ABSTRACT

| | |
|---|---|
| Title of Thesis: | **ANALYTICAL METHODS AND COMPARISON OF PROJECTILE POINTS AND KNIVES FROM WOODLAND AND MISSISSIPPIAN PERIOD CONTEXTS AT THE STATE-LINE SITE (12D18 & 33HA58).** |
| | Jacob Martin Carlson, Master of Professional Studies in Cultural Heritage and Resource Management, 2025 |
| Thesis Directed By: | Dr. Matthew Palus, Department of Anthropology |

The transition between the Woodland Period and the later Mississippian Period was a time of momentous technological and societal change and development for native peoples of the Ohio River Valley. The periods are differentiated by the introduction of maize agriculture, the transition to larger, more sedentary population centers, the adoption of different pottery styles and techniques, and the use of unique lithic tools, among other changes. The State Line Site (12D18/33HA58), situated in the Ohio River Valley on the state boundary between Indiana and Ohio, is a multi-component Native American village site primarily occupied by the Fort Ancient Culture of the Mississippian Period, with evidence of lighter occupation during the Woodland period. The Fort Ancient component may have been vital to the local area and for inter-regional

trade, due to its proximity to the Ohio River and a local salt lick. It is one of the densest and most significant prehistoric sites in either state, though previously relatively understudied.

Projectile points and Knives (PPKs) are useful for study due to their relative ease of identification, the uniformity of their manufacture within a range of types, and the huge body of comparative data available. Variations in PPK material, design, and wear can be used to help explain site utilization, lithic material sourcing, and migratory patterns that changed during this transition from the Woodland Period into the Mississippian Period. This thesis employs a combination of macro- and microscopic analyses on PPKs recovered from the recent excavations at the State Line Site in order to understand what lithic projectile points and knives (PPKs) from the State Line Site tell us about changing activities across the transition from Woodland to the Mississippian Period. Use wear was identified under low-power microscopy, between 8x and 15x. Each PPK's geometry was measured, including maximum length, thickness, width, basal width, basal thickness, neck length, neck width and thickness, notch height, notch depth, notch angle, blade angle, weight, and cortex percentage. With this data, this study aims to answer four Hypothesis statements:

**H1: Supported**

The typology, manufacture, and use of the State Line Site projectile points vary between Woodland and  Mississippian Period contexts. In the Woodland context, PPKs will more frequently have evidence of being used as tools for hunting seasonal game and the butchering process of said game, compared to those projectile points from Mississippian Period contexts.

**H2: Supported**

The lithic material of projectile points from Woodland contexts found at the State Line Site varies from that of Mississippian Period context PPKs. Lithic material associated with the

Woodland Period will have traveled a greater distance compared to that of the Mississippian Period contexts.

**H3: Supported**

Projectile points from Woodland contexts at the State Line Site are often more robust compared to those of projectile points from Mississippian contexts, and the Woodland assemblage has more signs of retouching compared to those of the Mississippian Period assemblage.

**H4: Falsified**

The lithic material most often identified in the Mississippian Period contexts at the State Line Site is that of local pebble cherts that are of lesser quality compared to sourced cherts seen with PPKs from Woodland contexts. In most cases, lesser quality cherts may be found to be heat-treated to assist with the manufacturing process of flintknapping to prevent unwanted breakage patterns. This leads to my hypothesis that the Mississippian Period PPK assemblage will contain a greater proportion of artifacts with evidence of heat treatment.

The Analysis has provided insight into aspects about not only the changes that took place at the State Line Site during the transition from the Woodland Period into the Mississippian Period, but also more data for a better understanding of how the Ohio River Valley/Midwest of America changed. Groups of the Ohio River Valley moved from using the area for hunting and butchering of game toward large sedentary villages focused on horticulture. Specifically at the State Line Site, the PPK analysis supports that during the Woodland Period, the site was used as a primarily hunting/butchering camp, and during the Mississippian Period was used as a large sedentary village site with hunting and butchering large game taking place elsewhere as hunting pressure of the local area would increase with larger populations.

# ANALYTICAL METHODS AND COMPARISON OF PROJECTILE POINTS AND KNIVES FROM WOODLAND AND MISSISSIPPIAN PERIOD CONTEXTS AT THE STATE-LINE SITE (12D18 & 33HA58).

by

Jacob Martin Carlson

Thesis submitted to the Faculty of the Graduate School of the
University of Maryland, College Park, in partial fulfillment
of the requirements for the degree of
Master of Professional
Studies in Cultural Heritage
and Resource Management
2025

Advisory Committee:
Dr. Matthew Palus, Chair
Dr. George Hambrecht
Dr. Kathryn Lafrenz Samuels

# Acknowledgments

I want to thank and acknowledge the contributions of several different groups and individuals. First, I would like to thank ASC Group, my employer, for allowing me to conduct this research and assisting me in many ways, including office space to work, access to the artifacts, and funding. I would also like to thank Dr. Kevin Schwarz, Collin Williams, Mike Wilson, M.A. RPA, David Klinge, Andrea Krider, M.A. RPA, and Dr. Logan Miller. Dr. Schwarz has been a mentor and has provided me with access to the artifacts and information necessary to complete my work, and assisted with many other things throughout the process. Collin Williams, the lab director with ASC Group, assisted with gathering the artifacts quickly used in my analysis. Mike Wilson, M.A. R.P.A., assisted with many day-to-day questions with methodology and analysis of lithic artifacts. They also provided literary information for references to help with writing my thesis. David Klinge assisted me in this process by allowing funding and office space to conduct the analysis. Andrea Crider M.A. R.P.A., the field director of the State Line Site project, has provided many insights into the project's background that were essential for my work. Dr. Logan Miller conducted microwear analysis on sample PPKs from the State Line Site in the past and was able to provide his previous studies and telecommunicate with me about methodology and what is necessary for conducting micro/use-wear analysis.

# Table of Contents

## Tables

## List of Abbreviations

PPKs: Projectile Points and Knives

R.P.A.: Registered Professional Archaeologist

# Chapter 1: Introduction

What do lithic projectile points and knives (PPKs) from the State Line Site tell us about changing activities across the transition from Woodland to the Mississippian Period, and the change from seasonal hunting and gathering subsistence strategies with long-term lithic tool longevity to sedentary village centers with horticulture subsistence strategies and expendable lithic tool use? The transition between the Woodland Period and the later Mississippian Period was a time of momentous technological and societal change and development for native peoples of the Ohio River Valley. The periods are differentiated by the introduction of maize agriculture, transition to larger, more sedentary population centers, adoption of different pottery styles and techniques, and unique lithic tools, among other changes. The State Line Site (12D18/33HA58), located in the Ohio River Valley on the state boundaries of Indiana and Ohio, is a multi-component Native American village site primarily occupied in the Mississippian Period, with evidence for less intensive occupation during the Woodland period. There is also evidence of paleo and archaic occupation, but as less dense than the Woodland and Mississippian Periods. The Mississippian Period/Fort Ancient Culture component may have been critical to the local area and inter-regional trade due to its proximity to the Ohio River and a local salt lick. It is one of the densest and most significant prehistoric sites in either state, though previously relatively understudied. Before continuing, the distinction between the Mississippian Period, Mississippian Cultures, and Fort Ancient Cultures needs to be explained. The Mississippian Period is a temporal period that ranges between 800 to 1600 A.D., and within this temporal period, distinct cultures spanned throughout the period. The Mississippian Culture, located in the

Eastern/Southeastern United States, occupied the region during the Mississippian Period, along with the Fort Ancient Culture that occupied the Midwestern United States during this period.

I expect to find evidence that either supports or falsifies a group of hypotheses that include:

**H1:**

The typology, manufacture, and use of the State Line Site projectile points vary between Woodland and Mississippian Period contexts. In the Woodland context, PPKs will more frequently have evidence of being used as tools for hunting seasonal game and the butchering process of said game, compared to those projectile points from Mississippian Period contexts.

**H2:**

The lithic material of projectile points from Woodland contexts found at the State Line Site varies from that of Mississippian Period context PPKs. Lithic material associated with the Woodland Period will have traveled a greater distance compared to that of the Mississippian Period contexts.

**H3:**

Projectile points from Woodland contexts at the State Line Site are often more robust compared to those of projectile points from Mississippian contexts, and the Woodland assemblage has more signs of retouching compared to those of the Mississippian Period assemblage.

**H4:**

The lithic material most often identified in the Mississippian Period contexts at the State Line Site is that of local pebble cherts that are of lesser quality compared to sourced cherts seen with PPKs from Woodland contexts. In most cases, lesser quality cherts may be found to be heat-treated to assist with the manufacturing process of flintknapping to prevent unwanted breakage patterns. This leads to my hypothesis that the Mississippian Period PPK assemblage will contain a greater proportion of artifacts with evidence of heat treatment.

These hypotheses were not only formed from the literature of PPKs and sites of the region but also from my time excavating at the State Line Site for three years and continuing at the time of preparation of this thesis. During this time, I began to notice some patterns in the lithic PPKs found. I thought a statistical analysis would be beneficial to the understanding of how State Line Site's use activities and subsistence strategies change between the Woodland and the Mississippian Period.

Also, during the excavation of the State Line Site, there has been meaningful and good faith consultation with the Miami Tribe of Oklahoma, with close work with tribal monitors each day. This consultation would consist of giving progress reports to the tribal monitor each day about new finds and methods for excavation. We would also receive feedback from the monitor about how the Tribe would like excavations carried out.

The study that follows includes these sections:

### *Historic Background*

A background of the State Line Site's history will be provided along with a regional background to allow for a fuller comprehension of how the data matches previous notions of the area's history and what new information can be provided to further our collective knowledge of the past. The background section not only provides a background of the Woodland and Mississippian Periods but also the Mississippian and Fort Ancient cultures. This includes settlement structure patterns, lithic tool types, and well-known sites dated and from those contexts.

*Acquisition of Data Sample and Methods:*

To address the proposed research question, a group of 62 complete/mostly complete projectile points and knives (PPKs) from Woodland and Mississippian Period contexts at the State Line Site was analyzed to provide a larger sample group, and then a subgroup from both contexts was chosen for microwear/use-wear analysis. This data assisted with the identification of activities, lithic material sourcing, and possible travel patterning/trade relation changes during the transition from the Woodland to the Mississippian Period at the State Line Site.

Projectile points and knives (PPKs) are useful for study due to their relative ease of identification, the uniformity of their manufacture within a range of types, and the huge body of comparative data available. Variations in PPK material, design, and wear can help explain site utilization, lithic material sourcing, and migratory patterns that changed during this transition from the Woodland Period into the Mississippian Period. A combination of macro- and microscopic analyses will be used on PPKs recovered from the recent excavations at State Line. Use wear was identified under low-power microscopy, between 8x and 15x. Each PPK's geometry was measured, including maximum length, thickness, width, basal width, basal thickness, neck length, neck width and thickness, notch height, notch depth, notch angle, blade angle, weight, and cortex percentage. The significance of these morphological measures is discussed later in this thesis.

*Data Results and Analysis*

An important portion of the research is to analyze the results to properly assess each hypothesis presented along with the overarching thesis question presented above. To make these determinations, the results were made into pivot tables and charts and ran through analytical tests of statistical significance. These data analysis methods provide a visual representation of the results, along with quantitative measurement of their significance rather than inferences made from reviewing the results.

*Key Theoretical Framing*

Theoretical frameworks for analyzing sites, lithic tools in the macro and micro, discerning typologies, and analyzing temporal periods/phases are keys to creating a strong foundation for my research. Each of these topics and their theoretical history and use for similar research in the field will be explored and provided to give a framework for how this research was conducted from its beginning. An example of previous microwear/use wear studies at the State Line Site was the work done by Dr. Logan Miller in 2022. This, along with research conducted by Yerkes (2009, 2018), provided examples for my analysis of the assemblage I have studied regarding their use wear and what information they can provide. The next chapter will delve deeper into the theoretical framework for my research.

# Chapter 2: Foundations of Thought: Theoretical Framework for Lithic Analysis.

*Introduction*

When considering theoretical frameworks for the projectile point analysis of PPKs at the State Line Site from Woodland and Mississippian Period contexts, I believe in providing the broad goals of archaeological research and how sites of this size may be studied. I also wanted to narrow the theory towards the specific questions that I am asking and how previous theories can provide a sturdy framework for conducting my analysis. This includes theory about lithic analysis and how to conduct this process, along with how to discern typologies of PPKs, which is needed for my research.

*The Goal of Archaeological Research*

When considering literature about archaeological analysis of cultures, sites, etc., one needs to consider the goal of research. There are many different ideas on this topic, some believe that "If seeking origin and tracing the history of culture was one task of archaeology, some researchers considered a further aim to be the reconstruction of the lifeways or the peoples responsible for the archaeological remains" (Binford 2017, 78). I find this aim to be a solid view, but it is not the whole responsibility of archaeologists. They are preserving and disseminating our findings to educate the public about their collective heritage. With future research of the State Line Site in mind, I do believe it is important to understand the relation between a site and the regional history that it connects with. This means we must have "a general recognition that local-level cultural phenomena can only be understood within a broader social and geographical frame of reference" (Stein 2002, 903). I plan to use this theoretical framework in my research of the State Line Site because most sites cannot truly be understood within a narrow context and require analysis of surrounding factors like other cultural interactions and influence. The environmental concerns of a region also prove to be of importance when it comes to how cultures evolve. However, the main goal of my research is to answer what changes in daily activities and site function occurred at the State Line Site during the transition from the Woodland Period to the subsequent Mississippian Period occupation. This is a way "that archaeologists have incorporated human behavior into their interpretations of archaeological sites" (Andrevsky 2005, 201).

*How to Analyze Sites and Phases*

As previously mentioned, there have been cases of sites being used for periods spanning from seasons to decades, and in cases of larger centers, longer. Still, some sites were only inhabited once while others were revisited. There is also interaction between groups at different rates throughout separate phases, which is why using a framework that isn't constrained by rigid boundaries can be useful when examining human interactions at various levels of specificity. According to Crema et al., "The assessment of spatial patterns in archaeology is hampered by several constraints, one of the most serious of which is the intrinsic temporal uncertainty associated with most of the archaeological record" (Crema et al. 2010, 1). An example at the State Line Site is that there have been many instances where features from different temporal periods are intersected, causing the depth of artifacts to be possibly displaced from their original contexts. One reason for the uncertainty is that "the temporal allocations of most events are fuzzy due to the intrinsic uncertainty of archaeological data" (Crema et al. 2010, 2). A suggestion to fix this problem of uncertainty is in probabilistic approaches that include the uncertainty and probability values in the data analysis process (Crema et al. 2010). When looking at human lifeways, one can look at aspects of personal, residential, societal, and regional culture, a scale of specificity in topics examined. This theoretical framework is important when considering what questions one is trying to answer about a certain topic, which may be a collection of varying levels of this specificity scale. The State Line Site has evidence of multiple occupational occurrences, all of which have their unique material artifacts and information to present. This thesis analyzes the lithic tools of each occupation to provide information on how the use of the site changed during the transition from the Woodland to the Mississippian Periods, along with daily activities. One theoretical point of view on how to delineate pre-Mississippian and Mississippian sites has been the fact that "most pre-Mississippian communities were occupied during a single recognizable phase and then were abandoned. Terminal Late Woodland communities at particular sites are never succeeded by equivalent-sized or similarly formatted Mississippian communities" (Fortier et al. 2002, 186).

### *Deeper Look at the Scaling of Data*

Scaling data is an aspect of analysis whose importance cannot be overstated. As I previously mentioned, data is most commonly analyzed at the site, state, and regional levels. However, this can be made much more specific by analyzing the residential level, personal level, etc. This could be done by analyzing one structure or feature inside a site area. Some, like Lewis Binford, propose that material culture should be used more to answer regional cultural questions, but also worked on more specific societal levels with ethnography, which gave him insight into residential and personal levels. One issue presented for looking at data analysis regionally is that it is a very large data set, and new sites can change the trends. Cook and Comstock say that "as more sites have been analyzed, this temporal scheme of Fort Ancient Culture triangular points has been modified, which is a healthy aspect of practical typologies" (2014:224), during their research of projectile point morphology changes in the Midwest of the United States. Another concern when dealing with data at different scales is discerning what scale of data is best used to find trends for our questions. It is said that the archaeologists' "challenge is to develop statistically valid temporally discernible forms and to outline a few testable hypotheses that could be explored to examine how those forms may have evolved" (Cook and Comstock 2014:223). Lewis Binford held that " the isolation and definition of ordered relationships in the archaeological record are necessary for empirical generalizations about the record, these generalizations then can serve as the referents for our explanations" (Binford 2017, 85). This I take to mean that isolation of data can be a way to properly and empirically study the data before comparing it to broader general regional data for answering questions. Analysis of PPKs from the State-Line Site is a contribution towards the definition of regional patterns in the Ohio River Valley.

## *Lithic Analysis and Discerning Typology*

### **Lithic Analysis**

I plan to use micro-wear analysis as part of my analysis repertoire of the State Line Site lithic tool materials. Firstly, it is vital to understand what lithics are and what characteristics would be sought after. The "characteristics for the best-chipped stone lithics are hardness, cohesiveness (lack of brittleness), and perfectly conchoidal fracture" (Rapp 2009, 69). To do this, I believe it to be important to use the multi-stranded approach that uses both statistical testing and quantification of material collections. This approach helps to dilute bias and conclusions based on small datasets because “ In the multi-stranded approach, single residue occurrences are interpreted to the best of the analyst’s abilities, and functional interpretations are based on the larger dataset recorded on a tool and a representative sample of (morphologically similar) artifacts” (Marreiros, et al 2014: 57). This approach will help reduce bias and give the State Line Site data set a comparative marker for true analysis. The comparative marker would be comparing the data from the State Line Site to other contemporary sites in the region. Another topic of importance when conducting lithic tool analysis is formal typology, which changed throughout temporal periods, providing the ability to date projectiles to different temporal periods in context. Along with this approach of discerning typology, the method for attaining measurements of points would be to measure the length from the tip to base, the width from the platform to the widest point, and the thickness measurement at the thickest point while avoiding the bulb of percussion ( Raviele, 2007, 101).

**Discerning Typology**

Since my focus on the State Line Site will be that of analyzing the temporal changes of lithic tools at the site, then the aspect of discerning typology is of great importance. Two important and commonly used methods, as mentioned previously, are the “two concepts for discerning typology," which include morphological typology and reduction sequence-based typology, and how this concept has changed the analysis of lithic tools (Schulenburg, 2010, 85). The first is morphological typology, which is practically the typing of materials/objects by the physical traits that they share (Schulenberg 2010). This analytical approach can at times be difficult to use because the morphology of a point can be influenced by the flintknapper's experience level/skill, more localized influences, etc. The issue of tools not always being fully intact can also present difficulty in identifying them using morphology. (Cook and Comstock

2014) write that “one of the most dangerous problems in creating typologies is that researchers often reify categories”. This means that once an archaeologist puts the typologies into the data set, then bias and the view of reality and what the archaeologists want to be true become blurred. The second analysis method is reduction sequence-based typology, which does not only consider the end form of the tool like morphological typology does but considers the “sequence of events that began with the cobble, continued throughout the “life” of the material, and ended with the deposition of the discarded tool into the archaeological record” (Schulenberg 2010, 87). This method does take into account and helps answer some of the issues that I mentioned about the morphological typology methods. One issue, however, according to (Schulenberg 2010), is that this methodology can lead to the view that a certain technique used can then identify the product. This, however, is not true because it has been found that end products of tools can be created using different techniques. The techniques may be more useful in identifying regional/localized cultural influences in style.

## *Conclusion*

The study of the State Line Site through lithic analysis and a broader archaeological framework of the Ohio River Valley Region can offer valuable information about site usage and human behaviors at the site and the changes that have occurred between the Woodland and Mississippian Periods. By combining a broad range of archaeological theory, lithic tool analysis, and spatial analysis, we can answer the questions mentioned previously. The multi-stranded theoretical approach through microwear analysis and typological categorization looks to provide a solid and robust approach to minimize biases and provide a clear framework to make conclusions about the findings. The conclusions look to enhance and add to our understanding of the region's history, along with the localized area surrounding the State Line Site. Specifically at the State Line Site, I look for the PPK analysis to support that during the Woodland Period, the site was used as a primarily hunting/butchering camp, and during the Mississippian Period was used as a large sedentary village site with hunting and butchering large game taking place elsewhere as hunting pressure of the local area would increase with larger populations.

# Chapter 3: Historical Background

## *Introduction Into the Broader United States Midwest and Eastern Woodland Period Background*

### **Introduction**

The State Line Site has a long and multifaceted history that spans multiple temporal periods and hosts many cultural groups. The context requires background not only about the State Line Site but also the surrounding region, including the cultures inhabiting this region, and similar sites found in the Ohio River Valley. This chapter provides a broader history of the area, the cultures known throughout the Woodland and Mississippian periods, sites connected with these cultures/temporal periods, their lithic material culture, and finally the background of the State Line Site itself, including the connection of The Miami of Oklahoma and Shawnee Tribes to Site area. This paper hopes to bring this wide array of history together to provide a strong background for my research.

### **Broader United States Midwest and Eastern Woodland Period Background:**

The Woodland temporal period in the Midwest of the United States of America spanned from 1,000 B.C. to 1,000 A.D. The period is considered a transitional period between hunter-gatherer archaic lifeways with some agriculture/horticulture of different plants, and the maize agricultural lifeways of the Mississippian and Fort Ancient cultures. In the case of previous farming histories, the terms agriculture and horticulture are sometimes interchanged, but some, like Fritz (2019) and Relf (1992), consider them to be separate practices. Horticulture is used in farming practices with a less committed utilization of farming, while agriculture is commonly used in societies that have a more committed utilization of farming. Another way to view this is that horticulture has a more connected relationship between a person and the natural plant that they harvest compared to agriculture, which is seen as more of a systematic and disconnected process (Relf 1992). The Woodland Period is also widely known for the development of a key aspect of their material culture of pottery. The Woodland period is commonly divided into a temporal time frame of three sections: Early, Middle, and Late Woodland. Conversely, another framing acknowledges a change in a less temporal-based way. This framing is divided by “early, post-Middle Woodland demographic shifts and variability in settlement patterns; widespread use of bow and arrow technology ca A.D. 600-800; and, after A.D. 800-1000, increased maize dependency as an aspect of sedentism, leading to transformations in hierarchical sociopolitical systems” (Church, 2013:3). For instance, at the site of Cahokia, Fritz (2019) argues that societal changes may not have been caused by changes in food subsistence strategies, or not completely at least. She suggests that Cahokia’s food subsistence economy was based on essential crops and was not on a larger scale than necessary (Fritz 2019). The transformation into sociopolitical systems that had hierarchies provided drastic changes in the material culture. This can take the form of different burial practices and even ornamental materials like lithic gorgets and specialized objects like lithic tools that the person may have used often in their daily work. These refer to tools crafted and specialized based on their purpose, area, cultural influences, etc.

## *Mississippian Period/Culture and Fort Ancient Background*

### **Mississippian Period**

The Mississippian period is a period that some (Fortier et al. 2002) consider distinguished from that of the Woodland Period, dating back from 1000 A.D. - 1050 A.D. to the period of contact with Europeans. The distinction of the two periods has been debated like many other aspects of archaeology because “the variations and the variables that archaeology deals with are characteristically elusive; they are arbitrarily demarcated and defined, in either fluid or static situations” (Chang, 1967: 227). With cultural/social sciences, the change of cultures from one period to another can sometimes be continuous and not abrupt, making clear distinctions difficult and leading to arbitrary delineation. The Mississippian period is recognized for the emergence of large settlements. The period is also known for the beginning of widespread maize agriculture, mound building, and shell-tempered pottery (Cook, 2007). These cultural traits were spread and integrated amongst groups, with each bringing their cultural materials and practices to the others, causing fluid cultural interaction between cultures. This means that these cultural practices will not be seen or present at all sites simultaneously, but patterns can still be identified in the material culture found during excavation.

### Fort Ancient Background

The Fort Ancient Culture was a horticulturalist culture that was based in the Ohio River Valley. The territory extended into Ohio, Kentucky, Southeastern Indiana, and West Virginia. The Fort Ancient Culture dates from 900 A.D. to 1750 A.D. The Fort Ancient Culture also borders another contemporary culture area called the Mississippian Culture area of the Southeastern United States. Interaction between the Fort Ancient and Mississippian Cultures varied quite a bit, and “because of the different contexts within which Fort Ancient/Mississippian interaction manifests itself, it may be more correct to consider Fort Ancient/ Mississippian ‘interactions’ rather than ‘interaction’” (Pollack et al. 2002: 217). The Fort Ancient Culture is known to have had primarily a sedentary village community structure. From previous studies, the Fort Ancient Culture did not rely only on horticulture but also hunted and fished for resources. The Ohio River and its tributaries made an attractive area to live in with plentiful food sources and made trade easier. The Fort Ancient culture is primarily known for being the first to bring domestic maize agriculture to the middle Ohio River Valley. The Fort Ancient Culture is contemporary with the Mississippian Culture of the Southeastern United States, and they came into contact near the Ohio River Valley. One trade good that the Fort Ancient Culture was known to supply was salt. This was interesting because the State Line Site is located next to a creek that has naturally occurring salt deposits (Vickery et al. 2000). This can have implications for trading materials and reasons for the specific site location for ease in hunting practices since animals are naturally drawn to salt licks.

**Mississippian Culture Background**

The Mississippian culture was based in the Eastern, Southeastern, and Midwestern United States of America and dates from 800 A.D. to 1600 A.D. during the Mississippian Period. The name Mississippian Culture is given by the cultural roots of origin along the Mississippi River before spreading east. The Mississippian culture is highly known for its earthen works of mounds, and platform mounds. The mounds are often related to the fact that during this time chiefdoms and social inequality became prevalent (Beck, 2003). Chiefdom is a word that can have different meanings, but "in anthropology, a notional form of sociopolitical organization in which political and economic power is exercised by a single person (or group of persons) over many communities" (Beck 2003). With the beginnings of chiefdoms and social inequality, social hierarchies became part of the culture. Large trade networks are also an aspect of Mississippian lifeways, and some evidence even points to trade relations with the Rocky Mountains of the Western United States. The Mississippian culture as previously mentioned had large reaches, which can be connected to the fact that the cultural area covered a large portion of the U.S. and this area has been separated into the "Lower Mississippi Valley (LMV), the Central Mississippi Valley (CMV), and the American Bottom (AB)" (Mehta et al, 2019:1).

*Sun Watch: A Major Fort Ancient Site*

One major Fort Ancient site that has provided a great deal of information about the Fort Ancient culture is the Sun Watch village site. This site is in Dayton, Ohio, along the Great Miami River. This site is of such importance that it was listed on the National Register of Historic Places in 1974. Evidence points to the site's habitation for 20 years with a population of around 250 people. Investigations have also highlighted post markings that may have coincided with the solar calendar for ceremonies/rituals on certain dates. The site was made in a circular formation, and there is evidence of defensive palisades surrounding it. The State Line Site does not show signs of palisades like this site, which requires more research on why they were absent. Professional archaeological work at Sun Watch began in 1971, and studies have been done since, providing valuable information. One study revealed that the people of the Sun Watch site interacted with the Mississippian Culture because "there is a concentration of non-local shell-tempered pottery and local imitations/hybrids in areas at Sun Watch also containing civic-ceremonial architecture, the burial of a village leader, and a wall trench house" (Cook et al. 2007: 156). This evidence pointed towards the possibility of the leader using trade and relations with the non-local forces and material culture to gain status (Cook et al. 2007).

*<u>Cahokia: A Major Mississippian Site</u>*

Regarding Mississippian sites, the Cahokia Mound State Historic Site in Southwestern Illinois is one of the most well-known and provides significant knowledge about Mississippian city-states and culture. The site's major occupation dates from 1150 A.D. to 1350 A.D. It is thought to have been inhabited by 15,000 to 20,000 people. The site has mounds numbering approximately 120, covering a six-square-mile area. Cahokia was “a city laid out according to the cardinal directions and dominated by a flat-topped, truncated earthen pyramid slightly more than 100 feet tall and covering approximately 14 acres at its base” (Fritz, 2019: 1). Cahokia is not the only site with evidence pointing towards the construction laid out in concert with cardinal directions and constellations. The site has been the nexus for cultural contact theory evolution, and “as this body of theory was being developed, Cahokia research moved in tandem” (Friberg, 2020: 10). Cultural Contact is “contact between peoples with different cultures, usually leading to change in both systems. The theory behind this term is that contact between cultures will cause changes from influence between each, however at times the influence can be one-sided because of the imbalance in power dynamics of each society (Pettigrew 1998: 66). The influence, however, does not show up the same across different sites in the archaeological record. This is shown by the “Richland Complex, which is difficult to define as the settlements seem to straddle the line (1) between direct involvement in Cahokia’s fundamental economic activities and (2) the negotiation of contact with Cahokia—two scenarios that distinguish patterns of lifeways between the American Bottom and northern hinterland Mississippian traditions” (Friberg, 2020: 33). Due to the site’s significance, it has been listed as a National Historic Landmark and is on the UNESCO World Heritage List. The site also shows evidence of trade interaction because examples of Cahokia local tool types are found at other sites in the region. Cahokia has other implications as to social economic concerns during this period and research at the site has developed over the years, with "adaptationist views, political-economic models emerged in the late 1980s that led to a concern with tracking the production and distribution of 'prestige goods' by emergent elites, a concern that had the side benefit of promoting the role of human agency (of elites, anyway) in the long-term development of a place" (Pauketat, 2002: 152). This is important because interactions between the Mississippian culture and Fort Ancient culture may have been impacted by the leadership of city leaders, causing an impact on influence and material culture trading. There are "settlements in the American Bottom and its eastern uplands show direct evidence of political and economic ties with Cahokia and are considered part of the Greater Cahokia cultural area" (Friberg 2020: 6). Cahokia can be considered a city because according to many (Pauketat 2002; Fritz 2019), the Cahokia site was one of the first great cities of the Eastern/Midwest United States during the Mississippian Period.

## *Middle to Late Woodland Period Lithic Tool Types and Fort Ancient/Mississippian Lithic Tool Types*

### **Middle To Late Woodland Period Lithic Tool Types**

During the Middle to Late Woodland Period, the Adena Stemmed (Figure 1), Copena Triangular (Figure 2), Scallorn, and low flared points (Figure 3) were some of this period's major projectile point types (Justice 1987). A few like the Scallorn type are known to spill into the Mississippian Period from the Late Woodland Period. Woodland Period PPKs/tools are often found to be made for long-term and specific use. These types of tools are often called formal tools instead of their expedient counterparts, frequently made with less intent and discarded more rapidly.

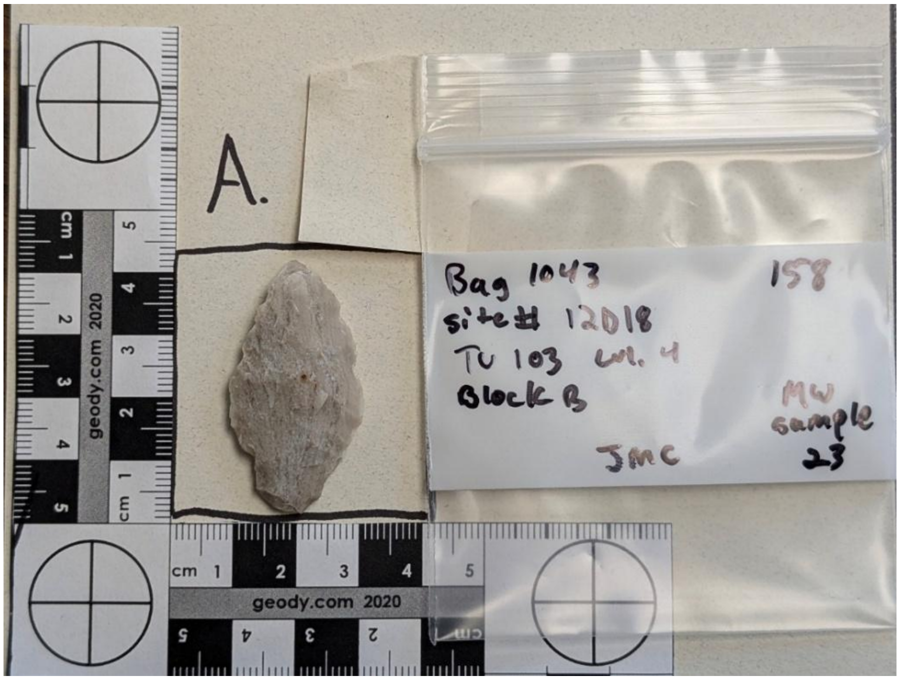


*Figure 1. Ventral Side of Sample 23 Adena Stemmed PPK. Photograph by Author*


*Figure 2. Ventral Side Sample 14 Copena Triangular PPK. Photograph by Author*

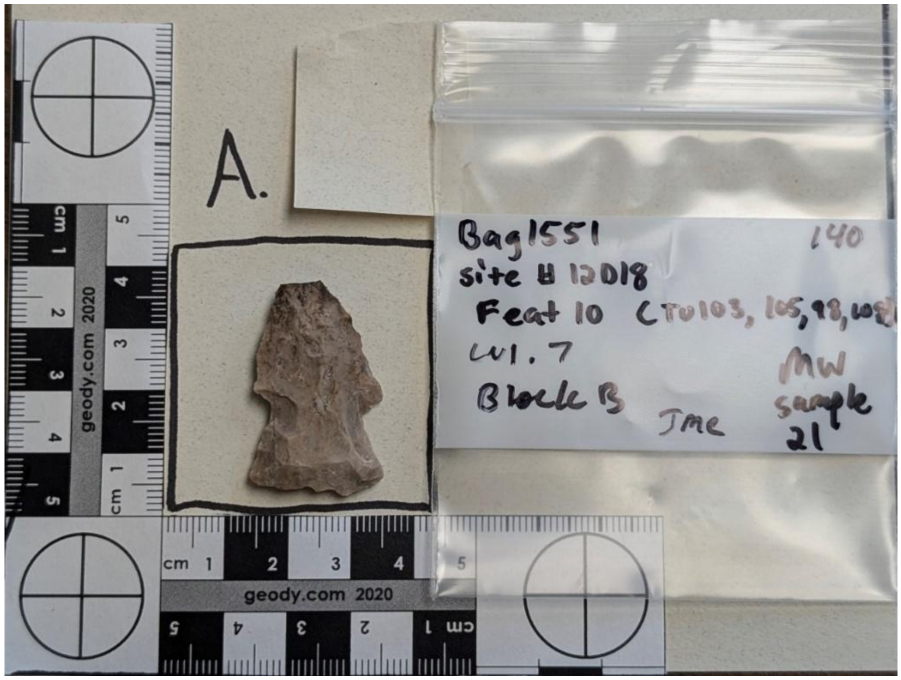


*Figure 3. Ventral Side Sample 21, Bakers Creek/Lowe Flared Base PPK. Photograph by Author*

**<u>Fort Ancient/Mississippian Lithic Tool Types</u>**

Two major lithic tool typologies that represent the Mississippian Period's toolset and Fort Ancient Culture were the Madison (Figure 4) and Cahokia (Figure 5) point types. These two projectile types have a triangular shape and lack the stem that Woodland- and Archaic-period PPKs have. During this period, the thought is that lithic tools were more commonly made with the idea of expedient use from local chert materials. Since much of the chert used from local sources was often of lesser quality, heat treatment was used to remedy this issue. Heat treatments' “advantages are mechanical in nature and are directly related to structural changes (greater homogeneity and elasticity) brought about by [heat] alteration” (Anderson 1979: 222).

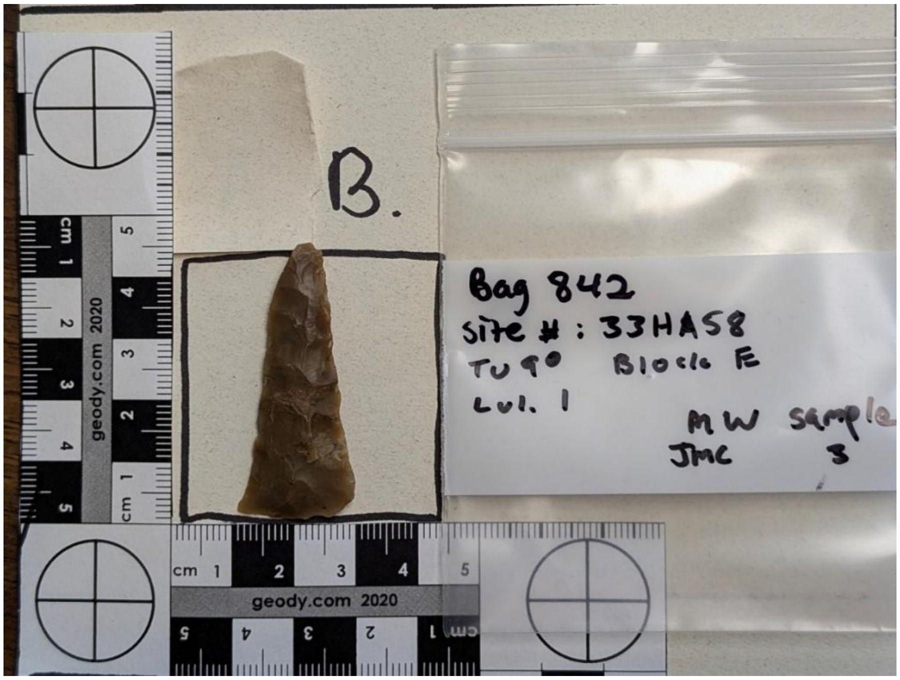


*Figure 4. Dorsal Side of Sample 3 Madison-Untyped PPK. Photograph by Author*


*Figure 5. Ventral Side of Sample 9 Cahokia PPK. Photograph by Author*

*State Line Site Pre-Contact and Historic Background*

**State Line Site Pre-Contact Background**

The State Line Site (12D18 and 33HA58) is one of the most dense and significant prehistoric sites in Ohio and Indiana. The State Line Site has a multicomponent basis with a denser habitation during the Woodland and Mississippian Periods, this village site may have had a significant role in trade throughout the region due to its location near a salt deposit and the Ohio River. Trade of ideas in the region is evident, especially due to the Fort Ancient ceramics from the Falls region resembling late middle Fort Ancient (1300–1400 A.D.) Anderson Ceramic Series, particularly the Anderson Shell-Tempered variety, is found primarily in southeastern Indiana/southwestern Ohio/northern Kentucky (Pollack 2021: 216). This evidence for interactions amongst other regions makes the site important to document the cultural heritage and to conduct research for a better understanding of the people who inhabited the site and their cultural lifeways. The earliest deposits at the site date to the Late Woodland period, which are evident by the six Woodland Mounds located in the surrounding area. Ceramic types from both periods are found at the site, but as of now, the large structures have been dated to only the Mississippian Period. It is also notable that the Fort Ancient period is characterized by maize connected to ceramics and burials found amongst the village site. The multiple Fort Ancient Culture structures and the over 1,000 features previously found on the site in the last 200 years make this site of great significance.

**State Line Site Historic Background**

The State Line Site (12D18 and 33HA58) historic occupation dates back to 1854 when a house was built on a burial mound, which was only recognized after findings while digging the basements. Mr. Abiah Hayes was the house's owner, which still stands on the Ohio side of the site today. The project is subject to Section 106 of the NHPA because ODOT and INDOT have received federal funding from the FHWA to conduct the project. Due to the dense cultural site and Native burials present, the site is subject to NAGPRA. ASC Group has worked in consultation with the Miami Tribe of Oklahoma as a primary consultant along with the Shawnee Tribe of Oklahoma. All “Native American burials and accompanying funerary items have been documented and removed to the Cincinnati Museum Center, for temporary curation, Native American Graves Protection and Repatriation” (Schwarz 2020: 4). Previous archaeology has been done by the Cincinnati Museum of Natural History in 1974, 1975, and 1979. This work was done because I-275 was being constructed at the time, and then in 2019-2020, the current work of the Site commenced.

# Chapter 4: Methods

*Introduction*

This chapter provides the methods for each aspect of my research. This includes methods for acquiring and determining my assemblage (a sample from the State Line Site Assemblage), along with samples identified for microwear analysis. The assemblage that was chosen included PPKs from Woodland and Mississippian Period contexts that were complete or mostly complete from the 2022 and 2023 mobilizations of fieldwork at the site. Microwear (aka use-wear) analysis is the examination of micro polishes, striations, and damage scars that form on the edges of chipped stone tools when they are used to perform specific tasks (cutting, scraping, etc.) with micro polishes especially useful in distinguishing particular types of materials (bone, wood, hide, etc.) (Miller 2022). This chapter will also include the methods for data collection and the methods for analyzing the gathered data.

*Acquisition of Sample Group*

Sixty PPKs were chosen to be included in the assemblage with a mix of Woodland and Mississippian Period contexts. These PPKs were chosen based on their temporal context along with their completeness. Complete or mostly complete PPKs were important for this analysis because they provided more information value compared to PPK fragments. The PPKs were selected by Dr. Kevin Schwarz with assistance from ASC Group's lab director Collin Skorig-Williams. Forty-two of the PPKs come from Mississippian Period contexts and twenty come from Woodland contexts. The majority of Mississippian Period PPKs are due to the heavier occupation of the site during the Mississippian Period compared to that of the Woodland and Archaic temporal periods. Twenty-four PPKs were chosen from the assemblage as a sample to be analyzed using microwear analysis methods. Twelve PPKs from Mississippian and Woodland contexts were chosen at random to be used to compare the two temporal periods. The PPKs were separated between the two temporal periods, and each was dumped into boxes where I blindly grabbed twelve from each box to have in the microwear study groups.

*Morphological Analysis*

A series of measurements were taken to analyze projectile points/knives (PPKs) from the State Line Site, including maximum length, thickness, width, basal width, basal thickness, neck length, neck width and thickness, notch height, notch depth, notch angle, blade angle, weight, and cortex percentage (Justice 1987:240, Andrevesky 2005:186). Microwear analysis was also used on a sample group of the overall assemblage to determine use wear type, retouch, number of use types, etc. All width, length, thickness, height, and depth measurements were taken using a digital caliper that was zeroed each time before use. These measurements were all recorded using the measurement unit of millimeters (mm). The weight of each PPK was taken using a digital scale that had sub-gram accuracy and was recorded using the unit of measurement of grams (g). Blade angle and notch angle measurements were taken using a small goniometer. Goniometers are plastic measuring tools with two arms used to determine the angles of objects. For blade angle, both the left and right blade angles were recorded by placing the blade edge as close as possible to the base or where the two arms of the goniometer meet. This method is subject to minor error because the PPKs do not always have a perfectly straight and consistent thickness throughout the entire PPKs morphology. However, this error was mitigated by taking the measurements of both sides' blade angles, producing an average for each PPK based on the measurements from each blade edge, and measuring at the midpoint of each PPKs blade to keep the point of measurement consistent. This reduces the error of having measurements that could be skewed if taken at the tip or base of the PPKs blade. Notch angle measurements were taken using the goniometer by placing one arm line in alignment with the middle of the PPKs base, and the second arm line was aligned to run in the middle of the notch (White 2019:4).

*Microwear Analysis Methods*

Before taking measurements and analyzing the PPKs under the microscope, the ventral and dorsal sides were determined for each. Photos were taken of each side with the bag/provenience/sample number of each, and either A (ventral) or B (dorsal) is shown to indicate which side was being photographed. The ventral side of a PPK is indicated by having a bulb of percussion evident, an earlier scar from impact, or, based on the curvature of the PPK, as the chert often removes from the core in a crescent shape from the side view. The ventral side is most commonly the convex side, while the dorsal side is the concave side from the side view. This allowed for consistent reference to notch sides and blade edges being remarked upon during the rest of the analytical process. The photos were taken using a Google Pixel 8 Pro on vanilla-colored paper with a section marked with black Sharpie to allow for the same photo size and position to be taken each time while also keeping in mind eliminating shadows of the PPKs for a clearer depiction of each. A scale of cm/mm was used to provide dimensional information for each PPK. Photos of each blade edge and basal edge on sides A and B of each PPK were taken and stored on the micro-SD card and then transferred to a laptop. Once transferred to the laptop, files for each PPK were created, and photos connected to that PPK were transferred into that respective file for review. Before photos were taken, the microwear samples required cleaning the PPKs in an ultrasonic cleaner (Miller 2022). The ultrasonic cleaner specifications are as follows: a 180 ml maximum tank capacity, 40 KHz frequency, five-minute run time, and powered using a wall charger. The cleaning solution was a 5:1 ratio of 100 milliliters (mL) of distilled water to 20 mL of 70 percent isopropyl alcohol, combined with three drops of Dawn dish soap. (Miller 2022). The amounts were chosen to allow for the submersion of the PPKs without exceeding the 180 mL maximum capacity of the ultrasonic cleaner. This process allows for the sediment on the PPKs to be removed without creating possible new wear by rubbing with fingers or using brushes. The sediment present could cause striations if rubbed, making identification of use-wear and microwear more difficult. The PPKs were cleaned using the ultrasonic cleaner and then rinsed with tap water. After being washed, they were placed on trays lined with paper towels to air dry. Air drying prevents any new polish from hand drying on the PPKs. The PPKs were cleared to be cleaned without worry of losing protein analysis data in the future, as many other PPKs from the site will undergo residue analysis apart from my assemblage. The microscope being used was the Opqpq 7” Digital Microscope 1200X, Dcorn 12 MP 1080P Photo/video Microscope with 10 LED Fill Lights, with PC view, Windows/Mac compatible. The microscope allowed for a low-power analysis of the PPKs at a magnification of between 8x and 15x. The photo index for identifying use wear on the State Line Site PPKs is from the Odell, George Hamley, and Frieda Odell-Vereecken paper “Verifying the reliability of lithic use-wear assessments by ‘blind tests’: the low-power approach" (1980). This study included photos of lithic tools conducting different tasks on different materials and provided a useful index during analysis. Pictures of the PPK microwear analysis will be taken using the microscope, stored on a 32 GB SD card, and then transferred to a computer for use. The angle and magnification of each PPK blade edge were done purposefully to get the clearest image for determining its use-wear instead of a mechanical method of every PPK being held at the same angle and magnification (Keeley, 1980:15).

### *Data Analysis Methods*

The macroscopic and microwear data were placed in a Microsoft Excel (Excel) sheet to be analyzed. Pivot tables, charts, and metrics like minimum, maximum, average, and standard deviation for different categories were calculated using the formulas section of Excel. Minimum and maximum provide information about the statistical boundaries of the category/metrics being analyzed. The median provides the average or most common number of a category/metric being analyzed. These numbers can also be displayed on charts and box plots. The standard deviation formula provides information about how measurements/metrics are spread out from the average. The attributes of cortex percentage, heat treatment, blade morphology, basal morphology, temporal period, typology, length, width, and other previously mentioned attributes were taken and then recorded into the Excel data sheet and were then used to create pivot tables and charts to better understand the data with counts and visual depictions of the data. T-tests will show if the differences between the two sets of data are significant, and p-values will show if the differences are statistically significant.

# Chapter 5: Results

## *Introduction*

The results of the Mississippian Period PPK and Woodland PPK assemblages for the State Line Site will be provided along with the microwear analysis PPK sample assemblage results. Tables and graphs provide visual aids for the similarities and differences between the two temporal periods and their perspective PPK assemblages.

## *Mississippian Period Results*

The sample group being analyzed included 42 PPKs that were deemed to be associated with the Mississippian temporal period, and the majority were associated with the Fort Ancient Culture of the Ohio River Valley and American Midwest, along with a few PPKs that were diagnostic of the Mississippian Culture of the American Southeast. Of the 42 artifacts, 15 separate types are present (See Table 1). These include subtypes (number present in sample group) of the Madison Point typology including Untyped (12), type 1 (2), type 2 (8), type 3 (1), type 4 (5), type 5 (1), type 6 (3), crude (1), and humped-back (1). There were also other types present in the sample, including the Cahokia (1), Sequoyah (1), Late Fort Ancient Stemmed (1), and Fort Ancient Knife (1) types.

| Type | Count | % |
|---|---|---|
| Madison-Untyped | 13 | 21 |
| Madison Type 2 | 8 | 12.9 |

| | | |
|---|---|---|
| Madison-Type 4 | 5 | 8.2 |
| Low Flared Base | 4 | 6.5 |
| Scallorn | 4 | 6.5 |
| Madison-Crude | 4 | 6.5 |
| Madison-Type 6 | 3 | 4.8 |
| Cypress Stemmed | 2 | 3.2 |
| Copena Triangular | 2 | 3.2 |
| Michigan Small notched | 2 | 3.2 |
| Madison-Type 1 | 2 | 3.2 |
| Adena Stemmed | 2 | 3.2 |
| Cahokia | 1 | 1.6 |
| Raccoon Notched | 1 | 1.6 |
| Copena | 1 | 1.6 |
| Fort Ancient Knife | 1 | 1.6 |
| Madison - Type 3 | 1 | 1.6 |
| Bakers Creek/Lowe Flared Base | 1 | 1.6 |
| Jack's Reef Corner Notched | 1 | 1.6 |
| Sequoyah | 1 | 1.6 |
| Madison - Type 5 | 1 | 1.6 |
| Late Fort Ancient Stemmed | 1 | 1.6 |
| Madison - Humped-back | 1 | 1.6 |

| | | |
|---|---|---|
| Total | 62 | 100 |

*Table 1. Distribution of formal PPK types within the assemblage of selected points from the Mississippian Period.*

A majority of the Mississippian Period assemblage PPKs are made from unidentified raw material/chert, comprising 25 of the 42 artifacts in the sample (See Table 2). The other raw material sources included Laurel (3), Four Mile Creek (3), Wyandotte (3), Holland (2), Vanport (1), Upper Mercer (1), Columbus-Delaware (1), Ferdinand (1), Indian Creek (1), and Jeffersonville (1).

| **Raw Material** | **Count** | **%** |
|---|---|---|
| Unidentified | 34 | 54.8 |
| Laurel | 5 | 8.1 |
| Wyandotte | 4 | 6.5 |
| Four Mile Creek | 4 | 6,5 |
| Holland | 4 | 6.5 |
| Vanport | 3 | 4.8 |
| Columbus-Delaware | 2 | 3.2 |
| Jeffersonville | 2 | 3.2 |
| Muldraugh | 1 | 1.6 |
| Indian Creek | 1 | 1.6 |
| Ferdinand | 1 | 1.6 |
| Upper Mercer | 1 | 1.6 |
| Total | 62 | 100 |

*Table 2. Distribution of Raw Material Types of the Entire PPK Assemblage*

The Mississippian Period assemblage contained 6 PPKs that showed evident heat treatment processes, while the majority of 36 did not. The blade morphologies (See Figure 6) for the Mississippian Period PPKs were recorded as follows: Excurvate (19), Straight (17), Incurvate (4), Serrated (1), and Recurvate (1).

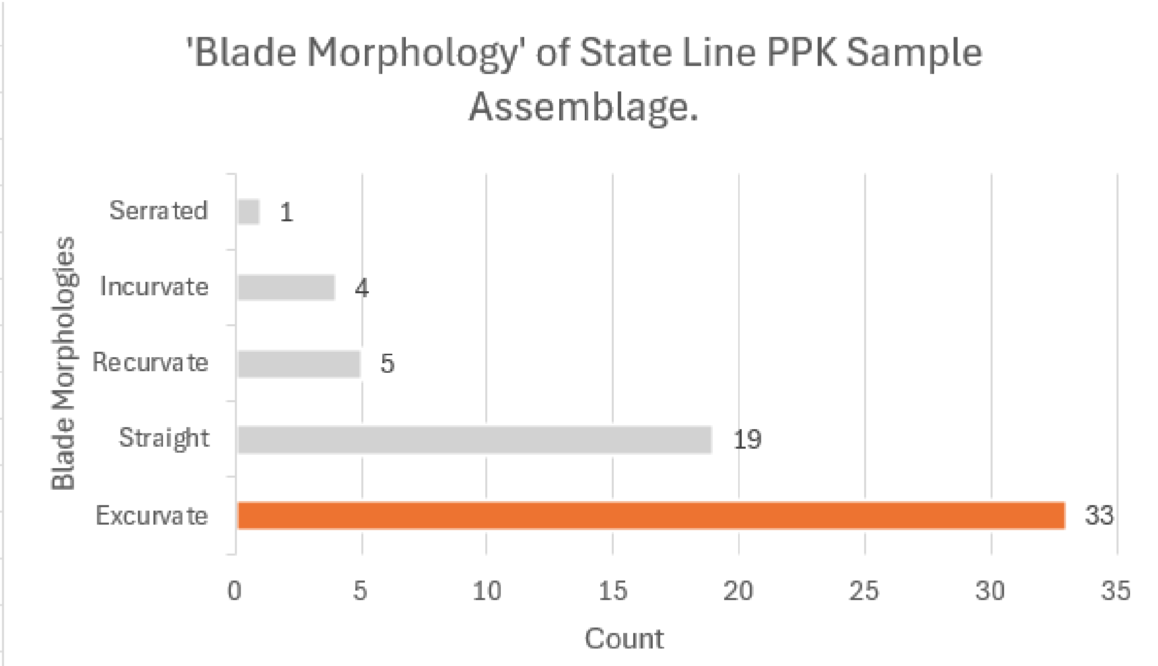


*Figure 6. Blade Morphology Chart of Entire PPK Assemblage*

The Mississippian Period PPK assemblage analysis provided the minimum, maximum, average, and standard deviation for 10 different measurements seen in Table 3. The Mississippian Period PPKs were shown to be smaller in all metrics compared to those of the Woodland PPKs. They are smaller in length, width, thickness, and blade angle. The size reduction is inferred to be due to the use of bow and arrow technology during the Mississippian Period.

| | Max Length (mm) | Max Width (mm) | Length: Width Ratio(mm) | Max Thickness (mm) | Length: Thickness Ratio (mm) | Basal Width (mm) | Basal Thickness (mm) | Blade Angle Right | Blade Angle Left | Blade Angle Average |
|---|---|---|---|---|---|---|---|---|---|---|
| **Min** | 18.3 | 5.3 | 1.21 | 2.8 | 3.17 | 8.7 | 0.6 | 46.0 | 46.0 | 46.0 |
| **Max** | 54.8 | 29.1 | 4.53 | 10.0 | 9.68 | 28.8 | 8.1 | 53.0 | 54.0 | 53.5 |
| **Avg** | 30.4 | 18.1 | 1.74 | 5.3 | 6.05 | 17.7 | 2.1 | 48.5 | 49.0 | 48.7 |
| **STDEV** | 8.036788 | 4.001666 | 0.565378 | 1.972656 | 1.548914 | 3.599288 | 1.577664 | 1.665306 | 1.863846 | 1.641131 |

*Table 3. Summary of Measurements with Standard Deviations for Selected Points from the Mississippian Period.*

## *Woodland Period Results*

The PPKs associated with the Woodland temporal period of the sample group accounted for 20 of the full sample of 62 artifacts from the State Line Site. The size of the Woodland PPK group is much smaller than that of the Mississippian Period Group due to the availability of mostly or entirely complete PPKs that have been found at the site. There have been a far greater number of PPKs associated with the Mississippian Period occupation of the site. The Woodland assemblage included ten different PPK types (Table 4) (number of types in assemblage) including Lowe Flared Base (4), Scallorn (4), Michigan Small Notched (2), Copena Triangular (2), Adena Stemmed (2), Cypress Stemmed (2), Jack's Reef Corner Notched (1), Raccoon Notched (1), Bakers Creek/Lowe Flared Base (1), and Copena (1).

| Type | Count | % |
|---|---|---|
| Lowe Flared Base | 4 | 20 |
| Scallorn | 4 | 20 |
| Michigan Small Notched | 2 | 10 |
| Copena Triangular | 2 | 10 |
| Adena Stemmed | 2 | 10 |
| Cypress Stemmed | 2 | 10 |
| Jack's Reef Corner Notched | 1 | 5 |
| Raccoon Notched | 1 | 5 |
| Bakers Creek/Lowe Flared Base | 1 | 5 |
| Copena | 1 | 5 |
| Total | 20 | 100 |

*Table 4. (Distribution of PPK Types of the Woodland Assemblage)*

The Woodland PPK assemblage comprises mostly unidentified raw material/chert at 9 of the 20. The other raw material sources include (Figure 7) Vanport (2), Holland (2), Laurel (2), Jeffersonville (1), Columbus-Delaware (1), Wyandotte (1), Muldraugh (1), and Four Mile Creek (1).

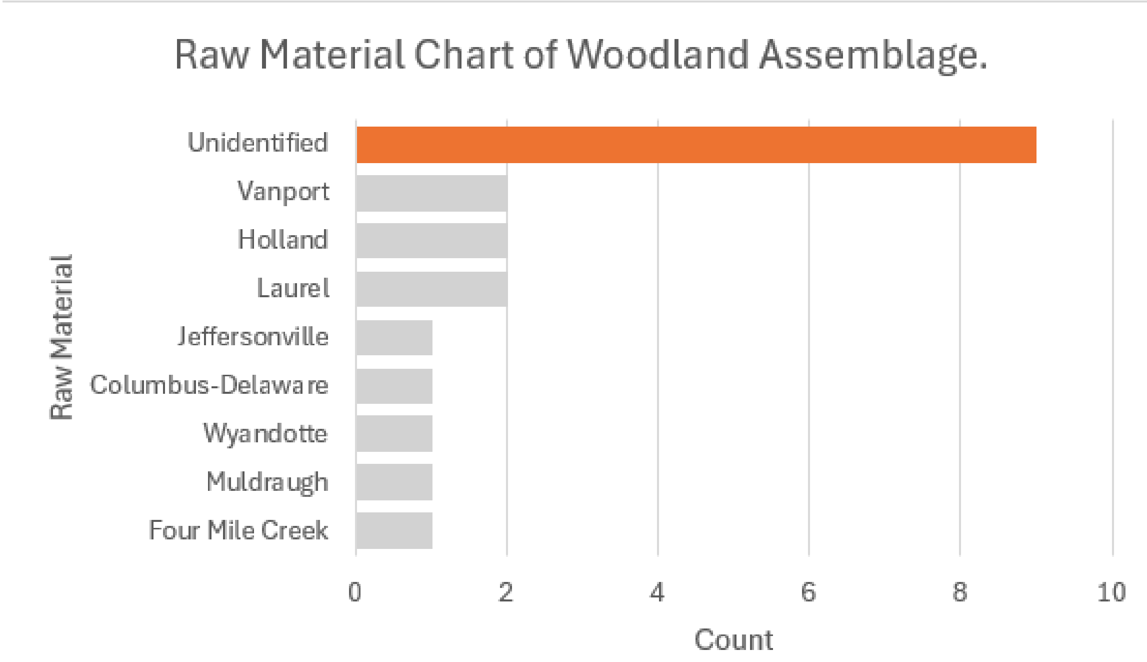


*Figure 7. Raw Material Chart of Woodland PPK Assemblage*

The Woodland Assemblage includes 7 PPKs having evidence of heat treatment processes, with 13 showing no heat treatment. The blade morphologies for the Woodland PPKs (Figure 8) were recorded as follows: Excurvate (15), Straight (1), and Recurvate (4).

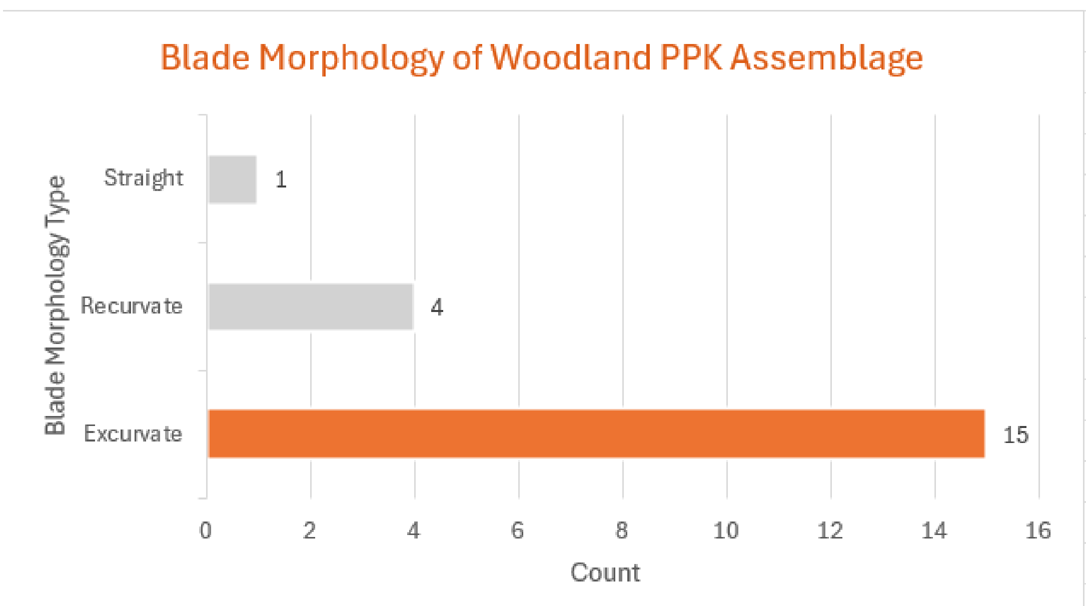


*Figure 8. Blade Morphology Chart of Woodland Assemblage*

For the Woodland assemblage, the outcomes of the different measurements taken show that, on average, they are all greater than that of the Mississippian Period PPK assemblage. The Woodland PPKs are more robust and are thought to be made this way for greater longevity of use, and do not break as easily (Table 5).

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Min. | 16.6 | 13.5 | 1.23 | 4.3 | 2.92 | 8.5 | 2.1 | 46.0 | 47.0 | 46.5 |
| MAX | 57.3 | 28.7 | 2.30 | 12.5 | 7.72 | 28.5 | 6.3 | 54.0 | 54.0 | 53.0 |
| AVERAGE | 38.3 | 21.0 | 1.82 | 7.0 | 5.40 | 17.0 | 3.6 | 49.9 | 49.7 | 49.8 |
| STDEV | 12.717 | 5.973867 | 0.457838 | 2.697804 | 1.624013 | 6.658497 | 1.536978 | 10.94792 | 10.92762 | 10.91916 |

*Table 5. Summary of Measurements with Standard Deviations for Selected Points from the Woodland Period.*

*Mississippian Period Microwear Sample Results*

From the 62 PPK assemblage, a sample of 24 PPKs was selected for the study's micro wear analysis portion. Of the 24 PPKs chosen, 12 were associated with the Mississippian Period temporal period and the Fort Ancient or Mississippian cultures. The PPKs were chosen at random, other than ensuring an even split between the Mississippian Period and Woodland Period Points for a more consistent and balanced comparison. Six different types (Figure 9) comprised the Mississippian Period microwear sample group, including Cahokia (1), Madison - Type 2 (3), Madison - Type 4 (2), Madison - Type 6 (2), Madison – Untyped (3), and Sequoyah (1).

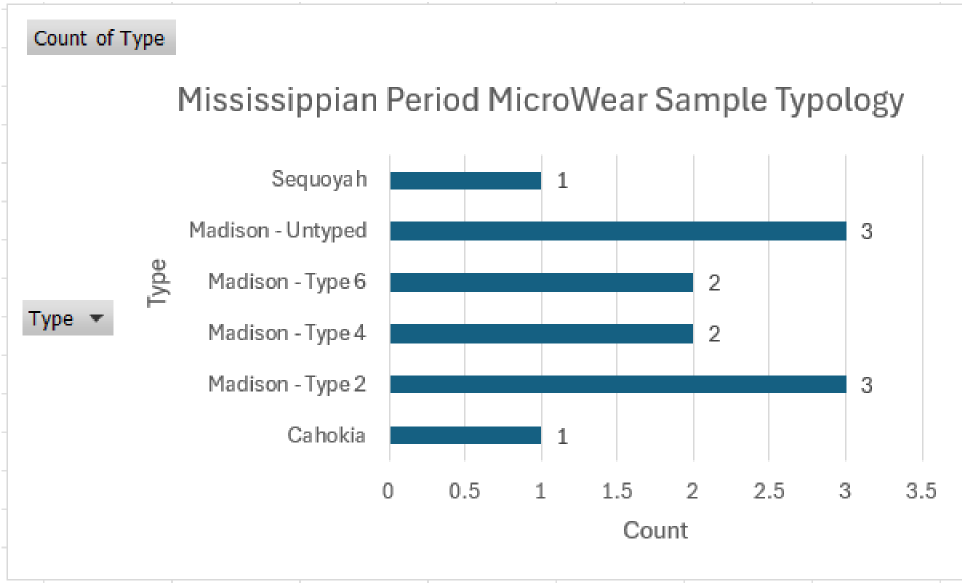


*Figure 9. Type Chart of Mississippian Period Micro Wear Sample Assemblage*

Ten of the twelve PPKs of the Mississippian Period microwear sample group were determined to be unidentifiable raw material sources, and the other two raw material types were Wyandotte and Laurel (Figure 10).

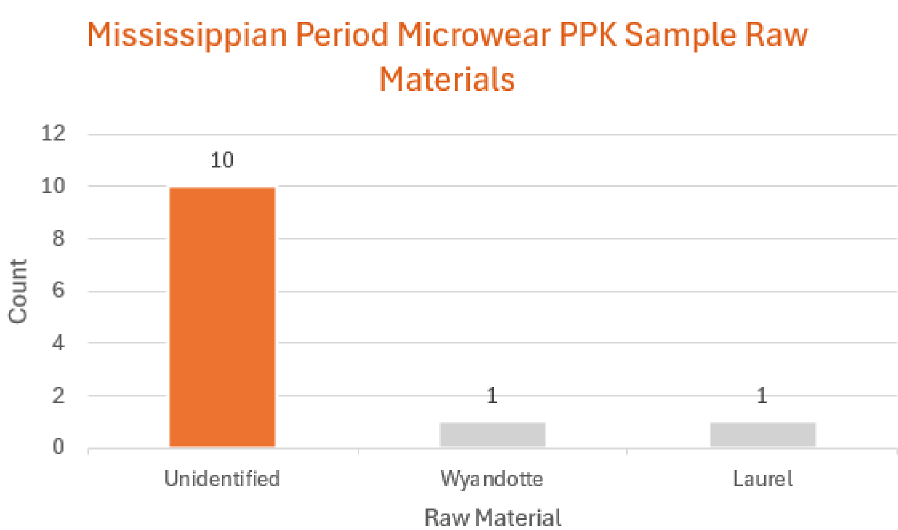


*Figure 10. Mississippian Period Microwear PPK Sample Raw Materials Chart*

A use-wear trace on a projectile (Figure 12) as a motion was determined to be the motion with the highest count with 5 of the 12, while the other motions present include cutting (2), cutting/projectile (2), cutting/drilling (1), scraping (1) (Figure 13), and Projectile/cutting/scraping/ engraving (1) (Figure 11). Motion in this instance is defined as the motion of the PPK that caused the use-wear on the PPK edges. Use wear is defined as the wear or breakage patterns seen on the PPK edges from being used in different activities.

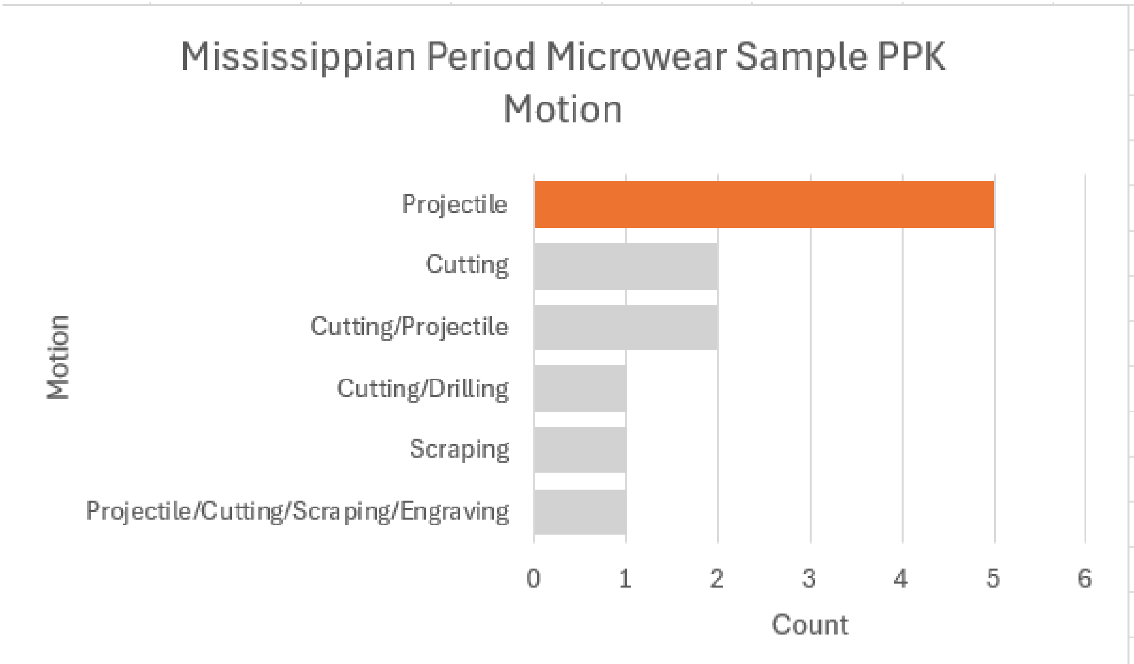


*Figure 11. Mississippian Period Microwear Sample PPK Assemblage Motion Chart*

*Figure 12. Sample 3 Dorsal Left Lateral Blade Edge Distal Section Overhead View Projectile Breakage shown. Photograph by Author*

*Figure 13. Sample 3 Ventral Basal Section, Evidence of Scraping Use wear. Photograph by Author*

From this data, I determined that 8 of the 12 PPKs appeared to have one motion/use type, and 4 had two or more motion/use types (Figure 14). Ten of the PPKs of the sample assemblage were determined not to have heat treatment evident, and two have evidence of heat treatment present.

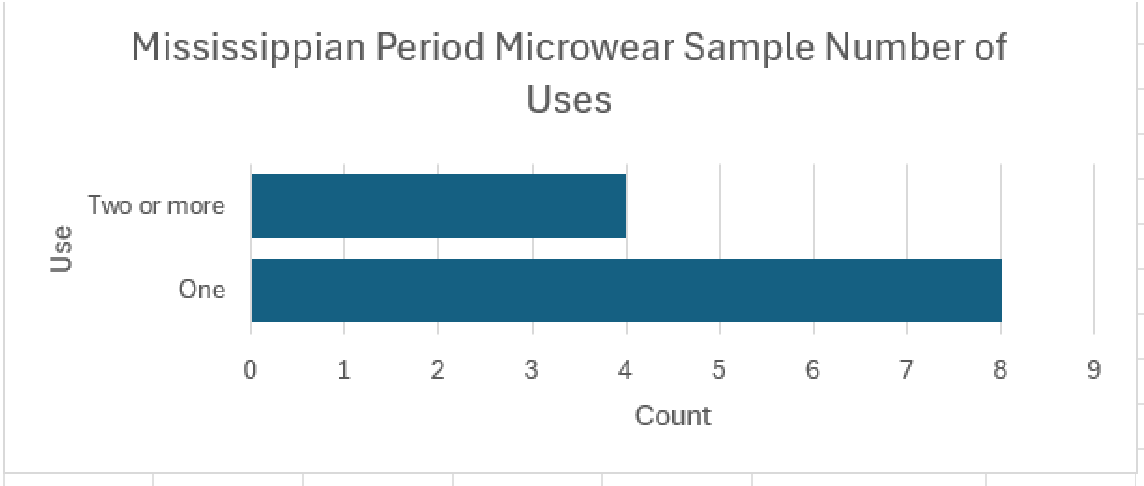


*Figure 14. Mississippian Period Microwear Sample Number of Uses Chart*

## *Woodland Microwear Sample Results*

Seven types made up the total of 12 PPKs of the Woodland assemblage (Table 6). The Scallorn (3) typology appeared most in the sample group with three, and the other typologies present were Adena Stemmed (2), Copena Triangular (2), Cypress Stemmed (2), Lowe Flared base (1), Bakers Creek/ Lowe Flared Base (1), and Raccoon Notched (1).

| Type | Count | % |
|---|---|---|
| Scallorn | 3 | 25 |
| Adena Stemmed | 2 | 16.7 |
| Copena Triangular | 2 | 16.7 |
| Cypress Stemmed | 2 | 16.7 |

| | | |
|---|---|---|
| Lowe Flared Base | 1 | 8.3 |
| Bakers Creek/Lowe Flared Base | 1 | 8.3 |
| Raccoon Notched | 1 | 8.3 |
| Total | 12 | 100 |

*Table 6. Distribution of Microwear Types in the Woodland Sample PPK Assemblage*

Ten of the twelve PPKs in the Woodland assemblage were shown to have one use type. Similar to the Mississippian Period sample group, most of the Woodland sample group PPKs are made of unidentified raw material (5). The other raw materials present (see Figure 15) in the sample group include Holland (2), Columbus-Delaware (1), Muldraugh (1), Jeffersonville (1), Wyandotte (1), and Laurel (1).

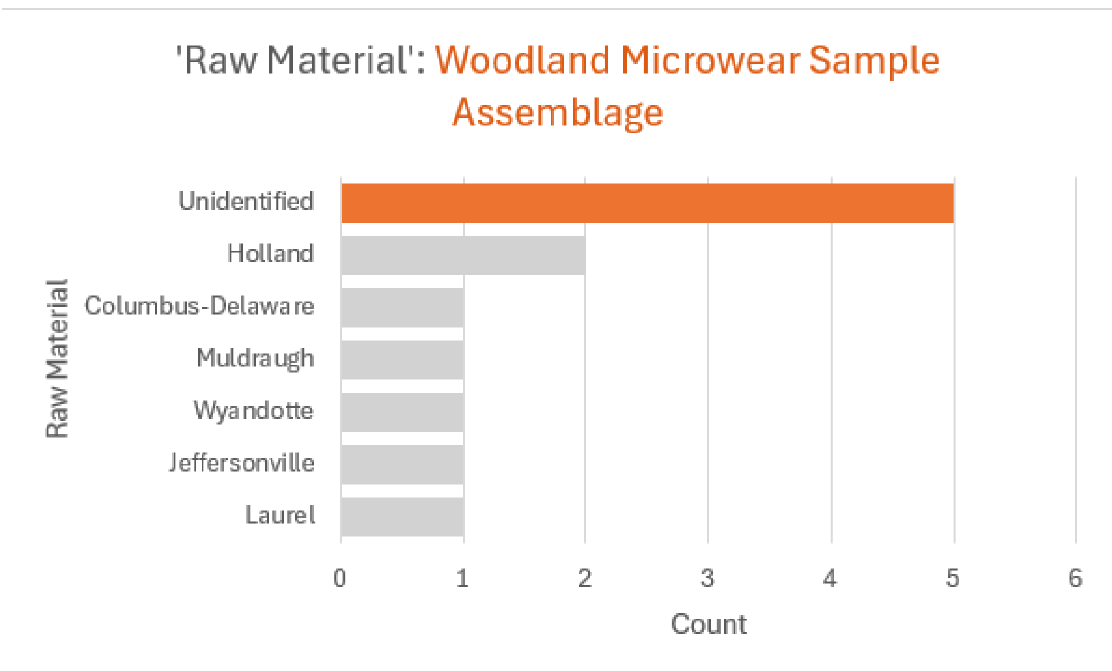


*Figure 15. Woodland Microwear Sample PPK Assemblage Raw Material Chart*

Cutting (4) is the motion with the greatest frequency present from the Woodland PPK sample group with there also being projectile (3), cutting/projectile (2), not used (1), scraping (1), and one where the motion was not evident (1)(Figure 16).

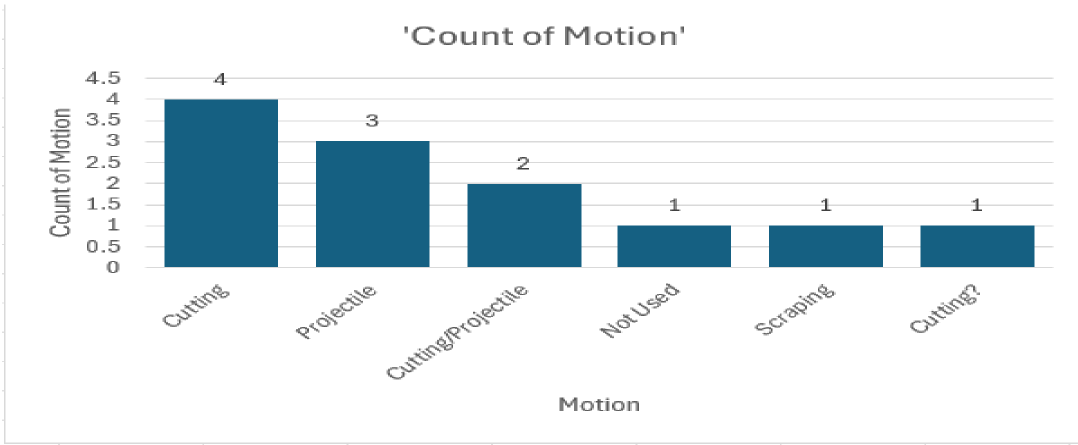


*Figure 16. Woodland Microwear Sample PPK Assemblage Motion Chart*

The Woodland microwear sample assemblage has more evidence of retouch flaking than the Mississippian Period assemblage, with 5 of the 12 PPKs having retouch present (figure 17). Zero of the Mississippian Period PPKs show signs of retouch flaking.

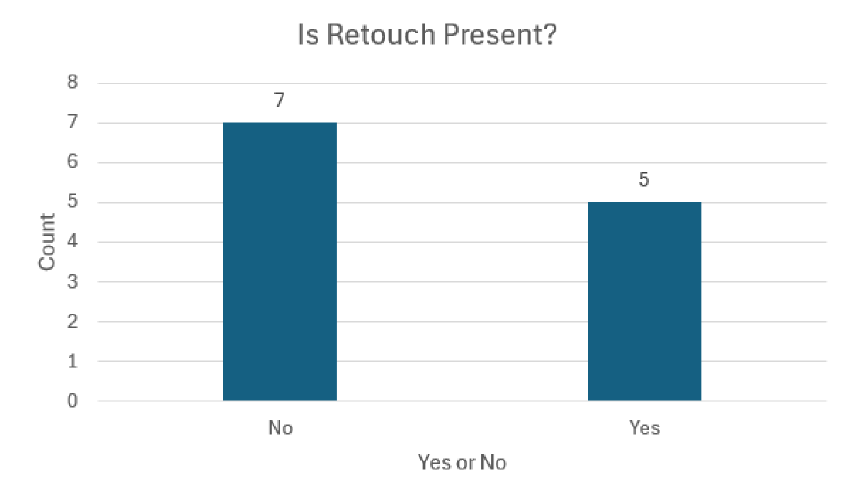


*Figure 17. Woodland Microwear Sample PPK Assemblage Retouch Chart*

The Woodland Period PPK sample assemblage has shown that the majority of the PPKs have evidence of one type of use wear present, with 10 of the 12 showing only one type of use wear, while 2 show two or more use wear types present (Figure 18).

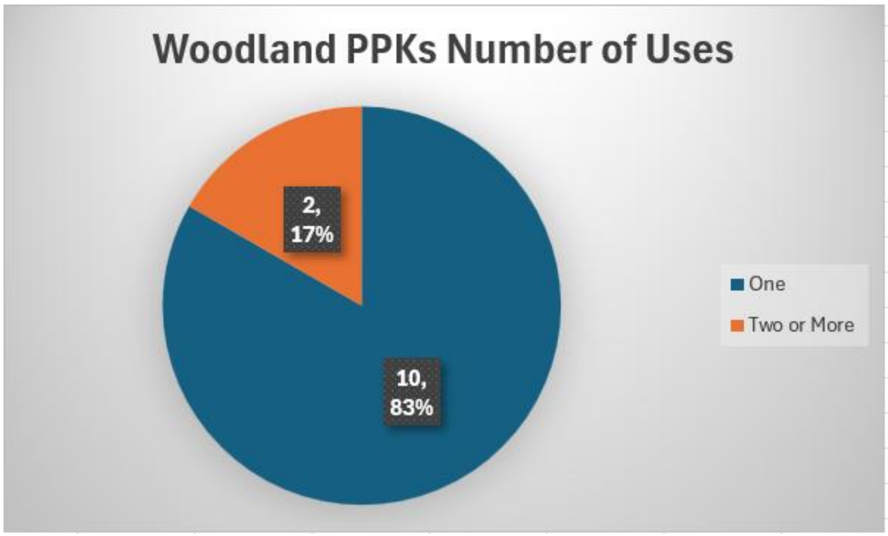


*Figure 18. Woodland Microwear Sample PPK Assemblage Uses Chart*

The Woodland microwear sample assemblage analysis resulted in 8 of the PPKs showing evidence of heat treatment while four did not, which is more than that of the Mississippian Period PPKs.

# Chapter 6:  Analysis

## *Introduction*

This portion will provide context for the results found during the State Line Site PPKs analysis and provide possible meaning to the similarities and differences found. This chapter hopes to provide an understanding of the results and come to conclusions about the following hypotheses, relating the characteristics of PPKs across Woodland, Fort Ancient, and Mississippian Period contexts at the site:

**H1:**

The typology, manufacture, and use of the State Line Site projectile points vary between Woodland and  Mississippian Period contexts. In the Woodland context, PPKs will more frequently have evidence of being used as tools for hunting seasonal game and the butchering process of said game, compared to those projectile points from Mississippian Period contexts.

**H2:**

The lithic material of projectile points from Woodland contexts found at the State Line Site varies from that of Mississippian Period context PPKs. Lithic material associated with the Woodland Period will have traveled a greater distance compared to that of the Mississippian Period contexts.

**H3:**

Projectile points from Woodland contexts at the State Line Site are often more robust compared to those of projectile points from Mississippian contexts, and the Woodland assemblage has more signs of retouching compared to those of the  Mississippian Period assemblage.

**H4:**

The lithic material most often identified in the Mississippian Period contexts at the State Line Site is that of local pebble cherts that are of lesser quality compared to sourced cherts seen with PPKs from Woodland contexts. In most cases, lesser quality cherts may be found to be heat-treated to assist with the manufacturing process of flintknapping to prevent unwanted breakage patterns. This leads to my hypothesis that the Mississippian Period PPK assemblage will contain a greater proportion of artifacts with evidence of heat treatment.

*Analysis of the Woodland and Mississippian Period Assemblages*

| | **Max Length (mm)** | **Max Width (mm)** | **Length: Width Ratio (mm)** | **Max Thickness (mm)** | **Length: Thickness Ratio (mm)** | **Basal Width (mm)** | **Basal Thickness (mm)** |
|---|---|---|---|---|---|---|---|
| P-Value | 0.002 | 0.16985 | 0.569 | 0.004483 | 0.103058 | 0.591145 | 0.000447 |

*Table 7. P-Value Chart Comparing Woodland and Mississippian PPKs*

The Mississippian Period assemblage had a length-width ratio average of 1.74mm, and the Woodland assemblage had a ratio of 1.82mm. When a T-Test was run to determine if this difference was significant, it showed that it was not with a p-value of 0.569. However, the differences in maximum length and width significantly differed when comparing the Mississippian Period and Woodland Period data assemblages. The p-values for max-length and max-width were 0.002 and 0.0170, respectively. The max thickness difference between the two assemblages also showed a significant difference with a p-value of 0.0045. Still, the max length-to-thickness ratio showed an insignificant difference with a p-value of 0.103. Basal thickness was deemed to have a significant difference between the two assemblages with a p-value of 0.00045. Still, the p-value for basal width was insignificant at a p-value of 0.591. The mass/weight of PPKs was taken, and the T-Test showed a significant difference between

Mississippian and Woodland Period PPKs with a p-value of 0.000370196. The thickness of the Woodland assemblage supports the inference that during the Woodland Period, PPKs were made to be more robust to allow their use life to be longer and allow for retouch flaking while traveling away from chert sources for hunting or other activities. This finding also supports the hypothesis that during this transition, the advent of bow and arrow technology use can be seen. The hypothesis that heat-treatment of lesser quality chert materials took place during the Mississippian Period proved not to be supported because 36 of the 42 PPKs from Mississippian Period contexts showed no evidence of heat treatment. Thirteen of the 20 PPKs from Woodland contexts show no evidence of heat treatment. Still, considering the smaller sample size from Woodland contexts in the overall assemblage, a higher percentage showed heat treatment in Woodland contexts. Heat treatment is usually considered to make tougher/grainier chert/flint easier to flake and reduce unwanted breakage during the flintknapping process (Figure 19)(Raviele, 2007).

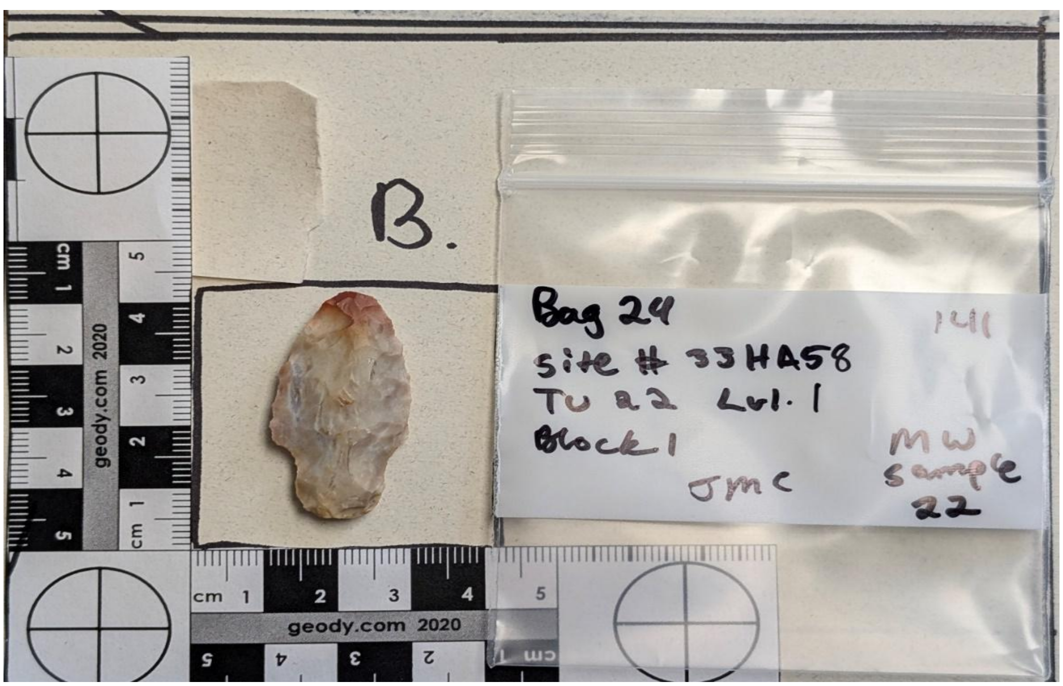


*Figure 19. Dorsal Side of Microwear Sample PPK 22, Showing evidence of Heat Treatment. Photograph by Author*

My previous thoughts were that this pattern would mean the Mississippian Period PPKs made from lesser quality local cherts would show heat treatment to make the crafting of the PPKs easier. However, the inference that Mississippian PPKs would require a higher frequency of heat treatment appears not to be supported and instead supports the idea that during the Mississippian Period, lithic material sourced locally was plentiful, and PPKs were used expediently and not needed for long periods of use. While the local pebble chert was not of higher quality, the availability meant that if, during the creation of PPKs, they broke, then they could easily restart. More frequent occurrence of heat treatment of PPKs in the Woodland context may support the interpretation that, due to farther travel from chert sources to the State Line Site, the need for precision crafting and maintaining PPKs for longer-term use was more prevalent. The number of PPKs found from each context can also provide insight into habitation density during the Woodland and Mississippian Periods. Complete or mostly complete PPKs were chosen for this study; 42 were from Mississippian Period contexts, and 20 were from Woodland contexts. This difference in material culture density supports the hypothesis that the State Line Site was inhabited seasonally during the Woodland Period and inhabited as a permanent village site during the Mississippian Period.

*Analysis of Mississippian Period Microwear Assemblage*

The following figure (Table 8) shows PPKs chosen for the Mississippian Period microwear sample with information about their type, temporal date, raw material, motion types, hafting, and whether retouch is present. The Mississippian PPKs were mainly Madison-type, made from local unidentified pebble chert. The majority show wear from being used as projectiles and do not show signs of retouch. The majority also show very little evidence of heat treatment.

| Sample # | Bag # | Type | Temporal | Raw Material | Used | Heat Treated | Cortex | Motion | Material | Hafting? | Retouch Present? | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 463 | Madison - Type 6 | Late Prehistoric | Unidentified | Yes | No | 0% | Projectile | Soft Tissue | Yes | No | |
| 2 | 1247 | Madison - Untyped | Late Prehistoric | Unidentified | Yes | No | 0% | Cutting/Projectile | Soft Tissue | No | No | |
| 3 | 842 | Madison - Untyped | Late Prehistoric | Unidentified | Yes | No | 0% | Projectile/Cutting/Scraping/Engraving | Soft Tissue/Bone | Yes | No | |
| 4 | 249 | Madison - Type 2 | Late Prehistoric | Unidentified | Yes | No | 0% | Cutting/Projectile | Soft Tissue | Yes | No | |
| 5 | 906 | Madison - Type 2 | Late Prehistoric | Unidentified | Yes | No | 0% | Cutting | Soft Tissue | No | No | Looks to have had Distal Portion Snapped during manufacture and then Utilized for cutting. (Nass 1987) |
| 6 | 1792 | Madison - Untyped | Late Prehistoric | Unidentified | Yes | No | 0% | Cutting/Projectile | | Yes | No | |
| 7 | 1562 | Sequoyah | Mississippian | Unidentified | Yes | Yes | 0% | Cutting/Drilling | Soft Tissue/ Bone/ Wood | Unsure | No | |
| 8 | 1247 | Madison - Type 6 | Late Prehistoric | Unidentified | Yes | No | 0% | Scraping | Hide | Yes | No | |
| 9 | 373 | Cahokia | Mississippian | Wyandotte | Yes | No | 0% | Projectile | Soft Tissue | Yes | No | |
| 10 | 1349 | Madison - Type 4 | Late Prehistoric | Unidentified | Yes | No | 0% | Projectile | | Yes | No | |
| 11 | 782 | Madison - Type 2 | Late Prehistoric | Laurel | Yes | Yes | 0% | Projectile | Soft Tissue/Bone | Yes | No | |
| 12 | 1379 | Madison - Type 4 | Late Prehistoric | Unidentified | Yes | No | 0% | Projectile | Unsure | Yes | No | |

*Table 8. Mississippian Period Microwear Results/Analysis*

Twelve PPKs were selected to be the Mississippian Period microwear sample group. As seen in Table 8, most of the microwear sample group was made from unidentified chert sources. It is thought that much of this chert was local pebble chert (Figure 20) found in streams near the site.

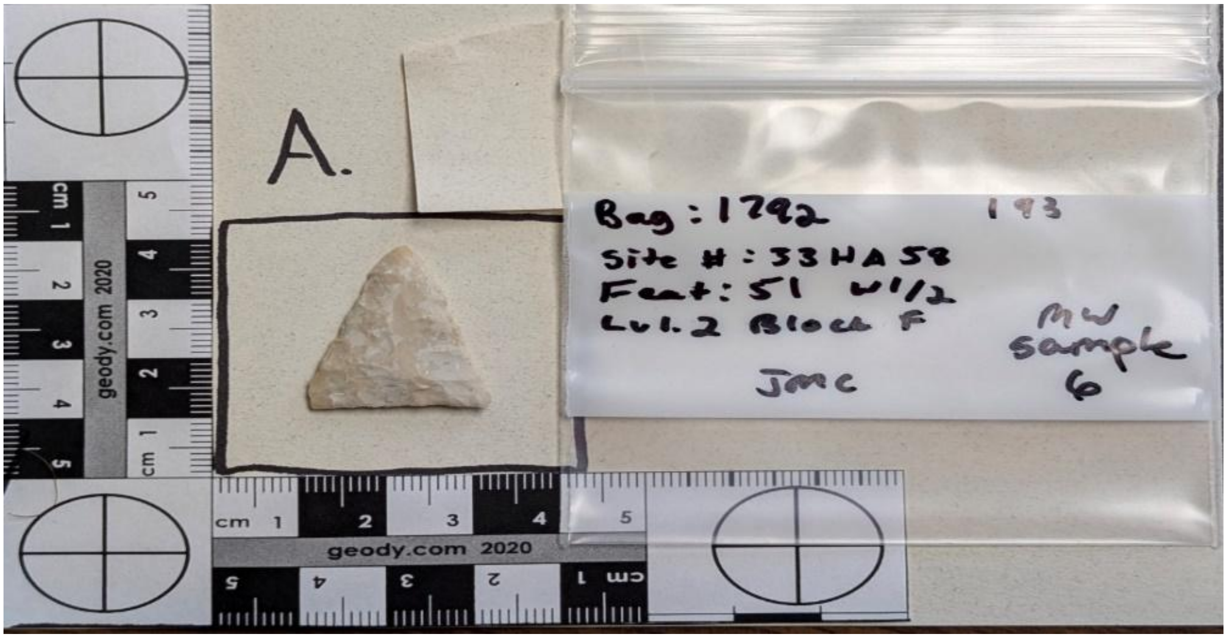


*Figure 20. Mississippian PPK from Pebble Chert, Ventral Side. Photograph by the Author*

This would follow our previous hypothesis that during the Mississippian Period, travel for higher quality chert was less frequent, and the use of lesser quality chert was more frequent for a more expedient tool creation process. Eight of the twelve PPKS from the Mississippian contexts were determined to have one type of motion wear present. The majority use type was that of projectiles, which follows our previous thoughts because of the increase in the use of the bow and arrow during this period. This use of the bow and arrow also leads to smaller PPKs and the idea of using expedient materials to create points that will most likely not be retrieved or more easily replaced. Zero of the twelve PPKs from the Mississippian Period microwear sample group showed signs of retouch flaking. This goes further to support the theory that during the Mississippian Period at the State Line Site, the use-life of a PPK's use was not very long, and strategies of making new PPKs rather than retouching previously used PPKs were preferred. One of the PPKs from the Mississippian Period sample group did, however, show a longer use life and was used for multiple activities, including as a projectile, seen by the impact flaking (Figure 12), and then repurposed as a scraper, seen by the unifacial wear seen in (Figure 13).

*Figure 12. Sample 3 Dorsal Left Lateral Blade Edge Distal Section Overhead View Showing Evidence of Projectile Use Wear Break Photograph By Author*

*Figure 13. Sample 3 Ventral Basal Section, Evidence of Scraping Use wear. Photograph By Author*

*Analysis of Woodland Microwear Assemblage*

The following figure (Table 9) shows PPKs chosen for the Woodland Period microwear sample with information about their type, temporal date, raw material, motion types, hafting, and whether retouch is present. The Woodland PPK sample is comprised of many different types and made from the majority of unidentified sources, but has more variety than that of the Mississippian Period sample. The majority show wear from being used as cutting/butchering tools and do show signs of retouch.

| Sample # | Bag # | Type | Temporal | Raw Material | Used | Heat Treated | Cortex | Motion | Material | Hafting | Retouch Present? |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 13 | 2502 | Cypress Stemmed | Early Woodland | Columbus-Delaware | Yes | No | <50% | Cutting/Projectile | Soft Tissue/Bone | Yes | No |
| 14 | 2909 | Copena Triangular | Middle Woodland | Wyandotte | Yes | No | 0% | Cutting | Soft Tissue/Bone | Yes | Yes |
| 15 | 2873 | Copena Triangular | Middle Woodland | Jeffersonville | Yes | No | 0% | Cutting | Soft Tissue | No | Yes |
| 16 | 2229 | Scallorn | Late Woodland to Mississippian | Muldraugh | Yes | Yes | 0% | Projectile | Soft Tissue | Yes | No |
| 17 | 432 | Scallorn | Late Woodland to Mississippian | Holland | No | No | 0% | Not used | None | Yes | No |
| 18 | 1816 | Scallorn | Late Woodland to Mississippian | Holland | Yes | No | 0% | Projectile | Soft Tissue | Yes | Yes |
| 19 | 117 | Raccoon Notched | Late Woodland | Laurel | Yes | Yes | 0% | Projectile | Soft Tissue/Bone or wood | Yes | Yes |
| 20 | 473 | Lowe Flared Base | Middle to early Late Woodland | Unidentified | Yes | No | 0% | Cutting | Bone or Wood | Yes | No |
| 21 | 1551 | Bakers Creek/Lowe Flared Base | Middle to Terminal Middle Woodland; Middle to early Late Woodland | Unidentified | Yes | Yes | 0% | Cutting | Soft Tissue | Unsure? | No |
| 22 | 24 | Adena Stemmed | Early Woodland | Unidentified | Yes | Yes | 0% | Scraping | Hide/Soft Tissue | No | Yes |
| 23 | 1043 | Adena Stemmed | Early Woodland | Unidentified | Yes | No | 0% | Cutting? | | No | No |
| 24 | 2661 | Cypress Stemmed | Early Woodland | Unidentified | Yes | No | 0% | Cutting/Projectile | Soft Tissue/Bone | Yes | No |

*Table 9. Woodland Microwear Results*

Twelve PPKs were selected to be a sample group from Woodland contexts for microwear analysis to match the sample group from Mississippian Period contexts. Four to five of the PPKs were determined to be used for cutting/butchering purposes, three as projectiles, one for scraping, and two for both projectiles and cutting. The Woodland PPKs data shows that the majority of the Woodland PPKs show evidence of butchering compared to those of Mississippian Period contexts, which one can infer is because, during the Woodland Period, the State Line site was used primarily as a hunting/butchering camp where those activities would take place. During the Mississippian Period, the Site was thought to have primarily been used as a village settlement focused on horticulture with a larger population, which I believe caused local hunting pressure to increase. This increase would then mean that groups would have to travel to areas away from the State Line Site to hunt and butcher their game before returning. Higher reliance on horticulture and hunting/butchering taking place away from the State Line Site during the Mississippian Period would explain why fewer of the Mississippian Period PPKs show less butchering use wear compared to the Woodland Period PPKs. One PPK showed no use-wear or cutting edge (see Figure 21).

*Figure 21. Sample 17 Ventral Left Lateral Blade Edge Distal Section Showing Rounded Lateral Edges. Photograph by Author*

The PPK was one of three Scallorn type in the Woodland assemblage, which are dated to the Late Woodland to Early Mississippian temporal periods. The Scallorn typology is mostly found in the range of Southwest Indiana and as far west and south as Texas and partially into Mexico. The dull edges and basal polish from hafting led to the inference that this point was either worn as an adornment/necklace or a gift. At the State Line Site, there are multiple Woodland mounds in the area, and PPKS like this may point to the site being visited for ceremonial uses, trade, etc. Five of the twelve PPKs in the Woodland microwear sample group showed signs of retouch flaking (See Figure 22). This further supports the fact that during the Woodland Period at the State Line Site, the long-term use of PPKs over making new PPKs was preferred.

*Figure 22. Sample 14 Dorsal Left Lateral Blade Edge Medial Section Showing Evidence of Retouch Flaking. Photograph by Author*

*Picture of State Line Site History*

The data from both the entire 62-artifact sample and the selected sample of 24 artifacts for microwear analysis provided a great deal of information about the use of the State Line Site and its site activities during the Woodland and Mississippian Periods and how activities at the site changed during this transitional period. The data supports the hypothesis that the State Line Site was used as a seasonal hunting/butchering camp during the Woodland Period and transitioned to a sedentary village settlement during the Mississippian Period. The data also support the hypothesis that PPKs during the Woodland Period were made to have a longer use life based on the robustness of the PPKs, retouch flaking present compared to that of Mississippian Period contexts. This finding also leads to the data supporting that lithic material sourcing was much more expansive during the Woodland Period at the State Line Site compared to that of the Mississippian Period, which can point to the higher rate of travel for hunting, ceremonial, and/or trade during that of the Woodland Period. This also supports the hypothesis that trade relations and the ability to travel throughout other areas were constricted during this transitional period. The data did not support the hypothesis that heat treatment would be more prevalent during the Mississippian Period at the State Line Site to mitigate lesser quality lithic material use. The data does not support this, but possibly points to the fact that due to the abundance of local pebble cherts and expedient use of PPKs, heat treatment was deemed not to be worth the time to ease manufacturing processes or not worth making the PPKs more brittle when used for projectiles more often. The Mississippian Period PPKs showed use as projectiles at a higher percentage than that of the Woodland PPKs, which were more commonly used for cutting (Figure 23).

*Figure 23. Sample 14 Ventral Left Lateral Blade Edge Proximal Section Showing Evidence of Cutting Use Wear. Photograph by Author*

# Chapter 7: Conclusion

_Restatement of Research Questions and Objectives_

What do lithic projectile points and knives (PPKs) from the State Line Site tell us about changing activities across the transition from Woodland to the Mississippian Period, and the change from seasonal hunting and gathering subsistence strategies with long-term lithic tool longevity to sedentary village centers with horticulture subsistence strategies and expendable lithic tool use? This is the big picture question to be answered, and I will use five hypotheses to assist with this endeavor. I will analyze the results of my research to either support or falsify my hypotheses, to then summarize my findings for creating a clearer insight into my findings, and to answer the previously mentioned larger question. The data collected for analysis included use-wear analysis of the PPKs to provide insight into activities like butchering, scraping, drilling, and use as a projectile.

**The main question to be answered**:

What do lithic projectile points and knives (PPKs) from the State Line Site tell us about changing activities across the transition from Woodland to the Mississippian Period, and the change from seasonal hunting and gathering subsistence strategies with long-term lithic tool longevity to sedentary village centers with horticulture subsistence strategies and expendable lithic tool use?

The 4 main questions/hypotheses that were to be supported or falsified included:

**H1: *Supported***

The typology, manufacture, and use of the State Line Site projectile points vary between Woodland and Mississippian Period contexts. In the Woodland context, PPKs will more frequently have evidence of being used as tools for hunting seasonal game and the butchering process of said game, compared to those projectile points from Mississippian Period contexts.

**H1 Discussion:**

The data supports the hypothesis that the State Line Site was used as a seasonal hunting/butchering camp during the Woodland Period and transitioned to a sedentary village settlement during the Mississippian Period. The Mississippian Period PPKs showed use as projectiles at a higher percentage than that of the Woodland PPKs, which were more commonly used for cutting/butchering. This finding implies that the primary function of the site during the Woodland Period was a hunting/butchering camp.

**H2:** ***Supported***

The lithic material of projectile points from Woodland contexts found at the State Line Site varies from that of Mississippian Period context PPKs. Lithic material associated with the Woodland Period will have traveled a greater distance compared to that of the Mississippian Period contexts.

**H2 Discussion:**

The data supports that lithic material sourcing was much more expansive during the Woodland Period at the State Line Site compared to that of the Mississippian Period, which can point to the higher rate of travel from the site for hunting, ceremonial, and/or trade during that of the Woodland Period. This also supports the hypothesis that trade relations and the ability to travel throughout other areas of surrounding states for lithic material were constricted during this transitional period.

**H3:** ***Supported***

Projectile points from Woodland contexts at the State Line Site are often more robust compared to those of projectile points from Mississippian contexts, and the Woodland assemblage has more signs of retouching compared to those of the Mississippian Period assemblage.

**H3 Discussion:**

The data also supports the hypothesis that PPKs during the Woodland Period were made to have a longer use life based on the robustness of the PPKs, retouch flaking present compared to that of the Mississippian Period contexts.

**H4: Falsified**

The lithic material most often identified in the Mississippian Period contexts at the State Line Site is that of local pebble cherts that are of lesser quality compared to sourced cherts seen with PPKs from Woodland contexts. In most cases, lesser quality cherts may be found to be heat-treated to assist with the manufacturing process of flintknapping to prevent unwanted breakage patterns. This leads to my hypothesis that the Mississippian Period PPK assemblage will contain a greater proportion of artifacts with evidence of heat treatment.

**H4 Discussion:**

The data did not support the hypothesis that heat treatment would be more prevalent during the Mississippian Period at the State Line Site to mitigate lesser quality lithic material use. The data does not support this, but possibly points to that due to the abundance of local pebble cherts and expedient use of PPKs, heat treatment was deemed not to be worth the time to ease manufacturing processes, or not worth making the PPKs more brittle when used as projectiles more often.

*Implications of the Study*

The Analysis has provided insight into aspects about not only the changes that took place at the State Line Site during the transition from the Woodland Period into the Mississippian Period, but also more data for a better understanding of how the Ohio River Valley/Midwest of America changed. Groups of the Ohio River Valley moved from using the area for hunting and butchering of game toward large sedentary villages focused on horticulture. Specifically at the State Line Site, the PPK analysis supports that during the Woodland Period the site was used as a primarily hunting/butchering camp and during the Mississippian Period was used as a large sedentary village site with hunting and butchering of large game taking place elsewhere as hunting pressure of the local area would increase with larger populations. This study also has the potential to assist with future analysis of State Line Site PPKs and even comparison of PPKs from other sites, given the database of microwear/use wear photographs and analysis from this research.

Limitations of the Study

The research limitations included the number of complete/mostly complete PPKs to be included in the assemblage. To be useful for Micro/use-wear analysis, PPKs that were mostly complete or complete were important to provide the information required to find answers to the proposed hypotheses. The microscope and its resolution power capabilities were another limitation. Motion type was easier to determine, but the material being enacted upon is more difficult to determine when considering materials like bone or wood. Another limitation that could have been enacted upon the PPKs during their excavation, screening, bagging, curation, etc. That is the contemporary polish or wear caused by actions to recover and curate the PPKs. While steps were taken to not introduce any new wear during my analysis, along with researching about differences between new use wear and older use wear, there is still a possible risk for discrepancies.

### *Future Research Recommendations*

For future research on this topic, I would recommend further analysis of the PPKs under higher resolution of a microscope capable of those abilities. I would also recommend that, as further excavations occur at the State Line Site, additional PPKs be added to increase the sample/data group for more in-depth statistics to be revealed, along with information that they may be able to provide. Along with this, I would recommend an analysis of faunal remains from both Woodland and Mississippian Period contexts to find data on butchering wear between the two periods.

### *Final Thoughts*

I believe this research to have been fruitful not only to my knowledge of lithic tools, and lithic materials, conducting research but also to providing useful knowledge as to the history of the State Line Site being pieced together to provide a clearer picture of how the Site was used, and the lifeways of the multiple habitation periods of the site. This research, I believe, is important as it focuses on a site that is not considered a monumental site, which is a category that is severely overlooked in the archaeological record. It also provides insight that, even with many thoughts that during the Mississippian Period, there was a large trade network with the emergence of larger societies and urbanization of the region, at the State Line Site, there was not much trade for lithic materials from other regions. With the introduction of bow and arrow technology in concert with abundant local pebble chert during this transitional period, evidence from State Line PPKs also points to an increase in disposability of PPKs, as there is no retouch flaking present on the Mississippian PPK sample group (Cook et al, 2014). With many more PPKs being found at the State Line Site currently, there will be more opportunities for similar analysis to provide a larger sample to possibly allow further support of my findings that PPKs from the site can provide insight that the State Line Site underwent site use change from a hunting/butchering camp to a large village site focused on horticulture with hunting/butchering taking place elsewhere. This analysis also provides an opportunity for comparison with other sites, including Mississippian Period village sites and hunting/butchering sites PPKs to provide a better understanding of how different groups and areas of the region changed throughout the transition from the Woodland Period into the Mississippian Period.

Appendices

## Figures:

Figure 1. Ventral Side of Sample 23 Adena Stemmed PPK (Photograph by Author)

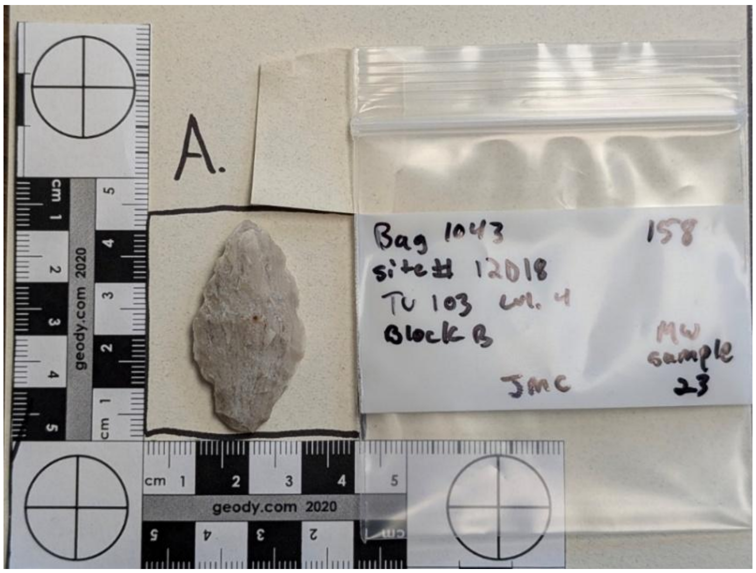


Figure 2. Ventral Side Sample 14 Copena Triangular PPK (Photograph by Author)

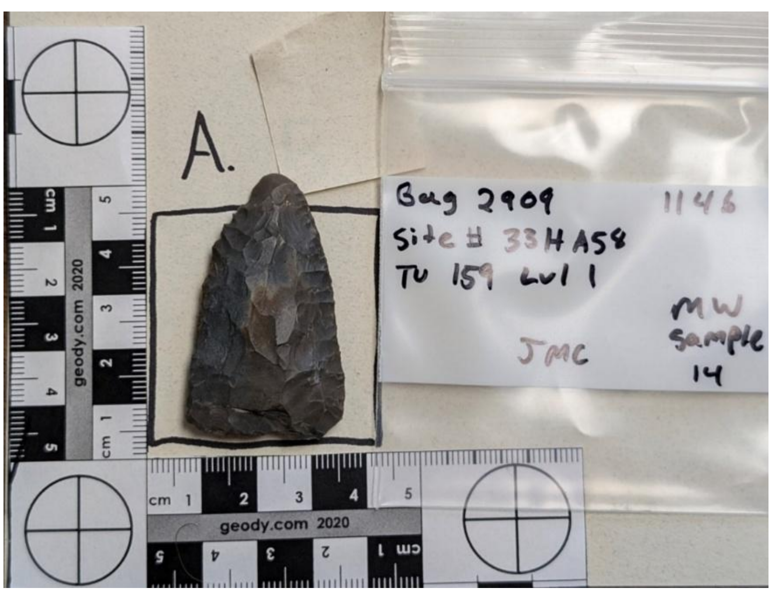

Figure 3. (Ventral Side) Sample 21, Bakers Creek/Lowe Flared Base PPK (Photograph by Author)

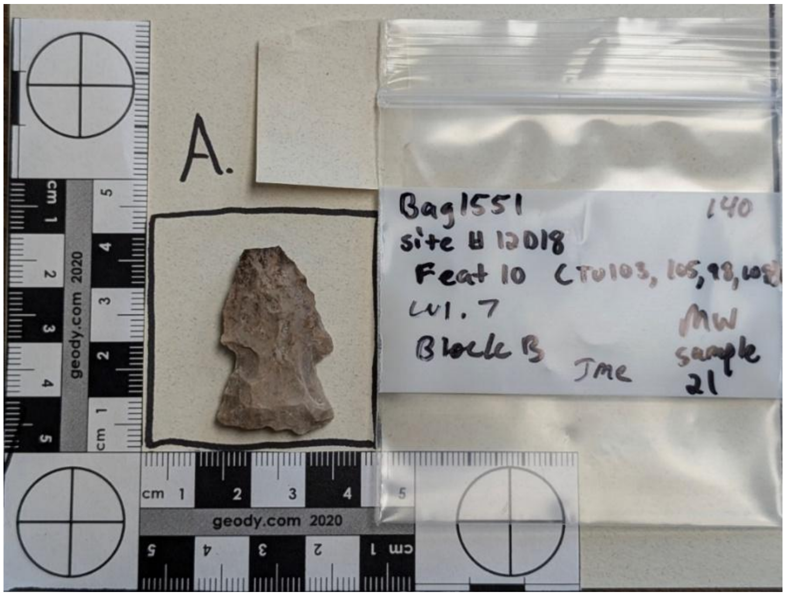


Figure 4. Dorsal Side of Sample 3 Madison-Untyped PPK (Photograph by Author)

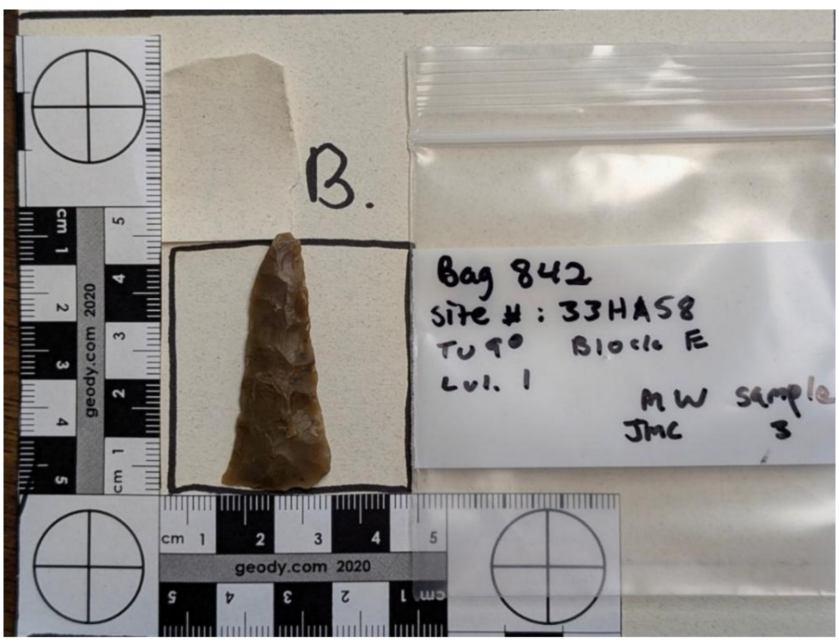

Figure 5. Ventral Side of Sample 9 Cahokia PPK (Photograph by Author)


Figure 6. ( Blade Morphology Chart of Entire PPK Assemblage)

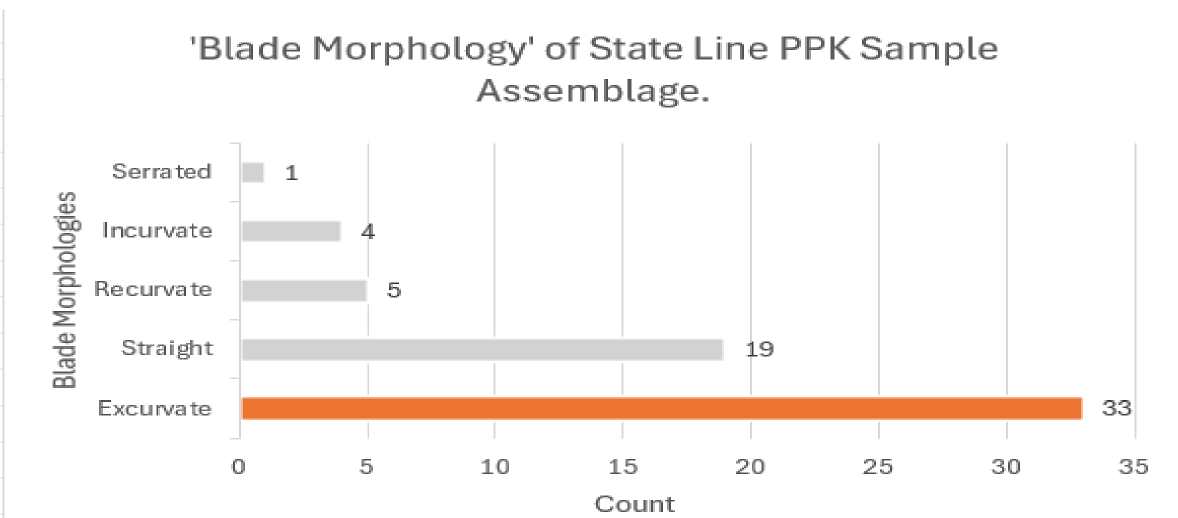

Figure 7. (Raw Material Chart of Woodland PPK Assemblage)

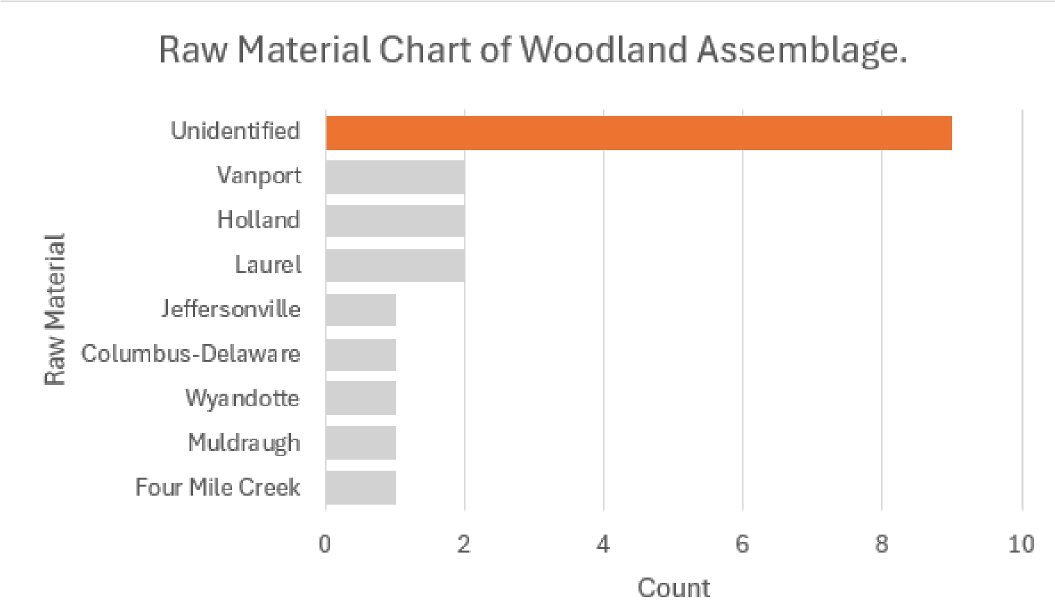


Figure 8. (Blade Morphology Chart of Woodland Assemblage)

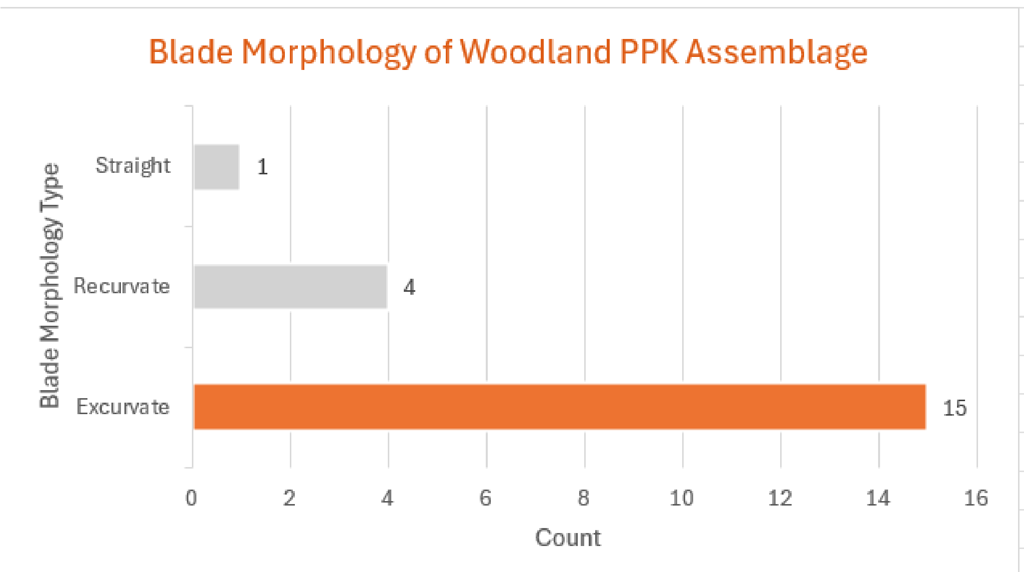

Figure 9. (Type Chart of Mississippian Period Micro Wear Sample Assemblage)

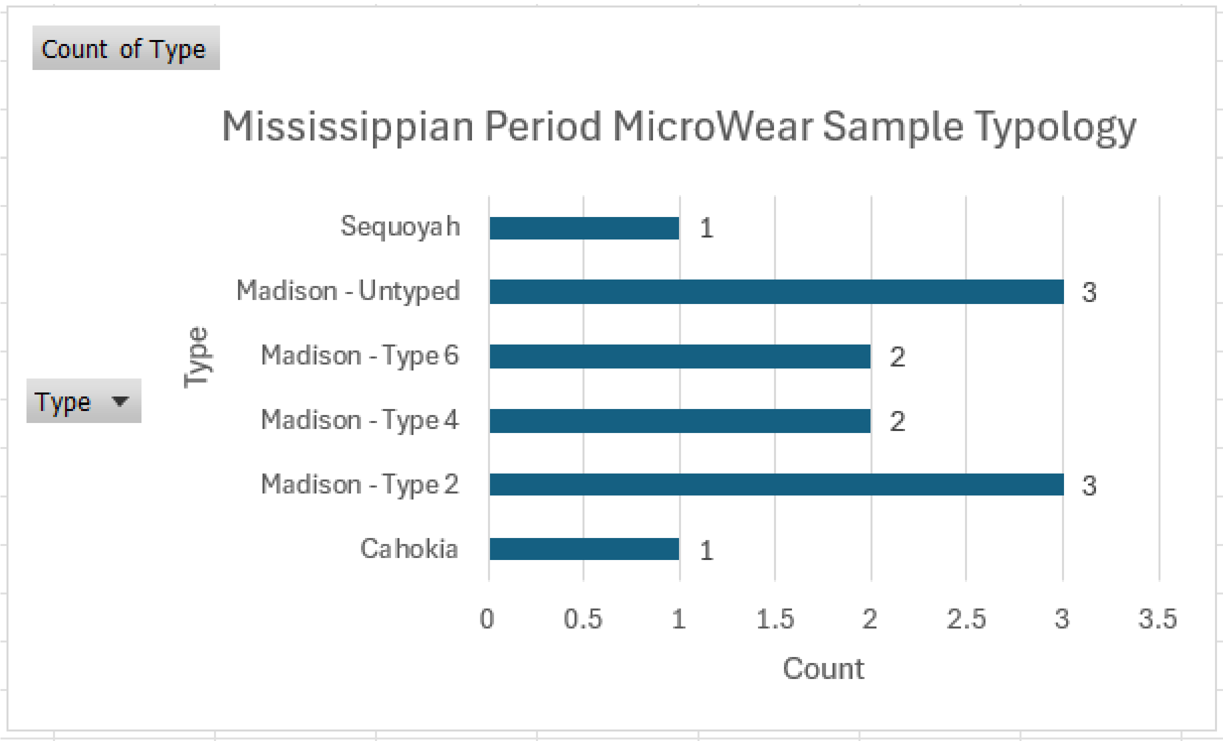


Figure 10. (Mississippian Period Microwear PPK Sample Raw Materials Chart)

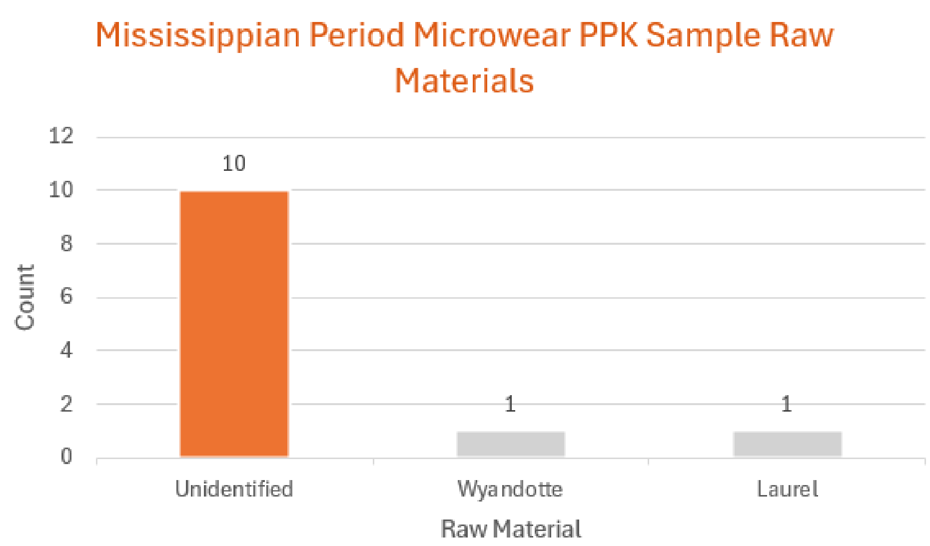

Figure 11. (Mississippian Period Microwear Sample PPK Assemblage Motion Chart)

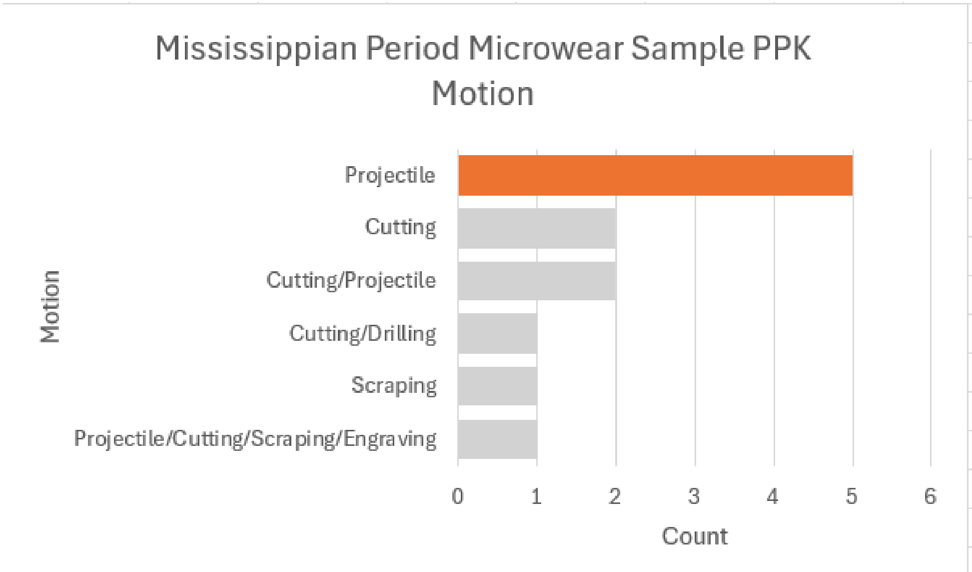


Figure 12. Sample 3 Dorsal Left Lateral Blade Edge Distal Section Overhead View Projectile Breakage shown (Photograph by Author)

Figure 13. Sample 3 Ventral Basal Section, Evidence of Scraping Use wear (Photograph By Author)

Figure 14. (Mississippian Period Microwear Sample Number of Uses Chart)

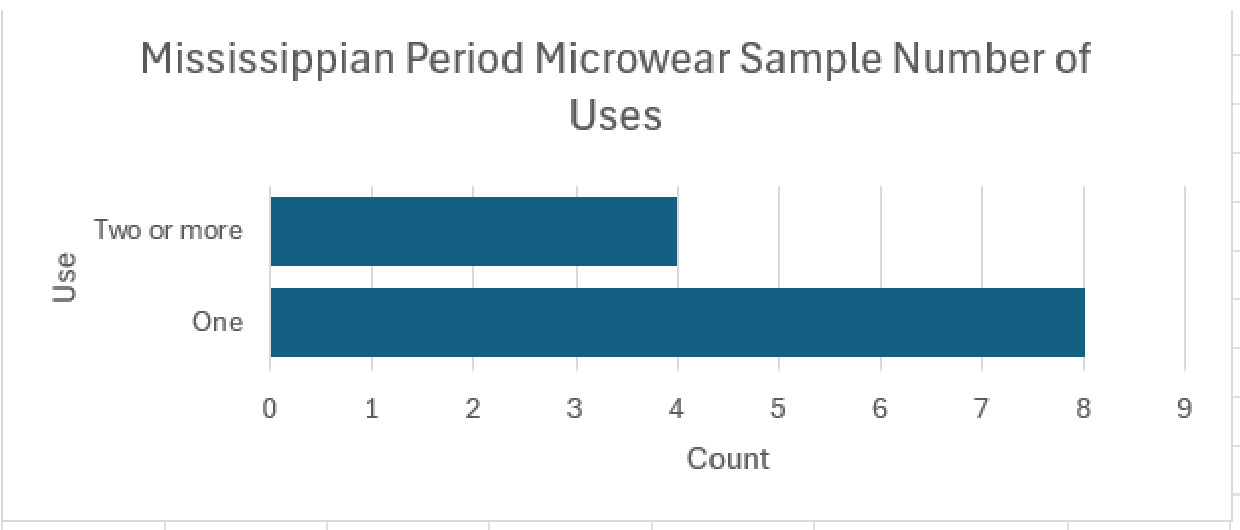

Figure 15. (Woodland Microwear Sample PPK Assemblage Raw Material Chart)

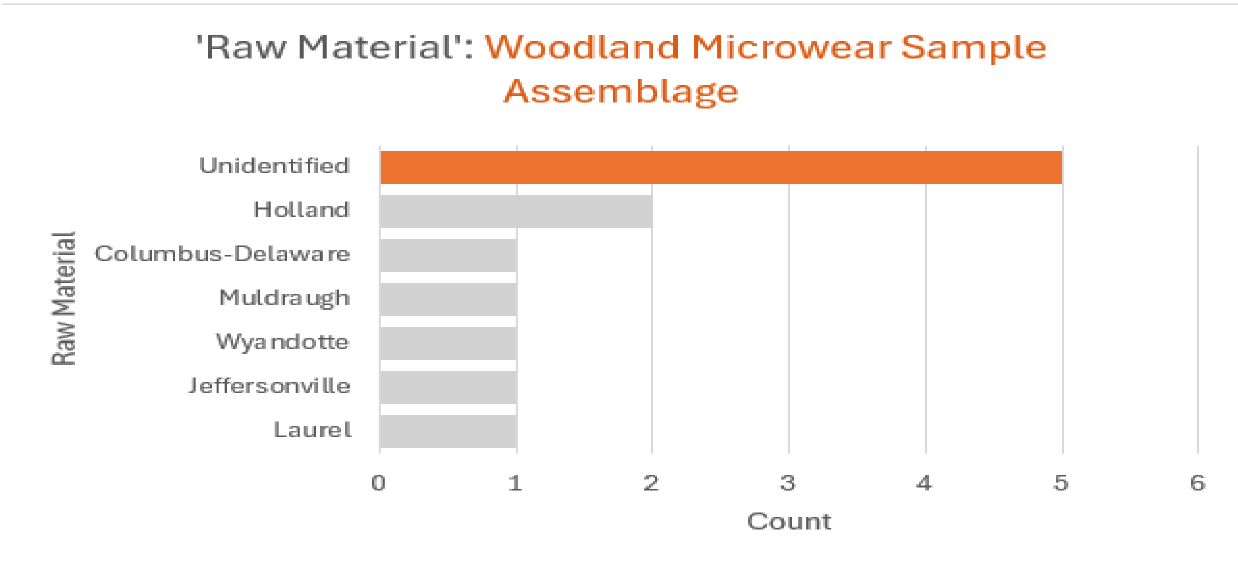


Figure 16. (Woodland Microwear Sample PPK Assemblage Motion Chart)

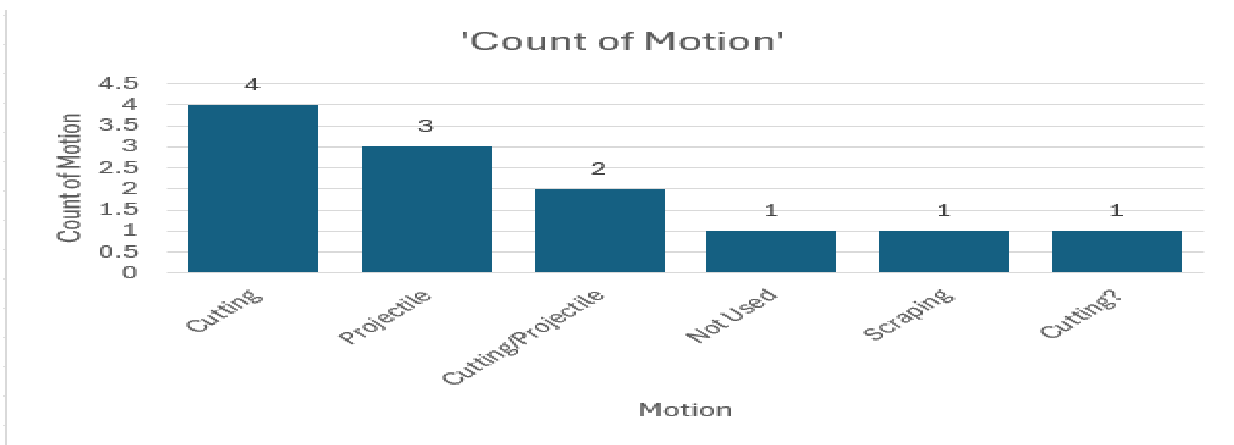

Figure 17. (Woodland Microwear Sample PPK Assemblage Retouch Chart)

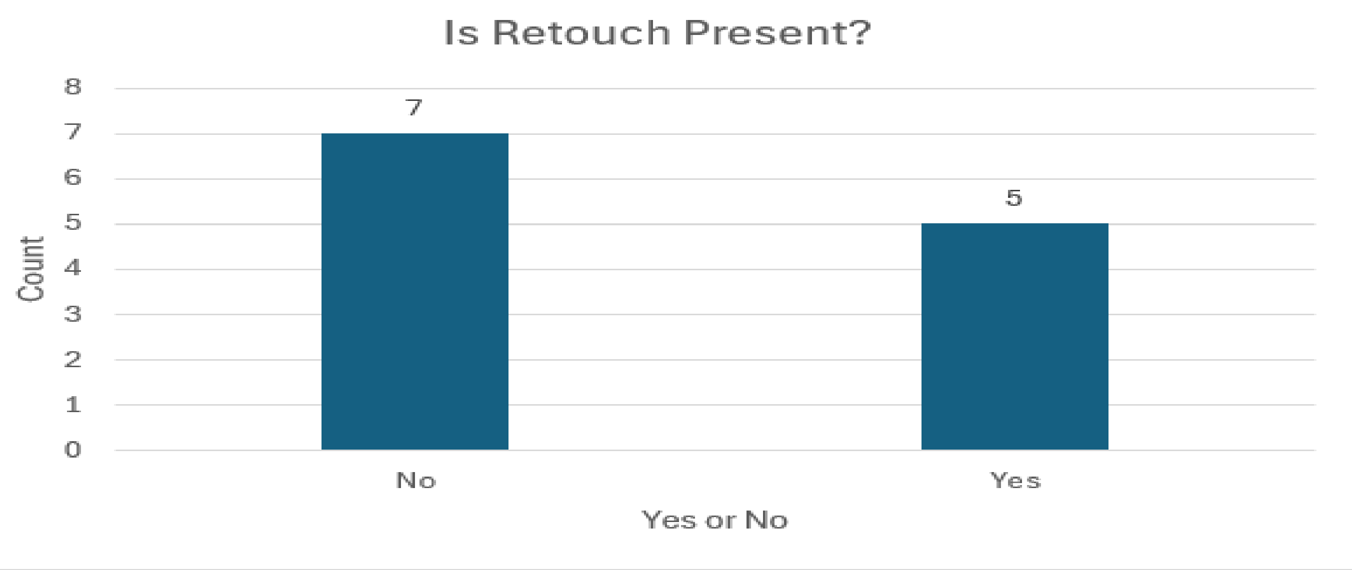


Figure 18. (Woodland Microwear Sample PPK Assemblage Uses Chart)

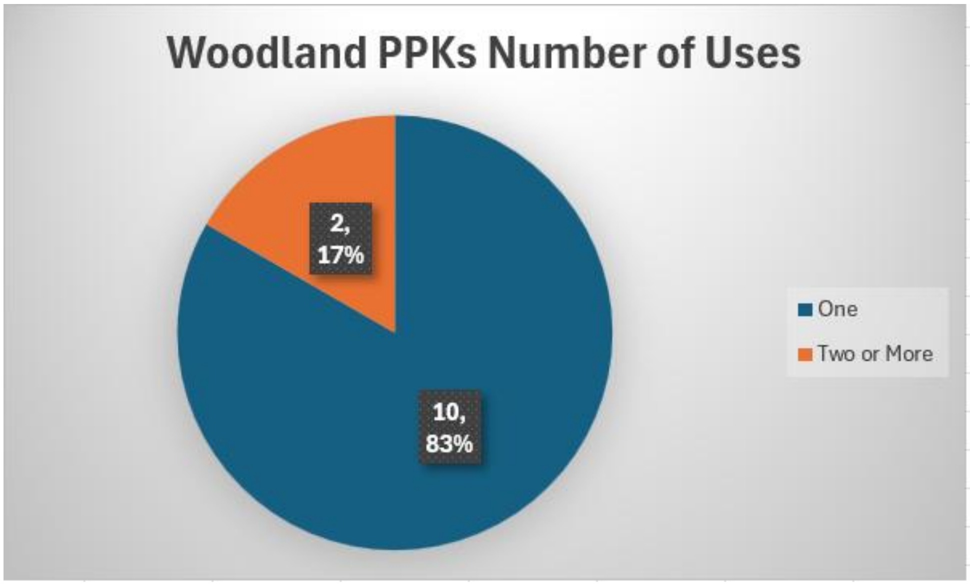

Figure 19. (Dorsal Side of Microwear Sample PPK 22)


*Figure 20*. Mississippian PPK from Pebble Chert, Ventral Side (Photograph by the Author)

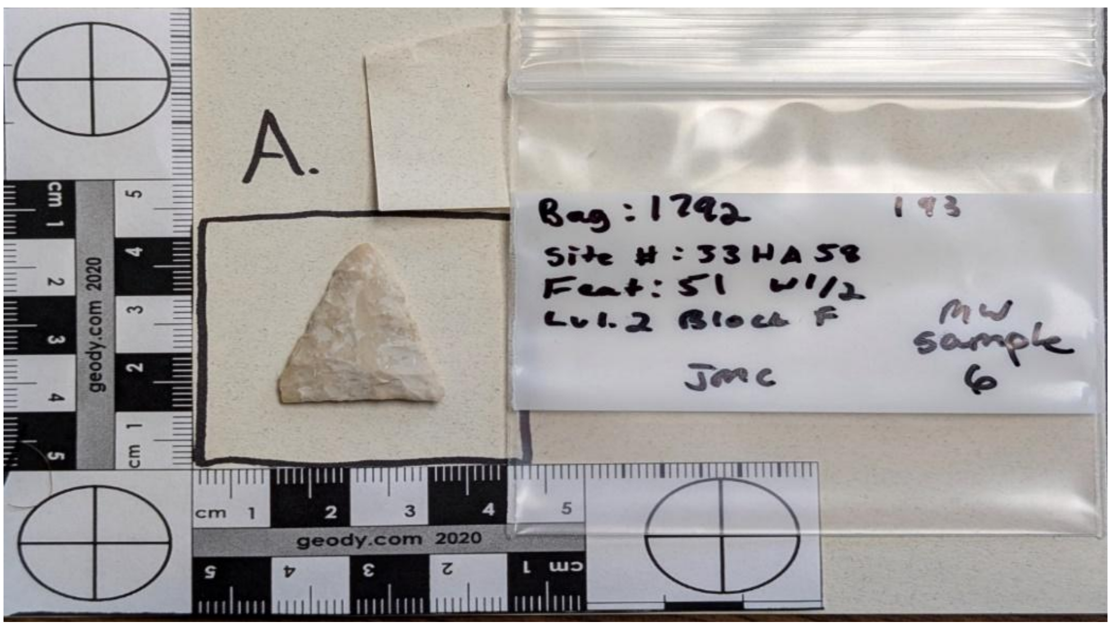

Figure 22. Sample 14 Dorsal Left Lateral Blade Edge Medial Section Showing Evidence of Retouch Flaking (Photograph by Author)

Figure 21. Sample 17 Ventral Left Lateral Blade Edge Distal Section Showing Rounded Lateral Edges (Photograph by Author)

Figure 23. Sample 14 Ventral Left Lateral Blade Edge Proximal Section Showing Evidence of Cutting Use Wear (Photograph by Author)

## Tables

| Type | Count | % |
|---|---|---|
| Madison-Untyped | 13 | 21 |
| Madison Type 2 | 8 | 12.9 |
| Madison-Type 4 | 5 | 8.2 |
| Low Flared Base | 4 | 6.5 |
| Scallorn | 4 | 6.5 |
| Madison-Crude | 4 | 6.5 |
| Madison-Type 6 | 3 | 4.8 |
| Cypress Stemmed | 2 | 3.2 |
| Copena Triangular | 2 | 3.2 |
| Michigan Small notched | 2 | 3.2 |
| Madison-Type 1 | 2 | 3.2 |
| Adena Stemmed | 2 | 3.2 |
| Cahokia | 1 | 1.6 |
| Raccoon Notched | 1 | 1.6 |
| Copena | 1 | 1.6 |
| Fort Ancient Knife | 1 | 1.6 |
| Madison - Type 3 | 1 | 1.6 |
| Bakers Creek/Lowe Flared Base | 1 | 1.6 |
| Jack's Reef Corner Notched | 1 | 1.6 |

| | | |
|---|---|---|
| Sequoyah | 1 | 1.6 |
| Madison - Type 5 | 1 | 1.6 |
| Late Fort Ancient Stemmed | 1 | 1.6 |
| Madison - Humped-back | 1 | 1.6 |
| Total | 62 | 100 |

*Table 10. Distribution of formal PPK types within the assemblage of selected points from the Mississippian Period.*

| **Raw Material** | **Count** | **%** |
|---|---|---|
| Unidentified | 34 | 54.8 |
| Laurel | 5 | 8.1 |
| Wyandotte | 4 | 6.5 |
| Four Mile Creek | 4 | 6,5 |
| Holland | 4 | 6.5 |
| Vanport | 3 | 4.8 |
| Columbus-Delaware | 2 | 3.2 |
| Jeffersonville | 2 | 3.2 |
| Muldraugh | 1 | 1.6 |
| Indian Creek | 1 | 1.6 |
| Ferdinand | 1 | 1.6 |
| Upper Mercer | 1 | 1.6 |
| Total | 62 | 100 |

*Table 11. Distribution of Raw Material Types of the Entire PPK Assemblage*

| | Max Length (mm) | Max Width (mm) | Length: Width Ratio(mm) | Max Thickness (mm) | Length: Thickness Ratio (mm) | Basal Width (mm) | Basal Thickness (mm) | Blade Angle Right | Blade Angle Left | Blade Angle Average |
|---|---|---|---|---|---|---|---|---|---|---|
| **Min** | 18.3 | 5.3 | 1.21 | 2.8 | 3.17 | 8.7 | 0.6 | 46.0 | 46.0 | 46.0 |
| **Max** | 54.8 | 29.1 | 4.53 | 10.0 | 9.68 | 28.8 | 8.1 | 53.0 | 54.0 | 53.5 |
| **Avg** | 30.4 | 18.1 | 1.74 | 5.3 | 6.05 | 17.7 | 2.1 | 48.5 | 49.0 | 48.7 |
| **STDEV** | 8.036788 | 4.001666 | 0.565378 | 1.972656 | 1.548914 | 3.599288 | 1.577664 | 1.665306 | 1.863846 | 1.641131 |

*Table 12. Summary of Measurements with Standard Deviations for Selected Points from the Mississippian Period.*

| Type | Count | % |
|---|---|---|
| Lowe Flared Base | 4 | 20 |
| Scallorn | 4 | 20 |
| Michigan Small Notched | 2 | 10 |
| Copena Triangular | 2 | 10 |
| Adena Stemmed | 2 | 10 |
| Cypress Stemmed | 2 | 10 |
| Jack's Reef Corner Notched | 1 | 5 |
| Raccoon Notched | 1 | 5 |
| Bakers Creek/Lowe Flared Base | 1 | 5 |
| Copena | 1 | 5 |
| Total | 20 | 100 |

*Table 13. (Distribution of PPK Types of the Woodland Assemblage)*

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Min. | 16.6 | 13.5 | 1.23 | 4.3 | 2.92 | 8.5 | 2.1 | 46.0 | 47.0 | 46.5 |
| MAX | 57.3 | 28.7 | 2.30 | 12.5 | 7.72 | 28.5 | 6.3 | 54.0 | 54.0 | 53.0 |
| AVERAGE | 38.3 | 21.0 | 1.82 | 7.0 | 5.40 | 17.0 | 3.6 | 49.9 | 49.7 | 49.8 |
| STDEV | 12.717 | 5.973867 | 0.457838 | 2.697804 | 1.624013 | 6.658497 | 1.536978 | 10.94792 | 10.92762 | 10.91916 |

*Table 14. Summary of Measurements with Standard Deviations for Selected Points from the Woodland Period.*

| Type | Count | % |
|---|---|---|
| Scallorn | 3 | 25 |
| Adena Stemmed | 2 | 16.7 |
| Copena Triangular | 2 | 16.7 |
| Cypress Stemmed | 2 | 16.7 |
| Lowe Flared Base | 1 | 8.3 |
| Bakers Creek/Lowe Flared Base | 1 | 8.3 |
| Raccoon Notched | 1 | 8.3 |
| Total | 12 | 100 |

*Table 15. Distribution of Microwear Types in the Woodland Sample PPK Assemblage*

| | **Max Length (mm)** | **Max Width (mm)** | **Length: Width Ratio (mm)** | **Max Thickness (mm)** | **Length: Thickness Ratio (mm)** | **Basal Width (mm)** | **Basal Thickness (mm)** |
|---|---|---|---|---|---|---|---|
| P-Value | 0.002 | 0.16985 | 0.569 | 0.004483 | 0.103058 | 0.591145 | 0.000447 |

*Table 16. P-Value Chart Comparing Woodland and Mississippian PPKs*

| Sample # | Bag # | Type | Temporal | Raw Material | Used | Heat Treated | Cortex | Motion | Material | Hafting? | Retouch Present? | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 463 | Madison - Type 6 | Late Prehistoric | Unidentified | Yes | No | 0% | Projectile | Soft Tissue | Yes | No | |
| 2 | 1247 | Madison - Untyped | Late Prehistoric | Unidentified | Yes | No | 0% | Cutting/Projectile | Soft Tissue | No | No | |
| 3 | 842 | Madison - Untyped | Late Prehistoric | Unidentified | Yes | No | 0% | Projectile/Cutting/Scraping/Engraving | Soft Tissue/Bone | Yes | No | |
| 4 | 249 | Madison - Type 2 | Late Prehistoric | Unidentified | Yes | No | 0% | Cutting/Projectile | Soft Tissue | Yes | No | |
| 5 | 906 | Madison - Type 2 | Late Prehistoric | Unidentified | Yes | No | 0% | Cutting | Soft Tissue | No | No | Looks to have had Distal Portion Snapped during manufacture and then Utilized for cutting. (Nass 1987) |
| 6 | 1792 | Madison - Untyped | Late Prehistoric | Unidentified | Yes | No | 0% | Cutting/Projectile | | Yes | No | |
| 7 | 1562 | Sequoyah | Mississippian | Unidentified | Yes | Yes | 0% | Cutting/Drilling | Soft Tissue/ Bone/ Wood | Unsure | No | |
| 8 | 1247 | Madison - Type 6 | Late Prehistoric | Unidentified | Yes | No | 0% | Scraping | Hide | Yes | No | |
| 9 | 373 | Cahokia | Mississippian | Wyandotte | Yes | No | 0% | Projectile | Soft Tissue | Yes | No | |
| 10 | 1349 | Madison - Type 4 | Late Prehistoric | Unidentified | Yes | No | 0% | Projectile | | Yes | No | |
| 11 | 782 | Madison - Type 2 | Late Prehistoric | Laurel | Yes | Yes | 0% | Projectile | Soft Tissue/Bone | Yes | No | |
| 12 | 1379 | Madison - Type 4 | Late Prehistoric | Unidentified | Yes | No | 0% | Projectile | Unsure | Yes | No | |

*Table 17. Mississippian Period Microwear Results/Analysis*

| Sample # | Bag # | Type | Temporal | Raw Material | Used | Heat Treated | Cortex | Motion | Material | Hafting | Retouch Present? |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 13 | 2502 | Cypress Stemmed | Early Woodland | Columbus-Delaware | Yes | No | <50% | Cutting/Projectile | Soft Tissue/Bone | Yes | No |
| 14 | 2909 | Copena Triangular | Middle Woodland | Wyandotte | Yes | No | 0% | Cutting | Soft Tissue/Bone | Yes | Yes |
| 15 | 2873 | Copena Triangular | Middle Woodland | Jeffersonville | Yes | No | 0% | Cutting | Soft Tissue | No | Yes |
| 16 | 2229 | Scallorn | Late Woodland to Mississippian | Muldraugh | Yes | Yes | 0% | Projectile | Soft Tissue | Yes | No |
| 17 | 432 | Scallorn | Late Woodland to Mississippian | Holland | No | No | 0% | Not used | None | Yes | No |
| 18 | 1816 | Scallorn | Late Woodland to Mississippian | Holland | Yes | No | 0% | Projectile | Soft Tissue | Yes | Yes |
| 19 | 117 | Raccoon Notched | Late Woodland | Laurel | Yes | Yes | 0% | Projectile | Soft Tissue/Bone or wood | Yes | Yes |
| 20 | 473 | Lowe Flared Base | Middle to early Late Woodland | Unidentified | Yes | No | 0% | Cutting | Bone or Wood | Yes | No |
| 21 | 1551 | Bakers Creek/Lowe Flared Base | Middle to Terminal Middle Woodland; Middle to early Late Woodland | Unidentified | Yes | Yes | 0% | Cutting | Soft Tissue | Unsure? | No |
| 22 | 24 | Adena Stemmed | Early Woodland | Unidentified | Yes | Yes | 0% | Scraping | Hide/Soft Tissue | No | Yes |
| 23 | 1043 | Adena Stemmed | Early Woodland | Unidentified | Yes | No | 0% | Cutting? | | No | No |
| 24 | 2661 | Cypress Stemmed | Early Woodland | Unidentified | Yes | No | 0% | Cutting/Projectile | Soft Tissue/Bone | Yes | No |

*Table 18. Woodland Microwear Results*

# Bibliography


Anderson, David G. "PREHISTORIC SELECTION FOR INTENTIONAL THERMAL ALTERATION: TESTS OF A MODEL EMPLOYING SOUTHEASTERN ARCHAEOLOGICAL MATERIALS." *Midcontinental Journal of Archaeology* 4, no. 2 (1979): 221–54. http://www.jstor.org/stable/20707840.

Andrefsky, Jr, William. *Lithics: Macroscopic Approaches to Analysis*. 2nd ed. of *Cambridge Manuals in Archaeology*. Cambridge: Cambridge University Press, 2005.

Beck, Robin A. "Consolidation and Hierarchy: Chiefdom Variability in the Mississippian Southeast." *American Antiquity* 68, no. 4 (2003): 641–61. https://doi.org/10.2307/3557066.

Binford, Lewis R. *Archeology in cultural systems*. Routledge, 2017. ( Look at Page 85 for Quote).

Chang, Kwang-Chih. "Major aspects of the interrelationship of archaeology and ethnology." *Current Anthropology* 8, no. 3 (1967): 227-243.

Church, Wendy. "Temporal shifts in lithic technology at the Clark Site (33Wa124): A Late Woodland site in Southwest Ohio." PhD diss., The Ohio State University, 2013.

Cook, Robert A. 2008. *Sunwatch: Fort Ancient Development in the Mississippian World*. Tuscaloosa: University of Alabama Press. http://site.ebrary.com/id/10387752.

Cook, Robert A., and Aaron Comstock. "Toward more continuous and practical artifact analyses: defining and learning from key dimensions of Fort Ancient triangular projectile points in the Miami Valleys." *Midcontinental Journal of Archaeology* 39, no. 3 (2014): 222-250.

Cook, Robert A., and Lane F. Fargher. "Fort Ancient-Mississippian Interaction and Shell-Tempered Pottery at SunWatch Village, Ohio." *Journal of Field Archaeology* 32, no. 2 (2007): 149–60. http://www.jstor.org/stable/40024663.

Crema, Enrico R., Andrew Bevan, and Mark W. Lake. "A probabilistic framework for assessing spatio-temporal point patterns in the archaeological record." *Journal of Archaeological Science* 37, no. 5 (2010): 1118-1130.

Dennis, Kayden. *A 3-Dimensional Approach to Projectile Point Classification*. University of Arkansas, 2021.

Eerkens, Jelmer W., and Carl P. Lipo. "Cultural transmission theory and the archaeological record: providing context to understanding variation and temporal changes in material culture." *Journal of Archaeological Research* 15 (2007): 239-274.

Eren, Metin I., Christopher I. Roos, Brett A. Story, Noreen von Cramon-Taubadel, and Stephen J. Lycett. "The role of raw material differences in stone tool shape variation: an experimental assessment." *Journal of Archaeological Science* 49 (2014): 472-487.Lithic Microwear Analysis of a Sample of 30 Tools from State Line (33HA58 and 12D18)

Evans, Adrian Aanthony, H. Lerner, D. A. Macdonald, W. J. Stemp, and P. C. Anderson. "Standardization, calibration, and innovation: a special issue on lithic microwear method." *Journal of Archaeological Science* 48 (2014): 1-4.

Fortier, Andrew C., and Dale L. McElrath. "Deconstructing the emergent Mississippian concept: The case for the terminal late woodland in the American bottom." *Midcontinental Journal of Archaeology* (2002): 171-215.

FRIBERG, CHRISTINA M. "Culture Contact and the Cahokia Phenomenon." In *The Making of Mississippian Tradition*, 1st ed., 10–42. University Press of Florida, 2020. https://doi.org/10.2307/j.ctv16x2b8w.7.

Fritz, Gayle. 2019. *Feeding Cahokia: Early Agriculture in the North American Heartland*. Tuscaloosa, Alabama: The University of Alabama Press. https://muse.jhu.edu/book/63525/.

G. Logan Miller, 2022. Lithic Microwear Analysis of a Sample of 30 Tools from State Line (33HA58 and 12D18).

Jeske, Robert J., and Katherine M. Sterner-Miller. "Microwear analysis of bipolar tools from the Crescent Bay Hunt Club site (47JE904)." *Lithic Technology* 40, no. 4 (2015): 366-376.

Justice, Noel D. 1987. Stone Age Spear and Arrow Points of the Midcontinental and Eastern United States: A Modern Survey and Reference. Indiana University Press, Bloomington.

Keeley, Lawrence H. *Experimental determination of stone tool uses: a microwear analysis*. University of Chicago Press, 1980.

Marreiros, Jõao, Nuno Bicho, and Juan F. Gibaja, eds. 2014. *International Conference on Use-Wear Analysis: Use-Wear 2012*. Newcastle upon Tyne, England: Cambridge Scholars Publishing. http://site.ebrary.com/id/11019510.

Mehta, Jayur Madhusudan, and John M. Connaway. "Mississippian Culture and Cahokian Identities as Considered Through Household Archaeology at Carson, a Monumental Center in North Mississippi." In *Cahokian Dispersions: Diasporic Connections in the Mississippian Southeast*, pp. 28-53. Singapore: Springer Nature Singapore, 2019.

Mika, Anna, Kat Flood, James D. Norris, Michael Wilson, Alastair Key, Briggs Buchanan, Brian Redmond, Justin Pargeter, Michelle R. Bebber, and Metin I. Eren. "Miniaturization optimized weapon killing power during the social stress of late pre-contact North America (AD 600-1600)." *Plos one* 15, no. 3 (2020): e0230348.

Pauketat, Timothy R. "A FOURTH-GENERATION SYNTHESIS OF CAHOKIA AND MISSISSIPPIANIZATION." *Midcontinental Journal of Archaeology* 27, no. 2 (2002): 149–70. http://www.jstor.org/stable/20708176.

Perishable Technology: A Case from the Great Lakes. Journal of Archaeological Science

Pettigrew, Thomas F. "Intergroup contact theory." *Annual Review of Psychology* 49, no. 1 (1998): 65-85.

Pollack, David, A. Gwynn Henderson, and Christopher T. Begley. "FORT ANCIENT/MISSISSIPPIAN INTERACTION ON THE NORTHEASTERN PERIPHERY." *Southeastern Archaeology* 21, no. 2 (2002): 206–20. http://www.jstor.org/stable/40713581.

Prehistoric lithic projectile points. Accessed April 13, 2024. https://efotg.sc.egov.usda.gov/references/Delete/2017-9-2/projectile_points.pdf.

Rapp, G. (2009). Lithic Materials. In: Archaeomineralogy. Natural Science in Archaeology. Springer, Berlin, Heidelberg. https://doi.org/10.1007/978-3-540-78594-1_4

Raviele, Maria. "SUBSISTENCE TRANSFORMATION AND THERMAL PRETREATMENT OF LITHIC RAW MATERIAL." *Lithic Technology* 32, no. 1 (2007): 99–114. http://www.jstor.org/stable/23273646.

Relf, Diane. "Human issues in horticulture." *HortTechnology* 2, no. 2 (1992): 159-171.

Rots, Veerle, and Hugues Plisson. 2014. Projectiles and the Abuse of the Use-Wear Method in a Search for Impact. Journal of Archaeological Science 48:154-165.

Rots, Veerle. "Toward a More Behavioral Approach." 2015

Rutkoski, Ashley R., G. Logan Miller, Leanna Maguire, Metin I. Eren, and Michelle R. Bebber. 2020. The Effect of Heat on Lithic Microwear Traces: An Experimental Assessment. Lithic

Schulenburg, Marcus. "Triangle Points and the Upper Mississippians: Oneota and Fort Ancient Typologies." *Field Notes: A Journal of Collegiate Anthropology* 2, no. 1 (2010): 8.

Semenov, Sergei A. 1964. Prehistoric Technology. Translated by MW Thompson. Barnes and Noble, New York.

Stein, Gil J. "From passive periphery to active agents: emerging perspectives in the archaeology of interregional interaction." *American Anthropologist* 104, no. 3 (2002): 903-916. Technology 45: 38-47.

Van Gijn, Anne Lou. "Science and interpretation in microwear studies." *Journal of Archaeological Science* 48 (2014): 166-169.

White, Andrew A. "A comparison of functional variability among Early Archaic notched points from the Lower Savannah River." *South Carolina Antiquities* 51 (2019): 1-21.

Pollack, David, Anne Tobbe Bader, and Justin N. Carlson. 2021 Falls of the Ohio River: Archaeology of Native American settlement. University of Florida Press.

Schwarz, Dr. K. 2020 Tech. SCOPE OF SERVICE PHASE III DATA RECOVERY STATE LINE SITE: 33HA58 AND 12D18 DEARBORN COUNTY, INDIANA AND HAMILTON COUNTY, OHIO.

Schwarz, Dr. K. 2021, Tech. Management Summary: Phase III Data Recovery of the State Line Site 12D18 and 33HA58, at the US 50 and State Line Road Intersection Improvement Project (Des. No. 1297183), Dearborn County, Indiana, and Hamilton County, Ohio.

Schwarz, Dr. K. 2020, Tech. Phase III Data Recovery Plan for the State Line Site, 12D18 and 33HA58, at the US 50 State Line Road Intersection Improvement Project (Des. No. 1297183), Dearborn County, Indiana, and Hamilton County, Ohio.

Schwarz, Dr. K. (2020). (tech.). The State Line Site, A Fort Ancient Village and Woodland Period Mound Center, Hamilton County, Ohio and Dearborn County, Indiana: History of Investigations and Research Potential

Odell, George Hamley, and Frieda Odell-Vereecken. "Verifying the reliability of lithic use-wear assessments by 'blind tests': the low-power approach." *Journal of Field Archaeology* 7, no. 1 (1980): 87-120.

Olausson, Deborah. "EDGE-WEAR ANALYSIS IN ARCHAEOLOGY."

Nass, John. "Use-wear analysis and household archaeology: a study of the activity structure of the incinerator site, an Anderson phase Fort Ancient community in southwestern Ohio /." Doctoral dissertation, Ohio State University, 1987. http://rave.ohiolink.edu/etdc/view?acc_num=osu1487332636476604

Yerkes, Richard W. "Microwear analysis of a sample of 100 chipped stone artifacts from the 1971–1977 excavations at the Seip earthworks." *Midcontinental Journal of Archaeology* 34, no. 1 (2009): 109-121.