To the Graduate Council:

I am submitting herewith a thesis written by William M. Reding entitled "Assessment of Spatial and Temporal Patterns of Log Structures in East Tennessee." I have examined the final paper copy of this thesis for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Science, with a major in Geography.

Charles S. Aiken, Major Professor

We have read this thesis and
Recommend its acceptance:

Accepted for the Council:

Vice Provost and Dean of
Graduate Studies

Assessment of Spatial and Temporal Patterns of Log Structures in East Tennessee

A Thesis

Presented for the

Master of Science

Degree

The University of Tennessee, Knoxville

William M. Reding
May 2002

Thesis
2002
.R43

DEDICATION

This thesis is dedicated to my parents, LTC(Ret) Donald J. Reding and Ann M. Reding, they have always believed in my abilities and encouraged me to excel, to my wife Angie Reding, her sacrifices made this effort much easier on me and her encouragement kept me going, and my daughters, Emily, Abby, and Mattie, their smiles and laughter make it all worthwhile.

ACKNOWLEDGMENTS

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I would also like to thank the students in the department that helped me with this thesis. I would like to thank two in particular, Kendrick Curtis for his assistance with ArcView and for listening to my complaints, and Daniel Lewis for his help with COFECHA and J2X programs, without their help this process would have been much more difficult, thanks.

ABSTRACT

The purpose of this research is to investigate hypotheses of settlement in the Ridge and Valley region of east Tennessee. The primary hypothesis of the study is that settlement patterns can be explained through the analysis of log structures in the region. I also hypothesize that survivability of log structures is associated with construction methods and wood used in the assembly and that dendrochronology can be used to determine construction dates. Through established research methods, dates of construction for log structures were obtained and locations were mapped temporally. This type of study has not been done in the region before and the results will help future research into the settlement of this area of east Tennessee.

Log structures with estimated construction dates between 1800-1860 are analyzed in four counties. The initial phase of research establishes the locations and estimated construction dates of structures using information collected for the Historical Building Survey by the Tennessee Historical Commission. Utilizing field techniques, locations were confirmed and core samples from logs were collected for dendrochronological analysis to determine the precise construction dates of four structures. Dendrochronology confirms the accuracy of the methods of dating structures employed by the Historical Commission survey teams.

The research validates the hypotheses and increases the understanding of settlement history in the Ridge and Valley region. The study also discovered a serious reduction in the numbers of log structures in the region. Preservation of log buildings

needs to be addressed. The continued decline of log structures will adversely impact future research of settlement employing dendrochronology.

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CHAPTER 1: INTRODUCTION

Europeans settled the Ridge and Valley region of east Tennessee as early as the 1760s. Little research has been done regarding the way in which the region was settled. The period from 1800 to 1860 saw the greatest influx of new settlers. First came settlers seeking to use Revolutionary War land grants. Later newcomers desired land south of the Little Tennessee River taken from the Cherokee Indians by the federal government (Claborn 1995, 8). In-migration is documented at the county level, but there is negligible information on the development of settlement across the region as a whole. A spatial analysis of settlement and relationship to the development of the region is needed.

The purpose of my thesis is to evaluate and explain four hypotheses of settlement in east Tennessee. The area selected for my study of settlement is a cross section of the Ridge and Valley region. The representative counties of Grainger, Jefferson, Hamblen, and Union were selected for my study (Figure 1.1). In these four sample counties, data were gathered about log structures. The sites were analyzed and dendrochronology was employed to determine the dates of construction. The first hypothesis is that the region was settled east to west. The second hypothesis is that settlement was closely tied to rivers and streams for transportation and water supply. The third is that the survivability of log structures in the region is closely related to the purpose of a building and the types of wood used in construction. The final hypothesis is that dendrochronology, tree-ring dating, can be used to determine the construction date of log structures in

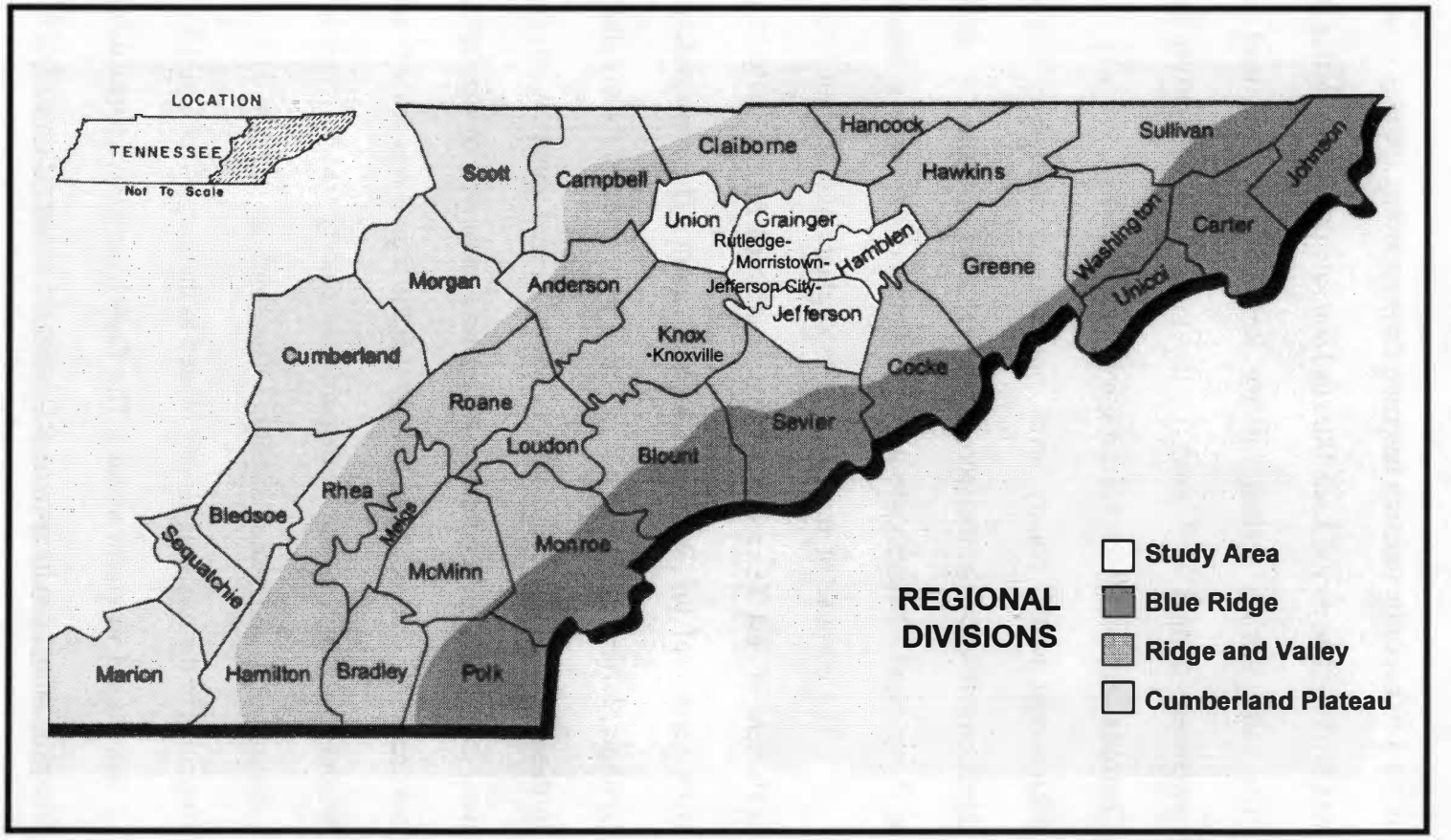

Figure 1.1. East Tennessee Landform Regions and the Study Area. Source: Tennessee Geography Alliance.

the interior southeastern United States to map time periods of settlement.

I chose log structures as the subject for analysis of settlement prior to 1860. Log structures are still on the landscape of east Tennessee, and they are integral to the history of the region. The structures were the primary form of construction from the late 1760s until the late 1850s (Morgan 1990, 13-15). Logs in these structures allowed me to use dendrochronology to effectively analyze their construction dates. My purpose is to systematically analyze the settlement pattern in the four counties selected. I divided my research into four categories: cultural background, methodology to obtain data, procedures for data analysis, and conservation and preservation.

The lack of large-scale development or urbanization in the study area since 1860 enabled me to effectively map and study how the region has developed over time. External influences have impacted the area to some degree since the early settlement period. The creation of Tennessee Valley Authority lakes in the 1930s and 1940s resulted in the relocation of many buildings (Jefferson 1996, 22). In addition, these lakes have caused measurable changes in the accuracy of the original locations of log structures in the study area. This issue of original site location is most visible in Hamblen and Union counties. The removal of buildings to ridges surrounding the lakes obscures the accuracy of their original locations. The study area also provides a relatively large population of structures, but they are disappearing at a rapid rate.

Selection Criteria

The study area was selected on the basis of several criteria. First, the counties had to contain a sizable population of log structures. The number of log structures was determined utilizing the Tennessee Historical Commissions Historic Building Survey.

The data for this survey were collected in the late 1970s and early 1980s. The survey categorized buildings erected prior to 1930 by construction type and estimated construction date. The next factor was the rural nature of the counties. The intent was to find counties with minimal disturbance of potential sites. Although the four counties are growing in population, they are not urbanizing as rapidly as other counties in the Ridge and Valley region due to their isolation and rugged terrain. The next factor was the settlement timeframe for each county. The period 1800-1860 was selected because it had the greatest in-migration closely associated with the construction of log structures. This period was also influenced less by external variables on migration, such as war or Native American hostilities, than other periods. The final factor was availability. The four counties included in the study had several log structures still standing in the 1970s and 1980s. I expected that a large percentage of the structures would remain on the landscape. The four counties selected are primarily rural with a few moderate-sized towns. The counties have changed over the past 200 years, but the current landscape largely depicts the past.

Regional Topography

The topography of the Ridge and Valley region is characterized by steep hills and ridges cut by streams with moderately level flood plains. Peak elevations in the region are less than 2,500 feet (770 meters) (Figure 1.2). The area has a vast drainage network including Clinch, Holston, and French Broad Rivers. The Ridge and Valley lies between regions that vary greatly in topography and land use. The Cumberland Plateau to the west was settled comparatively late in Tennessee's history and is characterized by terrain

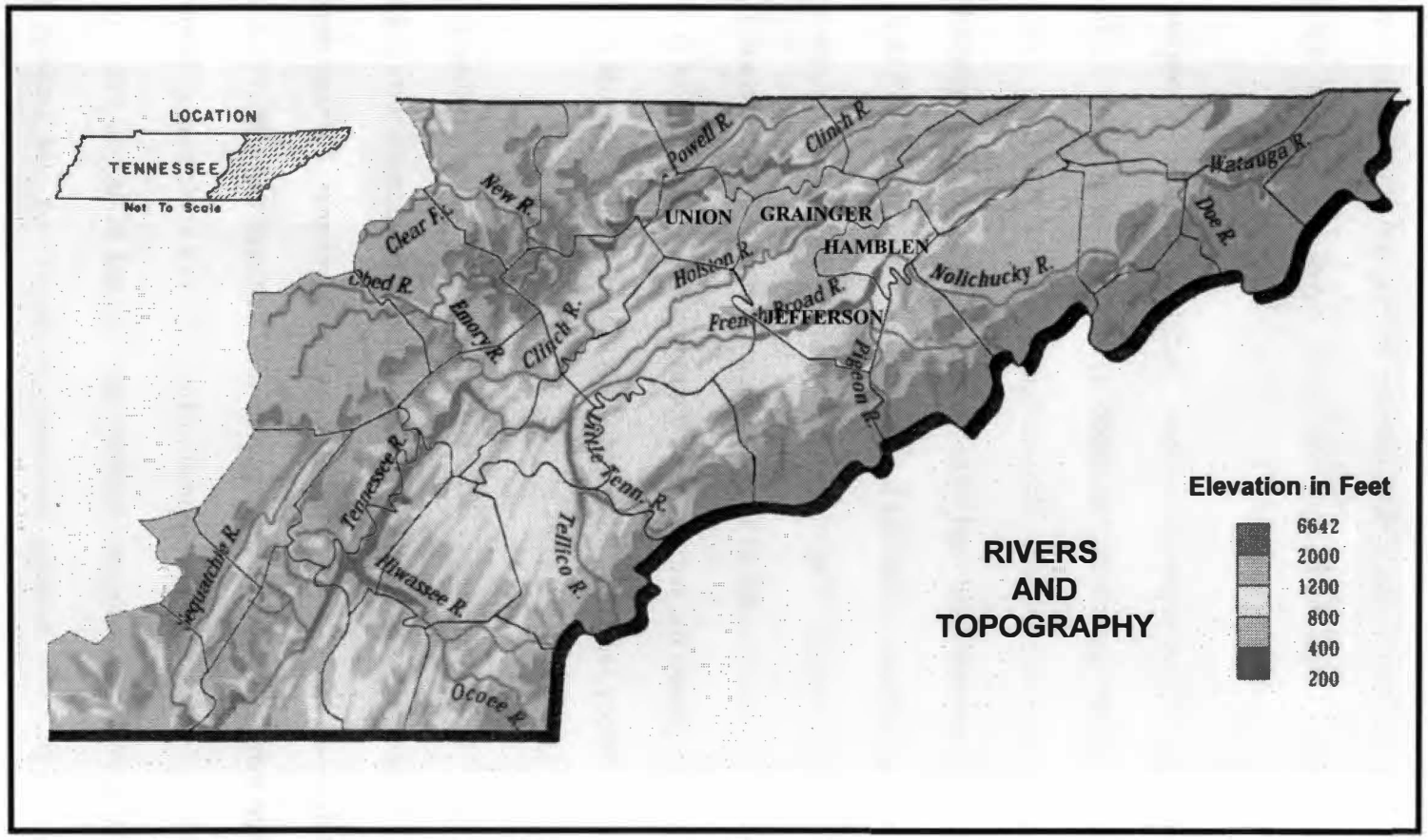

Figure 1.2. The Rivers and Topography of East Tennessee. Source: Tennessee Geography Alliance.

that varies from steep river valleys to flat plateau areas. The region's poor soil quality was not suitable for agricultural. The Blue Ridge to the east was the first region European settlers moved into in the 1760s. Steeply sloping mountains and deep valleys characterize the Blue Ridge, with only the lower coves and valleys suitable for agriculture.

The Ridge and Valley region, in contrast, had large numbers of settlers due to fertile valleys suitable for agriculture. In addition, the systems of rivers in the region provided transportation corridors for early settlement (Reber 1977, 5). The Native American tribes had used the Ridge and Valley for centuries as a hunting ground and for agriculture. Large populations inhabited towns during the Woodland and Mississippian Periods (Hudson 1976, 35-42). The most recent Native American occupants were the Cherokee Indians, who were removed from the region in the 1830s (Jefferson 1996, 5). This removal further spurred the settlement of the region due to the increase in available land and the perception by settlers of increased safety from potentially hostile inhabitants.

Economic Land-Use

Historically, semi-subsistence farmers settled the region, practicing limited agriculture and hunting to sustain their families. Ferries and gristmills were the limit of commercial industries. Once transportation corridors developed, taverns, inns, small stores, and stage stops developed. These commercial ventures had little impact on the landscape and only furthered the development of the region's settlement (Claborn 1995, 15). The reliance on semi-subsistence farming has changed in last 50 years to a more mixed economy with manufacturing increasing in importance and farming become recreation more than a necessity, Grainger County is the exception, were commercial

agriculture is visible today (Trevena and Garrett 1976, 19-21). Increased diversity and the decline of agriculture continues to shape the region. Development is centered along major roads, but is increasingly threatening the rural landscape.

Cultural Factors

Chapter two discusses the cultural factors related to settlement. The Ridge and Valley region was settled by groups of people with varied ethnic and cultural backgrounds. The end of the Revolutionary War created an availability of land in the Ridge and Valley that was unlike periods before. Veterans of the war from all along the eastern portion of the United States were given land grants in the region. These settlers were largely English, Scotch-Irish, German, and French, cultural backgrounds that are still seen in the region today (Claborn 1995, 9).

The agricultural practices, construction techniques, and daily patterns of life helped to develop settlement in the Ridge and Valley. The semi-subsistence agriculture methods employed by the groups help explain the use of land resources and the selection of log structures for building. The practice of clearing land for agriculture provided a readily available resource of logs for building. My analysis concerned how these methods were employed and the extent of their use in my study area.

Procedures

Chapter three describes the methodology used in this study. I established the criteria for use of sites and the methods employed to ensure accurate data. Field techniques developed for this study and methods of dendrochronology I applied in the collection of samples are also discussed, as well as information related to laboratory techniques and the analysis of collected samples and data. The laboratory analysis was

critical to establishing accurate and precise information on all sites analyzed.

I used dendrochronology to date structures in the Ridge and Valley to improve our knowledge of these structures. No structures in my study area had been dated using dendrochronology. I applied dendrochronological techniques, which helped develop a timeframe for settlement in the four counties studied. The information gathered allowed me to map the sites and assign dates of construction, mapping settlement through time. In addition, the application of dendrochronology to the study area will broaden the existing chronology for the region.

Chapter four describes the results of the analysis and the conclusions that I draw. I also discuss how dendrochronology could be applied in future research in the region. I develop explanations on migration and potential migrational patterns. Utilizing dendrochronology on selected sites helped confirm the accuracy of the dates gathered by the Tennessee Historical Commission Survey Teams.

Finally, chapter five is a comprehensive analysis of the deterioration and need for preservation of log structures. During the 25 years since the Tennessee Historical Commission conducted the surveys, the population of log buildings has dropped dramatically.

CHAPTER TWO: CULTURAL FACTORS RELATED TO SETTLEMENT

Development of Settlement

Grainger, Hamblen, Jefferson, and Union Counties share a common history. The area was initially settled by large numbers of Revolutionary War veterans, largely of Scotch-Irish, German, and English descent who moved into the region eager to make land claims were. Settlement in the region began in the early 1770s and increased in numbers and area through the middle of the 1800s (Goodspeed 1887, 508). The counties were among the first to be settled between 1800 and 1860 in Tennessee. Settlers came from neighboring areas of Tennessee and the adjacent states of Virginia, North Carolina, and Pennsylvania (Goodspeed 1887, 532). The immigrants were familiar with the difficulties associated with frontier life (Morgan 1980, 140). The influx of three ethnic groups was accompanied by different cultural traits, particularly in log construction techniques. The introduction of African-American culture is not as important in the Ridge and Valley as in other parts of Tennessee. Although slaves were part of the culture in the area, their use was more limited than in the Lowland South. None of the farm sites I examined displayed a typical plantation layout, with a main house and separate slave quarters. Some of the sites were attributed locally to African-Americans. However, I could not verify local beliefs as factual.

These new settlers were primarily semi-subsistence farmers that utilized the land to provide their daily needs. They raised crops for their families and sold or traded excess to acquire anything they could not produce (Morgan 1980, 138). The primary agricultural crops were corn, wheat, oats, and various garden vegetables. One of the by-products of clearing land for agriculture were trees that could be used to construct houses

and outbuildings. The region's lack of manufacturing facilities and the dependence on agriculture shaped the environment in ways that are visible today. The relatively large tracts of land and the subsistence economy account for the region's lack of large settlement centers. The mixed terrain of cleared valley bottoms surrounded by steep wooded hills and ridges reshaped the landscape (Trevena and Garrett 1976, 141).

In addition to crops, settlers raised various livestock to meet their needs for dairy products, eggs, pork, and wool. Few settlers had large herds of any particular type of livestock. Small numbers of animals were kept for basic needs. Animals such as hogs and goats were typical and were well suited to graze the ridges and hills (Claborn 1995, 12). Hunting in the vast woods provided food as well as leather for clothing, bags, and other items. The settlers were well equipped and knowledgeable in hunting and trapping game. Deer, elk, and wild turkey were among the game animals and could be hunted year around. The distances between most of the farms eliminated competition for game.

Initial settlement occurred along the major rivers of the region: the Holston, French Broad, and Clinch. Rivers were the primary means of transportation prior to the construction of roads. The locations of towns attest to the critical role the rivers played in development of the Ridge and Valley (Jefferson 1996, 8). Later settlements were established along trails that became major trade routes. As early as 1782, Charles McClung began work on a road from Knoxville to the Watauga Settlement along the old Cherokee war path. This road increased settlement and improved movement through the Ridge and Valley. The road further enabled trade. The first railroad in the region was built in 1856 by the East Tennessee, Virginia, and Georgia Rail Company (Claborn 1995, 13). The railroad was the final major transportation improvement prior to the Civil War.

Use of Log Structure

The use of log structures in the settlement of east Tennessee was very logical based on the available materials and the traditions of building brought by the new settlers. The immigrants to the Ridge and Valley region possessed a long history of log construction brought from Europe. The Scotch-Irish and English settlers learned log construction from other Europeans when they arrived in America, such as the Germans and Scandinavians, who were the earliest users of log buildings (Rehder 1992, 104). The log building, constructed of horizontal logs with notched ends, was developed in Europe where it was seen predominately throughout central and eastern European countries (Jordan 1978, 23). The use of logs for construction was common in the eastern and southern United States in the 1700 and 1800s (Figure 2.1). East Tennessee was an ideal environment to use log construction because of the availability of tall, straight trees and the need to clear land for agriculture (Morgan 1980, 138). Another factor that increased the frequency of log buildings was the lack of commercial sawmills. The labor required to "pit-saw" logs was more than most settlers were willing to invest. The process to saw planks required the construction of a pit with beams laid across the opening. Logs were laid across the beams and a large bucksaw was used to plank the logs with a man above and below (Bealer 1978, 22). Water-powered sawmills were available, but the limited accessibility and low population in the Ridge and Valley reduced their use. The limited market of the region and the expense required to run sawmills were the key factors to their low frequency in the Ridge and Valley. Portable sawmills that were steam-driven were not available in the region until the early 1850s.

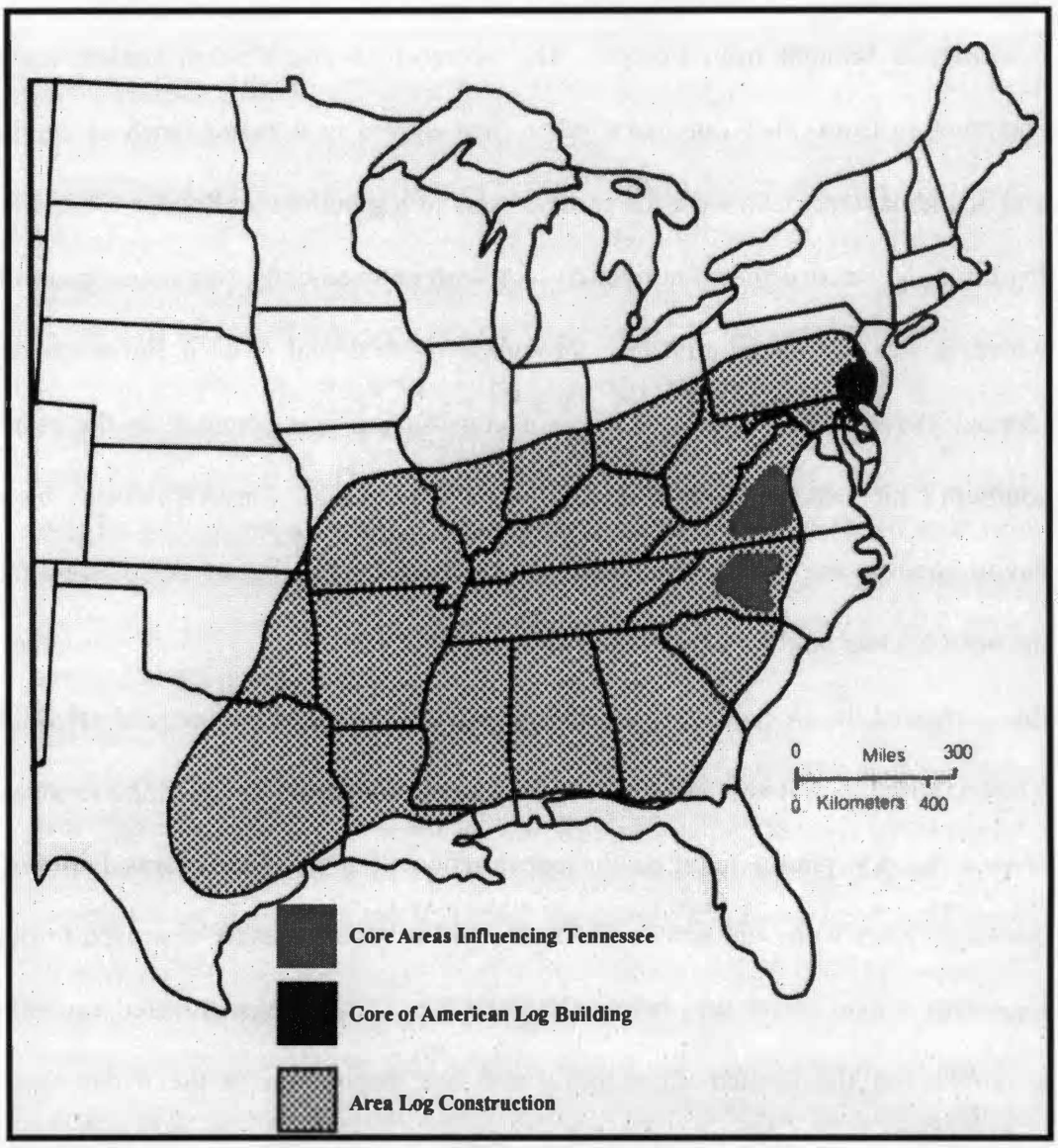

Figure 2.1. Log Buildings in the Eastern and Southern United States. Source: Morgan 1990.

Although frame structures were built in the region, they were relatively expensive to build prior to portable sawmills and were not as common prior to 1860 (Morgan 1990, 90).

The typical log house was a single pen structure, a square to rectangular-shaped floor plan with four exterior walls built with logs (Figure 2.2). Rectangular floor plans predominate in German and Scotch-Irish influences, while square floor plans were derived from British influences. The single pen floor plan can vary to include the addition of a half or full second story. Typical dimensions of log cabins vary from 18-22 feet (5-6 meters) by 16-18 feet (4-5 meters) (Rehder 1992, p.105-107). Log outbuildings were often built to suit specific needs, but the majority of structures were single pens. The buildings ranged from corncribs to hog pens and varied in size.

Log structures are generally built with sills placed on large fieldstones or piers constructed of mortared rocks. Typically, piers or stones elevated the structure by 12-18 inches and prevented moisture from the ground coming in contact with the sill logs. Across the sill logs, floor joists were laid, and the floorboards were nailed directly to these joists. The structures I examined contained logs of mixed wood types or were constructed of pine. All had oak or poplar sills and joists.

Chimneys were constructed of mortared stone or brick, although some were made of sticks and dirt. Chimneys were located on the gable end of the structure in log cabins. Some log cabins had eaves that extended out on the end to protect the chimney from erosion or rain damage. Most log cabins had windows, but they usually were not found in outbuildings. The number of windows varied, depending on the size of the structure.

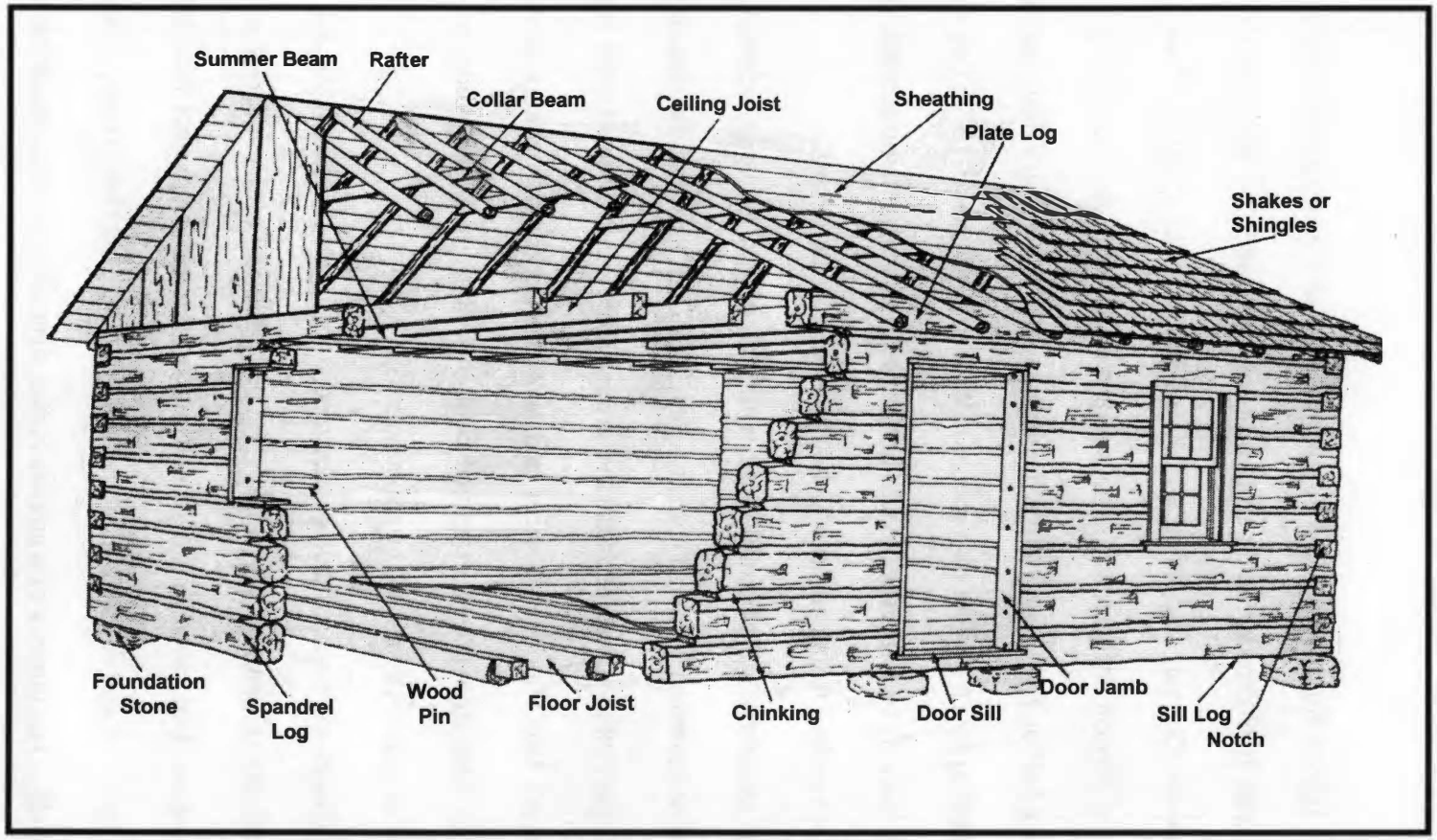

Figure 2.2. Log Cabin Components. Source: Modified from Bealer 1978.

Most had two or more windows. Windows were also added after cabins were constructed (Morgan 1980, 140). The roofs of log structures were wooden planks or shakes (shingles). The majority of surviving structures have sheet metal, tarpaper, or shingle roofs.

Log structures were built using trees readily available, primarily hardwoods such as oak and poplar, but softwoods (especially pine), were also used. The wood type tended to be related more to availability than to preference, at least in the latter half of the 1800s. Evidence indicates that poplar was the preferred wood in the early period of settlement because of its durability and straightness (Morgan 1980, 146). Grainger County has a large number of log buildings constructed of poplar, while other counties have large numbers of buildings constructed of oak, poplar, and pine. I was unable to attribute any ethnic association with wood types used in the study area primarily due to an inability to accurately identify the builders.

A distinctive characteristic of log buildings is the notch type employed in the construction. Notches are used to connect the logs at the ends and maintain the structural integrity of a building. Several types of notches were used in log construction. Typical notch types are: half-dovetail, "V", square, saddle, diamond, and full-dovetail. There are several variations, but none was found in the study area (Jordan 1982, 51) (Fig. 2.3). The significance of the type of notch in relation to when and who built a structure is open to debate. In the study area, most surviving log buildings were constructed with half-dovetail notches. Because I did not know the ethnic derivation of the builders, I could not make an association between ethnic groups and notch types. I found no spatial

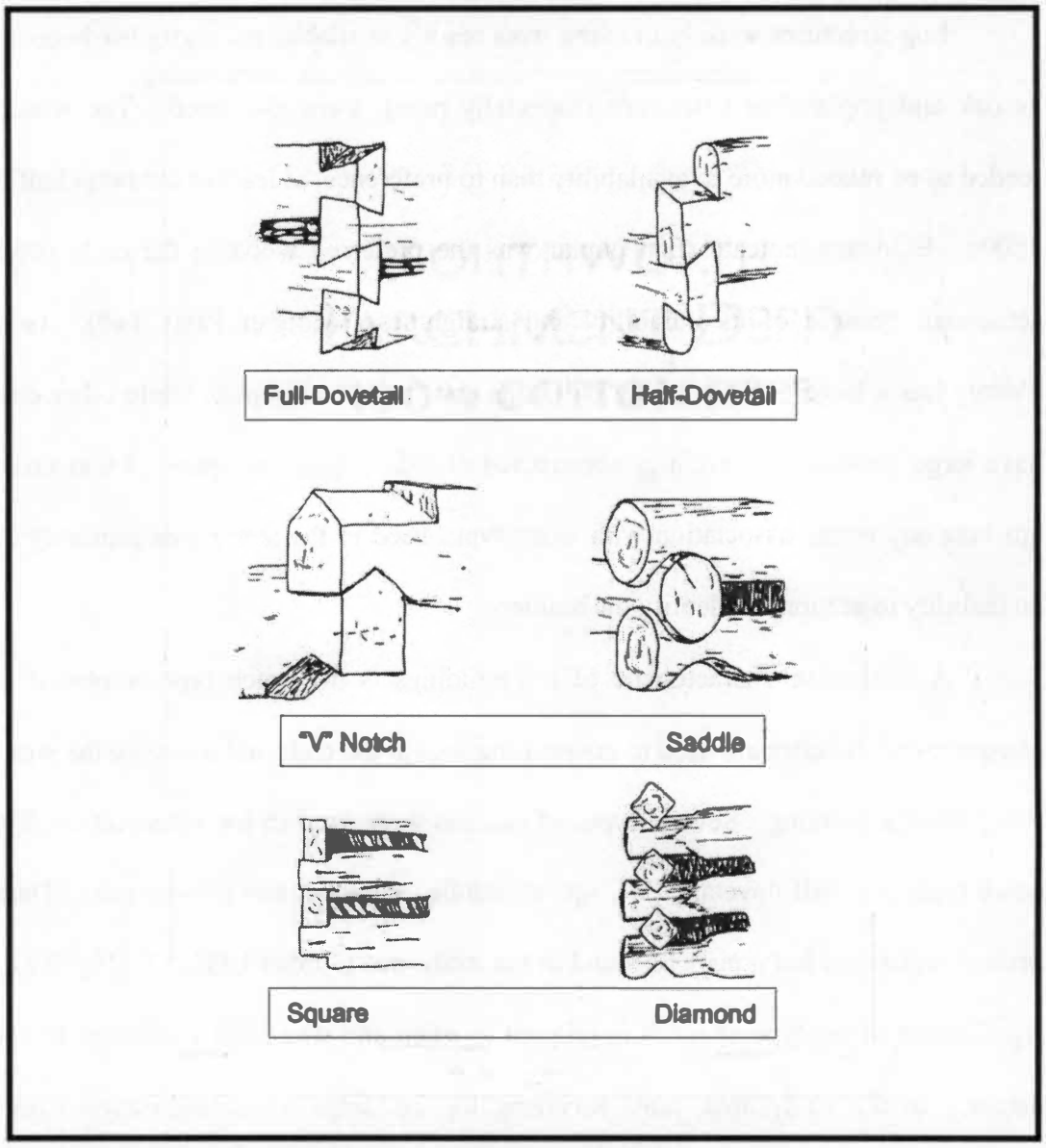

Figure 2.3. Common Notch Types. Source: Morgan 1990.

relationship between types of notches and spatial distribution, and no "islands" of a particular notch type.

The history, land use, ethnic makeup, and log structures in the study area are representative of the Ridge and Valley. The limitations imposed by the restrictive terrain and the importance of the valleys for agriculture and transportation are readily apparent. My research allowed me to apply different methodologies to analyze my data and draw plausible conclusions about settlement in the Ridge and Valley.

CHAPTER THREE: RESEARCH METHODOLOGY AND ANALYSIS

Tennessee Historical Commission Survey Data

One of the most valuable sources of data that I used was the historical building survey commissioned by the Tennessee Historical Commission. This survey was conducted in the late 1970s and early 1980s to establish a building inventory for the state. The intent was to identify all structures in the state built before 1930 and to catalog the details of each site. Specific information was gathered for each site, sketches were drawn, and pictures were taken. The quality of the data varied from county to county based on the surveyors, mostly composed of teams of college students, professors, high school students, and local historians. Each county had different teams, although some teams surveyed more than one county. The data fluctuate in accuracy, attention to detail, and thoroughness. Some counties were inventoried with great precision, while others were poorly surveyed (Tennessee Historical Commission 1992).

One of the greatest drawbacks to the data was the quality of the information for the structures. Grainger County, for example, has detailed information. The survey team went to great efforts to obtain accurate data on each site. All the sites were accurately located and mapped, thorough site descriptions were done, and extreme efforts were taken to establish background information on all buildings. In contrast, Jefferson County has minimal details regarding sites. Sites were poorly located and mapped; little research was done on the structures background and origin. These data proved very challenging to gain useful information.

Overall, the Historical Commission data provided a valuable starting point towards proving my hypotheses regarding settlement in the Ridge and Valley, but a

significant amount of additional analysis had to be conducted. Not all of the drawbacks were in data collection. The most common problem encountered was erroneous site information in the database. I applied several attributes to retrieve the data, including the type of structure, construction period, and material of construction. Eventually, I was able to filter out all unrelated sites prior to field research. I assume an equal number of sites that should have been included in my search were left out of the data output. Although this problem impacted the precision of my research, the effect on the results was only minimal (Figure 3.1).

Additional information was gathered at Middle Tennessee State University in Murfreesboro. Middle Tennessee State was awarded a contract to digitize all the map data and generate a database of site locations. The cartography laboratory at Middle Tennessee State provided digital location data I used to generate Arc View images. The images gave me accurate location information and reduced time required to find sites in the field. Data used to generate shape files helped to produce the maps used in my thesis (Figure 3.2).

The research process included four steps: mapping the log building sites, verifying their locations on the ground, assessing their condition, and obtaining dendrochronological samples. The process of mapping was done prior to conducting fieldwork. Once the sites were mapped, I verified whether the log structures still existed and assessed their condition. Site assessments were based on procedures outlined in the Historical Commission's survey form, which classifies conditions based on stability, deterioration, abusive alterations, and external encroachment (Tennessee Historical Commission 1992).

28 MAR 2001 PAGE

SITE REPORT

ID:GR.1025 SITE.TYPE:Survey
SITE NAME:
ASSESSMENT DATE
NOT ELIGIBLE
OWNER TYPE OWNER
Cora Sills
RECORDING ORGANIZATION DATE
UT GEOG 09/07/1978

SE.TAG	SR.TEXT
NAME	Log Smokehouse, On Old Sills Pl
NAME	Cora Sills Smokehouse
DATE.CONSTRUCTED	C. 1850
THEME	Art and Architecture
ETHNIC/CULTURAL.AFFILIATION	Anglo-American
INFORMANT	Lamer Lay
USE	other structure
USE	SMOKEHOUSE
USE	abandoned structure
SETTING	Rural Built-up
LOCATION	Original Location
ENDANGERED.PROPERTY	property stable
NEG.LOCATION	THC
STYLE	Plain Traditional
PORCH.HEIGHT	1
CONSTRUCTION.METHODS/MATERIALS	log construction; gable roof
DESIGN.ORGANIZATION	square plan
	metal roof
	full porch
	1.5 stories
INTEGRITY	original porch
	altered roof
HISTORIC.LANDSCAPE.FEATURES	undetermined
HISTORIC.LANDSCAPE.FEATURES	F
REMARKS	log smokehouse - poplar timbers. 1/2 dovetail notching.

COUNTY:Grainger MAPS:154 SW Powder Springs
UTM:16;8 00 243mE; 40 22 772mN
FULL.ADDRESS:0.1 MI NE OF MT EAGER CHURCH

Figure 3.1 Historical Survey Data Sheet. Source: Tennessee Historical Commission.

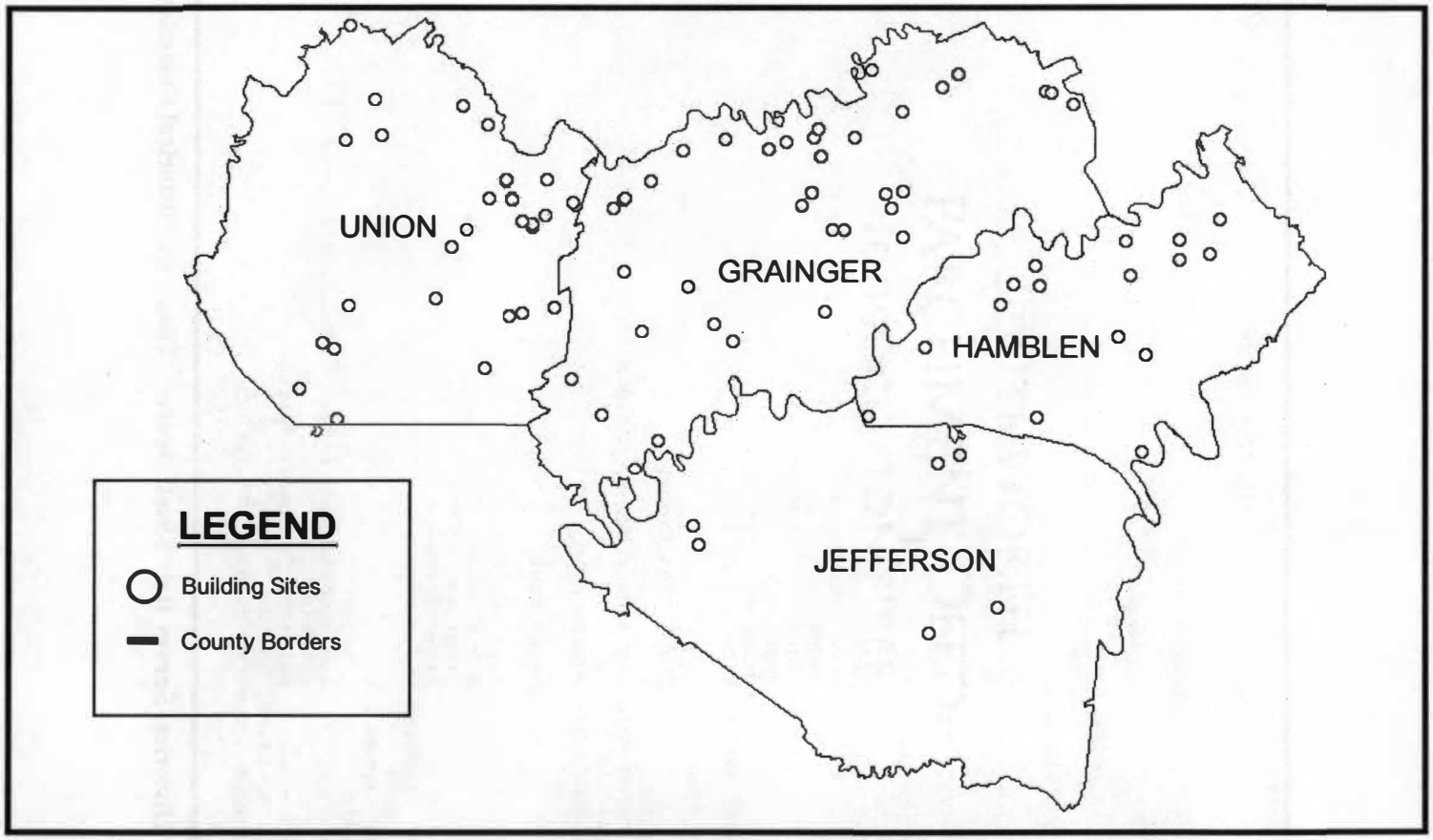

Figure 3.2. Building Sites in Study Area. Source: Tennessee Historical Commission.

Each site was photographed to compare with previous photographs to analyze long-term degradation of the structures and to determine the possibility of preservation. The final step was to determine the suitability of each structure for dendrochronological sampling by examining the logs for the existence of bark or beetle galleries. These indicate the presence of the tree's outer growth ring. I also took sample cores to examine the integrity of the wood. If the logs passed the initial inspection, samples were drawn (Stokes and Smiley 1996, 19).

The importance of dendrochronology in my research is two-fold. First the only way to achieve certainty of the dates of construction is to use dendrochronology. Dendrochronology provides a degree of precision no other science can approach (Stahle 1985, 279). Second, limited research has been conducted using dendrochronology in the eastern United States. This research is vital to future study because, by preserving the historical record of the log structures studied, other research could be conducted even if the structures are gone.

Prior to sampling, the sample logs were numbered using a system that includes the site number assigned by the Tennessee Historical Commission, a log number based on its relative location (*i.e.*, "004L" indicating the forth log from the bottom on the left side), and a core sample number. Each core mount was annotated with this information prior to sampling (Figure 3.3).

Samples taken for dendrochronological analysis were extracted with a 5mm increment bore (Figures 3.4 & 3.5). I used the manual increment borer instead of the electric drill powered borer due to the fragile condition of the logs. Power increment borers have increased torque and tend to twist or break samples when used in older wood.

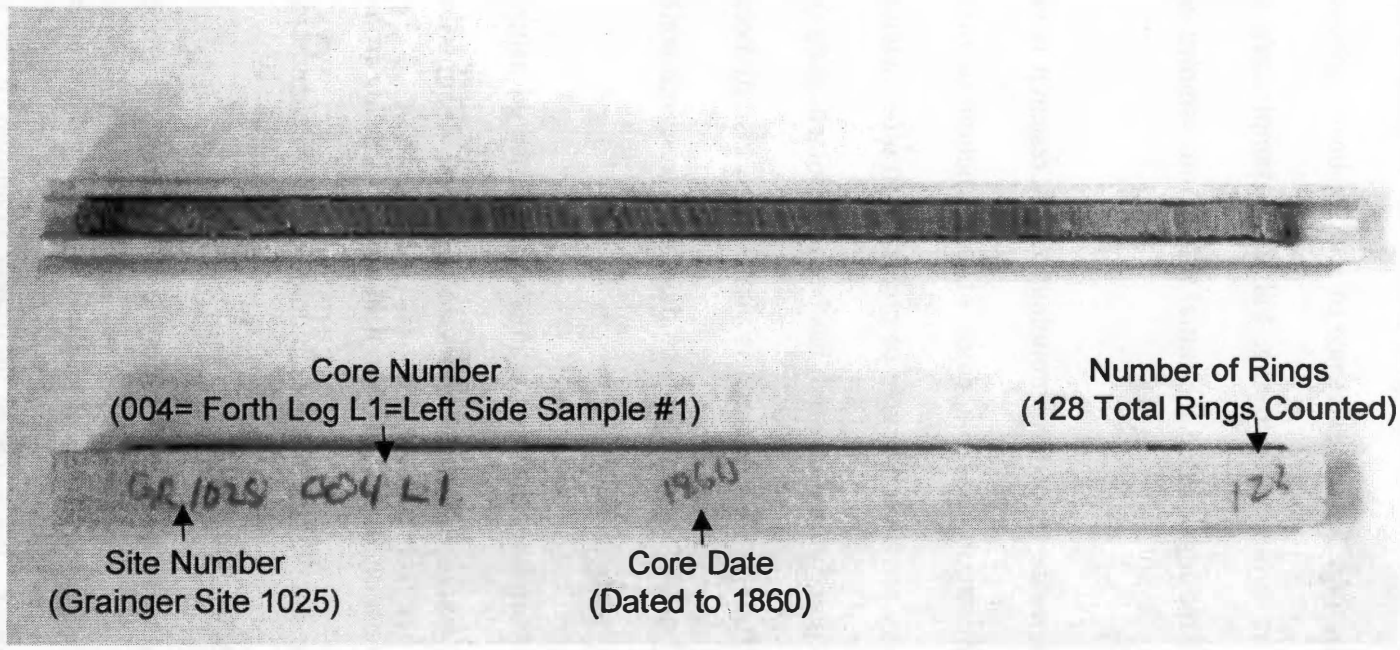

Figure 3.3. Mounted Cores and Numbering System. Source: William Reding 2002.

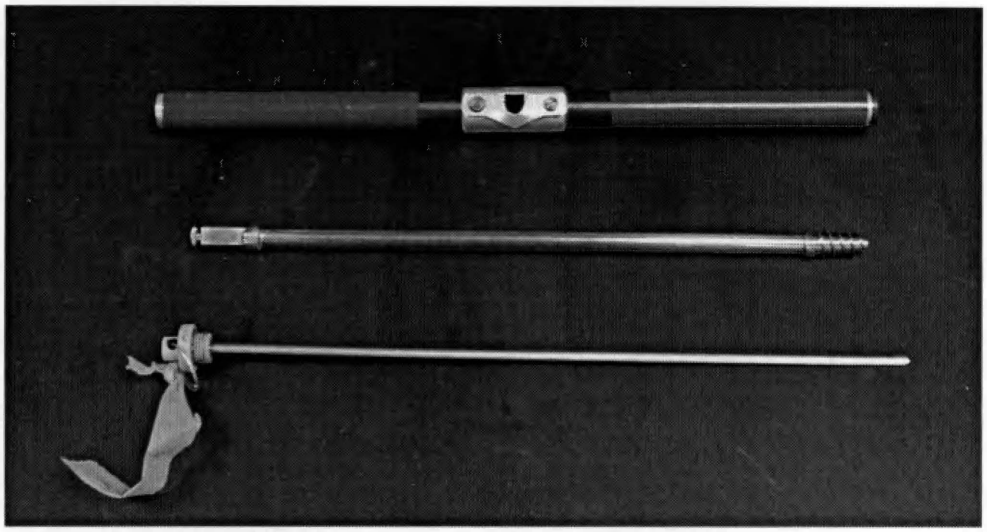

Figure 3.4 . Increment Borer Disassembled (Handle, Corer, and Spoon).

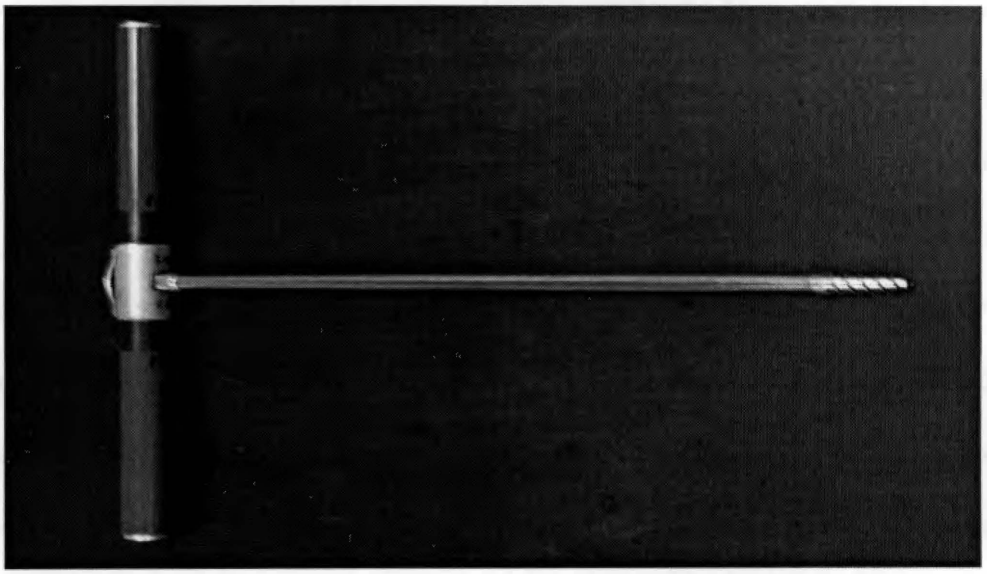

Figure 3.5. Increment Borer Assembled. Source: William Reding 2002.

Samples extended from the outermost ring to the pith, the center of the log. Inclusion of the outermost rings enabled me to determine the date the log was cut, which helped establish the probable construction date of the structure. A minimum of five individual logs were sampled and at least two cores were drawn from each. Due to the advanced decay of most of the buildings, few logs met the selection criteria. I selected a building from each county as a representative sample (Figure 3.6). The samples were used for the laboratory analysis portion of my research. Once the field collection of cores was completed, the samples were taken to the University of Tennessee's Laboratory of Tree-Ring Science for preparation and testing. The samples preserve the limited log building information available in the region and verify the accuracy of the survey team's age estimates based on interviews and legal documents.

Laboratory Work

I mounted the cores in the field utilizing water-soluble glue. The samples were surfaced using progressively finer grit sand paper (No.60 through 400) on an electric belt sander, allowing the cell structure of the wood to be visible under the microscope (Stokes and Smiley 1968, 46).

The principal that makes dendrochronology possible is crossdating. Crossdating is the comparison of ring patterns within trees and between samples from different trees. Crossdating establishes identifiable patterns that can be compared and verified with a master chronology that is "anchored in time" or one that has a known chronological sequence. To begin crossdating, I used standard methods of counting rings outlined by Stokes and Smiley (1968, 54). The pith ring is considered the "zero" ring, after which

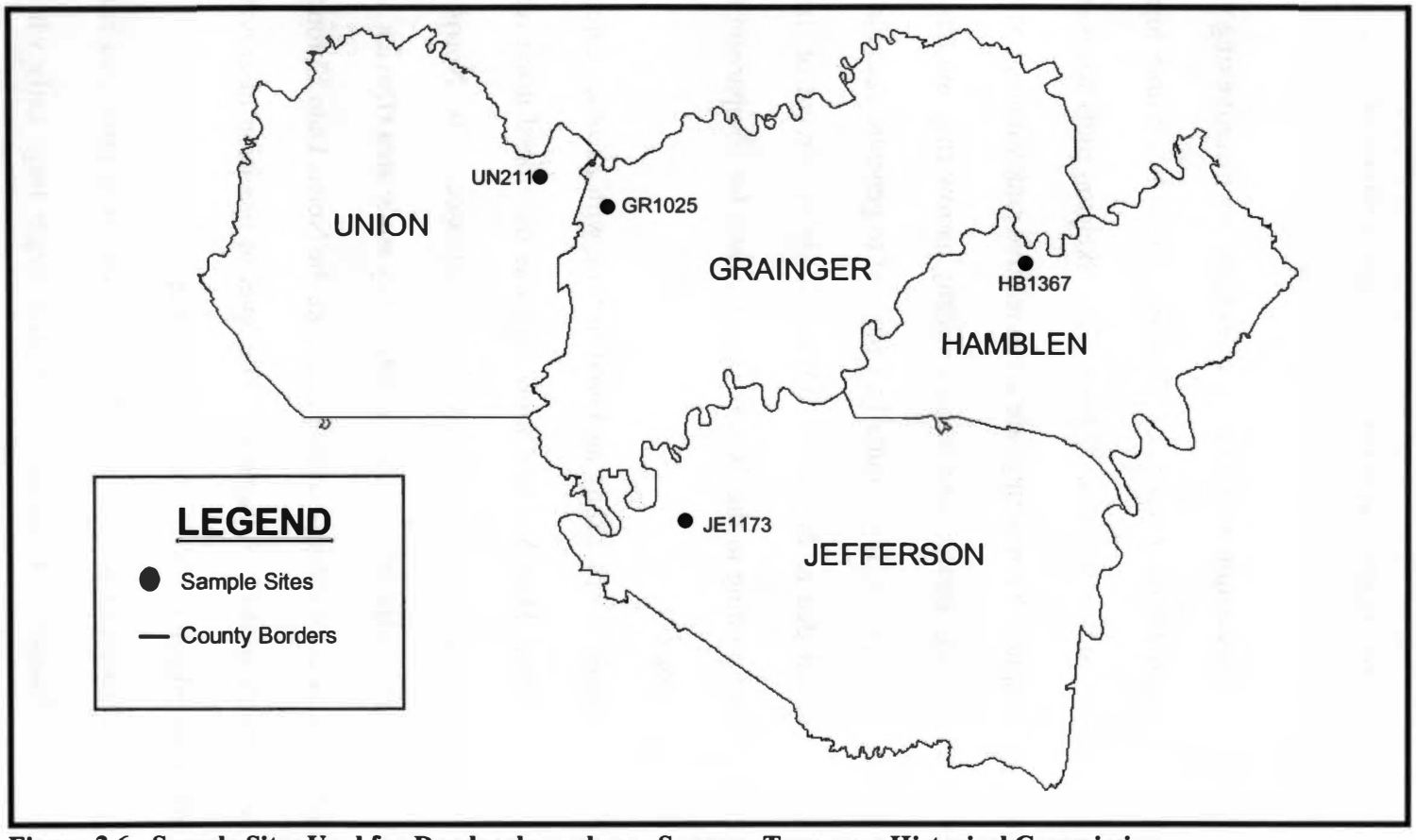

Figure 3.6. Sample Sites Used for Dendrochronology. Source: Tennessee Historical Commission.

each ring is counted progressing outward toward the outer edge of the core. At ten-year intervals along the core, a pencil dot is added. Two dots are made at fifty-year marks, while three dots are made at one hundred year marks. The total number of rings was then annotated on the core mount.

Skeleton plots are a crossdating method of translating the comparative ring widths of a specimen to graph paper for the purpose of analyzing similarities within logs and between other log samples (Stokes and Smiley 1968, 47). Skeleton plots focus on the narrow rings within the samples. Narrow rings are given relative rank values (1 to 10) in comparison to other rings in the sample, one being a slightly narrow ring and ten being the narrowest ring in a group of the rings. Initially, I planned to generate skeleton plots for all samples collected, but due to the poor condition of eighty percent of the logs sampled, I reduced skeleton plotting to the 48 core samples used for comparison to the Norris Dam Master Chronology.

The master chronology is one firmly anchored in time with an outer date taken from a living tree. The Norris Dam Master Chronology was developed using red oak (*Quercus rubra* L.) trees sampled around Norris Dam, Tennessee. The Norris Dam Chronology was selected primarily due to its proximity to my study area (Duvick 1980). Although no building selected for dating contained oak like the Norris Dam Chronology, the chronology was suitable to date my samples. The level of precision in crossdating was only marginally reduced due to the different species used.

It is important when ranking rings to understand how trees grow and react to various environmental influences. Trees tend to produce larger rings early when the stems are small and growth processes are dedicated to ring development. Trees tend to

decrease ring width as they age, but other environmental influences, such a drought or sudden cold spells, can also influence ring development (Stokes and Smiley 1968, 59-60). Narrow rings are primarily used in crossdating because they are easily distinguished.

I utilized narrow rings to develop my skeleton plots for each of the sample cores I collected from the four sample structures. The skeleton plots were then matched for each log building to develop site chronologies and master skeleton plots. Once the building plots were developed, I compared each site with my Master Chronology. Once comparisons were completed, tentative dating was made for each sample (discussed in chapter four).

Computer Analysis

To verify the dating obtained by crossdating with skeleton plots, computer verification was also used. The computer program COFECHA can statistically compare tree-ring measurements with master chronologies. The application of this software to evaluate my findings validated (and in some cases caused me to recheck) my findings. In addition, the output from this computer program forced me to resample one of my sites to obtain better dating. The program takes measurements for each sample and compares these data with the master chronology.

This process involved first measuring each core sample under a microscope with magnification from 10-100X. Each ring was measured to .001 mm precision. COFECHA software then compared the measurements by calculating correlation coefficients with the master chronology.

The 48 samples were measured and compared to the master chronology at a minimum of .500 correlation at 99 percent confidence. This level of precision allowed me to generate precise dates for all four sample buildings analyzed. I obtained higher levels of correlation with the four sample buildings. Due to the poor condition of the sites not in the sample group, 82 of the samples from other buildings could not be dated.

The use of dendrochronology enabled me to obtain precision in dating that could not be gained otherwise and confirmed the dates originally obtained by the Tennessee Historical Commission survey teams during their initial cataloging of buildings. Although my research did not extend the master chronology for east Tennessee back in time, it did preserve valuable samples for future research. The primary problem in this study is the poor condition of many buildings. My intent was to use dendrochronology to date as many log buildings as possible, but as my sampling and analysis proceeded, dendrochronology was less applicable because of the poor condition of the buildings themselves. Future research applying this science in other areas might provide outstanding results.

CHAPTER FOUR: RESULTS AND CONCLUSIONS RELATING TO HYPOTHESES OF SETTLEMENT IN EAST TENNESSEE

My analysis concentrated on verifying four hypotheses of settlement I developed after surveying the study area and map analysis of log building locations. The first hypothesis is that the Ridge and Valley was settled in an east to west direction, but the topography of the region caused a settlement pattern that trended along valleys. The second hypothesis is that initial settlement was closely tied to streams for transportation and water supply. The third hypothesis is that the survivability of log structures in the region was tied to their purpose and the wood used in construction. The final hypothesis is that dendrochronology can be used to determine construction dates of log structures and provide an accurate temporal element to the study of settlement.

Settlement Patterns Related to Stream Access and Topography

My analysis of settlement in the region was based on the hypothesis that migration tended to be in a general east to west pattern in east Tennessee. To effectively determine this, I mapped the sites of log structures and construction dates using the Tennessee Historical Commission Buildings Survey. Once I applied the date of construction, I was able to graphically display settlement through time.

Although settlement follows an east to west trend in the Ridge and Valley, the terrain forced a northeast to southwest pattern in the study area. Because of the steep, almost vertical nature of the ridges, settlement was most easily achieved along the river and creek valleys between the ridgelines (Figure 4.1). While this hypothesis tends to be true, an interesting variation is also evident; the pattern is closely tied to the access to the three major rivers. Not only does the settlement pattern follow the valleys, but the log

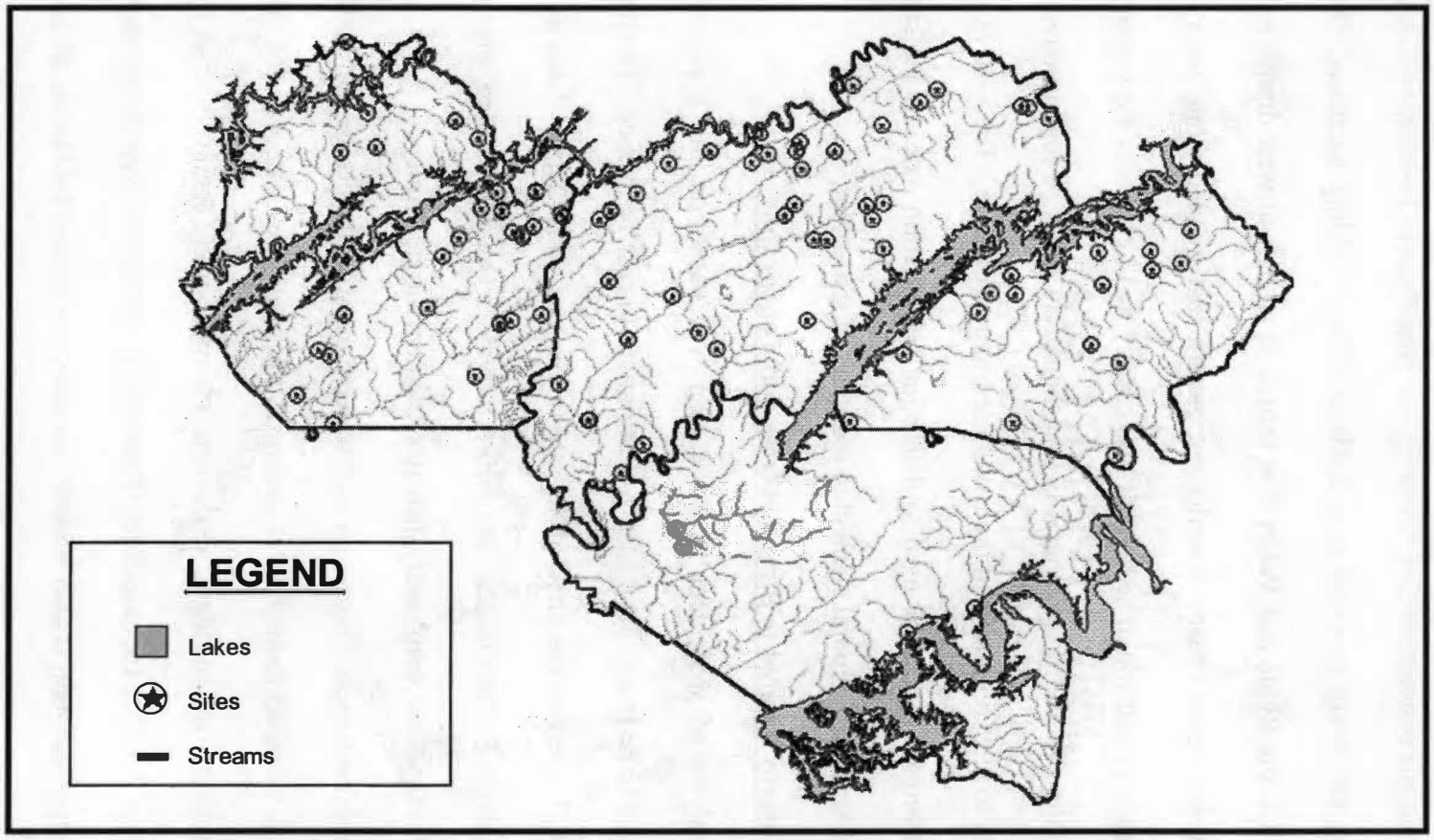

Figure 4.1. Log Building Sites Related to Streams. Source: Tennessee Historical Commission.

structures tend to radiate out from the major rivers (Figure 4.2). The oldest structures in each of the four counties are located in close proximity to the major rivers. Ninety-six of 98 sites of log buildings were located on streams. The explanation lies in the importance of usable water close to the settlement site. Water was required for daily tasks, and waterways provided navigable routes through the region. Although there were a few trails and roads in the region, the rivers and creeks afforded both an easier route of movement and a pathway that aided in orientation. Later, streams provided waterpower for operation of gristmills and sawmills. The need for moving water to run mills maintained the ties to streams. The creation of better roads allowed the expansion of settlement beyond the river and stream valleys

The dates of construction for the structures tend to diffuse outward in zones from the rivers. Variations occur in this pattern in Union and Grainger Counties, but they are attributable to the relocation of structures from their original locations in the 1930s and 1940s due to the creation of large lakes by the Tennessee Valley Authority. A linear alignment of sites in the valleys was also apparent.

The trend in the region saw settlement occuring first in the lowland adjacent to the major rivers. Next, settlement moved outward to the major tributary streams along the river valleys. Finally, when all the land that was located within the river and stream valleys was taken, settlement moved from the valley floors up the ridges. The dependence on streams for settlement in east Tennessee was similar to other developing areas of the country. Only two surviving log buildings were originally constructed away from waterways. Both are in Jefferson County and were built after 1830. There are two

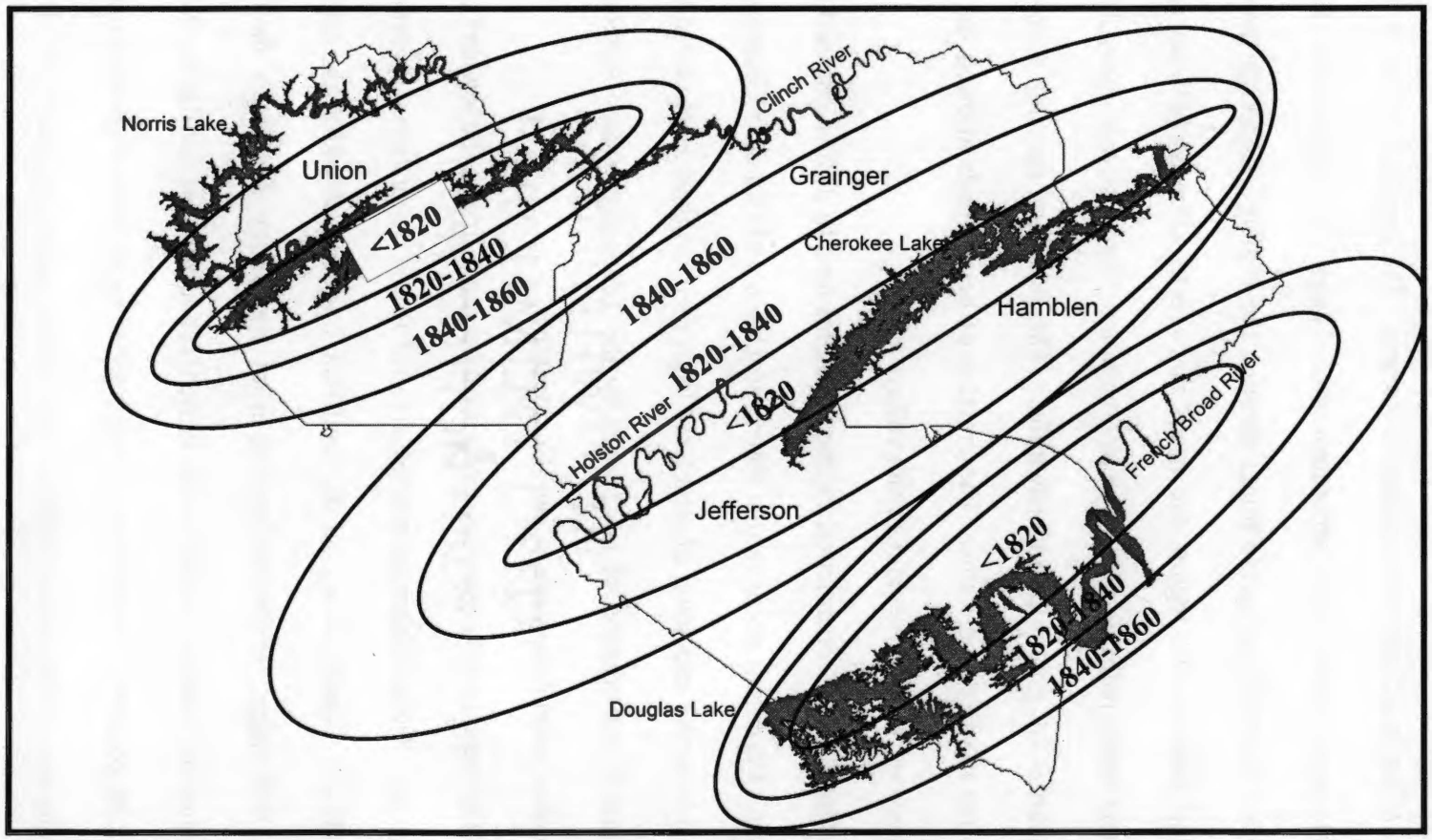

Figure 4.2. Settlement Pattern Through Time. Source: William Reding 2002.

possible explanations for their locations. First the construction date occured after the availability of a road. Second, the person(s) who constructed the building(s) could not compete for land access.

Structure Type and Survivability

The third hypothesis of settlement is that survivability is related to the purpose of a structure and the type of wood used in the construction. My initial premise was that structures used for homes survive longer than outbuildings. My first step was to establish the use of each of the structures between 1978 and 2002 (Table 4.1). The log cabin is the dominant structure type in all four counties, while the condition of each varied.

Grainger County had more outbuildings in usable or stable condition than log cabins. Buildings for storage, such as barns, cribs, or animal pens, were in much better condition and were still in use more than were log cabins. The explanation for the better condition of outbuildings in Grainger County lies in two factors. First, Grainger has more agriculture land-use than the other three counties. A strong agriculturally-based economy increases the need for usable structures for storage. Well-built log structures are durable. The expense saved in utilizing existing structures is cost effective. Although log structures are not the only ones associated with farms, they do provide useful functions. The second explanation for the good condition of log outbuildings is related to changes in agriculture. Less of the land in Grainger County is farmed by owners. The land is leased to multi-tenants, who rent from several owners. With no one living on the land, there is no need to maintain log cabins. Structures that are no longer occupied fall into neglect or are torn down. Some are disassembled and moved.

Table 4.1. Number and Use of Log Structures 1978 to 2002. Source: Tennessee Historical Commission.

	STRUCTURAL USE		TOTAL STRUCTURES	
COUNTY	CABIN	OUTBUILDING	1978	2002
Grainger	16	22	38	16
Jefferson	8	0	8	5
Hamblen	18	0	18	11
Union	18	16	34	12
Total	**60**	**38**	**98**	**44**

Log cabins in Hamblen, Jefferson, and Union counties are in better condition than log outbuildings. Eighteen of the log cabins in these counties are still used today as homes. Most log cabins have been covered in some way, but four are restored. The decreased dependence on agriculture is the primary reason, resulting in the poor condition of log outbuildings. The lack of use allows them to slip into deteriorated condition.

That more log cabins survive is logical. Because they are homes, the owners tend to invest more time and money in the maintenance. Because of their utility as either a dwelling or a storage structure, log houses are maintained even when new homes are built. Log structures are seen as reminders of the past for many families, and the desire to maintain them increases.

The type of wood used in construction is of equal or greater importance in survivability than the purpose of a structure. The relationship between wood types and survivability is readily apparent in the study area. The majority of structures in the counties studied were constructed of yellow or tulip poplar (*Liriodendrum tulipifera* L.), oak (red and white), pine, and a mixture of woods (Table 4.2). Sixty-three percent of the structures were constructed of poplar, more than any other type of wood. There is no data to evaluate whether survivability is reflective of the percent of structures originally constructed of poplar or if it is a function of the wood's characteristics. The condition of structures constructed with poplar were far better than that of ones built with other types of wood. I believe that the high percentage of poplar buildings in the study area is a function of the wood's characteristics. Poplar is durable and resistant to decay and insect destruction. Although the wood was used primarily because of its straightness, workability, durability, and availability were also key factors in its use.

Table 4.2. Wood Types Used in Log Structures. Source: Tennessee Historical Commission.

COUNTY	OAK NUMBER	%	POPLAR NUMBER	%	PINE NUMBER	%	MIXED NUMBER	%
Grainger	2	5	28	74	1	3	7	18
Jefferson	4	50	3	38	0	0	1	12
Hamblen	10	56	7	39	0	0	1	5
Union	2	6	24	70	4	12	4	12
Total	**18**	**18**	**62**	**63**	**5**	**5**	**13**	**14**

Oak is the next most abundant wood type in use in the study area. Eighteen percent of the log structures are oak. Oak is known for its strength and durability, but it was also sought for a variety of uses to include log buildings. One possible explanation for the lower number of oak structures may be the reuse of this wood for other purposes. As competition for wood rose, the reuse of oak logs likely increased and reduced the number of structures. Only 5% of the structures in the study area are constructed of pine. Pine was and is readily available, but it is not as durable as poplar or oak. Pine grows quickly to usable size for log construction and is easily worked, but its susceptibility to decay and insect destruction is well known. The use of pine for log cabins was limited. Pine may have been preferred for outbuildings and may have been a factor in a lower survival rate considering the occurrence of fewer outbuildings than log dwellings in the study area.

Notch types were another aspect of construction that may have contributed to the survivability of log buildings. The most common types of notches in log construction in the study area are half-dovetail and "V" notch (Table 4.3). Eighty-five percent of the log structures in the region were constructed with half-dovetail notches. Rather than attempting to make an association with ethnicity or prevalence of use at the time of construction, I attribute the use and survival of the half-dovetail to the notch's durability.

Half-dovetail notches are relatively complicated to use over other types, so novice builders are less likely to employ them. Structures made with this type of notch were better built and were used by more advanced builders. This factor directly influenced the numbers of structures that survive. The quality of construction, regardless of wood type, contributes to the durability.

Table 4.3. Notch Types Used in Log Structures. Source: Tennessee Historical Commission.

	HALF-DOVETAIL		"V" NOTCH		*FULL-DOVETAIL		*DIAMOND	
COUNTY	NUMBER	%	NUMBER	%	NUMBER	%	NUMBER	%
Grainger	36	95	2	5	0	0	0	0
Jefferson	8	100	0	0	0	0	0	0
Hamblen	13	72	5	28	0	0	0	0
Union	28	82	6	18	0	0	0	0
Total	**85**	**87**	**13**	**13**	**0**	**0**	**0**	**0**

* No Full-dovetail or Diamond notches were found in the study area

"V" notches are used in 13% of the structures in the study area. They are simple to construct and are durable. The numbers of structures with "V" notches that survive probably are a factor of frequency of use rather than the quality of construction or wood. No other notch types were seen in the study area. The full-dovetail notch is difficult to use, but is very durable. This notch was probably used in limited numbers of structures because of its complexity. Its absence is likely due to limited use.

Applying Dendrochronology to Cultural Research

The final hypothesis I examined concerned whether or not dendrochronology can be applied to help cultural research in the southeastern United States. Dendrochronology allowed me to precisely date four log structures in the study area. The ability to place a specific date to a structure confirmed the precision of the original survey data. The intent was to see if precise dating could be achieved and to determine the accuracy of the dating methods employed by the Tennessee Historical Commission survey teams.

Grainger County site GR1025 was the first structure where I used dendrochronology (Figure 4.3). The building was a log smokehouse that the survey team estimated to have been constructed in 1850 (Historical Survey 1978). The structure was constructed using poplar logs and half-dovetail notches. The structure was in good condition when I sampled it in 2001. My analysis indicates the structure was built in 1860 (Figure 4.4). The results have a correlation of .568 ($p < .0001$). The variation of only 10 years from the 1850 date estimated by the survey team is indicative of the amount of effort this team placed on researching the structure's history. The building is in good condition and is utilized by its owners as a utility shed. This site will likely be available for future research.

Figure 4.3. Grainger County Site GR1025. Source: Tennessee Historical Commission 1978.

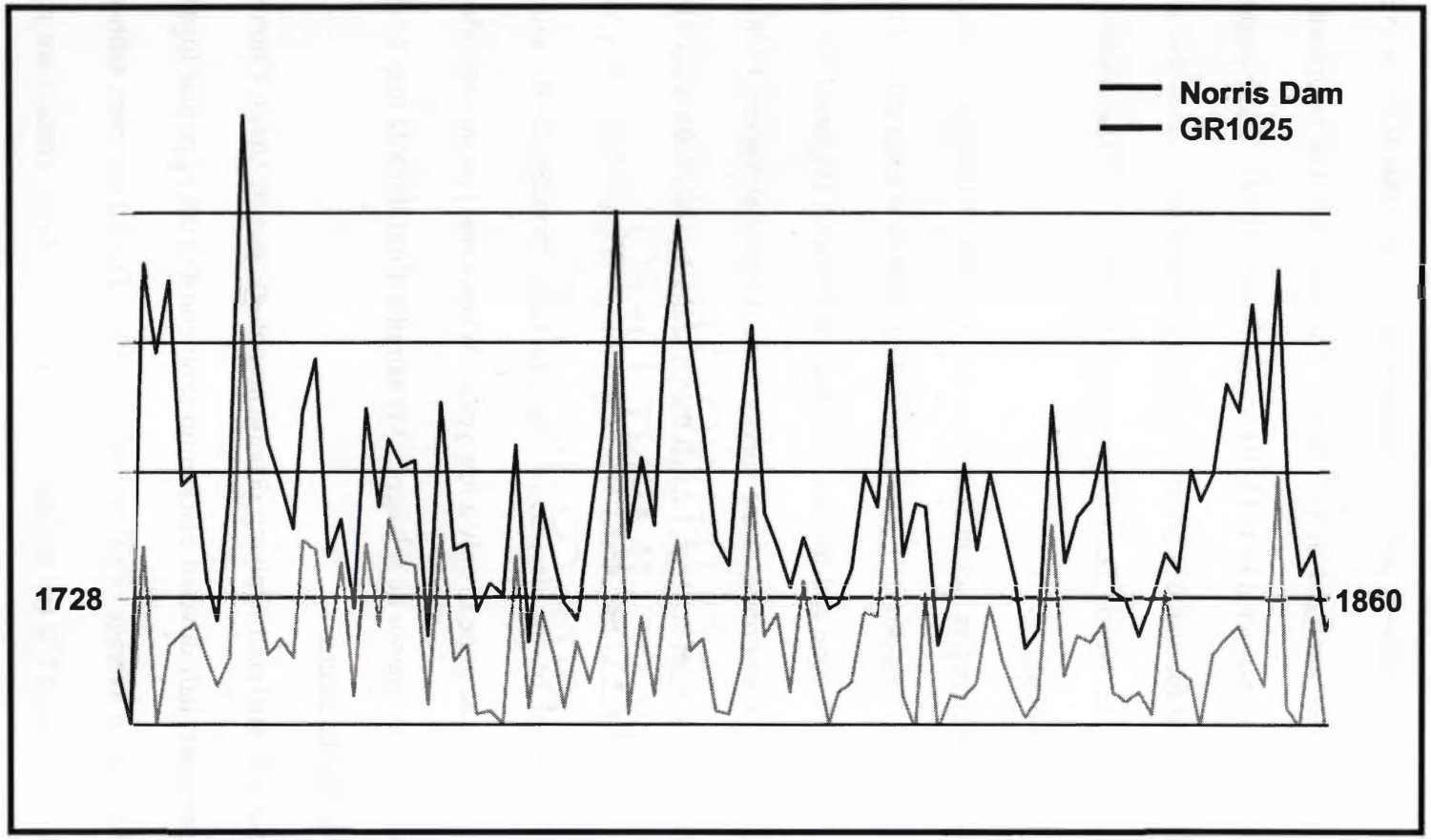

Figure 4.4. Comparison of Norris Dam and Grainger County Site GR1025 Chronologies.

The second structure analyzed with dendrochronology is located in Hamblen County. The site is a two-story log cabin constructed with poplar logs and "V" notches (Figure 4.5). The cabin is fully restored and is used as an office. This site was in the best condition of all the sites analyzed in the study. The building was estimated by the surveyors to have been constructed in 1815 (Historical Survey 1979). Twelve cores were taken from this structure for analysis. Applying dendrochronology, I dated this structure to 1812 compared to the Norris Dam Chronology (Figure 4.6). The results have a correlation of .724 ($p < .0001$).

The third dated structure lies in Jefferson County. The building was originally a two-story log cabin with half-dovetail, poplar logs. The cabin is abandoned and in severe degradation. The roof is gone and the rear wall has fallen down (Figure 4.7). The site was constructed in 1835 according to the survey team (Historical Survey 1978). After collecting cross-sections from six logs, I dated the structure to 1827 with a correlation of .773 ($p < .0001$) compared to the Norris Dam Chronology (Figure 4.8). This building, unfortunately, is typical of the decline of log structures throughout the study area. Structures like this will be gone in only a few years. When structures are degraded to the extent of this cabin, they cannot be salvaged. My samples from this site may be the only record preserved for the future.

The final site analyzed applying dendrochronology was in Union County. The building is a one-story, half-dovetail blacksmith shop constructed of poplar logs (Figure 4.9). The building is in average condition and is stable. The survey team estimated the date of construction was 1770 (Historical Survey 1979). Twelve cores were collected from the site for analysis and compared to the Norris Dam Chronology.

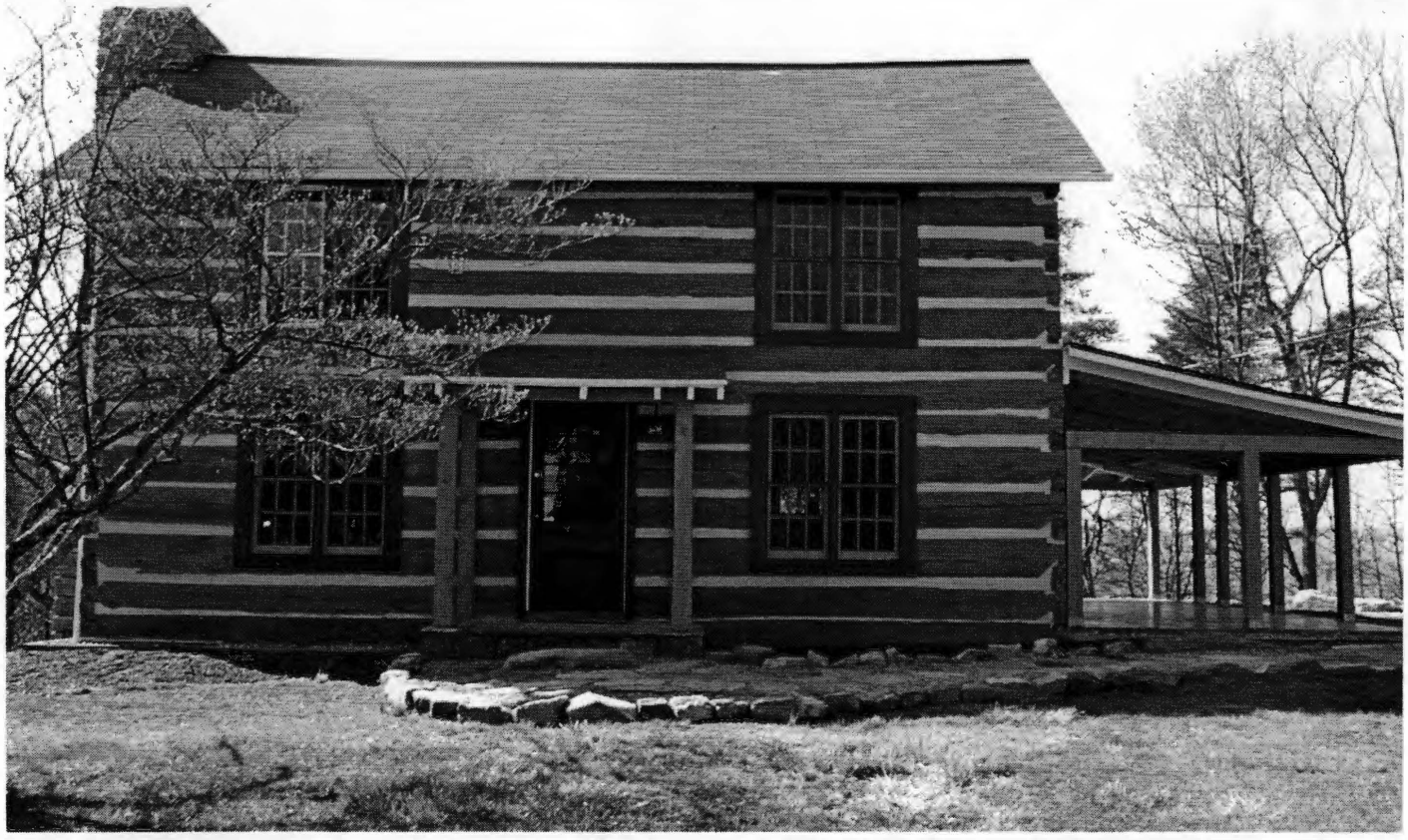

Figure 4.5. Hamblen County Site HB1367 in 2002. Source: William Reding 2002.

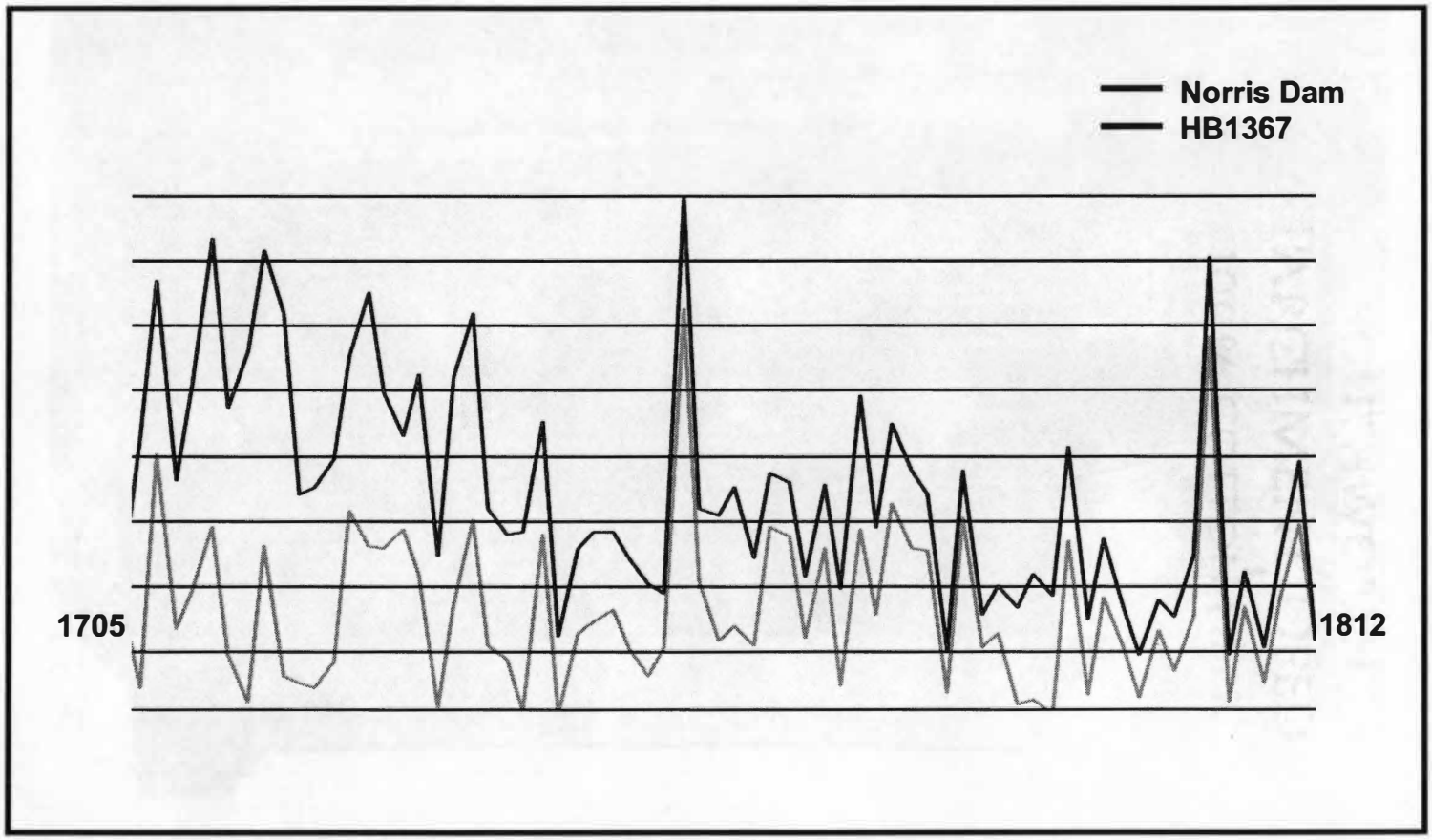

Figure 4.6. Comparison of Norris Dam and Hamblen County Site HB1367 Chronologies.

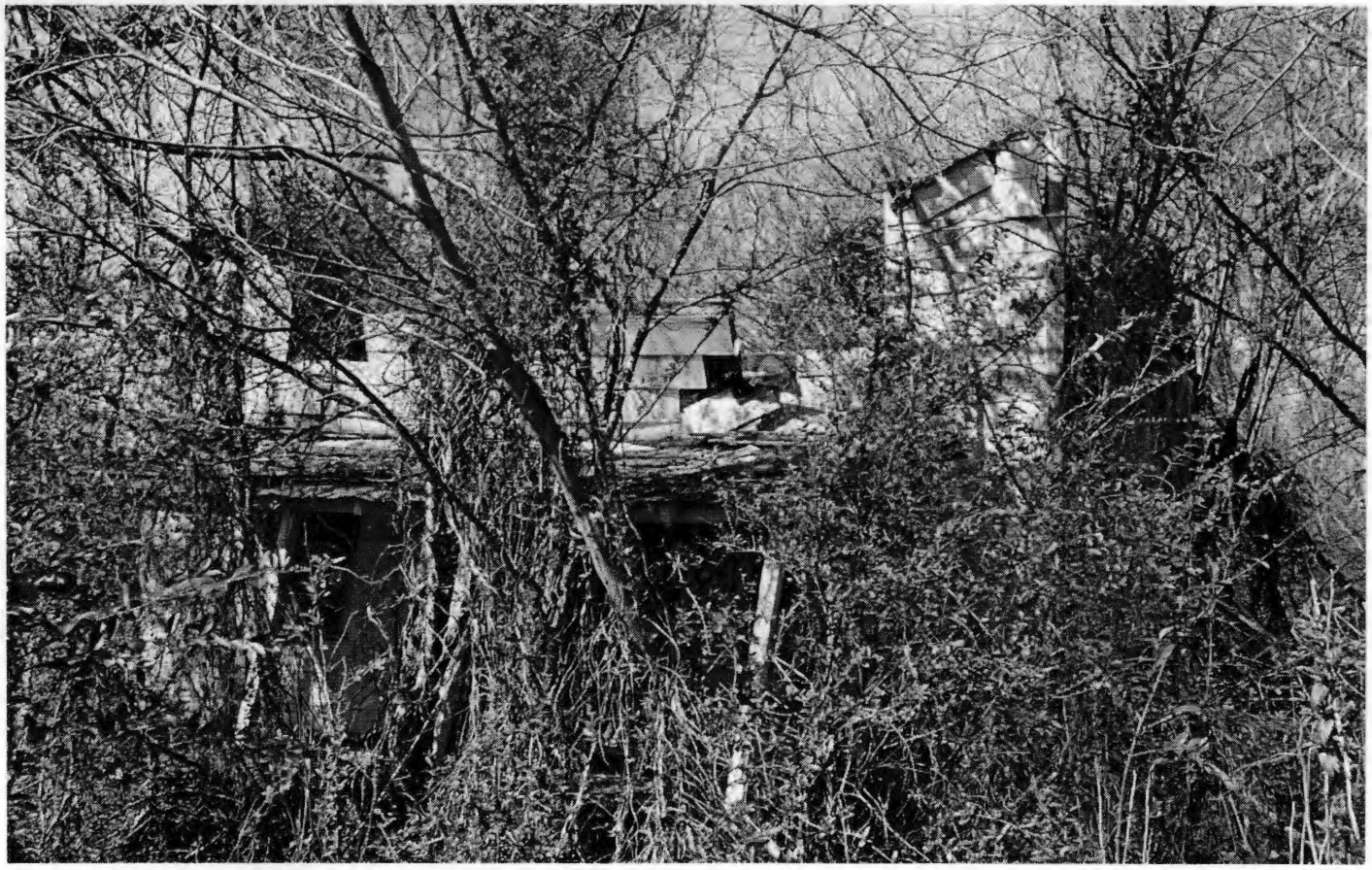

Figure 4.7. Jefferson County Site JE1173 in 2002. Source: William Reding 2002.

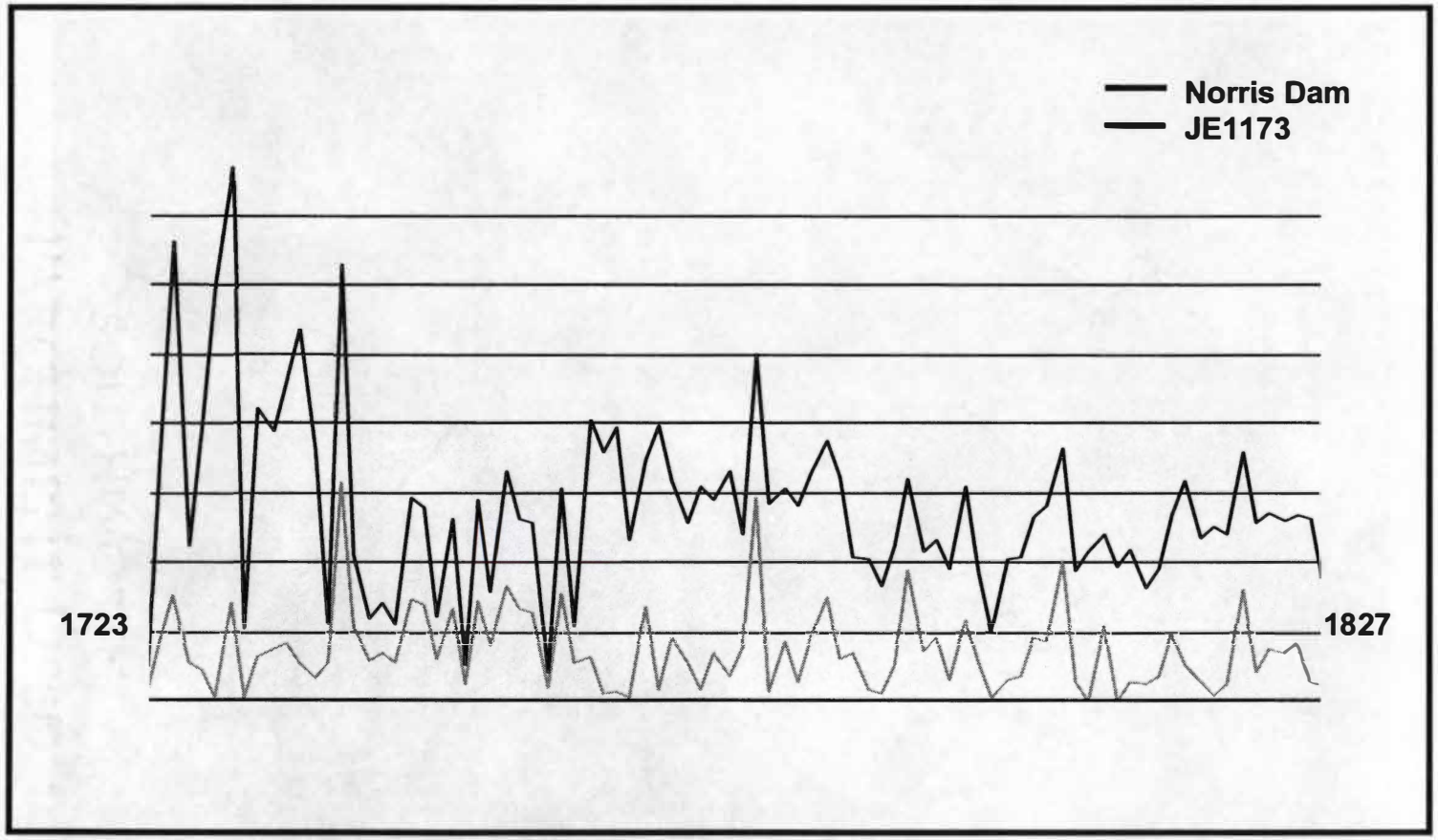

Figure 4.8. Comparison of Norris Dam and JE1173 Chronologies.

Figure 4.9. Union County Site UN211. Source: Tennessee Historical Commission 1979.

A construction date of 1793 was obtained with a .752 ($p < .0001$) correlation. The building chronology spanned from 1719 to 1793 (Figure 4.10).

The hypotheses with which I began my research were supported. The historical geography of settlement in the Ridge and Valley region is related to both topography and streams. The conditions of the log structures are tied to construction methods and wood types used. Dendrochronology improved the precision of dates of construction for log structures in the study area. I was able to demonstrate that dendrochronology can be effective applied to the study of settlement patterns.

The data gathered from the Tennessee Historical Commission enabled me to effectively structure my research into temporal ranges. The dates collected by survey teams were within 20 years of the dates obtained through dendrochronology. The information available from the Tennessee Historical Commission will provide future researchers with critical data for structural assessments and study. The continued survey of other counties will expand the available information and potentially provide more sites for analysis.

Additionally, I observed a drastic loss of log structures during the past 24 years. The decline of these structures will inhibit future research of this type and could reduce opportunities for further analysis. Understanding the importance of log structures and the need for their preservation and conservation is necessary to ensure their presence for future research.

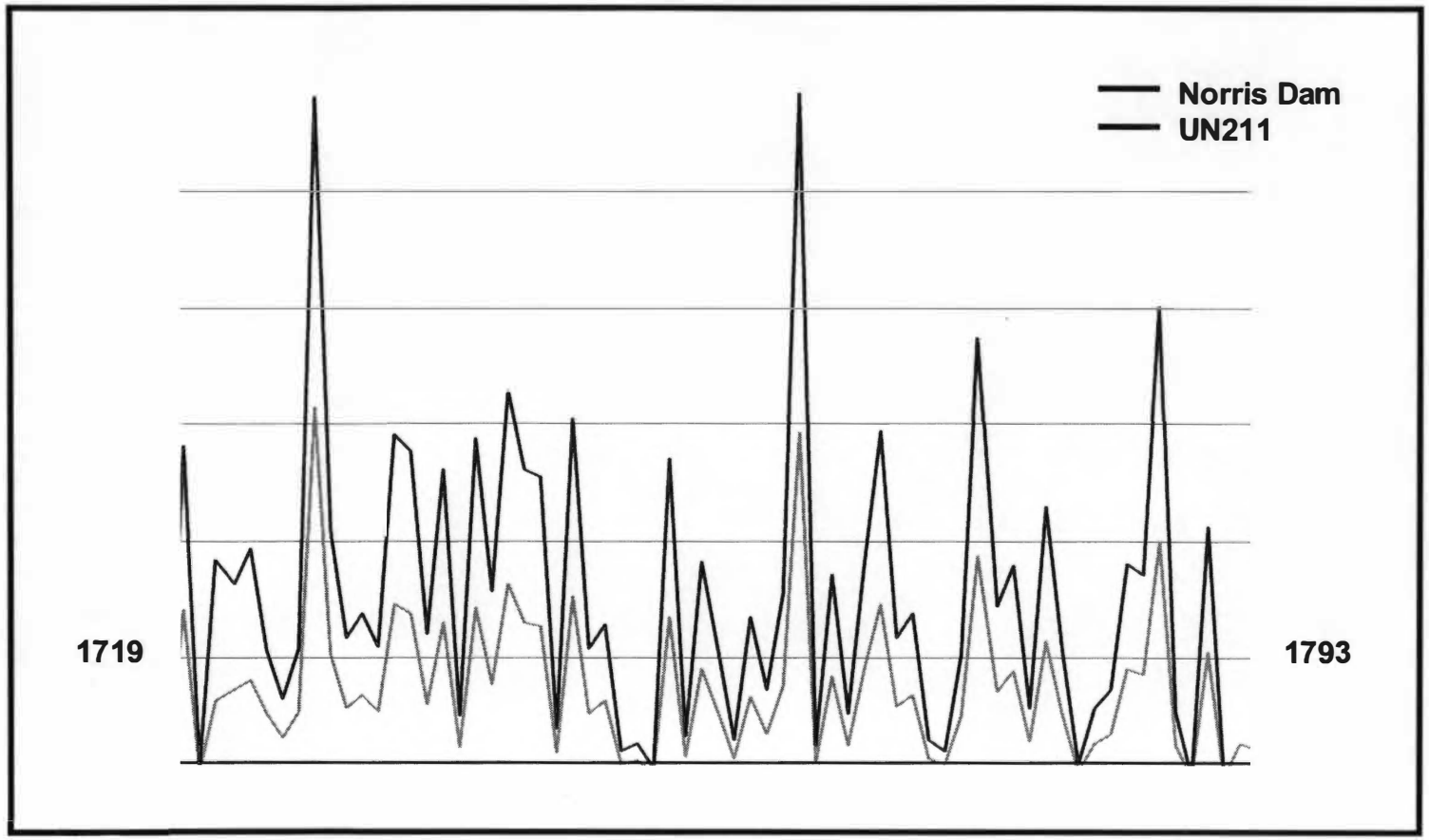

Figure 4.10. Comparison of Norris Dam and Union County Site UN211 Chronologies.

CHAPTER FIVE: PRESERVATION AND CONSERVATION ISSUES RELATED TO EAST TENNESSEE LOG STRUCTURES

Decline of Log Structure Population

One of the most dramatic observations during my research is the dramatic decline in the quantity and conditions of log buildings. Jordan (1978, 4) makes a similar statement about Texas log buildings he observed in the 1970s. He voiced concern over the lack of research and the small window of time left to study these wonderful markers of human passage. Forty-five percent of the log buildings identified by the Tennessee Historical Commission surveys in the study area disappeared between 1978 and 2002 (Table 5.1).

Initially, I had no intention of examining the decline of log structures in east Tennessee, but the disappearance of buildings and the degraded conditions of most remaining ones changed my intent. Less than 10% of the surviving structures are habitable. Of these, few structures are still in use as outbuildings or preserved either by owners or as historic landmarks. Thirty-eight percent of the log buildings discovered by the survey teams in 1978 were abandoned. Forty-five percent of the structures in use at the time of the surveys have been abandoned or destroyed (Figure 5.1).

Factors Contributing to Decline of Log Structures

Many factors contribute to the loss of buildings from the landscape, including fire, collapse, and sale for removal. In Grainger County, more than 15% of the structures were sold to buyers in North Carolina. In Hamblen County, three buildings were destroyed by arson, and in Jefferson County more than 20% were lost by collapse and by removal (Table 5.2). A chief contributing factor to the decline in use of log structures

Table 5.1. Decline of Log Structures from 1979 to 2002 Source: Tennessee Historical Commission.

	STRUCTURAL USE		TOTAL STRUCTURES		
COUNTY	CABIN	OUTBUILDING	1978	2002	% DECLINE
Grainger	16	22	38	16	58
Jefferson	8	0	8	5	38
Hamblen	18	0	18	11	39
Union	18	16	34	12	65
Total	**60**	**38**	**98**	**44**	**45**

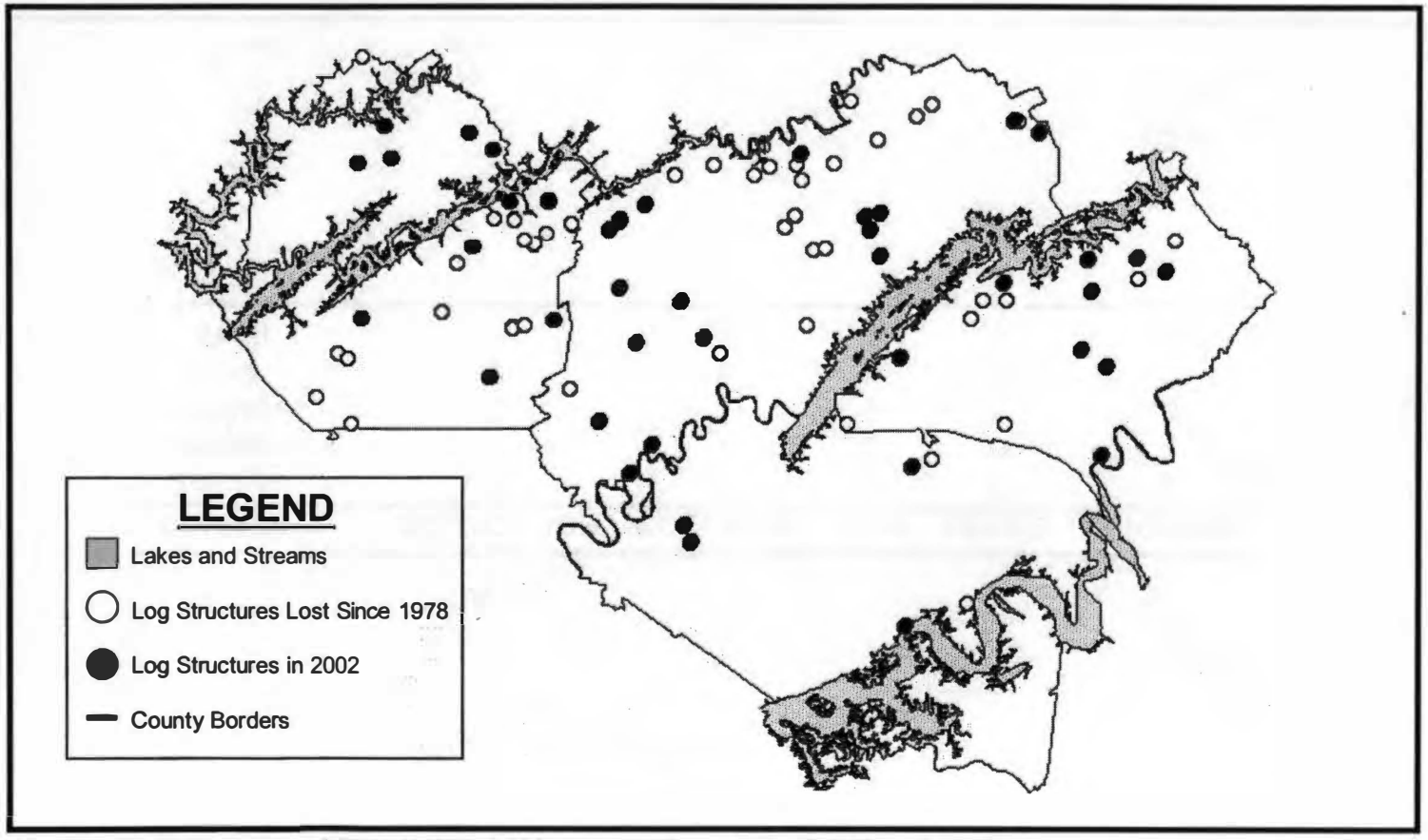

Figure 5.1. Comparison of Sites 1978 to 2002. Source: Tennessee Historical Commission.

Table 5.2. Causes of Log Structure Loss. Source: Tennessee Historical Commission.

COUNTY	RELOCATION	COLLAPSE	FIRE	REUSE	UNKNOWN
Grainger	3	8	3	2	6
Jefferson	1	1	0	0	1
Hamblen	2	1	0	1	3
Union	2	10	1	4	5
Total	**8**	**20**	**4**	**7**	**15**

is lack of finances for repair or rebuilding. Five of the owners I spoke with were sad to see the structures degrade but lacked the money to repair them. One owner had vacated his property and saw it vandalized and damaged beyond repair.

Another factor is the stigma associated with log structures. Log structures are perceived as property of backward, lower income segments of society (Morgan 1990, 84). As a result, many structures are allowed to slip into disrepair or are concealed beneath clapboards or tarpaper. Many times, owner's parents or grandparents occupied the structures temporarily and as soon as more modern buildings could be constructed, they vacated them. Although the perception and appreciation of log buildings have changed in recent years, the trend appears to be too late for the Ridge and Valley of Tennessee. Less than 10% of the 44 structures can be salvaged without complete rebuilding.

Site Comparison

I decided to determine if there are noticeable patterns of decay or degradation in structures between 1978 and 2002. Surprisingly, few of the structures that were not in decline in the 1970s show signs of recent deterioration. Most of the structures in use during the 1970s remain in use. The most important reason for deterioration is change of ownership. Once properties are sold to owners without historic ties to the property, neglect becomes more apparent. Comparisons of structures through time reveal rather slow degradation, providing roofs are not lost.

The site selected to illustrate the rapid degradation of a building is located in Jefferson County. The dwelling was abandoned at the time of the 1978 survey.

Originally a two-over-two house, it is constructed of half-dovetail poplar logs (Figure 5.2). Sometime during the past 24 years, the roof was destroyed and not repaired. Once the building's roof was gone, rapid loss of structural integrity occurred (Figure 5.3). This dwelling is just one example of 13 I encountered during my research.

Preservation of Log Structures

The type of use seems to have little relationship with the likelihood of preservation. In Grainger County, there is a dramatic emphasis on outbuildings. In Jefferson County, houses tend to be preserved in greater numbers. The difference between the two counties is Grainger's stronger agricultural economy and the need for outbuildings. Another aspect of preservation is the accessibility of structures. This appeared to be true in the 1970s, but with the recent population growth of the counties studied no area is isolated. Most sites are located within one mile (1.5 km) of an improved road. The increase of rural residential subdivisions actually threatens some sites. Accessibility of log structures will continue to work to the disadvantage of most. As development continues, structures will further be threatened by removal or destruction.

One topic for further research is preservation of the remaining structures. Although the number of sites will continue to decline, the potential for preservation remains. The stability of certain sites contributes to their potential for preservation. With the largest population of log structures, Grainger County presents the greatest potential. With a large portion of land still in agriculture, most sites are not threatened by urban growth. Jefferson County illustrates the opposite extreme regarding potential for preservation, with a low population of log buildings.

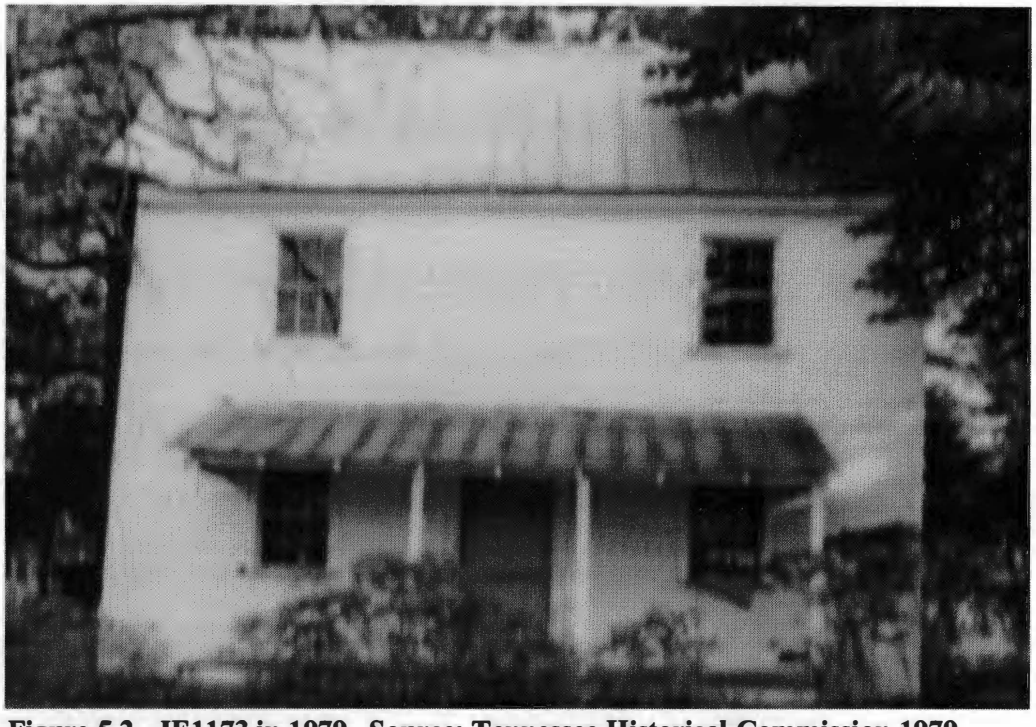

Figure 5.2. JE1173 in 1979. Source: Tennessee Historical Commission 1979.

Figure 5.3. JE1173 in 2002. Source: William Reding 2002.

Structures found in Hamblen and Union Counties are in the initial stage of preservation. Both counties have sizable populations of log structures and several are preserved. The counties differ in potential population growth. Hamblen County continues to grow, predominately around Morristown. The location of several sites in the urban fringe of Morristown threatens them. Union County, on the other hand, is still largely rural and the urban areas are relatively small. Union County presents the potential for preserving many log buildings. A downside to Union and Hamblen Counties is the relocation of buildings from original sites. The construction of Tennessee Valley Authority dams and lakes caused the relocation of buildings in the 1940s. The removal of buildings from their original sites distracts from their spatial relationships.

A building in Hamblen County is an example of the potential log structures have when properly restored and preserved. The building is a two-story log cabin constructed in 1812. The cabin was covered with siding in 1979 when it was surveyed by the Tennessee Historical Commission (Figure 5.4). The structure was in good condition but had little resemblance to its original appearance. In the fall of 2001, the site had just undergone an extensive restoration by the owners (Figure 5.5). The cabin is the best example of a restored site that I observed in my research. The care taken to restore the structure's original appearance is inspiring, and sets an example for other projects to preserve the past.

The preservation of log structures is a primary way to ensure future research into the settlement patterns and migration in east Tennessee. Disappearance of log structures will continue unless Tennessee and its landowners increase their preservation efforts.

Figure 5.5. HB1367 in 1979. Source: Tennessee Historical Commission 1979.

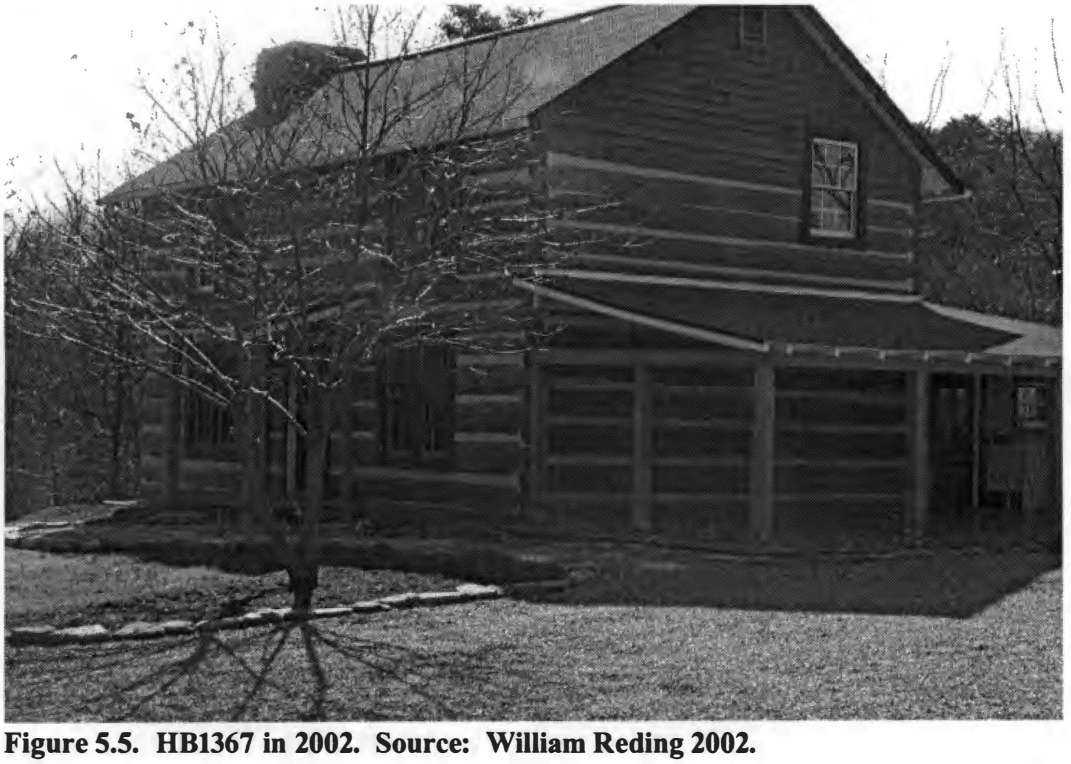

Figure 5.5. HB1367 in 2002. Source: William Reding 2002.

Very little research is currently conducted utilizing log structures, but with accurate tools such as dendrochronology, the potential for additional knowledge is limitless.

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VITA

CPT William M. Reding was born in Nurnberg, Germany in 1971. His father (Ret.) LTC Donald J. Reding was a career Army Officer and a graduate of the University of Minnesota and the University of Louisville. His mother Ann Russell Reding is a graduate of McKindry College and is a contract worker for Verizon. His parents reside in Elizabethtown, Kentucky. Bill is the youngest of nine children. Don, Dan, Tim, Lois, Reenie, David, Chris, and Sean. Bill lived in Ft. Riley, Kansas for six years prior to moving to his current "home" in Elizabethtown, Kentucky. A graduate of Murray State University with a BS in Geography, he was commissioned as an officer in the United States Army upon his graduation in 1993. Bill entered active duty service in the Army and has been an Engineer Officer for nine years.

Married in 1993 to Angela M. Barger, they have been married for nine years. They have three beautiful daughters Emily, Abby, and Mattie. Bill will leave the University of Tennessee and continue his military career as an instructor at the United States Military Academy at West Point, New York.