SPATIAL ANALYSIS OF BONE TOOLS AT SUNWATCH (33MY57),
A MIDDLE FORT ANCIENT INDIAN VILLAGE

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INTRODUCTION

Bone is a medium that has been used since the Paleolithic age to manufacture implements used for various activities, decorations, or for serving ceremonial functions. Bone tools represent a considerable portion of the archaeological record in all circumstances where bone itself is well-preserved. Like stone tools, they can be studied by looking at wear and breakage patterns, polish or patina, and their co-occurrence with other tools to determine context and function. Because they are modified and utilized by humans in a patterned manner (i.e. specific tools made in a specific way used for a specific set of tasks), bone tools can provide insight into how people organized themselves and their activities within living areas.

Traditionally, bone tools have been overlooked as a means of making statements about culture. This is due in part to the fact that bone is often less well preserved than more durable materials like stone. Additionally, they lack the artistry of ceramics and oftentimes are underrepresented in the archaeological assemblage compared to the larger collections of both lithics and ceramics. All of these reasons have made studying bone tools a low priority in most situations. Since much of the same information can be gleaned from them, though, if the situation presents itself, researchers should take advantage of the opportunity to carefully study bone tool assemblages as an additional and rich data set.

One such situation that is amenable to research is the collection of bone tools from SunWatch Village, a Fort Ancient culture site in Dayton, Ohio. As will be
discussed later in this thesis, the history of the site began in the 1970s with a salvage excavation that eventually turned into a major, long-term excavation sponsored by the Dayton Society of Natural History. Excavations continued almost every year until 1989 at which time more than half of the village was uncovered (refer to Figure 1), resulting in a substantial collection of archaeological materials. The reason this site’s collection was chosen as the case study for this thesis is due in part to the remarkable bone preservation that is the result of excellent drainage and a soil pH conducive to chemical stability, between 7.0 and 8.0 (Shane 1988: 169). Bone minerals at SunWatch are therefore not excessively leached by groundwater and the damage due to freeze-and-thaw induced mechanical breakage is minimized.

The extensive excavation also makes the sample of bone tools and various bone tool types large and amenable to statistical testing. The simple fact is that SunWatch “is the most extensively excavated and analyzed Fort Ancient site” (Cook 2008: 11) and the near-completeness of the village as a whole has made the site an incredibly unique and valuable research tool for making statements about community layout for a variety of prehistoric cultures, specifically for the Fort Ancient complex. The large sample of bone tools studied in the context of the entire community layout is beneficial to researchers whose sites are not as fully excavated or as well-preserved because of the patterns of association that become visible across the site as a whole.

On a larger scale, Fort Ancient sites are good places to study bone tools because of the marked increase in the use of bone as a raw material for tools from the Late Woodland to Prehistoric times (Prufer and Shane 1970: 142). Not only are there more
individual tools, but there is a greater variety in the number of tool classes which makes studying bone tools an interesting and useful endeavor.

This thesis will attempt to demonstrate four points regarding bone tools in general and the assemblage at SunWatch in particular. It will attempt to show that:

1. The bone tool assemblage at SunWatch possesses certain tool classes that are common and others that are uncommon in other Fort Ancient assemblages.
2. There are identifiable and distinct spatial clusters of bone tools at SunWatch.
3. There are statistically significant differential deposition patterns present in areas of the village.
4. Bone tool studies should be performed more regularly at archaeological sites due to the abundance of information that can be learned from their analysis.

Because the bone tools have been sadly understudied at SunWatch up to this point, it is worthwhile to discuss the collection in detail and the process of tool type classification that was used for this analysis. It is important to understand the methodology of tool classification because the following analysis is based on the functional categories derived from examining the wear patterns, shape, and size of the tools.

Once the tools have been classified, analysis can begin. For this project, spatial analysis will be used to test long-standing hypotheses about Middle Fort Ancient social organization by looking at the distribution of different tool types throughout the village. This kind of examination is valuable when trying to determine activity zones, differentiation in labor, kin group affiliation, and divisions between ceremonial and
domestic areas. Previously, only ceramic and lithic distributions have been used to
determine household boundaries, possible clans, and ceremonial areas of the site. Bone
tools, because they consist of both ceremonial and functional items, provide an excellent
way to examine these groupings.

Well-classified bone tools can reveal just as much about social organization as
lithics or ceramics and, as such, can be used to independently test issues relating to
village organization, and can also provide a separate line of evidence to support or refute
long-held conclusions based on these other materials. A literature review of the major
concepts and problems that are dealt with in this thesis will be followed by an
examination of the Fort Ancient concept and where SunWatch fits into that culture
construct. There will then be a description of the bone tool collection from SunWatch
with emphasis on classification, and also a brief discussion of some of the various studies
that can be performed with bone tools for illustrative purposes. After this background
information, the spatial distributions of the tools will be discussed as well as the
statistical analysis of a subset of tool classes which will be used to examine the patterns
of dispersion and clustering which might be present. These data will then be compared to
the lithic and ceramic assemblage data as a way to corroborate the assertion that bone
tools are an adequate, independent, and incredibly useful line of evidence that should be
used in archaeological research with much more frequency than has been the case in the
past.
CHAPTER 1
LITERATURE REVIEW

To better understand the nature of the problem, this section will review the literature concerning the main themes of this project including previous work with tool assemblages, spatial analysis, and statistical approaches to the study of distributions.

There is some debate as to how early formal bone tools appear, with estimates ranging from 50,000 to 300,000 years ago (McBrearty and Brooks 2000; see also Semenov 1964; Yellen 1998). Despite this apparent ambiguity, it is safe to say that bone tools have been a marker of human modernity for a very long time (LeMoine 2007: 16) and, as such, have served many functions in society over the centuries.

There are many important reasons to study bone tools, including the fact that they represent a different kind of technological niche than either lithics or ceramics, in part because of the intrinsic properties of bone itself. Bone is hard and durable and can be splintered and fashioned into a sharp point. It comes in a variety of shapes and sizes quite different than could be fashioned by stone or pottery and it is a “free” raw material that comes with every successful hunting or fishing trip. Bone tools, building on the advantages of the material itself, are employed in technological routines different or distinct from those worked in other raw materials. As such, they can provide commentary on cultural practices that supplement or complement other industries. Because they are a perishable technology, in some cases, such as with bone needles and harpoons, their presence and functionality can infer the utilization of other perishable
technology like baskets, nets and textiles (LeMoine 2007: 16; Soffer 2004; Walker 2007: 119). Like many other items of material culture, bone tools have been shown to shed light on cultural change, connections between and movements of people (Robitaille 2007), social status (Vanhaeren and d’Errico 2005), division of labor (Emery 2001, 2004) and social organization. The latter is the focus of the present investigation.

Typology/classification

Most bone tool studies begin with identifying those animal bones that were modified by humans and those that were not. The next step is generally to develop a typology for the modified objects based on morphology and measurements, the end result being a series of categories that organize the collection and identify the different tool types present. The bone debris or debitage can be analyzed along with refits, manufacture-related wear, and a series of experimental studies, ethnoarchaeological analogies, and usewear analysis, to develop a chaîne opératoire, or theoretical use-life model for individual tools or tool classes (David 2007: 35). Because artifact groups are a mixture of many different functional classes, archaeologists can only try to develop a methodology to exert as much control as possible on the materials being studied (Cook 1976: 19). Some tools do not fit neatly into just one category and it also needs to be determined how to handle the multifunctional tools, as Cook did with his Venn diagrams (1976: 17-18).

Typology can be performed by first looking at the overall morphology of the object, then moving on to the tip or functional edge to study use-wear as the determinate of function (Olsen 2007: 179; Scheinsohn and Ferretti 1995). Typological studies
generally assume that design, function, and material properties of any given tool are closely related, and understanding one of these aspects can convey information about the other two.

A logical problem noted by Shott (1989) and others is that once archaeologists have developed a typology, they tend to equate form and function. This goes along with the Middle Range theorists view that once divided into these classes, archaeologists assume that the tool frequencies are directly correlated to the frequency of the activities represented by their proposed functions (Shott 1989: 9). A related problem is that a given tool may be used for something other than its designed function particularly late in its use-life and/or as the situation demands.

Further complicating the typological issue is the fact that it is sometimes difficult to tell the difference between expedient tools and mere splinters resulting from carnivorous activity and/or humans trying to extract marrow from the interior of long bones (Olsen 2007: 175, Lyman 1984). This potentially affects the typology of tools because certain morphological traits may not be cultural, but because of the apparent use-wear created by nature or animals, they are misclassified which in turn leads to misinterpretation. Lyman states that this problem provides an important rationale for performing microwear studies after constructing testable hypotheses regarding how certain wear patterns should appear on bone and antler tools (315).

Another theoretical issue is the question of how to compare assemblages based on typologies developed by different researchers. One person’s awl could be another person’s needle, and it needs to be abundantly clear as to the criteria for placing certain
objects in one category over another. While a certain amount of individuality will always be inherent in typologies, a careful examination of the literature in order to base descriptions and classifications on what has come before is likely the best way to enable comparative studies until a more systematic approach is developed and utilized. For this study, 63 tool types and 8 functional categories have been identified and they have been influenced by a number of previous works, but with the basis being Griffin’s (1966) tool types of the Fort Ancient.

Formation processes

There are many variables to consider when talking about the formation of an artifact assemblage. Because archaeological remains are dynamic, they must be studied with a diachronic approach. In other words, factors beyond mere disposal patterns affect the spatial distribution of artifacts as archaeologists see them in the field. Some of these factors to keep in mind include:

1. Cleanup and disposal patterns of intensely used areas (Keeley 1991: 257-258)

2. Length of a site’s occupation (Keeley 1991: 258)

3. Size of the tool affects the probability of it entering the record “at or near the locus of its last use” (Keeley 1991: 258)

4. Primary and secondary deposition (Binford 1978)

5. Tool kits (Cook 1976)

6. Frequency of activity in which tool is used (Ammerman and Feldman 1974)

   and/or how long the object itself is used (use-life) (Shott 1989)

7. Curation/recycling/retooling (Shott 1989; Keeley 1991: 258)
8. Preferential treatment of certain objects—ceremonial items are often disposed of differently than functional tools

9. Manufacturing errors (Shott 1989: 13)

10. Taphonomical factors like differential erosion, movement from water and wind, or even carnivorous activity (Olsen 2007: 176; Marean and Bertino 1994)

All of these issues can play a role in both the final resting place of any particular artifact and the frequency of the tool in the record and must be remembered when making final conclusions about their spatial distribution.

Tool Analysis Studies

For a variety of reasons, most tool and artifact studies, especially for the Fort Ancient culture have focused on lithics and ceramics. These studies, especially those focused on stone tools, provide a framework for bone tool research in terms of methodology regarding typology systems, microwear studies, use-life reconstruction, and experiments. It is useful for purposes of this study to review the direction of bone tool investigations in the literature in the context of lithic tool studies. By understanding the methods used by lithic researchers, the analysis of bone tools can be performed in such a way as to facilitate the comparison of these different tool assemblages and create a clearer picture of what the culture as a whole was like.

Semenov’s (1964) microwear analysis call-to-arms, Prehistoric Technology, became the model for many future archaeologists studying tool functionality in archaeological contexts. His systematic approach and rigorous scientific methodology set the standard regarding what kinds of information could be gained from studying tool
wear, including manufacturing technology, materials that the tools were used on, degree of use, and especially type of use (i.e. drilling, punching, scraping, etc.). The analytical mantle was taken up later by a subsequent generation of archaeologists, notably Lawrence Keeley, who performed many such studies on stone tools (1974, 1982). Keeley used high-power microwear analysis to look at effects of hafting on stone tools (1982), and examined how information on tool utilization could be used in spatial studies (1991). In sum, microwear studies demonstrate that the purpose of a tool will produce characteristic patterns of wear and breakage.

Bone tool studies in the literature prior to the 1970s in Europe and the 1990s in North America are few and far between (LeMoine 2007: 14). Despite Semenov’s (1964) inclusion of bone tool microwear analysis in his seminal work, many archaeologists have continued to focus attention only on lithic assemblages. As Keeley has said: “the discussion has been limited solely to microwear studies of utilization on stone tools, since this is the principal interest for most archaeologists” (Keeley 1974: 323). In the last decade, especially, there has been a move towards more analytical studies of bone tools, but the work has been done primarily with European collections.

Recently, there have been many notable exceptions to the lithic-centric focus of microwear analysis (LeMoine 2007, 1994; Gates St-Pierre 2007, Vercoutere et.al. 2007; David 2007; LeGrand 2007; van Gijn 2005). The results of van Gijn’s study showed the importance of hide-working in a Mesolithic community based on the wear traces present on a large number of bone and antler tools that were consistent with that particular activity. In this way, use-wear studies can reflect the kinds of tasks that were paramount
to the functioning of a society and the emphasis that was placed on certain activities over
others. Gates St.Pierre’s work demonstrated the role that microwear analysis plays in
identifying the function of problematic categories of bone awls, a process which can
drastically change the typological scheme in a given assemblage.

Use-life, or the history of a tool from its manufacture, through its use,
resharpening, recycling and discard, has been looked at by many archaeologists including
use-life reconstruction involves the incorporation of use-wear analysis, raw material
usage, deposition context, and associated artifacts. Cook’s model for tools at the Archaic
Koster site predicts the products and by-products based on the type of task being
performed (i.e. maintenance, social and extractive) by separating each artifact into
functional types, manufacturing stages, and debris classes. He also deals with
multipurpose tools by creating a series of Venn diagrams which include the raw material,
products and by-products for each task’s tool kit. He even discusses the manufacturing
trajectories of deer bone and antler as raw materials for tools showing how the different
pathways for bone tool production can range from very simple, as it the case with deer
ulna awls, to complex, as is seen with bone pins or fishhooks (37-38).

Spatially, there have been many studies on lithics which examine microdebitage
and the site-formational processes that their presence and clustering infers (Hull 1987;
Janes 1989; Sullivan and Rozen 1985; Seeman 1994). With studies by Binford (1964,
1978, 1979), guiding them, these studies look at how waste from lithic tool production
accumulates at a site and what that means for how the site was organized in prehistory.
Due to reasons already addressed, studies of this nature conducted on bone tools have been limited by poor preservation and other factors.

Experiments have always been an important means of gathering information about tool use and function for both stone tools and bone tools. Many of the experiments on bone tools have focused on manufacturing processes (Newcomer 1974; David 2007) and investigating how wear patterns develop based on a variety of materials (Christidou and Legrand 2005). There are even experiments trying to find out which tools would work better for different tasks (Richter 2002; van Gijn 2005). Newcomer’s study of bone tools from a Paleolithic site in Lebanon uses comparisons of the actual artifacts to the experimental tools to demonstrate that the manufacturing technique used to produce certain tools was by scraping and not grinding. These kinds of results can have a major influence on use-life reconstruction and technological approaches at a site. Similarly, Christidou and Legrand used experimentation to show how the origin of hides and the desired end-product influences the tool used and the gestures of how the tool is used on the hide (scraping, punching, etc.). This study is important because it illustrates that tools are a final result of many different functions and all of them influence the way they appear in the archaeological record.

Experimental approaches are gaining in popularity because they can answer questions about manufacturing processes, function, recycling, curation, and length and intensity of use. They reveal the formational processes that are studied in the microwear analysis of archaeological specimens and contribute to the growth of middle-range theory. In an interesting example, LeMoine (1994) uses the field of tribology- the study
of friction, lubrication and wear- to examine the different traces left behind on bone and antler as a function of the tool being used for different tasks. She notes that different kinds of movement, like polishing, friction, and abrasion, all leave distinctly different patterns on bone or antler which can be used to infer what processes are being carried out by different tool types.

Stone tool studies are numerous in the literature, but within the last few decades, there has been an increasing interest in applying many of the same concepts to the analysis of bone tools with very useful results. It is fair to say at this point that most, if not all, of the dimensions of lithic analysis can be productively applied to bone tools as well and should therefore receive the same analytic attention as their stone counterparts.

Spatial Organization Studies

People often organize their tasks spatially, increasing so when living in one place for an extended period of time (Rigaud and Simek 1991: 200; Binford 1964, 1978, 1979). Consequently, it can be expected that the spatial patterns identified by archaeologists can tell us how particular groups in the past placed themselves within their environment, and perhaps a bit about their mentality as it pertains to how they thought about their surroundings and themselves. The most successful models of social organization within a community have been based on extensive excavations- a trait of SunWatch- which have enabled the recreation of a community plan. These sites are invaluable for considering spatial questions because much less information is left to the imagination because the hypotheses generated are based on a more complete picture of the site.
With the development of and subsequent improvements to spatial software, the analysis of spatial distributions of archaeological materials and features has become much easier and more accurate. Geographic Information Systems (GIS) software is one of the most widely used of these programs and its contributions to the field of archaeology are numerous and significant. A version of this software was used to complete the distribution analysis for the bone tool assemblage in this thesis. The quantitative analysis of spatial data precedes the development of GIS software by several decades, but the former has certainly facilitated the quantitative capabilities of the latter.

The final goal of spatial studies is to be able to make sense of the way people organized themselves in their environments, specifically in the place that archaeologists call a community. Community layout is something that many archaeologists want to talk about but few are able to due to the fact that many sites have very limited portions of the site exposed.

Yaeger and Canuto (2000: 5; citing Watanabe 1992) define community as “the conjunction of people, place, and premise” serving as an “ever-emergent social institution that generates and is generated by supra-household interactions that are structured and synchronized by a set of place within a particular span of time”. In other words, a community is a place where people interact and perform a variety of tasks during a particular period of time and that can be examined spatially. Analysis of a site at the household and community level is important because the variation that is seen at these levels of society can tell us about variation between families and other villages, and also variation in subsistence, division of labor, craft activity, and social status among other
things (Flannery 1976: 16). While these things may not be as apparent in egalitarian societies, of which the people of SunWatch were a part, being able to study groups of people at these different levels of organization can still help archaeologists reconstruct past life-ways.

As will be discussed in the following chapter, SunWatch is one of the very few Fort Ancient sites whose excavations have been extensive enough to be able to make arguments about community layout and social organization based on more than just a small percentage of the whole village. As such, SunWatch provides a unique opportunity for community-level research, including the spatial distribution of artifacts over a large portion of the village. These results can then be used as a benchmark to assist in predictive modeling at other, less excavated Fort Ancient sites.

This section has reviewed the literature that has guided my research into tool and spatial analyses and community layout. While many studies have traditionally focused on stone tools, I have discovered that many newer studies that have begun to focus on various aspects of bone tools and the things that they can say about a culture. Furthermore, I have shown the importance of looking at these tools in the larger context of a community which is one of the reasons why the SunWatch site is such an exemplary case. In the following chapter, I will present a background of the Fort Ancient culture and where SunWatch fits into the regional expression of the period.
CHAPTER 2
BACKGROUND ON FORT ANCIENT

The concept of a culture called Fort Ancient was first introduced by William Mills to describe the group of settled farmers who lived in the Ohio River Valley during the Late Prehistoric (Mills 1906: 135; Drooker 1997: 65; Griffin 1966: 210). Since Mills, there have been many debates over its chronology and relationship to other cultures on a regional scale. It is important to understand how these chronologies and concepts have been developed in order to understand how the SunWatch site fits into the generalized context of the culture concept and, by extension, the bone tools at the site that are the subject of this thesis.

History of Fort Ancient culture concept

To date, there exist numerous taxonomic methods that have been applied to the Fort Ancient culture. James Griffin (1966) was one of the first to attempt a classification scheme in 1943, which was based on McKern’s Midwestern Taxonomic System and grouped according to similarities in ceramics. The scheme was later modified by Olaf Prufer and Orrin Shane (1970), who used Willey and Phillips’s (1955) model to base their divisions on not only ceramic styles, but also environment and settlement changes. The scheme has been subsequently amended and altered by numerous subsequent researchers. All of these schemes utilize different methods and theoretical frameworks for the division of Fort Ancient groups and culture, which has led to much of the
ambiguity regarding exactly what Fort Ancient culture was and where it was located. Each researcher’s divisions and their defining characteristics are summarized in Table 1.

At this point, in the age of carbon-14 dating, it makes sense to employ a system that incorporates temporal placement. Also, as more sites are being excavated, more traits can be considered when dividing the various manifestations of this culture through time. I agree that pottery has been greatly emphasized and the danger of overgeneralizing distinct ethnic groups is definitely an issue, but there does need to be a systematic way of looking at the Fort Ancient culture as a whole and until a better way reveals itself, it appears as though pottery styles will continue to be the predominate trait used to identify similarities and differences. Archaeologists should do all that is possible to try to move away from this pottery-centric scheme of classification, however, because there is so much more to culture than ceramics, which is why studies like this, which focus on other aspects of material culture, are important to consider and include in the classification of Fort Ancient culture.

General Characteristics

Currently, most Midwest archaeologists agree that the culture began at around A.D. 950-1000 and continued right up to contact time around 1750 A.D (Pollack and Henderson 1992). This time frame can be divided into three periods- Early Fort Ancient (950-1250 A.D.), Middle Fort Ancient (1250-1450 A.D.), and Late Fort Ancient, also called protohistoric or the Madisonville Horizon (1450-1750 A.D.) (Prufer and Shane 1970: 257; Drooker 1997: 68). The criterion used to separate these time frames is based
<table>
<thead>
<tr>
<th>Classificatory Scheme</th>
<th>Phase/Focus</th>
<th>Pottery</th>
<th>Non pottery</th>
<th>Social</th>
</tr>
</thead>
<tbody>
<tr>
<td>Griffin (1966)</td>
<td>Baum Foci (early)</td>
<td>baum cordmarked incised, undecorated, mostly grit tempered, incised designs on neck, lug handles and some strap handles</td>
<td>cremation, crescent-shaped shell gorgets, turkey-head rattle, perforated deer phalanges, deer-toe arrowpoints, perforated epiphyseal disk</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fuert</td>
<td>Fuert incised, shell temper, mostly strap handles</td>
<td>oliva marine shell beads, bone flutes</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Anderson</td>
<td>Anderson cordmarked, rectilinear and curvilinear guilloche with lug and strap handles, large amounts of both grit and shell temper</td>
<td>Shell gorgets, wide-based triangular points, flattened stemmed long elbow pipes</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Madisonville</td>
<td>multiple pottery types (salt pans, bowls, jars), 90% strap handles, completely shell tempered, incised curvilinear guilloche</td>
<td>European trade goods, mask gorgets, shell spoons, decorated bone beads, flint end scrapers</td>
<td></td>
</tr>
<tr>
<td>Pruefer and Shane (1970)</td>
<td>Baldwin Phase</td>
<td>simple, undecorated rims and undecorated pots</td>
<td>Hocking Valley</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Baum</td>
<td>more pottery that is decorated</td>
<td>Scioto drainage</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Brush Creek</td>
<td>angular designs on pottery</td>
<td>Southwestern Ohio</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fuert</td>
<td>continuation of the Baum Phase</td>
<td>eastern part of state</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Anderson</td>
<td>angular, incised designs on pottery</td>
<td>west of the Scioto</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Madisonville</td>
<td>shell-tempered Madisonville cordmarked</td>
<td>entire Ohio river drainage</td>
<td></td>
</tr>
<tr>
<td>Pollack and Henderson (1992)</td>
<td>Early</td>
<td>handles and lugs, incised designs, jar is primary form</td>
<td>small villages occupied for short periods of time, dead buried outside settlement, no regional exchange networks</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Middle</td>
<td>distinctive regional ceramic series differing from early Fort Ancient by decoration, rim treatment, and surface treatment, strap handles</td>
<td>chipped limestone disks and sandstone discoids</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Late</td>
<td>shell temper, thinner strap handles, more body decoration</td>
<td>European trade goods, more variety of stone tool forms, teardrop shaped endscrapers, bicox y creases</td>
<td></td>
</tr>
</tbody>
</table>

Table 1. Fort Ancient Culture classifications
mainly on settlement characteristics. Within these periods there are multiple regional
phases, but the focus for this thesis will be on Fort Ancient as it relates to Ohio,
specifically the southwest portion of the state. The temporal data available for the
SunWatch site placed the main occupation with the Middle Fort Ancient period

In southwest Ohio, Early Fort Ancient is known as the Turpin phase, Middle Fort
Ancient is comprised of the Anderson and Shomaker phases, and Late Fort Ancient is
called the Mariemont phase (Drooker 1997: 68). One horizon marker for the early
Turpin phase is the presence of burial mounds, while the Anderson and Shomaker phases
are characterized by circular villages with concentric rings of features, and Late Fort
Ancient site contain Madisonville pottery and sometimes European trade goods.

A general trend in the transition for Late Woodland to Fort Ancient was a shift in
the kinds of plants utilized, larger, more permanent dwellings, and incised pottery with
lugs and handles (Pollack and Henderson 2000: 198). Relevant to this thesis, there was
also a notable increase in tools made from bone. This could, in part, be explained by a
climate change that occurred at the beginning of the Late Prehistoric (circa 850-1250
A.D.) to a warmer, more moist environment which provided abundant faunal resources
(Henderson 1992: 26). This abundance of bone as a raw material obtained by hunting
and fishing could possibly correlate with the increase in bone tool use and production,
causing Late Woodland bone tools assemblages to look “impoverished” compared to
those from Fort Ancient sites (Prufer and Shane: 1970: 142).
The faunal remains at many Fort Ancient sites all imply the same heavy reliance on big game animals of timbered and forest edge areas. The most utilized faunal resource at almost every Fort Ancient site was *Odocoileus virginianus*—the white tailed deer—but elk, bear, raccoon, beaver, turkey, and box turtle were also used in considerable quantities, comprising anywhere from 50-80% if the meat yield. Groups in southern Ohio relied more heavily on deer and less on elk and bear than their neighbors in Kentucky (Pollack and Henderson 2000: 197). All of these animals were used as raw materials for the Fort Ancient bone tool industry. Fish were not a major source of meat for Fort Ancient societies, perhaps because these people lived in areas with less aquatic environment than contemporaneous Mississippian populations to the south and west (Henderson 1992).

Seasonality of Fort Ancient sites can be examined using fauna such as migratory birds, and deer, whose age at death indicates in what season they were being hunted. Using this information, it can be said that Fort Ancient people lived, for the most part, in year-round villages (Pollack and Henderson 2000). An interesting theory related to seasonality was presented using data from the Shomaker site. The researchers at the site found that the largest percentage of meat throughout the year came from deer, but that in the spring and summer, there was an increase in the amount of fish that were included in the diet, corresponding with a slight decrease in the number of deer being hunted. The explanation for these numbers is that during the spring and summer months, there were more farming obligations that prevented assembling wide-ranging hunting parties, and so
the reliance on local sustenance like fish increased (Henderson 1992). This interpretation is arguable, but it does present an interesting theory for within-site diet variation.

Villages throughout the Fort Ancient period are often located on floodplains, terraces, or sometimes on bluffs above the floodplain (Drooker 1997: 85; Pollack and Henderson 2000: 196; Carskadden 1992; Prufer and Shane 1970). This is, of course, due to the advantages of these environments in access to farmable land, as these people were more intensively participating in maize agriculture at this time. There can be a minor differentiation made between earlier sites that are more likely to be located on high terraces and later sites that are congregated more around the floodplain of the Ohio River (Drooker 1997: 73). There was also a general trend toward settling in open areas because they were easier to clear for agriculture and settling near secondary-growth forests which provided lumber for buildings (Pollack and Henderson 1992: 284).

Because this thesis uses a Middle Fort Ancient village as a case study, the social organization of groups from this phase will be examined in more detail. Most Middle Fort Ancient sites are located on river floodplains or terraces overlooking those floodplains, again coinciding with the increasing use of these fertile soils for agriculture (Drooker 1997: 93). On a regional scale, there was an increase in population at this time which is evidenced by the increase in both village size and number. The villages were also occupied for longer periods of time, with multiple generations succeeding one another in the same village, a change from the Early Fort Ancient pattern (Pollack and Henderson 2000: 202).
As can be deduced by changes in village layout, the social organization of Middle Fort Ancient sites becomes more complex, with larger villages consisting of multiple clans or lineages, each presided over by a headman, as has been proposed at SunWatch (Cook 2008: 57). Even though there was a more centralized form of organization and multiple lineages lived in one village, the major form of political and economic order was formed around the kin group (Pollack and Henderson 1992: 284).

Using Philo II and SunWatch Village as examples from this time frame, village size increased to around 100-200 people (Pollack and Henderson 1992: 284) that occupied, on average, 20-30 rectangular houses at any one point in time (Pollack and Henderson 2000: 202; Carskadden and Morton 2000: 172). Some of these houses at the beginning part of this time frame are semi-subterranean pit houses but are gradually replaced by above-ground structures (Carskadden and Morton 2000: 175). Each domestic structure averaged 24-40m$^2$ and would have had enough space for 9-12 people; probably an extended family or several closely related nuclear families (Carskadden and Morton 2000: 173). There are also larger communal structures that could have been used for rituals and acted as a statement of community and cohesiveness, as seen with the Big House and Winter Solstice House at SunWatch- two structures whose floor areas are considered too big for one family group (Heilman 1988a: 56).

Another characteristic of Middle Fort Ancient site layout are the concentric rings of activity zones. As is seen at SunWatch, Philo II, and Florence, there are rings of houses encircling pits and disposal zones which enclose burials, all around a central plaza (Heilman 1988a: 57; Pollack and Henderson 2000: 202). This division of space is much
more formal and community-based than what is seen in the Early Fort Ancient period and would have underlined the increased importance of community rituals and ceremonialism during this time (Pollack and Henderson 2000: 213). There are also palisades present at some Middle Fort Ancient sites like SunWatch, which has been argued as evidence for increased conflict in the region (Heilman 1988a: 57).

Burials were often designated to specific zones within the village itself and the bodies were usually in an extended or flexed position in shallow graves with a limestone slab covering (Pollack and Henderson 2000: 203). This divergence from the mound constructions and internment outside the settlement boundaries also underscores the idea of community and belonging to a particular place over a longer period of time. Location of a person within the burial zone could also be an indication of increased social differentiation during this time (Pollack and Henderson 1992: 285).

**SunWatch Indian Village (33MY57)**

**History of Excavations**

Because of its excellent preservation and the high percentage of the village that has been excavated, SunWatch Indian Village has served as the model for Middle Fort Ancient village life in southwest Ohio. It is located on a floodplain of the Great Miami River in Dayton, Ohio and was excavated continuously for almost 17 years. The history of the excavations at SunWatch are a worthwhile topic to address due to the fact that the interpretation of many of the features in the site are inextricably linked to how they were excavated and the methodology that was used. Interpretations should be considered in the context of these procedures.
Excavations began in 1964 when an amateur archaeologist, John Allman, began to conduct excavations at what was then called the Incinerator site. Since the 1930s, it had been a farm and many people had been coming to the site to collect artifacts that had been tilled up to the surface. Allman was the first to dig at the site and did so for three summers. In 1968, he told James Heilman III, an archaeologist with the Dayton Museum of Natural History (DMNH) about his discovery and how the site was slated for destruction by the city to create a new sludge treatment pond (Lileas 1988: 36). Heilman got involved in 1971 and DMNH was able to obtain permission from the city to begin a professional excavation for the period of one year, at the end of which, the site would be destroyed as planned (Lileas 1988: 38). The dig became a salvage excavation with time being the most important factor. As more and more things turned up at the site, the museum was able to renew its one-year contract with the city until, finally, in 1974, the site was placed on the National Register of Historic Places and was safe from pending industrial development (Lileas 1988: 43).

Since the excavation began as a salvage project, the underlying methodology was one of finding as much information as possible in the shortest amount of time possible. A ten-foot grid pattern was used and a series of ten-foot square units was opened in various portions of the village. Not all excavated materials were screened in the first year, but subsequent years utilized dry mesh screening for sub-plowzone levels (Heilman 1988a: 56-57). Volunteers and student groups were used for much of the labor, which means that much of the recorded data, especially from the early years, varies in quality (Heilman 1988a: 58).
Heilman continued his analysis of the site until the early 1990s when he was succeeded by a series of new site archaeologists including Dr. Robert Cook, currently of Ohio State University, Andrew Sawyer, the present site archaeologist, William Kennedy and Lynn Simonelli, curators at Boonshoft Museum of Discovery. The site is partially reconstructed and is a major tourist site for visitors to come and see an interpretation of how the village may have looked 800 years ago. There are many programs for the public to be involved in, including a summer program where, in years past, children ages fourteen and older could help on the dig.

While full excavations at SunWatch stopped after the 1988 field season, the data that were obtained over the years have been analyzed and conclusions have been made, rechecked, and changed as new information and techniques become available. Due to the presence of a gravel road that runs through the majority of the east side, only the west side of the village has been excavated. It was thought in the past that it would be useless to dig there because there has been too much interference by cars and farm equipment on the road, but test excavations under the road provide hope that data may still be recovered from this side of the village at some point in the future (Cook 2008).

Description of the site

SunWatch is a Middle Fort Ancient site that was occupied for a period of about twenty to thirty years around the year 1200 A.D. and as such, is placed in the Anderson phase of this period. There is some debate, based on evidence of rebuilding episodes and bimodal radiocarbon chronology, as to whether or not there were multiple periods of occupation at the site (Cook 2008). More evidence is being gathered and evaluated and
hopefully a conclusion will be reached soon, but as yet, a single occupation is the hypothesis that will be used for purposes of this thesis.

SunWatch is a relatively large village (Figure 1), with an estimated 100-200 people living in the village at any one time (Cook 2008, 2007). It is circular in shape with concentric rings of village features beginning in the interior with a 5-acre central plaza surrounded by a ring of burials, a ring of trash pits, the structures, and finally the stockade which enclosed the whole village. One of the identifying features of this site is the center pole complex located in the center of the plaza and which is believed to have been used for astronomical alignments and from which the site derives its name. These alignments, first proposed by Heilman (1988b), appear at important times of the year, including winter solstice, over several village features such as the hearths of communal structures or lines of important burials.

The village is about 1,330 feet long (410 meters), and covers 36 acres, contains 17 excavated houses, 400 excavated pits, and 188 excavated burials. One of the largest structures, located in the western portion of the village has a total floor area of 545m², while the other, in the north has a floor area of 550m². The smaller houses to the north and south have floor areas ranging from 256m² to 460m². Since the east half of the village is unexcavated due to the disturbance of a historic road, it is unknown precisely how many more houses there were in the village, but could be roughly as many as are on the west side. There are multiple types of pit features, including bell-shaped, shallow basins, shallow flat-bottomed, and deep flat-bottomed (Nass 1987). While the frequency
Figure 1: GIS map of SunWatch Village showing excavated areas, features, and historic disturbances. Map created by William Kennedy of the Boonshoft Museum of Discovery.
of certain types of pits varies between households, the type of pits present in each cluster suggests that each family or household was responsible for a certain amount of their own food preparation and storage (Nass and Yerkes). The burials are predominately found in a flexed position, but there are also some that are fully extended. Some are also capped with a limestone slab. Cook’s (2008) analysis of SunWatch mortuary patterns indicates that the placement of groups of burials in relation to each other and to the center pole complex indicates that there might have been corporate groups within the village, most likely based on kinship and with the heads of households placed in predictable patterns within mortuary groups.

The general conclusion regarding site structure is that there are discreet residential areas and a ceremonial area within the village. The “ceremonial area” was determined by historic descriptions, key astronomical alignments, and the high frequency of ceremonial objects and exotic goods (Robertson 1988: 238), including the only whelk shell at the site. The latter was found in a burial located in a cluster of male burials of which many have a variety of burial goods (Cook 2008: 50-51). This burial cluster in the western portion of the site is directly to the north of the structure known as the “Men’s Lodge”- a communal structure presumably used primarily by men based on the high percentage of lithic debitage and stone artifacts found in the structure and in the surrounding pits. These contexts show that about half of all lithic debitage in the village occurs in this portion of the site. It is especially dense outside the “Men’s Lodge” where apparently much of the lithic tool production was taking place (Robertson 1988: 239-240). This structure was probably more of a meeting or council house than a living quarters for
males based on ethnographic comparisons. The western portion of the village also includes the largest structures, with the implication that they could have been used as communal meetinghouses or as leaders’ houses. Within this “ceremonial” section, Heilman (1988b: 250) identified three subdivisions, a central core of “high church” garbage with the two sub-sections to the north and south containing more mundane objects in addition to ceremonial artifacts. He supported the claim by the high number of pottery refits within these zones but limited refits between them.

Dual division of the village was determined by Cook and Sunderhaus (1999) by means of mapping pottery refits across the village. Their study augmented earlier studies by Heilman (1988b) in using these ceramic refits to make inferences about social organization. The initial study by Heilman analyzed over 37,000 pottery sherds. Pieces were refitted by dividing the sherds into tempering agent, vessel part, and design motif (Heilman 1988b: 244-246). The refits suggested three separate zones in the village where refits were common within but not between the different areas. Cook and Sunderhaus incorporated more pottery refits than utilized in Heilman’s study, and also incorporated a temporal consideration to the pits that were linked, with the end result being the proposed dual division of the village. Dual division systems, or moieties, appear commonly in southeastern indigenous groups, regional tribal groups of the historic period, and even some Mississippian sites to the south (Cook 2008: 17 citing Blitz 1999, Hudson 1976, Knight 2006, Zeder and Arter 1996). The line of the division runs from the northwest portion of the village to the southeast. Within each moiety there are two further
subdivisions of social groups, again based on pottery refits that were made within but not among the four areas (Cook 2008:16; Heilman 1988b).

The people of SunWatch, like other Fort Ancient groups, were egalitarian agriculturalists. They were deemed to be egalitarian based on the mortuary grouping that included males, females, and children with few elaborate or exotic grave goods and clustered into what are probably clans or lineages. Furthermore, different burial treatments were most likely determined not by status, but rather by age and/or gender (i.e. limestone slabs for many older males versus being buried in trash pits for some infants) (Cook 2008: 17; Evans-Eargle 1998: 97).

As has been discussed previously, SunWatch Village is unique and valuable in the large percentage of the village that has been uncovered. As a direct result, there is also a large sample size of many artifact classes on which to base a variety of research questions. There are only a handful of other extensively excavated Fort Ancient sites with site layouts comparable to SunWatch. Of the roughly 160 Fort Ancient sites recorded in Ohio, Indiana, Kentucky, and West Virginia, only about four other sites can be argued to have had excavations as extensive as SunWatch-- Madisonville (Drooker, 1997), Buffalo (Hanson 1975), Philo II (Carskadden and Morton 2000), and an unpublished site in Dayton, Ohio, 33My127. Even at Buffalo, a Late Fort Ancient site in West Virginia, researchers have had to extrapolate much of the village layout based on only about 13% of the site having been excavated (Hanson 1975: 1). At Neale’s Landing, another Late Fort Ancient village, only 20% of the village uncovered
(Hemmings 1977: 10). It is for this reason that spatial studies conducted at SunWatch have an automatic advantage over those conducted at other sites.

Based on this introduction to the Fort Ancient culture concept and a description of SunWatch itself, it is clear that SunWatch is a Middle Fort Ancient village that provides an important and relatively complete record of an entire community layout at this time in prehistory. Because of its near-complete community plan, spatial investigations of artifact distributions and patterning can be expected to provide important interpretive models. By being able to see the nearly complete spatial distributions of artifacts, in this case bone tools, throughout the entire village with little need for extrapolation, better reconstructions of social organization should result.
As mentioned previously, the bone tool assemblage at SunWatch lends itself remarkably well to scientific inquiry due to the nature of its excellent preservation and the extent of excavations which have uncovered a large sample size with which to examine patterning across an almost complete community layout. There are many tool types represented and the variation that is seen among these types is particularly interesting as a source of information regarding use-life. What follows is a description of the collection, including the classification scheme and proposed functional category for each tool type. An explanation will be provided for the types which are most debated or have an as-yet-unknown function. There will then follow a comparison to other Fort Ancient bone tool assemblages from sites dating to earlier, later, and at the same time as SunWatch in order to examine general trends within the same culture and roughly the same geographic area. Finally, an example of avenues for future research will be discussed by looking at the various characteristics of beamers, including refits, breakage patterns, and degree of use.

It should be noted that the numbers for each category refers not to the minimum number of individuals, but rather the total number of individual specimens recovered. This is a part of the methodology of bone tool studies which remains unstandardized with few researchers even explaining how they came up with their tool counts. Due to these discrepancies and with the hope that this problem will be revisited in the future, the
original counting procedure for the SunWatch collection- that of total number of samples, regardless of completeness- was maintained for this study. Furthermore, since this study is focused mainly on the distribution of bone tool debris, it seems logical that all debris be included in the analysis since leaving out major portions of the population, as MNI counts do, would skew the results just as much as keeping them in would. Another consideration to keep in mind is that because of a number of factors, including the excavation of many parts of the village by untrained amateurs and changing laboratory procedure over time, the provenience on many of the tools has been lost. Bone tools excavated by the amateurs in the northeast section of the village, currently housed at the Ohio Historical Society in Columbus, Ohio, were not included in this study, but remain a viable path for future investigations.

**Typology and Classification**

To begin with, most of the bone tools from SunWatch, like many other Fort Ancient sites were made from deer bone. This is due in large part to the degree that deer were hunted which, in turn, is because of the high meat yield that deer provide. Once the meat has been stripped from the bone, there still remains a very good source of raw material for tools that serve a multitude of purposes. At SunWatch, deer bone has been identified as the raw material for at least 42% of the bone tool assemblage. The next most used faunal raw material is turkey bone, which only comprises 5%. These and the other utilized animals were important raw material sources because certain bones in the bodies of these animals were of a shape and size that facilitated the manufacture of
particularly important tool classes. Figure 2 shows the percentages of the rest of the identified raw materials for the bone tool collection.

Specific parts of the deer were used to make specific tools, as Figure 3 shows. These kinds of diagrams have been used often in the literature to illustrate where specific tools come from on the hunted animal (David 2007: 38). It is a trait of all bone tool industries that the shape of the bone selected as the raw material predetermines what tool will be created and likewise, certain bones are being preferentially selected over other bones (Cook 1976: 38). The component that produced the greatest variety of tool types was antler because it is a more durable material compared to other bones in the carcass, and included types such as manufacturing debris, scrapers, torpedoes, drifts, and punches. Most of these tools were used for processing and fabrication tasks. Scapulas were used to make awls and knives, ulnas were used for awls and fishhooks, and metatarsals were used to make beamers.

The theoretical background for typology and classification studies was discussed in the previous chapter and this thesis takes into consideration these problems, but works under the assumption that these tools can be divided into classes which have at least some
Figure 3: Diagram of the parts of a deer utilized for common bone tools. Antlers were used to make awls, projectile points with groove and snap bases as the reflection on the original cultural uses for the tools. The assemblage was classified using a functional approach as opposed to a morphological approach. As such, Table 2 summarizes both the different tool types that have been identified as well as the functional categories to which each tool type was assigned. As with any archaeological classification system, there is always room for improvement with the advent of new information and future research. The descriptions and most of the types that follow were
compiled initially by Lynn Simonelli, Vice-President of Collections at the Boonshoft Museum of Discovery in Dayton, Ohio. Images of most of the tool types are located in Appendix A. As a side note, there are some tool classes which have not been photographed due to the fact that all samples were on display at the SunWatch Village museum.

The tool classes are divided into eight functional categories—ornaments/ceremonial items, processing, extractive, containers, evidence of manufacture, fabricating, unknown function, and fragments. These are based on traditional functional divisions in the literature. The ornamental/ceremonial category includes items such as pendants, beads, and possible “gaming pieces”. Griffin (1966) was one of the first to identify many of these categories as ornamental in his work defining and characterizing Fort Ancient artifacts through the entire period. Processing tool types were probably used mainly to process hides by scraping and cleaning the inner fat layers from the dermis (Parmalee et al. 1972). Extractive tools were used to extract resources from the environment, either by hunting or fishing. Fabricating tools were used to create and modify other materials such as hides and lithics. The remains of tool manufacture are distinguished from other tool categories in that they are by-products rather than finished tools. They provide evidence for what certain tools were made from and also the mode of production. Additionally, they shed light on primary manufacturing activity zones.
<table>
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<th>Processing</th>
<th>Fabricating</th>
<th>Unknown</th>
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<td><strong>Flakers/Punches- 35</strong></td>
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<td>squash knife- 3</td>
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<td>beaver tooth chisel- 30</td>
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<tr>
<td>canine molar- 1</td>
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The function of some tools, while showing modification and usewear to one degree or another, remain unidentified until more studies can be performed looking at microwear patterns.

**Ornaments/wealth/status**

*Tooth pendants (n=55), Plates 1-5*: Tooth pendants made from molars, incisors, or canines are present. Some pendants have been able to be identified as far as what animal the tooth came from, but most are unassociated with a particular animal. All of tooth pendants were modified by either grooving or drilling of the root for suspension. Examples of these kinds of ornaments can be seen as far back as the Archaic throughout the Midwest (Lewis and Lewis 1961; Ritchie 1965; Winters 1969).

*Bone pendant (n=1), Plate 6*: this is an isolated sample of a seemingly naturally rounded piece of bone, possibly turtle, which has two drill holes near the top of the piece. This category was used to describe a drilled deer phalanx at the Late Fort Ancient Hardin Village site that is of similar size but possessing only a single drill hole (Hanson 1966: 148). The example from SunWatch, however, is not flat like the one from Hardin, but rather is raised in the middle into a miniature cup shape.

*Turtle shell gorget/pendant (n=1), Plate 7*: This specimen is a fragment of turtle bone which has 2 drill holes that could have been used for suspension as a pendant or gorget. There is, however, the possibility that it could simply have been broken off a whole turtle shell and was not in itself intended as a small pendant, but rather a drilled section of the whole shell, as seen in Plate 8 in Appendix A. Drilled turtle shell
carapaces are seen in some Woodland contexts like at the Apple Creek site, where some shell fragments have up to eight holes (Parmalee et al. 1972: 29).

**Bone beads (n=73), Plate 9:** These beads, made from bird bone and other naturally hollow bone, with only a few examples derived from bones which were drilled, are numerous and show signs of grooving and snapping as a means of production. There is a high degree of polish and they range in length from 7-60mm with an average length of 26.8mm. Bone beads are another artifact class that reaches back to the Archaic period (Cook 1976: 199; Ritchie 1965: 66; Winters 1969). These forms are also sometimes called bone tubes, with the apparent distinction in some cases being length (Cook 1976: 199). They are also prolific at other Fort Ancient sites, including Madisonville (Drooker 1996), Buffalo (Hanson 1975), Hardin (Hanson 1966), and Richards (Carskadden 1977).

**Cut wolf jaw (n=7):** This is a piece of wolf jaw modified by cutting. The presence of these objects at other sites confirms that they were used as items of adornment and worn on the chest or elsewhere on the body (Parmalee et.al. 1972). While it has no obvious function, it was included in the ornamentation category due to the symbolic importance of wolves in many Native American tribes and also the presence of wolf imagery on other items at SunWatch, including the Wolfman pipe, implying the importance of the animal to this group (Heilman 1988b). Cut animal jaws are seen throughout time, but fox, dog and squirrel jaws appear at the Richards site (Carskadden 1977: 63).

**Drilled deer/elk toes (n=27), Plate 10:** While no other contextual evidence has been found to support the function of these drilled and/or cut phalanges, based on
ethnographic information, they are considered ostensibly to have been used as either tinklers (ornaments) or game pieces for the pin-and-cup game recorded in some native groups (Winters 1969: 83; Kelly 1990: 251). Cut animal phalanges have been identified in the Woodland period (Parmalee et. al. 1972: 53), Archaic (Winters 1969: 84), and Fort Ancient periods (Carskadden 1977: 63).

**Bone combs (n=2):** These two objects, one finished and one a perform, are small, four-tooth combs made of unidentified bone. Bone combs, sometimes made out of antler, have been found at the Richards site (Carskadden 1977: 52), Buffalo site (Hanson 1975: 86), and even in New York State during the Archaic (Ritchie 1965: 115-116).

**Bone disc (n=1), Plate 11:** Small, drilled disc fashioned from bone (28mm long and 26mm wide), probably used as a pendant. It is similar in size to the object identified as a bone pendant, but more flat with rounded margins, which is why it is its own category.

**Elk incisor effigies (n=2):** Elk incisors fashioned into effigy owls. Effigy figures are seen in many ceremonial and ornamental objects, including bird effigies on the base of a bone comb from an Archaic site in New York State (Ritchie 1965: 115-116).

**Processing**

**Deer/Elk antler scrapers (n=2), Plate 12:** These are scraping tools made from antler. They were identified as scrapers by the rounded distal end with traces of wear. A similar example of an elk antler scraper was found at the Hardin Village site (Hanson 1966: 146). Other sites have identified scrapers that were made from bones such as scapulas (Ritchie 1965: 49, 99), but none have been identified at SunWatch.
**Beamers (n=117), Plate 13:** These hide-processing tools were made by constructing a concave working edge along the midsection of a deer metatarsal. The wide range in lengths, from 29-282mm, is a function of beamer fragments being included in the overall count. There are three examples of broken beamer portions being recycled into awls (Plate 14). A more detailed discussion of beamer analysis will occur later in this chapter. This tool class has been recorded at many sites going back to the Woodland period (Parmalee et al. 1972).

**Extractive**

**Antler tip projectile points (n=165), Plate 15:** These are any antler tine that has been grooved and snapped from its base then sharpened and drilled to create a projectile point. The range is 12-86.78mm long, again with some broken points being included in the count, but the average length is 32.4mm and there is evidence of polish and wear on the tip, continuing down the shaft. Points had been made from antler for centuries due to the density and hardness of the material (Winters 1969). At the Buffalo site, there are some examples of antler projectile points that have drilled holes in the base, presumably to assist in hafting to a shaft (Hanson 1975: 58). There are no such drilled specimens in the SunWatch assemblage.

**Fishhooks (n=96), Plate 16:** Generally made from deer ulna, this category includes performs of fishhooks (which look like flat rectangles with rounded ends and a high degree of polish), as well as finished specimens. They are significantly polished and have a grooved end with a small bulge for attachment to a fishing line. One blank was made from a rib bone, probably from a deer. Complete fishhooks range in length from
13-80mm (including broken pieces) with the average length of 32.3mm. Bone fishhooks are seen in assemblages dating from the Archaic (Cook 1972; Lewis and Lewis 1961; Ritchie 1965), although some, like at the Eva site, appear to have been made from antler as well (Lewis and Lewis 1961: 95).

**Containers**

*Turtle shell bowls (n=21), Plate 17:* A complete, or nearly complete, carapace of a box turtle. Sometimes the edges are cut or the spine extrusions on the interior of the bowl are rubbed smooth, but not in every instance. Because these objects were often broken into several pieces, and because refitting is difficult if not impossible in many cases, only the ones that were relatively intact were included in the artifact count.

*Turtle shell dippers (n=2), Plate 18:* Ladle-like object created by cutting down the turtle shell to a smaller size. At the Apple Creek site from the Woodland period, these shallower carapaces were called plates or dishes instead of dippers (Parmalee et al. 1972: 30).

**Fabricating**

*Awls (n=458), Plates 19-24:* Highly varied, this tool category includes formal tools such as ulna awls, antler awls, deer leg bone awls, scapula awls, turkey leg awls, and expediency tools like splinter bone awls. The differences between formal awls and expedient awls can be found in the degree of use wear, pattern of breakage, and sometimes even size of the tool. Formal awls show a more careful construction, being sharpened and pointed at one end while the rest is given a certain degree of polish in finishing or possibly simply from handling during use. Splinter bone awls, as expediency
tools, commonly display spiral fracturing and may be a passive result of bone processing rather than purposeful manufacture. As bone is broken, sharp edges appear and are utilized in the same way that formal awls are—generally to punch holes in leather according to ethnographic analogy. Splinter awls seem to be used for a shorter period of time before discard as the patina is generally irregular and slight.

One observation is that there are enough awls at SunWatch for every man woman and child to have had several awls. A possible explanation for this overabundance is that some of the awls that have been labeled awls were, in fact, used for something else or were broken from a different tool. Microwear analysis needs to be performed to support this hypothesis. A different explanation is that according to ethnographic studies among the Huron, each person, on average, requires seven hides per outfit and that each outfit needs to be replaced at least every two years (Gramly 1977). Awls and other hide-working tools may be proportionate to the amount of leatherworking at a given site. Awls are, without question, one of the most numerous bone tool categories throughout prehistory. Examples of every awl type can be found in the literature dating back to the Archaic (Ritchie 1965; Cook 1976; Lewis and Lewis 1961; Winters 1969; Parmalee et al. 1972; Hanson 1966, 1975; Carskadden 1977).

*Flakers/Punches (n=35), Plates 25-27:* Presumably used for flintknapping, these tools are, with one exception, made from durable antler in order to serve as punches or soft hammers for lithic production. These tools have also been called “drifts” in the literature and have a bluntly rounded distal end (Winters 1969).
**Needles (n=16), Plates 28, 29:** Pointed at one end with an eye at the other, usually the location of a break, these needles are said to be used in the matting process, although no microwear evidence can be given at this time to support this hypothesis. They range in length from 7 to 325mm, but complete needles average 202mm. Some of these tools are similar to Ritchie’s (1965: 94) category which he also calls bone needles, used for sewing mats. This tool class, along with pins, is problematic due to the fact that long, pointed objects can be interpreted to have a variety of different functions. For example, the matting needles from SunWatch, since they do not possess eyes, could also be interpreted as what Winters (1969) calls simple shuttles, used for weaving. Some of the objects that have a more rounded end could be what Hanson (1975: 81) terms netting needles.

**Knives (n=4):** The three squash knives are made from deer scapula and range in size from 117 to 280mm. It is unknown under what criteria they were deemed squash knives and I was unable to find any examples in the literature. Knives as a category, however, are seen in the Archaic and are made from deer ulnas (Ritchie 1965: 61). The bone fillet knife is made of unknown bone but has tally marks along both edges and is 154mm in length.

**Beaver tooth chisels (n=30), Plate 30:** These beaver teeth are commonly cited in the literature as chisels (Carskadden 1977: 49-50). The assumption is that beaver canines were isolated as a superlative wood-working tool and would have been salvaged from the carcass expressly for this purpose. Included in this count are small pieces of
broken beaver teeth with no obvious evidence of wear as well as larger pieces and complete specimens.

**Evidence of Manufacture**

*Deer/Elk ulna fishhook bases (n=48), Plates 31, 32:* The ulna of a deer or elk, these are the bases from which fishhook performs were made and then grooved and snapped off. Evidence of this grooving and snapping method is seen on many of the tools’ ends.

*Groove and snap bases (n=267), Plate 33:* These are the discarded bases of antler projectile points after the tines have been grooved and snapped off. These objects are called “cut discard sections” at the Apple Creek site (Parmalee et al. 1972), but are exactly the same thing.

**Unknown function**

*Bone pins (n=404), Plate 34:* The most numerous tool type at the site, these pins are bipointed and show a deep polish along the whole length. They vary in length from 8-207mm and some show evidence of having been burnt (15%). Their function is unknown, but once their use-wear has been studied, there may be further insights into their function. Possible functions include them being part of tattooing kits or holders for trash pit mats. Based on the limited evidence from other sites, the majority of cases are assumed to be hairpins, however these documented examples seem to be longer and oftentimes more decorated than the pins at SunWatch (see Cook 1976: 202). Additionally, the bone pins at SunWatch are predominately bi-pointed and resemble what have been called fishing gorges in other studies (Ritchie 1965: 49; Carskadden 1977: 61).
Elk ankle bone fragment \((n=1)\): This one sample has been proposed to serve as a feather holder. The origins of this hypothesis are unknown and there are no known examples in the literature.

Antler/bone tools \((n=15), \text{ Plates 35-38}\): Pieces of antler or bone that have been worked and shaped into unidentifiable tools. The objects made from antler may include a possible baton or knapping tool.

Antler torpedo \((n=46), \text{ Plate 39}\): Torpedo-shaped pieces of antler with an unknown use. Ranging in length from 21 to 103mm (average of 59.7mm) both ends are pointed and they are highly polished, but no obvious function can be inferred. These could serve the same function as bone pins, but this would not explain the different shape and the different material from which the torpedoes are made. A somewhat similar form was found at an Archaic site in New York and Ritchie (1965: 49) calls it a weaving tool.

Bone skewer \((n=54), \text{ Plate 40}\): These are very thin and delicate bone, possibly fish ribs, with an unknown function. They evidence polish, either as a function of manufacture or utilization. The length range is 14-110mm, the average length is 62.1mm.

Notched bone \((n=2), \text{ Plate 41}\): Unidentified animal bone with a notch at the end, making the tip bi-pointed.

Raccoon baculum \((n=18), \text{ Plate 42}\): The penis bone of a raccoon that is smooth and it is generally considered to have been used as a punch due to the striations at the tip and along the shaft (Parmalee et al. 1972: 39-40; Hanson 1966: 142).

Rib \((n=1), \text{ Plate 43}\): worked piece of unidentified animal rib bone 50mm long.
Worked bone splinter \((n=2)\), Plate 44: A worked splinter of bone, but not a splinter bone awl due to the bluntness of the tips and less polish along the shaft.

Fragments \((n=71)\)

This category includes the tips of awls and bone pins that were broken off, but were not included in the awl/bone pin/fishhook category or their fragmentary condition and the possibility of misclassification.

Unmodified \((n=12)\)

These objects, which consist of bear teeth, canine teeth and an elk molar, show no evidence of modification for suspension or use, but are included in this description because due to the significance placed on those animals and the fact that pendants were made from other teeth from them, it is likely that they were somehow utilized even though they show no obvious sign of it.

Tool categories not observed at SunWatch

While there is a rich bone tool assemblage at the site, there are also some tool classes that are conspicuously absent from the collection. Some of these categories were not expected to be present, but the absence of others is something of a surprise. For example, while there are modified wolf jaws, there are no cut deer jaws, a tool that was used often for dekerneling corn (Carskadden 1977: 64). Also, while there are an abundance of hoes made from mussel shell, there are no obvious examples of hoes made from elk or deer scapula which are the most abundant bone artifact type found at Pammel Creek, an Oneota site in Wisconsin (Theler 1989: 219). There is also no evidence that musical instruments like whistles, flutes, rattles, and rasps were a part of the bone tool
assemblage, standing in stark contrast to Archaic (Lewis and Lewis 1961: 89), Woodland, and even other Fort Ancient sites (Carskadden 1977: 52; Hanson 1966: 152; Hanson 1975: 88).

Burial goods

Items placed with the dead during the Late Prehistoric period of Ohio in general and at SunWatch in particular do not show strong status distinctions in the same way as they do in many other maize-farming cultures. Objects interred with Fort Ancient people were usually tools that were more functional than ornamental. This is probably a function of the basically egalitarian social organization of these modest agricultural societies showing little social differentiation (Pollack and Henderson 2000). Figure 4 illustrates the density of bone tools within burials throughout SunWatch.

Figure 5 shows the burials which included bone tools along with the gender and proposed age of the interred individual. The most common burial object made from bone is the bone pin, present in seven of the 17 burials that have bone tools. Most of the burials (from B4/78 to B5/72 on the chart) are located within the western portion of the site in the “ceremonial” area. All but one of these burials are of males or infants and all of the males are over the age of 25 years.
Figure 4: Density map of burials which have bone tools in them. The darker the color, the more bone tools are in that particular burial.
Comparison to other Fort Ancient sites

The following graphs and tables compare the relative frequencies of different tool types and classes among selected Fort Ancient sites with relatively large assemblages. They are assumed to represent the relative similarities and differences in the composition of different assemblages of sites within the Fort Ancient time period. Figure 6 shows the major tool types by percentages for each of the sites. Information from Hardin Village
was taken from Hanson (1966) (total assemblage, n=959). Data from Blain Village was taken from Prufer and Shane (1970) (total assemblage n=257). Data from Philo II and Richards was taken from Carskadden (1977) (total assemblage for Philo II: n= 499, Richards: n=564). Data from Neale’s Landing was taken from Hemmings (1977) (total assemblage, n=116). The total number of bone tools categorized and used in this thesis is n= 2054. The comparisons in the chart were done by using percentages of the total assemblages since some of the numbers reported for the various tool categories were only in percentages of the total.

Figure 6 shows that SunWatch has comparatively more awls, pins/needles, fishhooks and projectile points than the other five sites, but has a relative deficiency of beamers, antler drifts, and bone beads. This data is problematic and comparisons should be viewed with caution due to the differences in classification schemes and the amount of subjectivity that each investigator brings to his or her typological system. Sample size and sample bias also play a major role in making these kinds of regional comparisons difficult to interpret, but until a more standardized typology is in place, these data are the only ones with which to work. With these limitations in mind, these graphs show general trends on a large scale and illustrate in which tool classes SunWatch is ample and in which classes it is scarce. The tools that are the most frequent at many of the sites, namely awls, beamers, pins, and beads, are objects that can logically be assumed to have been frequently lost, replaced and/or broken causing a high replacement and deposition rate. Conversely, more durable materials like scrapers, turtle shell bowl, knives, and punches are less frequent in the record, probably due to lower replacement rates.
Table 3 is adapted from Griffin’s (1966) Table XIV (377) where he shows tools and artifact types throughout the Fort Ancient period and at what sites they are located. While in need up an update, this information gives a general background as to the different periods of time during which each of the tools were found, creating a rough chronology of bone tool technology, not taking into account sample bias. It is obvious that most tools, except scapula knives and bone flutes were present in varying frequency.
<table>
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**Table 3**: Chart of the number of Fort Ancient sites that contain certain tool types and when they appear in the Fort Ancient culture (E=early, M=middle, L=late).
throughout the time period, but that bone awls, antler projectile points, flakers, beamers, and splinter bone awls were found at the most number of sites in Griffin’s study sample, frequencies which coincide well with the data from SunWatch.

**Explorative beamer studies**

Since the previous conclusions about social organization at SunWatch have been based on lithic and ceramic refits, I wanted to see if bone tools could be studied in the same way. Because bone is a perishable material that is more susceptible to weathering and disintegration than either stone or pottery, this is an avenue of research that is underrepresented in the literature. Due to time constraints and an otherwise lack of training, I chose one specific tool type to examine to see if refits with bone tools were feasible.

**Methodology**

I chose to look at beamers because of their clear proximal and distal ends and the fact that it is a tool that was prone to patterned breakage due to its fragile medial section. Refits, as discussed above, are important in order to indicate patterned relationships between households, activity zones, and or artifact clusters (Rigaud and Simek 1991: 201), and have been thus utilized at SunWatch (Cook 2008; Heilman 1988b; Robertson 1988).

**Results**

I was able to refit one beamer from two different pits in the northwest section of the village (Figure 7). This is an area that has already been grouped into the same household group through lithic and ceramic refits, but the fact that the beamer refit
corroborated these other lines of evidence is encouraging. This is obviously just a brief overview of the different kinds of study that this collection is amenable to based on the large sample size of individual tool types and excellent preservation. This is a necessary avenue of future research that should be performed soon.

**Figure 7:** A map of the north portion of the village showing the beamer refit

In sum, this chapter has provided basic information on the methodology and literature used to create a typological system for the SunWatch bone tools. This is important because the interpretations of the subsequent spatial distributions hinge on knowing which tools belong to which category. The following chapters will use the classification scheme to analyze the spatial distribution of the tool types across the site.
CHAPTER 4
SPATIAL AND STATISTICAL ANALYSIS

Spatial Analysis

I used ArcGIS 9.2 to perform the spatial analysis of tool distributions at SunWatch. The base map of the village was created by William Kennedy, Curator of Anthropology at Boonshoft Museum of Discovery in Dayton, Ohio. The database of tools and their locations was uploaded into the GIS map and the locations were geocoded so that each object became a point on the map. The full collection of maps for each of the separate tool classes can be seen in Appendix B, but Figure 8 shows the result of the geocoding, with points placed throughout the village denoting individual tools. The point distribution maps in the appendix are especially useful when looking at the distributions of tool types with a relatively small sample size, in order to be able to see in which parts of the village they occur and also in order to compare different tools’ distributions.

The way that the data were collected and recorded at the site only allowed a point to be placed in the middle of the pit or feature context in which the bone tool was found. Any more precise placement was made impossible by the fact that the specific x- and y-coordinates in a consistent grid system were not taken at the time of excavation. The result is that even though there is one point to an object, they are placed exactly over one another, making it difficult to assess the density concentrations. To resolve this problem, I created density maps created using the Kernel density function in order to determine concentrations of tools in the various locations for tool types that were present in large
Figure 8: Map showing results of geocoding all bone tools in ArcGIS
quantities in a single pit- a situation which the simple point distribution maps did not consider. I chose Kernel density because it created a more smoothly tapered surface between the points as opposed to the point density function which only calculated the density for a given cell, making the resulting map have more abrupt delineations between the points.

The closest analog to this method I was able to find was performed on artifacts at the Snodgrass site, a Mississippian site in Missouri (Price and Griffin 1979), where artifact classes were analyzed in the context of the spatial data from the whole site. Various types of ceramic and lithic artifacts were put onto the site map as points. They were analyzed to determine concentrations in certain segments of the village, just as with the SunWatch analysis. The conclusions ranged from identifying areas of high lithic production (Price and Griffin 1979: 72) to determining where left-handed potters were located in the village (Price and Griffin 1979: 133). The major difference between the two sites, other than temporal designation, is the fact that the tools at Snodgrass were much less ubiquitous- they were all located in houses, as opposed to SunWatch where they are located in burials, pits, and some in house floors. These differences in placement are important when making conclusions about disposal behavior patterns. There appears to be a tendency at SunWatch to dispose of tools and debris outside the house in designated pits.

Results

One of the most interesting patterns the point and density maps illustrated was that of the location of deer ulna fishhook debris (Figures B.52 and B.53 in Appendix B).
This “tool”, as already mentioned, has been described as the manufacturing byproduct in the creation of fishhooks. As such, their placement in the village is more likely to be close to the location of their initial use as opposed to other tools which may have traveled extensively both inside and outside of the village before being disposed of (Binford 1979; Schiffer 1972). It appears that there are more of these objects and in a higher concentration in the southern portion of the side than in the northern half (n=20 out of 48 total vs. n=6 out of 48 total). Taken together with the density distribution of fishhooks, which are more ubiquitous but also show a somewhat higher concentration in certain sections of the south half (n=26 out of 96 total), the resulting conclusion is that people in the south, specifically the southwest portion of the site, were probably engaging in more fishhook production than inhabitants of the north. This agrees with the moiety division of the village put forth by Cook and Sunderhaus (1999) based on the analysis of stone tool refits and ceramic refits. Moiety divisions have been seen in the ethnographic literature in groups of people at this same level of social complexity such as many Native American tribes in the Southwest and the Plains (Tooker 1971; Lowell 1996).

Another interesting pattern is that of certain ceremonial objects including tooth pendants and cut jaws (Figures B.23, B.58, B.59, B.46 in Appendix B). Only taking into consideration those objects that have been positively identified with a specific animal species, it appears that there are more objects associated with bears in the south and west portions of the village and more objects associated with wolves in the northeast section while the elk incisor effigies are limited to the northwest. These patterns, while interesting, are based on extremely small sample sizes. Because they are generally
considered to be ornamental and/or ceremonial, however, more can be said about fewer examples than in the case of objects that have a much higher frequency due to the fact that ornamental objects were probably more prized and so the location of their disposal would have possibly been more controlled than a tool like a splinter bone awl.

The mere visual inspection of the maps, while enlightening, enables only a descriptive analysis of the patterns that may or may not be apparent to every viewer. A more systematic analysis is required in order to make sure that the resulting patterns are reliable and rigorous, especially for those researchers who wish to test these conclusions on other data sets (Dacey 1973: 320). Even though the visual technique still allows for the recognition of clear patterns, quantitative techniques can recognize the finer scale patterns not immediately apparent (Riguard and Simek 1991: 217). Some of the distributions which look completely ubiquitous, like splinter bone awls and bone pins, may end up having an underlying pattern that cannot be seen with the eye. As such, multiple statistical tests were performed on a subset of the data to reach conclusions based on percentages and numerical patterning.

**Statistical Analysis**

Statistics and cluster analysis are important means by which conclusions can be reached regarding spatial distributions of artifacts. There are many statistical methods researchers have used, but it is best to recognize that the actual tests that are performed must relate to the quantity and type of data available. For example, different statistical tests should be performed on categorical data versus continuous data and those tests will produce different conclusions based on either type.
A few additional points on statistical analyses are in order. It should be noted, for example, that some archaeologists, when addressing the problem of spatial patterning, have looked at simply the presence or absence of spatial association (Dacey 1973; Hodder and Orton 1976). This approach divides the study area into cells and assigns pluses and minuses to each cell based on whether or not a particular tool type is located within it. In this way, the test is able to pick up random patterns of distributions, but it fails to relate the degree to which certain tool types are associated; it merely detects if one type is found in the presence of another or not. Additionally, since the analysis is based on data that are categorical (i.e. presence vs. absence), the results are less powerful than if they were based on continuous data. Furthermore, the associations are usually tested using a continuity correction that is impractical to use with more than four tool types, thus limiting its applicability (Hodder and Orton 1976: 202).

Another test that has been used is a permutation test for analyzing the distribution of artifacts into classes (Berry et. al. 1980, 1983). In this procedure, the average distances between artifacts are used as the primary unit of analysis and measuring clustering by averaging these distances for each tool class (Berry et. al. 1983: 548-549). This type of analysis, while incorporating high-level statistics, is only useful in situations where each tool has x- and y- coordinates in order to measure the precise distances in the way the test was intended. In a situation in which this level of provenience data has been lost, the test becomes less appropriate.

Ammerman and Feldman (1974), in studying stone tool assemblages, use correlation coefficients to interpret activity patterns and the presence of tool kits. They
produce a correlation matrix which they feel reflects the underlying structure of the activities being performed (Ammerman and Feldman 1974: 613) and then perform a factor analysis in order to isolate specific tool kits. Their model is based on estimating the frequency with which certain activities are performed during the year and the rates at which the tools are abandoned (“dropping rates”). This model assumes that this kind of information is known or can be reasonably projected, an assumption which may not be valid in cases where the set of activities which utilize one tool type over another is unknown. The article in which they present this model is highly theoretical and does not actually use a specific case study to support their hypothesis, making the whole argument based only on what one could do if this type of information was known rather than working with what information is actually feasible in the archaeological record.

Cluster analyses are very popular in interpreting spatial distributions of particular artifact classes. Rigaud and Simek (1991) use the k-means cluster approach on their Mousterian cave site in France. This technique locates clusters in space, identifies their individual members and then measures the cluster size. They then put the clusters into principal components analysis to examine the class relationships over space (Rigaud and Simek 1991: 207). Like the previous tests, this procedure works on the assumption that the data for each artifact includes specific, individual x-and y-coordinates.

A more recent study by Hally (2008) on the distribution of burial grave goods at the King site, a Mississippian village in Georgia, uses a hierarchical cluster technique to determine patterns. Specifically, he used Ward’s hierarchical agglomerative clustering procedure with a Euclidian distance measure (Hally 2008: 375). While incredibly fancy,
he readily admits that most of the information that this technique produced had been observed already through the more simple bivariate analyses that he had conducted previously and thus did not add anything significant to his conclusions. This is an illustration of the temptation archaeologists face in trying to dress up their hypotheses with superfluous statistics in the hope that it will make them appear somehow more “scientific”.

These statistical analyses, while may have been useful in some circumstances, are inappropriate for the site that this thesis will examine due to their limitations, as will be discussed later in this study. The analyses included in this thesis use tests on continuous datasets in order to discuss correlations and clusters.

At SunWatch, the divisions for the village and spatial distributions were initially done by lithic and ceramic refits, but with no supporting statistical analysis (Heilman 1988b; Robertson 1988). Cook (2008) ran correspondence analysis on a variety of artifact types based on temporal affiliation of groups of pits. For the present study, the temporal issues are laid aside for future consideration and all pits are treated as being potentially filled within the same occupation.

Due to the fact that there were large sections of the village that had been uncovered adjacent to one another, the data were amenable to analysis on a continuous scale by means of a method developed for this specific situation by Dr. Richard Meindl of Kent State University and the author. The map of the village was divided into 25 equal-sized wedges. Each wedge is roughly 9.6 degrees which is enough to encompass the entire study area of the village which is about 240 degrees (Figure 9). The number
Figure 9: Map showing the 25 subdivisions that were the basis of the statistical analysis
25 was chosen because it was small enough to pick up patterns in the data between sections, but large enough to avoid getting zeros in too many fields indicating not enough observations were made in each slice.

Only the tool classes where \( n > 25 \) were included in the analysis to prevent skewness brought about by outliers where there were not enough samples in the tool class to come up with a discernable pattern in a correlation matrix. Tools were counted in each wedge to create a continuous, one dimensional scale from 0-240 degrees to measure the concentrations of each tool class in the different wedges. This continuous scale allowed for certain questions to be answered that could not be addressed with categorical data. The linearity of the data allows the question to be asked of whether or not certain tool types go together. Most of the literature on this topic in archaeology is two dimensional and based on the discontinuous excavated portions of the site (Hodder 1977, 1976; Dacey 1973), yielding data which cannot be interpreted in this way.

The first step was to create frequency count charts to look at patterns of dispersion and clustering. Clustering can be the result of a number of factors, including the localization of activities, localization of tool discard, the periodic cleaning or reorganization of site, or natural disturbances like differential erosion and wind or water disturbance (Hodder and Orton 1976: 32; Rigaud and Simek 1991). It is difficult to distinguish between these processes with only one type of analysis. Frequency counts were used in order to be able to compare raw counts between categories without the misrepresentation that is the result of making the counts into percentages where smaller
classes end up having higher percentages. Graphs (Figures 10 to 25) illustrate the basic cluster patterns of each tool type based on their location across the village.

*Antler drifts*- there is a small spike in wedges 3 in the south and 24 in the north, but otherwise the distribution is fairly constant.

*Bone pins*- fairly ubiquitous throughout the village, with a slight increase in wedge 13, in the middle of the “ceremonial” area.

*Antler tip projectile points*- there appears to be a concentration in the western portion of the site from wedge 12 to wedge 15.

*Bone skewers*- a very high relative concentration in wedge 3 in the south, and a consistent grouping in the western portion of the village from wedge 12 to wedge 16.

*Antler torpedoes*- two spikes in wedges 8 and 14, but a consistent distribution otherwise.

*Awl tips*- isolated grouping from wedge 9 to wedge 17, encompassing all of the “ceremonial” zone.

*Beamers*- there appears to be a slight increase in concentration going from the south to the north.

*Beaver tooth chisels*- grouping in the western portion of site from wedge 12 to wedge 17 with a spike in wedge 15.

*Bone beads*- some spikes at different places in the village, but highest number appear to be located in wedges 12 and 13 in the western “ceremonial” section.

*Canine tooth pendants*- definite isolated group in the north (wedges 23 and 24), with another high concentrated grouping in the southwest (wedges 6-9).
Deer ulna fishhook- high density in the south (wedges 2-5) and another smaller cluster in the northwest (wedges 14 and 15).

Drilled deer toes- three apparent modes, one in the south (wedges 1-4), one in the west (wedges 11-15) and one in the north (wedges 21-24).

Fishhooks- higher density cluster in the south and southwest wedges from 3-9

Splinter bone awls- generally these are ubiquitous throughout the site, but there does appear to be two peaks in the south (wedge 3) and in the west (wedges 14-15).

Turkey leg awls- consistent throughout site except for certain wedges in the west and northwest (wedges 12, 15, and 18).

Groove-and-snap bases- comparatively high frequency in the south (wedges 2-5), correlating to the high concentration of the other manufacturing debris, deer ulna fishhook bases.
**Figure 10**: Concentrations of antler drifts according to wedges

**Figure 11**: Concentrations of bone pins according to wedges
**Figure 12:** Concentrations of antler tip points according to wedges

**Figure 13:** Concentrations of bone skewers according to wedges
Figure 14: Concentrations of antler torpedoes according to wedges

Figure 15: Concentrations of awl tips according to wedges
Figure 16: Concentrations of beamers according to wedges

Figure 17: Concentrations of beaver teeth according to wedges
**Figure 18:** Concentrations of bone beads according to wedges

**Figure 19:** Concentrations of canine tooth pendants according to wedges
Figure 20: Concentrations of deer ulna fishhooks according to wedges

Figure 21: Concentrations of drilled deer toes according to wedges
**Figure 22**: Concentrations of fishhooks according to wedges

**Figure 23**: Concentrations of splinter bone awls according to wedges
**Figure 24**: Concentrations of turkey leg awls according to wedges

**Figure 25**: Concentrations of groove-and-snap bases according to wedges
A correlation matrix was then produced in SPSS 15.0 using these same 16 tool classes in order to determine if there were any tools that existed primarily with other tools which could mean being a part of the same tool kit (positive correlation) or tools that were rarely found together which would imply special activity zones (negative correlation). These correlation scores range from -1 to 1, with the numbers closer to the extremes being more significant pairings. “The scores of the correlation coefficients serve as a measure of the co-variation between different tool types which is considered to reflect the underlying structure of activities performed” (Ammerman and Feldman 1974: 613). The only highly significant (p < .01) correlations were positive and were present for a large number of tool pairs (Table 4).

![Table 4: Correlation matrix with Pearson’s correlation at a p < 0.01 significance](image)

As mentioned above, the visible association of deer ulna fishhook bases with groove-and-snap bases was supported by the statistics, scoring a correlation coefficient of .642 (highly significant). Other correlations were less apparent to the eye, as shown with beaver teeth and splinter bone awls, showing the highest correlation coefficient of all,
Upon reexamination of the histograms for these tool types, it does make sense that they would be correlated because splinter bone awls are incredibly ubiquitous and both have a peak in concentrations from wedges 12-15. This association would have been very difficult and more time-consuming to demonstrate without the statistical tests. Some other correlations between tool types appear not to make any sense at all—beamers and antler points for example. What the reader must remember is that only bone tools were included, and even then, not every class was used in the statistical analysis. When taken with other artifact classes like lithics or pottery, these associations may have more meaning.

Nevertheless, there is still a lot of information in the correlation matrix that can be reduced to a more simplified, concise format. In order to perform this simplification of the results of this 16x16 chart, data reduction through a Principle Components Analysis was performed. PCA is a means by which certain components are extracted that contribute most significantly to the observed variation in the location of tools. Five principal components with scores greater than one were isolated, but it was determined that most of the variation (51.2%—Table 5) was in the first two components which are the ones that will be discussed (Table 6).
Table 5: Total variance explained in PCA analysis. The first two components explain over half of the variation in bone tool distributions across the site.

Table 6: Component matrix of the extracted components from PCA analysis showing how each tool type scored on each component.
The first component, on which tools such as splinter bone awls, deer ulna fishhook, and beaver teeth scored the highest, is interpreted as being a measure of the concentration of deposition in a given wedge. The denser the tool concentration in a wedge, the higher the component score will be for the given tool. Component 2 was much more difficult to interpret, given the fact that many of the tool classes included in the statistical analysis have unknown functions. One common trait that was observed was that sections scoring high on Component 2 were interpreted as having more tool types that were replaced more often, especially turkey leg awls and beamers, while sections scoring low on this component had lower replacement rates, specifically canine tooth pendants and antler torpedoes. Although this latter tool class’s function is unknown, it is obvious that a lot of effort was put into creating and polishing these forms.

Looking at Figure 26, where Component 1 is graphed against Component 2, it appears that section 3 has a lot of deposited tools with more tools that had a lower replacement rate, section 8 has a high deposition rate that was comprised of many tools with low replacement rates. Section 15 has a high deposition of tools that could be considered less durable because they were replaced more often which is interesting due to the fact that it is right in the middle of the “high church” area as inferred by Heilman (1988b) and it would have been expected to have more materials that were deposited less frequently.
The wedges that were ranked similarly and are thus closely clustered also give important information about distributions, showing that these areas were similar enough to each other to not stand out in the presence of any particular tool type. This is actually to be expected with a community such as SunWatch- an egalitarian group of households that all perform the same kinds of tasks with similar types of tools.

It is clear that many of these conclusions would not have been able to be reached without the use of statistics. This demonstrates the importance of why systematic statistical analyses should be included in artifact distribution studies. Through these tests,

Figure 26: Graph of deposition concentration (y-axis, Component 1) against frequency of tool replacement (x-axis, Component 2).
I was able to show clusters of artifact types throughout the village, specifically deer ulna fishhook bases and groove-and-snap bases in the south part of the village. I also showed how the correlation matrix generated by SPSS can help to confirm the degree of significance of these associated tool classes. Data reduction was an invaluable tool to distill these correlations into a workable data set that enabled me to interpret larger patterns in the data across the whole site, identifying two such components of variation in the distribution of bone tools at SunWatch.
CHAPTER 5

DISCUSSION AND CONCLUSIONS

Based on the distributions, it appears that this bone tool analysis supports, for the most part, the existing generalizations about the social organization of SunWatch. Bone ornaments are generally found in the western or “ceremonial” portion of the site, while the functional tool classes are much more ubiquitous, with a few exceptions.

Observation #1: Upon visual inspection of the GIS distribution maps, there is a concentration of both wolf jaws and canine tooth pendants in the northeast part of the village. Similarly, elk incisor effigies and elk molar pendant were all clustered in the northwest portion while bear tooth pendants were in the west and south.

Conclusion #1: There may have been a group associated with dogs or wolves in this portion of the village, especially since many of these ornamental items appear in a burial context. Elk and bear materials in the northwest and south, respectively, are consistent with the interpretation that these materials relate to kin group and/or clan affiliation in those household clusters. As an aside, the small sample size of each of these objects must be considered in drawing conclusions about ideological affiliations.

Observation #2: Groove-and-snap bases and deer ulna fishhook bases, both objects that evidence the manufacturing of specific extractive tools, are significantly correlated and are clustered in the south portion of the site. Since these are non-functional classes, it makes sense that they would be closer to their locus of original use rather than the actual fishhooks or projectile points which would have moved
significantly around the site after their production due to the fact that they were used primarily outside the village and then brought back.

**Conclusion #2:** More manufacturing of antler tools and fishhooks was taking place in the south portion of the site than in other segments of the village. This could indicate either a specified manufacturing activity zone for these tools or perhaps a small degree of part-time craft specialization by one or several proximal households. The fact that both tool types are located in other parts of the site does not necessarily mean that their concentration in the south is not significant. When looking at refuse to determine activity zones and tool kits, there is the assumption that activities will be differentially distributed at the site, but that is not to say that the activity is limited only to the one area, just that the activity is performed more often in one area than another (O’Connell et. al. 1991).

**Observation #3:** Deer ulna fishhook bases and fishhooks are both clustered with more frequency in the south half of the village. While not peaking in exactly the same wedges, both tool classes share a general trend of being focused in the south. The reason why they are not significantly correlated in the correlation matrix could be due to the fact that the arbitrarily assigned wedges were too small to detect the trend that appears to cover a wider area.

**Conclusion #3:** The households in the south and southwest could have specialized in producing and utilizing fishing equipment. Better evidence for this would be if the antler torpedoes were, indeed, used as fishing gorges as has been suggested in
the literature because the tool class also correlates significantly with fishhooks and has a cluster in the southwest.

Observation #4: High deposition concentration, as noted as a component of variability in the PCA analysis, was observed for various sections of the village, but most drastically in wedges 3, 4, 14, and 15. Lowest density was observed in wedge 19.

Conclusion #4: The degree of bone tool deposition in these instances could be explained by two theories. One is that the concentration is a reflection of a longer time depth for the pits in these wedges, or that there were just more activities that were occurring in the south and west portions of the site. Since this study did not take other temporal distinctions into consideration, it is not possible at this time to say which of these explanations is more likely. The results for wedge 19 are not surprising after looking at the small number of pits and features located in that section, indicating that this low score was more a matter of the research divisions than the result of cultural behavior.

Observation #5: Wedges that are located in the traditionally considered “ceremonial” section of the village, specifically 12 and 15, scored higher on Component 2, which was identified as more tools that are replaced more frequently. Conversely, wedges in traditional “residential” areas like 3 and 8 apparently contain more tools that are not replaced as often such as canine tooth pendants and antler torpedoes.

Conclusion #5: This pattern is difficult to interpret in light of the other evidence of social organization from SunWatch. At this time, I argue that the fact that the western segments have more tool types that are frequently replaced is more a function of
differential deposition choices by inhabitants (i.e. Green Corn Ceremonialism) than a reflection of the actual activities being performed there.

*Observation #6*: The majority of village segments were very similar in their characteristics, as seen when the two PCA components are graphed against one another. Even more than that, they cluster around the middle of both components, indicating similar deposition concentrations and a balance of tool types.

*Conclusion #6*: The fact that most of the wedges are similar is consistent with the conclusions of other researchers’ findings that Fort Ancient communities were egalitarian and did not evidence significant social differentiation or craft specialization (Pollack and Henderson 2000; Cook 2008). Further evidence for an egalitarian social structure is the largely ubiquitous distributions of many of the functional tool classes, which implies that the household level of production is predominant, a statement which supports previous conclusions in the literature on Middle Fort Ancient social organization throughout the Ohio Valley (Pollack and Henderson 1992).

*Other observations*: Spatial analysis alone was insufficient to make any general statements about men’s tool kits versus women’s tool kits. The distributions of the bone tools are much too complex and the burial goods are too sparse to be able to separate tool usage by gender.

The difficult thing to remember when performing analyses with bone tools is the fact that the only common denominator for all the tool classes is the raw material. More than other artifact classes, there is great variety in the functions and purposes of items made from bone. They relate to a great number of different behaviors within the society,
from resource extraction to decoration, to containers. In this respect, it is difficult to try and find common threads between all classes, but on the other hand, bone tool assemblages reflect more of the variety of behaviors occurring at the site than either lithics or ceramic items. The distributions and concentrations of these highly varied tool classes supports, for the most part, the idea that the people at SunWatch were engaging in household production of artifacts, but also that there is a distinct difference between the western portion in relation to the north and south and also a difference between the kinds and intensity of activities occurring in the north and in the south. Whether or not this is a reflection of temporality or activity organization will be better determined after additional analyses with a stronger focus on site formational processes are undertaken.

While I am not arguing that there is craft specialization on the same order as is seen at sites like Snodgrass or some other Mississippian towns, there does seem to be a distinct zone at SunWatch, supported by maps and statistics, where an abundance of bone tools are being produced, specifically fishhooks and antler projectile points. If other Fort Ancient sites were excavated to a comparable degree, it would be interesting to compare spatial data for these tool classes to see if there is indeed a cultural trend to focusing these activities in one area of the village, specifically the south and southwest. It does not seem too far out of the realm of possibility that there would be a subset of the population that was better at or in some way more disposed to producing certain tool types. Or perhaps the people that produced these items would gather in the southern portion of the site in order to make their tools together while discussing hunting strategies or something similar.
Subgroup specialization at SunWatch seems especially plausible when taken in conjunction with some of Cook’s (2008) interpretations of the site. He argues that there seems to be a period of occupation and/or building at the time when there was likely Middle Mississippian interaction. In this context, an increasing level of specialization, to the extent that there were designated areas, seems likely. Furthermore, the distributions of ceremonial artifacts, as discussed in previous chapters, supports the claim that there is a leadership infrastructure in place at SunWatch, although the degree to which these leaders influenced or controlled their followers remains unclear.

Future Research

This thesis is admittedly exploratory, and many aspects of the SuWatch bone tool assemblage remain for future work. For example, this thesis does not incorporate the temporal element at SunWatch, which continues to be a topic of much debate at the site. Cook’s (2008) recent book considered the temporal element when separating features and pits, and his conclusions could be broadened to include bone tools as well. It is often useful to consider the effects that the temporal element can play a role in the distribution of artifacts (Upham et.al. 1981), especially considering the prospect that there may have been either a longer habitation of the site than the radiocarbon dates indicate or perhaps that there were two distinct occupation episodes, separated by a number of years (Cook 2007). The length of habitation can influence distribution patterns and they usually become much more complex the longer the site is utilized (Gargett and Hayden 1991: 29; Keeley 1991: 258).
It should be noted that not all classes were included in the present statistical analysis. I chose to only include the 16 categories that had at least 25 tools in the class. I wanted to avoid skewed results based on too little information for each of the tool categories. This was a personal decision that may have greatly affected the results, since many of the classes that were excluded were ornamental objects supposedly tied to ideology and/or kin affiliation.

The fact that not all tool classes have a known function also makes interpretation of my component analysis difficult. Trying to figure out what component of variation is being represented without knowing what all the tools are is somewhat like putting together a puzzle in the dark. Future research with use-wear and microwear analysis will help with this problem greatly. These types of analysis will also help to reclassify some tools that may have been misclassified based on form rather than demonstrated function.

Methodologically, the proveniences that have been preserved for the bone tools in my study are limited to fairly generalized proveniences, often, for example, with unsystematic notations of level or x-and y-coordinates within a pit feature that could have been used to place an individual specimen in the larger framework of the site. As a result, the information on distributions and clustering are limited to pits or house floors as the smallest unit of analysis. Oddly, there are no recorded tools found outside of burials, pits, or houses, indicating that almost every single specimen was in a secondary context, making any conclusions concerning activity zones to be tenuous and limited to fairly generalized, household-level situations. Future research projects could not only address
this issue but look into incorporating the amateur bone tools from the excavations in the northeast segment of the village.

The purpose of the thesis was to show that studying bone tools in a spatial and statistical manner is a viable means of obtaining information about social organization and activity zones. By looking first at how the tools were defined and grouped, a deeper appreciation for their organization around the site is gained. Determining spatial patterning is not merely looking at a map, but must incorporate new techniques like GIS mapping and statistical analysis to really support claims that are made about distributions at a site. The reason why these studies are important is because they help us understand how people really lived and organized themselves in the past. I believe that the methods used in this thesis are among the more useful ways of uncovering that enigmatic past.
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Appendix A:

Photographs of SunWatch Bone Tools
Plate 1. Bear canine pendants

Plate 2. Canine tooth pendants (selection)
Plate 3. Molar pendants

Plate 4. Incisor pendants (selection)
Plate 5. Tooth pendant (selection)

Plate 6. Bone pendant
**Plate 7.** Turtle shell gorget/pendant

**Plate 8.** Example of turtle shell bowl with two drilled holes, as is seen in the proposed turtle shell “gorget”
Plate 9. Bone beads (selection)

Plate 10. Drilled deer toes (selection)
Plate 11. Bone disc

Plate 12. Antler scraper
Plate 13. Beamers (selection). The top most fragments were the only ones demonstrate a cross-feature refit.

Plate 14. Beamer/awl
Plate 15. Antler tip points (selection)

Plate 16. Fishhooks (selection), including preforms
Plate 17. Turtle shell bowls (selection)

Plate 18. Turtle shell dippers
Plate 19. Deer scapula awls (selection)

Plate 20. Deer leg bone awls
Plate 21. Deer ulna awl (selection)

Plate 22. Bone awls (selection)
Plate 23. Splinter bone awls (selection)

Plate 24. Turkey leg awl (selection)
Plate 25. Antler flakers (selection)

Plate 26. Antler punch
Plate 27. Bone punch

Plate 28. Matting needle (selection)
Plate 29. Bone needle

Plate 30. Beaver tooth chisels (selection)
Plate 31. Deer ulna fishhook base (selection)

Plate 32. Elk ulna fishhook base
Plate 33. Groove and snap base (selection)

Plate 34. Bone pins (selection)
Plate 35. Bone tools, unidentified function (selection)

Plate 36. Deer ulna tool
Plate 37. Antler tools

Plate 38. Worn antler tips (selection)
Plate 39. Antler torpedo (selection)

Plate 40. Bone skewers (selection)
Plate 41. Notched bone

Plate 42. Raccoon baculum (selection)
Plate 43. Worked rib

Plate 44. Worked bone splinters
Appendix B:

GIS Distribution and Density Maps of SunWatch Bone Tools
Figure B.25. Beaver tooth

Figure B.25. Beaver tooth Kernel density map
Figure B.34. Bone pin

Figure B.35. Bone pin Kernel density map
Figure B.38. Bone skewer

Figure B.39. Bone skewer
Kernel density map
Figure B.50. Deer ulna awl

Figure B.51. Deer ulna awl Kernel density map
Figure D.52: Deer ulna fishhook base

Figure D.53: Deer ulna fishhook base Kernel density map
Figure B.76. Splinter bone awl

Figure B.77. Splinter bone awl
Kernel density map