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DENDROCHRONOLOGICAL INVESTIGATION OF THE SAMUEL E. JOHNSON FARMHOUSE, LBJ-NHP

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INTRODUCTION

Dendrochronology is the science of tree-ring dating; dendroarchaeology, a subfield of dendrochronology, is the use of tree-ring specimens from archaeological and historical contexts to address questions concerning past human occupation of a particular site or landscape. This particular investigation explores the past use of the Samuel Ealy Johnson, Sr. Farmhouse, a National Historic Property in Lyndon B. Johnson National Historic Park (LBH NHP).

The objective of this research was to accurately date the original construction of the farmhouse, and to develop a dated construction sequence for the various later additions. With this information, park interpreters will be able to present a more in-depth discussion of the home, and park management will have needed information to develop a plan for the future renovation of the structure so that it conforms to the interpretation of the site.

PROJECT BACKGROUND

This project was initiated through consultations between Mr. Jason Lott of LBJ NHP and Dr. Ronald Towner of the Laboratory of Tree-Ring Research (LTRR) at the University of Arizona. Field work was conducted for one week during February 2005, and dendroarchaeological analysis was conducted at the LTRR during the summer and fall of 2005.

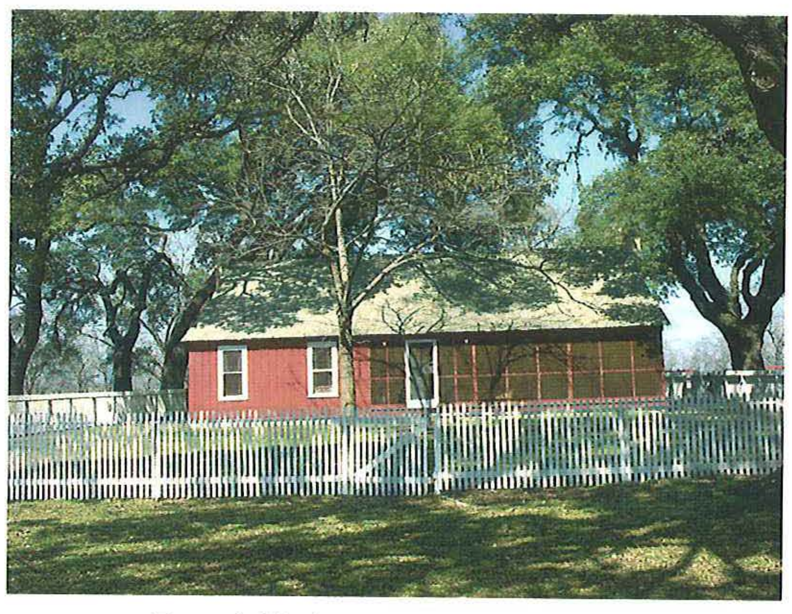

Figure 1. The SEJ Farmhouse, LBJ NHP.

Mr. Lott conducted archival and oral history research during the summer and fall of 2005, research that continues at present. An initial public presentation of the results was scheduled in Johnson City, TX for late September 2005, but was postponed due to hurricanes Katrina and Rita. Two public discussions of the project, one attended by NPS personnel and the other attended by the general public, were conducted in December 2005, and resulted in a wealth of new, important information provided by members of the audiences.

SITE BACKGROUND

The Samuel Ealy Johnson (SEJ) Sr. Farmhouse (Figure 1), the homesite of President Lyndon B. Johnson's grandparents, is a historic site interpreted at the LBJ Ranch for LBJ NHP. This structure, the home of Samuel and Eliza Johnson, is believed to have been originally constructed sometime between 1889 when SEJ Sr. established the farm, and 1905 when the Martins (SEJ's daughter's family) vacated it and SEJ Sr. moved into it. LBJ's grandparents lived here from 1905 until their deaths in 1915 and 1917. It was at this home, located next to the LBJ Birthplace, that a young Lyndon B. Johnson would visit almost daily to spend time with his grandfather learning about the Civil War, cattle drives, and the frontier settlement of Texas. It was here that LBJ obtained his sense of history and appreciation of his elders.

When the family farm was sold in 1922, the SEJ Sr. Farmhouse was taken over by a number of successive owners, the last being H.A. Jordan, who bought it in 1943. The home came back to Johnson control when it was leased by LBJ in 1965 and eventually purchased in 1972. At this time, the structure was being utilized as a ranch guest house for visitors and employees of the LBJ Ranch.

Although the structure is interpreted as the home of LBJ's grandparents (1905-1917), its outward appearance is that of the ranch guest house (1965-1972). One issue with this structure is that that particular interpretation is confusing and misleading because it is actively interpreted as the grandparent's home. This is misleading because its current appearance is that of a ranch guest house. To compound this problem, there is no documentation describing what the house looked like during the period of the structure's most important significance as the home of Sam and Eliza Johnson.

RESEARCH OBJECTIVES

This research project has the following objectives: 1) to resolve the original date of construction for SEJ Sr. Farmhouse; 2) to determine the construction chronology for each additional expansion of the structure; 3) to develop a tree-ring chronology for LBJ NHP for future studies and research; 4) to adequately train LBJ NHP personnel on how to collect tree-ring samples; 5) to conduct a training session with park staff that will allow for enhanced interpretation and management of the site; and 6) to provide a detailed technical report and layperson reports, detailing research results and interpretative guidance. This report constitutes the final technical report. Presentations in Johnson City in December 2005 have informed the public about the project. Pending additional volunteered research, we anticipate submitting both scholarly and public-oriented articles for publication.

RESEARCH DESIGN AND METHODS

Simply put, dendrochronology is the dating of past events through the study of tree ring growth. Botanists, foresters, and archaeologists began using this technique in the early part of the 20th century. Discovered by A.E. Douglass from the University of Arizona, who noted that the wide rings of certain species of trees were produced during wet years and, inversely, narrow rings during dry seasons, dendrochronology now has broad applications. Each year a tree adds a layer of wood to its trunk and branches thus creating the annual rings that can be seen when viewing a cross section. New wood grows from the cambium layer between the old wood and the bark. In the spring, when moisture is plentiful, the tree devotes its energy to producing new growth cells. These first new cells are large, but as the summer progresses their size decreases until, in the fall, growth stops and cells die, with no new growth appearing until the next spring. The contrast between these smaller old cells and next year's larger new cells is enough to establish a ring, thus making crossdating possible.

Because most historic log structures were constructed with green wood, cutting dates, with few exceptions, identify the actual year of construction. Variables such as seasoning and stockpiling may be indicated by clusters of cutting dates. Hewn or sawn dimension lumber in frame buildings also can produce cutting dates, due to the taper of trees and the intersection of the taper during the sawing process. When a beam or board is cut out of a log, the edge may intersect the outer surface of the conical tree and bark may adhere to the board or an outer surface. A single tree may produce several beams or boards at a sawmill, increasing the chances of duplication. Sawmills often mix several stands of trees. When sold commercially, such lumber may be extremely difficult to crossdate. However, in the case of local sawmills, or lot purchase of lumber, dates may be obtainable. Also, dates may be obtained by the direct association of piers and sills and other integral structural elements.

METHODS

Our sampling goals at the SEJ Farmhouse were to collect as many samples from as many different architectural units and elements as possible with minimal impact to the resource. The collection of tree-ring samples were conducted by Dr. Towner, Mr. Lott, and other NPS personnel. No excavation or collection of non-dendrochronological samples was undertaken. We collected and analyzed 74 samples suitable for dendroarchaeological research from the different sections of the farmhouse.

Sampling the SEJ farmhouse presented several interesting problems. Typically, dendroarchaeological samples are collected as log cross sections or using a specially designed hole saw to collect core samples (Figure 2). The board-and-batten construction of the SEJ Farmhouse, however dictated a novel approach to sampling. After initial attempts to core roof joists and rafters proved inadequate, we determined that using a skill saw to removed small sections of the top of the board-and-batten ends would be the most productive and least invasive. To our knowledge, this technique has not been used previously. All samples collected were documented on a site map and provenienced appropriately. Provenience and sample attributes were also recorded on specifically designed LTRR tree-ring sample forms. A few samples were collected as ½" cores using a specially adapted drill bit similar to an elongated hole saw; most were collected as cross sections from boards in the attic, crawl spaces, and above door lintels to minimize the visual impact of the sampling. All field activities were photodocumented.

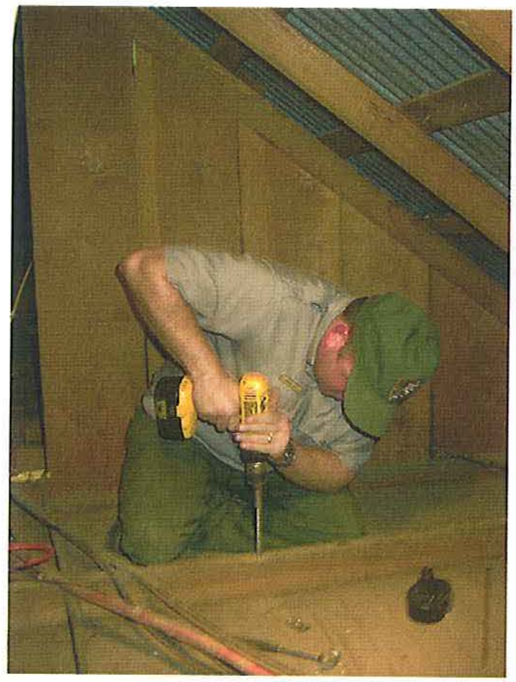

Figure 2. Jason Lott collecting a dendroarchaeological sample using the coring technique.

RESULTS

The project yielded significant results with a minimum of impact to these valuable cultural resources. Results were generated in three general categories: human resources, cultural resources, and dendroarchaeology.

Human Resources

In terms of human resources, the project provided training experience for NPS staff. In the longer term, such training will allow participants to properly collect, document, and evaluate tree-ring data without the aid of LTRR personnel. Such a result enhanced future dendroarchaeological studies in the central Texas area, as well as in other areas with suitable tree species. In addition, the collaboration of the general public via the public presentations in 2005 significantly enhanced our interpretations, and also stimulated additional interest by several members of the audience. They continue to provide historic and oral history sources, and suggest additional structures that may be sampled in the future.

Cultural Resources

There are several important aspects of the dendroarchaeological results of this project. First, the samples and the information they contain remain the property of the NPS but are on permanent loan to the LTRR and have become part of the most extensive, best curated collection of archaeological tree-ring samples in the world; they are available for future nondestructive studies. This preservation of the samples themselves is very important; as biological materials, tree-ring specimens are subject to erosion of outer rings due to weathering and destruction by insects, fire, and vandalism in site contexts. By removing small areas of the wooden elements in a structure (cores and sections), we have insured the preservation of samples and data in the event that the site itself is destroyed.

DENDROCHRONOLOGICAL RESULTS

Three basic types of information can be derived from dendroarchaeological samples: behavioral, chronological, and environmental. Each area contributes to a fuller understanding of past use of a site. Behavioral analysis involves delineating how past people used wood as a resource. How did they procure wood for construction? Which species did they prefer and use? How did they modify the wood to meet their particular cultural and individual dictates?

Chronological analysis takes two forms: relative and absolute. Relative dating illuminates the chronological position of the samples relative to each other, i.e. were the trees cut at the same time or did some grow in different eras. Such a relative chronology can provide internal dating even in the absence of absolute dates. Absolute dating provides Christian-calendar dates, accurate to the year and sometimes season, for samples in a collection.

Environmental analysis also takes two forms: species selection and dendroclimatic reconstruction. The species people select to meet their building needs often, but not always, reflect local availability and environmental conditions. If timbers are imported from a great distance, however, the tree-ring samples will reflect environmental availability form that area. Because most trees reflect environmental variability (precipitation and/or temperature), tree-rings can be used to reconstruct past environmental variability. Like species availability, however, dendroarchaeological samples reflect conditions where the trees grew, not necessarily where they were discovered in a site context.

Behavior: Architectural Analysis

An important aspect of dendroarchaeology is the precise provenience of wood samples, i.e. their architectural context. During the collection of tree-ring samples from the SEJ Farmhouse, we were able to document it construction techniques and relative building sequence. Our architectural evaluation of the structure resulted in several important discoveries, First, the current structure only minimally resembles the original building as occupied by Samuel Ealy Johnson. All of the exterior rooms—the porches, kitchen, etc.—were added to the original structural core. This farmhouse was originally a dog-trot home that was continually upgraded and expanded by the enclosure of the center passage-way, the addition of a room and screened area on the front porch, and the complete enclosure of the back porch. Other modifications probably included the upgrading of the roof to metal sheeting, running water, and the addition of a bathroom. Second, we discovered that the entire original core structure was built of board-and-batten construction without any internal frame support, such as 2 x 4 framing. The board-and-batten supports a pitched roof, both of which were probably added after World War II.

Third, the original core of the structure consisted of two rooms and a covered breezeway—a typical "dog-trot" structure (Figure 3). Most importantly, however, the structure was built in two separate construction episodes. Room 1, the

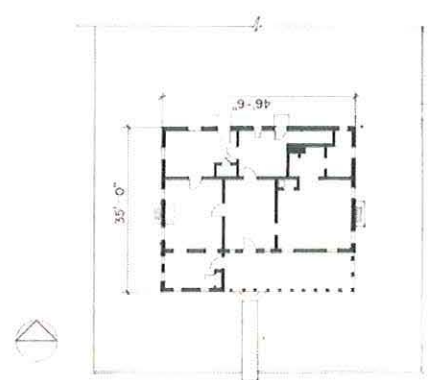

Figure 3. Plan map of the SEJ Farmhouse.

West room, was the first architectural unit and it was built and roofed as a free-standing unit. Our evidence for this inference is that the east wall of Room 1, adjacent to the breezeway, extends from the floor all the way to the ceiling (Figure 4). Thus, there was no was to pass from the attic of Room 1 to any other part of the attic.

Room 2 and the breezeway were added as a single unit at some later time. This inference is based on the fact that the west wall of Room 2 extends only from the floor to the attic, but not to the pitched roof. The Room 1 East Wall, on the other hand, extends from the floor to the roof, effectively partitioning the attic. Another aspect that supports our inference that it was once an exterior wall of a free-standing room is its condition in the attic. As can be seen in Figure 4, the exterior of these boards was painted. It is also important to note that there were pieces of batten covering all the board joints. Only one partial piece of batten remains, but others are evidenced by the unpainted board segments exposed where the batten was removed. We infer that the batten was removed when the breezeway and Room 2 were built. Thus, the breezeway and Room 2 were connected at the attic level. We are unable to discern the elapsed time between the construction of Room 1 and Room 2/breezeway, however; it may have been hours, days, weeks, or years.

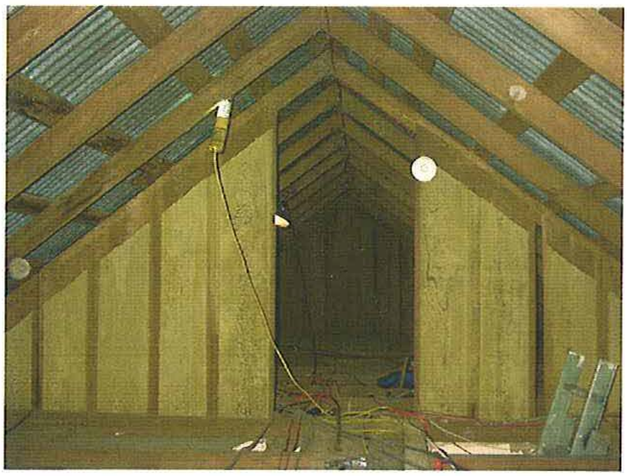

Figure 4. View of the attic and East Wall of Room 1.

The architectural evidence indicates that if LBJ-NHP wishes to restore the SEJ Farmhouse to its original conditions, it would be a one-room free-standing building (Room 1). Another option would be to restore the original dog-trot structure, which probably was completed a short time later and consists of Room 1, Room 2, and the breezeway (Room 3) connecting them.

Sample Collection, Preparation, and Analysis

A total of 74 samples was collected from the SEJ farmhouse. Room 1 yielded 31 samples and Room 2 yielded 37 samples; two samples (LBJ-65, 66) were collected from the South Wall of the Center Room (Room 3), two samples (LBJ 35, 36) were collected from the "kitchen" area, and two samples (LBJ-73, 74) were collected from loose shingles found in the attic spaces.

All of the samples, except the two shingles, were sanded with 400-grit sandpaper to expose details of the ring structure (Figure 5). After sample preparation was complete, we were able to identify the tree species used in the SEJ Farmhouse construction. Fortunately, an intensive Wood Anatomy course was being conducted at the LTRR at the time of the sample analysis. Dr. Fritz Schweingruber of the Swiss Federal Institute for Forest, Snow, and Landscape Research, a world expert in wood identification, identified the SEJ samples as Southern Yellow pine (*Pinus pilastrus*). The importance of this identification is discussed below.

Figure 5. A core of Southern Yellow Pine after sample preparation.

Room 1

Nine samples from Room 1 (LBJ 1-9), taken as 5/8" core samples, were collected from the 2 x 4" roof joists. None retain enough rings for crossdating. Eleven Room 1 samples (LBJ-10 to LBJ-20) were collected from the East Wall; sample LBJ-13 was lost in the field and was unavailable for analysis. Room 1 also yielded four samples (LBJ-21 to LBJ-24) from above the east door; one of these samples (LBJ-24) was a filler board. The north door of Room 1 yielded seven samples (LBJ-25 to LBJ-31); four of these samples (LBJ 25, 27, 29, 31) are pieces of batten, and three (LBJ-26, 28, 30) are boards.

Figure 6. Sealed window in the SEJ kitchen.

The west door of Room 1 yielded three samples (LBJ-34 to LBJ-34), all boards. Two samples (LBJ-35, 36) were collected from what appears to be a sealed window in the kitchen (Figure 6). This area may be the exterior (north) wall of Room 2; this window would have opened into the "closet" in Room 2, so it was probably sealed when the closet was added at some later date.

The Room 2 samples were collected from the West, South, and North walls. The East wall is currently inaccessible. Eight samples (LBJ-37 to LBJ-44), all boards, were collected from the West wall. Two samples (LBJ-45, 46) were collected from a "hatch" in the East wall; the function of the hatch is unknown at this time. Eighteen samples (LBJ-47 to LBJ-64) were collected from the South wall of Room 2; one sample (LBJ-50) is a piece of filler, the remainder are boards. The North wall of Room 2 yielded six samples; three (LBJ-68, 70, 72) are boards, and three (LBJ-67, 69, 71) are pieces of batten.

The center room (Room 3) yielded two samples (LBJ-65, 66) from the South wall. These samples are very important because they are the only independent samples from the breezeway and could potentially date its construction.

The two shingles were collected from spaces between the roof and the walls, and cannot be associated with any particular room. We assume they are part of the original construction (see below), but they contain too few rings for crossdating.

Chronological Results: Dating

After preparation, the samples were analyzed using the "skeleton plot" method developed by A.E. Douglas in the early 1900s. Crossdating is possible when a group of trees (samples) have responded to the same environmental variable, usually annual variation in precipitation or temperature. A lack of crossdating, however, can be caused by several factors, including the absence of a local or regional chronology, different growth microenvironments for individual trees, or trees from different areas in the sample collection. Unfortunately, this method failed to produce any absolute or even relative dates for the samples.

The skeleton plot method is not the only method of crossdating. Measuring individual rings and comparing them statistically is a technique that has been used in the eastern US and Europe for decades. We are currently in the process of measuring each individual ring on the SEJ samples. Mr. Okochi has also developed a CT-Scan method that we hope will provide us with absolute dates in the future.

Environmental Results

The lack of dating of the SEJ samples limits the amount of environmental information available for us to use. However, the samples exhibit characteristics that can be very valuable if we are able to date them in the future. First, there is clearly variability in ring width that is undoubtedly related to annual and season variations in climate—either precipitation or temperature. Second, the SEJ samples also exhibit significant variability in the amount of late wood present. Late wood chronologies have been developed for the Southeast; thus, when we are able to date the SEJ samples, they may provide information relevant to broad-scale late-season climatic patterns in Louisiana, such as hurricanes, killing frosts, etc.

Behavioral Results: The Importance of Species Use at the SEJ Homestead

As discussed above, all of the joists, rafters, boards, batten, and even shingles used in the SEJ farmhouse are Southern Yellow Pine (*Pinus pilastrus*). This species does not grow locally, and there is no evidence it grew in the area historically. It's current, and presumably historical, range is from the low areas of east Texas across the Gulf states as far east as Florida (Figure 7).

Figure 7. Distribution map of *Pinus pilastrus*.

This species distribution explains why the SEJ samples do not crossdate against any local west Texas chronologies—the trees were growing in a very different environment. We have compared the SEJ samples against known chronologies available on the International Tree-ring Data Bank (ITRDB), but have yet to establish crossdating.

The use of *Pinus pilastrus*, however, raises very interesting questions regarding the economics and logistics of the SEJ construction. Where did the boards, batten, and shingles originate? Were they delivered to the region, local area, or even Farmhouse as finished products? How were they transported from the forests of the Southeast to the Hill Country of West Texas?

Our working hypothesis is that the raw timber was grown in Louisiana, initially processed in the sawmills there, and transported by rail to San Antonio. Support for this inference comes from two sources. First, at the public presentation in December 2005, a member of the audience stated that his grandfather had a similar dog-trot structure and the boards in the attic were stamped with "Calusia" (still visible), a Louisiana based wood products company. Second, Mr. Lott discovered historical resources, including advertisements in the San Antonio newspaper archives by "Calusia Lumber" that promote a variety of wood products for sale. Unfortunately, none of the advertisements contained dates, so we cannot determine when Calusia began delivering wood products to the Hill Country.

CONCLUSIONS

Despite the lack of absolute or even relative dates, from the SEJ Farmhouse, we are pleased with our results and very optimistic about the future. The architectural analyses provide a previously unknown construction sequence for the structure that will give future LBJ-NHP managers various options concerning how to present the structure for public interpretation. The identification of Southern Yellow Pine as the species used as all the construction lumber, including roof joists and rafters, boards, batten, filler, and shingles raises a plethora of interesting questions concerning the technological, economic, transportation, and social aspects of homestead construction in the late 19th and early 20th century Hill Country of West Texas. Finally, the collection of these samples will allow us to explore new analytical methods of crossdating and, we hope, ultimately provide absolute dates for this historic structure.