure that dates to this interval. It seems likely that Anderson lived in the original, now-collapsed cabin built by Samuel Myers and later he and his family built the barn in 1830–1831. In addition, our finding disproved the date on the tax deed the current landowner found that suggested the barn was built in 1814 and instead confirmed the date listed in the nomination report. We cannot, however, discount that a previously-built barn may have once existed at the farm complex to which the tax deed record could be referring.

The NRHP nomination estimated that the standing cabin and smokehouse were constructed in the early to mid-19th century. Our results refined the temporal placement of construction for these two structures as they were built contemporaneously in 1838–1839. John Gish most likely built the standing cabin and smokehouse because he purchased the property in 1837 and the trees used for the construction of the two structures were felled just a few years after this date. The nomination stated that peculiar architectural details (i.e., diagonal pegs used to secure the door and window jambs) suggested “that the meat house and cabin were built at roughly the same time or by the same builder or team of builders” (Pezzoni, 2009), a rather remarkable observation confirmed by our research and a testament to the efficacy of assessments made by architectural historians.

Our study emphasized limitations and difficulties in conducting dendrochronological research on historic structures. Our greatest concern was that many logs had soft, friable sapwood, and created challenging sampling conditions. If we could not extract a core with most of the sapwood intact after initially drilling into the log approximately 15 mm, we then relocated the drill bit to another nearby location on the log, and continued this process until we extracted a sound core with most sapwood intact. Rarely did we have to attempt more than two cores, but the property owners were concerned of our making too many holes in their valued structures. Even with careful planning, the sapwood separated from the rest of the core on some samples and required us to manually count the rings in the detached sapwood and assign the core a “++” symbol.

We also found a few logs that had been placed in the structures at a later date and a few logs from trees that had been cut earlier than the construction dates. For example, we found a replacement log in the collapsed cabin (CC01) that was likely cut during the same period (1829) that the barn was constructed. We also found a loose log in the barn from a tree cut in 1920 that we initially believed to have been an original log of the barn, but obviously was not. These two situations are common and illustrate the need to have a large sample size to help the construction years of a structure. Occasionally, owners of possibly historic structures will extract a complete section from one or two log ends and send them to us for dendrochronological evaluations, but we stress to the owner that we prefer a larger number of samples and their resulting outermost ring/cutting dates to ensure we are not evaluating a replacement log cut later or from a log cut earlier. We look for clustering of outermost ring dates that suggest the likely cutting dates and therefore construction dates of the structures.

Table 4
Results from the COFECHA correlation analysis conducted for tree-ring measurements from the Standing Cabin, with outermost ring date and cutting date type.

Series	Years	40-Year segment tested							Outer ring	Date type[b]
		1680–1719	1700–1739	1720–1759	1740–1779	1760–1799	1780–1819	1800–1839		
MCE03	1703–1838		0.25A	0.44	0.82	0.84	0.73	0.51	1839r	CD
MCE06	1711–1838		0.50	0.40	0.65	0.79	0.76	0.72	1839r	CD
MCN03	1705–1838		0.49	0.69	0.71	0.62	0.65	0.51	1839r	CD
MCN04	1711–1830		0.56	0.50	0.72	0.69	0.68	0.63	1832vv	Non-CD
MCN05	1705–1838		0.57	0.54	0.77	0.64	0.49	0.57	1839r	CD
MCN07	1756–1833				0.77	0.78	0.71	0.51	1839r++	CD
MCS04A	1790–1838						0.67	0.65	1839r	CD
MCS04B	1730–1839			0.73	0.71	0.75	0.78	0.30[a]	1840r	CD
MCS07	1698–1838	0.45	0.45	0.60	0.86	0.81	0.61	0.50	1839r	CD
MCW03	1697–1838	0.70	0.73	0.71	0.87	0.90	0.75	0.56	1839r	CD
MCW04	1691–1837	0.23[a]	0.29[a]	0.19[a]	0.60	0.75	0.68	0.51	1838r	CD
MCW05	1697–1829	0.41	0.43	0.6	0.79	0.77	0.40	0.24[a]	1839r++	CD
MCX25	1701–1837		0.38	0.56	0.72	0.75	0.57	0.28[a]	1838r	CD
Average correlation		0.45	0.46	0.54	0.75	0.76	0.65	0.50		

[a] Indicates a segment flagged by COFECHA (low correlation).
[b] CD = Cutting date.

Table 5
Results from the COFECHA correlation analysis conducted for tree-ring measurements from the barn, with outermost ring date and cutting date type.

Series	Years	40-Year segment tested							Outer ring	Date type[b]
		1680–1719	1700–1739	1720–1759	1740–1779	1760–1799	1780–1819	1800–1839		
NPNL03A	1725–1829			0.69	0.51	0.43	0.55	0.55	1830r	CD
NLNL03B	1725–1829			0.60	0.40	0.40[a]	0.59	0.55	1830r	CD
NPNL04	1710–1829		0.45	0.56	0.83	0.89	0.86	0.74	1830r	CD
NPSL03B	1730–1829			0.77	0.72	0.81	0.84	0.79	1830r	CD
NPSL04	1770–1829					0.74	0.74	0.68	1830r	CD
NPEL03	1733–1829			0.66	0.71	0.72	0.53	0.50	1830r	CD
NPEL06	1706–1821		0.59	0.83	0.90	0.92	0.79	0.72	1822vv	Non-CD
NPEU03	1708–1812		0.54	0.52	0.69	0.68	0.53		1812vv	Non-CD
NPSU01A	1707–1829		0.82	0.74	0.69	0.82	0.68	0.56	1830r	CD
NPSU01B	1707–1819		0.64	0.62	0.64	0.67	0.81		1819v	Near CD
NPSU02	1723–1829			0.71	0.48	0.49	0.80	0.73	1830r	CD
NPSU04	1707–1829		0.24[a]	0.21B	0.40	0.46	0.41	0.41	1830r	CD
NPSU05	1705–1815		0.24[a]	0.64	0.77	0.66	0.64		1816vv	Non-CD
SPEL04B	1711–1829		0.52	0.63	0.76	0.68	0.60	0.60	1830r	CD
SPWL06	1704–1813		0.81	0.83	0.83	0.69	0.55		1829v++	Near-CD
SPNU03	1699–1830	0.60	0.63	0.83	0.81	0.80	0.69	0.49[a]	1831r	CD
SPEU04	1695–1829	0.61	0.75	0.66	0.71	0.81	0.72	0.72	1831r	CD
SPWU07	1709–1829		0.55	0.59	0.70	0.70	0.61	0.57	1829r	CD
CWS01A	1731–1823			0.62	0.74	0.75	0.44	0.34[a]	1824vv	Non-CD
CWE01	1692–1830	0.22[a]	0.36[a]	0.61	0.58	0.58	0.78	0.82	1831r	CD
CWE03	1726–1830			0.49	0.68	0.72	0.35[a]	0.36[a]	1831r	CD
CWE04	1712–1829		0.77	0.73	0.77	0.77	0.56	0.46	1830r	CD
CWW01	1739–1835			0.74	0.75	0.76	0.58	0.39	1836r	CD
NPX01C	1722–1817			0.73	0.82	0.76	0.70		1818vv	Non-CD
NPX02[c]	1808–1919							0.44	1920r	CD
NPX03	1709–1816		0.61	0.68	0.70	0.65	0.48		1830r++	CD
Average correlation		0.48	0.57	0.65	0.69	0.69	0.63	0.57		

[a] Indicates a segment flagged by COFECHA (low correlation).
[b] CD = Cutting date.
[c] Indicates a likely replacement log cut much later.

For the standing cabin, barn, and smokehouse where logs were sequentially numbered from bottom to top, the cutting dates revealed that some logs near the top portions of walls on these structures predate or have similar dates of harvest to logs found on lower portions of the walls. For example, upper logs MCE06, MCN07, and MCS07 in the standing cabin (only seven logs per wall) have the same cutting date (1839) as the lower MCE03, MCN03, and MCW03. In the smokehouse, upper logs MSE08, MSW07, and MSW08 have cutting dates (1838) that predate those for logs found on lower portions of the walls. The barn contained logs in the upper floor with cutting dates that predated or were identical to cutting dates found for logs on the lower floor. This finding indicates that each structure was constructed all at once from logs that likely had been stockpiled after harvest.

Our dendrochronological study evaluated the most structures on any one piece of property ever in the southeastern U.S. and demonstrated that tree-ring dating can complement and refine the dates of construction and ownership/builder histories determined by architectural and historical assessments of the structures. Our results not only refined the construction dates of all four structures but provided more accuracy on the builders themselves: Samuel Myers built the now-collapsed cabin in 1809–1810, Joseph Anderson built the double-pen cantilever barn in 1830–1831, and John Gish built the standing cabin and smokehouse in 1838–1839.

Table 6
Results from the COFECHA correlation analysis conducted for tree-ring measurements from the smokehouse, with outermost ring date and cutting date type.

Series	Years	40-Year segment tested						Outer ring	Date type[b]
		1700–1739	1720–1759	1740–1779	1760–1799	1780–1819	1800–1839		
MSE07	1740–1834			0.67	0.65	0.61	0.40[a]	1835v	Near CD
MSE08	1706–1837	0.69	0.69	0.78	0.53	0.49	0.44	1838r	CD
MSE09	1776–1835				0.53	0.52	0.34[a]	1839r++	CD
MSN07	1722–1835		0.47	0.50	0.57	0.65	0.55	1837v++	Near CD
MSN08A	1726–1839		0.36[a]	0.53	0.53	0.69	0.52	1840r	CD
MSN08B	1774–1840				0.51	0.67	0.53	1841r	CD
MSS05	1726–1837		0.81	0.73	0.61	0.58	0.50	1838r	CD
MSS07	1735–1838		0.50	0.59	0.66	0.61	0.54	1839r	CD
MSS08	1732–1838		0.72	0.72	0.55	0.47	0.33[a]	1839r	CD
MSW05[c]	1720–1833		0.63	0.66	0.59	0.55	0.45	1834B	CD
MSW06	1721–1838		0.55	0.66	0.60	0.50	0.44	1839B	CD
MSW07	1724–1817		0.41	0.48	0.55	0.60		1838r++	CD
MSW08	1716–1837	0.61	0.61	0.65	0.58	0.55	0.44	1838r	CD
Average correlation		0.65	0.58	0.63	0.57	0.58	0.46		

[a] Indicates a segment flagged by COFECHA (low correlation).
[b] CD = Cutting date.
[c] Indicates a log from a tree cut earlier than the others.

Although many historic structures still exist in the Southeastern U.S., their numbers continue to dwindle due to log salvaging, neglect, land development, deterioration and decay, and eventual collapse. The National Register of Historic Places, however, provides incentives for landowners to preserve and protect these structures, and we suggest increased use of dendrochronological techniques to provide a means for supporting and enhancing archaeological, architectural, and socio-historical techniques to help determine construction dates.

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Appendix A. Supplementary material

Supplementary material associated with this article can be found, in the online version, at http://dx.doi.org/10.1016/j.jas.2012.05.038.

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