SITE-LESS SURVEY AND PREHISTORIC ARTIFACT DISTRIBUTION FOR BLACKFORD COUNTY, INDIANA

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Abstract

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This thesis focuses on the distribution of prehistoric artifacts in Blackford County that were recovered during the course of two Historic Preservation Fund (HPF) Grants: FY 2011 HPF Grant # 31921-4 and FY 2012 HPF Grant # 18-12-41921-3. The research led to the discovery of 466 archaeological sites, but the focus of this thesis is not on the sites per se, but on the distribution of the prehistoric artifacts and an analysis of the associated behaviors.

The basic question underlying this thesis is: (1) What is the distribution of human activity on the landscape of Blackford County? The related and subsidiary questions are: (2) How was the landscape being used in prehistoric times? (2a) What kinds of artifacts are found in association with others? The distribution of behaviors on the landscape may be determined by the association or disassociation of certain artifacts. (2b) What was the distance to water for all of these sites? Distance to water is important to measure because it indicates a basic necessity and it may be revealed through this analysis that certain behaviors are either closer or further from water sources. (2c) Are certain types of artifacts/behaviors associated with certain types of soils? (2d) Based on the distribution and morphology of lithic debitage, what can be said about cultural behaviors?
The primary methods used in this thesis are a comprehensive metrical and morphological analysis of all prehistoric artifacts, GIS analysis of the distribution of these artifacts within their artifact types, and statistical analyses based on the GIS analysis looking for correlation and divergence among all of the artifacts. The resulting research from this thesis will greatly contribute to the knowledge of the Tipton Till Plain archaeology and further refine our understanding of the distribution of artifacts on the landscape of Blackford County, Indiana. The results indicate that the Mississinewa watershed was a persistently used area for residential activities and that the Salamonie watershed was repeatedly used as an area for resource extraction activities.
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I would like to thank the members of my thesis committee: Dr. Kevin C. Nolan (chair), Dr. Mark A. Hill, and Dr. S. Homes Hogue, all of Ball State University’s Department of Anthropology. I greatly appreciated Dr. Nolan’s suggestion for the topic of a distributional approach and for all of his invaluable advice, direction, and encouragement throughout the writing of my proposal and thesis. I am also indebted to Dr. Hill for the countless hours discussing theory and the role that lithic debitage analysis can play in understanding the past. It was under his direction that I first learned of lithic debitage analysis and what those bits of waste material can tell us. I would also like to thank Dr. Hogue for agreeing to be on my committee and stepping out of her comfort zone of bioarchaeology to learn a little of debitage analysis.

I would also like to thank Christine K. Keller for all of her time and effort spent on the two HPF Grants and all of those countless hours in Blackford County surveying field after field. Chris has always been a very helpful sounding board and provided new ways of looking at the artifacts that I might not have considered. Also, Chris was largely responsible for organizing all of the student workers who took part on these two grants at the Applied Archaeology Laboratories within the Department of Anthropology at Ball State University.

Thanks to all of the student workers, both undergraduate and graduate, at the AAL for helping in all aspects of the two grants and for making this thesis possible. Thanks to all of the landowners who agreed to take part in the two surveys and willingly allowed us to come onto their fields to survey. Finally, I would like to thank my family for all of their support and encouragement over the past few years as I worked on this degree.
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Chapter One
Introduction and Problem Statement

Introduction

The cultural landscape is fashioned from a natural landscape by a culture group. Culture is the agent, the natural area is the medium, the cultural landscape is the result. Under the influence of a given culture, itself changing through time, the landscape undergoes development, passing through phases, and probably reaching ultimately the end of its cycle of development. With the introduction of a different—that is, alien—culture, a rejuvenation of the cultural landscape sets in, or a new landscape is superimposed on the remnants of an older one.

Carl Sauer (1925:46)

Sauer’s work in geography more than eighty years ago highlights the impact that culture has on the archaeological landscape. The material remains that persist on these landscapes—once recovered archaeologically—can be used to identify and reconstruct the different kinds of behavior that occurred on those landscapes. The archaeological landscapes of Blackford County, Indiana offer opportunities to explore some of these persistently used cultural landscapes in eastern central Indiana. My thesis further examines the archaeological materials that were gathered as part of two Historic Preservation Fund (HPF) Grants. The Ball State University, Department of Anthropology’s Applied Archaeology Laboratories (AAL) conducted a FY 2011 HPF Grant and FY 2012 HPF Grant to do two 900 acres pedestrian surveys of Blackford County,
Indiana in 2011 to 2013 (Figure 1). A few of the goals of the grants were to see what the density and distribution of archaeological sites on the landscape was and to identify the settlement patterns for the different cultural contexts. As a result of the FY 2011 Grant, 179 archaeological sites were added to the State Historic Architecture and Archaeology Research Database (SHAARD), and a total of 1,595 artifacts were discovered of which 256 were prehistoric artifacts and 1,339 were historic artifacts. As a result of the FY 2012 Grant, 287 archaeological sites were added to the SHAARD database, and a total of 1,999 artifacts were discovered of which 838 were prehistoric artifacts and 1,161 were historic artifacts. My thesis examines the debitage and other lithic materials recovered as part of these surveys and observes the distribution of prehistoric artifacts across the landscape of Blackford County. Debitage is the stone waste associated with stone tool production (Andrefsky 2005:xi); it includes proximal flakes, flake shatter, angular shatter, and cores/core tools (core tools are lumped with cores since their primary function was as a core and secondarily used as a tool).

The basic question underlying this thesis is:

(1) What is the distribution of human activity on the landscape of Blackford County?

The related and subsidiary questions are:

(2) How was the landscape being used in prehistoric times?

(2a) What kinds of artifacts are found in association with others? The distribution of behaviors on the landscape may be determined by the association or disassociation of certain artifacts.

(2b) What was the distance to water for all of these sites?

(2c) Are certain types of artifacts/behaviors associated with certain types of soils?
(2d) Based on the distribution and morphology of lithic debitage, what can be said about cultural behaviors?

**Background Summary**

In order to answer the questions posed above, a brief introduction to the physiography and natural setting of Blackford County is necessary. Blackford County is the second smallest county in the state of Indiana, only 106,022 acres (42,905 hectares) in size. The county is drained by the Salamonie River in the northeastern corner of the county and the Big and Little Lick Creeks in the southern half of the county which drain into the Mississinewa River. The county straddles this watershed divide between the Salamonie River in the northeast and the tributaries of the Mississinewa River in the south. Both river systems are part of the Wabash watershed, but the distinction between the Salamonie and the Mississinewa may prove to be an important one (Figure 2). Blackford County is within the general physiographic unit known as the Tipton Till Plain, an area of low relief with extensive areas of ice-disintegration features (Gray 2000). The Tipton Till Plain has a nearly flat to gently rolling topography which is crossed by several end moraines created during the Wisconsin glaciation (Wayne 1966:34). However, the end moraines within the area are so low and poorly developed that the Tipton Till Plain is generally characterized as “virtually featureless” (Schneider 1966:49). These nested end moraines are located in the northeastern part of the county (Camp and Richardson 1999:236; Gray 2000:5).

The majority of soils found in Blackford County are a product of either glacial or fluvial parent materials. Glacially deposited sediments of the ridge and ground moraines typically have clayey to silty textures while kames and eskers consist of sands and gravels. The areas surveyed incorporated five soil associations mapped within the county. Soil associations in till plain and
moraine settings include (Bono-Houghton, Blount-Pewamo-Glynwood, Glynwood-Blount-Pewamo, and Glynwood) and represent the majority of the project area (Table 1). Soil associations identified as forming in flood plains (Saranac-Eel) represent the minority of the survey areas (Kluess 1986). The surveys encountered 13 different Soil Map Units (SMUs) during the course of the two grants (Table 2). The soil associations mapped within the project area are suited to providing a variety of flora and fauna but are considered less desirable or of poorer quality than soils found in adjoining ecoregions (Omernik 1987). Blackford County is within the ecoregion 55a (which largely assumes the shape of the Bluffton Till Plain; Figure 3 and Figure 4), which is characterized by clayey lime soils (Omernik 1987).

My thesis primarily complements and enhances the conclusions drawn in the two HPF grant reports by thoroughly investigating the prehistoric lithic materials and by comprehensively analyzing the data obtained in the two HPF projects. The results from this thesis will supplement the two HPF grants (Miller 2013; Miller et al. 2012) and provide insights into the patterning of prehistoric behaviors relevant to Tipton Till Plain archaeology.
Figure 1: Location of Blackford County within the state of Indiana.
Figure 2: Location of Blackford County within the Mississinewa and Salamonie watersheds.
Figure 3: Ecoregion 55a (Omernik 1987). Note the similar shape of the pattern of Ecoregion 55a with the Bluffton Till Plain. Blackford County is outlined in red.
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Chapter Two

Background Research and Literature Review

General Literature Review

*The landscape is a palimpsest on to which each generation inscribes its own impressions and removes some of the marks of earlier generations. Constructions of one age are often overlain, modified or erased by the work of another. The present patchwork of settlement… has evolved as a result of thousands of years of human endeavor, producing a landscape which possesses not only a beauty associated with long and slow development, but an inexhaustible store of information about the many kinds of human activities in the past.*

Aston and Rowley (1974:14)

As Aston and Rowley correctly note above, the archaeological landscape is a palimpsest. Each generation adds to this landscape and it is our job as archaeologists to discern the patterns. The nature of the two HPF grants required a distributional approach to surveying the agricultural fields in order to perceive these patterns and to explain the specifics of what was happening on the landscape. Whereas Aston and Rowley (1974) dealt with the post-Roman landscape of Europe, Blackford County may be no less of a palimpsest in need of explication. Therefore, research for this thesis follows two tracks. First, research will investigate archaeological distribution studies and the applicability of the site-less survey method of archaeological investigation. Second, research also examines lithic (i.e., stone materials) debitage analysis and cultural behaviors based on the distribution and morphology of that debitage. This chapter is by no means an exhaustive discussion of distributional archaeology or the complex realm of
debitage analysis, but simply a rather brief review of some relevant literature that is germane to the task at hand.

*Distributional Archaeology*

Robert C. Dunnell and William S. Dancey wrote a seminal article that advocated and lauded the benefits of the distributional approach to archaeology arguing that agricultural activity does not cause massive disturbance to sites, and that “useful spatial patterning is easily discernible when systematic surface-collection techniques are employed” (Dunnell and Dancey 1983:269). They argue against excavation as the only method of attaining archaeological knowledge and contend that the surface distribution of artifacts “constitutes an appropriate source of archaeological data” (Dunnell and Dancey 1983:270; emphasis theirs). Furthermore, surface data can inform archaeologists on regional scales and should be thought of as the recovery of artifacts rather than the discovery of sites. Artifacts can then be grouped in clusters based on density and distribution in a region and then “assigned either to clusters or to intercluster space” (Dunnell and Dancey 1983:273). The surficial distribution of artifacts is further enhanced by analysis of the cultural behaviors associated with those artifacts, as will be discussed below.

James Ebert (1992) also describes the benefits of distributional archaeology and comments on the dissatisfaction that archaeologists have with full excavation surveys as being too costly and usually uncovering the same number of artifacts as surface survey archaeology. Ebert also notes that with surface surveys, archaeologists can focus on mobility, procurement of materials, and prehistoric use of landscapes (Ebert 1992:10). The surface data is a reflection of repeated human activities and materials across a landscape over long periods of time (Ebert 1992:12-13).
Kevin C. Nolan, in examining the Reinhardt site in Pickaway County, Ohio, used a multi-stage approach to decipher community structure. The different methods of data collection were excavation, gradiometer survey, magnetic susceptibility survey, surface collection, and volumetric shovel testing (Nolan 2011:105). The intensive surface collection was coupled with the volumetric shovel testing which resulted in 8,434 artifacts that almost mirrored the more than 8,000 artifacts collected from the excavations (Nolan 2011:118, 125). The point is not the accumulation of artifacts but the fact that archaeologists do not need to rely on excavation alone to garner data to interpret community structure. In fact, the aggregate analysis of the various surveys provided complementary data to the excavations and preserved more of the site by not using the destructive force of excavation. Therefore, a more complete picture of the Reinhardt site was achieved by means other than excavation alone. Nolan’s work demonstrates that surface collection is more cost effective and can offer a plenary view of a geographical area without reliance on excavation as the sole means of archaeological knowledge (see also Dunnell and Dancey 1983; Ebert 1992; Fish and Kowalewski 2009:v-xi, 261-276).

Sarah Schlanger (1992:92) in noting that archaeologists tend to favor “sites” and overlook “isolated finds”, suggests that the concept of the “persistent place” is helpful to link the two together stating that a persistent place is “used repeatedly during the long-term occupation of a region”. She makes the distinction between hunter-gatherers and farmers noting that hunter-gatherers typically had smaller tool assemblages over a broader area (hence isolated finds) and that farmers would have had a more diverse tool assemblage concentrated around visible architectural features (hence sites) (1992:91-92). Although Schlanger’s discussion focuses on the southwest corner of Colorado and Anasazi settlement systems, her primary dataset is the archaeological materials on the ground surface and how those reflect the long-term land use by
the Anasazi. In reviewing Schlanger’s work, Matthew Purtill states that Schlanger was the first to introduce the concept of persistent place as a tool to link physical and temporal aspects to the archaeological record (Purtill 2012:1; Schlanger 1992). Purtill also explains that Schlanger recognized two inter-related causes of persistent places: first, certain landscapes have a “unique quality that serves to repeatedly attract populations on a regular, or planned, basis” (Purtill 2012:1; Schlanger 1992). Second, human activity may craft the landscape so that it is highly visible and therefore invites future reoccupation (Purtill 2012:1; Schlanger 1992). These unique qualities may be a fresh water source or chert source, or human activity that clears the land for swidden agriculture or annual communal villages.

Russell Stafford and Edwin Hajic (1992) discuss how different geomorphic processes affected landscapes that impacted cultural settlements and how these same processes affect the archaeological record as it progresses through time. Stafford and Hajic use the older model of Foley (1981) to study the intersection of “settlement strategies, topographic variation, and cultural deposition” along with the accumulation of cultural debris on stable landforms, but they also note the impact that variation in landforms has on the settlement strategies of hunter-gatherers (Stafford and Hajic 1992:137-138). They view this variation through the lens of differing scales: foraging range, migratory range, and repeated interactions by means of trade (Stafford and Hajic 1992:139). Marquardt and Crumley (1987) refer to these ranges as the maximal spatial extent of a certain phenomenon (see also Wandsnider 1998:89). The range in which archaeologists can detect interpretable patterns and the range that a particular process operates is often noted as the effective scale (Wandsnider 1998:85).

Not all archaeologists are agreed that the distributional approach is as expedient and archaeologically relevant as its proponents contend (Binford 1992; Plog 2009). Lewis Binford
strongly argues that the “site” concept is a necessary tool of the archaeologist and that without it
archaeological data falls into the realm of meaninglessness (Binford 1992). In contrast to Chang
(1967), it seems that Binford is in agreement with Dunnell and Dancey that artifacts are the basic
unit of observation in archaeological contexts (Binford 1992:44; Dunnell and Dancey 1983:270;
Wandsnider 1998). However, Binford (1992:44) contends that “sites are places where there are
concentrations of artifacts”, neglecting to differentiate that sites are an archaeological decision
made in the field and not an observation of realia (cf. Dunnell and Dancey 1983:271). Also,
Binford fails to define what a concentration of artifacts is. Is it two artifacts, five artifacts, or
1,000 artifacts? Furthermore, Binford seems to ignore the fact that sites are fluid and plastic and
not subject to rigid or arbitrary zones that archaeologists decide on in the field.

Fred Plog critiques some of the benefits of distributional archaeology raised by Stephen
Kowalewski. In his essay on the merits of full coverage survey, Kowalewski highlights eight
benefits over the sample survey method (Kowalewski 2009:37-63). Plog disagrees, citing that
while distributional archaeology is theoretically and oftentimes logically more productive, the
same results can be achieved using sample surveys (Plog 2009:245-248). Kowalewski (2009:37)
suggests that larger databases and greater variability can be reached through distributional
archaeology but Plog says that the same results are achieved through sample surveys (Plog
2009:245). Kowalewski also suggests that spatial relationships, rare items, detection of
uninhabited zones, and regional boundaries can all be detected through distributional approaches;
whereas Plog states that sample survey (or re-survey) has the same chance of differentiating
these as full coverage survey (Kowalewski 2009; Plog 2009). I agree with Plog that sample
surveys can arrive at the same results as full coverage surveys, given that enough samples are
taken and that the sample survey methods are as fine-grained as distributional approaches.
However, Plog seems to overemphasize that sample surveys can be as thorough and efficient as distributional surveys.

Another small issue that detractors have with the distributional approach is that the surface record may be a distortion of the subsurface record because of the nature of tilled fields and the lateral movement of artifacts (Dunnell 1990:592; Ford and Robinsong 1972; Medford 1972). In 1987, George Odell and Frank Cowan conducted an experiment that would test the distortion of the subsurface record and analyze the results to identify the recovery rate of “planted” artifacts (Odell and Cowan 1987). Odell and Cowan’s (1987) experiment attempted to recreate the effects of tillage on the lateral displacement of surficial archaeological remains over a period of two years to see how much distortion there is and what tillage does to a controlled experiment.

Several experimental studies preceded Odell and Cowan’s (Ammerman 1985; Ammerman and Feldman 1978; Frink 1984; Lewarch 1979; Lewarch and O’Brien 1981; Reynolds 1982; and Trubowitz 1978), but Odell and Cowan attempt to answer some of the questions that these others do not address. For instance, what percentage of artifacts can be expected to be recovered from a surface survey? How far are artifacts displaced from their original location? Does plowing irretrievably destroy the integrity of an entire archaeological site, in terms of area and displacement (Odell and Cowan 1987:456)? As Lewarch and O’Brien (1981:45) suggest “surface assemblages likely represent less than 10% of the total plowzone population”, this seems like a small percentage. However, Odell and Cowan’s experiment corroborates this number and even suggests a lower recovery rate of five to six percent (Odell and Cowan 1987:461; cf. Ammerman 1985). Another issue is what is called “size effect” that larger artifacts are more abundantly represented on the surface than the proportion of large
artifacts within the subsurface population (Ammerman and Feldman 1978; Baker 1978; Baker and Schiffer 1975; and Lewarch and O’Brien 1981). Odell and Cowan’s (1987:480) experiment confirm that size effect is the operative force in a tilled field; they found that longer and heavier objects were recovered more often. They also note that over time and after repeated plowing episodes the recovery ratio of large to small artifacts decreases and reaches a quasi-equilibrium. One final point that their experiment discovered is that plowing and disking effectively doubles the area of a site (Odell and Cowan 1987:481).

Dunnell (1990:592) disagrees with this assessment, not with their entire experiment or conclusions per se, but with the implicit assumption that Odell and Cowan have regarding the object size in relation to lateral displacement. Dunnell (1990:593) notes that Odell and Cowan fail to take into account the fact that the tillage equipment itself may be responsible for the larger artifact displacement and that artifacts embedded in a peds matrix are more likely to move laterally with the soil than artifacts within a sand matrix. Also, Dunnell disagrees with their position that the surficial record is only important in so far as it correlates with the subsurface archaeological record. The correlation is not necessary, but when it does occur that is fortuitous (cf. Dunnell and Dancey 1983). This discussion is germane to my thesis because of the nature of the HPF grant surveys being conducted on cultivated agricultural fields. If the surface finds are only at about five to six percent of the population total as Odell and Cowan (1987) and Lewarch and O’Brien (1981) all state, then some isolated finds may not be isolated and prehistoric sites may in fact be much larger than currently known. However, following the argument of Dunnell and Dancey, the surface record is valuable archaeological information in and of itself, irrespective of the subsurface record.
The distributional archaeology method of gathering archaeological data has been shown to be an effective and productive way of analyzing past behaviors. As Dunnell and Dancey (1983), Ebert (1992), Fish and Kowalewski (2009), Kowalewski (2009), Nolan (2011), Purtill (2012), and Schlanger (1992) have all shown, the surficial data is oftentimes comparable to and complementary to the subsurface archaeological record. The data gathered as part of the HPF Grant survey follows in this method and can be further analyzed to understand cultural behaviors associated with the distribution of these artifacts. In conjunction with a site-less survey approach is also an analysis of human behaviors based on lithic debitage analysis. Debitage analysis looks at the small bits of waste material from the production of stone tools and answers questions about human behaviors based on that waste.

*Debitage Analysis and Ethnographic Analogies*

William Andrefsky (2005:201) notes that the interpretation of site function is often determined by artifact function. Once the function of the artifact can be inferred, then the function of the site can be determined, goes the logic. A variety of different lithic tools and waste materials are potentially present, including bifaces, cores, various flake tools, proximal flakes, flake shatter, and angular shatter. The broad categories used in this thesis are tools and non-tools. The tools encountered include bifaces (both hafted and non-hafted), unimarginal tools, core tools, bladelets, endscrapers and sidescrapers, edge modified flakes, utilized and retouched flakes, as well as non-chert tools such as groundstone tools, hammerstones, and other chipped stone tools. The non-tools encountered include flake shatter, proximal flakes, angular shatter, minimally modified cores, and fire cracked rocks (FCR). Approximately 65 percent of the artifacts encountered were non-tools.
The vast majority of prehistoric artifacts recovered (ca. 95%) were made of chert raw materials, and the other five percent were made of unidentified igneous rocks that were glacially deposited. Chert is a chemically precipitated sedimentary rock that forms in an ocean environment (Andrefsky 2005:52; Luedtke 1992). Chert is composed of silicon dioxide (also known as silica) that is secreted by microscopic organisms called diatoms, which then chemically precipitates into opal-A which is then precipitated into opal-CT and then precipitated into quartz (Andrefsky 2005:52; Luedtke 1992:23). The chert then occurs as nodules in the parent material, such as limestone, and can be found in large beds or layers within this parent material (Andrefsky 2005:52). Cherts are homogeneous in terms of crystal size, and when chipped they break along conchoidal fractures (Andrefsky 2005:52). This ability to fracture conchoidally is the reason why people use cherts as stone tools. Conchoidal fractures are predictable fracture lines that allow pieces (or flakes) to detach from objective pieces (or cores), and these fracture lines follow a Hertzian cone which is a cone shape that originates at the point of applied force and radiates out at approximately a 136 degree angle (Andrefsky 2005:26). Because the fracture lines and resulting Hertzian cone are predictable, chert is an excellent material to use for a variety of lithic tools which can be made efficiently.

Objective pieces are rocks or stone materials “that have been hit, cracked, flaked or modified in some way” (Andrefsky 2005:9-11). Bifaces are objective pieces that have evidence of flake removal on both sides. Bifaces can further be classified into hafted and non-hafted categories. Hafted bifaces are those that fit into a handle or shaft and could have been projectile points, dart points, knives, scrapers, arrowheads, or drills. Non-hafted bifaces are those that may have been used as cores, knives, or scrapers (Andrefsky 2005:179-181). Bifaces that are hafted can be analyzed based on their morphological shape to determine specific point type (e.g.,
Justice 1987), but morphological shape does not necessarily mean function and stone tools turn out to be multifunctional (e.g., Andrefsky 2005:201). Diagnostic projectile points were included in this thesis, but are only classified as bifaces and not projectile points; however, my main focus was not on the chronological importance of sites, but rather the cultural behaviors that pattern on the landscape.

Stone tools are morphologically dynamic, that is, they change dramatically throughout their use-life from chert resource procurement to discard (Andrefsky 2005:38-40). The concept of chaîne opératoire examines this morphological variability as forager-collectors purposefully embedded lithic procurement strategies into their mobility strategies, and sought to extend the use-life of the tool as well as the quantity of raw material (Andrefsky 2005:38-39). Chert resources that may have required greater costs, in terms of trade or travel, may have been better conserved and maintained than more readily available local resources. The chaîne opératoire approach may help explain some of the patterns that may develop as a result of statistical tests and distributional maps.

In Blackford County the largest artifact type in the debitage category that was clearly identifiable was proximal flakes. As mentioned above, debitage is the non-tool waste material in the production of stone tools. Many different types of debitage may potentially be present including proximal flakes, flake shatter, cores, minimally modified cores, and angular shatter. Analyzing debitage offers insights into the production of stone tools and offers valuable information in its own right. For example, proximal flakes can demonstrate if prehistoric inhabitants were breaking down cores to begin manufacturing tools or if they were maintaining stone tools. Each type of proximal flake will yield different kinds of information that will speak as to which behavior was being performed. Proximal flakes are characterized by having a
striking platform and a bulb of percussion. The striking platform is the location where the hammerstone or billet or pressure flaker contacts the flake to remove the flake from the objective piece. The type of striking platform can be used to determine the stage of reduction, and it has been shown that in later stages of production there is greater preparation to the striking platform (Andrefsky 2005:90). Also, the striking platform can be used to determine if the objective piece is being used in bifacial manufacture or from core reduction (Andrefsky 2005:90; Steffen et al. 1998:134). The specific types of striking platforms are discussed below in the methods section along with discussion of the associated cultural behavior.

Binford characterizes prehistoric hunter-gatherers as either foragers or collectors and that mobility was based on either a residential or logistical pattern; although this was a broad spectrum and not necessarily a binary duality (Binford 1980). Residential mobility was characterized by moving the entire group from location to location, and logistical mobility was characterized by moving individuals or small groups to perform a task and then back to the residential location (Andrefsky 2005:210-211; Binford 1980; Odell 2004:190-191). Within a logistical strategy, Odell notes that stone tools had to have the ability to be maintained, the ability to be flexible, and the ability to be used in any given situation (Odell 2004:191). Odell also addresses the question of how prehistoric hunter-gatherer mobility organization can be clarified through lithic data, citing that mobile hunter-gatherers tended to have a fairly standardized tool assemblage for both foraging and collecting resource strategies (Odell 2004:196-197).

Recent research into hunter-gatherers (Kelly 1995) and Paleoindian toolkits (Eren and Andrews 2013:166-180) seem to suggest that: 1) Binford’s model of foragers and collectors is not a one-size-fits-all category for all hunters and gatherers; and 2) highly mobile Paleoindians
had a less refined but more variable toolkit than previously thought (Eren and Andrews 2013:176; see also Bamforth 2003; Ellis 2008; Kelly 1988; LeTourneau 2001; Meltzer 2009; Wilke 2002).

Prior to Binford’s discussion of foragers and collectors was the famous “Man the Hunter” conference that suggested hunters and gatherers moved quite frequently over large distances to procure resources (Binford 1980; Kelly 1995:111; Lee and Devore 1968:11). In the past forty years since the conference, ethnographic and archaeological evidence suggests that hunters and gatherers were just as variable as the types of environments and subsistence practices that they were pursuing. As mentioned above, the two types of hunter-gatherer settlement systems were residential, where the entire group was moved to a resource area (foragers); or logistical, where the group was located in a key area and individuals or small groups went out to procure resources (Binford 1980; Kelly 1995:117). Kelly notes that Binford’s typology model is only a description of the “organization of camp movement relative to food-getting activities”, and not a paradigm that encompasses all aspects of hunting and gathering (Kelly 1995:120, emphasis his). In general, a forager strategy can be expected when food sources are available for the majority of the year; and in contrast, a collector strategy can be expected when there is greater variability in food resources (Kelly 1995:120). Aquatic resources also factor into the discussion, and ethnographic studies suggest that a collector strategy is operative within an aquatic environment (Kelly 1995; Yesner 1980). In other words, aquatic resources may take the place of terrestrial game and the location of a known water source negates the need to move the entire group (Kelly 1995:125). However, this by no means equates with a sedentary strategy.

It will be a major hypothesis in this thesis that prehistoric hunter-gatherers of all cultural and chronological periods relied on the same sorts of lithic curation (maximizing a lithic resource
from large chert nodule to an exhausted and discarded tool, such as a discarded or broken biface) as the Paleoindians discussed by Eren and Andrews (2013). Previously, it has been assumed and debated that hunter-gatherers were using bifaces as a “mobile core” since these theoretically would better conserve the raw material and serve as readily available and functional tools (Eren and Andrews 2013:167). To test the hypothesis that bifaces were used as mobile cores, Eren and Andrews measured the thickness of biface cores that Eren knapped, and also measured the ratio of width to thickness which indicates the stage of reduction (Eren and Andrews 2013:168-169). In this experiment; since maximum thickness is unaffected by retouch (Morrow 1997; Shott and Weedman 2006; Surovell 2009), and the ratio width to thickness was documented from the start of the biface production to the “exhausted” biface core; the authors were able to record the flakes that were removed in sequence and measure the widths and thicknesses of the detached flakes (Eren and Andrews 2013:168-170). The results indicate that early in the reduction sequence the flakes were thicker and wider, and that as reduction continued the flakes became thinner and narrower. Using known Paleoindian sites from the Great Lakes region, the authors compared their experimental results to the thicknesses and widths of the detached flakes that were in these sites. Their results and comparison also show that Paleoindians were knapping unifacial tool blanks at the source of the raw material and then transporting these rather than carrying bifacial cores (Eren and Andrews 2013:174-176). The authors conclude that these unifacial blanks were highly variable in terms of thicknesses, widths, lengths, and raw materials; and that this is a strategy that foragers would have used to minimize risk (Eren and Andrews 2013:175-176). The risks are minimized because the toolkit is varied enough in terms of durability and use-life while being transported to deal with any potential situations that the hunter-gatherers may have faced.
in unknown regions (Odell 2004:191); whereas, a bifacial core is less multifunctional and has the potential for easier breakage.

Prehistoric hunter-gatherers operated under the same impetus and decision making processes as modern hunter-gatherers in order to minimize risk and maximize returns (Kelly 1995:334). The aphoristic four necessities in life (i.e. food, shelter, water, and clothing) were just as necessary in the prehistoric past as today. Therefore, what has been ethnographically studied, written, debated, and confirmed about modern hunter-gatherers can cautiously be projected back onto the past since modern hunter-gatherers “replicate the conditions of the past” (Kelly 1995:334). The Paleoindian toolkit of variable-sized unifacial blank tools may have been the toolkit used by all prehistoric mobile forager-collectors; rather than mobile bifacial cores. Of the 1,094 prehistoric artifacts recovered from the two HPF surveys, 929 artifacts were debitage. Through debitage analysis and statistical analysis, I will be able to see if Eren and Andrew’s conception and hypothesis of a variable toolkit of hunter-gatherers is consistent with Blackford County.

The questions then become: is there any evidence in Blackford County for either type of hunter-gatherer strategy based on the results of our surface surveys and the lithic materials that remain? Can an analysis of lithic debitage answer questions about resource (i.e., food or chert materials) procurement strategies? Is one settlement system operative for Blackford County, or are both? What do the different types or categories of debitage tell us about the settlement systems? Does any of the debitage found in Blackford County collate with the findings of Eren and Andrews (irrespective of Paleoindian cultures)? In other words, did the surveys discover more debitage that agrees with and support the findings of Eren and Andrews, or is the nature of the distributional survey such that finding support is unfeasible and inconclusive?
Flake types are the analytical unit used in this debitage analysis since they allow for both fine-grained attribute studies and the more inclusive aggregate categories. Inclusiveness means the scope or range of the phenomenon in which the units are constructed; whereas resolution means the specificity obtained in the attribute categories (Steffen et al. 1998:135; see also Dunnell 1971:145-147). As Steffen et al. note (1998:135), as inclusiveness increases, the resolution of the analysis decreases. For my thesis, resolution is increased for finer analysis of the different attributes of the debitage and then inclusiveness is included in the interpretation in order to generalize for the patterns of the county.

What types of meaningful patterns will emerge as a result of analyzing the metrics of the debitage and their location on the landscape? In a broad general sense, debitage can either reflect maintenance and sharpening activities or reflect early stages of stone tool production. In the case of proximal flakes, flakes with an abraded or complex striking platform are consistent with maintaining or sharpening bifaces (Andrefsky 2005). Flakes with a flat or cortex striking platform are consistent with earlier stages of reduction and the use of cores. As Eren and Andrews’ study has shown, flakes that are chipped off early in the reduction sequence tend to be longer, wider, and thicker than flakes that are removed later in the stone tool production sequence (Eren and Andrews 2013:168-172). In Blackford County, proximal flakes that are longer, wider, and thicker and have cortex present with either flat or cortical platforms will be considered as early stage reduction (statistical tests will determine if the lengths, widths, and thicknesses are significantly different than other proximal flakes). Proximal flakes with abraded or complex platforms that are significantly thinner, narrower, and shorter without cortex present will be considered as part of maintenance and sharpening behaviors and not production-starting behaviors.
Bifaces will also follow the same considerations as proximal flakes in terms of lengths, widths, weight, and thicknesses. The only factors that will not be in operation for bifaces are striking platforms, since these generally are not evidenced on bifaces. Bifaces that exhibit further modification in the form of notches or abrading for the purposes of hafting are differentiated from non-hafted bifaces in the academic literature (Andrefsky 2005:179-181). However, my research only recorded the fact that an artifact was a biface and not some type of debitage irrespective of hafted or non-hafted categories. I joined all bifaces together under the biface category due to the small number of diagnostic projectile points and due to the fact that my thesis focuses on behavior and not chronological cultural periods. This lumping of bifaces was a decision made to lessen the number of artifact categories in the data table yet still maintain the ability to tease out diagnostic projectile points for other analyses if necessary. Diagnostic projectile point types were recorded in the diagnostic column in the spreadsheet. Projectile points are defined as a biface that has a hafting area and were used as projectile tips, such as arrow points, dart points, or spear points (Andrefsky 2005:260). Diagnostic morphology is based on projectile point types recorded in Justice (1987) and by nomenclature conventions of archaeological reports from the state of Indiana. My thesis only examines the location of projectile points on the landscape and avoids discussion of chronological significance.

**Previous Archaeology in Blackford County**

Prior to the two surveys conducted by the Applied Archaeology Laboratory of Ball State University, there had been few archaeological investigations done in the county (Miller 2013; Miller et al. 2012). Archaeological investigations in Blackford County have been predominantly oriented toward surface surveys and only a small percentage of sites have been tested or
excavated. Only a few other major surveys have been conducted within and around the county, these include: a reconnaissance survey in Hartford City resulting in three sites (12-BI-108 to 110) with site 12-BI-108 having a diagnostic Kirk Corner Notched projectile point (Jeske and Stillwell 1994a); a reconnaissance survey near Hartford City for a proposed ethanol plant resulting in nine sites inventoried (Jackson and Vosvick 2006); southwest of Montpelier a reconnaissance survey of a proposed industrial park resulting in 13 sites inventoried (Stillwell 2003). Excavations within Blackford County consist of an archaeological test excavation of site 12-BI-110 to determine if any historic features may be present; however none were found (Jeske and Stillwell 1994b). One major excavation of a burial site (Secrest-Reasoner site) was conducted in 1933, and a total of 18 burials, a refuse pit, two hearths, and numerous lithics and bone tools were uncovered (Black 1933, 1935).

The prehistory of eastern North America can generally be divided into roughly sequential developmental periods of Paleoindian, Archaic, Woodland, Mississippian, and Historic. Each of these is often further divided into early, middle, and late, and collectively they span a time period from approximately 12,000 years ago to the present. The Paleoindians (ca. 10,000-7,500 B.C.) are believed to be the first Native Americans following the retreat of the Wisconsin Glacier who had a sophisticated lithic tool kit specializing in hunting big game, and they lived in small, short term activity areas (Jones and Johnson 2012:3)

The Early Archaic period (ca. 8,000-6,000 B.C.) evinces a population growth and an environmental climate similar to today’s climate (Jones and Johnson 2012:4). The Early Archaic period also shows an increase in the types and varieties of stone tools, and the emergence of the atlatl (or spear thrower). The increases in populations are found in most environmental settings and the people were still nomadic hunter-gatherers (Jones and Johnson 2012:4). The Middle
Archaic period (ca. 6,000-3,500 B.C.) is poorly understood in Indiana, but seems to be characterized by a dramatic warming trend and the emergence of new projectile point types, grooved axes, spear-thrower weights, and mortuary practices (Jones and Johnson 2012:5). The Middle Archaic also has evidence of increases in harvesting of resources, such as hickory nuts and starchy seeds, in bulk processing centers (Jones and Johnson 2012:5). The Late Archaic period (ca. 4,000-1,000 B.C.) is a changing continuation of the Middle Archaic period, the transition is not well understood. What is apparent though are ‘distinguishable cultural or ethnic differentiation or boundaries, from drainage to drainage”, and a highly detailed knowledge of the environment (Jones and Johnson 2012:6). Late Archaic projectile points tend to be made of poorer quality cherts with less concern for craftsmanship of those points, but an increase in tools associated with woodworking and food processing (Jones and Johnson 2012:6). Also, external ornamentation increases, such as “beads made of shell, pearls, and copper, pendants, gorgets, and hairpins” (Jones and Johnson 2012:6). Site types for the Late Archaic period include: shell middens, mounds, semi-permanent villages, and cemeteries (Jones and Johnson 2012:7).

The Early Woodland period (ca. 1,000-200 B.C.) is differentiated from the Late Archaic period based on the presence of ceramics at sites (Jones and Johnson 2012:8). Also, there is an increase in mounds and mortuary complexes, and projectile points tend to be large bladed (Jones and Johnson 2012:8). The Middle Woodland period (ca. 200 B.C. – A.D. 600) has a blossoming of cultural activities with the advent of the Hopewell manifestation, inter-regionally related groups, inter- and intra-regional trade networks, mound and earthworks complexes, ceremonial and mortuary sites, and hierarchal social organizations (Jones and Johnson 2012:9). Aside from diagnostic projectile points, there are several diagnostic tool types such as bladelets and blade cores, clay figurines, copper celts, and pipes; and inter-regional trade networks exchanged mica,
copper, galena, shell, and obsidian raw materials and artifacts (Jones and Johnson 2012:10). The Late Woodland period (ca. A.D. 500-1,200) evinces the appearance of the bow and arrow and true arrowheads, as well as large triangular knives, and hoes used in agriculture (Jones and Johnson 2012:11). Large and intensive agriculture is evident, mostly focused on the production of maize, beans, and squashes (Jones and Johnson 2012:11). Diagnostic ceramic types are recovered and distinct cultural groups or phases can be identified, such as Albee, Yankeetown, Newtown, and Allison-Lamotte, and Oliver (Jones and Johnson 2012:11).

The Mississippian period (ca. A.D. 1,000-1,650) continues the distinct and transitional cultural groups or phases evinced in the Late Woodland period. Classic Mississippian sites are characterized by truncated mounds, public and ceremonial complexes, plazas, nucleated villages with associated hamlets or farmsteads, cemeteries, intensive agriculture (again maize, beans, and squash), and stratified or hierarchical social organizations (i.e. chiefdoms) (Jones and Johnson 2012:13). Artifacts that are diagnostic of the Mississippian period include shell-tempered pottery, triangular projectile points, hoes, effigies, and Nodena and Cahokia projectile points (Jones and Johnson 2012:14). The Angel phase and Caborn-Welborn phase are the two best known Middle Mississippian cultures in southwestern Indiana, and in the eastern side of the state Fisher and Huber phases tend to represent the Upper Mississippian sites in Indiana (Jones and Johnson 2012:14-15). Fort Ancient occupations were particularly frequent in southeastern Indiana (Jones and Johnson 2012:15).

The cultural history for the county seems to be dominated by the Early Archaic and Late Archaic periods followed by the Late Woodland. At least the northern and northeastern portion of the county is dominated by the Early Archaic, Late Archaic, and Late Woodland periods (Miller et al. 2012); however, the southern and southwestern portion of the county evinces a
strong Woodland presence (Miller 2013). No diagnostic points or artifacts from the Paleoindian, Early Archaic, or Middle Archaic periods were recovered in the southern portion of Blackford County, as part of our surveys (Miller 2013). The FY 2011 grant recovered three Early Archaic, one Middle Archaic, four Late Archaic, two Early Woodland, two Middle Woodland, and two Late Woodland period diagnostic artifacts (Miller et al. 2012). The FY 2012 grant recovered one Late Archaic, one Early Woodland, eight Middle Woodland, and four Late Woodland period diagnostic artifacts (Miller 2013). Since discard rate between the different cultural periods cannot be sufficiently demonstrated in this analysis, for the purposes of this thesis, I am assuming that the discard rates for the different cultural periods are roughly equivalent. The significance and results of all this will be discussed in the following two chapters.
Chapter Three

Methods

Definitions of Attributes

*Our continuing challenge as archaeologists is to infer process from pattern.*

*LuAnn Wandsnider (1998:87)*

The following methods and definitions were used to guide both the research and analysis of the lithic debitage. Definitions of lithic debitage largely follow those outlined and described by William Andrefsky (2005). All lithic debitage and projectile points were examined using a 10X or greater microscope to determine chert type and artifact type. Groundstone tools were examined macroscopically, sometimes using magnifying lenses and diffuse lighting. Chert types were identified using the lithic comparative collection in the Applied Archaeology Laboratories (AAL), Department of Anthropology, Ball State University. Mark Cantin’s (2008) chert analysis was also used as a supplement to the AAL lithic comparative collection. Projectile points were identified using the AAL’s’ projectile point comparative collection in conjunction with published works such as Justice (1987). An Excel spreadsheet has been designed for recording each of the variables of interest: artifact type, chert material, heat treatment, maximum length, maximum width, maximum thickness, completeness, weight, presence or absence of cortex, platform type (if it is a proximal flake), if the tool was used or not, and comments. Measurements of projectile
points also follow these measurements for my thesis. In the two HPF grants, the point metrics devised by Justice (1987), including basal width, shoulder width, neck width, basal concavity, and stem length were all measured, but these were not included in the artifact spreadsheet due to the need for consistency in all measurements.

Once all of the data was collected, geographic information systems (GIS) analyses were conducted that examined artifact type in relation to landform or distance to water or soil type. These analyses were then used to compare the different artifact types and begin to formulate some understandings of cultural behaviors based on these results. Figures and graphs follow the results chapter (Chapter Four) and all tables can be found in Appendix 1. The question of what is the distribution of human activity on the landscape of Blackford County is the ultimate focus of this thesis. Prehistoric artifacts from the two HPF grants were analyzed according to the following definitions and processes. The distributional approach to archaeological survey was the method employed for gathering all of the data, and this was considered an appropriate method used for these large-scale HPF Grants (cf. Dunnell and Dancey 1983; Fish and Kowalewski 2009; Kowalewski 2009). The nature of the survey areas must be taken for granted considering they are not randomly selected, or necessarily representative of all of Blackford County. These surveys are only representative of 1,800 acres of the 106,022 total acres in Blackford County; and can only answer direct questions about how human activity patterns on the landscape in this sample. These surveys may be representative of a larger population(s), but since no large-scale systematic surveys were conducted in neighboring counties it is difficult to ascertain these populations. Furthermore, this research is only focused on the archaeological materials recovered from Blackford County. However, the patterns and trends that are revealed
may be enough to generalize for the county as a whole. To accomplish this generalization, secondary questions must be asked that will specifically target behaviors.

First, how was the landscape being used in prehistoric times? As seen in the previous chapter, hunter-gatherers had diverse strategies for procuring and exploiting resources. So the question becomes: were people obtaining resources in Blackford County and then exporting those resources to surrounding areas or were they bringing in materials from other areas and using Blackford County as a home base? Chert types, debitage types, debitage size, and platform types of proximal flakes should help answer these questions because chert types indicate if they had to move or trade over long distances to obtain chert material. The different debitage types and sizes and platform types indicate if they are breaking down chert cobbles and nodules into new stone tools or if they are sharpening and maintaining tools that they already have.

Second, what kinds of artifacts are found in association with each other? This question is only relevant to lithic scatters and not isolated finds. If people were breaking down chert nodules and producing new stone tools then it can be hypothesized that lithic scatters of variable-sized proximal flakes with a large concentration of cortex or flat platform surfaces represent early stages of reduction. If lithic scatters tend to consist of short, narrow, and thin flakes that have no cortex and the platforms are complex or abraded, then it can be hypothesized that these scatters represent sharpening and maintenance activities.

Third, what is the distance to water for all of these sites? Distance to water is difficult to assess for prehistoric dependence on water sources. Modern drainage ditches may have obscured prehistoric waterways or have altered the nature of standing water in the county. For example, the county may have exhibited a higher concentration of bogs or marshes in prehistoric times than are currently known due to drainage ditches emptying these wetlands. These hypothetical
wetland environments would have attracted a variety of flora and fauna and hunter-gatherers. As Kelly (1995:125) notes, food sources in an aquatic environment can take the place of terrestrial game which would have been an attractive locale for hunter-gatherers.

Fourth, are certain artifact types/behaviors associated with certain types of soil? Are sites found on well drained soils such as Glynwood soils, or are they located on poorly drained soils like Blount-Glynwood or Pewamo or frequently flooded soils like Saranac or Eel?

These questions will be answered through an analysis of the lithic debitage under the categories in the definitions section below; and through statistical tests run on the different metrics outlined below.

The data was collected in a total of 29 survey areas in the northeastern and southwestern portion of the county. As part of the FY 2011 HPF Grant, 915 acres of cultivated land were sampled resulting in 256 prehistoric artifacts; and the FY 2012 HPF Grant sampled 908.5 acres of cultivated land resulting in 838 prehistoric artifacts. Areas were selected for survey using aerial maps, soil information, and reconnaissance information. The surveys were constructed to sample different landforms within the county. Cultivated fields with optimal visibility were sought for survey. The field survey was executed using pedestrian transects spaced at 10 meter intervals. The survey interval was reduced to five meters when artifacts were encountered. The areas surveyed by pedestrian transects had between 50 percent and 90 percent ground surface visibility. All prehistoric artifacts were collected and bagged by site specific provenience. The site coordinates were collected with GeoXT Series GPS units. The method used for data collection was the same for every survey area, with one exception. In one field, due to the dense concentration of prehistoric artifacts, the pedestrian transects were reduced to five meter intervals with every prehistoric artifact collected.
All survey areas sampled during the FY 2011 HPF Grant were located on till plain and moraine landforms. During the FY 2012 HPF Grant, 10 survey areas were located on till plain and moraine landforms, and three were located on flood plains (N = 216.5 acres) (Kluess 1986:General Soils Map). The frequency of flooding in these three survey areas may potentially affect the recovery of artifacts. The Saranac and Eel soils that are found in these flood plains have the potential to create a chronological time bias, in that earlier materials may be expected to be buried deeper than later materials due to frequent flooding. One would expect the alluvial soils to inhibit artifact recovery; but in fact, one of the survey areas located on flood plains had the densest concentrations of artifacts occurring on alluvial soils along the Big Lick Creek. No survey areas were located along the Salamonie River within flood plains, but in adjacent till plain and moraine landforms were three survey areas that yielded numerous artifacts including three diagnostic Early Archaic projectile points. The potential for frequent flooding in alluvial settings to adversely affect the recovery of artifacts does not seem to be a large impediment to that recovery and comparison in this thesis. This may be due to the fact that the Salamonie River and Big Lick Creek do not have the volume of overflow to have significantly buried cultural materials, especially earlier cultural materials. However, in small areas of the county where flood plains exist, there is the potential to miss earlier cultural materials due to flooding and alluvial deposition.

Definitions

The following definitions used in this thesis are based on Andrefsky (2005), except as otherwise noted.

Biface Tools are objects that have been extensively modified and have two sides or faces that meet to form a single edge that circumscribes the entire artifact (Andrefsky 2005:77). The
inherent characteristic is that both sides of the tool have been worked. The second characteristic of bifaces is the presence or absence of a hafting element, bifaces are considered either hafted or unhafted based on the presence of these hafting elements. A hafting element is where the biface attaches to another element like a shaft or handle. This part of the biface has deliberately been modified, dulled, or otherwise shaped to be able to be attached without cutting the bindings that were used. Haft elements can be recognized by the presence of notches or shoulders or by a wear pattern on the edges of the biface (Andrefsky 2005:77). There are several different hafting styles, including lanceolate, side-notched, contracting-stemmed, and basal-notched. Bifaces with hafting elements are called hafted bifaces, but not all bifaces are hafted. For the purposes of this research, all bifaces, regardless of hafted or unhafted, are lumped together and analyzed under the category of biface.

Proximal flakes are the end of a flake or detached piece that has a platform and bulb of percussion present (Andrefsky 2005). A flake or detached piece is a portion of chert cobble or nodule that was chipped or flaked off of an objective piece and exhibits one ventral surface and a dorsal surface that might have one or more prior flake removals or is cortex. The platform is the location where the hammerstone or billet or pressure flaker contacted the objective piece and the point of applied force. The bulb of force is the bulbous portion of the proximal flake on the ventral surface that is a result of a Hertzian cone being generated from the hammerstone or pressure flaker striking the objective piece (Andrefsky 2005). Striking platforms can be one of four main types used in this analysis: cortex, flat, complex, or abraded. Cortex platforms are those that are composed entirely of cortex and generally indicate an early stage in the production of stone tools (Andrefsky 2005:94). Flat platforms are smooth flat surfaces that “result [from] detaching pieces from non-bifacial tools” (Andrefsky 2005:95). Abraded platforms result from
abrading or grinding the objective piece and indicate more care taken on the part of the knapper to remove a precise shape of flake. Abraded platforms may indicate the final stages of production of a bifacial tool (Andrefsky 2005:97-98). Complex platforms are either rounded or have a convex appearance based on multiple flake scars being removed to produce the complex platform (Andrefsky 2005).

**Bladelets** are a specialized subtype of proximal flakes that are flake tools which are diagnostic of the Middle Woodland period and are at least twice as long as they are wide, and must have three attributes present in order to be classified as a blade or bladelet (Greber *et al.* 1981; Nolan 2005:19; Odell 2004:45; Pi-Sunyer 1965). First, there should be evidence of prior removals from the dorsal surface that are roughly parallel to the axis of force. Second, the lateral margins must be roughly parallel. Third, the striking platform should have a broad angle and evidence of core preparation (Nolan 2005:19). All of the bladelets examined in this research have evidence of use-wear along the edges, thus making them a flake tool and not just another type of proximal flake.

**Flake tools** are any portion of a flake that was edge-modified to be used as a tool. Flake tools were determined based on the presence of contiguous flake scars on the edges of the flake and micro step- and hinge-fractures which may indicate use (Andrefsky 2005). The presence of the flake scars indicates either use or possibly intentional retouch that results from secondary modification of the flake by billet, hammerstone, or pressure flaker (Odell 2004:65). Odell further clarifies that intentional retouch was not random but intended to shape, blunt, or sharpen a flake tool, and that flake removals were contiguous and are roughly the same size (Odell 2004:66). Retouch does occur on artifacts in the form of human or animal trampling, laboratory wear, mechanical damage due to agricultural machinery, or through natural taphonomic
processes (Flenniken and Hagerty 1979; Mallouf 1981; Nash 1993; Odell 2004; Prost 1988; Pryor 1988). To the best of my abilities I attempted to take all of this into account as I assessed if a flake was indeed a flake tool and not the product of natural or mechanical retouch, but rather something intentionally shaped into a tool. Some examples of flake tools analyzed in this thesis are endscrapers, unimarginal tools, spokeshaves, and drills. Endscreapers are usually modified on the dorsal side of the flake and are characterized as having an edge angle that approaches 60 to 90 degrees (Andrefsky 2005:255). Another example of a flake tool are spokeshaves, which are flake tools with a concave cutting edge having a scraper-like edge angle (Andrefsky 2005:261). A drill is a flake tool used in a rotation motion and may have been used to perforate materials (Andrefsky 2005:255). For the purposes of this thesis, edge modified flakes were categorized as a flake tool that had any edge modification on any edge of the flake; and retouched flakes were considered to have a greater degree of edge modification over-laying the existing flake scars. In other words, a retouch flake had evidence of both initial edge modifications that were subsequently retouched to either sharpen or shape the flake tool. Unimarginal tools were flakes that had evidence of flake scars on the dorsal surface only, with contiguous flake scars along the lateral margins. Unimarginal tools can include endscrapers and sidescrapers, but for this research I considered an artifact a unimarginal tool if it could not be placed in another more definitive category, such as endscraper. A utilized flake tool was considered to be less refined than any of the flake tool categories above, and may have been just a proximal flake or piece of flake shatter that had evidence of use wear along one of the edges. For this research, if an edge of a proximal flake or piece of flake shatter had this use wear but no further signs of modification, then it was considered a utilized flake. Meaning it was used expediently and then discarded.
**Flake shatter** is any portion of a flake that exhibits one ventral surface, but does not have the striking platform or bulb of percussion (Andrefsky 2005:81-83; Odell 2004:122).

**Angular shatter** is not a flake but still a piece that was detached in the production of flakes. In general, angular shatter was not used; and none of the angular shatter recovered in the HPF surveys show evidence of use. Only weight, presence or absence of cortex, and chert type were recorded for angular shatter.

**Cores/Core Tools** are objective pieces that serve as sources for detached pieces (i.e., flakes), and core tools may be further refined for chopping or cutting (Andrefsky 2005:254). Cores were measured for length, width, thickness, presence or absence of cortex, and whether it was used as a tool. Tool use was assessed by the presence of a bifacial margin that has evidence of use wear (use wear was identified macroscopically and microscopically, and was either polish or a crushed bifacial margin and had many micro-step or micro-hinge fractures (Odell 2004:139). The function of the core tool was not assessed or assumed, the core was noted as either used or not used). Cores that did not meet these criteria are listed in the spreadsheet as “core”, and cores that did meet these criteria are listed as “core tool”.

**Minimally Modified Cores** are a chert cobble that has the majority of the surface that is either weathered or cortex and has evidence of one to four flake removals. The use or purpose of the resulting flake is not taken into consideration for determining if a cobble is a minimally modified core, only one to four flake removals and the presence of a weathered or cortex surface (Miller 2013). This category of artifact may overlap (to an unknown degree) the class of artifacts that some archaeologists refer to as tested cobbles (which are never defined; thus the overlap).

**Groundstone tools** are artifacts that were shaped by abrasion, repeated use, or a formal reduction process such as pecking or grinding. Hammerstones are groundstone tools used to chip
off flakes in percussion flaking and could be used in other tasks as well, such as food production (Andrefsky 2005:11-12). Groundstone tools were only weighed and their location on the landscape was noted.

**Fire Cracked Rocks (FCR)** are rocks or stones that have been heated in fires and subsequently cracked due to thermal shock. FCR was usually not collected as part of the HPF surveys, but the FCR that was collected was weighed and their location on the landscape was noted.

**Local cherts** are cherts that outcrop approximately less than 100 kilometers from Blackford County (Cantin 2008:9). For the purposes of this thesis, Liston Creek, Kenneth, and Fall Creek cherts will be considered as local cherts. One hundred kilometers is an arbitrary distance that these three chert types happen to fall within. They also happen to outcrop on the Wabash and White Rivers. Attica chert also outcrops on the Wabash River, but is outside the 100 kilometers boundary and will be considered in the non-local category.

**Non-Local cherts** are cherts that outcrop more than 100 kilometers from Blackford County, and represent the majority of chert types in Indiana and Ohio (Cantin 2008:9). Again 100 kilometers is an arbitrary distance used to differentiate between chert sources that are closer to Blackford County from those that are much further. One of the goals of this thesis is to see if they are more heavily dependent on non-local resources or the more readily available local sources.

**Measurements**

Eleven attributes were recorded for this thesis. The attributes recorded were: 1) artifact type; 2) raw material; 3) heat treatment; 4) maximum length; 5) maximum thickness; 6) maximum width; 7) completeness of maximum length, thickness, and width; 8) weight; 9)
presence or absence of cortex; 10) platform type (if it was a proximal flake); 11) artifact use (in general, angular shatter was not a used artifact). Artifact type was determined based on the definitions above following Andrefsky (2005) and Justice (1987). Raw material was identified based on comparisons with Ball State University’s comparative chert collection in the Applied Archaeology Laboratories, resources such as Cantin (2008), and frequent discussions with my thesis chair, Dr. Kevin Nolan, and committee member, Dr. Mark Hill. Heat treatment was noted as either being present or absent on the Excel spreadsheet and this determination was based on AAL’s chert comparison collection and the presence of attributes such as reddened coloration and a high degree of luster that are known to correlate with heat treatment (Andrefsky 2005:256; Luedtke 1992:91-96). Maximum length, width, and thickness were measured to the nearest 0.01 millimeter using digital calipers accurate to 0.01 millimeter. Completeness of length, width, and thickness was determined by the ability to see that the measurement was unimpeded by a broken surface. This was a categorical scale; I was only recording whether the object was complete or incomplete. No attempt was made to estimate the original measurement or degree of completeness. For instance, if a proximal flake was missing just the very edge of the distal end then the length was not complete; or if a proximal flake was missing a portion of a lateral margin then the width was not complete. I considered hinge fractures on proximal flakes as complete since this is part of the original termination of the flake. Weight was measured using a digital scale accurate to the nearest 0.1 gram. Artifacts exceeding 375.0 grams, and nearly all groundstone tools, were weighed on the bar scale in the AAL accurate to the nearest five grams. Presence or absence of cortex was determined by the presence or absence of cortex on the artifact. If there was no cortex visible on any surface of the artifact then it was noted as being absent. In most cases the amount of cortex was visually estimated and recorded in the comments.
section of the Excel spreadsheet; however, the amount of cortex was not included in any of the GIS analyses. *Platform type* was determined based on the definitions from Andrefsky (2005) discussed above and by using a 10X or greater microscope in the AAL lab. *Artifact use* was determined based on using a 10X or greater microscope to see if the edges of proximal flakes and flake shatter were used. Artifact use was only a category used in the beginning of the analysis to see if a flake was used or not used. If the artifact had evidence of use then it was placed in one of the appropriate tool categories. If it did not have evidence of use then it was placed in one of the appropriatedebitage categories. Bifaces, flake tools, core tools, and groundstone tools were all noted as having been used. Proximal flakes and flake shatter were all noted as not having been used. In general, angular shatter was not used and none of the angular shatter analyzed for this thesis had evidence of use.

*Maximum Length* for projectile points and flake tools, this was done from the tip of the proximal end to the base of the distal end. For proximal flakes, this was done from the striking platform to the distal end while measuring vertically down from the center of the striking platform (Andrefsky 2005). For cores, this was done by measuring the longest axis. *Maximum Width* was recorded at the widest location perpendicular to the axis of length (following Andrefsky 2005). *Maximum thickness* was recorded at the point on the artifact where it was thickest, irrespective of location on the artifact. On proximal flakes the bulb of percussion was usually measured as the thickest portion of the flake; when measuring, I considered the entire flake and not just the thickness below the bulb of force. I am not testing for specialization or comparisons in proximal flakes in this thesis; therefore, I saw no reason not to include the bulb of percussion in my analysis.
**Statistical Analyses**

The tests for differences in the artifact populations were carried out using Microsoft Excel 2010 statistical packages. To mitigate potential errors in the Microsoft Excel 2010 statistical programs, the Oneway ANOVA tests and the Tukey *post hoc* test were also conducted using GraphPad Prism 6.0 (Graphpad 2013) software and in every case the results were identical to Microsoft Excel 2010. A Chi-Square template was created by the author in Microsoft Excel 2010 (following Nolan 2005), and all Chi-Square tests were conducted based on this template. Chi-Square, t-Tests, and Oneway ANOVA statistics were used to identify differences. The Chi-Square test was used because it examines the frequencies of occurrence in each categorical variable and can also tell if two variables are independent or related to one another. For this thesis, the categorical groupings tested were: artifact types and the watershed they occurred in; local and non-local cherts and bifaces, cores, and proximal flakes; and local and non-local cherts and the mean lengths, widths, and thicknesses of proximal flakes. The t-Test was used because it examines the differences between means of two groups against each other to see if the two groups are different. The mean lengths, widths, and thicknesses of local and non-local cherts were tested for all proximal flakes. The Oneway ANOVA test was used because it examines the differences between means of two or more groups and can tell if there are systematic differences between group means. The Oneway ANOVA test also uses categorical groupings which were: the top five chert types and the distance to water; proximal flakes, bifaces, and cores/core tools and distance to water; and platform type and distance to water.

**Rationale**

The specific attributes and measurements were chosen based on similar attributes measured by Nolan (2005). It is assumed that patterns will develop and perhaps the easiest way to determine the patterns is through analysis of these standard measurements (i.e. length, width,
thickness, platform type, etc.). In general, the patterns that are expected to develop are that longer, wider, and thicker debitage will be made of local cherts (since they would be using the local materials for the more mundane flake tools and bifacial tools). In contrast, shorter, narrower, and thinner flakes will be made of non-local cherts and reflect a greater degree of refinement in the trajectory of stone tool production consistent with sharpening and maintenance of tools. As described above in the literature review, the different types of debitage are related to the different types of cultural behaviors that produced them and therefore systematic ranges of metrics were necessary to determine the patterns of artifact type. For example, large proximal flakes with flat platforms are thought to be in the earlier stages of lithic production; whereas tiny proximal flakes with complex platforms are thought to be in the later/finishing stages of biface production (Andrefsky 2005). These two patterns will emerge through accurate measurements and can be mapped on the landscape through the GIS analyses. The statistical analyses complement the GIS analyses by demonstrating the significant differences or independence of multiple variables and how those differences pattern on the landscape. The results of all of these analyses are found in the following chapter.
Chapter Four

Results

Results

Simply walking around the countryside in the hopes of stumbling on an archaeological site is good exercise, but the rewards are likely to be small unless the searcher knows what to look for and approximately where to find it.

Ivor Noël Hume (1969)

This chapter will present the results of the statistical tests run on the different variables analyzed. A total of 1,094 prehistoric artifacts were recovered as part of the two HPF grant surveys conducted over 1,800 acres of cultivated land in Blackford County. Of the 1,094 prehistoric artifacts, the majority was debitage and cores, while the tool assemblage was dominated by edge modified flakes and expedient tools (Table 3). Of the diagnostic artifacts, hafted bifaces identified as projectile points were the prevalent category. Statistical tests were run to see what patterns emerge in the prehistoric assemblages of Blackford County and to see if relationships exist between the prehistoric components of the northern half of the county with those of the southern portion of the county. The implications and significance of these statistical tests and findings will be discussed in the next chapter, as will the conclusions drawn from the results of this thesis and the two HPF grants.
**Continuous Attributes**

The continuous attributes that were recorded for bifaces (both diagnostic and non-diagnostic), bladelets, cores/core tools, the various formal flake tools, proximal flakes, flake shatter, and minimally modified cores were: length, width, thickness, and weight.

*Length, Width, and Thickness:* There were 824 artifacts that were recorded for length, 823 artifacts recorded for width, and 825 artifacts recorded for thickness. The mean value for lengths, widths, and thicknesses was calculated for eleven artifact types: bifaces, bladelets, unimarginal tools, cores/core tools,endscrapers/sidescrapers, edge modified flakes, retouched flakes, utilized flakes, proximal flakes, flake shatter, and minimally modified cores (Table 4).

**Categorical Attributes**

The categorical attributes that were recorded for bifaces (both diagnostic and non-diagnostic), bladelets, cores/core tools, the various formal flake tools, proximal flakes, flake shatter, and minimally modified cores were: chert type, heat treatment, presence or absence of cortex, platform type, and whether it was used or not.

*Chert type:* The prehistoric inhabitants of Blackford County used at least 21 different types of chert to make their various chert tools, there is also a very broad category of unidentified chert types that may encompass many more chert types than the above 21 types (Figure 5). The vast majority of lithics (53.79%) recovered from Blackford County were Liston Creek chert (N=560). The top five chert types – Liston Creek (N=560), Indian Creek (N=52), Derby (N=46), Holland (N=37), and Muldraugh (N=34) comprise 70.02 percent of the total (Figure 6). The results show that local chert types (Liston Creek (N=560), Fall Creek (N=21), and Kenneth (N=21)) were favored or used more than non-local chert types (57.83%). However, when Liston
Creek is removed from the count, local cherts (Fall Creek and Kenneth) only account for 4.04 percent of the total cherts. Cherts that outcrop between 100 and 200 kilometers from Blackford County include: Attica, Cataract, Laurel, Jeffersonville, Stanford, Bryantsville, and Indian Creek and these comprise 14.6 percent of the total. Cherts that outcrop between 200 and 300 kilometers from Blackford County include: Derby, Delaware, Flint Ridge, Haney, Holland, Muldraugh, Upper Mercer, and Wyandotte and these comprise 16.9 percent of the total. Cherts that outcrop more than 300 kilometers from Blackford County include: Ditney and Keokuk and these comprise 2.04 percent of the total. Finally, unidentified chert types cannot definitively be tied to a geographical location or chert outcrop so they remain unidentified and comprise 8.36 percent of the total cherts recovered.

Heat treatment: Heat treatment was recorded on 46 prehistoric artifacts. This represents the minority of the sample (4.42%), whereas the majority of the sample was not exposed to heat treatment (95.58%). Liston Creek (N=16), Jeffersonville (N=8), Flint Ridge (N=6), and Delaware (N=5) are the majority of heat treated specimens (Figure 7). Also, bifaces (both diagnostic and non-diagnostic) (N=7; 15.22%), proximal flakes (N=15; 32.61%), formal lithic tools (N=9; 19.57%), and flake shatter (N=9; 19.57%) comprise the majority of artifact types that were exposed to heat. Of the heat treated bifaces, two are diagnostic Late Archaic stemmed points.

Presence or Absence of cortex: The presence or absence of cortex can give some indication as to relative stage of stone tool production (i.e., were prehistoric people breaking down cores or sharpening bifaces?). Also, the presence of cortex demonstrates that stone tools were being manufactured in Blackford County, and not just maintained. There were 1041 artifacts that were recorded for the presence or absence of cortex, and 460 (44.19%) of these had
cortex present and 581 (55.81%) did not have cortex (Figure 8). Fire Cracked Rocks (FCR), groundstone tools, hammerstones, and chipped stone tools were eliminated from the count, so as not to skew the data. As Figure 9 and Table 5 show, angular shatter and proximal flakes were the artifact types that had the most cortex present. Flake shatter and cores/core tools also had large amounts of cortex. When absence of cortex is analyzed, flake shatter is the artifact type with the most artifacts lacking cortex. Proximal flakes and angular shatter retain numbers that are similar to artifacts with cortex present. Cores/core tools on the other hand are barely represented with cortex absent.

**Platform type:** There were 224 proximal flakes recorded for this thesis. Of those 224 proximal flakes, 39 had cortical platforms, 129 had complex platforms, 2 had abraded platforms, 45 had flat platforms, and 9 had N/A platforms (Figure 10). N/A platforms mean that the platform may have been crushed or destroyed or missing but the bulb of percussion was present along with secondary indicators (i.e., gull wings, fissures, or compression rings) all pointing to the location of the missing platform. This demonstrates that the prehistoric people of Blackford County were sharpening and maintaining tools more frequently than they were breaking down cores or beginning the tool production sequence. This is further substantiated when taken into consideration with the amount of proximal flakes that had cortex absent (N=122; 21%) as seen above. When cortical platforms and flat platforms are combined, their total only equals 37.5 percent of the total proximal flakes. In addition, when average lengths, widths, and thicknesses are taken into consideration, it is clear that proximal flakes with cortex and flat platforms are longer, wider, and thicker than proximal flakes with complex or abraded platforms (Figure 11). It should be noted that the width for the abraded platforms is a little high, but this is due to the fact that there were only two proximal flakes with abraded platforms. These averages are consistent
with what can be expected in the reduction process of stone tool manufacture; it is expected that flake early in the reduction sequence will be larger, wider, and thicker than those that are sharpening or maintaining the stone tools.

*Used or not used:* As discussed in Chapter 3, use was determined using a 10X or greater microscope to see if the edges of proximal flakes and flake shatter showed wear indicative of use. Bifaces, flake tools, core tools, and groundstone tools were all noted as having been used (since it is assumed that they were by definition). In general, angular shatter was not used and none of the angular shatter analyzed for this thesis had evidence of use. Of the 224 proximal flakes, 23 showed evidence of use (10.27%) and 201 had no evidence of use (89.73%). Of the 231 pieces of flake shatter, 10 had evidence of use (4.33%) and 221 had no evidence of use (95.67%). Of the 8 bladelets, all 8 had evidence of use (100%). It seems fairly clear that prehistoric people in Blackford County were not using proximal flakes or bits of flake shatter as expedient tools.

*Other Categorical Attributes*

There were also six other categorical attributes recorded for all prehistoric artifacts: soil association, soil type, soil texture, soil drainage, distance to water, and elevation.

*Soil Association:* soil association was determined using a soil survey for the county (Kluess 1986). There are five soil associations in Blackford County: soil associations in till plain and moraine settings (Bono-Houghton, Blount-Pewamo-Glynwood, Glynwood-Blount-Pewamo, and Glynwood) represent the majority of the project area. Soil associations identified as forming in flood plains (Saranac-Eel) represent the minority of the survey areas (Kluess 1986:General Soils Map) (Table 1). Of the 1,094 artifacts, 20 were found on Bono-Houghton soils, 389 were
found on Blount-Pewamo-Glynwood soils, 60 were found on Glynwood-Blount-Pewamo soils, 236 were found on Glynwood soils, and 389 were found on Saranac-Eel soils (Figure 12).

**Soil Map Units:** Soil series was determined by using the soil map units (SMU) in Kluess (1986) (Table 2). There were 13 different soil series encountered in the two HPF grant surveys (Miller 2013; Miller et al. 2012). In the northern portion of the county, there were four different series of soil encountered, with Blount-Glynwood (B1A) being the most frequent. In the southern portion of the county, there were twelve different series of soil encountered, with Glynwood (GsB3) being the most frequent. Figure 13 shows the different types of artifacts, with the most frequently encountered soil series within that artifact category. As can be seen in the graph, Glynwood (GsB3) is the most frequently encountered soil series across all artifact categories. Glynwood soils (GsB3 and GsC3) are moderately well drained loamy soils that were created in glacial till and are prone to erosion, but not flooding or ponding (Table 1 and Table 2).

**Soil Texture:** Soil texture was also determined by using Kluess (1986). The soil textures encountered in the surveys were silt loam, clay loam, silty clay, clay, and loam. In the northern portion of the county, there was a preference for silt loam texture soils; however, in the southern portion of the county, there was a preference for clay loam texture soils (see Figure 14 and Table 6). When soil texture is considered by cultural period, there was a marked preference for clay loam textured soils followed by silt loam textured soils (Table 7).

**Soil Drainage Class:** Soil drainage classes were also determined using Kluess (1986). There were five soil drainage classes encountered in the surveys: well drained, moderately well drained, somewhat poorly to moderately well drained, poorly drained, and very poorly drained. In the northern portion of the county, somewhat poorly to moderately well drained soils (N=131
artifacts) were the predominant drainage class; in the southern portion of the county, well
drained soils (N=357 artifacts) were the predominant drainage class (see Figure 15 and Table 8).

**Distance to Water:** Distance to water was determined by using ArcMap and measuring
the distance from the site to the nearest water source using the measuring tool, measured to the
nearest meter (Figure 16 and Figure 17). In the northern portion of the county the mean distance
to water was 283.14 meters, with the standard deviation being 267.2 meters, with a minimum
distance of 6 meters and a maximum distance being 1090 meters. In the southern portion of the
county the mean distance to water was 241.89 meters, with the standard deviation being 149.81
meters, with a minimum distance of 7 meters and a maximum distance being 760 meters.

**Elevation:** Elevation was also determined by using ArcMap and visually noting the
elevation to the nearest elevation contour line to the site (Figure 18 and Figure 19). In the
northern portion of the county the mean elevation for all sites was 884.4 feet, with the standard
deviation being 6.62 feet, with a minimum elevation of 875 and a maximum elevation of 900. In
the southern portion of the county the mean elevation for all sites was 889.4 feet, with the
standard deviation being 20.57 feet, with a minimum elevation of 870 and a maximum elevation
of 930.

**Statistical Analyses**

To better understand the nature of the two surveys in terms of differences or similarities,
exploratory statistical analyses were conducted first. These exploratory analyses looked at
artifact types and local and non-local cherts to see which were being used more frequently for the
different activities. Also statistical tests were used to see if distance to water impacted the types
of artifacts that were used or the types of behavior associated with the different kinds of proximal
flakes. Finally, the exploratory analysis looked at the relationship between artifact type and whether it was recovered in the northern portion or southern portion of the county, and what inferences may be drawn from the results. All statistical tests were conducted with \( \alpha = 0.05 \).

The living cultural systems in the prehistoric past may be further elucidated through these exploratory tests by looking to see if in fact the results from the GIS analysis are statistically significant. In other words, is this grouping of proximal flakes or that grouping of bifaces really statistically closer to water resources, or can logistical strategies of resource procurement be differentiated between the northern and southern portions of the county? These are the kinds of questions I attempted to answer in the exploratory statistics. The results of the GIS analysis further resolve the issues of distribution of artifacts by highlighting the locations of the different artifact types on the landscape.

**Local vs. Non-Local cherts:** Local and non-local cherts were totaled for proximal flakes, bifaces, and cores/core tools to see which type was being used in Blackford County. Local cherts were used more frequently (N=193) than non-local cherts (N=156) to manufacture proximal flakes, bifaces, and cores/core tools, the results were statistically significant \( (X^2 = 6.90; df = 2; p < .05) \), but there was a weak correlation \( (Cramer’s V = 0.141) \) (Table 9). Proximal flakes (local = 134, non-local = 94) and cores/core tools (local = 35, non-local = 26) were made of local cherts more frequently than expected, but bifaces were more often made from non-local sources (local = 24, and non-local = 36).

To test the hypothesis that local cherts were used to manufacture longer, wider, and thicker debitage (consistent with less refined flake and bifacial tools) in contrast to shorter, narrower, and thinner debitage (consistent with sharpening and maintenance of more refined tools) hypothesized to be made from non-local cherts, three t-Tests were conducted. The mean
lengths, widths, and thicknesses of all proximal flakes in the local and non-local chert categories were calculated and then analyzed in three t-Tests (Table 10). The results were all statistically significant (Length t-Test = t = 4.773; df = 128; p < 0.000; Width t-Test = t = 4.132; df = 128; p < 0.000; Thickness t-Test = t = 4.909; df = 128; p < 0.000), which strongly suggests that there was a marked difference in preference for local or non-local chert resources when it came to manufacturing new stone tools within the project area. It is clear that prehistoric people were using local chert resources (i.e. Liston Creek, Fall Creek, and Kenneth) to manufacture the less refined flake and bifacial tools, and were using the more “exotic” (i.e. non-local) chert resources for the more refined tools. This also strongly suggests a difference in behavior towards lithic resource curation (conserving lithic raw material by maximizing the tool’s use-life) in that they maximized the use-life of their non-local chert tools through repeated resharpening and maintenance activities that resulted in the shorter, narrower, and thinner flakes.

**Chert Types:** When the top five chert types and the distance to water were analyzed in a One-way ANOVA test (Table 11), the results show that there is not a significant difference between the chert types for distance to water ($F = 2.236; df = 4; 727; p = 0.0636$). Therefore, the distance to water where the activity took place was not a factor when it came to the types of chert that people were using to make stone tools.

**Artifact Type and Distance to Water:** An One-way ANOVA test was conducted on proximal flakes, bifaces, cores/core tools, and angular shatter and the distance to water (Table 12). The results show that there is a significant difference between the type of artifact and distance to water ($F = 5.602; df = 3, 557; p < 0.001$). Table 13 shows the pairwise Tukey post hoc test that was then conducted to see where the differences were, and there was a significant difference between bifaces and proximal flakes ($p < 0.05$), and a significant difference between
bifaces and angular shatter \((p < 0.001)\). The reason why there is no significant difference between bifaces and cores/core tools may be due to the fact that bifaces are on the opposite end of the chaîne opératoire spectrum from cores and represent two altogether different kinds of activities. Bifaces are the result of lithic reduction and may have been discarded further from water sources because that was where the game was. Cores are the beginning of the lithic reduction process, along with proximal flakes and angular shatter, and may be expected to be located nearer water resources. As can be seen, there is no significant difference between cores/core tools and angular shatter, or cores/core tools and proximal flakes. Proximal flakes and angular shatter have similar distribution patterns throughout the northern and southern portions of the county (Figure 27 and Figure 28); whereas cores and core tools are found almost entirely in the southern portion of the county and mostly along the Big Lick Creek (Figure 22 and Figure 23). It may be that such a large concentration of cores and core tools along the Big Lick Creek in conjunction with both proximal flakes and angular shatter account for the lack of significant difference between these three artifacts categories.

**Platform Type and Distance to Water:** As was discussed earlier, platform type represents different aspects of the technological system that could be expected to vary spatially as resources and occupational activities are practiced differentially. As a result, platform type was tested against distance to water in an ANOVA (Table 14). The results show that there is no significant difference between platform type and distance to water \((F = 1.604; df = 4, 219; p = 0.174)\). Since there is no significant difference, it can be concluded that distance to water was not a factor in prehistoric activities involving breaking down cores or in the maintenance of tools. However, there were only two abraded platform proximal flakes encountered, and several N/A platform types, and both of these types may be skewing the data. With such a small number of abraded
and N/A platforms, finding any difference may be difficult. Yet proximal flakes yield other data that is helpful in analyzing chert resource usage. As seen above, local chert sources were used for the more pedestrian and expedient tools, whereas non-local sources were being used to manufacture and maintain the more formal tools and bifaces.

*Artifact Type and Location:* The different types of artifact categories are representative of different types of resource and occupational activities that may also vary spatially. In addition, the two different portions of the county may be expected to have served as two distinct *loci* on the hunter-gatherer spectrum in terms of foraging or collecting strategies. To see if there is a significant relationship between artifact type and whether the artifact was found in the northern portion of the county or the southern portion of the county, I conducted a Chi-square test (Table 15). Proximal flakes, bifaces, cores/core tools, angular shatter, edge modified, retouched, utilized flakes, groundstone tools, flake shatter, sidescrapers, and unimarginal tools were all compared, and the results were significant ($\chi^2 = 132.088; df = 10; p < 0.05$). The correlation is weak to moderate ($Cramer's V = 0.358$). When these results are compared to the distribution maps of the various artifact categories, it becomes clear that the majority of diagnostic projectile points were discarded in the Salamonie watershed, but the majority of all other artifact categories were located in the Mississinewa watershed and specifically concentrated around the Big Lick Creek. This implies that the Mississinewa watershed, and specifically the Big Lick Creek, was used more intensively as habitation areas and that the Salamonie watershed may have served as hunting grounds more frequently than as a habitation area. Groundstone tools, the majority of cores and core tools, the majority of endscrapers and sidescrapers are all found in the Mississinewa watershed, also supporting the notion that the Mississinewa watershed served as ideal locations for base camps.
GIS Analysis

The results of the GIS analysis show that the southern portion of the county was more intensively used than the northern portion. Waterways appear to be the dominant factor in the placement of artifacts. In fact, the two watersheds themselves appear to be responsible for two different types of meta-behaviors. In the Mississinewa watershed portion of the county, the behavior is consistent with settlements or base camps. Whereas the Salamonie watershed portion of the county is consistent with resource acquisition tasks.

The distribution of bifaces appears to be evenly distributed throughout both watersheds; however, when diagnostic projectile points are isolated the distribution shows a greater concentration of diagnostics in the Salamonie watershed (Figure 20 and Figure 21). In contrast, the concentration of cores, core tools, endscrapers, sidescrapers, and groundstone tools all appear to be more frequently located in the Mississinewa watershed, and mostly concentrated along the Big Lick Creek (Figure 22, Figure 23, Figure 24, Figure 25, and Figure 26). Proximal flakes and angular shatter both appear to be evenly distributed in both watersheds; however greater numbers and greater concentrations of both artifact types were recovered in the Mississinewa watershed (Figure 27 and Figure 28).

Of the diagnostic projectile points, the distributions of the various point types appears to be concentrated along the Salamonie River and within the Salamonie watershed, and then over time the distributions slowly advance south towards the Mississinewa watershed. These distributions and movements over time are unusual. As discussed above, the Salamonie watershed appears to be the hunting grounds of the two watersheds and the discard rate of diagnostics is consistent with the chaîne opératoire approach. The diachronic view of these
diagnostic distributions shows that the Salamonie watershed served as this hunting ground for many thousands of years, and it was only in the Late Woodland that the Mississinewa watershed became more frequently used as hunting grounds. There is the possibility that this is a shift from more of a foraging strategy during the early periods moving towards more of a collector strategy in the later periods. Furthermore the development of horticulture and later agriculture may be acting on this shift from one watershed to the other. These changing mobility, economic, and settlement strategies that place more emphasis on longer occupations in the Mississinewa watershed during the later time periods could be accountable for this unknown impetus. Suffice to say, there was a very real and noticeable shift from one watershed to the other over time, as the distribution maps clearly indicate.
Figure 5: Distribution of Indiana cherts (Cantin 2008). Blackford County is outlined in red.
Figure 6: Chert types by percentage.

Figure 7: Top four chert types that had evidence of heat treatment.
Figure 8: Presence or absence of cortex on all chert types.

Figure 9: Presence or absence of cortex on five artifact types.
Figure 10: Platform type on all proximal flakes.

Figure 11: Mean length, width, and thickness of all proximal flakes by platform type.
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Figure 13: Frequency of seven artifact types by soil series.
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Figure 20: Distribution of diagnostic bifaces.
Figure 21: Distribution of bifaces.
Figure 22: Distribution of cores.
Figure 23: Distribution of core tools.
Figure 24: Distribution of endscrapers.
Figure 25: Distribution of sidescrapers.
Figure 26: Distribution of groundstone tools.
Figure 27: Distribution of proximal flakes.
Figure 28: Distribution of angular shatter.
Figure 29: Distribution of Early Archaic points (N = 3) within the Salamonie watershed.
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Figure 35: Distribution of Late Woodland points (N = 6) within the Mississinewa and Salamonie watersheds.
Chapter Five

Discussion

Discussion

*It has slowly emerged that there is archaeological information in the spatial relationships between things as well as in things themselves.*

David L. Clarke (1977)

In this chapter I will discuss some of the patterns found in Blackford County which will answer some of the questions posed at the start of this thesis. Second, I will examine the results of the statistical analyses to illumine what implications that they may have for Blackford County. Finally, I will discuss the ramifications of these findings for Blackford County and for Till Plain archaeology in general.

The question of how human activity patterns on the landscape can only be answered for the 1,823.5 acres that were surveyed as part of the two HPF grants. Of the 106,022 total acres in Blackford County, our surveys only covered 1.72 percent of the land in the county. However, based on the prehistoric artifacts recovered and the locations of these artifacts/sites on the landscape, certain trends have developed that may enable some predictive modeling. Broadly speaking, prehistoric inhabitants of Blackford County tended to favor well drained clay loam Glynwood soils (GsB3) about 240 to 280 meters from water at about an elevation of 885 feet.
Glynwood soils (GsB3 and GsC3) were well suited to a favorable environment, the terrain is gently sloping and moderately well drained and would have supported grasses in a prairie or wooded areas (Kluess 1986) (Table 2). Glynwood soils were loamy and not prone to flooding or ponding, but are prone to erosion. Activities that pattern on Glynwood soils include virtually every activity. Many different types of artifacts were found on Glynwood soils including cores, bifaces, bladelets, various flake tools, angular shatter, proximal flakes, and flake shatter. Since these soils are well drained and well suited to habitation, it is not surprising that a variety of different lithic activities can be found on these soils.

Chert is the predominant archaeological material recovered from the prehistoric period. Of that chert, Liston Creek is the predominant chert resource. This is not surprising considering the fact that Liston Creek chert outcrops on the Wabash River, of which both the Salamonie and Mississinewa Rivers are tributaries. A total of 560 artifacts were made of Liston Creek chert which suggests that prehistoric inhabitants of Blackford County were heavily relying on this local chert material. The other top four chert material types suggest that the resources are coming from distances that would have required longer resource procurement strategies or trade networks. Another possibility is that the non-local cherts were glacially deposited in the gravel till and were scavenged by the prehistoric inhabitants. Surprisingly, the majority of bifaces are manufactured from non-local chert resources. Of the twenty diagnostic bifaces, eight are made of Liston Creek chert, and seven of the remaining twelve are made of cherts that outcrop distances greater than 200 kilometers from Blackford County. This suggests that bifaces made of these higher quality cherts that are coming from great distances are being brought into the region rather than being manufactured in Blackford County. The relatively lower frequency of these
“exotic” (i.e. non-local) cherts in the proximal flake and angular shatter assemblages corroborates this view.

As discussed above in Chapter Two, Eren and Andrews (2013) hypothesized that a variable toolkit of thicker flakes and unifacial tools would have been used by hunter-gatherers in unfamiliar territory as they scouted for toolstone resources as well as food resources rather than bifacial cores. They argue that this was done to mitigate risk and to help prevent breakage of valuable stone tool resources (Eren and Andrews 2013:176). Building on this hypothesis, I attempted to see if the results from Blackford County could shed any light on this subject. The nature of the HPF Grants did not allow the fine-grained analysis of known chert quarries or habitation sites such as Eren and Andrews’s study did. However, the mean length, width, and thickness of proximal flakes, and distance to water can be used as good indicators of lithic technology and the decisions made about local and non-local cherts as source material for expedient tools or more formal tools. In an attempt to see if local cherts were used to manufacture the more expedient flake tools or bifaces or if non-local cherts were used to manufacture higher quality flake tools or bifaces, t-Tests were done and the results show that there was a significant difference between the usage of local and non-local cherts in the production of stone tools (see Table 10). Also, when examining the mean lengths, widths, and thicknesses of all proximal flakes it is clear that those with cortex or flat platforms present tended to be longer, wider, and thicker than complex or abraded proximal flakes (see Figure 11). This is consistent with what is known about reduction stages in stone tool production.

In Chapter Two, the question was raised if there was any evidence in Blackford County for either type of hunter-gatherer strategy present based on the lithic materials? Or were both settlement systems operative in Blackford County? As a result of the statistical tests and the
distribution maps, it seems fairly clear that both settlement systems were present in Blackford County at least in the diachronic perspective. It is impossible to know whether both settlement systems were operative at the same time, all that can be said is that there is evidence to support both types of strategies and that they may have co-occurred. The evidence that supports a forager strategy (\textit{sensu} Binford 1980) is the paucity of artifacts in the Salamonie watershed coupled with a high frequency of projectile points and bifaces (Figure 20 and Figure 21). These kinds of tools are more consistent with a residential mobility strategy where the majority of the group is moved from location to location in the pursuit of resources (Andrefsky 2005; Binford 1980; Kelly 1995). The evidence that supports a collector strategy (\textit{sensu} Binford 1980) in the Mississinewa watershed is the sheer quantity of artifacts compared to the Salamonie watershed coupled with the far richer assemblage of lithic tools that are present in the Mississinewa watershed. In a logistical organization, individuals or small groups move about the landscape and gather resources and bring these back to the base camps (Andrefsky 2005; Binford 1980; Kelly 1995). One would expect to find numerous artifacts in an area used by a logistical organization because the majority of tools and debitage are being generated at the base camp and very few were brought into the field due to weight and mobility constraints. The majority of cores and core tools and groundstone tools are all located in the Mississinewa watershed (Figure 22, Figure 23, and Figure 26). In addition to the cores and groundstone tools, are flake tools that are not found in the Salamonie watershed, such as a spokeshave, a drill, bladelets, hammerstones, and a nutting stone. One would expect to find this denser and more diverse tool assemblage in areas where people are living, working, processing resources, and manufacturing new stone tools.

There is also a pronounced diachronic pattern of these two watersheds being used persistently as these two different mobility organizations. In roughly 12,000 years of history, the
Salamonie watershed is persistently used as a location of resource extraction activities (or forays). Only 256 prehistoric artifacts were recovered from ~ 900 acres in the Salamonie watershed and these artifacts encompass the longue durée of the history of the county. This strongly suggests that the Salamonie watershed was repeatedly used only for this type of activity, at least within the confines of the Blackford County boundaries. Although there is an area along the north bank of the Salamonie River where there is a concentration of Early Archaic projectile points, cores, proximal flakes, and angular shatter (Figure 22, Figure 27, Figure 28, and Figure 29), which may lead to the conclusion that there was a possible base camp in that location during the Early Archaic period. The Mississinewa watershed is also repeatedly used throughout history, but as a location of residential habitation and residential activities. There were 838 prehistoric artifacts recovered from ~ 900 acres in the Mississinewa watershed, and as discussed above, this is a far richer tool assemblage than the Salamonie watershed. The distribution maps corroborate this interpretation by clearly demonstrating the concentrations of cores, core tools, groundstone tools, endscrapers, and sidescrapers all densely concentrated in the Mississinewa watershed (Figure 22, Figure 23, Figure 24, Figure 25, and Figure 26).

The interpretation of these two distinct mobility strategies is supported by the fact that the two HPF Grants surveyed approximately the same number of acres (FY 2011 = 915 acres; FY 2012 = 908.5 acres) in each watershed and was conducted by the same institution (AAL) which used the exact same methodology and collection strategy for both grants.

The statistical tests were used to get a better sense of the overall picture of Blackford County. Since the county boundaries themselves are an arbitrary unit that has no bearing on prehistoric behaviors or activities, it is better to think of the study universe in terms of the two watersheds – the Salamonie and Mississinewa watersheds. The questions then become: is
prehistoric behavior distributed differently between the two watersheds or largely similar? How was each watershed being used? Finally, what kinds of patterns of behavior can be linked to the landscape? The statistical analyses answered some of these questions and offers hints at others that can be more definitively answered by examining the distribution maps.

The results of these statistical analyses demonstrate that there was a heavy reliance on local cherts (specifically Liston Creek), but it also appears that local and non-local cherts were used unequally to make different kinds of artifacts. There was a significant statistical difference between the mean lengths, widths, and thicknesses of local and non-local chert artifacts. It is clear that local chert materials were being used to make expedient tools and less refined tools; whereas non-local chert materials were used to produce and maintain higher quality tools and bifaces. Also, these non-local chert proximal flakes indicate that prehistoric people were conserving these higher quality chert sources for tools by extending the use-life of the tool through repeated sharpening episodes. However, it appears that distance to water had no bearing on the types of activities that were performed, in terms of lithic material remains. Furthermore, distance to water had no bearing on the types of proximal flakes that were generated in the stone tool manufacturing process. The early stages of production including breaking down cores and the later stages of production including maintaining bifaces all seem to have occurred in distances from water sources that are not statistically significantly different.

What is different are that bifaces are found significantly further from water sources than cores/core tools, angular shatter, and proximal flakes. On average, bifaces are approximately 45 meters to 100 meters further from water sources than cores/core tools, angular shatter, and proximal flakes. When this result is taken in conjunction with the watershed that these artifacts were recovered in, it becomes obvious that the use of bifaces in the Salamonie watershed was
different than other artifacts. Eleven different artifact categories were compared between the two watersheds to see if there were any differences and the results were significant. The distribution maps also help illumine the statistical results, by showing greater concentrations of cores/core tools, endscrapers/sidescrapers, groundstone tools, proximal flakes, and angular shatter being in the Mississinewa watershed; whereas diagnostic bifaces are more concentrated in the Salamonie watershed. The distributions of both proximal flakes and angular shatter appear to be equally distributed throughout both watersheds, but by sheer count, the Mississinewa watershed is far more populated by both of these artifact categories, suggesting a base camp.

There are two distinct loci of activity that are reflected in the two different watersheds; the discard of tools in the Salamonie watershed and the production of stone tools in the Mississinewa watershed. Once again, the distribution maps demonstrate that the Mississinewa watershed had far more activities relating to early stage reduction of cores and also to many everyday activities that required flake tools of various sorts. There were also a number of groundstone tools that indicate the presence of food processing activities. Additionally, the sheer quantity of lithic artifact recovered from the Mississinewa watershed versus the relatively low number of artifacts recovered in the Salamonie watershed suggest that the Mississinewa watershed was intensively occupied throughout prehistoric times. The Salamonie watershed, on the other hand, appears to have offered favorable resource extraction areas, since it was frequented throughout the prehistoric period from the Early Archaic period through the Late Woodland period. Therefore, it can be concluded that the Mississinewa watershed served as a location of repeated habitation throughout the prehistoric past. Also, the Salamonie watershed served as a location of repeated forays for resource extraction where prehistoric people discarded
their spent bifacial and flake tools, with only minimal resharpening or early stage production of stone tools occurring.
Chapter Six

Conclusions

Surface surveys are helpful and necessary archaeological work. They can provide good previews of excavation. And they help to recreate the paleoecology of a site or region. The limitations of surveys, however, must be duly recognized. They are merely preliminary work, and any conclusions drawn from them must be considered provisional until the more definitive work of excavation can be undertaken.

John Currid (1999:54; emphasis mine)

Currid’s comments should be taken with a grain of salt, he is writing about excavation in the Levant and his comments are more germane to the Preclassical archaeology of the eastern Mediterranean world and not authoritative for all questions in archaeology regardless of period or region of focus. However, this quotation demonstrates how pervasive the persistent notion that surface surveys cannot yield adequate or substantive archaeological knowledge is. The nature of the HPF grants requires a surface survey methodology, and through countless HPF grants administered by the Division of Historic Preservation and Archaeology (DHPA) over the years to various institutions, knowledge of Indiana’s prehistoric past has increased exponentially. This is not just preliminary work either, but substantive and definitive work in its own right.
As a result of the two HPF grants, it can be said that Blackford County was not intensively used in prehistoric times. The paucity of artifact data would suggest that Blackford County was not a resource rich environment, nor a culturally significant region. Moreover, there are archaeological gaps within the chronological timeframe that further exacerbate the situation (e.g., the almost complete lack of information from the Middle Archaic period). Adding to the archaeological gap is the pervasive collector community within Blackford County that is very active and very secretive. I have not discussed the role of collectors in either HPF grant report or in this thesis, but their collections are large and come from all over Blackford County. Collectors are people who actively seek out archaeological resources for their private collections or to be sold to the masses. None of these collectors report the locations of archaeological sites or the contents or their collections to official archaeological channels. Thus, their archaeological information is lost and furthers the gap that is detrimental to the prehistory of Blackford County.

As discussed above, the results from the two HPF Grants and this thesis demonstrate that the southern portion of the county may have served as base camps and/or villages throughout the prehistoric past and that the northern portion of the county along the Salamonie River may have served as the resource extraction areas for these habitation sites. Residential activities can be expected to have larger quantities and varieties of stone tools that would facilitate activities such as food processing/preparation, maintaining tools, and also cores that indicate the start of stone tool production (Andrefsky 2005:210-211; Binford 1980; Odell 2004:190-191). As can be seen in the distribution maps, there is a concentration of groundstone tools, cores, and other formal lithic tools indicative of residential organization all within the Mississinewa watershed. Resource extraction activities can be expected to have fewer tools and more bifaces/projectile points that would have been used in procuring game. As can be seen in the distribution maps, there are
relatively fewer artifacts in the Salamonie watershed, yet a greater concentration of projectile points.

As mentioned above, Blackford County is an arbitrary unit that is imposed upon two different watersheds, and the archaeological surveys sampled from these two watersheds. These watersheds extend much further beyond the county boundaries throughout the Tipton Till Plain. To better understand the socio-economic forces that were acting upon the behavior of prehistoric inhabitants of Blackford County, more large-scale regional surveys throughout the Tipton Till Plain need to be undertaken. To my knowledge, none of the counties surrounding Blackford County have been subjected to large-scale surveys. If these surrounding counties can be surveyed, then perhaps a more complete picture of the Mississinewa watershed as the location of habitation sites can be more fully developed. Or perhaps a better understanding of the Salamonie watershed as the location of resource extraction areas would be beneficial.

Blackford County can be seen as a palimpsest, with repeated activities occurring on the same landscapes throughout time. As discussed above, throughout the various time periods and occupations, there was a strong emphasis on using local cherts to manufacture stone tools (specifically Liston Creek). While Liston Creek was the predominant chert type, they also used a variety of non-local cherts to manufacture both the pedestrian tools of everyday life (i.e., utilized flakes or edge modified expedient tools) and the more refined bifaces (both hafted and non-hafted). It is also clear, based on the statistical tests and distribution maps; that distance to water had no bearing on the types of activities associated with stone tool production. Beginning the core reduction process or sharpening and maintaining preexisting stone tools occurred in equal distances to water that are not statistically different. What is statistically different is that bifaces are significantly further from water sources than cores/core tools, proximal flakes, and angular
shatter and also that bifaces tend to have been discarded in the Salamonie watershed far more frequently than in the Mississinewa watershed. One would expect to see expedient flake tools, groundstone tools, cores, endscrapers/sidescrapers, and a variety of proximal flakes and angular shatter in a habitation locus and this is exactly what was encountered in the Mississinewa watershed. One would also expect to see a differential discard of bifaces (particularly diagnostic bifaces) and few other stone tools in an area associated with logistical forays, as was encountered in the Salamonie watershed.

On the forager-collector spectrum, resource and occupational activities are practiced differentially and these different systems can be expected to vary spatially on the landscape. As a result of the statistical tests and distribution maps, this differential patterning can be seen on the landscape of Blackford County. Residential activities can be seen as prevalent in the Mississinewa watershed and resource extraction activities can be seen as operational for the Salamonie watershed. However, there appears to be a concentration of artifacts on the north bank of the Salamonie River that may be indicative of a base camp, at least in the Early Archaic period. The forager-collector spectrum is not a duality, but just that: a spectrum. It is unreasonable to assume that one locale on the landscape can only be used for one type of mobility strategy. Yet for Blackford County, this perceived duality seems to be substantiated throughout history by the repeated usage of these two watersheds for the two very different types of activities.

The question posed at the start of this thesis was: what is the distribution of human activity on the landscape of Blackford County? Through an analysis of the distribution maps and various statistical tests the broad general answer is that the two different watersheds evince two different aspects of the hunting and gathering spectrum – areas of residential activity can be seen
in the southern portion of the county and areas of resource extraction activities can be seen in the northern portion of the county. These two broad categories are persistent places in the sense that these two types of activities are repeated in these same loci over the millennia. The evidence from both surveys suggests that the Mississinewa watershed was persistently used as a residential area and that the Salamonie watershed was persistently used as an area for resource procurement.

In sum, Blackford County is a small unit within the two different watersheds, and the HPF Grants only sampled a small percentage of this county (ca. 1.72 percent). Additionally, the surveys only recovered 1,094 prehistoric artifacts, which is a relatively small number of artifacts. However, the results of this thesis demonstrate that a distributional approach to archaeological surveys can be beneficial to our understanding of the prehistoric past in eastern central Indiana. Even with a small sample size and a small artifact count, patterns of human activity can be teased out through distribution maps and statistical tests. John Currid would do well to realize that surface surveys are more advantageous than mere preliminary work; the scope of a distributional approach to surveys is broader than any excavation and can yield far richer information about behavioral systems in a region than a limited excavation unit could.
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Plog, Fred

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Wilke, Philip J.  
Zvelebil, Marek, Stanton W. Green, and Mark G. Macklin  
Appendix 1
Tables
### Table 1: Soil Associations in Blackford County (Kluess 1986).

<table>
<thead>
<tr>
<th>Association</th>
<th>Description</th>
<th>Landform</th>
<th>% of County</th>
<th>Acres Surveyed</th>
<th>% of Area Surveyed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blount-Pewamo-Glynwood</td>
<td>Nearly level, gently sloping, somewhat poorly drained to moderately well drained silty, clayey, and loamy soils formed in glacial till.</td>
<td>Till Plain and Moraines</td>
<td>50%</td>
<td>1110.7</td>
<td>60.91%</td>
</tr>
<tr>
<td>Bono-Houghton</td>
<td>Nearly level, very poorly drained clayey and mucky soils formed in lacustrine clay over outwash materials and organic deposits.</td>
<td>Till Plain and Moraines</td>
<td>3%</td>
<td>75.5</td>
<td>4.14%</td>
</tr>
<tr>
<td>Glynwood</td>
<td>Gently sloping, moderately well drained loamy soils formed in glacial till.</td>
<td>Till Plain and Moraines</td>
<td>12%</td>
<td>176.5</td>
<td>9.68%</td>
</tr>
<tr>
<td>Glynwood-Blount-Pewamo</td>
<td>Nearly level, moderately well drained to poorly drained, loamy, silty, and clayey soils formed in glacial till.</td>
<td>Till Plain and Moraines</td>
<td>28%</td>
<td>249.3</td>
<td>13.67%</td>
</tr>
<tr>
<td>Saranac-Eel</td>
<td>Nearly level, very poorly drained and moderately well drained, clayey and loamy soils formed in alluvium.</td>
<td>Floodplains</td>
<td>7%</td>
<td>211.5</td>
<td>11.60%</td>
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</table>
Table 2: Soils Within the Project Area (Kluess 1986).

<table>
<thead>
<tr>
<th>SMU</th>
<th>Name</th>
<th>Topography</th>
<th>Slope</th>
<th>Erosion</th>
<th>Drainage</th>
<th>% of County</th>
<th>Flood</th>
<th>Pond</th>
</tr>
</thead>
<tbody>
<tr>
<td>B1A</td>
<td>Blount-Glynwood</td>
<td>Till plain and moraine</td>
<td>0-3%</td>
<td>Somewhat Poorly Drained</td>
<td>31.74</td>
<td>None</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td>Bo</td>
<td>Bono</td>
<td>Till plain and moraine</td>
<td>0-1%</td>
<td>Very Poorly Drained</td>
<td>3.82</td>
<td>None</td>
<td>Frequent</td>
<td></td>
</tr>
<tr>
<td>E1A</td>
<td>Eldean</td>
<td>Flood plains</td>
<td>0-2%</td>
<td>Well Drained</td>
<td>0.18</td>
<td>None</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td>Ee</td>
<td>Eel</td>
<td>Flood plains</td>
<td>0-1%</td>
<td>Well Drained</td>
<td>0.61</td>
<td>Frequent</td>
<td>None</td>
<td></td>
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<tr>
<td>EnB3</td>
<td>Eldean</td>
<td>Flood plains</td>
<td>2-6%</td>
<td>Eroded</td>
<td>0.27</td>
<td>None</td>
<td>None</td>
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<td>EnC3</td>
<td>Eldean</td>
<td>Flood plains</td>
<td>6-12%</td>
<td>Eroded</td>
<td>0.006</td>
<td>None</td>
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<td>GsB3</td>
<td>Glynwood</td>
<td>Till plain and moraine</td>
<td>2-6%</td>
<td>Eroded</td>
<td>26.76</td>
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<tr>
<td>GsC3</td>
<td>Glynwood</td>
<td>Till plain and moraine</td>
<td>6-12%</td>
<td>Eroded</td>
<td>2.88</td>
<td>None</td>
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<tr>
<td>MaA</td>
<td>Martinsville</td>
<td>Till plain and moraine</td>
<td>0-2%</td>
<td>Well Drained</td>
<td>0.28</td>
<td>None</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td>MoD3</td>
<td>Morley</td>
<td>Till plain and moraine</td>
<td>12-20%</td>
<td>Eroded</td>
<td>0.49</td>
<td>None</td>
<td>None</td>
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<tr>
<td>Pm</td>
<td>Pewamo</td>
<td>Till Plain and moraine</td>
<td>0-1%</td>
<td>Poorly Drained</td>
<td>28.06</td>
<td>None</td>
<td>Frequent</td>
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</tr>
<tr>
<td>St</td>
<td>Saranac</td>
<td>Flood plains</td>
<td>0-1%</td>
<td>Very Poorly Drained</td>
<td>2.88</td>
<td>Frequent</td>
<td>None</td>
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</tr>
<tr>
<td>Ud</td>
<td>Udorthents</td>
<td>Till plain and moraine</td>
<td>0-1%</td>
<td>Well Drained</td>
<td>0.31</td>
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<td>None</td>
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<tr>
<td>Artifact Type</td>
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<td>Cores/Core Tools</td>
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<td></td>
<td></td>
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<tr>
<td>Unimarginal Tools</td>
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<td></td>
</tr>
<tr>
<td>Endscrapers/Sidescrapers</td>
<td>28</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Edge Modified Flake</td>
<td>93</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Retouched Flake</td>
<td>6</td>
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<td></td>
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<td>Utilized Flake</td>
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<td></td>
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<td></td>
<td></td>
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<tr>
<td>Proximal Flake</td>
<td>224</td>
<td></td>
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<td></td>
<td></td>
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<td>231</td>
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<tr>
<td>Angular Shatter</td>
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<td>Minimally Modified Cores</td>
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<td>Chipped Stone Tool</td>
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<td>Groundstone Tools</td>
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<td>Hammerstone</td>
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<td>Nutting Stone</td>
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<td></td>
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<tr>
<td>Fire Cracked Rock (FCR)</td>
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<td></td>
<td></td>
<td></td>
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<td></td>
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<td><strong>Total</strong></td>
<td><strong>1094</strong></td>
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</table>
Table 4: Mean Lengths, Widths, and Thicknesses of Eleven Artifact Types.

<table>
<thead>
<tr>
<th>Artifact Type</th>
<th>No.</th>
<th>Length</th>
<th>Width</th>
<th>Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biface</td>
<td>60</td>
<td>33.99</td>
<td>27.14</td>
<td>9.30</td>
</tr>
<tr>
<td>Bladelet</td>
<td>8</td>
<td>20.96</td>
<td>12.71</td>
<td>5.02</td>
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<tr>
<td>Unimarginal Tool</td>
<td>15</td>
<td>25.64</td>
<td>21.41</td>
<td>6.50</td>
</tr>
<tr>
<td>Cores/Core Tools</td>
<td>61</td>
<td>50.85</td>
<td>36.63</td>
<td>25.03</td>
</tr>
<tr>
<td>Endscrapers/Sidescrapers</td>
<td>28</td>
<td>25.25</td>
<td>21.58</td>
<td>10.21</td>
</tr>
<tr>
<td>Edge Modified Flake</td>
<td>93</td>
<td>25.35</td>
<td>19.73</td>
<td>9.01</td>
</tr>
<tr>
<td>Retouched Flake</td>
<td>6</td>
<td>24.64</td>
<td>15.51</td>
<td>6.48</td>
</tr>
<tr>
<td>Utilized Flake</td>
<td>70</td>
<td>25.33</td>
<td>20.81</td>
<td>9.78</td>
</tr>
<tr>
<td>Proximal Flake</td>
<td>224</td>
<td>20.38</td>
<td>19.87</td>
<td>6.02</td>
</tr>
<tr>
<td>Flake Shatter</td>
<td>231</td>
<td>18.14</td>
<td>18.65</td>
<td>6.98</td>
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<tr>
<td>Minimally Modified Cores</td>
<td>26</td>
<td>39.70</td>
<td>30.96</td>
<td>22.61</td>
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</table>

Table 5: Artifact Types with Most Cortex Present and Absent.

<table>
<thead>
<tr>
<th>Artifact Type</th>
<th>Present Number</th>
<th>Absent Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Angular shatter</td>
<td>103</td>
<td>113</td>
</tr>
<tr>
<td>Proximal Flakes</td>
<td>102</td>
<td>122</td>
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<tr>
<td>Flake Shatter</td>
<td>75</td>
<td>156</td>
</tr>
<tr>
<td>Cores/Core Tools</td>
<td>46</td>
<td>15</td>
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</tbody>
</table>

Table 6: Soil Texture and Number of Artifacts per Class.

<table>
<thead>
<tr>
<th>Soil Texture</th>
<th>North Number</th>
<th>South Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Silt Loam</td>
<td>131</td>
<td>152</td>
</tr>
<tr>
<td>Silty Clay</td>
<td>69</td>
<td>32</td>
</tr>
<tr>
<td>Clay Loam</td>
<td>56</td>
<td>600</td>
</tr>
<tr>
<td>Clay</td>
<td>0</td>
<td>39</td>
</tr>
<tr>
<td>Loam</td>
<td>0</td>
<td>15</td>
</tr>
<tr>
<td>Total</td>
<td>256</td>
<td>838</td>
</tr>
</tbody>
</table>
### Table 7: Soil Texture by Cultural Period.

<table>
<thead>
<tr>
<th>Cultural Period</th>
<th>Soil Texture</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Early Archaic</td>
<td>Clay Loam</td>
<td>3</td>
</tr>
<tr>
<td>Middle Archaic</td>
<td>Silty Clay</td>
<td>1</td>
</tr>
<tr>
<td>Late Archaic</td>
<td>Silt Loam/ Clay Loam</td>
<td>3/3</td>
</tr>
<tr>
<td>Early Woodland</td>
<td>Clay Loam</td>
<td>1</td>
</tr>
<tr>
<td>Middle Woodland</td>
<td>Silt Loam/ Silty Clay/ Clay Loam</td>
<td>1/ 1/ 1</td>
</tr>
<tr>
<td>Middle Woodland (Bladelets)</td>
<td>Silt Loam/ Clay Loam/ Clay</td>
<td>1/ 6/ 1</td>
</tr>
<tr>
<td>Late Woodland</td>
<td>Silt Loam/ Clay Loam/ Clay</td>
<td>3/ 2/ 1</td>
</tr>
</tbody>
</table>

### Table 8: Soil Drainage Class and Number of Artifacts per Class.

<table>
<thead>
<tr>
<th>Soil Drainage</th>
<th>North Number</th>
<th>South Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Well Drained</td>
<td>0</td>
<td>357</td>
</tr>
<tr>
<td>Moderately Well Drained</td>
<td>57</td>
<td>315</td>
</tr>
<tr>
<td>Somewhat Poorly to Moderately Well Drained</td>
<td>131</td>
<td>95</td>
</tr>
<tr>
<td>Poorly Drained</td>
<td>66</td>
<td>31</td>
</tr>
<tr>
<td>Very Poorly Drained</td>
<td>2</td>
<td>40</td>
</tr>
<tr>
<td>Total</td>
<td>256</td>
<td>838</td>
</tr>
</tbody>
</table>
Table 9: Chi-Square Test of Local and Non-Local Artifacts.

<table>
<thead>
<tr>
<th></th>
<th>Proximal</th>
<th>Biface</th>
<th>Core</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Local</strong></td>
<td>134</td>
<td>24</td>
<td>35</td>
</tr>
<tr>
<td><strong>Non-Local</strong></td>
<td>94</td>
<td>36</td>
<td>26</td>
</tr>
<tr>
<td>Observed</td>
<td>228</td>
<td>60</td>
<td>61</td>
</tr>
<tr>
<td><strong>Expected</strong></td>
<td>Proximal</td>
<td>Biface</td>
<td>Core</td>
</tr>
<tr>
<td><strong>Local</strong></td>
<td>126.0859599</td>
<td>33.18051576</td>
<td>33.73352436</td>
</tr>
<tr>
<td><strong>Non-Local</strong></td>
<td>101.9140401</td>
<td>26.81948424</td>
<td>27.26647564</td>
</tr>
<tr>
<td>Expected</td>
<td>228</td>
<td>60</td>
<td>61</td>
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</tbody>
</table>

X2 6.900333912  
df 2  
α=.05  
X2crit 5.99  
Significant Yes  
Cramers V 0.1406
Table 10: T-Tests of Mean Lengths, Widths, and Thicknesses of Proximal Flakes.

<table>
<thead>
<tr>
<th></th>
<th>Mean Length</th>
<th>Mean Width</th>
<th>Mean Thickness</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Local</td>
<td>Non-Local</td>
<td>Local</td>
</tr>
<tr>
<td>SD</td>
<td>10.09</td>
<td>11.48</td>
<td>10.30</td>
</tr>
<tr>
<td>Df</td>
<td>128</td>
<td>128</td>
<td>128</td>
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<tr>
<td>T Statistic</td>
<td>4.773</td>
<td>4.132</td>
<td>4.909</td>
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<tr>
<td>P Value (2-Tailed)</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
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<tr>
<td>T-Critical (2-Tailed)</td>
<td>1.979</td>
<td>1.979</td>
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</table>

Table 11: Oneway ANOVA Test of Chert Types and Distance to Water.

Anova: Single Factor

SUMMARY

<table>
<thead>
<tr>
<th>Groups</th>
<th>Count</th>
<th>Sum</th>
<th>Average</th>
<th>Variance</th>
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<tbody>
<tr>
<td>Liston Creek</td>
<td>560</td>
<td>127589</td>
<td>227.8375</td>
<td>29674.05</td>
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<tr>
<td>Derby</td>
<td>46</td>
<td>12794</td>
<td>278.1304</td>
<td>46140.34</td>
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<tr>
<td>Indian Creek</td>
<td>52</td>
<td>12903</td>
<td>248.1346</td>
<td>22134.75</td>
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<tr>
<td>Holland</td>
<td>40</td>
<td>10545</td>
<td>263.625</td>
<td>20111.88</td>
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<tr>
<td>Muldraugh</td>
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<td>9941</td>
<td>292.3824</td>
<td>26304.43</td>
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</table>

ANOVA

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>F</th>
<th>P-value</th>
<th>F crit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>263805.8</td>
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<td>65951.45</td>
<td>2.235758</td>
<td>0.063630574</td>
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<td>Within Groups</td>
<td>21445393</td>
<td>727</td>
<td>29498.48</td>
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<td>Total</td>
<td>21709199</td>
<td>731</td>
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110
Table 12: Oneway ANOVA Test of Artifact Type and Distance to Water.

Anova: Single Factor

Artifact type and Distance to Water

<table>
<thead>
<tr>
<th>Groups</th>
<th>Count</th>
<th>Sum</th>
<th>Average</th>
<th>Variance</th>
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</thead>
<tbody>
<tr>
<td>Biface</td>
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<td>19519</td>
<td>325.3167</td>
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<td>224</td>
<td>54885</td>
<td>245.0223</td>
<td>44526.99</td>
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<td>Core/Core Tool</td>
<td>61</td>
<td>17110</td>
<td>280.4918</td>
<td>33472.35</td>
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<td>Angular</td>
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<td>47107</td>
<td>218.088</td>
<td>20437.69</td>
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ANOVA

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<th>MS</th>
<th>F</th>
<th>P-value</th>
<th>F crit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>617860.4</td>
<td>3</td>
<td>205953.5</td>
<td>5.60225</td>
<td>0.000865</td>
<td>2.62090384</td>
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<tr>
<td>Within Groups</td>
<td>20476786</td>
<td>557</td>
<td>36762.63</td>
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<td></td>
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<td>Total</td>
<td>21094647</td>
<td>560</td>
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</table>

Table 13: Pairwise Tukey *Post Hoc* Test.

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<tr>
<th>Comparison</th>
<th>Mean difference</th>
<th>q</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biface vs Proximal</td>
<td>80.294</td>
<td>*</td>
<td>p&lt;0.05</td>
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<tr>
<td>Biface vs Core/Core Tool</td>
<td>44.825</td>
<td>ns</td>
<td>p&gt;0.05</td>
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<tr>
<td>Biface vs Angular</td>
<td>107.23</td>
<td>***</td>
<td>p&lt;0.001</td>
</tr>
<tr>
<td>Proximal vs Core/Core Tool</td>
<td>-35.469</td>
<td>ns</td>
<td>p&gt;0.05</td>
</tr>
<tr>
<td>Proximal vs Angular</td>
<td>26.934</td>
<td>ns</td>
<td>p&gt;0.05</td>
</tr>
<tr>
<td>Core/Core Tool vs Angular</td>
<td>62.404</td>
<td>ns</td>
<td>p&gt;0.05</td>
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</table>
Table 14: Oneway ANOVA Test of Platform Type and Distance to Water.

Anova: Single Factor Platform and Distance to water

<table>
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<th>Groups</th>
<th>Count</th>
<th>Sum</th>
<th>Average</th>
<th>Variance</th>
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</thead>
<tbody>
<tr>
<td>Abraded</td>
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<td>984</td>
<td>492</td>
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<td></td>
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<td>3163</td>
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<td>45695.7579</td>
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<tr>
<td>Complex</td>
<td>129</td>
<td>1100</td>
<td>1</td>
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<td>Cortex</td>
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<td>1</td>
<td>2</td>
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<td>Flat</td>
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<td>8871</td>
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ANOVA

<table>
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<th>SS</th>
<th>df</th>
<th>MS</th>
<th>F</th>
<th>P-value</th>
<th>F crit</th>
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</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>282744.186</td>
<td>5</td>
<td>70686.0466</td>
<td>1.60470672</td>
<td>0.17413828</td>
<td>2.4128698</td>
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<tr>
<td>Within Groups</td>
<td>9646774.70</td>
<td>219</td>
<td>44049.1995</td>
<td>2</td>
<td>5</td>
<td>9</td>
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<tr>
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<td>8</td>
<td>223</td>
<td>5</td>
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</table>
Table 15: Chi-Square Test of Artifact Types and Location in County.

<table>
<thead>
<tr>
<th></th>
<th>Proximal</th>
<th>Biface</th>
<th>Cores/Core Tools</th>
<th>Angular</th>
<th>Edge Mod</th>
<th>Retouch</th>
<th>F. Shatter</th>
<th>Utilized</th>
<th>Groundstone</th>
<th>Sidescraper</th>
<th>Unimarginal</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>North</strong></td>
<td>88</td>
<td>33</td>
<td>6</td>
<td>28</td>
<td>7</td>
<td>1</td>
<td>69</td>
<td>6</td>
<td>2</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td><strong>South</strong></td>
<td>136</td>
<td>27</td>
<td>55</td>
<td>188</td>
<td>86</td>
<td>5</td>
<td>162</td>
<td>64</td>
<td>44</td>
<td>8</td>
<td>5</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>224</td>
<td>60</td>
<td>61</td>
<td>216</td>
<td>93</td>
<td>6</td>
<td>231</td>
<td>70</td>
<td>46</td>
<td>10</td>
<td>15</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Proximal</th>
<th>Biface</th>
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<th>Angular</th>
<th>Edge Mod</th>
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<th>F. Shatter</th>
<th>Utilized</th>
<th>Groundstone</th>
<th>Sidescraper</th>
<th>Unimarginal</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>North</strong></td>
<td>54.69767442</td>
<td>14.65116279</td>
<td>14.89534884</td>
<td>52.74418605</td>
<td>22.70930233</td>
<td>1.465116279</td>
<td>56.40697674</td>
<td>17.09302326</td>
<td>11.23255814</td>
<td>2.441860465</td>
<td>3.662790698</td>
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<tr>
<td><strong>South</strong></td>
<td>169.3023256</td>
<td>45.34883721</td>
<td>46.10465116</td>
<td>163.255814</td>
<td>70.29069767</td>
<td>4.534883721</td>
<td>174.5930233</td>
<td>52.90697674</td>
<td>34.76744186</td>
<td>7.558139535</td>
<td>11.3372093</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>224</td>
<td>60</td>
<td>61</td>
<td>216</td>
<td>93</td>
<td>6</td>
<td>231</td>
<td>70</td>
<td>46</td>
<td>10</td>
<td>15</td>
</tr>
</tbody>
</table>

α = .05
X2          | 132.0886876 |
df          | 10          |
X2crit      | 18.307      |
Sign        | Yes         |
Cramer's V  | 0.3577      |