

THE HISTORICAL DENDROARCHAEOLOGY OF THE XIMÉNEZ-FATIO HOUSE, ST. AUGUSTINE, FLORIDA, U.S.A.

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ABSTRACT

In recent decades, agencies charged with managing historic structures and sites have found dendroarchaeological studies increasingly valuable, given the ability of such studies to verify (or refute) accepted dates of construction. The Ximénez-Fatio House has well-documented historical and cultural significance for the state of Florida, as it is one of St. Augustine's oldest, best-preserved, and most studied historic properties. According to documentary sources, the two-story coquina-stone main house was reportedly built around 1797–1798, and included a one-story wing of warehouses, giving the house a distinctive “L” shape. Documentary evidence also suggests that a second story was added above the wing sometime between 1830 and 1842. However, after studying the building fabric itself, historical architects now believe the entire wing of the house was remodeled two decades later in the 1850s. Our goals were to: (1) determine the probable construction years for the original house and wing using tree-ring dating techniques, and (2) verify the probable construction year for the remodeling that occurred in the wing section of the house. A total of 74 core samples were extracted from longleaf pine (*Pinus palustris* P. Miller) timbers used to construct the house. Twenty-six were confidently crossdated both visually and statistically against each other to produce a 185-year floating tree-ring chronology. A statistically significant ($p < 0.0001$) correlation between our chronology and a longleaf pine chronology from Lake Louise, Georgia, anchors our chronology between 1673 and 1857. No cutting dates were obtained from the main house, but the lack of any tree rings that post-date 1798 supports the 1797 construction date. Furthermore, cutting dates obtained from beams in the first-floor wing revealed that the extensive remodeling of the wing likely occurred in the period 1856 to 1858 soon after the house had been purchased by Louisa Fatio in 1855.

Keywords: dendroarchaeology, dendrochronology, tree rings, Ximénez-Fatio House, St. Augustine, Florida, Louisa Fatio.

INTRODUCTION

First settled in 1565 by the Spanish, St. Augustine, Florida is the oldest continuously occupied European community in the continental United States. Given its extensive history, St. Augustine is a city of particular archaeological (Deagan 1985) and anthropological (Manucy 1985) interest. Situated in the heart of the city's

oldest community is the Ximénez-Fatio House (Figure 1), at the corner of Avilés and Cadiz Streets (Figure 2). The Ximénez-Fatio House is one of the oldest standing structures in St. Augustine. It is not only the age, however, that makes this a structure of special interest, but also the excellent state of preservation in which the house exists today. Contrary to other historic structures in the area, much of the original materials (e.g. wood beams, lintels, rafters, and joists) used to construct the house remain un-

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Figure 1. The Ximénez-Fatio House as viewed from the courtyard, showing the main house on the left and the wing to the right.

changed. The condition of the original structural materials makes the house an excellent candidate for dendrochronological analysis.

Many believe the original house was constructed around 1797–1798 and a major remodeling of the wing occurred between 1830 and 1842. Historical documents suggest that a second story was added above the original wing adjacent to Cadiz Street sometime during the latter period (Waterbury 1985). Tree-ring analysis could provide supporting evidence regarding the construction of the original structure and subsequent renovations. The objectives of this study were to: (1) collect a comprehensive set of cores from both floors of the main house and the wing; (2) crossdate the tree rings from these cores against a regional master reference chronology; and (3) obtain the exact year when any one tree was harvested for inclusion in the Ximénez-Fatio House during construction. If a cutting date was not possible, we used the outermost years represented in the tree rings of all sampled timbers to make inferences on when the house was constructed (*i.e.* a *terminus post quem*, or the earliest year of construction). Because the house is made largely from squared timbers, the outermost ring that would provide the cutting dates of harvested trees likely would not be preserved, but we hoped the range of years in the tree rings from these cores would lend support for both the initial construction date and the dates of renovations.

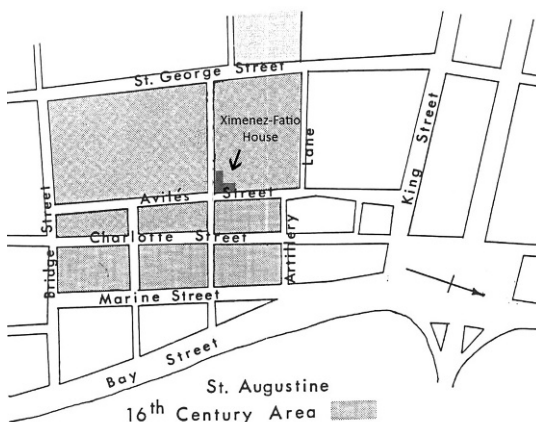


Figure 2. Location of Block 34, Lot 2 (eventual location of the Ximénez-Fatio House) situated in the heart of St. Augustine's oldest community (modified from Waterbury 1985).

Dendroarchaeological Research in the Southeastern U.S.

Dendroarchaeological research on historic sites has increased in recent decades (Grissino-Mayer 2009). Bowers and Grashot (1976) attempted to analyze the construction period of President Andrew Jackson's First Hermitage plantation, but were unable to develop cutting dates for the logs used to build the structures. Stahle (1979) standardized dendroarchaeological methods and techniques used in the southeastern United States by successfully dating 24 historic log and frame buildings throughout Arkansas, as well as improving and extending existing modern tree-ring chronologies for the state. Mann (2002) was the first study to combine dendrochronological (tree-ring dating of timbers) and archaeological (dating of artifacts recovered during excavations) principles to accurately date a historic structure in eastern Tennessee. Such complementary studies are becoming desirable because many agencies charged with managing historic sites wish to authenticate the construction date(s) of these structures using as many lines of evidence as possible (Grissino-Mayer 2009).

Occasionally, dendrochronological evidence has questioned the accepted date of construction (Mann 2002; Grissino-Mayer and van de Gevel 2007; Henderson *et al.* 2009), and agencies charged with managing historic structures

throughout the southeastern United States recognize the importance of dendrochronological verification (Bortolet *et al.* 2001; Reding 2002; Wight and Grissino-Mayer 2004; Lewis *et al.* 2009; Slayton *et al.* 2009). This verification is accomplished by comparing tree-ring patterns from the historic structure with regional reference tree-ring chronologies that currently exist for many species throughout the southeastern United States. In this process, a reasonable range of years when a structure was built can be determined by assessing the degree of clustering associated with crossdated cutting dates of logs used in the structure (Stahle 1979). In part because of the higher rates of wood decay in subtropical and tropical regions, these techniques have not yet been tested for their effectiveness in dating historic structures in the lower latitudes of the southeastern United States south of Georgia. Up to now, the farthest south a structure has been successfully dated by tree rings is in northern Georgia (DeWeese Wight and Grissino-Mayer 2004). Establishing the validity of this approach would greatly expand the capacity of archaeologists and historical architects to accurately define the age of historic structures in question, and to more precisely assess their cultural, societal, and political relevance and meaning within the region.

Background on the Ximénez-Fatio House

The parcel of land on which the Ximénez-Fatio House is located was legally known in the 16th Century as Block 34, Lot 2 (Waterbury 1985). Maps and legal documents attest to a long record of occupation on the parcel, but the structures built by the early colonists in the 16th Century were not long-lasting (Waterbury 1985). Yet, archaeologists suggest that during this time, Block 34, Lot 2 could have been one of the highest economic status sites in St. Augustine (Deagan 1985).

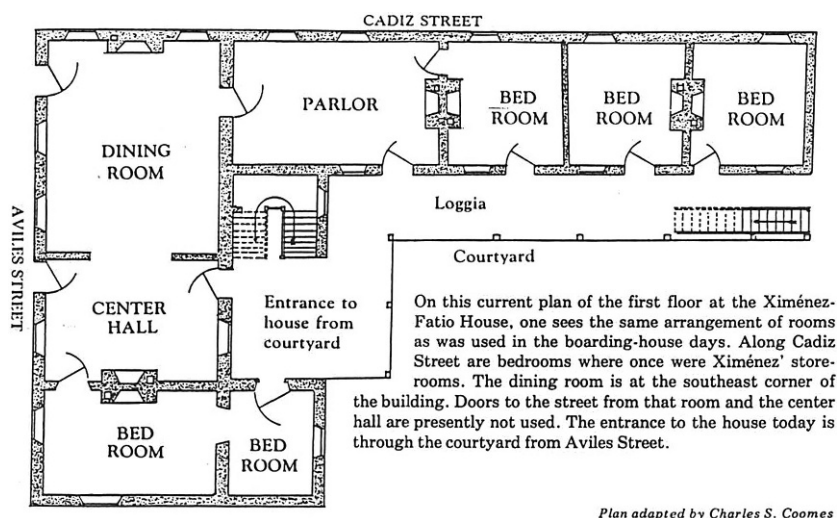
Through the 18th and 19th Centuries, control of St. Augustine fluctuated between the Spanish and British, as did the ownership of Block 34, Lot 2. The plot was bought, sold, and deeded on multiple occasions throughout this time, usually between merchants or from a merchant to

government (Waterbury 1985). During the late 16th Century, the Spanish Crown was listed as the owner of Block 34, Lot 2. On April 8, 1791, an auction of the Crown properties left Juan Hernandez the owner of the plot. Hernandez remained the owner for six years until he found a buyer, Andres Ximénez (Waterbury 1985).

A native of Ronda, Spain, Ximénez already had been living in St. Augustine for some time before marrying Juana Pellicer in April 1791 (Waterbury 1985). Following his marriage, Ximénez purchased a two-story wooden house on the southeast corner of present-day Cadiz and Aviles streets. This house served as the family's domicile and a successful general store and billiard room. Ximénez's store prospered for several years, and in November 1797, he was able to purchase the piece of property (Block 34, Lot 2) directly across Aviles Street. This new piece of property afforded him the opportunity to expand his business and sometime after November 1797 he began construction on a house/store structure (Waterbury 1985).

The original structure consisted of a two-story house containing the living quarters and a one-story wing of warehouses that stretched to the west along present-day Cadiz Street (Figure 3). The Ximénez family, however, did not live at the residence long, as Juana Ximénez died in 1802 and Andres died in 1806. The deed of the property was left to their three children and the contents of the house and store were auctioned. The Ximénez-Fatio House was rented on and off until it was rented to Margaret Cook in 1823 and subsequently sold to her in 1830 after she started buying shares of the property from the Ximénez children in 1826 (Waterbury 1985).

Cook turned the property into a boarding house and is believed to have converted the old store rooms into bedrooms for paying customers. Because St. Augustine was now located in a territory of the United States, tourists flocked to the city during the 1830s. Realizing the need for more room in the boarding house, Cook made structural changes to the house. Historical architect Herchel Shepard dates the only major renovations to the house in its 200+ years of occupation between 1830 and 1842 (Waterbury



Plan adapted by Charles S. Coomes

Figure 3. First story floor plan of the Ximénez-Fatio House, with south at the top of the diagram (Waterbury 1985).

1985; Harper and Rogers 1993) when a second story and balcony were added above the original Andres Ximénez store rooms. The property operated as a boarding house until Eliza Whitehurst, the proprietress, died and Cook sold the house to another business person, Sarah Anderson, on July 27, 1838 for \$4,000. Anderson turned the property back to a private residence and occupied the house until 1855, at which time she sold the property for \$3,000 to an already well-known boarding-house owner and host, Louisa Fatio (Harper and Rogers 1993). Miss Fatio had been managing this house as a boarding business since 1852 for Mrs. Anderson. Fatio not only accepted traveling tourists, but many of her boarding houses were occupied by invalids suffering from tuberculosis and other pulmonary diseases (Sewall 1849). It should be noted that Cook's selling the house for \$1,000 less than the price she herself paid argues against any major renovations having been made during the period 1830 to 1842.

For nearly 20 years, Louisa Fatio operated the Ximénez-Fatio House as one of the prime boarding-house destinations in St. Augustine (Waterbury 1985). Business waned during the Civil War (1861–1865), but recovered slowly in the following years. Fatio continued to operate a successful boarding house until her death in 1875. Her nephew David L. Dunham obtained title and

his son David R. Dunham eventually inherited the house. Little is known about the operations and conditions of the property following Fatio's death, however the property was occupied by various individuals, groups, and/or organizations. An 1882 Max Bloomfield article states it was used as a storehouse (Oppermann 2009). In 1939, The National Society of The Colonial Dames of America (NSCDA) in The State of Florida purchased the property from then-owner Judge David R. Dunham, who provided a transactional clause that prohibited the buyers from materially changing the "present exterior architectural lines of the building" (Waterbury 1985). Under NSCDA ownership, the Ximénez-Fatio House was tastefully restored to the historically accurate condition in which it is found today. This attention to original detail, combined with few structural alterations, makes the Ximénez-Fatio House an excellent historical laboratory for dendrochronological analysis.

METHODS

Field Methods

We extracted at least one core (approximately 0.4" [10 mm] in diameter) from nearly every accessible timber (which sometimes required the use of an extension ladder or scaffolding) using a 10-inch-long [25-cm] hollow drill bit attached to a

0.5" [13 mm] variable-speed hand drill. Timbers throughout the house and wing had been exposed during major renovations in 2007 that removed sections of incompatible modern wall plaster while retaining the early plaster (Oppermann 2009). Each core was labeled by the site code (XF), floor number ("1" or "2"), specific location (*e.g.* R = rafter and S = stairs) or room number (1 digit), and core letter (*e.g.* "A" is the first core extracted; "B" is the second, *etc.*) (*e.g.* XF2R16A). All rooms were assigned numbers based on the blueprints of the Ximénez-Fatio House prepared by the Works Progress Administration (Official Project No. 265-6907) for the Historic American Buildings Survey (Survey No. FLA-116).

During our visual inspections, we found most beams were squared, so we extracted the core as near to the corner of the beam as possible to ensure that (1) the maximum number of rings would be obtained, and (2) the outermost ring would be as close to the true cutting date as possible. We closely evaluated each beam to find, if possible, the tree center (pith or near pith), which aided determining from which corner to extract the core. We drilled into the beam about 5 to 7 mm, then removed the bit and placed a large ink dot on the surface of the beam to later verify that the outermost rings remained intact after coring. We then reinserted the bit and continued to drill until we reached the middle of the beam. A specially-designed steel rod with a metal hook was then inserted alongside the suspended core and turned to break the core from the parent beam. As each core was pulled from the beam, we immediately glued them to wooden core mounts with the cells vertically aligned to ensure a transverse view of the wood surface under a microscope when sanded. All cores were appropriately labeled on the core mount itself and detailed information on the location of each core was recorded.

Data Processing

We sanded the cores with a 4" × 24" [102 × 610 mm] Makita belt sander using progressively finer sandpaper, beginning with ANSI 100-grit (125–149 μm) and ending with ANSI 400-grit (20.6–23.6 μm) sandpaper (Orvis and Grissino-

Mayer 2002). This process yielded a wood surface with clearly discernable cellular features under standard 7–10× magnification, which is important when determining boundaries between the annual tree rings. Using a microscope, the innermost complete ring on each sample was assigned the relative year "1" and each subsequent 10th ring was marked with an "X" with a mechanical pencil. We then measured all tree-ring widths to 0.001 mm accuracy using a Velmex measuring stage coupled with MEASURE J2X software.

Internal and External Crossdating

To achieve absolute dating of the samples, we used COFECHA, a computer program that uses segmented time series correlation techniques to assist in crossdating (*i.e.* absolute dating) of undated tree-ring time series (Grissino-Mayer 2001). When using COFECHA, it is imperative to not rely solely on the program, as considerable visual and graphical assessments must also be made to support the temporal placement for each core suggested by COFECHA (Holmes 1983). When statistically crossdating short series (approximately 50 years in length) internally against other longer series or against the reference chronology, the correlation coefficient for the suggested placement made by COFECHA had to be at least twice as high as the second highest correlation and had to be temporally logical (*e.g.* an outer ring date in the 1500s is not likely) (Grissino-Mayer 2001), otherwise the series was excluded from further analyses. The final suggested temporal placement made by the program had to be convincing graphically (similar temporal patterns in the wide and narrow rings) and statistically (correlation coefficient significant at $p < 0.0001$) (Holmes 1983; Grissino-Mayer 2001).

We used COFECHA to assist in crossdating the undated ("floating") tree-ring measurement sequences from the Ximénez-Fatio House against an independent reference (*i.e.* "anchored" in time) tree-ring chronology created from a nearby site in southern Georgia. The reference chronology was developed from longleaf pine (*Pinus palustris* P. Miller) stumps and remnant woody material found lying on the sandy soils that surround Lake

Louise (30°43'30"N, 83°15'21"W) in southern Georgia, a coalesced sinkhole lake (or *polje*) located in karst topography (Watts 1971; Tepper 1998). The living tree portion of the reference chronology was developed from cross-sections obtained from old-growth longleaf pines that had been cut to make way for construction on the nearby Valdosta State University campus. The Lake Louise chronology spans A.D. 1421 to 1999, and includes 94 crossdated series with a series intercorrelation of 0.58.

We used individual measured series from the Ximénez-Fatio House that had a statistically significant correlation with the Lake Louise chronology to build a chronology to date the remaining series from the Ximénez-Fatio House. When all remaining floating series were crossdated, we assigned the correct calendar years to all tree rings using program EDRM ("Edit Ring Measurement"). All individual measurement series were next combined into one file and again processed through COFECHA as dated series to ensure the correct temporal placement for each. Crossdating was verified when the correlation coefficient for the majority of 40-year segments on each series being tested exceeded 0.37 ($p < 0.01$), although coefficients were usually much higher (for example, $r > 0.55$, $p < 0.0001$).

To further ensure statistical accuracy of the final temporal placements of each series, we created a residual chronology (*i.e.* all low-frequency trends caused by normal aging and autocorrelation removed) from the crossdated Ximénez-Fatio tree-ring series using program ARSTAN (Cook 1985), which standardizes tree-ring measurement data to a common mean (1.0). Each ring measurement for all series was divided by a predicted annual value of growth based on a trend line or curve fit to the measurement data, resulting in a dimensionless index of growth for that year (Fritts 1976; Graybill 1982). In addition, any adverse effects of internal autocorrelation in each series (which also can hinder crossdating attempts) were removed by ARSTAN using autoregressive procedures (Meko 1981; Cook 1985; Monserud 1986). Once each individual series was standardized, a master chronology was created in ARSTAN that represents information from all

successfully crossdated series from the Ximénez-Fatio House. This Ximénez-Fatio residual chronology was then tested for crossdating accuracy against the Lake Louise residual chronology using COFECHA techniques described previously. Crossdating was confirmed by a correlation coefficient that was statistically significant ($p < 0.01$).

Establishing Cutting Dates

Once all tree rings from each series of the Ximénez-Fatio chronology were crossdated and assigned calendar years, the outermost dated ring on each core was inspected under high magnification (35×) to determine possible cutting dates for trees used to construct the Ximénez-Fatio House. We assigned symbols to help evaluate the possible year of cutting (Robinson *et al.* 1975):

- B: Bark was present, indicating the outer ring was fully intact (a cutting date).
- v: The date is within a few years of the cutting date (modified from Robinson *et al.* 1975). We base this interpretation 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 noncutting date).

RESULTS

Seventy-four cores were extracted from the structure, 20 of which were too damaged from the coring process to be of further use. We measured the tree-ring widths from 54 cores, but 18 of these series were too short (<45 year) to be considered suitable for successful graphical and statistical crossdating. Of the remaining 36 cores, 10 could not be confidently crossdated either graphically or statistically, despite some series being exceptionally long (>100 year). Our final data set consisted of 26 series that were confidently crossdated internally against each other (with interseries correlation coefficients >0.40, with corresponding p -values < 0.001).

Crossdating

Two of the measured series crossdated significantly with the Lake Louise reference chronology. We found correlation coefficients of 0.51 for sample XFH4A ($n = 121$ years, $t = 6.42$, $p < 0.0001$) and 0.56 for sample XF174 ($n = 87$ years, $t = 6.30$, $p < 0.0001$). A residual chronology created from these two series that spanned 132 years had a correlation of 0.44 ($t = 5.54$, $p < 0.0001$) with the residual chronology from the Lake Louise samples, and a graphical comparison shows a convincing match (Figure 4). These combined series were used to date the remaining samples from the Ximénez-Fatio House. Three other series from the Ximénez-Fatio House were significantly correlated with the Lake Louise chronology: XFH3AL ($r = 0.33$, $n = 130$ years, $t = 3.96$, $p < 0.001$); XF1007A ($r = 0.37$, $n = 93$ years, $t = 3.83$, $p < 0.0001$); and XFH2B ($r = 0.35$, $n = 98$ years, $t = 3.71$, $p < 0.0001$), but they were not included in the initial residual chronology being tested for crossdating. Although a t -value of 3.5 is considered the minimum value needed to indicate a possible statistical match (Baillie 1982; Orton 1983; Wigley *et al.* 1987), we prefer to see t -values at or above 4.0. We next compared the residual chronology created from all of the Ximénez-Fatio House measurement series with the residual chronology from the Lake Louise samples and found an r -value of 0.35, which was statistically significant ($n = 185$ years, $t = 4.97$, $p < 0.0001$). We are confident that these multiple lines of evidence demonstrate that the Ximénez-Fatio House chronology is anchored from 1673 to 1857.

The average interseries correlation for the Ximénez-Fatio House measurement series was 0.53, indicating successful internal crossdating. A value that approaches 0.50 is considered high for southern pine species (Grissino-Mayer 2001) and attests to the common climatic signal that influences tree growth and facilitates crossdating tree rings among numerous series. The average mean sensitivity, a measure of year-to-year variability (Fritts 1976), was 0.34. We consider a value above 0.20 as the minimum needed for extracting useful climate information from tree species in the southeastern United States. Of 124 40-year seg-

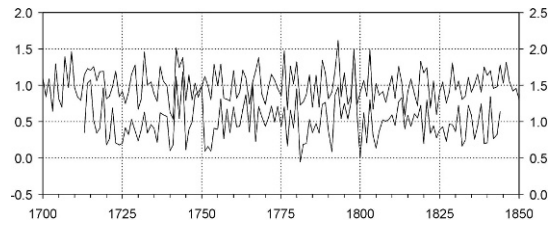


Figure 4. Crossdating between the Lake Louise residual chronology (top) and a residual chronology created from samples XFH4A and XF174 from the Ximénez-Fatio House (bottom) ($r = 0.44$, $n = 132$ years, $t = 5.54$, $p < 0.0001$), demonstrating successful crossdating, and thereby anchoring the tree rings from the Ximénez-Fatio House absolutely in time. Values on the y-axis are dimensionless indices of tree growth with a mean of 1.0.

ments (lagged 10 years) tested by COFECHA, 13 (10.5%) were flagged because of low correlations ($r < 0.37$, $p > 0.01$) (Table 1), but visual inspection of these segments indicated correct temporal placements.

Cutting and Noncutting Dates

Three samples provided firm cutting dates: 1856 on sample XFH2B, 1857 on XFH2AE, and 1858 on sample XFH3A (Table 2). Samples XFH2A and XFH2B represent the same beam, a lintel located above the window next to the door that leads into Room 5 (Table 3). Three samples provided near-cutting dates (based on the presence of sapwood): XF174 (1799), XF181A (1790), and XFH4A (1845). The remaining 20 samples had outermost rings that were far from cutting dates (Table 2). The fact that most samples with noncutting dates have outermost rings in the early, mid-, and late 1700s supports the historical documentation that suggests that construction and subsequent renovations of this house occurred in the late 1700s to early 1800s (Table 2). All outermost ring dates conform to known construction and remodeling dates and argue against any re-use of timbers from an earlier structure.

DISCUSSION

Internal and External Crossdating

The number of flagged segments for our Ximénez-Fatio House data set (13 of 124 40-yr

Table 1. Internal correlation testing of the Ximénez-Fatio House tree-ring measurement series.

		40-year Segment Lagged 10 Years																	
Begin Year	End Year	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790	1800	1810	1820			
		1719	1729	1739	1749	1759	1769	1779	1789	1799	1809	1819	1829	1839	1849	1859			
		Correlation Coefficient*																	
XFH2AE	1804	1856												0.52	0.47	0.48			
XF2R15	1796	1847											0.52	0.53	0.33A				
XFH2B	1758	1855											0.47	.35A	0.55	0.41			
XF181A	1743	1789						0.72	0.71	0.75	0.64	0.59							
XFH3AL	1728	1857			0.56	0.51		0.55	0.68	0.65	0.62	0.61	0.53	0.55	0.62	0.63			
XF2F1	1726	1797			0.37	0.38	0.33B	0.41	0.44										
XFH4A	1724	1844			0.46	0.56	0.67	0.67	0.70	0.58	0.56	0.46	0.46	0.42	0.41B				
XF184	1724	1785			0.55	0.52	0.46	0.30B											
XF1S5	1724	1770			0.57	0.57	0.56												
XF1007A	1722	1814			0.72	0.69	0.66	0.46	0.31B	0.42	0.48								
XF151A	1721	1803			0.31A	0.35A	0.41	0.65	0.57										
XF1S3	1719	1774		0.46	0.46	0.56	0.59												
XF2R19	1714	1764		0.81	0.79	0.77													
XF174	1712	1798		0.24A	0.48	0.62	0.69	0.81	0.82										
XF2R17	1705	1779	0.59	0.51	0.37	0.39	0.29B												
XF152	1705	1753	0.67	0.51	0.40														
XF2R16	1704	1771	0.78	0.79	0.72	0.59	0.57												
XF1011A	1704	1751	0.63	0.47	0.44														
XF2R18	1702	1765	0.65	0.65	0.60	0.58													
XF2R7	1696	1754	0.61	0.66	0.64	0.68													
XF2S4	1692	1751	0.51	0.44	0.53	0.54													
XF173	1686	1756	0.46	0.46	0.38	0.30B													
XF1S1BL	1682	1754	0.50	0.47	0.51	0.30A	0.23B												
XF2R4	1680	1755	0.58	0.47	0.51	0.30A	0.23B												
XF1010A	1680	1737	0.67	0.86	0.82	0.67	0.66												
	1680	1737	0.67	0.60	0.45														
XF2R8	1672	1733	0.42	0.66	0.66														
Average correlation			0.57	0.60	0.61	0.53	0.51	0.55	0.54	0.60	0.61	0.57	0.56	0.49	0.47	0.48	0.51		

* “A” or “B” in these columns indicates a 40-year segment flagged by COFECHA. “A” indicates a low correlation but a better alternate dated position could not be found, and a “B” indicates COFECHA found a higher correlation elsewhere.

Table 2. Outermost tree-ring dates for beams sampled from the Ximénez-Fatio House.

Sample ID	Inner Date	Measured Outer Ring	Outermost Ring Date	Ring Type	Cutting Date?*	Comments
XFH2AE	1804	1856	1857	B	CD	1857 could be complete, cut in late 1857
XF2R15	1796	1847	1848	vv	Non CD	No sapwood, far from cutting date
XFH2B	1758	1855	1856	B	CD	1856 could be complete, cut in late 1856
XF181A	1743	1789	1790	v	Near CD	1790 ring present, sapwood present
XFH3AL	1728	1857	1858	B	CD	1858 could be complete, cut in late 1858
XF2F1	1726	1797	1798	vv	NonCD	No sapwood, far from cutting date
XFH4A	1724	1844	1845	v	Near CD	1845 ring present, sapwood present
XF184	1724	1785	1786	vv	NonCD	No sapwood, far from cutting date
XF1S5	1724	1770	1771	vv	NonCD	No sapwood, far from cutting date
XF1007A	1722	1814	1815	vv	NonCD	No sapwood, far from cutting date
XF151A	1721	1803	1804	vv	NonCD	No sapwood, far from cutting date
XF1S3	1719	1774	1775	vv	NonCD	No sapwood, far from cutting date
XF2R19	1714	1764	1765	vv	NonCD	No sapwood, far from cutting date
XF174	1712	1798	1799	v	Near CD	1799 ring present, sapwood present
XF2R17	1705	1779	1780	vv	NonCD	No sapwood, far from cutting date
XF152	1705	1753	1754	vv	NonCD	No sapwood, far from cutting date
XF2R16	1704	1771	1772	vv	NonCD	No sapwood, far from cutting date
XF1011A	1704	1751	1752	vv	NonCD	No sapwood, far from cutting date
XF2R18	1702	1765	1766	vv	NonCD	No sapwood, far from cutting date
XF2R7	1696	1754	1755	vv	NonCD	No sapwood, far from cutting date
XF2S4	1692	1751	1752	vv	NonCD	No sapwood, far from cutting date
XF173	1686	1756	1757	vv	NonCD	No sapwood, far from cutting date
XF1S1BL	1682	1754	1755	vv	NonCD	No sapwood, far from cutting date
XF2R4	1680	1755	1756	vv	NonCD	No sapwood, far from cutting date
XF1010A	1680	1737	1738	vv	NonCD	No sapwood, far from cutting date
XF2R8	1672	1733	1734	vv	NonCD	No sapwood, far from cutting date

*CD = Cutting Date; Near CD = Near Cutting Date; NonCD = Noncutting Date.

segments tested, or 10.5%) warranted further inspection because this percentage is near the 10% value usually considered the maximum for a crossdated tree-ring data set with a common climate signal. Close visual re-inspection of the tree rings and analyses of the suggested alternate dating adjustments made by COFECHA yielded no indication of any misdated series, however. We found no systematic dating adjustments that would indicate misdated series (Grissino-Mayer 2001). All alternate placements of the data set suggested by COFECHA were found to be unreasonable (*e.g.* moving a 40-year segment backward 5 years when segments on either side were dated correctly). Furthermore, all flags were dispersed among a number of cores; hence, no single core sample contained the majority of flags, which would indicate a misdated series.

We noted that most of the flagged segments (8 of 13) occurred near the beginning or near the

end of each measured series. This is commonly observed during statistical crossdating. This can be attributed to a lack of common climatic response when a tree is young because the earliest tree rings formed rarely respond to climate, but more so to inherent physiological conditions (Fritts 1976). This also occurs when a tree is mature and approaching its maximum life span, and is no longer being driven by climatic factors that impart crossdating capability. For example, flagged segments are found at the end of the series for samples XF2R15, XFH4A, XF184, XF2R17, XF173, and XF1S1BL (Table 1).

Construction Dates for the Ximénez-Fatio House

All timbers in the Ximénez-Fatio House had been squared, which made determining the year of construction challenging. This procedure of squaring timbers involved processing logs either by a

Table 3. Outermost dates and locations of beams (which now include the outermost incomplete and unmeasured ring) sampled from the Ximénez-Fatio House.

Sample ID	Outermost Ring Date	Location
First Floor		
XF1S3	1775	1st floor under stairwell
XF1S5	1771	1st floor under stairwell
XF1S1BL	1755	1st floor under stairwell
XFH2AE	1857	1st floor, hallway, lintel above window next to door leading into Room 5
XFH2B	1856	1st floor, hallway, lintel above window next to door leading into Room 5
XFH3AL	1858	1st floor, hallway, lintel above window next to door leading into Room 6
XFH4A	1845	1st floor, hallway, lintel above window next to door leading into Room 8
XF1010A	1738	1st floor, Dining Room, lintel above window located on northeast side of room
XF151A	1804	1st floor, Room 5, beam above doorway between Rooms 4 and 5
XF152	1754	1st floor, Room 5, beam to the right of doorway between Rooms 4 and 5
XF1007A	1815	1st floor, Room 5, lintel above window located on southeast side of room
XF1011A	1752	1st floor, Room 5, beam to the right of doorway between Rooms 4 and 5
XF173	1757	1st floor, Room 7, lintel above window facing the street
XF174	1799	1st floor, Room 7, lintel above window facing the courtyard
XF181A	1790	1st floor, Room 8, lintel above window facing the courtyard
XF184	1786	1st floor, Room 8, beam below above window facing the street
Second Floor		
XF2S4	1752	2nd floor step on stairway
XF2F1	1798	2nd floor, exposed floor joist
XF2R4	1756	2nd floor porch rafter number 4
XF2R7	1755	2nd floor porch rafter number 7
XF2R8	1734	2nd floor porch rafter number 8
XF2R15	1848	2nd floor porch rafter number 15
XF2R16	1772	2nd floor porch rafter number 16
XF2R17	1780	2nd floor porch rafter number 17
XF2R18	1766	2nd floor porch rafter number 18
XF2R19	1765	2nd floor porch rafter number 19

two-person pit saw or a water-driven (“up-and-down”) sash saw in a sawmill. During this process, several squared timbers were made from a single log. The removal of bark often meant the removal of much of the sapwood, which makes it difficult to assign a cutting or near-cutting date to a particular timber. A lack of confirmed cutting dates prohibits assigning an exact construction year or years to the main house. Nonetheless, the outermost dates for rings on all cores certainly suggest a late 18th Century construction for the Ximénez-Fatio main house because no tree rings postdate 1798 (sample XF2F1, an exposed floor joist in the stairwell) on any of our dated samples from the main house.

In St. Augustine, the production of lumber has occurred since the beginning of the colony of Florida. In 1565, the earliest sawmills “... were huge pits where one Negro slave standing at the

top and another at the bottom sawed great logs [cypress] into planks” (Kendrick and Walsh 2006). By 1790, several water-driven sawmills existed throughout northern Florida, including Jacksonville (approximately 40 mi. north of St. Augustine), then known as Cowford until 1822. Therefore, the timbers used to construct the original house could have been derived from a local sawmill, or from a water-driven sawmill near present-day Jacksonville. In 1801, two citizens from St. Augustine were granted a claim of 2,500 acres by the Governor of East Florida for the purpose of building a water-powered sawmill. The two erected their sawmill at the head of Moultrie Creek (known as Woodcutter’s Creek in the 19th Century), which runs into the Matanzas River, and enabled the people of St. Augustine to purchase lumber at a reasonable cost (Kendrick and Walsh 2006). In 1850, the first circular saw in

eastern Florida was established near Jacksonville. This mill contained a heavy cast iron blade, which was a part of a sash-saw powered by water, and was able to produce lumber at a higher rate than previous mills (Kendrick and Walsh 2006). Hence, similar to the materials in the original structure, the timbers used to construct the wing of the house might have derived from the mill at Moultrie Creek, or from the circular sawmill in Jacksonville.

Our data suggest that the first-story wing was not built along with the original 2-story housing structure, and that the second-story wing of the structure was not built during the reported construction period between 1830 and 1842 (Waterbury 1985). Based on the cutting dates we were able to assign to two beams found in the wing, our data strongly suggest that the entire wing was constructed in the late 1850s, most likely between 1856 and 1858. The timbers from which each of the near-cutting and cutting date samples were extracted were also squared and processed in a sawmill, but one corner of the squared timbers had retained the sapwood and outermost ring and, in two instances, the bark remained on the beams, XFH2 from Room 5 and XFH3 from Room 6 (Table 2). The 1856 to 1858 construction period places this major renovation of the Ximénez-Fatio House shortly after Louisa Fatio purchased the building in 1855.

Project Limitations

Several limitations were encountered during this project that may inform future dendroarchaeological research on historic structures elsewhere throughout the southeastern U.S. First, squared timbers were used throughout the house and this prevented us from obtaining cutting dates, which are more common on hewn log structures. Luckily, we did find bark on two beams, which indicated we would obtain the cutting dates of these trees. We also found curvature on some samples, notably underneath the stairwell leading up to the second floor, but these samples could not be reliably dated. We recommend that a thorough search throughout all rooms and on all exposed timbers be conducted

before sampling to identify beams that should be specifically targeted, to ensure efficient use of time and energy.

Second, the first two trips (September 2007 and December 2007) to the site were of limited success, in terms of sample quality, because we had little experience extracting cores from long-seasoned pines (likely longleaf pine) characterized by extensive amounts of oleoresin-laden heartwood. These pines, although having been cut over 100 year ago, still exuded pitch during the coring process. The heat of the drill would liquefy the pitch, thus causing the drill bit to become clogged, which caused cores to break into multiple pieces. This breakage rendered many of these samples useless. However, during the final trip in March 2008, we used paint thinner to constantly lubricate the borer, which vastly improved the quality of the cores by keeping them largely intact during extraction.

Finally, this area of the southeastern U.S. has few tree-ring chronologies developed from pines that could be used for a reference when dating the floating chronologies. Several other longleaf pine chronologies do exist in other locations in the Southeast; however, these chronologies were either too short or their locations were too distant to be used in this project. Nonetheless, we were surprised at the ability of the Lake Louise pine chronology to date some of the St. Augustine floating tree-ring series, as the locations are separated by a significant distance of about 150 mi. This suggests a common climate signal to which these longleaf pines are responding, which further suggests that these data could eventually be used to reconstruct climate for southern Georgia and northeastern Florida. The fact that the Lake Louise chronology could not date all the samples from the Ximénez-Fatio House is not surprising, given this distance. The beams from the house that could be dated with the Lake Louise chronology may have been cut from trees harvested from an intermediate location between Lake Louise and St. Augustine, whereas those that could not be dated with the Lake Louise chronology may have been cut from trees that had grown much closer to St. Augustine. The development of the new Ximénez-Fatio House refer-

ence chronology for coastal portions of northeastern Florida sets the stage for accurate and precise dating of additional historic structures and artifacts (such as ship timbers) in the region.

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