THE EFFECTS OF INTERPRETATION ON VISITOR KNOWLEDGE AND ATTITUDE REGARDING THE CROSS TIMBERS ECOREGION

By

ANNE BROCKMAN

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University of Oklahoma

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Thesis Approved:

Dr. Lowell Caneday

Thesis Adviser

Dr. J. Berton Fisher

Dr. Kevin Gustavson

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Thank you to the Keystone Ancient Forest officials, especially Grant Gerondale, who allowed my research to happen and I hope that these findings help you in your plan for this wonderful piece of property. Since I began this project, the Keystone Ancient Forest has already expanded its Open Trails Days so that more people can experience this important piece of Oklahoma.

In the future, I hope to bestow the numerous good deeds my family, classmates, professors and advisors have given to me to someone else. In the words of Freeman Tilden, "Through interpretation, understanding; through understanding, appreciation; through appreciation, protection."

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Title of Study: THE EFFECTS OF INTERPRETATION ON VISITOR KNOWLEDGE AND ATTITUDE REGARDING THE CROSS TIMBERS ECOREGION

Major Field: Environmental Science

Abstract: A visitor study was conducted at the Keystone Ancient Forest to determine if a change in knowledge of the Cross Timbers occurred, as well as if there was a change in attitude regarding preservation of the ecoregion. Of the day's visitors, an initial response rate of 27 percent resulted in 43 valid pre-visit and post-visit questionnaires that were analyzed. These questionnaires consisted of 10 knowledge-based multiple-choice questions and attitude scales, along with gathering demographic data. For the Cross Timbers knowledge, a significant mean increase between the two tests resulted. Pre-test means were 6.3 on a maximum scale of 10, and post-test means increased to 7.723 (t=-5.545, df=42, $p<0.001$). Three attitude-based questions were analyzed against a demographic variable and with pre- and post-visit assessments. Attitude responses analyzed by the demographic variable found no significance. Attitude responses were analyzed to assess the relationship between visitor attitudes pre-visit versus post-visit showed significance on all three accounts. The study and results of this research provides similar sites insight into interpretive tools and programs and how visitor knowledge and attitude is affected.

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INTRODUCTION

Background

People visiting and experiencing the Keystone Ancient Forest do more than just take a walk in the woods. Visitors encounter an environment few today have seen. The Cross Timbers ecoregion is the setting for a story that has become far too familiar. Today, virgin Cross Timbers forests are rare, but originally covered thousands of square miles from Kansas through Oklahoma and into Texas. In Sand Springs, Oklahoma, the Keystone Ancient Forest is one of few remaining virgin Cross Timbers forests that have not been affected by timber, grazing, or farming practices. What remains is a living example of what Washington Irving dubbed the "forests of cast iron" (1956, p. 125). With 300- to 500-year-old oaks and cedar trees spread out over more than 1,300 acres of woodland, savannah and rocky outcrops, this preserve provides visitors with a true depiction of this unique ecoregion (City of Sand Springs, 2013).

The Keystone Ancient Forest consists of lands previously owned by U.S. Army Corps of Engineers, the Tulsa Audubon Society and private landowners. Over the years, organizations such as The Nature Conservancy have dedicated resources to investigate and document the forest's ecosystem, including its wildlife and plant species. Researchers proved the historical and ecological significance of this tract of land and local agencies moved toward protecting this forest, which became a reality in 2007 (Caneday, Chang, Jordan, Bradley, Hassell, 2011). Since then, the preserve has been managed by the City of Sand Springs Parks and Recreation Department. The forest is open to visitors one Saturday each month, when volunteer trail guides are available to lead forest interpretation. Several interpretive signs are stationed throughout the preserve to provide visitors information on the biological, historical, and significant features of the preserve. The Keystone Ancient Forest boasts two trails – the Childers Trail

and the Frank Trail. The Childers Trail is .6 mile in length and is an ADA-accessible asphalt trail with minimal grade difference. The Frank Trail is approximately 2.8 miles in length, unpaved with variance in grade and several switchbacks (City of Sand Springs, 2013). Both trails are named after generous landowners and conservationists who wanted to see the preserve become a reality (Caneday, et. al, 2011).

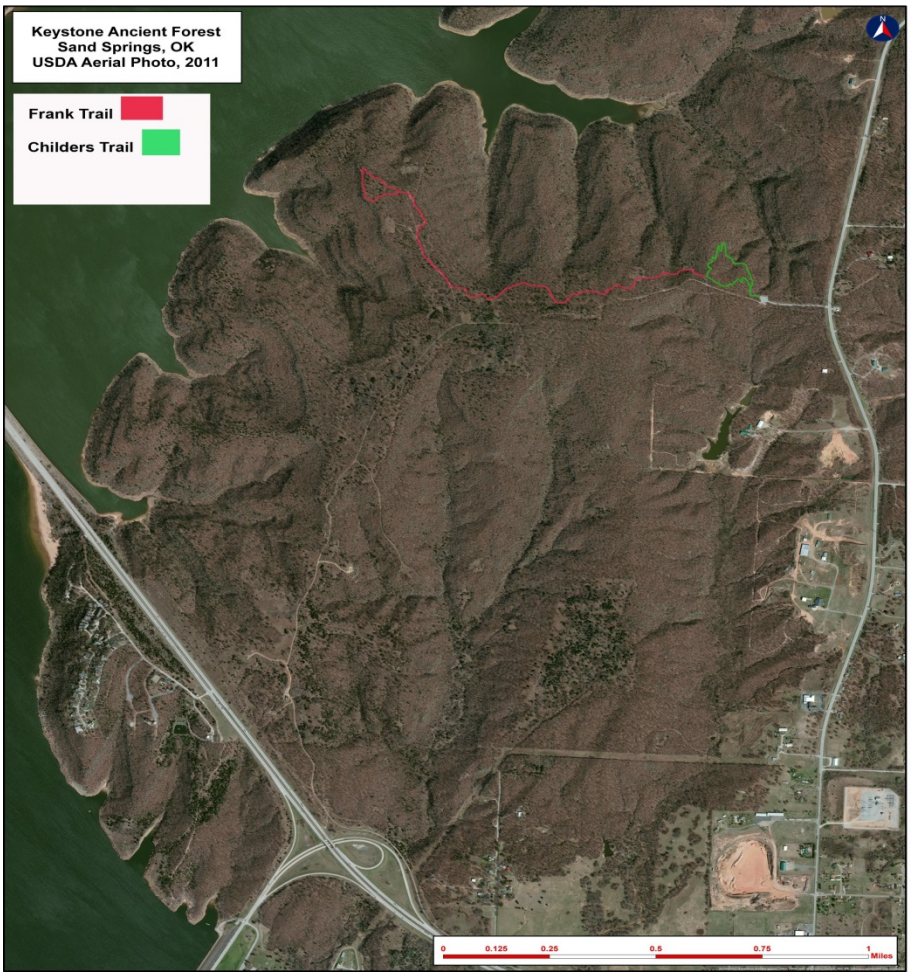


Figure 1: Map of Keystone Ancient Forest and hiking trails. (United States Department of Agriculture Aerial Photo Database, 2013).

Statement of the Problem

While the trees that make up the Keystone Ancient Forest are hundreds of years old, the preserve is young and has only been open to visitors less than 10 years. City personnel and volunteers have worked to promote the preserve to new and returning visitors. At the preserve, interpretation happens through guided hikes, brief interactions with volunteer trail guides, or by reading the available interpretive signs. This project aims to determine what visitors are learning while they are there and what are they taking away once they leave the Keystone Ancient Forest.

Figure 2: Interpretive signs located at the trailhead to the Frank and Childers trails.

Within the last year, permanent interpretive signs were erected at the trailhead and midway through the Frank Trail loop. All of the signs stress certain topics, including one focusing solely on the Cross Timbers. Trail guides have been a mainstay of interpretive information since the preserve's inception.

Figure 3: Interpretive sign at the trailhead to the Frank and Childers trails describing the Cross Timbers ecoregion.

Research conducted in this study can provide information regarding the impact of interpretation on visitor knowledge. This tangible information and education on the Cross Timbers and the ecoregion's environmental significance, has the potential to show that visitors leave with increased knowledge and positive attitudes urging them to share the importance of the Cross Timbers and champion for its preservation.

Significance of Study

As attendance, interest, and awareness of the Keystone Ancient Forest continues to rise, it is important to know what people are learning about the site and its value to the audience. This study aims to determine if the average visitor's knowledge about the Cross Timbers ecoregion increases through the effective use of interpretive tools currently administered at the preserve. Upon the study's conclusions, the Sand Springs Parks and Recreation Department and Keystone Ancient Forest officials can assess the effectiveness of interpretation methods and be able to grow and expand programming. With lofty, yet attainable future plans, the organization can use these findings to grow upon and flourish.

Hypotheses

The following null hypothesis will be tested:

H_0: There is no significant difference in a visitor's knowledge and attitude of the Cross Timbers ecoregion before and after visiting the Keystone Ancient Forest and interacting with the available interpretive tools.

H_1: There is a significant difference in a visitor's knowledge and attitude of the Cross Timbers ecoregion before and after visiting the Keystone Ancient Forest and interacting with the available interpretive tools.

Scope of Study

The study's scope reaches visitors who attend an Open Trails Day at the Keystone Ancient Forest: however it is also applicable to other locations that provide interpretation regarding Cross Timbers segments. Preserve officials may use the information gathered in this study to determine the effectiveness of current interpretive programs while planning future visitor activities and educational opportunities. It

should also give demographic information that would be useful for future planning and administrative procedures.

ASSUMPTIONS, LIMITATIONS AND DELIMITATIONS

The following assumptions, limitations, and delimitations will be considered in the research. The following basic assumptions are accepted:

1. The average visitor to the Keystone Ancient Forest knows little of the Cross Timbers ecoregion and the importance to preserve this particular portion of virgin forest.
2. The average visitor resides within a 20-30 minute drive of the Keystone Ancient Forest.
3. Few visitors truly realize how very little old-growth, virgin forests remain.
4. Visitors who attend the Open Trails Day at Keystone Ancient Forest are assumed to have an interest in the forest and the environment.

Limitations

Limitations to this study include:

1. Only those persons who visit the Keystone Ancient Forest during the October 2013 Open Trail Days will be included in this study.
2. Past Keystone Ancient Forest visitors can participate in the survey if they are in attendance on the study dates. These visitors may already possess knowledge of the Cross Timbers, as well as an affinity to preserve and protect the ecoregion.
3. Not all visitors to the Keystone Ancient Forest take a guided hike or read interpretive signs.

4. To reach at least 30 survey participants, the researcher may have to make the survey questionnaires available at more than one Open Trails Day.

Delimitations

Delimitations to this study include:

1. At least 30 valid questionnaires will be gathered by the researcher.
2. Knowledge will be tested by a pre-test and post-test assessment. Questions will be designed as yes/no and multiple choice. Attitude will be tested by a Likert scale type of questioning.
3. Only visitors to the Keystone Ancient Forest who are 18 years of age and older can participate in the survey.
4. A participant can only take the survey once.

Statement of Research Design

Research will determine the effects of current interpretive programming regarding the Cross Timbers at the Keystone Ancient Forest on visitor knowledge and attitudes regarding the ecoregion. A pre- and post-test assessment will be conducted via questionnaire at the Keystone Ancient Forest on the October 2013 Open Trails Day. Questionnaires allow for more specific audience feedback and can measure three important criteria: knowledge, attitude and enjoyment (Knudson, Cable, Beck, 1999). Yes/no and multiple choice questions will be asked to participants. An instrument designed with Likert scale items will be administered pre- and post-test to determine a participant's attitude toward the Keystone Ancient Forest and the preservation of the Cross Timbers ecoregion. Demographics of visitors will also be gathered during this research.

Definition of Terms

Cross Timbers – An area of North America where post oak and blackjack oak species grown in such close association that crowns intermingle, along with other species, in an underlying sandstone geologic area (Francaviglia, 2000).

Interpretation – "An education activity which aims to reveal meanings and relationships through the use of original objects, by firsthand experience, or by illustrative media, rather than simply communicate factual information" (Tilden, 2007, p. 33).

Likert scale – "This is a summated scale consisting of a series of items to which the subject responds. The respondent indicates agreement or disagreement with each item on an intensity scale. The Likert technique produces an ordinal scale that generally requires nonparametric statistics…This scale is highly reliable…" (Miller and Salkind, 2002, p. 330).

Ecoregion – "Designed to serve as a spatial framework for the research assessment and monitoring of ecosystems and ecosystem components, ecoregions denote areas within which ecosystems (and the type, quality, and quantity of environmental resources) are generally similar" (United States Environmental Protection Agency, 2013).

CHAPTER II

LITERATURE REVIEW

Interpreting the Cross Timbers

The Cross Timbers ecoregion includes portions of Kansas, Oklahoma and Texas and is defined by its transition zone that bridges the eastern woodlands and the grassland. These oak forests are encompassed by prairie and develop on sandstone with an abundant variety of life that springs forth (Francaviglia, 2000). The origin of the term "Cross Timbers" is not known, but according to Therrell and Stahle (1998), its nomenclature may have arisen when early settlers traveling west had to cross successive bands of open prairie and dense upland forest to claim their lands. Portions of the Cross Timbers ecoregion exist to this day because of the land it occupies – often not suitable for farming, grazing or timber harvest. The Keystone Ancient Forest exemplifies this with its portions of steep, rocky terrain. This type of land limits economic potential. While the ecoregion has been studied, examined, and explored by many over the centuries, "…awareness of the true abundance and antiquity of the Cross Timbers is low among scientists, land managers, and the public. At the same time, the ancient Cross Timbers face an increased risk of destruction as the economics of rural land use change in response to factors such as suburbanization and the rising demand for hardwood fiber by the wood products industry" (Therrell and Stahle, 1998, p. 854).

The National Association for Interpretation defines interpretation as "a mission-based communication process that forges emotional and intellectual connections between the interests of the audience and the meanings inherent in the resource" (2013). Freeman Tilden (2007) developed the six principles of interpretation, which today are harnessed by interpreters to inspire, provoke, and illuminate the imaginations of visitors to the site.

1. Any interpretation that does not somehow relate what is being displayed or described to something within the personality or experience of the visitor will be sterile.
2. Information, as such, is not interpretation. Interpretation is revelation based upon information. But they are entirely different things. However, all interpretation includes information.
3. Interpretation is an art, which combines many arts, whether the materials presented are scientific, historical, or architectural. Any art is in some degree teachable.
4. The chief aim of interpretation is not instruction, but provocation.
5. Interpretation should aim to present a whole rather than a part and must address itself to the whole man rather than any phase.
6. Interpretation addressed to children should not be a dilution to the presentation to adults but should follow a fundamentally different approach. To be at its best it will require a separate program. (p. 34-35)

Interpretation is a powerful tool to increasing knowledge, adjusting attitudes, and promoting a behavior change. Beck and Cable (2011) say, "Just as solid interpretation helps the visitor begin to value the place, another benefit is preservation of the area…Most visitors are truly concerned and responsive to calls for the preservation of a place of natural beauty or cultural significance" (p. 34). White, Virden and Cahill claim that interpretation is known for its ability to not only educate a visitor, but also appeal to a visitor's values, emotions, and behavior (2005). Research has confirmed that interpretation does have value when it comes to influencing a visitor's attitude toward the environment, responding to calls of action affecting the resource. "Interpretation is a process, a rendering, by which visitors see, learn, experience and are inspired firsthand" (Beck and Cable, 2011, xxi). How does this learning differ from environmental education? The Environmental Protection Agency, defines environmental education as a process meant to help create a strong sense of environmental issues by exploring these issues at hand and possess the skills and knowledge to make "informed and responsible decisions" while engaging in

problem solving and actions to improve the environment (2013). Cable and Cadden (2006) distinguished between the two disciplines that are strongly interrelated. First, the setting differs between formal classrooms or labs and an informal recreational location. Second, the audience type differs. Interpretation typically occurs with those on leisure compared to environmental education occurring with those usually required to be in attendance. Third, a difference in purpose is evident between those who lead based on curriculum or behavior change and those who are vetted in a recreational, emotional or experiential purpose. Fourth, interpretation has typically a limited, expedited timeframe, whereas environmental education may span over multiple sessions. Fifth, interpretation is assessed informally, but environmental education is evaluated by a formal assessment of learning.

In the world of interpretation, it is more than just knowledge that interpreters wish to leave with their visitors. Interpretation is a delicate balance between formal education and entertainment. Attitude and behavior change also have roles in developing interpretive services. Many interpretive programs stress resource management, a theme that comes into play with the Keystone Ancient Forest. A resource management goal can connect the visitors to the resource and influence projected behavior toward the subject. In regards to the Keystone Ancient Forest, because of its infancy, this researcher believes it is important to stress knowledge growth of visitors first, and hope behavior and attitude change springs forth from this.

The Natural Forest

Common trees in the Keystone Ancient Forest, as well as the rest of the ecoregion, include post oak, blackjack oak, and eastern red cedar. Francaviglia (2000) claims post oaks, when grown in certain conditions, can grow to 400 and 500 years old, which is indicative of some examples at the preserve. A study by Stahle noted that ancient post oaks tend to grow in rugged uplands – a contradiction to the typical well-watered riparian locations of other species. These ancient trees tend to have a twisting trunk

which resonates in a spiral-grained wood. Other visible traits of ancient trees include reduced canopy, crown dieback, heart rot, heavy lichen growth, bark irregularity, scars and relative size (Stahle, 1996-1997).

Blackjack oaks have some very similar traits to post oaks. Blackjacks tend to be found in poorer, sandy and gravelly sites, much like post oak, but differences include contorted branches and an asymmetric crown (Francaviglia, 2000).

The eastern red cedar has been a part of the Cross Timbers for hundreds of years. Typically found among the common oaks as they provide both food and shelter to animals, the cedar thrives on hillsides with expansion credited to an increase in grazing (Francaviglia, 2000). Because of fire suppression, this tree has boomed in many Cross Timbers tracts, and in some areas is becoming a dominant species.

Fires, soils and climate are the chief factor to determine what type of vegetation thrives in a natural setting (Hallgren, DeSantis, Burton, 2011). Fires, whether prescribed or free-ranging, both terminate and stimulate new growth. Over the years, researchers have studied fire and this ecoregion to determine if more fires happened before or after European settlement and what effects those fires have had on these ancient forests. Extensive studies by researchers have both found that fire occurring in the 20th century tended to "be less severe than those that occurred prior to Euro-American settlement" (Stambaugh, Guyette, Godfrey, McMurry, Marschall, 2009, p. 59). While fires happened, the landscape and geography of the preserve is what allowed many trees to survive, creating a place where ancient trees can continue to thrive.

There is no doubt that the Cross Timbers has a strong relationship with the prairie and grasslands that abut the region. According to Francaviglia (2000), "An interpretation of the Cross Timbers must mention the magnificent prairie openings that existed within, and the vast oceans of prairie grasses that generally surrounded, the forest in prehistoric and early historic times" (p. 51). Prairie grasses found throughout the tallgrass region consist of big and little bluestem, Indian grass, and switch grass, as well as

shorter grasses like buffalo grass, silver bluestem and side oats grama. These grasses are also found in the Cross Timbers (Francaviglia, 2000).

Historical Setting

Whether it was experienced by indigenous tribes, Spanish conquistadors, European settlers, or military investigation tours, the Cross Timbers has been the scene of generations of history. Many have explored the expansive region, but few have brought as much awareness to the area as famed author and writer Washington Irving. In 1832, Irving's "A Tour on the Prairies" was published. The journal told of his adventures exploring Indian Country as part of a military expedition. It is in this literature that he first dubs the Cross Timbers as the "forests of cast iron" (Irving, 1956).

> The Cross Timber is about forty miles in breadth, and stretches over a rough country of rolling hills, covered with scattered tracts of post-oak and black-jack; with some intervening valleys, which at proper seasons, would afford good pasturage…The whole tract may present a pleasant aspect in the fresh time of year…Unfortunately, we entered it too late in the season…The fires made on the prairies by Indian hunters, had frequently penetrated these forests, sweeping in light transient flames along the dry grass, scorching and calcining the lower twigs and branches of the trees, leaving them black and hard, so as to tear the flesh of man and horse that had to scramble through them. I shall not easily forget the mortal toil, and the vexations of flesh and spirit, that we underwent occasionally in our wanderings through the Cross Timber. It was like struggling through forests of cast iron. (p. 125).

Efforts to Save and Educate

Throughout the Cross Timbers region, conservationists, educators, politicians, property owners, and others have made concerted efforts to preserve what they can of the modern and ancient Cross Timbers. One such example is the Fort Worth Nature Center where visitors are able to see how a Cross Timbers forest may have looked in the early 1800s, the same timeframe of Irving's visit through the surrounding Keystone Ancient Forest area. Francaviglia notes that protected forests in Kansas and Oklahoma may have a harder time to come to fruition because of attitudes and behaviors of many area property owners. "The preservation of the prairie, while the Cross Timbers are often either ignored or regarded as scrub forest land, points to an important issue – namely, that there is relatively little public consciousness of the Cross Timbers region as a conservation area" (Francaviglia, 2000, p. 201). Over the decades, the term Cross Timbers became a recognizable phrase as businesses, communities, developments and other entities helped make it part of the regional vernacular by dubbing properties with the name of the ecoregion. One can find the name Cross Timbers representing private commercial ventures, subdivisions, organization names, and more. In Texas, it has been recorded that about 15 percent of the general regional population recognizes the term, while only 7 percent can define it. In a study of Oklahomans and the recognition of the term, only about 5 percent of the population recognizes it (Francaviglia, 2000). Even though the Cross Timbers is so engrained in the state's landscape, its meaning and definition is lacking. "Despite Washington Irving's popularization of the term for rugged, forested areas of Indian Territory, it seems never to have been as widely used in Oklahoma as in Texas" (Francaviglia, 2000, p. 207). The Nature Conservancy, an international organization that works to conserve and protect "ecologically important" lands and waters, has had its hand in conservation projects in Oklahoma for years, including the Keystone Ancient Forest. The Nature Conservancy has been involved in the protection of the Keystone Ancient Forest for years. "Until now there has been no park or preserve dedicated to these historic forests. And conservationists estimate the vast majority already has been destroyed. The Nature Conservancy hopes that this preserve will do for the ancient crosstimbers

what the Tallgrass Prairie Preserve north of Pawhuska has done for tallgrass" (The Nature Conservancy, 2013).

The Keystone Ancient Forest's significance to the ecoregion as a whole is defined by research conducted by the University of Arkansas' Tree-Ring Laboratory, which suggests the Cross Timbers covers more than 17.8 million acres, with 890,747 acres projected to be probable old growth forest (2013). The Keystone Ancient Forest's approximate 1,300 acres consists of .15 percent of the probably old growth forest in existence.

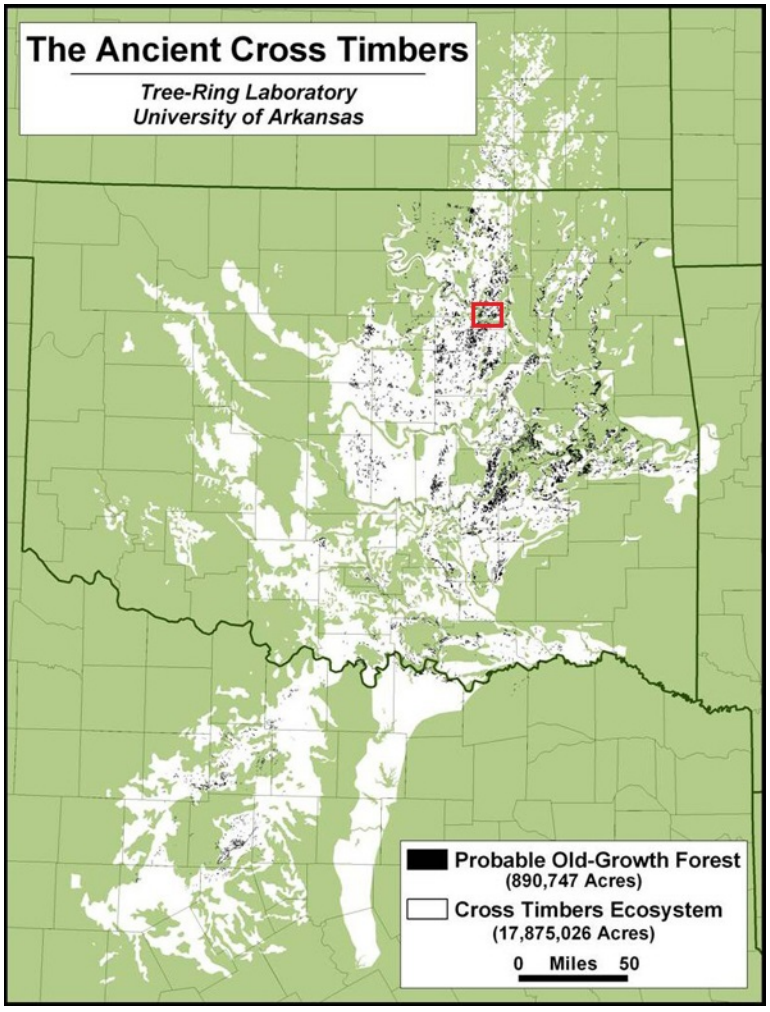


Figure 4: Map of the Ancient Cross Timbers noting the approximate location of the Keystone Ancient Forest in red. (University of Arkansas Tree-Ring Laboratory, 2013).

Interpretation Studies

Interpretation's purpose is proven on a number of fronts. "Evaluation puts a value on interpretation. It should indicate not just the faults in the programs but its strengths and the satisfactions produced" (Knudson et al., p. 442). By evaluating the knowledge and attitudes of tour participants, a researcher can learn if the intended message was received, what they found most interesting, if improvements need to be made, and what message is ultimately remembered by visitors (Jacobson, McDuff, Monroe, 2006). Pre- and post-test assessments are often tools to measure knowledge, allowing to measure initial knowledge level and gained knowledge after a treatment (LaBarge, 2007).

In a study by Harrison, Banks, and James, the impact of a river guide's interpretation training was measured based on a client's interest and knowledge scale. Questions, gauging both interest in the environment and knowledge of the environment, were measured on a Likert scale. The researchers grouped the clients based on whether the guide had taken the interpretation training or not. After analyzing the collected data, it was determined that all interest and knowledge scores were significantly higher, no matter the guide's interpretation experience. Pre-test scores were similar for all groups, but differences arose in post-test results. Clients led by an interpretation-trained river guide had significantly higher post-test scores than those who were led by guides without the training. Because all clients increased their knowledge and interest of the environment, it was determined by the researchers that "just being exposed to the river environment can begin the process of influencing recreationists to become more aware and interested in the environment. However, increases in knowledge and interest in the environment were significantly higher for the group whose guides had participated in a Headwaters Institute seminar" (Harrison, Banks, James, 2010, p. 42).

Agency personnel at Big Bear Lake, located in California's San Bernardino National Forest, frequently use interpretation to instill knowledge about the natural resources and management policies to its many visitors. To determine how user fees affected visitor satisfaction of interpretive programs,

Morgan, Absher, and Whipple collected data from every canoeist during the 1999 study period (2003). These researchers used a census approach to improve statistical power and generalizability. Two controls (before and after canoeing) and two levels of structure (self-guided and naturalist-led trips) were administered in the 2 X 2 factorial design. Study participants were questioned either preceding or following the canoe trip. Those that were self-guided were interviewed before or after the trip at the location's marina. Those that canoed with a naturalist on the fee-based trip were given a questionnaire by the interpreter. The researchers did not use a pre- and post-test design due to time constraints and "the likelihood of a pre-test sensitization effect" (p. 44). Four questionnaires were produced. Depending on if the questionnaire was administered pre- or post-trip, participants were posed questions as "expectations," and others were asked about "satisfaction." All questioning was the same besides those points. Likert scales measured attitude and motive. Knowledge was tested with multiple choice questions. Those who canoed with a naturalist were asked about the program. All were asked about fee-based interpretation, as well as demographics. Knowledge, motive, and attitude results were calculated. Timing and structure both had significant relationships with a participant's knowledge. Researchers determined that those who were self-guided did not score as highly on the knowledge test as those who were led by a naturalist (Morgan, Absher, and Whipple, 2003).

Another study evaluating interpretive methods on knowledge and attitude was conducted by Wiles and Hall using a pre- and post-test Solomon four-group experimental design (2005). The researchers wanted to know how different messages expressed in an interpretive guided tour at Mesa Verde National Park affected visitor knowledge and attitudes regarding wildland fire – an important element to life for the Ancestral Puebloans who lived at Mesa Verde, as well as an element that plays an important role to the ecosystem. Those in the control groups did not receive treatment messages but attended a program that described typical Ancestral Puebloan activities, without any reference to wildland fire. The three other treatments – affective arguments, cognitive arguments and a combination of both arguments – experienced the same core program that did express how wildland fire was not only

important to the lives of Ancestral Puebloans, but also the world today. Pre- and post-test questionnaires were used at these tours. National Park Service rangers handed out the questionnaires and delivered the interpretive program. The questionnaires were numbered with a tag and study participants tore the tag from their pre-test to match up to the corresponding post-test. This was done so that changes in knowledge and attitudes could be tracked. The tag was stapled to the post-test to allow for anonymity. The researchers used the expectancy-value theory of attitudes to develop attitudinal measures, including both belief strength and evaluation of each belief. Attitudinal questions were vetted through a panel of judges and a pre-test convenience sample. The knowledge-based questions were derived from the interpretive programs. Five multiple choice questions were asked and each had a "don't know" option. Researchers scored "don't know" answers as incorrect. Results included low pre-test knowledge levels across the different treatment and control groups, as well as a positive attitude, on average, regarding fire's ecological consequences and only slightly negative feedback on fire's destructive potential. The interpretive programs did more than just educate the participants as knowledge scores rose from .69 to 2.08, but they also changed visitor attitudes related to wildland fires, just with less significance. Overall, the study found that interpretive programs on fire do have an effect on people's knowledge and attitudes of wildland fire (Wiles and Hall, 2005).

LaBarge conducted a study to test participant knowledge before and after a soil fertility workshop. Considering that participants may guess the answers on the pre-test, he decided to conduct his pre-test assessment with the inclusion of "Yes, I know the answer" and "No, I am guessing" after each pre-test base knowledge question. This method would provide not only instructor feedback, but also determined confidence levels of answers, gauge time that should be devoted to certain subjects, and identify where inaccuracies are believe to be correct. These questionnaires employed true/false and multiple choice questions. Questionnaires were matched to participants by the last four digits of their phone number. LaBarge tallied the answers in a traditional correct/incorrect fashion, and also tallied them with the "know" and "guess" qualifiers. Those that were guessed on by the participant were marked

incorrect. Based on traditional scoring, participants increased their scores by 42 percent the "guessing" qualifier increased the knowledge gained by 10 percent compared to the traditional tallying method. What these individuals learned in the program allowed them to have more confidence in their answers post-test, too. A 53 percent decrease in "guessing" occurred post-test (LaBarge, 2007).

CHAPTER III

METHOD AND DESIGN

Introduction

The purpose of this study is to test the effects of current interpretation methods at Keystone Ancient Forest, with specific emphasis on how these methods affect visitor knowledge of the Cross Timbers and attitude toward the ecoregion. Guided walks and signage are the main interpretive offerings to visitors at the Keystone Ancient Forest. Guided walks allow visitors and the volunteer trail guides the opportunity to interact with each other and the preserve's natural resources. Numerous studies, as mentioned in previous chapters, have been conducted regarding interpretation and its effects on various factors.

The researcher obtained full approval from Oklahoma State University's Institutional Review Board (Appendix C) before conducting this study.

Assumptions, Limitations, and Delimitations

As previously stated, the following assumptions, limitations, and delimitations will be considered in the research.

The following basic assumptions are accepted: The average visitor to the Keystone Ancient Forest knows little of the Cross Timbers ecoregion and the importance to preserve this particular portion of virgin forest. The average visitor resides within a 20-30 minute drive of the Keystone Ancient Forest.

Few visitors truly realize how very little old-growth, virgin forests remain. Visitors who attend the Open Trails Day at Keystone Ancient Forest are assumed to have an interest in the forest and the environment.

Limitations to this study include: Only those who visit the Keystone Ancient Forest during the October 2013 Open Trail Days will be used in this study. Past Keystone Ancient Forest visitors can participate in the survey. These visitors may already possess knowledge of the Cross Timbers, as well as an affinity to preserve and protect the ecoregion. Not all visitors to the Keystone Ancient Forest take a guided hike or read interpretive signs. To reach at least 30 survey participants, the researcher may have to make the survey questionnaires available at more than one Open Trails Day.

Delimitations to this study include: At least 30 valid questionnaires will be gathered by the researcher. Knowledge will be tested by a pre-test and post-test assessment. Questions will be designed as yes/no and multiple choice. Attitude will be tested by a Likert scale type of questioning. Only visitors to the Keystone Ancient Forest who are 18 years of age and older can participate in the survey. A participant can only take the survey once.

Selection of Subjects

Visitors to the Keystone Ancient Forest on the October Open Trails Day, October 12, 2013, were conveniently selected to participate in this study. Only subjects age 18 and older were allowed to participate in this study. The researcher obtained demographic information that contributes to assessment as well as provides Keystone Ancient Forest officials with informative data.

Research Design and Assessment Tools

Once participants gave consent, the subjects completed a pre-test questionnaire for this cross-sectional design. Demographic information was collected at this time including gender, age, zip code and primary reason for visiting the preserve (exercise, outdoor activity, learning experience, other). They also were asked if they were first-time visitors. A pre-test and post-test were administered as part of this survey to determine the knowledge level of participating visitors regarding the Cross Timbers ecoregion. Both questionnaires followed aspects of Dillman's Total Design Method, using "social exchange theory to guide the careful integration of specific procedures and techniques" (1991, p. 233). This research follows three considerations outlined by Dillman. First, the questionnaire was designed to be efficient and not appear time-consuming to potential research participants. Second, questions of interest were included to grab the participant's attention. Third, trust was gained through the use of stationary with university designations (1978). Questions were ordered so that demographic appeared first on the document, with topic-related questions appeared at the end. Not all of Dillman's recommendations applied to this study, as it is not necessary to create a booklet for this survey, nor was it necessary to follow his suggestions regarding mail surveys. All questionnaires were completed in-person at the Keystone Ancient Forest. None were mailed and no format was published online. "The major strength of the Total Design Method as a comprehensive system is that meticulously following the prescribed procedures consistently produces high response rates for virtually all survey populations. Response rates typically reach 50-70 percent for general public surveys, and 60-80 percent for more homogenous groups where low education is not a characteristic of the population" (Dillman, 1991, p. 234). Due to a lack of previously used research instruments, this study used a questionnaire designed by the researcher to test visitor knowledge of the Keystone Ancient Forest, their attitude toward the ecoregion and its preservation, as well as demographic information regarding the visitor and their time at the preserve.

The pre-test (Appendix A) consisted of 10 questions pertaining to the Cross Timbers – its scope, definition, common species, and regional history. These were formatted in a yes/no and multiple choice

design, along with a confidence interval similar to the studies conducted by LaBarge with his soil workshop and Wiles and Hall's wildland fire research. Attitudes of visitors will be measured via a Likert scale similar to the previously mentioned studies, as well as the one conducted by Morgan, Absher, and Whipple. The post-test (Appendix B) included the same questions as those asked in the pre-test. The same Likert scale questions were asked, as well as some post-experience attitude questions. Audience information was gathered during the post-test pertaining to the visit. The pre- and post-test questionnaires were linked together by the participant's initials, along with the last four digits of their phone number. This was chosen as convenience for the participant, rather than assigning a number or having them keep track of special tabs.

Collection of Data and Considerations

Assessment of the pre- and post-test questionnaires created the opportunity for a wealth of information about the average Keystone Ancient Forest visitor, but guidelines for visitor participation were set before collection date. The investigator was assisted by trained volunteers who asked for visitor participation at the Keystone Ancient Forest's entrance to the trails. These volunteers, or research assistants, were trained by the investigator on acquiring consent, the purpose of the survey and its part in this research conducted through Oklahoma State University. The investigator made these volunteers aware of special considerations and circumstances that may arise on collection day.

Those age 18 and older with vision or hearing impairments who wanted to participate in the survey could do so with the assistance of the investigator or research assistants who would ask each question and provide each range of responses for the person from which to choose. This had the potential to make some surveys occupy too much time, which may account for the visitor failing to participate, but this instance never arose on data collection day.

If a person decided to not answer gender, birth year, zip code, reason for visiting or first visit, then the questionnaire was still valid and was scored. If a person did not answer a knowledge-based question the corresponding pre- or post-score was still scored and summed to generate a pre-test total and a post-test total. If they do not answer an attitude-based question then it will be marked neutral. If they failed to answer more than four questions then both their questionnaires were not analyzed. Only one instance of this happened during this study.

Figure 5: Data collection day at the Keystone Ancient Forest.

Figure 6: Study participants completing pre-test questionnaire on site.

Analysis of Data

Data were collected in a pre-test and post-test questionnaire, resulting in two scores on knowledge level as well as the participant's demographic and attitudinal responses. Data were analyzed and the following hypotheses were tested:

H_0: There is no significant difference in a visitor's knowledge and attitude of the Cross Timbers ecoregion before and after visiting the Keystone Ancient Forest and interacting with the available interpretive tools.

H_1: There is a significant difference in a visitor's knowledge and attitude of the Cross Timbers ecoregion before and after visiting the Keystone Ancient Forest and interacting with the available interpretive tools.

The 10 pre-test knowledge scores were totaled and compared to the sum of the 10 post-test knowledge scores. These pre- and post-test sums were matched by participant and analyzed using matched pairs *t*-test statistics with significance set at *p*-value of 0.05. Pre- and post-test scores are the dependent variable with the interpretive tool's effects on the individual participants as the independent variable.

Both pre- and post-test questionnaires contain demographic information associated with the participant and their experience at the Keystone Ancient Forest. Demographic information was presented in the questionnaires by itself, and analyzed with the knowledge and attitudinal scores.

Attitudinal responses are designed as Likert scales and were analyzed using appropriate non-parametric statistics. The attitudinal responses were analyzed using the chi-square goodness-of-fit statistic with significance set at a *p*-value of 0.05. Attitudes are the dependent variables and the demographic information are considered the independent variables.

CHAPTER IV

FINDINGS

In this chapter, an overview of the data collection numbers will be presented; in addition, the statistical information regarding respondents' knowledge of the Cross Timbers ecoregion obtained from the questionnaires will be discussed. Demographics will also be presented in the discussion.

Data were collected on October 12, 2013. Weather was pleasant that day, resulting in a relatively high number of visitors for the site. There were approximately 161 attendees at the Keystone Ancient Forest. One group of middle school Boy Scouts and accompanying adults came to the forest that day. This group totaled at least 20 and was counted toward the total attendance that day although the youth were not eligible for consideration in this study. Numerous visitors under the age of 18 were in attendance that day as well, but no specific data was gathered on those younger than the survey's age requirement. Because of the lack of an exact number of minors, the researcher can only estimate that the number of visitors under the age of 18 was 50. The response rate to the survey was 27 percent of the total in attendance, with 44 completed questionnaires gathered during data collection. When taking under consideration the number of visitors under the age of 18, the response rate is more appropriate at 40 percent. The researcher believes this return rate is satisfactory for analysis. One completed set of questionnaires was eliminated as more than half of the knowledge-based questions were unanswered by the participant. An additional 23 pre- and post-questionnaires were gathered, but were unable to be matched to their corresponding questionnaire as the participants did not complete the identifying components.

Demographics of Response Pool

Of the 43 valid questionnaires, the response pool consisted of 18 men and 25 women. The majority (35 visitors or 81 percent) had never visited the Keystone Ancient Forest before the data collection date. Only six (or 14 percent) had visited the preserve before. Two participants did not respond to this question. Thirteen visitors were born between the years 1949-1958, the most of any age group. Eleven were born between 1969 and 1978, with seven each in the respective timeframes of 1979-1989 and 1959-1968. Three visitors were born in the years 1939-1948, with one born between 1995-1990 and one nonresponse.

The researcher asked for the participant's zip code to see if visitor knowledge and attendance was related to the proximity in which the person lived related to the Keystone Ancient Forest. Only two respondents were from outside Oklahoma, with the remaining primarily residing in the Sand Springs and Tulsa areas. The most dominant zip codes were74063 (Sand Springs) and 74037 (Jenks), making up 11 of the 43 responses.

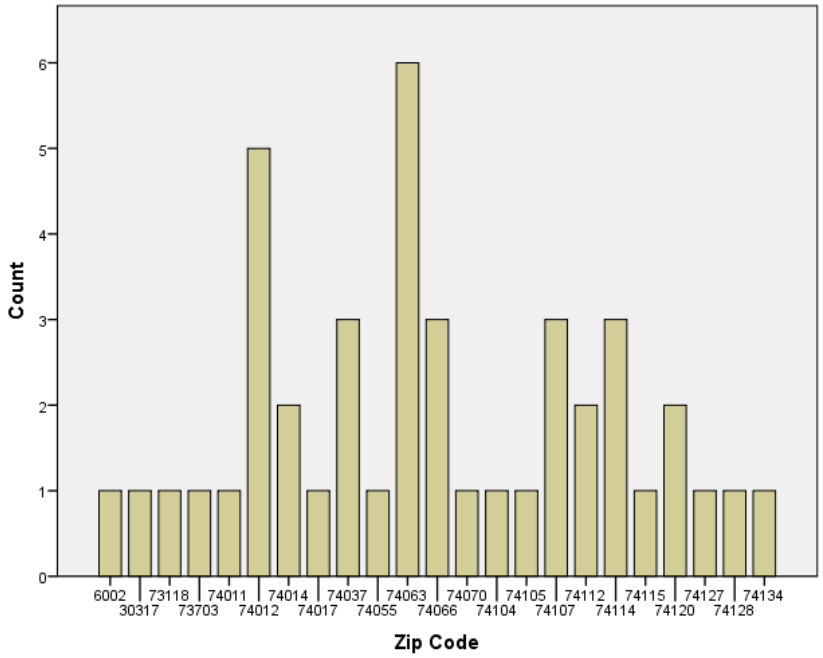


Figure 7: Zip code distribution of visitors

Figure 8: Map of 74063 zip code.

Most of the respondents (17 visitors) claimed to visit the Keystone Ancient Forest solely for an outdoor activity. A learning experience was the second most popular reason, while the combination of exercise, outdoor activity and a learning experience came in third.

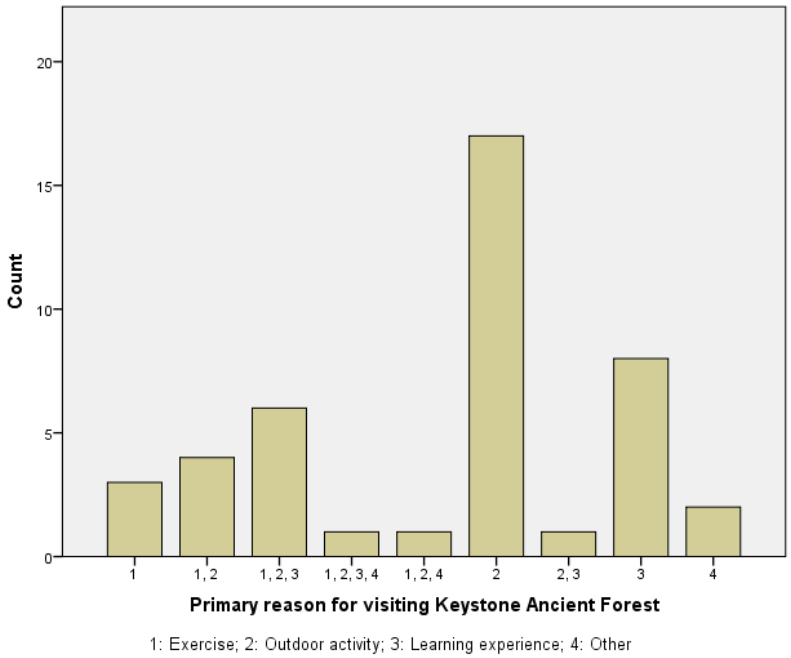


Figure 9: Graph depicting the primary reason for visiting the Keystone Ancient Forest.

Regarding interpretation influences on the participant's experience at the Keystone Ancient Forest, 40 individuals reported reading signs throughout the forest, with only two reporting they did not. There was one individual who did not respond to this question. Most (28 visitors) reported speaking to a volunteer trail guide before, during or after their hike. Fifteen marked that they did not do this. Only six visitors reported hiking with a volunteer trail guide. Thirty-seven participants did not hike with a trail guide. The six who received interpretation through a guided walk also read signs throughout the Keystone Ancient Forest and spoke with a trail guide before, during or after their hike. Five of the six individuals who took a guided hike received higher marks on their post-test assessment compared to their pre-test. One individual maintained the same score pre- and post-test.

Statistical Analysis

Data were collected at the Keystone Ancient Forest through a set of questionnaires testing knowledge and attitude change before and after visiting the site. Conducting the experiment included a test of the null hypothesis: There is no significant difference in a visitor's knowledge and attitude of the Cross Timbers ecoregion before and after visiting the Keystone Ancient Forest and interacting with the available interpretive tools. A research hypothesis was also tested: There is a significant difference in a visitor's knowledge and attitude of the Cross Timbers ecoregion before and after visiting the Keystone Ancient Forest and interacting with the available interpretive tools.

To examine the hypothesis that there was a difference of visitor knowledge of the Cross Timbers, the researcher conducted a paired-samples *t* test. The independent variable was the individual participants. The dependent variables were the pre- and post-test scores. There was a statistically significant effect of an individual's experience with the site's interpretive tools on their knowledge, $t(42) = -5.937$, $p = <0.001$; this study's evidence supports this with pre-test results (M = 6.14, SD = 1.754) and post-test

results (M = 7.67, SD = 1.629). The means increased by 1.53 and showed slightly less variation in the post-test.

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	PreScore	6.14	43	1.754	.267
	PostScore	7.67	43	1.629	.248

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	PreScore - PostScore	-1.535	1.695	.259	-2.057	-1.013	-5.937	42	.000

Figure 10: Paired samples *t*-test (with non-responses)

The raw scores of the pre- and post-test assessments were entered into SPSS to conduct statistical analysis. These raw scores included missing data from eight of the respondents. Mean scores were based on a possible maximum of 10. Conducting a paired samples *t*-test resulted in a *t* score of -5.937 since the calculation was pre-test scores minus post-test scores. The null hypothesis states that there is no significant difference in a visitor's knowledge and attitude of the Cross Timbers ecoregion before and after visiting the Keystone Ancient Forest and interacting with the available interpretive tools. The research hypothesis states that there is a significant difference in a visitor's knowledge and attitude of the Cross Timbers ecoregion before and after visiting the Keystone Ancient Forest and interacting with the available interpretive tools. The results of the *t*-test led the researcher to reject the null hypothesis.

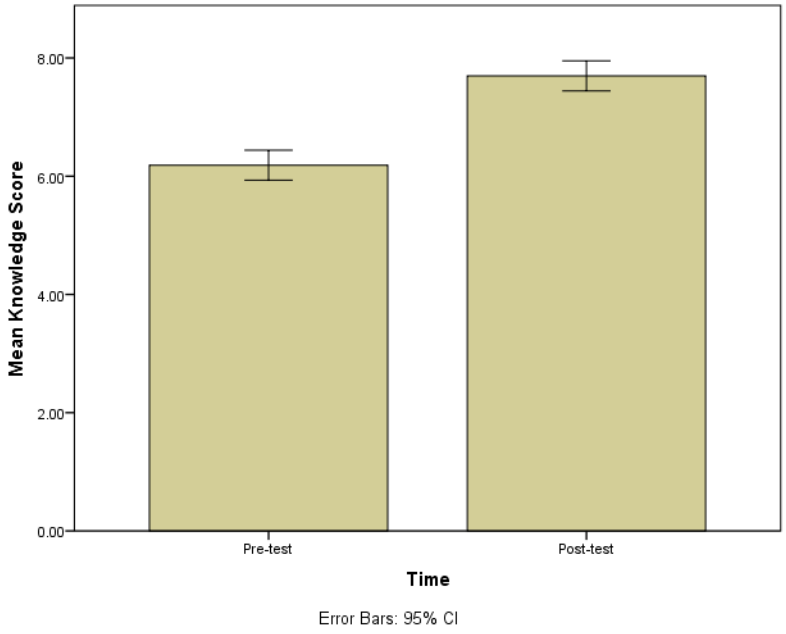


Figure 11: Paired samples *t*-test results graph

Because of the *t*-test resulting in a significance of $p<0.001$, the test was conducted again with the missing scores removed and replaced with the mean of that question's responses. By replacing the missing values with the means of the responses, those respondents who failed to answer questions did not skew the data. This second analysis gives a more accurate picture of possible real differences between pre-test and post-test scores. Again, there was a statistically significant effect of an individual's experience with the site's interpretive tools on their knowledge $t(42) = -5.545$, $p = <0.001$; this study provides evidence supporting this with pre-test results (M = 6.30, SD = 1.7983) and post-test results (M = 7.723, SD = 1.6186). The raw scores of the pre- and post-test assessments were entered into SPSS to conduct statistical analysis. The mean increased by 1.42 and the post-test scores were more closely grouped than the pre-test scores. This shows learning did occur and the sample was more cohesive after the visitors' experience.

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	PreScoreADJ	6.300	43	1.7983	.2742
	PostScoreADJ	7.723	43	1.6186	.2468

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	PreScoreADJ - PostScoreADJ	-1.4233	1.6832	.2567	-1.9413	-.9052	-5.545	42	.000

Figure 12: Paired samples *t*-test results (with non-responses replaced with series mean)

Mean scores were based on a possible maximum score of 10. Conducting a paired samples *t*-test resulted in a *t* score of -5.545 since the calculation was pre-test scores minus post-test scores. While the significance reached a similar level, the results of this *t*-test better reflect true differences in the scores. These finding led the researcher to reject the null hypothesis.

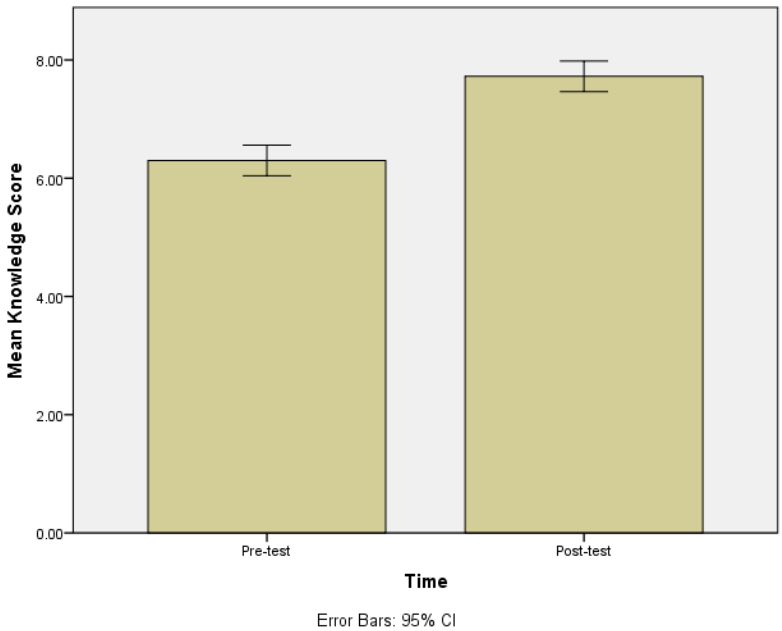


Figure 13: Paired samples *t*-test results (with non-responses replaced with series mean) graph

Analysis of Incorrect Knowledge-based Answers

All knowledge-based question scores improved on the post-test assessment except for question 10, which asked which grass was not common in the Cross Timbers. Pre-test assessment saw 14 incorrect responses, compared to 17 on post-test assessment. Five participants marked an incorrect response on both tests. Twelve marked a correct score on their pre-test but were incorrect or did not respond on post-test assessment.

Question 6, asking which is not a common grass or tree species associated with the Cross Timbers, was by far the most-frequently-missed item on both assessments, with 31 responses missing it on the first attempt and 24 missing it on the second attempt.

The least missed question was Question 4. It asked if the Keystone Ancient Forest was a "virgin" forest. This was a dichotomous question. Seven incorrect answers were given on first attempt and only one was given on second attempt.

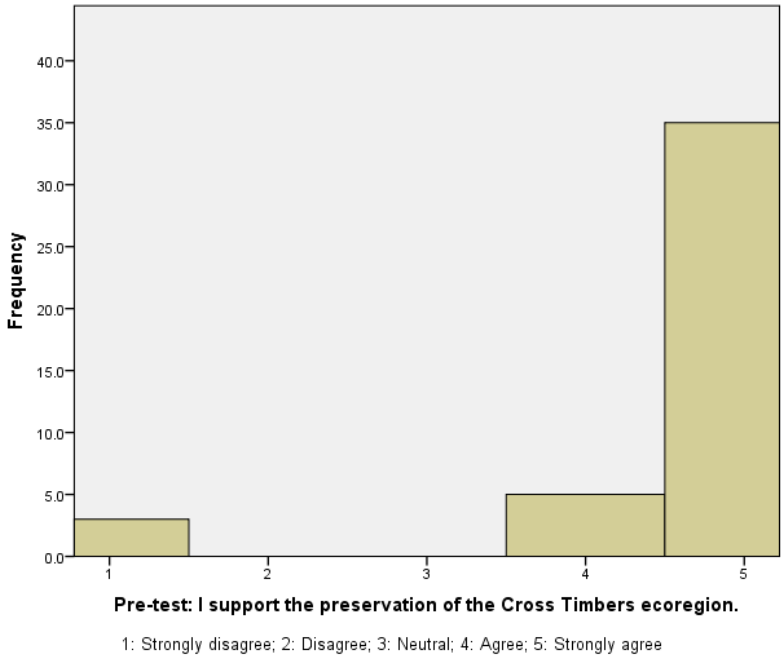
Confidence in Response

Both sets of questionnaires asked if the participant was confident in answering each question. This dichotomous response showed an increase in confidence from pre-test to post-test. During the initial survey, an average of 17.7 responses were marked "yes" and an average of 24.6 responses were marked "no" when presented with the question "I am confident in this answer." The post-test evaluation saw an increase in the average of responses marked as confident by the respondents. On average, 29.7 of the responses were marked "yes" and 12.2 were marked "no" when presented with the same question in the post-test.

Attitude Regarding Cross Timbers Ecoregion

Participants answered all the attitude-related questions on both pre- and post-test instances so there was no need to mark any participant's answers neutral due to no response. The attitude-related statements and agreement responses test a null hypothesis and a research hypothesis.

The first attitude-based question appearing on both the pre- and post-test was: I support the preservation of the Cross Timbers ecoregion. The null hypothesis suggests on pre-test, first-time and repeat visitors to the Keystone Ancient Forest have the same attitude toward Cross Timbers preservation. The research hypothesis states that on pre-test, first-time visitors and repeat visitors to the Keystone Ancient Forest have different attitudes towards Cross Timbers preservation. On first account, there were 35 individuals who reported they strongly agree with this statement. Five responded as they agree and three responded they strongly disagree with the statement. On post-test questioning, 39 respondents answered they strongly agree; three responded they agree; and one responded they strongly disagree.



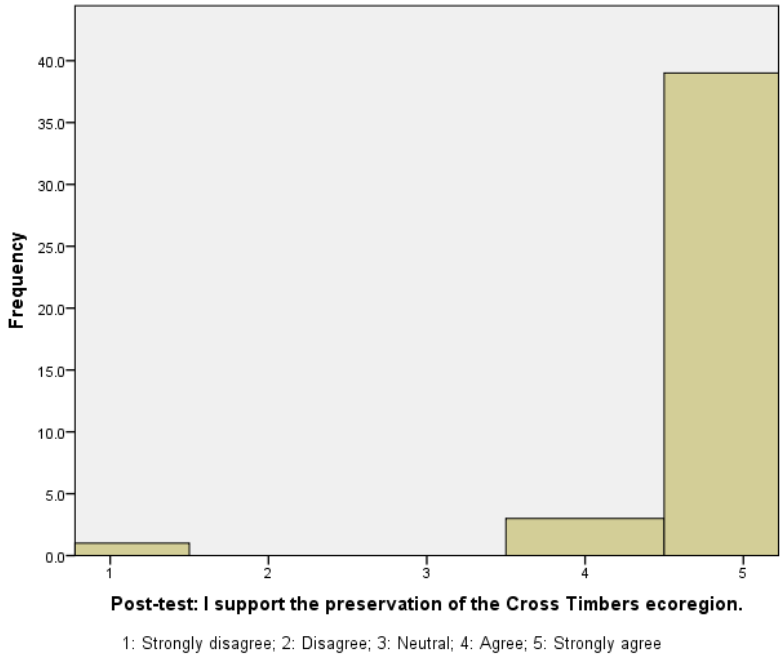


Figure 14: Preservation attitude graphs

A chi-square test for goodness-of-fit was conducted to see if on the pre-test there was a relationship between a person's attitude of Cross Timbers preservation and if they had previously visited the Keystone Ancient Forest. The test resulted in findings indicating there was no difference among new and past visitors on the pre-test, indicating a failure to reject the null hypothesis.

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	1.147[a]	4	.887
Likelihood Ratio	1.907	4	.753
Linear-by-Linear Association	.040	1	.841
N of Valid Cases	43		

a. 8 cells (88.9%) have expected count less than 5. The minimum expected count is .14.

D4	1 (Strongly Disagree)	4 (Agree)	5 (Strongly Agree)	Total
0 (No Response)	0	0	2	2
1 (Yes)	3	4	28	34
2 (No)	0	1	5	6
Total	3	5	35	43

Chi-square = 1.147, df = 4, p = 0.887

Figure 15: Preservation attitude chi-square results (with demographic indicator)

Since no difference was found, a second chi-square test was conducted to determine if a relationship was found between the pre-test and post-test responses to the same attitudinal question. The null hypothesis suggests from pre-test to post-test results visitors to the Keystone Ancient Forest have the same attitude regarding support of the preservation of the Cross Timbers. The research hypothesis states that from pre-test to post-test visitors to the Keystone Ancient Forest have different attitudes regarding support of the preservation of the Cross Timbers. This test resulted in a chi-square of 19.699 with p = .001, meaning a significant relationship between the pre- and post-test attitude responses in relation to the visitor's attitude toward Cross Timbers preservation. The null hypothesis was rejected.

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	19.699[a]	4	.001
Likelihood Ratio	10.436	4	.034
Linear-by-Linear Association	16.891	1	.000
N of Valid Cases	43		

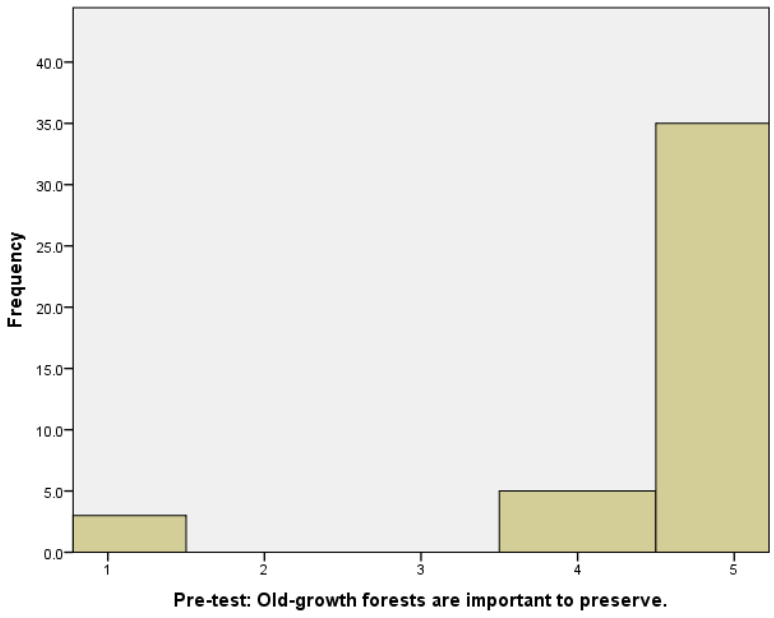
a. 8 cells (88.9%) have expected count less than 5. The minimum expected count is .07.

	Q11B			
Q11A	1 (Strongly Disagree)	4 (Agree)	5 (Strongly Agree)	Total
1 (Strongly Disagree)	1	1	1	3
4 (Agree)	0	1	4	5
5 (Strongly Agree)	0	1	34	35
Total	1	3	39	43

Chi-square = 19.99, df = 4, p = 0.001

Figure 16: Preservation attitude chi-square results (pre-test and post-test)

The second attitude-related question was: Old-growth forests are important to preserve. The null hypothesis suggests on pre-test, first-time and repeat visitors to the Keystone Ancient Forest have the same attitude in regards to the importance of preserving old-growth forests. The research hypothesis states that on pre-test, first-time visitors and repeat visitors to the Keystone Ancient Forest have different attitudes in regards to the importance of preserving old-growth forests. During the pre-test 35 individuals reported they strongly agree with the statement. Five responded as they agree and three responded as they strongly disagree. At post-test the results were that 36 responded as they strongly agree, six responded as they agree and only one responded they strongly disagree.



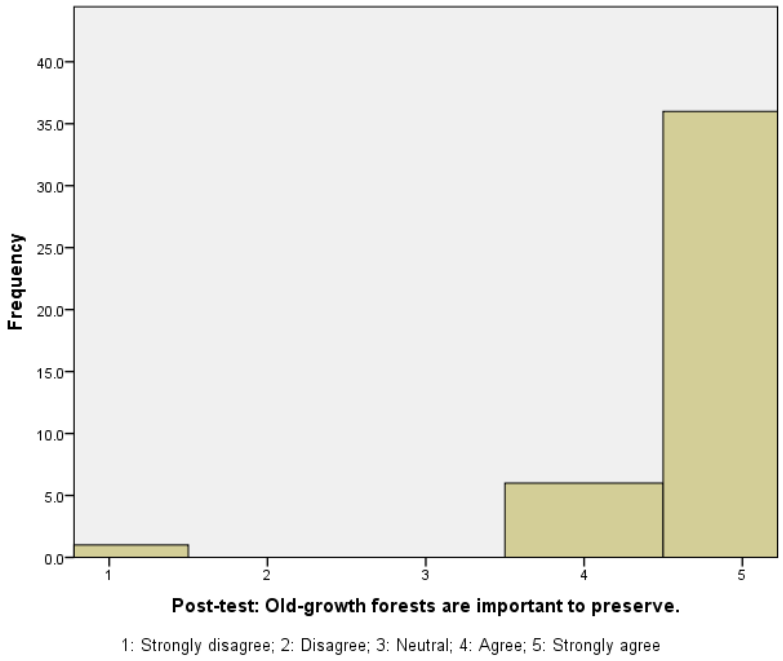


Figure 17: Old-growth forest attitude graphs

By conducting a chi-square test for goodness-of-fit based on visitor response pre-test to this question and looking for association with the demographic qualifier if they had visited the preserve before, the researcher found no significant results. The researcher failed to reject the null hypothesis.

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	1.147[a]	4	.887
Likelihood Ratio	1.907	4	.753
Linear-by-Linear Association	.040	1	.841
N of Valid Cases	43		

a. 8 cells (88.9%) have expected count less than 5. The minimum expected count is .14.

	Q12A			
D4	1 Strongly Disagree	4 Agree	5 Strongly Agree	Total
0 (No Response)	0	0	2	2
1 (Yes)	3	4	28	35
2 (No)	0	1	5	6
Total	3	5	35	43

Chi-square = 1.147, df = 4, p = 0.887

Figure 18: Old-growth forest attitude chi-square results (with demographic indicator)

The same attitudinal question underwent chi-square analysis a second time due to the lack of significance found between the demographic variable and the pre-test responses. The null hypothesis suggests that based on pre-test and post-test results Keystone Ancient Forest visitors have the same attitude regarding the importance of preserving old-growth forests. The research hypothesis states that from pre-test to post-test, Keystone Ancient Forest visitors have different attitudes regarding the importance of preserving old-growth forests. The pre-test and post-test responses were analyzed using

chi-square to look for association. This test resulted in a significant finding where $p < 0.001$ and a chi-square = 26.756. The researcher rejected the null hypothesis.

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	26.756[a]	4	.000
Likelihood Ratio	18.067	4	.001
Linear-by-Linear Association	22.420	1	.000
N of Valid Cases	43		

a. 8 cells (88.9%) have expected count less than 5. The minimum expected count is .07.

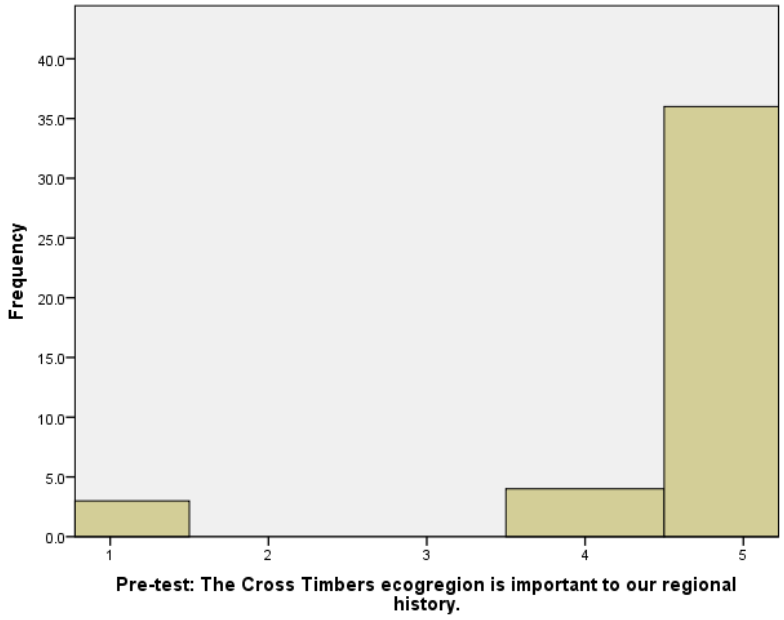
	Q12B			
Q12A	1 (Strongly Disagree)	4 (Agree)	5 (Strongly Agree)	Total
1 (Strongly Disagree)	1	2	0	3
4 (Agree)	0	2	3	5
5 (Strongly Agree)	0	2	33	35
Total	1	6	36	43

Chi-square = 26.756, df = 4, $p < 0.001$

Figure 19: Old-growth forest attitude chi-square results (pre-test and post-test)

The third question regarding attitude appearing on the pre- and post-test was: The Cross Timbers ecoregion is important to our regional history. The null hypothesis suggests on pre-test, first-time and repeat visitors to the Keystone Ancient Forest have the same attitude in regards to the importance of the Cross Timbers ecoregion to our regional history. The research hypothesis states that on pre-test, first-time visitors and repeat visitors to the Keystone Ancient Forest have different attitudes in regards to the importance of the Cross Timbers ecoregion to our regional history. On the pre-test 36 marked they

strongly agreed with the statement; four agreed; and three strongly disagreed. On the post-test 36 marked they strongly agreed with the statement; six agreed; and one strongly disagreed.



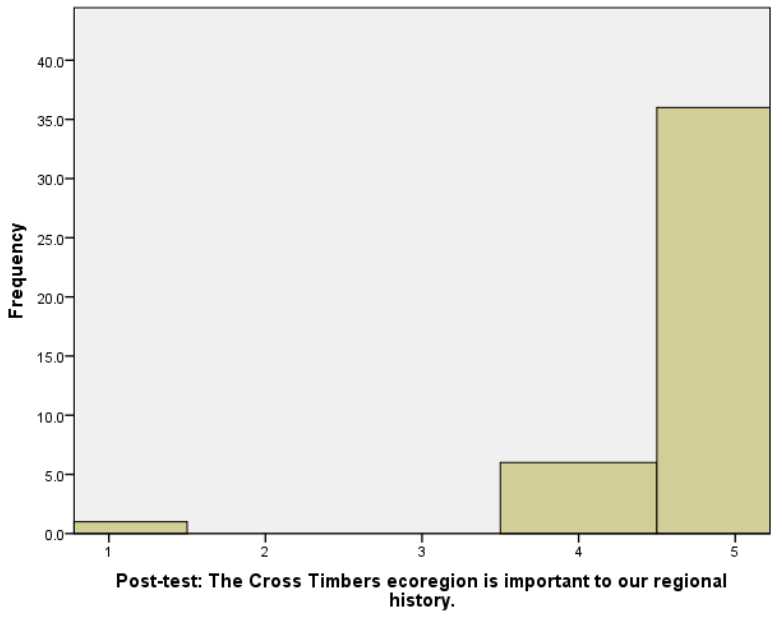


Figure 20: Importance attitude graphs

A chi-square analysis was conducted to test for goodness-of-fit between the demographic identifier of whether they had visited the Keystone Ancient Forest before, or not, and their response to this variable during the pre-test. As in the other attitudinal comparisons with the demographic variable, no significance was found and therefore the researcher failed to reject the null hypothesis.

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	1.308[a]	4	.860
Likelihood Ratio	1.973	4	.741
Linear-by-Linear Association	.029	1	.866
N of Valid Cases	43		

a. 7 cells (77.8%) have expected count less than 5. The minimum expected count is .14.

	Q13A			
D4	1 (Strongly Disagree)	4 (Agree)	5 (Strongly Agree)	Total
0 (No Response)	0	0	2	2
1 (Yes)	3	3	29	35
2 (No)	0	1	5	6
Total	3	4	36	43

Chi-square = 1.308, df = 4, p = .860

Figure 21: Importance attitude chi-square results (with demographic indicator)

Again, because of the lack of significance another chi-square test was conducted between the pre-test and post-test results to the question of whether the Cross Timbers ecoregion is important to our regional history. The null hypothesis suggests that based on pre-test and post-test results Keystone Ancient Forest visitors have the same attitude regarding the importance of the Cross Timbers ecoregion to our regional history. The research hypothesis states that from pre-test to post-test, Keystone Ancient

Forest visitors have different attitudes regarding the importance of the Cross Timbers ecoregion to our regional history. This test resulted in a chi-square = 20.405 and $p < 0.001$, meaning a significant relationship was found. Therefore, the researcher rejected the null hypothesis.

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	20.405[a]	4	.000
Likelihood Ratio	11.160	4	.025
Linear-by-Linear Association	15.490	1	.000
N of Valid Cases	43		

a. 7 cells (77.8%) have expected count less than 5. The minimum expected count is .07.

	Q13B			
Q13A	1 (Strongly Disagree)	4 (Agree)	5 (Strongly Agree)	Total
1 (Strongly Disagree)	1	1	1	3
4 (Agree)	0	2	2	4
5 (Strongly Agree)	0	3	33	36
Total	1	6	36	43

Chi-square = 20.405, df = 4, $p < 0.001$

Figure 22: Importance attitude chi-square results (pre-test and post-test)

Four additional questions were asked of visitors on their post-test questionnaire. These were not intended to be a part of the attitude inventory as they were only asked post-visit. The questions apply more to visitor demographics and may help management in future visitor assessments. Responses were requested in the same manner as the attitudinal responses with visitors able to choose from strongly disagree to strongly agree.

The potential for repeat visitation was addressed with the statement of "I will visit the Keystone Ancient Forest." Based on data collected, repeat visitation looks promising as 36 visitors marked they strongly agree with the statement. Four marked they agree with the statement. Only two visitors marked neutral and one responded with a strongly disagree.

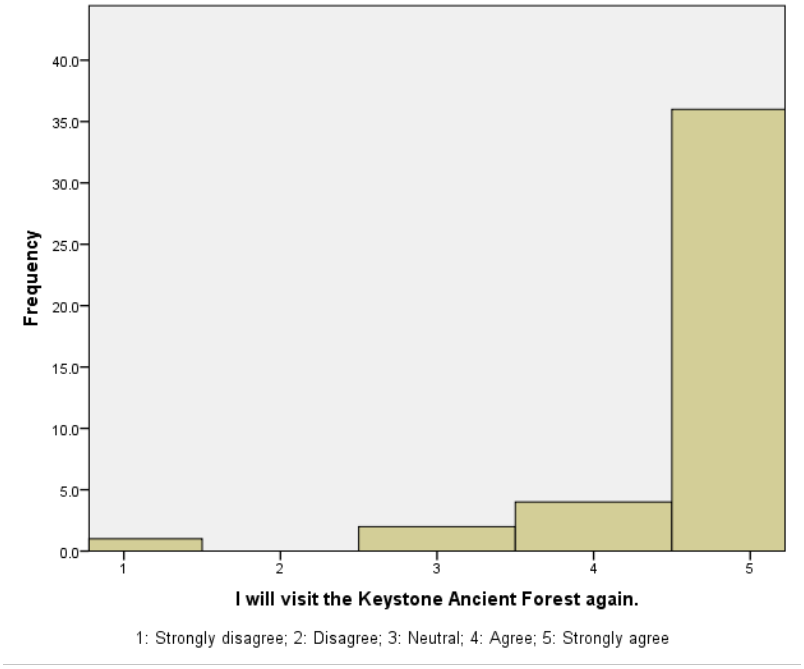


Figure 23: Likelihood of repeat visitation graph

The second statement inquired on the state of the visitor's awareness of the ecoregion. Twenty-nine visitors responded that they strongly agree with the statement "After my visit, I am more aware of the Cross Timbers ecoregion." Twelve visitors marked agree, while one visitor marked disagree and strongly disagree in each instance.

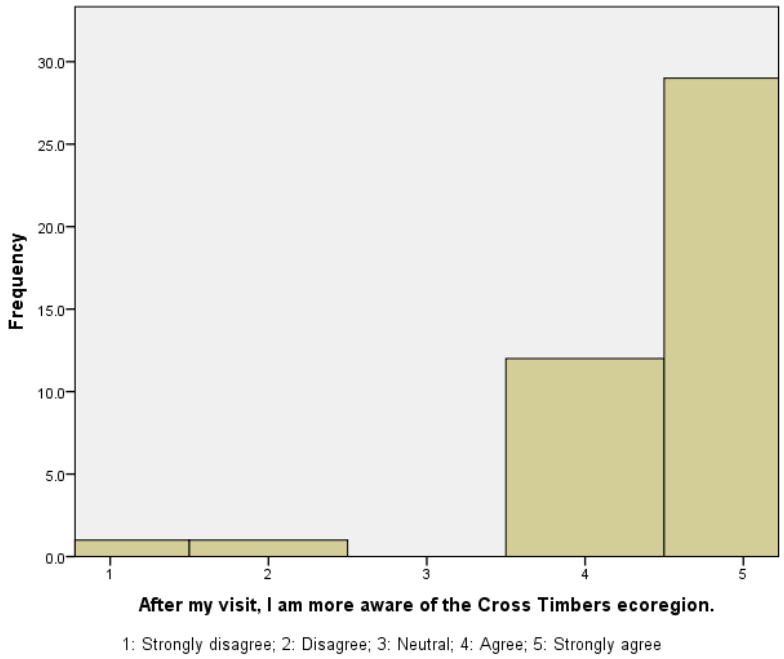


Figure 24: Awareness of Cross Timbers graph

Since a change in knowledge was a key part of the study, the researcher wanted to know how the participant felt about this key factor. The statement, "I gained knowledge of the Cross Timbers ecoregion after my visit to the Keystone Ancient Forest today," was a part of the post-test questionnaire in order to analyze this intended change. Twenty-four participants felt they strongly agreed with the statement. Another 16 felt positive about this statement by marking agree. Only one responded neutral. Two participants strongly disagreed with the statement.

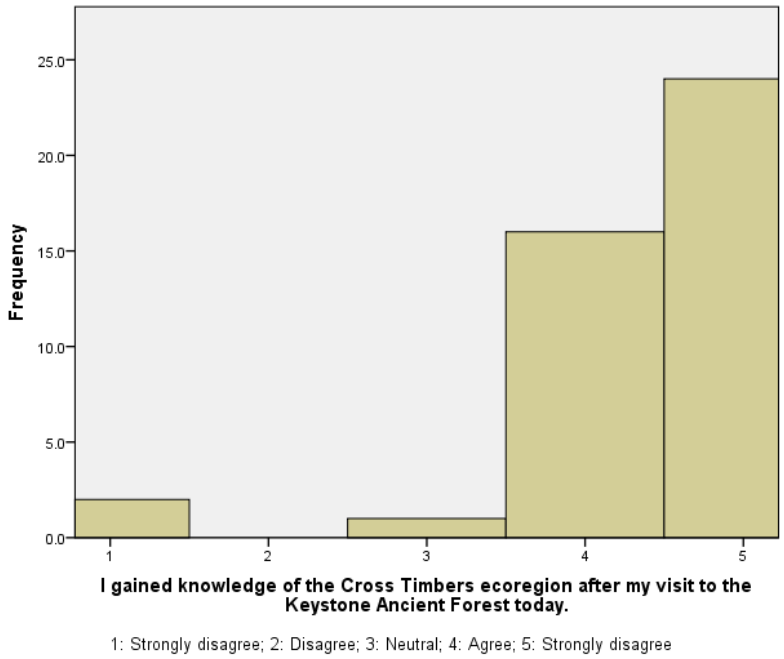


Figure 25: Visitor awareness in change of knowledge graph

Attitude was another key element to the researcher's study so the visitors were asked to respond to the statement "My attitude of old-growth forests changed today." This statement received the widest distribution of responses. Nine responses were marked strongly agree. Ten participants felt they strongly agreed that attitude changed. Eighteen marked neutral in terms of this statement. Those who disagreed tallied four and two strongly disagreed with the statement.

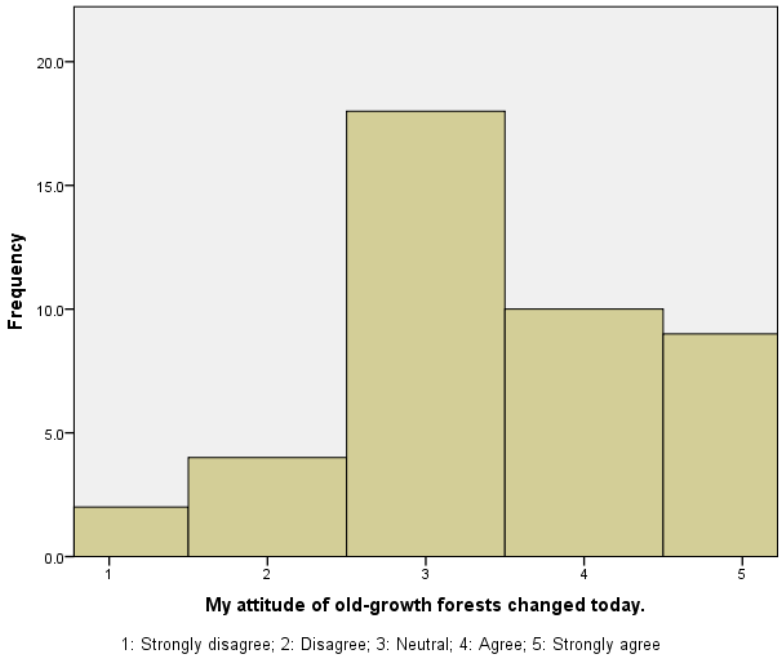


Figure 26: Old-growth forest attitude graph

CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS

Research conducted regarding Cross Timbers knowledge change after interpretation at the Keystone Ancient Forest resulted in a number of findings. Data collected and analyzed in relation to change in knowledge resulted in a rejection of the null hypothesis. Two paired-samples *t*-tests were conducted, one with missing answers remaining and another with missing answers replaced with the mean of the response series. Both resulted in a rejection of the null hypothesis. Attitude-based statements were included in both versions of the questionnaire and a chi-square goodness-of-fit test was conducted to look for associations between a person's past with the Keystone Ancient Forest, a demographic variable, and their responses to the three attitude-based statements on pre-test. These three statements also underwent chi-square analysis to look for association between the pre- and post-test results.

When the researcher began to investigate and plan this study, the hope, as evident in the research hypothesis, would be that there was a difference in visitor knowledge and attitude regarding the Cross Timbers at the Keystone Ancient Forest site because of interpretation. By conducting this experiment, it suggests that knowledge of the Cross Timbers increased significantly in those who participated.

Research and Findings Conclusions

This research indicated a greater knowledge of the Cross Timbers for this group of participants after their visit to the Keystone Ancient Forest. That knowledge was assessed through a test before and after their visit, as agreed upon by the participant. By asking an individual to take a test after they visited the park may urge them to read more signage and pay attention more to what guide have to say. This may

have swayed their knowledge gain. There is no way to definitively say this occurred, but this is one of the hazards of surveys administered in this fashion.

The increase in knowledge bodes well for the interpretive offerings at the Keystone Ancient Forest. Knowledgeable volunteer trail guides, correct signs and the availability of guided interpretive hikes provide the visitors many opportunities to learn about the facts and figures of this old-growth forest. More interpretive offerings may be needed at this site in the future, but since the park is still in the early years of its existence, the education and interpretation that is occurring seems to be effective based on this study.

The assessment of a person's attitude toward the Cross Timbers and its preservation, as well as the preservation of old-growth forests, shows that no matter if a participant had been to the site before or not, it still left an impact on their attitude after their visit that day.

Research and Findings Recommendations

Looking back on the study, the experiment's setup and execution could have alterations made to them to ensure even better success. One characteristic would be to relocate the participant's indicator, the last four digits of the phone number and initials. Fourteen pre-tests could not be linked to corresponding post-tests because of a lack of those indicators. There were nine post-tests that were completed that were not linked back to pre-tests. The researcher suggests that future evaluation forms have these fields located somewhere on the document that cannot be covered by a clipboard's clasp. That seems to be what happened in this situation. Even though the researcher and assistants advised people to fill out the field, the participant's inability to see it because of the clipboard may be the reason for the field's vacancy.

Five individuals did not fill out post-test evaluations, meaning that the researcher and research assistants failed to reconnect with the individual, the participant exited the trails another way, or they did

not realize there was a post-visit evaluation. Future evaluations at the Keystone Ancient Forest may be performed better if the researcher sets up other than where the trail guides gather. It may have been difficult for the participants to reach or feel comfortable getting to the designated spot.

Conclusions

Keystone Ancient Forest officials, according to these findings, do an adequate job of teaching and interpreting the Cross Timbers to its visitors. Whether that is through guided hikes or simply in the trail signage, people are leaving with more knowledge than what they came with into the forest. Time will progress and new trails and amenities will continue to be created for visitors. For any visitor it is imperative that these interpretive offerings continue to maintain this high knowledge base and increase for new visitors, as well as those who frequent the site. The park's close proximity to a significant population provides it an opportunity to serve not only those in the Sand Springs area, but the entire Tulsa metropolitan area. By educating the public on something significant like the Cross Timbers, a key element to the regional environment, the park can maintain its role in the community as a vessel for this kind of education.

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Appendix A

For Office Purposes Only: A

Last 4 Digits of Phone Number:___ ___ ___ ___

Month and Year of Birth: ___ ___ / ___ ___

Gender: ☐ Male ☐ Female Zip code: ___ ___ ___ ___ ___

Year of Birth: _____ Is this your first visit to the Keystone Ancient Forest? ☐ Yes ☐ No

What is your primary reason for visiting the Keystone Ancient Forest?

☐ Exercise ☐ Outdoor Activity ☐ Learning Experience ☐ Other

For the following questions, please circle your chosen answer.

The term Cross Timbers refers to what?

A. An ecoregion containing parts of Kansas, Oklahoma and Texas, that includes similar soils, animals and plants.
B. A mix of oak forest, Tallgrass prairie and savanna.
C. An ecoregion where species living at their eastern or western extremes live together.
D. A region where timbers of the eastern United States merge with massive grasslands.
E. All of the above.

I am confident in this answer: ☐ Yes ☐ No

Which of the following tree species are traditionally found in the Cross Timbers? (Choose any that apply)

☐ Post oak ☐ Eastern red cedar ☐ Willow ☐ Elm ☐ Hickory ☐ All of the above

I am confident in this answer: ☐ Yes ☐ No

How old are some of the preserve's oldest trees?
A. 100 years B. 200 years C. 500 years D. 1,000 years

I am confident in this answer: ☐ Yes ☐ No

Is the Keystone Ancient Forest a "virgin" forest? ☐ Yes ☐ No

I am confident in this answer: ☐ Yes ☐ No

How were the older trees in the Keystone Ancient Forest protected? (Choose any that apply)

☐ The landscape protected them. ☐ Wildfires never affected the property.

☐ The land was never used for grazing, farming or timber practices.

I am confident in this answer: ☐ Yes ☐ No

See Reverse Page

For Office Purposes Only: A

Last 4 Digits of Phone Number:___ ___ ___ ___

Month and Year of Birth: ___ ___ / ___ ___

Which of the following is not a common grass or tree species associated with the Cross Timbers?

A. Blackjack oak
B. Post oak
C. Hickory
D. Eastern red cedar
E. Redbud

I am confident in this answer: ☐ Yes ☐ No

In 1832, what American author experienced the Cross Timbers, possibly even this exact land?

A. James Fennimore Cooper
B. Ralph Waldo Emerson
C. Washington Irving
D. Henry David Thoreau
E. Walt Whitman

I am confident in this answer: ☐ Yes ☐ No

What rocks can be found in the Cross Timbers ecoregion?

A. Basalt and shale
B. Sandstone and limestone
C. Sandstone and shale
D. Granite and basalt
E. Gypsum and limestone

I am confident in this answer: ☐ Yes ☐ No

What are some signs that a tree in the Cross Timbers might be really old?

A. Broken top
B. Twisting or rotating trunk
C. Missing limbs
D. Scars
E. All of the above

I am confident in this answer: ☐ Yes ☐ No

Which grass is not common to the Cross Timbers?

A. Big bluestem
B. Buffalo grass
C. Yellow indiangrass
D. Little bluestem
E. Hairy grama

I am confident in this answer: ☐ Yes ☐ No

See Additional Page

For Office Purposes Only: A

Last 4 Digits of Phone Number:___ ___ ___ ___

Month and Year of Birth: ___ ___ / ___ ___

For the following statements, please indicate how you agree with each by marking an X in the appropriate box.

I support the preservation of the Cross Timbers ecoregion.

Strongly Disagree	Disagree	Neutral	Agree	Strongly agree

Old-growth forests are important to preserve.

Strongly Disagree	Disagree	Neutral	Agree	Strongly agree

The Cross Timbers ecoregion is important to our regional history.

Strongly Disagree	Disagree	Neutral	Agree	Strongly agree

Appendix B

For Office Purposes Only: B

Last 4 Digits of Phone Number:___ ___ ___ ___

Month and Year of Birth: ___ ___ / ___ ___

Did you read any of the signs throughout the Keystone Ancient Forest? ☐ Yes ☐ No

Did you speak with a volunteer trail guide before, during or after your hike? ☐ Yes ☐ No

Did a volunteer trail guide hike with you today? ☐ Yes ☐ No

For the following questions, please indicate your chosen answer(s).

The term Cross Timbers refers to what?

A. An ecoregion containing parts of Kansas, Oklahoma and Texas, that includes similar soils, animals and plants.
B. A mix of oak forest, Tallgrass prairie and savanna.
C. An ecoregion where species living at their eastern or western extremes live together.
D. A region where timbers of the eastern United States merge with massive grasslands.
E. All of the above.

I am confident in this answer: ☐ Yes ☐ No

Which of the following tree species are traditionally found in the Cross Timbers? (Choose any that apply)

☐ Post oak ☐ Eastern red cedar ☐ Willow ☐ Elm ☐ Hickory ☐ All of the above

I am confident in this answer: ☐ Yes ☐ No

How old are some of the preserve's oldest trees?
A. 100 years B. 200 years C. 500 years D. 1,000 years

I am confident in this answer: ☐ Yes ☐ No

How were the older trees in the Keystone Ancient Forest protected? (Choose any that apply)

☐ The landscape protected them. ☐ Wildfires never affected the property.

☐ The land was never used for grazing, farming or timber practices.

I am confident in this answer: ☐ Yes ☐ No

Which of the following is not a common grass or tree species associated with the Cross Timbers?

A. Blackjack oak
B. Post oak
C. Hickory
D. Eastern red cedar
E. Redbud

I am confident in this answer: ☐ Yes ☐ No

See Reverse Page

For Office Purposes Only: B

Last 4 Digits of Phone Number:___ ___ ___ ___

Month and Year of Birth: ___ ___ / ___ ___

In 1832, what American author experienced the Cross Timbers, possibly even this exact land?

A. James Fenimore Cooper
B. Ralph Waldo Emerson
C. Washington Irving
D. Henry David Thoreau
E. Walt Whitman

I am confident in this answer: ☐ Yes ☐ No

What rocks can be found in the Cross Timbers ecoregion?

A. Basalt and shale
B. Sandstone and limestone
C. Sandstone and shale
D. Granite and basalt
E. Gypsum and limestone

I am confident in this answer: ☐ Yes ☐ No

What are some signs that a tree in the Cross Timbers might be really old?

A. Broken top
B. Twisting or rotating trunk
C. Missing limbs
D. Scars
E. All of the above

I am confident in this answer: ☐ Yes ☐ No

Which grass is not common to the Cross Timbers?

A. Big bluestem
B. Buffalo grass
C. Yellow indiangrass
D. Little bluestem
E. Hairy grama

I am confident in this answer: ☐ Yes ☐ No

Is the Keystone Ancient Forest a "virgin" forest? ☐ Yes ☐ No

I am confident in this answer: ☐ Yes ☐ No

See Additional Page

For Office Purposes Only: B

Last 4 Digits of Phone Number:___ ___ ___ ___

Month and Year of Birth: ___ ___ / ___ ___

For the following statements, please indicate how you agree with each by marking an X in the appropriate box.

I will visit the Keystone Ancient Forest again.

Strongly Disagree	Disagree	Neutral	Agree	Strongly agree

After my visit today, I am more aware of the Cross Timbers ecoregion.

Strongly Disagree	Disagree	Neutral	Agree	Strongly agree

I gained knowledge of the Cross Timbers ecoregion after my visit to the Keystone Ancient Forest today.

Strongly Disagree	Disagree	Neutral	Agree	Strongly agree

I support the preservation of the Cross Timbers ecoregion.

Strongly Disagree	Disagree	Neutral	Agree	Strongly agree

My attitude of old-growth forests changed today.

Strongly Disagree	Disagree	Neutral	Agree	Strongly agree

Old-growth forests are important to preserve.

Strongly Disagree	Disagree	Neutral	Agree	Strongly agree

The Cross Timbers ecoregion is important to our regional history.

Strongly Disagree	Disagree	Neutral	Agree	Strongly agree

Oklahoma State University Institutional Review Board

Date:	Friday, October 11, 2013
IRB Application No	GU1312
Proposal Title:	The Effects of Interpretation on Visitor Knowledge and Attitude of Cross Timbers Ecoregion
Reviewed and Processed as:	Exempt

Status Recommended by Reviewer(s): Approved Protocol Expires: 10/10/2016

Principal Investigator(s):

Anne Brockman
18922 E 49th Pl
Tulsa, OK

Lowell Caneday
180 Colvin Center
Stillwater, OK 74075

The IRB application referenced above has been approved. It is the judgment of the reviewers that the rights and welfare of individuals who may be asked to participate in this study will be respected, and that the research will be conducted in a manner consistent with the IRB requirements as outlined in section 45 CFR 46.

X The final versions of any printed recruitment, consent and assent documents bearing the IRB approval stamp are attached to this letter. These are the versions that must be used during the study.

As Principal Investigator, it is your responsibility to do the following:

1. Conduct this study exactly as it has been approved. Any modifications to the research protocol must be submitted with the appropriate signatures for IRB approval. Protocol modifications requiring approval may include changes to the title, PI, advisor, funding status or sponsor, subject population composition or size, recruitment, inclusion/exclusion criteria, research site, research procedures and consent/assent process or forms.
2. Submit a request for continuation if the study extends beyond the approval period of one calendar year. This continuation must receive IRB review and approval before the research can continue.
3. Report any adverse events to the IRB Chair promptly. Adverse events are those which are unanticipated and impact the subjects during the course of this research; and
4. Notify the IRB office in writing when your research project is complete.

Please note that approved protocols are subject to monitoring by the IRB and that the IRB office has the authority to inspect research records associated with this protocol at any time. If you have questions about the IRB procedures or need any assistance from the Board, please contact Dawnett Watkins 219 Cordell North (phone: 405-744-5700, dawnett.watkins@okstate.edu).

Sincerely,

Shelia Kennison, Chair
Institutional Review Board

Script

For Principal Investigator:

Hi, my name is Anne Brockman. I am a graduate student from Oklahoma State University conducting research on visitor experience and interpretation here at the Keystone Ancient Forest. I am asking for participants to be a part of my research on knowledge and attitude regarding the Cross Timbers ecoregion and the interpretive experiences here at the Keystone Ancient Forest. Participation involves answering an anonymous questionnaire before and after your visit to the preserve today. Each questionnaire should take a maximum of 7 to 10 minutes. Would you be willing to participate?

For Assistants:

Hi, my name is _____. I am assisting Anne Brockman, a graduate student from Oklahoma State University who is conducting research on visitor experience and interpretation here at the Keystone Ancient Forest. I am asking for participants to be a part of this research on knowledge and attitude regarding the Cross Timbers ecoregion and the interpretive experiences here at the Keystone Ancient Forest. Participation involves answering an anonymous questionnaire before and after your visit to the preserve today. Each questionnaire should take a maximum of 7 to 10 minutes. Would you be willing to participate?

Before proceeding to the survey, please read the following information

Project title:

The Effects of Interpretation on Visitor Knowledge and Attitude Regarding the Cross Timbers Ecoregion

Investigator:

Anne Brockman, mbroc@ostatemail.okstate.edu, Oklahoma State University
Lowell Caneday, Ph.D., lowell.caneday@okstate.edu, Oklahoma State University, advisor

Purpose:

The pre-test and post-test questionnaire is to determine how interpretive tools affect the knowledge and attitude visitors to the Keystone Ancient Forest has regarding the Cross Timbers ecoregion.

Procedures:

Continuing with the printed pre-test survey will imply your consent to participate in this study. If you decide to participate, you will complete the pre-test and post-test survey with instructions on the first page of the survey. You will be asked about your knowledge of the Cross Timbers ecoregion and your attitude regarding its conservation and preservation, as well as basic demographic questions. You will answer all the questions in the printed survey. Each questionnaire is designed to last approximately 7 to 10 minutes.

Risks of Participation:

There are no known risks associated with this project that are greater than those ordinarily encountered in daily life. If, however, you begin to experience discomfort or stress in this research, you may end your participation at any time.

Benefits:

The assessment will assist in determining the effectiveness of current interpretive tools present at the Keystone Ancient Forest. The data collected will be used to assess the current programs and plan for future programs at the preserve. Demographic information will also be collected to help determine who visits the Keystone Ancient Forest.

Confidentiality:

All information about you will be kept confidential and will not be released. The information will be saved for up to one year and the records of this study will be kept private. Any written results will discuss group findings and will not include information that will identify any individual participant. Research records will be stored securely and only researchers and individuals responsible for research oversight will have access to the records.

Compensation:

There is no compensation for participation in this needs assessment.

Contact:

If you have any questions or concerns about the study, please contact principal investigator Anne Brockman, (918) 633-2295, mbroc@ostatemail.okstate.edu, Environmental Science, Oklahoma State University-Tulsa, Tulsa, OK, 74106; or Lowell Caneday, Ph. D., (405) 744-5503, lowell.caneday@okstate.edu, Leisure Studies, 184 Colvin Center, Oklahoma State University, Stillwater, OK, 74078. If you have questions about your rights as a research volunteer, you may contact Dawnett Watkins, IRB Manager, 217 Cordell North, Stillwater, OK 74078, (405) 744-5700 or dawnett.watkins@okstate.edu.

Participant Rights:

Your participation in this research is voluntary, and there is no penalty for refusal to participate. You are free to withdraw your consent and participation in this study at any time.

Consent:

I have read and fully understand the consent form. I understand that my participation is voluntary. By completing the pre-test questionnaire, I am indicating that I freely and voluntarily and agree to participate in this study and I also acknowledge that I am at least 18 years of age.

VITA

Anne Mary Brockman

Candidate for the Degree of

Master of Science

Thesis: THE EFFECTS OF INTERPRETATION ON VISITOR KNOWLEDGE AND ATTITUDE REGARDING THE CROSS TIMBERS ECOREGION

Major Field: Environmental Science

Biographical:

Education:

Completed the requirements for the Master of Science in Environmental Science at Oklahoma State University, Tulsa, Oklahoma in May, 2014.

Completed the requirements for the Bachelor of Arts in Journalism and Mass Communications at the University of Oklahoma, Norman, Oklahoma in 2004.

Experience:

September 2009- Present

Assistant Editor (January 2014-present), Marketing Coordinator (October 2010-December 2013), Editorial Assistant (September 2009-September 2010)
TulsaPeople Magazine/Langdon Publishing Co., Tulsa, Oklahoma

January 2008-July 2009

Public Information Officer
Gilcrease Museum, Tulsa, Oklahoma

October 2004-December 2007

Reporter/Photographer (Nov. 2006-Oct. 2007), Editorial Assistant (Oct.2005-Nov. 2006), Obituary Clerk (Oct. 2004-Oct. 2005)
Tulsa World, Tulsa, Oklahoma

Memberships & Activities:

Keystone Ancient Forest volunteer trail guide, City of Sand Springs Parks Department, 2007-present
Tulsa Archery Association secretary, 2008-present
DVIS Community Relations committee, 2011-present
Tulsa Area Alumnae Chapter of Phi Mu Fraternity, secretary (2011-present), member (2005-present)
Up With Trees Citizen Forester, 2014-present