ONEOTA LITHICS: A USE-WEAR ANALYSIS OF THE CRESCENT BAY HUNT CLUB ASSEMBLAGE FROM THE 2004 EXCAVATIONS

by

Katherine M. Sterner

A Thesis Submitted in
Partial Fulfillment of the
Requirements for the Degree of

Master of Science
in Anthropology

at
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May 2012
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Graduate School Approval

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ABSTRACT

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by

Katherine M. Sterner

The University of Wisconsin-Milwaukee, 2012
Under the Supervision of Robert J. Jeske

The lithic assemblage from the Crescent Bay Hunt Club site (47Je904), an Oneota habitation on the shore of Lake Koshkonong in Southeastern Wisconsin provides valuable insight into 13th-14th century material culture and technology in the Great Lakes. This study examines materials from the 2004 UWM field school excavations at the site. The analysis first addresses the topics of resource procurement, tool assemblage complexity and diversity, and energetic efficiency, with information derived from a macroscopic analysis of the lithic tools and mass analysis of the debitage. A combination of low power (10-50x) and high power (200x) microscopic use-wear analyses address issues of tool form and function, including traditional categories of Madison points, humpback bifaces, and thumbnail scrapers as well as the rarely examined class of unretouched flake tools.
For Rob Miller

And for my parents, who give the best advice:

“Figure it out.”

I have done so to the best of my ability.
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CHAPTER 1: INTRODUCTION

The Wisconsin Oneota cultural tradition is a component of the larger Oneota archaeological classification whose sites are found from Canada to Missouri and Nebraska to Michigan (Brown and Sasso 2001; Griffin 1960; Hall 1962; McKern 1942; McKern 1945; Overstreet 1997). Within Wisconsin Oneota there are several discrete geographical localities that have been defined throughout the state (Overstreet 1997), as well as a wider comparative temporal framework (Hall 1962; Overstreet 1997). Oneota is often described as a pottery culture, as the ceramic styles are the chief elements used to define the boundaries of the Oneota phenomenon (Foley-Winkler 2004, 2011). However, the attention to ceramic variation has resulted in a lack of focus on the lithic economy employed at Oneota sites (Sterner 2011). This thesis is an investigation of the lithic assemblage of the Crescent Bay Hunt Club site, a 13th-14th century Oneota site along the shores of Lake Koshkonong.

The focus of this study is to describe and understand the lithic technology employed by the people who occupied the Crescent Bay site through the study of the lithic material procurement, stone tool use, and discard patterns of its inhabitants. A central aspect of this thesis is the use of microscopy to perform a functional analysis on a sample of the tool assemblage. Through a comparison of the Crescent Bay assemblage and other Wisconsin Oneota site assemblages, we can discover if the Crescent Bay site fits the Oneota lithic assemblage framework described by Hall (1962), Overstreet (1995, 1997), Boszhardt (1999), Lambert (2001), and O’Gorman (1993, 1994, 1995).
Intra-site Questions

This analysis will attempt to answer several questions about the lithic economy that was employed at the Crescent Bay Hunt Club site. Two analytic approaches, microscopic and macroscopic, were taken in order to obtain the greatest amount of information about the assemblage. Each of these avenues of study provides answers to different questions about the Crescent Bay lithics.

Macroscopic Approaches

The macroscopic analysis of the Crescent Bay lithic assemblage includes a mass analysis of the debitage from the 2004 field season and an in-depth examination of the lithic tools from the same field season. This method of study may provide answers to a variety of questions about the Crescent Bay lithics. Some basic questions regarding the nature of the raw lithic materials present at the site are addressed. What raw materials were the inhabitants of Crescent Bay utilizing to produce their stone tools? Which raw material type was the most commonly found? What is the general quality of the lithic material being used? What is the average percentage of cortex present on the lithic debitage and tools? What percentage of lithic materials was heat altered? Was bipolar production utilized at the site? What can the size grades of debitage tell us about the lithic economy at Crescent Bay?

The raw materials utilized in the production of tools at the site provide information essential to understanding the lithic economy. An examination of the raw material types represented in the Crescent Bay assemblage will make it possible to determine whether the inhabitants were using mostly local raw material sources as the
majority of Oneota and late prehistoric groups were (Hall 1962; Jeske 1992a; Lambert 2001; Overstreet 1997). The appearance of bipolar production and heat treatment also provide information about the inhabitants’ focus on the energetically efficient methods of tool production. Heat alteration is a process undertaken to make poor quality raw materials more amenable to knapping (Andrefsky 2005; Rick 1978). The general quality of raw materials found at the site should then provide a correlate for the prevalence of heat treatment.

The percentage of cortex on debitage from the assemblage supplies information about the form in which the lithic material entered the site. A high percentage of cortex would suggest that the raw material was brought to Crescent Bay in rough cobble form with little modification prior to tool production at the site. However, a low percentage of cortex would imply that cores were being flaked prior to their transport to the site. The size grades of debitage provide similar information on the stage of production taking place at Crescent Bay.

Questions about the basic components of the assemblage are also addressed. What is the most common basic tool form found at the site? How were most tools modified? Did the method of modification vary based on the tool form or raw material type? How refined was the modification on the majority of the bifaces found? All of these questions relate back to the topic of energetic efficiency and how large a role it played in the production of stone tools at Crescent Bay Hunt Club.
Microscopic Approaches

Further questions may be asked of the Crescent Bay Hunt Club assemblage by using high power microscopy to examine a sample of the tools recovered from the site. The microwear analysis of the tools included examination at 10x, 50x, and 200x magnification using two different microscopes. This approach to tool analysis provides answers to a whole host of different questions. What type of micropolish was most commonly found on tools from the assemblage? Were more tools used on hard substances or soft substances? Were transverse motions more prevalent than longitudinal motions? How directly does basic tool form correlate with use?

The examination of micropolish under 200x magnification provides a wealth of information about the dominant use of the tool. Often, polish may be identifiable as something as specific as plant polish or hide polish, telling us exactly what substance the tool was used on (Keeley 1980; Odell 2004; Vaughan 1985). In other instances, the polish may only tell us if the tool was utilized or not. Regardless, as micropolish is usually the first evidence of use that forms on tools, it is also one of the most reliable methods for determining if a tool was used and on what substance (Vaughan 1985). The determination of what the dominant motion of a tool was is arrived at through the examination of a number of different factors. The presence and direction of striations, location of rounding, and contiguity of microflaking all contribute to the assessment of what type of motion a tool was used in (Odell 1981; Vaughan 1985). This analysis allows us to distinguish the difference between transverse or longitudinal motions, greatly narrowing the field of possible tasks for which a tool may have been used.
A deeper look into the data provided by the microwear analysis examines the relationship between form and function. Are triangular bifaces only used as projectile points? Do tools placed in the morpho-functional category of scrapers actually exhibit evidence of use as scrapers? What is the predominant use of the unretouched flake tools that dominate the assemblage? These questions can more accurately answer the larger questions of site use and function. They also allow flake tools to be added to functional categories such as scraper or knife. This augmentation of the data provided by the macroscopic division of tools into morpho-functional categories may significantly alter the ratio of tool functions exhibited by the assemblage. This is particularly important when arguments like the oft-mentioned temporal and regional change in the scraper versus triangular point index are considered (Boszhardt and McCarthy 1999; Hall 1962; Lambert 2001; Overstreet 1997). The identification of the use of flake tools has the potential to require us to revise previous assumptions about dominant tool use at the Crescent Bay Hunt Club site, and by extension, Oneota sites in general.

**Expectations**

The Crescent Bay Hunt Club is securely dated to A.D. 1200-1400 (Edwards 2010; Foley-Winkler 2004; Jeske 2001) at Lake Koshkonong, in southeastern Wisconsin. Therefore, an analysis of the lithic assemblage should find that the stone tools and debitage fit a framework already established by other archaeologists for Oneota sites from the same time period and geographic region.

Previous research has indicated that local raw materials dominate Oneota assemblages (O'Gorman 1995; Overstreet and Richards 1992; Rosebrough and Broihanan
2005), a trend we would expect to see at Crescent Bay as well. In the case of southeastern Wisconsin, this also implies the predominance of poor quality materials as most chert is found in the form of glacial cobbles (Overstreet 1997). We expect a higher incidence of bipolar reduction will be evident at Crescent Bay as it is often associated with the production of flakes from small chert cobbles (Jeske 1992a; Jeske and Lurie 1993; Overstreet 1997). Tool manufacture is inferred to be of an expedient nature because informal cores and flake tools are common (O'Gorman 1995).

The formal tools that dominate Oneota assemblages are triangular bifaces and end scrapers (Lambert 2001; O'Gorman 1995; Overstreet 1997). A geographic and temporal trend has been noted among Wisconsin Oneota, suggesting that the scraper to projectile point ratio increases over time, and that it also increases geographically from eastern to western Wisconsin (Boszhardt and McCarthy 1999; Hall 1962; Lambert 2001; Overstreet 1997). The proposed explanation for this pattern is an increase in bison utilization and hide scraping activities. In this model, Crescent Bay should have significantly more projectile points than scrapers. However, the projectile point to end scraper model is based strictly on morphology, and begs the question of tool function.

Analysis of the lithic assemblage allows us to determine how well Crescent Bay fits the model of a 13th-14th century Oneota site in southeastern Wisconsin as depicted in the literature.
CHAPTER 2: ONEOTA CULTURE AND BACKGROUND

Oneota Origins

The Oneota cultural tradition is a well-known and geographically far-reaching phenomenon. Sites defined as Oneota are located from Ontario and Manitoba in the north to Missouri in the south and from as far west as Nebraska to the southwestern corner of Michigan (Hall 1962; Overstreet 1997; Rodell 1983). Oneota is classified as an Upper Mississippian culture, associating it with other peripheral groups that existed concurrently with the more elaborate Middle Mississippian complex. The name Upper Mississippian dates as far back as McKern’s (1931) proposed use of the term to refer to a particular ceramic ware typical of the Grand River culture in Wisconsin. Later, the Oneota classification was extended to cover many of the cultures McKern originally classified as Upper Mississippian. The term Upper Mississippian was then used to include a number of previously defined archaeological cultures, including the Oneota, Fort Ancient, Fisher and Langford groups, which were considered to be marginally related to the Middle Mississippian groups (Brown 1961; Hall 1962). The classification of Upper Mississippian serves the purpose of recognizing the similarities and interactions linking people during the later prehistoric time period while at the same time providing a convenient division among distinct material cultural complexes.

The term Oneota was coined by Keyes (1929) in reference to archaeological sites that were likely associated with a historic group in Iowa. Keyes declared Oneota distinct from other groups due to their shell-tempered ceramics and triangular bifaces. While the
name Oneota originated as the name for the Upper Iowa River, many of the earliest Oneota sites are found in eastern Wisconsin.

The Oneota tradition in Wisconsin spans roughly eight hundred years. Although the beginning and ending dates are still contested, they range from ca. A.D. 950 to A.D. 1720 (Overstreet 1995; Theler and Boszhardt 2006). However, it seems likely that the temporal period that includes Oneota in Wisconsin is securely datable between circa A.D. 1100-1550 (Jeske 2010; Richards and Jeske 2002). The origins and disappearance of Oneota culture are still widely debated (Gibbon 1982; Henning 1995). Arguments for the origins of Oneota and other Upper Mississippian populations in the upper Midwest typically fall into one of two categories: in situ development and migration (Emerson 1999; Gibbon 1982; Jeske 1992b; Theler and Boszhardt 2000)

Edwards (2010) and Foley Winkler (2004) both provide extensive discussion of Oneota origins in their Masters theses. Currently the data available are inadequate to provide an answer to the question of origins. Overstreet (1997) posits that perhaps the most likely scenario is a combination of the various current hypotheses.

**Identifying Oneota in the Archaeological Record**

Oneota culture is most recognizable through its ceramic style: globular vessels with a wide mouth, shoulder decorations, and typically shell temper with some grit temper used as well (Overstreet 1997). Oneota sites are also typified by chipped stone lithic assemblages composed of triangular hafted bifaces, distinctive thumbnail scrapers, and numerous flake tools. The most common ground stone implements found at Oneota sites are grooved sandstone abraders. However, due to the propensity of Late Prehistoric
groups across North America to use small expediently made chipped stone tools, the lithics alone from Oneota sites do not provide a reliable identification of sites as definitively Oneota (Gibbon 1986).

In addition to the use of shell as a tempering agent, it was also utilized in the production of pendants and numerous other tools such as fishing lures, hoes, spoons, and scrapers (Edwards 2010). Assorted copper artifacts with both utilitarian and non-utilitarian functions have also been found at Oneota sites. These artifacts as well as other archaeological signatures such as domestic architecture and subsistence strategies, as evidenced through floral and faunal remains, serve not only to define Oneota as a cultural phenomenon but also to further divide Wisconsin Oneota into geographic localities and temporal horizons.

**Wisconsin Oneota Localities**

Overstreet (1997) defines seven discreet areas, termed “Localities,” of Oneota habitation sites in Wisconsin (Figure 2.1). Another such locality is now recognized in the Waupaca River (Schneider and Miller 2012) and potentially another one in northeastern Wisconsin (Overstreet 2009). These localities are separated by significant regions without occupations, a phenomenon noted for Upper Mississippian occupation of adjacent regions (Emerson 1999; Jeske 1990, 2000b, 2003b; Richards and Jeske 2002).
Figure 2.1 Wisconsin Oneota Localities (Overstreet 1997:253 Figure 10.1)
**Wisconsin Oneota Chronology**

In order to provide a way to compare Oneota sites across the state the Wisconsin and not just within their individual locality, sites are often classified as belonging to one of four horizons. Horizons recognize the similarity of material culture across a broad landscape in a relatively short time frame. The first three horizons (Emergent Oneota, Developmental Oneota, and Classic Oneota) were defined by Hall (1962:106-109). Overstreet (1976) then added the Historic Horizon to extend Oneota occupation past A.D. 1650 (Figure 2.2). Recent research suggests that the divisions such as phases and horizons serve little analytical purpose, are often logically circular, and serve to hide inter-site and interregional variation in material culture (Hart and Brumbach 2003). Recent research at Late Woodland and Oneota sites in southern Wisconsin throw doubt on the archaeological reliability of these kinds of divisions in this region specifically (Clauter 2003; Moss 2010; Schneider 2008).

The timing and analytical utility of horizons or phases is beyond the scope of this thesis, except to note that these recent analyses demonstrate that there is a significant amount of overlap in the features that have been used to divide the four Wisconsin Oneota Horizons. At this time it is perhaps best to describe a more generic early to late set of trends, and the following description uses a more general notion of early to late temporal trends within geographic localities. The Door Peninsula, the Middle Fox River Passageway, Lake Koshkonong and the Lake Pepin Localities are all noted as containing early occupations (Overstreet 1997).
### Wisconsin Oneota Tradition—Horizons, Phases, and Sites

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<th>Developmental Horizon A.D. 1150-1350</th>
<th>Classic Horizon A.D. 1350-1650</th>
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<td>1. Crescent Bay Hunt Club</td>
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Figure 2.2 Oneota Horizons, Phases, and Localities (Overstreet 1997)
These sites are characterized by ceramics lacking shoulder decoration and handles but with some lip decoration. Ceramic types noted include variations of Mero, Grand River, Silvernale, and Carcajou. Hall (1962) and Overstreet (1997) note a dearth of end scrapers at these sites as compared to later sites (although Crescent Bay may very well diverge from this trend).

Several different house types are noted, including wigwams, rectangular, and pit houses (Overstreet 1997:260), although Crescent Bay may buck this trend with its longhouses. Although the data are often poor, subsistence during this time period is diverse, encompassing not only cultigens such as maize but wetland resources as well. Faunal remains point to the consumption of both terrestrial game and fish or other aquatic animals. The best characterization of Oneota diet at sites occupied during the 11th through 13th century is as a diverse one (Hunter 2002; Overstreet 1995, 1997).

Oneota occupations become larger and more widespread during the next several centuries. In addition to previous localities, Oneota sites are found on the La Crosse terrace. (Hall 1962; Overstreet 1997).

In addition to increased occupation, archaeologists note a trend for less common ceramic rim decoration over time (Hall 1962; Hunter 2002; Overstreet 1997). New ceramic types defined include: Grand River Trailed and Carcajou Curvilinear. While some changes in ceramics seem to occur, subsistence practices remained virtually the same as since the first Oneota occupations. Maize contributed to the Oneota diet but aquatic based hunting and gathering formed the bulk of the Oneota food source. Domestic architecture was believed, until recently, to consist solely of wigwam style houses (Overstreet 1995). However, current investigations at the Crescent Bay Hunt
Club site have uncovered what is interpreted as a longhouse that appears to date to circa A.D. 1200-1400 (Moss 2010). There is also a possibility for longhouses at the Waupaca locality around this time period, although most Oneota longhouses are noted from sites later in time (Hollinger 1995; McKusick 1971, 1973). Palisades also seem to have been more common as time went on (Overstreet 1997).

By the beginning of the 15th through 17th century, Oneota sites became even more frequent within the previously mentioned localities. Significant changes in ceramics included increased decoration, typically expressed in incised vertical and horizontal lines on the shoulder, often bordered by punctates. Strap handles became more common. Changes are also seen in the lithic assemblages, with a significant increase in the number of end scrapers. While agricultural production continued to intensify during this period, it remained only a supplementary food source for an Oneota diet which was still mostly supplied by hunting and gathering (Overstreet 1995, 1997), with an increase in bison (Gibbon 1986). However, recent research with both floral and faunal data from flotation of recovered contexts is throwing doubt on the linear nature of intensification in agricultural production (Jeske, personal communication 2012).

Post A.D. 1650 Oneota sites have been provisionally linked to the Winnebago (Ho-Chunk) tribe in eastern Wisconsin and the Ioway in western Wisconsin (Overstreet 1995). However, the actual extent of the connection is debatable. Benchley (1997) notes that except for a number of late sites found in the La Crosse Locality, there is no material from a Wisconsin Oneota site that can be reliably dated to the historic period. Not only is there a chronological gap between the historic Winnebago sites and the dates for the Historic Oneota Horizon Lake Winnebago Phase sites, but there are also stylistic gaps
between these sites as well (Richards 1993). Overstreet (1997) has put forward the Aster site as a possible Oneota-European contact site, but that designation has been contested (Mason 1981). Some scholars have argued that, with the exception of Orr Phase ceramics recovered from the Mississippi River valley, there is no clear continuity between any prehistoric Oneota ceramic styles and those found at historic sites (Benchley, et al. 1997; Edwards 2010; Green 1993; Richards 1993). A more in depth discussion of the problems linking historic groups to prehistoric ones may be found in Brown and Sasso (2001). In eastern Wisconsin, there are only five Oneota sites which have yielded European trades goods and the association of each of these artifacts with Oneota material is debated at all of them (Edwards 2010).

The Crescent Bay Hunt Club has yielded many of the trends and patterns in subsistence, ceramics, lithics, and domestic architecture that define several of the earlier defined phases and horizons, although the temporal occupation of the site seems relatively short-lived (i.e. 200 years of Overstreet’s proposed 700 year span). Recent theses and research by Edwards (2010), Foley Winkler (2004, 2011), Hunter (2002), Jeske et. al. (2001, 2003a, 2010), Moss (2010), Olsen (2003), and Rawling et. al. (1999) provide ample detailed descriptions of Oneota settlement patterns, mortuary practices, and subsistence, and the place of Crescent Bay within Oneota framework.
CHAPTER 3: THE CRESCENT BAY HUNT CLUB SITE

The Crescent Bay Hunt Club site is located on the property of the Crescent Bay Hunt Club, in Sumner Township of southwestern Jefferson County, Wisconsin (Figure 3.1). It is situated atop a ridge of limestone till-covered bedrock which runs parallel to the western shore of Lake Koshkonong. The site is one of a cluster of sites found along the shores of Lake Koshkonong and its tributaries such as Koshkonong Creek. The first possible mention of the site is an article by Stout and Skavlem (1908). However, it is unclear whether they are referring specifically to the Crescent Bay site, the Schmelining site or other neighboring Oneota cultural material (Figure 3.2). The site was first excavated by a University of Wisconsin-Madison field school under the direction of David Baerreis in 1968 (Jeske 2000a). The University of Wisconsin-Milwaukee currently holds the unpublished notes from these investigations, recorded by Guy Gibbon, a UW-Madison graduate student at the time. Further work was not undertaken at the site until 1995 when the Southeast Wisconsin Archaeological Project at the University of Wisconsin-Milwaukee conducted a survey of the Hunt Club property (Hanson 1996). Beginning in 1998, the UW-Milwaukee archaeological field school has returned bi-annually to the Crescent Bay Hunt Club site, under the direction of Robert Jeske. Excavations have lasted seven field seasons to date (Edwards 2010; Jeske 2010).

The 1968 excavations uncovered a number of ceramic sherds, representing the vessel styles known as Carcajou Curvilinear, Carcajou Plain, Grand River Trailed, and Grand River Plain (Edwards 2010; Schneider 2008). The lithic collection included two triangular points, cores, a flake graver, scrapers, grinding stones, an abrading stone, a
hoe, a paint stone, and various debitage (Gibbon 1968). Several pieces of copper were also recovered. In addition to the artifacts, several Oneota features were discovered, including 193 postholes of a wigwam style house (Gibbons 1968).

Figure 3.1 Location of the Crescent Bay Hunt Club site (47Je904) after (Edwards 2010)
Since the first University of Wisconsin-Milwaukee field school in 1998, further intensive excavations have been undertaken at the site in the form of both shovel probes and test pits (Figure 3.3). Numerous other features have been uncovered, including two additional wigwam style houses and what is currently being interpreted as at least one, and probably two, Oneota longhouses (Edwards 2010; Jeske 2010; Moss 2010). A variety of new ceramic styles have been encountered during the course of the UW-Milwaukee excavations with types from Emergent, Developmental, and Classic Horizons represented. Fisher wares from Illinois are also found at the site, suggesting a southern connection (Jeske 2001; Schneider 2008).
Figure 3.3 Locations of Positive Shovel Probes and Excavation Units (Edwards 2010)
Burials at Crescent Bay were found in a number of different contexts, including refuse pits, with all burials located within the habitation area (Foley-Winkler 2004). By the end of the 2010 field season an area of 900 m² had been excavated in a site that covers approximately 21,000 m², which means that an estimated 4.3 percent of the site has been excavated at this time (Jeske 2010).

Based on the recent excavations, the Crescent Bay Hunt Club site is interpreted as an Oneota village site that dates primarily between A.D. 1200-1400 (Edwards 2010). There are 22 radiocarbon dates from Crescent Bay, which, when calibrated, show a strong tendency to cluster around circa A.D. 1300 (Figure 3.4). The pooled mean of all dates is 736 B.P. with a fairly tight variance (Jeske 2010).

While it is probable that the site was occupied for several years, abandoned for some time, and then reoccupied, it is not clear how long the occupations lasted. Abandonment and reoccupation is evidenced in the number of postholes around the wigwams as well as the overlapping wall trenches in the longhouse. Moss (2010) states that this pattern would probably have been repeated multiple times throughout the site occupation. Rawling et. al. (1999) demonstrate that the posts that composed House 1, discovered in 1998, rotted in place rather than having been pulled or burned.

Examination of the floral and faunal material from Crescent Bay gives the appearance of continuity with the general Oneota subsistence patterns discussed in the previous chapter. Olsen’s (2003) analysis of the Crescent Bay floral remains identified 35 taxa of plants including both “indigenous seeds and exotic cultivars.” While maize at Crescent Bay had a relatively low density, “based on the 1:1 kernel to cupule ratio, maize was processed on or near the Crescent Bay site” (Olsen 2003). Of note, chenopodium
seeds indigenous to Missouri or southwestern Illinois buttresses the inference of southern connections implied by the Fisher ceramics.

Figure 3.4 Radiocarbon Dates from Crescent Bay Hunt Club. Sources of dates are indicated under the colored bars on the right. (Jeske 2010)
Hunter (2002) notes that fish composes 56% of the Crescent Bay Hunt Club’s faunal assemblage, while 18% of the faunal remains are mammal bones. Bird and reptile bones made up 14% and 12% of the assemblage respectively. Both the floral and faunal data indicate an emphasis on wetland resources and upland game such as bison or elk. These data also indicate that Crescent Bay Hunt Club was occupied from at least spring through fall with the possibility of a winter occupation as well (Edwards 2010; Hunter 2002; Olsen 2003). Winter occupation may be inferred from the recent identification of tree leaf buds from features at the site, which provide evidence for a February-March occupation (Katie Egan-Bruhy, personal communication 2012). The presence of both longhouses and wigwam style houses also supports the idea of a winter occupation. This possibility has been suggested before in relation to the Iowa Oneota (McKusick 1971, 1973). McKusick compares this pattern of seasonally occupied villages with the Iroquois, noting that:

When first described by explorers and missionaries, the Iroquois lived in longhouses the year round. The Midwestern pattern of seasonal, summer use is different. A twenty foot high longhouse would be almost impossible to heat during the winter, and the Indians shifted to small, low, more easily heated structures during the winter when the bands traditionally broke up into smaller foraging groups (1971:89).

While this explanation easily fits sites like the Grant Oneota village in Iowa where only one house form is present, it is not such an easy fit for sites such as the Crescent Bay Hunt Club, where both house forms exist. A possible explanation in this case is found in the radiocarbon dates, which encompass a 200 year range of occupation (Jeske 2010). During that time, Crescent Bay Hunt Club could have served both as a winter and summer occupation site at different times. It is possible that one generation’s summer hunting grounds could have been another’s winter foraging grounds. However,
the radiocarbon data are not refined enough at this time to determine conclusively whether both house types were utilized concurrently or sequentially (Edwards 2010; Moss 2010).
CHAPTER 4: MACROSCOPIC METHODS OF ANALYSIS

The approach taken in this thesis is what has been termed an assemblage-based approach (Jeske 1987; Winkler 2011). The assemblage approach is geared towards the elucidation of the lithic technology of a human group, including its energy and overall economic aspects. The assemblage based approach is useful in that it avoids the pitfalls of more traditional morpho-functional based typologies. It has been noted that the classification of lithic assemblages by way of a morpho-functional analysis often leads to misinterpretation and inaccurate assumptions about use (Flenniken and Raymond 1986; Jeske 1989). It is particularly important to avoid these sorts of assumptions when a microwear analysis is being conducted on the assemblage in order to determine use, independent of assumptions due to form. To this end, descriptive terms (e.g. biface, uniface, edge-only) are used in this analysis rather than terms that imply function (e.g. projectile point, scraper, knife). However, as morpho-functional terms are still pervasive in the literature, these terms are also tentatively applied to tools after all other descriptive variables had been utilized.

Macroscopic Methods of Analysis for the Lithic Assemblage

During the 2004 field season at the Crescent Bay Hunt Club site, 1,465 pieces of lithic debris over 8 mm in size were recovered. The debris was collected and the unit and level where it was found were recorded. Material from the same provenience was placed in the same bag. Features were bisected and half of the feature fill was floted. A total of 226 pieces of debris over 8mm in size were recovered through flotation while 1,239 were
recovered during excavation. This number seems lopsided due to the large amount of lithic debris found outside of features: 538 pieces. Regardless of method of recovery (excavation or flotation), lithic debris was bagged and labeled by provenience.

The 2004 Crescent Bay assemblage was analyzed using an adapted version of the Lithic Documentation and Schema (Appendices A and B) developed by Lurie and Jeske (1990). While the original scheme on which this analysis was based included both an individual and mass analysis for debitage, the scope of this study did not permit individual study for each piece of debitage. Due to the focus of this study on the functional analysis of the tools from the assemblage, only a mass analysis was conducted for the debitage from the 2004 assemblage. Suspected tools were separated from the debitage during the mass analysis and set aside for further study.

**Mass Analysis of Lithic Debitage**

Analysis of the lithic material from the 2004 excavations at Crescent Bay began with a mass analysis of all lithic debitage (Ahler 1983; Blodgett 2004; Odell 2004:130; Winkler 2004, 2011). Mass analysis is a technique which is geared to produce data by processing large amounts of debitage quickly. This is in comparison to an individual analysis which requires the consideration of more categories of information and takes considerably more time (Odell 2004:121). During the process of the mass analysis, the contents of each bag were examined and basic information about the lithic material was recorded for each bag (type: flake, flake-like, or non-flake; size grade; count and weight per size grade; presence of heat alteration; etc.) (Appendix A).
Upon removing the lithic material from its bag, the first sorting that was undertaken was the separation of all tools from the debitage. Tools were identified as any piece of lithic material that showed evidence of modification by chipping, battering, or use-wear. At this point in the analysis, tools were identified solely through macroscopic observation. Tools were then labeled with their provenience and set aside for individual analysis. The remaining contents of each bag were then divided into three categories: flake, flake-like, or non-flake. These categories are based on an adaptation of Sullivan and Rozen’s (1985) attribute key for analysis of unretouched debitage. Sullivan and Rozen divide debitage into four categories: complete flake, broken flake, flake fragment, and debris. The category of flake in the modified classificatory system simply combines these first two categories of complete flake and broken flake. To be considered a flake in the modified typology, debitage must exhibit a striking platform/bulb of percussion and clear termination. Flake-like pieces are those that have at least one of these features but not all of them. Non-flake pieces are those that have none of these features. They are often referred to as block shatter. Once the lithic material had been sorted into one of these three categories, it was then further sorted by size grade.

The debitage was placed in one of four size grades: less than 8 mm, 8 to 12.5 mm, 12.5 to 25 mm, or greater than 25 mm. The number of pieces of debitage in each of the size categories was recorded to get a count of the total amount of debitage as well as the count for each size grade. Following the record of count and size grade, the debitage was weighed by size grade on an Ohaus Scout Pro Portable Digital Balance. The weight of each size grade (within the larger categories of flake, flake-like, and non-flake) was recorded in grams.
Three additional categorical variables were recorded for each of the pieces of debitage: amount of cortex, presence of heat alteration, and evidence of bipolar reduction. All data were entered into a Microsoft Excel Database.

The information acquired from a mass analysis of a lithic assemblage may provide insight into many of the activities related to the lithic economy of the site in question. Often the amount of cortex and size grade categories provide information about the process of reduction taking place at the site (Andrefsky 2005:115-118; Odell 2004:131). Due to the reductive nature of knapping, as the process progresses, the debitage produced becomes increasingly smaller in size. Therefore, if one groups the debitage from a site by size grade, it is possible to draw conclusions about the stage of the knapping process that was taking place at the site. For instance, a high percentage of Size Grade 4 (greater than 25 mm) debitage at a site implies that the lithic assemblage was in the earlier stages of reduction. Whereas if there is a larger percentage of Size Grade 1 and 2 (less than 8 mm and 8-12.5 mm) debitage recovered the implication is for more refined reduction taking place.

Similar conclusions may be drawn from the amount of pieces of debitage still displaying cortex. In the majority of cases, most of the cortex is removed during the early stages of the reduction process. The presence of cortex on a large percentage of debitage therefore suggests that the assemblage was in the initial stages of reduction.

The variables of heat treatment and evidence of bipolar reduction provide a different set of information. Jeske (1992a) notes the increase in the economic use of poor-quality local raw materials during the late prehistoric period. Heat treatment is a process by which the lithic material is heated in order to change its structure in an effort
to make it more amenable to knapping (Rick 1978). Bipolar reduction is also a technique employed to increase the efficiency of lithic production by producing two points of impact through the use of both a hammer and anvil so as to remove more flakes at one time than is possible through free-hand reduction (Jeske and Lurie 1993). The presence of a large number of heat treated or bipolar debitage lends credence to Jeske’s (1992a) theory of increased interest in the most efficient methods of tool production.

The advantages of the use of the mass analysis approach for examining the debitage from the 2004 Crescent Bay field season are significant. This process is one that is easily replicated and allows for analysis of a large sample of debitage that would not be possible if a more detailed analysis were conducted.

**Macroscopic Analysis of Lithic Tools**

There are a number of several features that are important for the characterization of the tools of a lithic assemblage. These tools were subjected to an in depth macroscopic analysis for the purpose developing a greater understanding of the economy in place at the site. The first step of this analysis began with the separation of the tools from the debitage during the mass analysis. Following the designation of a piece as a tool, each one was assigned a tool number. A total of 244 tools and potential tools were identified. For each of these tools, 30 different variables were examined and recorded, using a modified version of Lurie and Jeske (1990) (Appendix B).

The first three variables that were recorded for each tool were: the site number, catalog number, and tool number. The site number in this case is 47Je904. The catalog
number is a code expressing the unit or feature the tool was recovered from. The tool number is an arbitrary number assigned to each tool as it was examined for this study.

The next four variables to be recorded relate to the material used in the production of the tool and include: raw material type, raw material quality, amount of cortex present, and the presence/absence of heat alteration. Raw material type was identified mainly by comparison with a reference collection at the UWM Archaeological Research Laboratory, although some comparisons with plates and descriptions in DeRegnaucourt’s (1998) *Prehistoric Chert Types of the Midwest* were made.

Raw Material Quality was also defined using comparative samples from the UWM laboratory collection. Features such as inclusions, fossils, fracture planes, and grain size were used to establish the quality of the raw material used. The Amount of Cortex is a record of the percentage of cortex or patina found on the surface of the tool. Cortex amounts were recorded as 0%, less than 50%, between 50% and 100%, and 100%. Patina which had accumulated after the manufacture of the tool, seen as patination covering flake scars, was ignored in this category.

The presence or absence of heat treatment was recorded based on the following variables: luster contrast, degree of luster, heat fracture scars, conchoidal ripples, and changes in color (Rick 1978). Increase in luster and change in color, often to a shade of pink or red, were the most common indicators of heat treatment. The UWM Archaeological Research Lab reference collection was also utilized in the identification of heat altered tools.

The next several variables are concerned with tool morphology and manufacture. Technique of manufacture places tools into one of two categories: free hand or bipolar,
depending on the most likely reduction process for that tool. Basic form allows for the
classification of tools as one of several types: edge or functional unit only, unifacial,
bifacial, multifacial, nonfacial, prismatic blade or bladelet, or unknown, based on the
location of retouch or modification on the piece. Edge modification characterizes the
location of retouch or use on a specific edge as unifacial, bifacial, both unifacial and
bifacial (for pieces with more than one edge), or not applicable (for pieces without
edges).

The category called “Method of Modification” applies to both the edges and body
of the tool and can be categorized as flaked, battered, both flaked and battered, use-wear
only, or not applicable (typically used to refer to pieces too small to identify the method
of modification). Refinement reflects the quality of workmanship of bifacial tools only
and is determined by consideration of features such as the size of flake scars along the
edges, regularity of tool outline, and thickness of the transverse cross-section. The scores
for refinement are based on comparison with a reference sample and are as follows:
crude, medium, refined, cannot determine (for incomplete pieces), and not applicable (for
non-bifacial tools).

Completeness of the functional unit is a fairly self-explanatory category with
designations as broken, whole, cannot determine (when it is difficult to tell whether a
break interrupted the functional unit or the functional unit was created after the break
occurred), and not applicable (for fragments without functional units). The variable
entitled Element present refers to the entire tool instead of the functional unit and
characterizes tools as displaying the distal end, mid-section, proximal end, indeterminate
end section, all elements, or cannot determine. Reworking or reuse refers to the situation
in which tools are resharpened if an edge becomes dull. Sometimes resharpened tools will exhibit flakes scars from the original edge and may become progressively asymmetrical as they are resharpened. Abrupt changes in tool outline or retouch on a broken edge may also be used as indicators of reworking. Retouch will be classified as either present, absent or possible in this section.

The Distal End Morphology category refers only to tools with identifiable distal ends. The distal end can be defined in two ways: for flakes the distal end is the termination end, opposite the striking platform; for non-flakes the distal end is simply the working end of the tool. Four categories may be used to describe the distal end morphology: blunt, pointed, not applicable (for pieces without distal ends), and cannot determine (for pieces where the distal end is difficult to identify). The Position of Retouch or Use category may be classified as the end, side, end and side, cannot determine, or not applicable.

The next three variables are related specifically to edge configuration and morphology. The Number of edges is a numeric variable. Edge angles is also a numerical variable measured for all edge functional units. Up to four edge functional units were recorded for each tool. Pieces that have more than four edges are noted in the comments. Measurements were taken with a goniometer and were taken 5 mm back from the edge in order to measure the production angle. Angles were placed in one of four categories: 0-40 degrees, 46-75 degrees, greater than 75 degrees or not applicable (for pieces without edges). The Edge Configuration category was used to record all edges and was described as smooth, serrated, denticulate, notched, or not applicable.
The Hafting Element variable was recorded for all whole or almost whole tools, or those broken pieces with obvious hafting elements. Hafting elements were classified as present, possible, absent, not applicable, or as having modification for hafting by thinning and/or grinding the tool base. Two variables relate to the presence and configuration of projections on lithic tools. Projections are defined by intentional retouch or wear on an unretouched area that extends out from the body of the piece. Projections are categorized as present, absent, or not applicable. The Modification of Projections variable further describes these features. Referring to them as present means that they have been formed by intentional retouch; absent indicates that they have been defined on the basis of wear; and not applicable signifies that there are no projections present.

The remaining variables are metric measurements of length, width, thickness, and weight. Any metric variable that it was possible to measure was recorded. Weight was not recorded for broken or incomplete pieces. Detailed comments about the tools were included in the next two sections. The type of tool was then identified based on common morpho-functional categories. As each tool was examined, they were also selected, or not, to be part of the sample for microwear analysis.
CHAPTER 5: DESCRIPTION OF THE LITHIC ASSEMBLAGE FROM THE CRESCENT BAY HUNT CLUB SITE

Lithic Debitage

The Crescent Bay Hunt Club site debitage assemblage from the 2004 field season is composed of 1,221 lithic pieces that collectively weigh 2,259.5 grams (Table 5.1). Of the total number of pieces, 18.8% displayed cortex and 25.4% showed evidence of heat treatment.

<table>
<thead>
<tr>
<th>Size Grade</th>
<th>n of Pieces</th>
<th>Weight (g)</th>
<th>n with Cortex</th>
<th>% with Cortex</th>
<th>% of Total</th>
<th>% Total w/ Cortex</th>
<th>n with HT</th>
<th>% with HT</th>
<th>% Total w/ HT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>12</td>
<td>0.9</td>
<td>0</td>
<td>0</td>
<td>1.0</td>
<td>0</td>
<td>7</td>
<td>58.3</td>
<td>2.3</td>
</tr>
<tr>
<td>2</td>
<td>190</td>
<td>29.4</td>
<td>19</td>
<td>10</td>
<td>15.6</td>
<td>8.3</td>
<td>50</td>
<td>26.3</td>
<td>16.1</td>
</tr>
<tr>
<td>3</td>
<td>810</td>
<td>550.4</td>
<td>142</td>
<td>17.5</td>
<td>66.3</td>
<td>62.0</td>
<td>204</td>
<td>25.2</td>
<td>65.8</td>
</tr>
<tr>
<td>4</td>
<td>209</td>
<td>1,678.8</td>
<td>68</td>
<td>32.5</td>
<td>17.1</td>
<td>29.7</td>
<td>49</td>
<td>23.4</td>
<td>15.8</td>
</tr>
<tr>
<td>Total</td>
<td>1,221</td>
<td>2,259.5</td>
<td>229</td>
<td>18.8</td>
<td>100</td>
<td>100</td>
<td>310</td>
<td>25.4</td>
<td>100</td>
</tr>
</tbody>
</table>

The pieces were divided into the following size grades:

- Size Grade 1 = < 8 mm
- Size Grade 2 = 8 mm to 12.5 mm
- Size Grade 3 = 12.5 mm to 25 mm
- Size Grade 4 = > 25 mm

The debitage was also divided into the categories of flake, flake-like, and non-flake, as noted in the previous chapter. Table 5.2 illustrates the debitage data based on these categories as opposed to size grade.

<table>
<thead>
<tr>
<th>Type</th>
<th>n of Pieces</th>
<th>Weight (g)</th>
<th>n with Cortex</th>
<th>% with Cortex</th>
<th>% of Total</th>
<th>% of Total w/ Cortex</th>
<th>n with HT</th>
<th>% with HT</th>
<th>% Total w/ HT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flake</td>
<td>476</td>
<td>465.9</td>
<td>75</td>
<td>15.8</td>
<td>39.0</td>
<td>32.8</td>
<td>127</td>
<td>26.7</td>
<td>41.0</td>
</tr>
<tr>
<td>Fl-Like</td>
<td>142</td>
<td>114.1</td>
<td>19</td>
<td>13.4</td>
<td>11.6</td>
<td>8.3</td>
<td>35</td>
<td>24.6</td>
<td>11.3</td>
</tr>
<tr>
<td>Non-Fl</td>
<td>603</td>
<td>1,679.5</td>
<td>135</td>
<td>22.4</td>
<td>49.4</td>
<td>58.9</td>
<td>148</td>
<td>24.5</td>
<td>47.7</td>
</tr>
<tr>
<td>Total</td>
<td>1,221</td>
<td>2,259.5</td>
<td>229</td>
<td>N/A</td>
<td>100</td>
<td>100</td>
<td>310</td>
<td>N/A</td>
<td>100</td>
</tr>
</tbody>
</table>
As expected, the percentage of pieces with cortex increases with size grade. Thus, as the cortex is the removed during the initial shaping, larger flakes with more cortex are created. After much of the cortex is removed, knapping becomes more refined, producing smaller flakes exhibiting less cortex. In a preliminary analysis of the lithic material recovered during the 2006 excavations, Jeske et. al. (2006:4) note an anomaly at Crescent Bay, where only 30% of screened debitage display cortex and only 10% of debitage recovered through flotation. However, the same anomaly is not exhibited by the 2004 data, as 60% of the debitage recovered from screen and flotation combined exhibit some portion of cortex. It is possible that Jeske et al.’s work suffers from sampling bias. A comprehensive examination of lithics from the 1998-2012 seasons will be necessary to produce a fuller picture.

The percentage of heat treatment hovers around 25% regardless of division by size grade or by debitage type. The only exception to this is the size grade 1 debitage, which is likely anomalous due to the small sample size (n=12). While Table 5.2 displays the percentage of cortex for each debitage type category as well, a Chi-square test shows that there is no significant relationship between the debitage type and percentage with cortex. There is also no significant relationship between debitage type and size grade. However, the number of pieces identified as bipolar does directly correlate with the increase in size grade (Table 5.3).

<table>
<thead>
<tr>
<th>Size Grade</th>
<th>n Pieces</th>
<th>n Bipolar Pieces</th>
<th>% Bipolar</th>
<th>% of Total Bipolar</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>12</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>190</td>
<td>3</td>
<td>1.6</td>
<td>2.0</td>
</tr>
<tr>
<td>3</td>
<td>810</td>
<td>101</td>
<td>12.5</td>
<td>68.2</td>
</tr>
<tr>
<td>4</td>
<td>209</td>
<td>44</td>
<td>21.1</td>
<td>29.8</td>
</tr>
<tr>
<td>Total</td>
<td>1,221</td>
<td>148</td>
<td>N/A</td>
<td>100</td>
</tr>
</tbody>
</table>

Table 5.3 Crescent Bay Hunt Club bipolar debitage by size grade
This is expected, as bipolar reduction is usually a technique utilized to quickly reduce cores into more manageable flakes which are then knapped into tools using free-hand techniques (Jeske and Lurie 1993).

**Chipped Stone Tools**

In this study tools were defined as any piece of stone that showed evidence of modification by humans through use or retouch through flaking, battering, or crushing. The lithic assemblage from the 2004 excavations at the Crescent Bay Hunt Club site includes 244 chipped stone tools, 16.7% of the entire chipped stone assemblage recovered in excavations that year. The debitage to tool ratio is 5:1, which is even smaller than the ratio of 17:1 previously reported by Jeske, et. al. in 2006. The ratio is very small when compared to contemporaneous sites in northern Illinois with ratios such as 50:1 at Robinson Reserve, 55:1 at LaSalle County Farm, and over 100:1 at the Zimmerman site (Jeske et. al. 2006:3). Classic Horizon sites in Western Wisconsin such as Tremaine, Thiel, and Pammel Creek also produce debitage to tool ratios of over 100:1. However, closer to Crescent Bay, Rosebrough and Broihahn (2005:22) give a ratio of 56:1 and Jeske et. al. (2006:3) give an even smaller ratio of 36:1 for the Carcajou Point site. Nevertheless, a ratio of 17:1 and certainly 5:1 is significantly lower than all of the comparisons previously mentioned, which could be partially explained by the sampling bias inherent in the excavation strategy at the site. Jeske et. al. (2006:2) make clear that only a small sample of the plowzone was screened. Features were bisected and one half was screened through 6 mm mesh while the other half was bagged for flotation. However, even the half that was screened likely missed a large chunk of debitage under 6
mm in size, explaining the low number of pieces in size category 1. Nonetheless, the small flake to tool ratio is a phenomenon that has been noted at Crescent Bay since 1998 (Gaff 1999; Jeske 2001, 2003a).

Raw Material

The lithic material from the Crescent Bay Hunt Club site that was recovered during the 2004 field season is composed largely of locally available cherts (Table 5.4).

<table>
<thead>
<tr>
<th>Raw Material Type</th>
<th>n</th>
<th>% of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local</td>
<td>147</td>
<td>60.2</td>
</tr>
<tr>
<td>Non-Local</td>
<td>46</td>
<td>18.9</td>
</tr>
<tr>
<td>Unknown</td>
<td>51</td>
<td>20.9</td>
</tr>
<tr>
<td>Total</td>
<td>244</td>
<td>100</td>
</tr>
</tbody>
</table>

These are mostly Galena, Oneota, and Upper Prairie du Chien cherts with a few Platteville cherts (Table 5.5), which correlates well with earlier reports (Jeske et. al. 2006:4). In that work, 80% of Crescent Bay tools were made from locally available raw materials. The only significant divergence between the two years is the relatively high percentage of Burlington and Silurian chert tools recovered in 2004.

<table>
<thead>
<tr>
<th>Raw Material Type</th>
<th>n</th>
<th>% of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Galena</td>
<td>106</td>
<td>43.4</td>
</tr>
<tr>
<td>Unknown</td>
<td>51</td>
<td>21.0</td>
</tr>
<tr>
<td>Oneota</td>
<td>29</td>
<td>11.9</td>
</tr>
<tr>
<td>Burlington</td>
<td>17</td>
<td>6.9</td>
</tr>
<tr>
<td>Silurian</td>
<td>15</td>
<td>6.1</td>
</tr>
<tr>
<td>Upper Prairie du Chien</td>
<td>9</td>
<td>3.7</td>
</tr>
<tr>
<td>Quartzite</td>
<td>6</td>
<td>2.5</td>
</tr>
<tr>
<td>Silicified Sandstone</td>
<td>6</td>
<td>2.5</td>
</tr>
<tr>
<td>Platteville</td>
<td>3</td>
<td>1.2</td>
</tr>
<tr>
<td>Exotic (Excello Shale, Harrison Co.)</td>
<td>2</td>
<td>0.8</td>
</tr>
<tr>
<td>Total</td>
<td>244</td>
<td>100</td>
</tr>
</tbody>
</table>
The largest portion of the assemblage by far is composed of Galena chert at 43.4%. Galena chert is gray to brown, mottled to lightly banded, and contains small fossils and dark worm burrows. Galena cherts outcrop in Middle Ordovician strata of the Galena formation and are most frequently encountered in southwestern Wisconsin (Rosebrough and Broihahan 2005). The Galena formation also extends into eastern Wisconsin but is typically buried by glacial drift. Rosebrough and Broihahn (2005:22) note that residents of the Lake Koshkonong area must have either found an accessible outcrop nearby or engaged in extensive trade with their neighbors to the west. Galena chert also makes up the majority of the debitage and tools at the neighboring Carcajou Point site (Rosebrough and Broihahn 2005:22).

The second most common raw material source utilized at Crescent Bay, apart from the 51 tools made from unidentifiable glacial till, was Lower Prairie du Chien. The largest outcrops are in western Wisconsin, the Oneota and Shakopee. In order to distinguish the lower Oneota Prairie du Chien from upper Shakopee Prairie du Chien, it is referred to as Oneota chert in this study. Oneota chert is oolitic while Upper Prairie du Chien or Shakopee chert is heavily mottled. Oneota chert composed 11.9% of the entire tool assemblage from the 2004 field season. Oneota chert was also one of the most common raw materials noted in the 2004 excavations at the neighboring Carcajou Point site (Rosebrough and Broihahn 2005:23).

The next most common chert type utilized at Crescent Bay is something of an anomaly. Burlington chert composed 6.9% of the tools from the 2004 field season. Burlington ranges in color from white to tan to brown and is often heat-treated, changing the color to pink, orange or red. “Some streaks and banding occur depending on what
variety of Burlington is used” (DeRegnaucourt and Georgiady 1998:172). The nearest outcrop of Burlington is located in west-central Illinois, although there are also outcrops in east-central Missouri and southeastern Iowa (DeRegnaucourt and Georgiady 1998).

With only 17 tools made of chert identified as Burlington it is difficult to judge the extent of trade with neighbors in Illinois that may have been occurring, however, like chenopodium (Olsen 2003) and fisher ceramics (Schneider 2008) the lithics support the connection to Illinois populations. A more in depth analysis of the debitage from the 2004 field season, in addition to other seasons would go a long way toward confirming the prevalence of Burlington in the Crescent Bay assemblage.

Silurian chert makes up 6.1% of the chert used to make stone tools at Crescent Bay. Silurian chert is local, found in eastern Wisconsin in outcrops of the Mayville formation (Rosebrough and Broihahn 2005:24) and is frequently found eroding from glacial till deposits and in stream beds in the region (Jeske, personal communication). Silurian is typically dull and chalky, either gray or white in color, and contains numerous fossils. Silurian chert was also pervasive at the Carcajou Point site.

Upper Prairie du Chien/Shakopee chert composed 3.7% of tools. Various quartzites, including Baraboo Quartzite, Barron County Quartzite, and Quartz account for 2.5% of the material used to make tools at Crescent Bay. An additional 2.5% were made from Hixton or unknown silicified sandstone. Only 1.2% of the Crescent Bay tools recovered in 2004 were made from Platteville chert, which outcrops in Grant County, circa 100 km from Lake Koshkonong. Platteville is also not common at Carcajou Point, nor even at Oneota sites on the La Crosse terrace which are even closer to the outcrop (O’Gorman 1993, 1995; Rodell 1989; Rosebrough and Broihahan 2005).
The remaining 0.8% of the assemblage consists of two tools, one made from Excello Shale and one made from Harrison County (aka Wyandotte) chert. Excello shale comes from the Starved Rock area in northern Illinois (Jeske 2003b) while Harrison County chert is found in the Ohio River valley of southern Indiana and western Kentucky (Munson and Munson 1972). These two were classified as exotics due to the fact that neither is found in the Wisconsin/Illinois area. While the 2004 Crescent Bay Hunt Club includes a number of different non-local materials, the preference of the residents was overwhelmingly for local materials, particularly Galena, various unidentified glacial till cherts, Oneota Prairie du Chien, and Silurian chert.

The vast majority of tools in the 2004 Crescent Bay assemblage were made from material rated as fair quality; 86% of the tools were made from fair quality materials. Good quality raw material accounts for only 2.9% of the material used to make Crescent Bay tools, while poor quality material accounts for 11.1% of the material.

As indicated by the debitage, heat alteration of lithic material also occurred at Crescent Bay. Of the tools examined for this study, 27.5% showed signs of heat treatment. Only one tool appeared to have been burned prior to deposition. The percentage of heat treatment of debitage at Crescent Bay is rather low in comparison to neighboring Carcajou Point at which 81% of Galena debitage and 63% of Prairie du Chien debitage were heat treated (Rosebrough and Broihahan 2005). However, only 22% of the tools recovered at Carcajou Point in 2004 were heat treated. The percentage of heat treated tools at Crescent Bay was significantly greater than that at the Tremaine site (10%) (O'Gorman 1995).
Approximately 72% of the tools showed no sign of cortex on the surface. However, approximately 24% of the pieces displayed cortex covering up to one half of the surface of the tool, suggesting that the early stages of reduction were taking place at the site. Only 4% of the tools had cortex that covered more than half of their surface area.

*Tool Morphology and Modification*

Chipped stone tools from the 2004 Crescent Bay assemblage fell into one of four categories of basic form: bifacial, unifacial, multifacial, or edge-only (Table 5.6).

<table>
<thead>
<tr>
<th>Basic Tool Form</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Edge-Only</td>
<td>135</td>
<td>55.3</td>
</tr>
<tr>
<td>Bifacial</td>
<td>67</td>
<td>27.5</td>
</tr>
<tr>
<td>Unifacial</td>
<td>27</td>
<td>11.1</td>
</tr>
<tr>
<td>Multifacial</td>
<td>15</td>
<td>6.1</td>
</tr>
<tr>
<td>Total</td>
<td>244</td>
<td>100</td>
</tr>
</tbody>
</table>

Over half of the tools recovered during the 2004 field season are classified as edge-only, meaning that there was no modification through retouch or crushing to the body of the piece. Bifacial (27.5%) and unifacial tools (11.1%) make up the majority of the remaining portion of the assemblage. The high prevalence of edge-only tools is not unique to Crescent Bay, as the Tremaine site also exhibits a large percentage of edge-only pieces (Figure 5.1). Bifacial tools are more common at Pammel Creek, though only by a small margin, and the OT site.

Whole or complete tools where all elements of the functional unit were present and intact made up approximately 80% of the assemblage. Fractured or broken tools
accounted for 18% and the remaining 2% of tools were those where it could not be
determined whether or not the functional unit was broken.

![Figure 5.1 Comparison of basic tool forms present at Oneota sites](image)

Just over half of the tools recovered during the 2004 field season were modified
solely by flaking (Table 5.7). However, 21.7% were modified only by use-wear. At the
Tremaine site only 6% of tools were identified as modified only by use, although
O’Gorman (1995:154) admits that this is a low number since use-wear was only
identified macroscopically. At the OT site, only 4% of tools were identified as modified
by use alone (O’Gorman 1993:82). Unfortunately, the report of the Pammel Creek site
does not specify whether flakes were retouched or modified solely by use and they are
categorized merely as “utilized flakes” (Rodell 1989:99).
Both flaking and battering were used to modify 14.3% of the tools and the remaining 7% were modified entirely by battering. While 17.2% of tools were interpreted as having been produced through bipolar reduction methods as opposed to free-hand knapping, it is difficult to determine whether bipolar techniques were used in this final stage of reduction (Jeske and Lurie 1993). Bipolar reduction is typically only used to remove flakes from a core that can later be further shaped into tools. Most of the features that would identify a piece as a bipolar flake are likely to be removed during the retouch that follows the initial removal of flakes. As a result, most of the tools that were able to be identified as bipolar were either multifacial cores (21.4%) or edge-only tools without a great deal of retouch (57.1%). On the other hand, Jeske (1992) has argued that Madison triangular points (which may or may not be bifacial) are often the result of bipolar flaking—and one can make an argument that many of the unifaces with characteristic humped backs (i.e., so-called thumbnail scrapers) probably were produced using a bipolar technique.

**Tool Identification and Description**

As noted in the previous chapter, the recording scheme utilized by this analysis makes every effort to avoid assigning functional traits to the tools under examination. However, as the use of morpho-functional categories persists in the literature, their

---

<table>
<thead>
<tr>
<th>Method of Modification</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flaked</td>
<td>139</td>
<td>57.0</td>
</tr>
<tr>
<td>Use-wear Only</td>
<td>53</td>
<td>21.7</td>
</tr>
<tr>
<td>Flaked and Battered</td>
<td>35</td>
<td>14.3</td>
</tr>
<tr>
<td>Battered</td>
<td>17</td>
<td>7.0</td>
</tr>
<tr>
<td>Total</td>
<td>244</td>
<td>100</td>
</tr>
</tbody>
</table>
limited use was required to a degree in this study. Tools were assigned to one of several formal tool categories based on morpho-functional types documented at other Oneota sites by Hall (1962), Brown (1967), O’Gorman (1995), Overstreet (1997), Lambert (2001), Rosebrough (2005), and Jeske (2006) (Table 5.8).

<table>
<thead>
<tr>
<th>Morpho-functional Category</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unidentified Tool</td>
<td>151</td>
<td>61.8</td>
</tr>
<tr>
<td>Triangular Point</td>
<td>65</td>
<td>26.6</td>
</tr>
<tr>
<td>Bipolar Core</td>
<td>9</td>
<td>3.7</td>
</tr>
<tr>
<td>Core</td>
<td>6</td>
<td>2.5</td>
</tr>
<tr>
<td>End Scraper</td>
<td>6</td>
<td>2.5</td>
</tr>
<tr>
<td>End and Side Scraper</td>
<td>5</td>
<td>2.0</td>
</tr>
<tr>
<td>Knife</td>
<td>2</td>
<td>0.8</td>
</tr>
<tr>
<td>Total</td>
<td>244</td>
<td>100</td>
</tr>
</tbody>
</table>

Three different categories of projectile points were identified during the analysis: Madison points, unclassified triangular tools, and bipolar triangular tools. Together, these three classes of triangular tools make up 26.6% of the total tool assemblage. While the term hafted biface is often preferred to projectile point, as it offers fewer implications of function, the word biface does not necessarily fit all of the tools in this category. For example, 20% of the tools identified as triangular points were either unifacial or edge-only tools, not bifacial. Jeske et. al. (2006:5) also note that “many of the triangular points [from the 2006 excavations] aren’t even true bifaces, but are retouched flakes or unifaces with bifacial edge retouch.” It seems more appropriate to refer to these tools as triangular points (or perhaps simply triangular tools—see functional analysis below) rather than bifaces or projectile points.

Triangular points account for the largest portion of the assemblage except for the unidentified tool category. Cores are the second most common artifact class in the 2004 Crescent Bay assemblage. Cores from both free-hand and bipolar knapping were
identified. Bipolar cores were slightly more common than free-hand cores, but together the two types only make up 6.1% of the total assemblage. Cores compose a slightly larger percentage (13.2%) of the assemblage at Pammel Creek (Rodell 1983). Of the cores noted at Pammel Creek, significantly more were identified as platform cores (69%) while the remaining 31% were identified as bipolar. At the OT site, only 13% of the 23 cores recovered were categorized as bipolar. While the sample size from Crescent Bay is slightly smaller than those from Pammel Creek and the OT site, if the data from other field seasons at Crescent Bay provide values similar to that of the 2004 field season, it would suggest a higher incidence of bipolar production at Crescent Bay than at these other Wisconsin Oneota sites.

Morpho-functionally defined scrapers, of both the end and side variety, compose only 4.5% of the assemblage. However, it should be kept in mind that these are only scrapers as identified by morphology. This portion of the analysis does not actually identify these tools, or those in other categories, with regard to use.

The remaining 0.8% of the 2004 Crescent Bay lithic assemblage is composed of two larger bifaces identified as possible knives. The following pages provide a more detailed accounting of the tools in each of the aforementioned categories. Each tool type is defined and the various characteristics of the tools in each class are provided.

**Triangular Points**

Madison points were the most common variety of triangular point, composing 19.7% of the total assemblage and 73.8% of all of the projectile points classified by this analysis. A total of 48 Madison points were identified. Six tools were categorized as
bipolar projectile points and another eleven were classified as projectile points of an unidentified variety (although see Jeske 1992 for an argument that most triangular points begin their use-life as bipolar flakes). The majority of the projectile points that were unclassified were categorized as such due to the fact that they were broken. The metric values for each of these projectile point classes are displayed in Table 5.9.

<table>
<thead>
<tr>
<th>Point Type</th>
<th>Measurement</th>
<th>n</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Madison Points</td>
<td>Length (mm)</td>
<td>40</td>
<td>20.3</td>
<td>4.4</td>
</tr>
<tr>
<td></td>
<td>Width (mm)</td>
<td>45</td>
<td>14.8</td>
<td>2.8</td>
</tr>
<tr>
<td></td>
<td>Thickness (mm)</td>
<td>48</td>
<td>4.1</td>
<td>1.2</td>
</tr>
<tr>
<td></td>
<td>Weight (g)</td>
<td>29</td>
<td>1.3</td>
<td>0.9</td>
</tr>
<tr>
<td>Unclassified Points</td>
<td>Length (mm)</td>
<td>8</td>
<td>26.4</td>
<td>5.6</td>
</tr>
<tr>
<td></td>
<td>Width (mm)</td>
<td>9</td>
<td>18.5</td>
<td>3.3</td>
</tr>
<tr>
<td></td>
<td>Thickness (mm)</td>
<td>11</td>
<td>5.4</td>
<td>1.8</td>
</tr>
<tr>
<td></td>
<td>Weight (g)</td>
<td>7</td>
<td>3.0</td>
<td>0.8</td>
</tr>
<tr>
<td>Bipolar Points</td>
<td>Length (mm)</td>
<td>5</td>
<td>25.4</td>
<td>6.0</td>
</tr>
<tr>
<td></td>
<td>Width (mm)</td>
<td>6</td>
<td>20.1</td>
<td>7.1</td>
</tr>
<tr>
<td></td>
<td>Thickness (mm)</td>
<td>6</td>
<td>8.2</td>
<td>3.9</td>
</tr>
<tr>
<td></td>
<td>Weight (g)</td>
<td>5</td>
<td>3.2</td>
<td>1.6</td>
</tr>
</tbody>
</table>

**Madison Points**

Justice (1987:224) and Ritchie (1961:33) typify Madison points simply as a straight sided isosceles triangular arrowheads (Figure 5.1). They usually exhibit concave or straight bases, although convex bases are seen as well. The base is always the widest part of the tool. The vagueness and inclusiveness of the definition demonstrates the near pointlessness of the category.

Madison points from Crescent Bay were, on average, were shorter and not as wide as the other two types of projectile points noted at the site. Some of the points are bifacial while others are unifacial or display retouch along the edges of the tool only. In
some cases, the base of the point shows no signs of retouch at all and is merely a feathered flake termination. Also included in the category of triangular points were two of the humpbacked bifaces mentioned by Munson and Munson (1972) and Jeske (1992a).

Figure 5.2 Triangular projectile points from Crescent Bay Hunt Club

The fact that there is as much variation in form within the Madison point category as across the three triangular point categories suggests that lumping all of these triangular tools into one category may be unjustifiable. Many projectile points are differentiated based on the style of flaking as opposed to the actual morphology of the tool (Justice 1987). It seems unconscionable to then categorize all late prehistoric triangular points,
which exhibit a variety of modification styles, as Madison, Levanna, or some variation thereof. Further discussion of the morphological differences within the triangular point category, including the humpback bifaces, is covered in Chapter 8.

Multifacial Cores

Cores in this analysis were defined as chert nodules from which several flakes had been struck on multiple faces of the piece. The 2004 Crescent Bay Hunt Club lithic assemblage yielded 15 cores. Two types of cores were noted at Crescent Bay: those utilized in bipolar production and those used in the free-hand production of flakes. Of the two types, bipolar cores were more common, composing 3.7% of the total assemblage and 60% of the total number of cores. Cores greatly varied in size both within and between the two types (Table 5.10).

<table>
<thead>
<tr>
<th>Core Type</th>
<th>Measurement</th>
<th>n</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bipolar Cores</td>
<td>Length (mm)</td>
<td>9</td>
<td>31.4</td>
<td>11.5</td>
</tr>
<tr>
<td></td>
<td>Width (mm)</td>
<td>9</td>
<td>22.9</td>
<td>12.5</td>
</tr>
<tr>
<td></td>
<td>Thickness (mm)</td>
<td>9</td>
<td>13.0</td>
<td>6.3</td>
</tr>
<tr>
<td></td>
<td>Weight (g)</td>
<td>9</td>
<td>12.4</td>
<td>16.7</td>
</tr>
<tr>
<td>Free-Hand Cores</td>
<td>Length (mm)</td>
<td>6</td>
<td>33.5</td>
<td>16.0</td>
</tr>
<tr>
<td></td>
<td>Width (mm)</td>
<td>6</td>
<td>25.5</td>
<td>11.4</td>
</tr>
<tr>
<td></td>
<td>Thickness (mm)</td>
<td>6</td>
<td>16.4</td>
<td>9.0</td>
</tr>
<tr>
<td></td>
<td>Weight (g)</td>
<td>6</td>
<td>21.8</td>
<td>29.3</td>
</tr>
</tbody>
</table>

Bipolar Cores

Nine bipolar cores were identified in the 2004 Crescent Bay lithic assemblage, five of which are pictured in Figure 5.3. Cores were classified as bipolar if striking platforms could be identified at both ends of the flake scars present on the core. Crushing was also typically present at both ends of the core due to multiple strikes with the
hammer stone and percussion against the anvil. Bipolar reduction is typically utilized when lithic materials are scarce and the conservation of resources is necessary or materials of poor quality are being knapped (Jeske 1989; Jeske and Lurie 1993).

![Figure 5.3 Bipolar cores from Crescent Bay Hunt Club](image)

**Free-Hand Cores**

Six of the cores recovered during the 2004 field season at Crescent Bay did not display evidence of bipolar reduction (Figure 5.4). On average, the free-hand cores weighed more than the bipolar cores. However, with such a small sample size and large standard deviation, this relationship is not a significant one. Both the free-hand and bipolar cores were made from local cherts such as Galena, Silurian, Oneota, or Platteville.
Scrapers

Eleven scrapers were identified in the Crescent Bay assemblage from 2004. These tools are often referred to as steep-edged unifaces (Blodgett 2004:83) in order to avoid functional connotations. Unfortunately, as 36% of the scrapers recovered from the 2004 Crescent Bay excavations are not unifacially shaped, this terminology also does not seem entirely appropriate. Thus, in this analysis, tools with unifacially shaped edges and an edge angle of 75 degrees or more were referred to as scrapers.

Two different varieties of scrapers appeared in this assemblage: end scrapers and end and side scrapers. End scrapers were slightly more common, composing 2.5% of the total assemblage and 55% of the total number of scrapers. The difference between the two types is simply a reference to the location of retouch. End scrapers display retouch...
only on one side whereas end and side scrapers are retouched on two or three sides of the tool. The metric values for both of these scraper types are presented in Table 5.11.

<table>
<thead>
<tr>
<th>Table 5.11 Means and standard deviations for scraper dimensions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scraper Type</td>
</tr>
<tr>
<td>----------------</td>
</tr>
<tr>
<td>End Scrapers</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>End and Side Scrapers</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

*End Scrapers*

Six end scrapers were included in the 2004 Crescent Bay lithic assemblage, five of which are pictured in Figure 5.5. Two were made from Oneota chert, two from Galena, and two from unknown raw materials. All of the end scrapers were retouched solely by flaking, except for one end scraper which was modified by both flaking and battering. Length and width measurements for the end scrapers tended to be very similar, giving the tools a round or square shape.

![Figure 5.5 End scrapers from Crescent Bay Hunt Club](image-url)
End and Side Scrapers

Five end and side scrapers were identified in the 2004 Crescent Bay lithics, three of which are shown in Figure 5.6. All of the end and side scrapers were made from Galena chert except for one scraper that was knapped from an unknown raw material type. End and side scrapers tended to be longer than they are wide, although the small sample size does not permit any significance to be attributed to this trend.

Figure 5.6 End and side scrapers from Crescent Bay Hunt Club

Knives

Two tools from the 2004 Crescent Bay Hunt Club assemblage were identified as knives: a tentative designation as there is absolutely no indication as to their use. They could better be termed relatively large bifaces. Both are broken and only the distal end of
each remains. They are both larger than any of the other projectile points from the assemblage (Table 5.12).

<table>
<thead>
<tr>
<th>Tool</th>
<th>Measurement</th>
<th>n</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knives</td>
<td>Length (mm)</td>
<td>1</td>
<td>45.86</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>Width (mm)</td>
<td>2</td>
<td>25.8</td>
<td>5.0</td>
</tr>
<tr>
<td></td>
<td>Thickness (mm)</td>
<td>2</td>
<td>7.8</td>
<td>1.0</td>
</tr>
<tr>
<td></td>
<td>Weight (g)</td>
<td>0</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

No weights were recorded for either tool, as the functional unit was not intact. Only one length measurement could be recorded as the other tool was too damaged to allow such a measurement.

One tool was made from Galena chert but the other was made from an unidentified high quality, glossy material that resembles Moline chert from northwestern Illinois (Figure 5.7). Without a use-wear analysis of these two tools, it is impossible to tell what they were used for. If they were used solely as spear points there would likely be little trace of it since the penetration of projectile points rarely produces traces of use (Odell 1981). Nevertheless, on the basis of morphology, their size alone necessitated their separation from the other triangular bifaces of the assemblage.
The largest portion of the 2004 Crescent Bay Hunt Club lithic assemblage was composed of tools that were designated as unidentified. A total of 151 tools, 61.8% of the total assemblage did not fit into any of the traditional morpho-functional categories. Of these 151 tools, 126 (83.4%) were edge-only tools (Figure 5.8). There were also 12 (7.9%) unidentified bifacial and 13 (8.6%) unifacial tools. From a morpho-functional perspective, 93.3% of all edge-only tools were classified as unidentified tools. Other than their type of edge modification, the tools in this category appear to have little in common (Table 5.13).
Table 5.13 Means and standard deviations for unidentified tool dimensions

<table>
<thead>
<tr>
<th>Modification Type</th>
<th>Measurement</th>
<th>n</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Edge-Only</td>
<td>Length (mm)</td>
<td>125</td>
<td>27.0</td>
<td>13.2</td>
</tr>
<tr>
<td></td>
<td>Width (mm)</td>
<td>126</td>
<td>19.9</td>
<td>6.9</td>
</tr>
<tr>
<td></td>
<td>Thickness (mm)</td>
<td>126</td>
<td>6.2</td>
<td>2.6</td>
</tr>
<tr>
<td></td>
<td>Weight (g)</td>
<td>125</td>
<td>4.2</td>
<td>7.8</td>
</tr>
<tr>
<td>Unifacial</td>
<td>Length (mm)</td>
<td>13</td>
<td>25.4</td>
<td>15.0</td>
</tr>
<tr>
<td></td>
<td>Width (mm)</td>
<td>13</td>
<td>17.1</td>
<td>9.2</td>
</tr>
<tr>
<td></td>
<td>Thickness (mm)</td>
<td>13</td>
<td>6.8</td>
<td>4.4</td>
</tr>
<tr>
<td></td>
<td>Weight (g)</td>
<td>12</td>
<td>5.6</td>
<td>12.8</td>
</tr>
<tr>
<td>Bifacial</td>
<td>Length (mm)</td>
<td>10</td>
<td>14.7</td>
<td>4.7</td>
</tr>
<tr>
<td></td>
<td>Width (mm)</td>
<td>10</td>
<td>16.5</td>
<td>6.2</td>
</tr>
<tr>
<td></td>
<td>Thickness (mm)</td>
<td>12</td>
<td>5.2</td>
<td>2.1</td>
</tr>
<tr>
<td></td>
<td>Weight (g)</td>
<td>3</td>
<td>3.7</td>
<td>2.1</td>
</tr>
</tbody>
</table>

Table 5.13 indicates that the unidentified bifacial tools are not only smaller than the edge-only and unifacial tools but they also display less variability, illustrated by the lower standard deviation values. Beyond that, there are little in the way of patterns different from other tools at the site. The raw materials used for these tools run the gamut of both local and non-local materials. 42% of the unidentified edge-only tools are modified through use-wear only, flaking accounts for 40% of the unidentified edge-only tools and the remaining 18% were modified through a combination of flaking and battering or by battering alone. As these tools do not fit into any of the traditional morpho-functional categories (closest would be “utilized flake” (O’Gorman 1995; Rodell 1989)), their function is best addressed by the use-wear analysis portion of this thesis.
Figure 5.8 Edge-only tools from Crescent Bay Hunt Club
CHAPTER 6: BACKGROUND OF USE-WEAR ANALYSIS

Even as early as the middle of the nineteenth century, there were a number of archaeologists who noted the significance of wear traces with regard to interpretation of function. Sven Nilsson, writing in the 1830s, as translated by Olausson (1980) notes that “through carefully examining how tools were worn, one can often with certainty conclude how they were used.” Many early use-wear studies relied most heavily on ethnographic analogy. However, even in the earliest functional analyses controlled experimentation was advocated as a way to produce wear patterns comparable to those found on archaeological specimens (Olausson 1980). Spurrell (1884) and Curwen (1930) provide use-wear experiments where they attempted to replicate the polish they observed on early sickle blades by sawing various objects; bone, horn, wood, straw, and plant matter, with experimental blades. Curwen (1930) included photographs of the results of his experimentation as well as notation with regard to how long he used his experimental flakes.

Western archaeologists failed to pick up on use-wear analysis until after the publication of Semenov’s (1964) monograph, a comprehensive study of a number of different use-wear patterns. In fact, Semenov’s monograph was published in Russia in 1957 but it was another seven years before it was translated into English. Olausson (1980:50) notes that:

Although Semenov’s work was more systematic and more comprehensive than any previous edge-wear research, his contribution lies more in the recognition of the many variables which may affect edge-wear and in the technical advances in observing and recording edge-wear, than in a systematic application of experimentation to provide unequivocal statements about the influence of variables on edge-wear.
Tringham’s (1974b) study was a milestone in the experimental application of use-wear analysis. This study was the first to account for factors such as post-depositional forces and number of strokes of use (Olausson 1980). It also provided photomicrographs taken both before and after use to note the effects of use on the edge of the tool, which allowed the authors to control for issues like manufacturing scars and edge morphology. Tringham (1974b) examined more features of wear than any previous study, providing a thorough background for recording use-wear.

Keeley and Newcomer’s (1977) blind tests of experimental use-wear analysis provided proof that functional information could be extrapolated from microwear analysis with the proper controls. Newcomer independently created fifteen tools of Middle or Upper Paleolithic type and then used them in ways suspected to be compatible with that time period. Of 16 trials, Keeley correctly identified the area utilized 14 times, the movement of the tool 12 times, and the material worked in 10 of the cases (Keeley and Newcomer 1977). Keeley’s results strongly support the use of experimentation as a viable method for the extrapolation of functional information from edge wear on stone tools. Keeley then applied this and several other experiments with use-wear analysis to archaeological assemblages in his 1980 book: Experimental Determination of Stone Tool Uses. Though progress has certainly been made since Keeley, he laid the groundwork for future use-wear studies and advances.

At the same time, two other comprehensive volumes on use-wear analysis were published: Odell’s (1977) doctoral dissertation and Kamminga’s (1982) functional study of Australian stone tools. However, while Odell and Kamminga employed a technique called low-power analysis, Keeley utilized a strategy termed high-power analysis. Not
only do these two methods differ in the type of equipment used but the information derived from the analysis is also different. Following the first Conference on Lithic Use-Wear in Vancouver, British Columbia hosted by Brian Hayden in 1977, the proceedings of which have since been published (Hayden 1979), a rift between practitioners of these two methods began to develop (Odell 2004). The chief concern at the time was “to prove the accuracy of the technique—to justify the expenditure of effort involved, to attract practitioners to the field, and to render the results of such studies believable to outsiders” (Odell 2004). The question arose: which of the two techniques was best qualified to derive functional information from use-wear?

**Low-Power Use-Wear Analysis**

Low-power use-wear analysis typically employs equipment referred to as a stereomicroscope, which is the type of microscope originally utilized by Semenov and was adopted by future use-wear analysts as well. There are numerous types available with a variety of features and they are most commonly employed in biological laboratories as “dissecting microscopes” (Odell 2004). In a low-power analysis, objects are typically scanned at 10-20x magnification and then assessed at 20-40x magnification (Odell and Odell-Vereecken 1980). Advocates of low-power analysis, of which Odell was one of the strongest, note several advantages of this method. One of its most appealing features is the ease and speed with which analysis is accomplished. In Odell’s (1980) blind low-power tests the average observation time was 5 minutes/tool, not including variable recording. However, in a blind high-power test, the average observation time was 1.5 hours/tool (Unrath et. al. 1986:165). The large difference in
time expended makes the low-power analysis of large assemblages feasible in a way that high-power is not (Odell and Odell-Vereecken 1980).

Low-power analysis is most often portrayed as focused solely on the variable of microchipping; an image that some of Odell’s work (1981) has done little to dispel. However, he does note “it is dangerous to interpret any pattern of wear traces solely on the basis of fracturing without confirmatory evidence from abrasive damage” (Odell 2004:144). He also brings Johan Kamminga’s (1982) work to the fore as an example of a low-power analysis which does adhere to the principle of multiple lines of evidence. Kamminga’s study includes notation of striations and two types of polish in addition to diagnostic microchipping. The location and degree of rounding and type of microflaking are the two features most often visible and utilized in low-power analyses, although striations and some types of polish may be visible as well. These variables are most accurate in predicting the dominant motion the tool was engaged in. For a more accurate interpretation of the material with which the tool made contact, even Odell admitted that high-power analysis is the best approach to take.

**High-Power Use-Wear Analysis**

The microscope used in most high-power analyses is the binocular incident-light metallurgical microscope (Keeley 1980; Odell 2004; Vaughan 1985). The optimal magnification for these microscopes to view polishes and striations is between 200-300x magnification (Keeley 1980; Vaughan 1985). As the magnification increases, the light intensity increases, meaning that the higher the magnification the better the image quality.
and clarity. This feature makes the metallurgical microscope ideal for high power analyses.

The greatest strength of metallurgical microscopes lies in their ability to interpret changes in surface topography caused by different abrasive forces (Odell 2004), which means that high-power analyses can discriminate between types of polish associated with specific worked materials. Striations and rounding are also relatively easily identifiable at high magnification. The area in which high-power analysis is lacking is the detection of patterns in microchipping. At magnifications greater than 50x, it is almost impossible to note and interpret microflaking along an edge. As the image quality of metallurgical microscopes tends to decrease with the magnification, this makes analysis at low magnification difficult.

The obvious solution to the deficiencies of both low-power and high-power methods is to include both in an analysis in order to examine the greatest amount of variables. Combining the techniques is a method that is being embraced more in recent years (Brass 1998; Clemente and Gibaja 1998) and is the strategy employed in this thesis.

**Variables Assessed Through Use-Wear Analysis**

Examining functionality through use-wear analysis requires the consideration of several factors such as the dominant motion the tool was engaged in or the material with which it made contact. In order to acquire the most accurate picture of tool function possible, it is necessary to look at a number of variables that may provide information about the function of the tool. Most use-wear analyses, high-power or low, look at some combination of the features described below.
Microchipping/Microflaking

Odell (1977; 1981; 2004; 1980) advocates the use of microflaking as the main category in a functional analysis. He notes that when the worked material is a soft substance there is a wider contact area and correspondingly, the incidence of fracturing decreases. Instead, abrasive wear in the form of edge rounding and polish develops. With harder contact materials there is a higher incidence of fracturing, particularly hinge and step fracturing (Odell 1981).

The three main types of flake terminations are hinge, step, and feathered (Andrefsky 2005). Smooth terminations that gradually shear the flake away from the objective piece are referred to as feathered. When a flake snaps or breaks during removal, a step fracture is created. Sometimes the force of impact used to remove the flake rolls away from the objective piece creating a hinge fracture. Odell (1981) notes the importance of identifying these different fracture types, as hinge and step fractures are often diagnostic of tool use on a harder substance.

Microflaking may also be used to help determine the dominant tool motion. Tools motion is typically described as falling into one of two categories: transverse or longitudinal. Transverse motions are those in which the movement of the piece is perpendicular to the working edge such as whittling, planing, chopping, and scraping. Longitudinal motion means that the movement runs parallel to the working edge of the tool. Examples of longitudinal motions are sawing, cutting, and slicing. Odell (1981; 1980) notes a tendency for transverse motions to result in more contiguous edge scarring, while longitudinal motions tend to produce less contiguous edge scarring. There is also a tendency for transverse actions to result in largely unifacial microchipping whereas
longitudinal actions produce bifacial edge scarring. However, Vaughan’s (1985) extensive experimental use-wear analysis of 249 flint tools suggests that these criteria are not as distinguishable as Odell laid out. Nevertheless, he concludes that the general tendencies ascribed to by Odell are usually accurate.

**Striations**

Vaughan (1985) introduces three classes of striations in his study: superficial, deep, and directional indicators. However, he then dismisses the categories of deep and superficial due to the fact that they seem to be caused solely by grit or microchips that may come between the tool edge and the worked material. The directional indicators are just that: indicators of the direction of the motion of tool use. Typically, tools used in a transverse action exhibit striations perpendicular to the working edge while tools used longitudinally display striations parallel to the working edge. Additionally, transverse motions usually result in the formation of striations on the surface of the edge in contact with the working material. Tools used in longitudinal motions are more likely to exhibit striations on both sides of the edge. Vaughan (1985) also notes that a high percentage of observations do not show striations at all. Consequently, one cannot depend on striations alone to determine dominant tool motion.

**Rounding**

Edge rounding provides information about both the worked substance and the motion of the tool. Substantial edge rounding is considered an indicator of use on a soft material. Hard materials typically cause greater fracturing of the edge and any rounding
that has developed vanishes due to microflaking but since softer materials do not cause as much fracturing, the edge instead becomes worn down and rounded.

Rounding can also provide information about the type of action in which the tool was engaged. Similar to patterns in microchipping, tools engaged in longitudinal motions typically exhibit rounding on both sides of the edge. Likewise, tools used in a transverse action are more likely to exhibit rounding on the side facing the worked material (Vaughan 1985).

**Micropolishes**

The mechanical and chemical processes responsible for the creation of use-wear polishes have been discussed at great length (DelBene 1979; Diamond 1979; Kamminga 1979; Unger-Hamilton 1984; Witthoft 1955, 1967). There are three accepted explanations for the formation of micropolishes at the present time. The most commonly referenced is the abrasion model (Diamond 1979; Kamminga 1979). This hypothesis suggests that “polish is produced by the gradual loss of surficial material and smoothing of those surfaces” (DelBene 1979:172). The polishing agents are the intrusive abrasive particles in the working area such as dust, sand, and microchips (Vaughan 1985).

The second hypothesis explaining polish formation is the frictional-fusion hypothesis (Witthoft 1955, 1967). This explanation proposes that the silica comprising the tool surface melts or fuses due to localized frictional heat generated in the contact area of the tool edge in use. However, as DelBene (1979:174) notes, there is some question as to whether or not the heat generated is sufficient to melt the tool. As a result, references to this hypothesis are now somewhat obscure.
The third, and most recent explanation of polish formation is termed the amorphous silica gel model (Unger-Hamilton 1984). This hypothesis proposes the development of polish through the localized dissolution of silica in the tool surface followed by the subsequent formation of a layer of amorphous silica gel on the surface of the contact area of the tool (Vaughan 1985). A number of factors influence this process and allow the silica concentration on the tool’s edge to rise above the critical level. However, at the current time, the hypotheses remain incompletely tested with regard to the nature of polish. More recent research has yet to resolve the abrasion versus deposition controversy although there is currently more support for the abrasion hypothesis (Evans and Donahue 2005). Consequently, it seems that the best definition of polish is one that does not imply any process of formation. According to Vaughan (1985:13) “polish is a surface which reflects light, whatever its origins may be.”

There are a number of stages of polish development that may be observed on tools used for varying lengths of time. Vaughan (1985:28) describes the initial result of contact with worked materials as “generic weak polish”. Generic weak polish is visibly dull and flat with a stucco-like rough surface limited linkage (Figure 6.1). It occurs with very limited contact. Vaughan (1985) documents generic weak polish after “100 strokes of cutting cattail, 50 strokes in working wood and soaked antler, and at only 10 strokes from working bone.”

The second common stage of polish development noticed on all chipped stone tools regardless of the worked material is titled “smooth-pitted” polish (Vaughan 1985). It is referred to as such due to the micropits and depressions in the surfaces of the linkage between smooth polish components (Figure 6.2). Vaughan (1985:29) notes that the
smooth-pitted stage did not last very long as polish then quickly progressed to the third and final stage. He also noticed that invariably, sawing on materials such as bone, antler, wood, and reeds did not produce any polish that progressed past the smooth-pitted stage. Polish resulting from sawing any of these materials is virtually indistinguishable.

In the third stage of polish, further linkage of polish components is established and diagnostic surface features form on the areas of greatest contact along the working edge. It is this stage which allows for the identification of worked material. In this study, five types of distinct, fully developed polish were identified: bone, reed, wood, plant, and hide polish. Descriptions of each of those types follow Keeley (1980); Keeley and Newcomer (1977); and Vaughan (1985).

Figure 6.1 Generic weak polish (200x magnification)
Detailed descriptions of bone, wood, plant, and hide polish, with the addition of reed, antler, meat and several other types of polish may be found in Vaughan’s (1985) volume and Keeley’s (1962) work. The descriptions in this thesis are merely working definitions of the major characteristics diagnostic of the four main types of polish derived from worked materials encountered in this study.

Bone polish may appear differently depending on the type of motion the tool was engaged in. As noted before, smooth pitted polish typically develops on tools used to saw bone, antler, wood, and reeds. However, transverse motions typically produce a very bright flat polish bevel with frequent comet-tails in the polish surface. Only one case of bone polish from a transverse motion was identified in this study.

Wood polish from sawing actions also appears a smooth pitted polish. Transverse motions generate very bright, smooth polish domes in a variety of stages of linkage (Figure 6.3). There are typically somewhat linear depressions between domes that may
indicate direction. Wood polish is more widespread, extending a greater distance away from the working edge than either bone or antler polish but is still less pervasive than plant polish.

Plant polish is bright to extremely bright with a pockmarked aspect until it reaches the level of full linkage (Figure 6.4). It is very widespread and covers a large portion of the surface of the tool. There are often striations and comet-shaped pits located within the polish surface. The most advanced stage of plant polish is known as sickle gloss.

Dry hide polish is typified by a dull, highly pitted surface (Figure 6.5). It exhibits widespread coverage over the utilized edge and extensive rounding along the working edge and surface ridges. Numerous striations may be produced when grit is introduced to the process of hide preparation.

Figure 6.3 Wood polish (200x magnification)
Figure 6.4 Plant polish (200x magnification)

Figure 6.5 Dry hide polish (200x magnification)
In addition to polish derived from intentional use of a tool on a worked material, polish may also develop through various manufacturing and depositional processes. Vaughan (1985:39-44) notes several different types of polish that may be produced through processes not specific to the function of the tool, including finger prehension and hafting, hammerstone and bone/antler polish from knapping and retouch, and micropolishes from contact with soil and grit. Within the category of soil and grit micropolish Vaughan (1985:42) defines two distinct types of grit polish: smooth grit and rough grit.

Smooth grit polish is typically found on the elevated portions of the tool including edges and ridges on the surface of the object. It is usually recognizable by its very bright polish spots on raised domes elevated above the relatively smooth surface. Areas of smooth grit polish are only loosely linked or altogether separate from one another.

At its most basic stage of development, rough grit polish is seen as generic weak polish. However, more extensive soil contact produces a dull polish with a rough and pitted surface. Some grooves or troughs may be observed and microcraters are indicative of grit contact. There is also a certain degree of edge and ridge rounding present.

There is a significant risk of misidentifying soil sheen or grit polish as a type of use-wear polish due to the similarity of some features (Keeley 1980). It is important to note the subtle differences in polish features, particularly when differentiating between smooth grit and wood polish, as misidentification may significantly skew the conclusions of the study.
CHAPTER 7: MICROSCOPIC METHODS OF ANALYSIS

Prior to the microwear analysis of the Crescent Bay Hunt Club assemblage, a series of blind tests were conducted to ascertain the author’s ability to identify the dominant action performed and material worked using lithic tools. Odell (2004), Keeley (1980), and Vaughan (1985) note the importance of blind experimental tests as a way to verify the accuracy of the analysis of stone tool function. Accordingly, after the macroscopic analysis of the tools from Crescent Bay was completed, blind use-wear tests were conducted preceding the microscopic analysis of the assemblage.

Blind Test Protocols

Nine flakes of Galena chert from Grant County, Wisconsin were made for the use-wear tests in this study. Galena chert was chosen because it represented the largest percentage of the Crescent Bay Hunt Club assemblage as noted during the macroscopic analysis. Flakes were removed with a hammerstone by utilizing a free hand flaking technique. Nine flakes suitable to be used as tools were selected for the experiment once the flakes were removed.

Flakes were numbered 1-9 with a Sharpie marker and masking tape was placed over the number so the author could not identify the tool number during use. The flakes were relatively homogenous in morphological appearance so as not to be easily remembered. Five flakes were on wood and four on meat. Of the five flakes used on wood, two were used in transverse motions and three in longitudinal motions. Mr. Robert Miller recorded which flake was used for each task.
Prior to use, the edges of the flakes were examined at 10x magnification using the AO Series Forty stereomicroscope. Additionally, flakes were examined at 50x and 200x magnification using the Olympus BH-2 upright microscope with reflected light fluorescence attachment. The light source for the attachment of this microscope is a 50 watt, 12 volt halogen light powered by a transformer with 0-12 variable voltage. Voltage was always set at 12 for the blind tests and the following microwear analysis of the archaeological assemblage.

Edges of the flakes were photographed at 50x magnification using a Nikon Coolpix 4300 camera in conjunction with a camera attachment for the trinocular tube of the Olympus BH-2 microscope. A record was kept of the photographs for each flake.

Five flakes were used on a branch from a freshly hewn maple sapling. Two of the flakes were used to scrape bark from the branch while the remaining three were used to saw the branch into segments. Each of these flakes was used continuously for ten minutes with an average of 100 strokes per minute. Four flakes were used to cut raw chicken breast meat. As meat polish often takes longer to develop than polish from hard materials such as wood (Vaughan 1985), these flakes were used for fifteen minutes with an average of 100 strokes per minute.

After the flakes had been utilized, the tape covering their numbers was removed and the wood-used and meat-used flakes, kept separate until now, were combined. The flakes were then washed in warm, soapy water using an Ultrasonik 28X ultrasonic cleaner for twenty minutes. The flakes were then laid on a paper towel to dry prior to microscopic observation.
Each flake was then examined in turn using the Olympus BH-2 microscope at 50x and 200x magnification and the AO Series Forty microscope at 10x magnification. For each tool, a recording sheet was filled out (Appendix C). The following fields were recorded: site number, tool number, tool raw material, edge number, striation direction, microflake shape, microflake termination, location/presence of edge rounding, and presence and type of polish. A series of drawings of the working edge were recorded. The dorsal side was drawn at 10x magnification, the ventral side at 50x, and the distal end, with the tool oriented vertically, at 10x. The dorsal and ventral sides were both examined for traces of polish at 200x magnification.

Using the traits diagnostic of use on hard or soft substances (Odell 1981; Vaughan 1985) that were articulated in the previous chapter, each flake was marked as having been used on meat or wood. The flakes determined as used on wood were designated as used in a transverse motion or in a longitudinal motion. Following the analysis of all nine flakes, Miller revealed the key where the number of each tool was recorded, along with the motion it was used in and the surface it was used on. All nine flakes were identified correctly with regard to use in blind tests. The successful identification of the test artifact functions provides support for the inference that the analysis of the prehistoric material from Crescent Bay is generally accurate.
Procedures for the Microwear Analysis of the Crescent Bay Hunt Club Assemblage

Procedures followed for the analysis of the Crescent Bay lithic tool assemblage were similar to those used in the blind tests. During the macroscopic analysis of the 244 tools from the 2004 field season at Crescent Bay, 100 tools were designated as candidates for use-wear analysis.

One of the main goals of the use-wear analysis of the Crescent Bay Hunt Club assemblage was to ascertain the function of the edge-only tools that composed 55% of the 2004 assemblage. While three of these edge-only tools were morpho-functionally identified as scrapers and another six as projectile points, the remaining 126 edge-only pieces were classified as unidentified tools. Accordingly, 81% of the tools selected for the use-wear analysis were edge-only tools. Edge-only tools were chosen for the analysis if they exhibited macroscopic traces of use that could only be confirmed through microwear. Triangular bifaces, steep-edged unifaces, and multifacial cores were selected if they exhibited all of the morphological characteristics that typify their morpho-functional category. Tools were washed in warm soapy water using the ultrasonic cleaner immediately prior to examination, waiting only until they could dry before studying them under the microscope.

Tools were first examined at 10x magnification using the AO Series Forty stereomicroscope. This microscope has no adjustable stage and required that tools be manipulated by hand under the lens. Specimens were solidly positioned through the use of a greaseless plastolene, which made it feasible to orient the tool so that the edge being examined was as flat as possible, regardless of the shape of the piece. The dorsal side of the tool was examined at 10x magnification and drawn on the recording form. Features
such as microflaking and rounding were noted. The ventral side of the tool was then examined at 50x magnification using the Olympus BH-2 upright microscope, which has an adjustable stage. The tool was placed on a glass slide on the stage and affixed using the plastolene with the edge under examination facing away from the observer. The specimen was then brought into focus and another diagram was drawn on the recording sheet, this time of the ventral side at 50x magnification. The same types of features (e.g., rounding, microchipping, and other edge damage) were noted. Then, with the same area of focus, the magnification was increased to 200x.

Up until now, the issue of using neither a stereomicroscope nor a metallurgical microscope for high-power microscopy has not been addressed. As Odell (2004) notes, the incident lighting metallurgical microscope has been most often used for high-power analyses due to its ability to focus better at higher magnification. However, Odell (1986, 2004) also states that there are several drawbacks to using this type of microscope; most notably its inability to view specimens stereoscopically. This problem was remedied in this study by using the AO Series Forty stereomicroscope to view specimens at lower magnifications. While neither the incident lighting microscopes nor the BH-2 upright microscope can view specimens stereoscopically, they do allow for binocular vision. Odell (2004:151) admits that the lack of stereoscopic capabilities is not problematic if one restricts observations to surface abrasive phenomena.

The use of an incident lighting metallurgical microscope was not necessary as the reflected light fluorescence attachment provides the same mode of illumination as the metallurgical microscope. Incident light metallurgical microscopes shine light down through the objectives onto the surface of the specimen and then reflect it back through
the lenses. This is the same process exhibited by the reflected light fluorescence illuminator that was attached to the Olympus BH-2 stereomicroscope (Figure 7.1).

![Figure 7.1 Principle of reflected light fluorescence illuminator (Olympus Optical Co, Ltd)](image)

The use of the Olympus BH-2 as opposed to a metallurgical microscope allows for the same advantages as provided by incident lighting, without some of the other disadvantages articulated by Odell (2004:151), such as small stages and short working distances. While some metallurgical microscope models might exhibit such drawbacks, no such problems were encountered while using the Olympus BH-2.

Observation at 200x magnification, in this study, was designed to examine and identify polish, striations, and edge rounding. Most rounding was established at 50x magnification (Appendix D, Plates 4-7), and though only the ventral side was drawn at 50x, both sides were examined. Microchipping was evaluated at lower magnifications using the more appropriate AO Series Forty stereomicroscope.
No drawings were made at 200x magnification due to the fact that at such high magnification, it is often difficult to keep the entire viewable area of the specimen in focus. Often viewing requires constant movement using the x- and y-axis low drive knobs on the stage and refocusing using the fine focus knobs on the stand. While no drawings were made, photographs were taken of specimens exemplifying different types of polish and striations (Appendix D). Micropolishes were identified using the features described by Vaughan (1985) and noted in the previous chapter of this thesis. After both the dorsal and ventral sides of the tool were examined at 200x magnification, the piece was replaced on the AO Series Forty stereomicroscope to examine the distal end at 10x magnification. The tool was oriented vertically, with the working edge facing the objective of the microscope and affixed using plastolene. The distal end was drawn and microflaking and rounding were noted on the drawing.

Following this examination, the notes and diagrams were reviewed. Information regarding type and extent of polish, form and placement of microchipping, amount and location of edge rounding, and the orientation of striations was taken into consideration. These variables were used to determine the type of motion the tool was predominantly used in and the hardness of the substance on which it was used. In some cases only one of these questions could be answered reliably. In all cases it was at least possible to determine whether or not the tool had been used.

After the microwear analysis of all 100 specimens had been completed, a reliability test was performed. Twenty of the specimens were reexamined without reference to notes from the previous analysis. While drawings were not made, the same features (striation direction, microflake shape and termination, presence and location of
edge rounding, and type of polish) were recorded and the tools were identified with regard to dominant motion and hardness of worked substance. In the reexamination of the tools, only five discrepancies in attributes appeared, three in microflake shape and two in differentiation of wood polish and smooth grit polish. Only one divergence in worked material type was recorded and there was no change in the number of tools identified as utilized versus non-utilized between the initial and secondary examination. On the basis of the sub-sample reexamination, it can be inferred that the observations in this study are generally precise and reproducible. Combined with the experimental results for accuracy, it is fair to say that inferences made from the microwear study are likely to be both accurate and precise.

**Characterizing the Microwear of the Crescent Bay Hunt Club Assemblage**

Of the 100 potential tools examined in the use-wear analysis of the Crescent Bay Hunt Club assemblage, 78 were determined to have been utilized. Of the tools that were utilized, 79% were identified with regard to the hardness of the material they were used on and the specific substance on which they were used was determined for 64%. The dominant motion in which the tools were used was ascertained for 90% of the utilized tools. Only 10% of the utilized tools remained entirely unknown with regard to tool motion and 20% were indeterminate with regard to contact material. Only seven (9%) of the utilized tools were indeterminate with regard to both tool motion and contact material. These seven tools had clearly been used, but conflicting signatures in polish, microchipping, and rounding made an accurate interpretation impossible.
Dominant Motion

Of the utilized tools, 31% were used in longitudinal motions, 59% were used in transverse motions, and 10% were unidentifiable with regard to dominant motion (Table 7.1).

<table>
<thead>
<tr>
<th>Dominant Motion</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Longitudinal</td>
<td>24</td>
<td>31</td>
</tr>
<tr>
<td>Transverse</td>
<td>46</td>
<td>59</td>
</tr>
<tr>
<td>Unknown</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>Total</td>
<td>78</td>
<td>100</td>
</tr>
</tbody>
</table>

Dominant tool motion was ascertained through the consideration of several factors, the foremost of which was the placement of rounding. Longitudinal motions more often produce equal rounding on both sides of the working edge while transverse motions produce more rounding on the side in contact with the worked material (Vaughan 1985). When present, striations are diagnostic of tool motion: perpendicular striations indicate a transverse movement while parallel striations imply a longitudinal motion. However, striations were only observed on 9% of utilized tools. Therefore, it was necessary to use other features, in addition to striations, to determine tool motion. Microchipping was also used to determine tool motion. Odell (1981) notes that longitudinal motions more often produce bifacial edge scarring and transverse motions more often produce contiguous, as opposed to intermittent edge scarring.

General Contact Material Type

The contact materials for this study were divided into four categories of hardness based on Odell and Odell-Vereecken (1980). Each category comprises a number of materials of similar hardness. The four classes are: hard, medium-hard, medium-soft, and
soft. Hard substances are usually bone or antler, although some dry woods may also fall into this category. The materials classified as medium-hard are usually hard woods such as oak, soaked antler, or fresh bone. Medium-soft materials are either soft woods or reeds. Substances categorized as soft are meat, hides, and green plant stems. Vaughan also found these categories useful in his 1985 study and they are widely accepted (Kamminga 1982; Odell 1996; Olausson 1980; Tringham, et al. 1974a).

The largest percentage (58%) of the utilized tools in the Crescent Bay assemblage was used on soft materials. Only 4% were used on medium-soft and 9% on medium-hard materials. Another 9% were used on hard substances. The remaining 20% were unidentifiable with regard to contact material hardness (Table 7.2).

<table>
<thead>
<tr>
<th>Worked Material Hardness</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hard</td>
<td>7</td>
<td>9</td>
</tr>
<tr>
<td>Medium-Hard</td>
<td>7</td>
<td>9</td>
</tr>
<tr>
<td>Medium-Soft</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Soft</td>
<td>45</td>
<td>58</td>
</tr>
<tr>
<td>Unknown</td>
<td>16</td>
<td>20</td>
</tr>
<tr>
<td>Total</td>
<td>78</td>
<td>100</td>
</tr>
</tbody>
</table>

Contact material hardness was determined using multiple characteristics. The most diagnostic feature of material hardness was micropolish. If a specific type of well-developed micropolish could be identified, such as wood, hide, or plant polish then this was typically the most reliable method of determining contact material hardness. However, in cases where micropolish was not well-developed enough to provide a resolution, other features were used. As noted by Odell (1981), use on hard substances is usually typified by a greater amount of hinge and step fractures along the edge of the tool. Softer substances also produce a greater amount of edge rounding than do harder substances. Degree of rounding and the type of flake terminations observed on the
working edge were used to supplement information from micropolish when determining the contact substance hardness.

Specific Contact Material Type

Odell (2004:151) and Keeley (1980:2) note that the greatest advantage of a high-power analysis is that it allows for the determination of the exact worked material. The main traces of wear that allow for this exact determination are micropolishes. Both in the literature and in the experimental project, it is evident that over time, polish becomes more developed and distinct with variations in brightness, pitting, and coverage depending on the worked material. This distinctive variation in polish attributes allows for the identification of the exact material with which the tool came in contact.

The largest percentage of the assemblage, 47%, displayed hide polish (Appendix D, Plates 13-16), 8% exhibited plant polish (Plates 11-12) and a further 6% showed signs of wood polish (Plates 8-9). There was only one case of bone polish and one case of reed polish (1% each). The remaining 37% of utilized tools were not identifiable with regard to specific worked material. A total of 19% displayed smooth pitted polish (Plate 10), which is an earlier stage of polish, not necessarily diagnostic of a specific worked material. The earliest stage of polish development, which develops on tools even before smooth pitted polish is generic weak polish. Generic weak polish made up 17% of the utilized tools. The remaining 1% was a single case of smooth grit polish (Table 7.3).
Table 7.3 Micropolishes on Utilized Tools

<table>
<thead>
<tr>
<th>Micropolish Type</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hide</td>
<td>37</td>
<td>47.4</td>
</tr>
<tr>
<td>Plant</td>
<td>6</td>
<td>7.7</td>
</tr>
<tr>
<td>Wood</td>
<td>5</td>
<td>6.4</td>
</tr>
<tr>
<td>Bone</td>
<td>1</td>
<td>1.3</td>
</tr>
<tr>
<td>Reed</td>
<td>1</td>
<td>1.3</td>
</tr>
<tr>
<td>Generic Weak</td>
<td>13</td>
<td>16.7</td>
</tr>
<tr>
<td>Smooth Pitted</td>
<td>14</td>
<td>17.9</td>
</tr>
<tr>
<td>Smooth Grit</td>
<td>1</td>
<td>1.3</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>78</td>
<td>100</td>
</tr>
</tbody>
</table>

Of the 22 specimens which were determined to have not been utilized, 45% exhibited smooth grit polish, 27% showed signs of generic weak polish, and 14% displayed rough grit polish. There was one isolated case of smooth pitted polish (5%). The remaining 2 pieces (9%) did not show any signs of polish. Vaughan (1985) notes that in some cases, grit polish, which develops post deposition, may obscure actual polish from worked materials. It was therefore important to examine other diagnostic features such as rounding and microchipping in those cases to determine whether or not the tool had been utilized. Generic weak polish can develop from nonuse factors such as finger prehension in addition to development due to use. The presence of micropolish is not always an indicator that a tool was utilized. Other variables must be assessed to correlate with the data derived from micropolishes.

**Implications from Microwear Analysis**

When the variables recorded during the microwear analysis of the Crescent Bay Hunt Club assemblage are compared not only with each other but with some of the features recorded by the macroscopic analysis, some interesting patterns arise.
Particularly noteworthy are those factors that highlight the importance of a use-wear analysis in order to correctly interpret an assemblage.

For instance, of the 78 artifacts that demonstrated use-wear in the microwear analysis, 35% were modified by use only. There was no intentional retouch to either the edge or body of these tools by flaking or battering. However, of the 22 tools that were determined not to have been utilized, 82% of them had been retouched through flaking, battering, or both. Without a use-wear analysis, macroscopic examination alone would not necessarily have accurately determined whether or not these pieces were even tools. While the frequent use of unmodified pieces as tools correlates well with the use of energetically efficient production methods at the site, not utilizing already retouched tools does not fit well with economizing behavior. However, it is possible that the tools were simply used expediently so no polish formed. The use of heat treatment and local raw materials represent economizing behavior and the sheer number of edge-only tools utilized at the site does suggest that energetic efficiency did play a part in the site economy though.

Of the 100 tools examined for microwear, 81 were edge-only tools. Of these, 20% exhibited no signs of use while 80% did display use-wear. If the percentages from this sample of the assemblage are applied to the entire assemblage, 24% of tools at the site are expediently made edge-only pieces that show utilization. Moreover, 42% (n=27) of the edge-only tools displaying use-wear were modified by use only, with no additional retouch. So we can expect that about 23% of utilized tools at the site are pieces that have no modification other than edge damage. Outside of the 100 tools inspected for traces of use-wear, an additional 22 pieces from the 2004 Crescent Bay assemblage were marked
as modified by use-wear only during the macroscopic analysis. It is hard to say how many other pieces of debitage with no retouch may have escaped notice as tools in addition to the 53 identified during the mass analysis of the debitage. While it is not feasible to suggest that the entire collection of debitage from sites be subjected to a use-wear analysis, a sample of tools that includes edge-only pieces not modified through retouch provides essential information about the predominant basic tool form at Crescent Bay. The large percentage of flake tools found at other Oneota sites (Hall 1962; O’Gorman 1995; Rosebrough and Broihahan 2005) makes it apparent that further consideration of this tool class at Oneota sites is warranted. Understanding Oneota lithic economy will require more consistent use-wear analyses on other Oneota sites.

Another significant contribution of this microwear analysis is the considerable increase in the number of hide scrapers it indicates. Prior to the use-wear analysis, 11 tools were identified as hide scrapers, based on morpho-functional traits. Use-wear analysis confirmed that the two of these that were examined were used in transverse motions on hides, as indicated by the hide polish on the pieces. However, an additional 31 tools, including three triangular points, were also identified as having been used in transverse motions on hide during the use-wear analysis. These additions alter the percentage of the assemblage composed by hide scrapers from 5% to 17%, a significant increase that is particularly important in terms of the projectile point/scaper ratio noted in Wisconsin Oneota sites (Boszhardt and McCarthy 1999; Hall 1962; Overstreet 1997). It also makes clear that using the term “projectile point” to describe triangular tools found at late prehistoric sites is misguided and obscures the nature of the lithic assemblages at these sites.
While 45% of edge-only pieces were identified as hide scrapers, several other functions were observed as well. Approximately 5% of the utilized edge-only tools were used in transverse motions on wood, 6% were used in longitudinal motions on plant matter, and 3% were used on hide but in a longitudinal motion. One tool showed polish from each category of bone, reed, and smooth grit. The remaining utilized edge-only tools displayed either smooth pitted polish (15%, n=10) or generic weak polish (14%, n=9). While the specific worked material could not be ascertained for these 19 tools, the dominant motion was identified for 14 (74%) and the degree of hardness of the worked material was identified for eight (42%). Thanks to the use-wear model, we can now remove these tools from the category of “unidentified” and make some inferences about what they are. A flow chart for the determination of dominant use can be found in Appendix F.

The use-wear analysis also found that many formal tools with functions implied by the morpho-functional names assigned to them were, in fact, multipurpose tools. For instance, Odell (1981:206) notes that when wear is present on projectile points from actual penetration, it most often appears as evidence of a longitudinal motion. However, three of the projectile points displaying traces of wear appear to have been used in transverse motions, suggesting that they were either recycled and used as scrapers at the end of their use as projectile points or they were multipurpose tools throughout their use lives. Additionally, four projectile points show no use-wear apart from wear from hafting. Hafting wear was only identified due to its location at the proximal end of the tool as Cahen et. al. (1979:681) note that “there is no simple discrete wear pattern that can be called ‘haft wear’”. While the number of tools placed into morpho-functional
categories present in this use-wear analysis (n=16) is not large enough to make any statistically significant statements about the multi-functionality of tools, it does suggest that there is no direct correlation between form and function. One cannot assume a function based on form, a conclusion also supported by the array of functions evidenced in the much larger assemblage of edge-only tools examined by this study of microwear.

In conclusion, the largest percentage (43.6%) of utilized tools identified by this use-wear analysis was used in transverse motions on hide, i.e. for hide scraping (Table 7.3). A total of 7.7% of tools were used in longitudinal motions such as cutting or sawing on plant matter. 6.4% were used in transverse motions on wood such as planing or whittling, while 3.8% of the utilized tools were used on hide but in longitudinal motions. There was also one case (1.3%) of bone polish from a transverse motion and one case of reed polish from a transverse motion. The remaining 35.9% (n=28) of the utilized tools were unidentified either with regard to motion or exact worked substance. However, only seven (25%) of these tools were unidentified with regard to both hardness of worked material and dominant tool motion.

<table>
<thead>
<tr>
<th>Tool Function</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hide Scraping</td>
<td>34</td>
<td>43.6</td>
</tr>
<tr>
<td>Plant Cutting</td>
<td>6</td>
<td>7.7</td>
</tr>
<tr>
<td>Wood Whittling/Planing</td>
<td>5</td>
<td>6.4</td>
</tr>
<tr>
<td>Hide Cutting</td>
<td>3</td>
<td>3.8</td>
</tr>
<tr>
<td>Bone Scraping</td>
<td>1</td>
<td>1.3</td>
</tr>
<tr>
<td>Reed Planing</td>
<td>1</td>
<td>1.3</td>
</tr>
<tr>
<td>Unidentified Specific Worked Material</td>
<td>28</td>
<td>35.9</td>
</tr>
<tr>
<td>Total</td>
<td>78</td>
<td>100</td>
</tr>
</tbody>
</table>

Given the measures taken to ensure the reliability of this analysis, both through blind tests and re-examination of a sample of tools, we can be reasonably confident that the data from this use-wear analysis may be applied to the rest of the Crescent Bay
assemblage. However, apart from noting the hide scraping was a common activity at the site, the sample sizes for each of the other functional categories are too small to state with any certainty what the prevalence of these activities was. With larger samples from both the 2004 and other field seasons from Crescent Bay, further conclusions about the frequency of specific activities at the site may be reached.
CHAPTER 8: ASSEMBLAGE AND FUNCTIONAL ANALYSIS

In the literature on Oneota lithics, form and function is an oft-discussed topic. For instance: the identification of humpback bifaces as knives, projectile points, scrapers or otherwise (Brown, et al. 1967; Jeske 1992a; Munson and Munson 1972), or the perceived temporal and regional change in the scraper/triangular projectile point index at Oneota sites (Boszhardt and McCarthy 1999; Hall 1962; Lambert 2001; Overstreet 1997). The proclivity of Oneota researchers to focus on the morphology of a tool rather than its functional and economic characteristics when identifying distinct types is unfortunate since there has not yet been any comprehensive use-wear analysis conducted on a large Oneota site lithic assemblages and little discussion of how lithic technology fits into the overall economy of these people.

Taking an assemblage view of the analysis of late prehistoric stone tools is essential to understanding the economy of the group in question. Jeske (1992a) explores the idea of energetic efficiency as an explanation for the decline in lithic tool quality after the Middle Woodland period. The use of local raw materials and bipolar reduction techniques are used as examples of economizing behavior in late prehistoric lithic assemblages. However, “efficiency” and “economy” should not be used interchangeably. Efficiency refers to the use of time and energy in tool production whereas economy explains the management of raw materials and natural resources (Jeske 1992a). While sometimes the two goals may be at odds, they can often be combined. Bipolar reduction is an example of economic efficiency. Bipolar manufacture efficiently removes several flakes from a core which can be formed into tools, and it is seen as an economizing
strategy because it allows for the recycling of exhausted bifaces as small bipolar cores. Understanding the way in which raw materials are used at Crescent Bay helps us understand what was important to the site’s residents. The functional analysis in this thesis adds a whole new dimension to the discussion of late prehistoric tool use. Not only do the tools from the site supply information about the economy of tool production at the site but they may now be used to interpret other aspects of Crescent Bay’s economy and determine the dominant tasks for which these tools were used. The analysis provides another layer of interpretation regarding the economizing behavior of the site residents, such as the multipurpose nature of tools in use at the time of occupation. Previous use-wear analyses at Oneota sites have not provided such a comprehensive picture of the entire lithic assemblage.

Boszhardt (1999) focuses specifically on utilizing use-wear analysis on a sample of 142 scrapers from three Oneota sites in the LaCrosse locality to provide support for the hypothesis of increased bison hunting during the Late Prehistoric. Jeske (2002:106-108) used high powered microscopy to examine the chipped stone tools from the Langford occupation at the LaSalle County Home site, in the Upper Illinois River Valley. However, his work was based on a small number of tools (n=62) and is of limited utility. Many of the tools (45.16%) showed no traces of wear at all. Of the tools that did display polish, as identified at 100x magnification, the greatest percentage (37.25%) exhibited meat polish, a similar result to the 37% of the Crescent Bay assemblage which exhibited hide polish. However, on the whole, Oneota lithics have been generally overlooked as a valuable source of information.
There are probably several reasons for this overall neglect. Archaeologists often find ceramics to be more informative than stone tools (Overstreet 1997). Oneota sites produce a great deal of variation in pottery and a limited array of tool types. Perhaps their most recognizable archaeological signature is their widely variable ceramic styles, both regionally and chronologically. Oneota lithics, however, do not differ in any significant way from those of many contemporaneous cultural groups across the northeastern United States (Gibbon 1986; Overstreet 1997). Additionally, Oneota lithic tools are not the most aesthetically pleasing tools to look at. They are typically made from fair to poor quality raw materials and often do not fit into formal tool types (Jeske 1992:470). Most are expediently made and are often interpreted as multipurpose tools with no easily discernible function. In cases where form does not readily indicate function, the tools are simply classified as “retouched flakes” (O’Gorman 1995) with no reference to function or assumptions are made that “it is likely that these objects were used for a variety of cutting activities” (Blodgett 2004:80). The tendency is to overlook the functional and economic information provided by these tools and focus on the tools which may be interpreted on the basis of a morpho-functional typology. However, given the large portion of the Oneota lithic assemblages composed of these non-formal tools, (e.g., 62% at Crescent Bay), a functional analysis of these artifacts has the potential to significantly alter the observations we make about an assemblage. The use-wear analysis of the Crescent Bay lithic assemblage, in addition to the macroscopic analysis, provides a clearer understanding of the lithic economy that was present at the site and which may have been present at other Oneota sites as well.
Assemblage Analysis: Lithic Material Procurement and Use

Locally available raw materials accounted for approximately 66% of the 2004 Crescent Bay tool assemblage when considering only those raw materials that were definitively identifiable. However, when one includes the unidentified raw materials, which are likely local pebble cherts, the percentage of local raw materials jumps to 87%. This places Crescent Bay right on par with the 81% from Carcajou Point (Rosebrough and Broihahan 2005), the 91% at the Tremaine site (O’Gorman 1995), and the 80% reported by Jeske et. al. in 2006 at Crescent Bay. It is significantly greater than the 51% of raw materials that were reported as local at Pammel Creek (Rodell 1989).

The assemblage is also overwhelmingly made up of fair quality raw materials (Figure 8.1). The remaining two categories of raw material quality are poor (13%) and good quality (3%).

![Raw Material Quality Frequencies](image)

Figure 8.1 Frequencies of raw material quality for lithic tools at Crescent Bay Hunt Club
This tendency to use fair quality local raw materials conforms to the pattern seen both at other Oneota sites (Benchley, et al. 1997; Hall 1962; O’Gorman 1995; Rodell 1989; Rosebrough and Broihahan 2005) and during the late prehistoric period in general (Jeske 1992a; Mason 1981). Jeske (1992:468) refers to this trend as “a recognized decline in the diversity and complexity of stone tool assemblages beginning at approximately A.D. 500.” This noted decline points to an increased emphasis on expediency not only in the procurement of raw materials for tool production but also in the rest of the production process. The trend represents an increased reliance on bipolar technology and heat treatment, as well as the production of less refined tools than those of previous time periods. The percentages of both tools and debitage that were determined to have been produced by bipolar reduction are shown in Figure 8.2.

Figure 8.2 Frequencies of manufacturing methods at Crescent Bay Hunt Club
Definitively bipolar pieces account for approximately 13% of the total tool and debitage assemblage from the 2004 field season at Crescent Bay. If, as Jeske (1992a) suggests, many late prehistoric triangular tools begin as bipolar flakes, this amount would rise to 40%. However, for the purpose of this analysis only pieces where two striking platforms could be identified were labeled as bipolar, significantly narrowing the field of interest. While much of the shatter (non-flakes) in the debitage assemblage may have been created through bipolar techniques, a formal bipolar analysis (see Jeske and Lurie 1993) was beyond the scope of this project. Nevertheless, the amount of bipolar tools and debitage that was able to be identified indicates that bipolar production was well underway at Crescent Bay.

Heat alteration is relatively common at Crescent Bay with approximately one quarter of both the tools and debitage exhibiting evidence of heat treatment (Figure 8.3).
Heat treatment is typically utilized to make poor quality raw materials more amenable to knapping (Rick 1978). Given the high percentages of fair and poor quality raw materials displayed in Figure 8.1, the prevalence of heat alteration at the site is as expected. Lurie (1989:51) also notes the correlation between thermal alteration and the use of coarse and medium grained, fossiliferous cherts as an economizing strategy at the Koster site.

The high percentage (55%) of edge-only tools recovered in 2004 also suggests a focus on the efficient production of expedient tools. Some tools are retouched only by battering (7%) or not at all (22%), which means many tools do not fit into any morpho-functional formal typological categories. The bifaces produced are often crudely refined in an effort to promote efficiency and perhaps economy (Figure 8.4). Additionally, cortex is still found on 28% of the tools at the site (Figure 8.5). Tools are relatively small, with an average length of 26.7 mm for edge-only tools, 24.5 for unifacial tools, and 20.2 mm for bifaces (Table 8.1). This small size suggests the use of local cobble cherts as opposed to large energy expenditures in acquiring materials from outcrops.

Overall, the factors relating to tool production at the site seem to point to the use of relatively low quality local raw materials to produce small, rough, expediently made tools that served a variety of functions. Bifaces seem to be slightly more refined, making up 57% of the tools made with good quality raw materials, 33% of tools with no cortex, and 35% of tools modified through flaking. Bifaces, most of which are triangular points (78%), are smaller and more uniform in size than unifaces or edge-only tools (Table 8.1). T-tests (Appendix E) run on the data presented in Table 8.1 were statistically significant. It appears that more energy is expended on the production of bifaces than other tool forms. Their small size also implies that they are retouched and reused more than other
tools but the difficulty of assessing reuse on stone tools leaves this inference unconfirmed.

Figure 8.4 Frequencies of the degree of refinement of bifaces at Crescent Bay Hunt Club

Figure 8.5 Frequencies of cortex present on tools at Crescent Bay Hunt Club
<table>
<thead>
<tr>
<th>Modification Type</th>
<th>Measurement</th>
<th>n</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Edge-Only</td>
<td>Length (mm)</td>
<td>134</td>
<td>26.7</td>
<td>12.9</td>
</tr>
<tr>
<td></td>
<td>Width (mm)</td>
<td>134</td>
<td>19.9</td>
<td>6.8</td>
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<td></td>
<td>Thickness (mm)</td>
<td>135</td>
<td>6.2</td>
<td>2.5</td>
</tr>
<tr>
<td></td>
<td>Weight (g)</td>
<td>133</td>
<td>4.1</td>
<td>7.6</td>
</tr>
<tr>
<td>Bifacial</td>
<td>Length (mm)</td>
<td>54</td>
<td>20.2</td>
<td>6.5</td>
</tr>
<tr>
<td></td>
<td>Width (mm)</td>
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<td>16.1</td>
<td>4.7</td>
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<td></td>
<td>Thickness (mm)</td>
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<td>4.9</td>
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<td></td>
<td>Weight (g)</td>
<td>35</td>
<td>2.0</td>
<td>1.4</td>
</tr>
<tr>
<td>Unifacial</td>
<td>Length (mm)</td>
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<td>24.5</td>
<td>11.1</td>
</tr>
<tr>
<td></td>
<td>Width (mm)</td>
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<td></td>
<td>Weight (g)</td>
<td>24</td>
<td>3.9</td>
<td>9.1</td>
</tr>
</tbody>
</table>

**Tool Use and Function**

One of the primary goals of this thesis was not only to characterize the morphology and production of the tools in the 2004 Crescent Bay assemblage but also the function of the tools. In order to accomplish this, a use-wear analysis was performed on a sample of 100 lithic tools recovered during the 2004 field season at Crescent Bay Hunt Club. This analysis was designed to examine the accuracy of the designations of morpho-functional typologies and to provide functional information about the tools that do not fall into any of the morpho-functional categories. Most of the tools examined were edge-only pieces, although some bifaces, unifaces, and one multiface were also examined (Figure 8.6).
The methods by which the tools in this study were modified were more varied than the basic forms included in the microwear analysis (Figure 8.7).

Figure 8.6 Frequencies of basic form types for tools selected for use-wear analysis

Figure 8.7 Frequencies of methods of modification on tools in use-wear analysis
Analysis of these tools at 200x magnification allowed for the identification of several different types of polish that were the most diagnostic indicator of what type of material the tools had come in contact with (Figure 8.8). All but two of the tools displayed some sort of polish. Even those tools that were determined to be unutilized (22) displayed some type of polish, usually smooth or rough grit or generic weak polish (see Vaughan 1985). However, the most common type of micropolish encountered during the analysis was hide polish (37%). Microwear patterns of fracturing and rounding also confirmed that 33 of these 37 tools were used in transverse motions on hide. The recognition of edge-only pieces with hide polish significantly increases the number of tools that should be considered “scrapers” (see Boszhardt and McCarthy 1999) in the assemblage from 11 to 42. The increase in hide processing tools effects how Crescent Bay fits into the temporal and regional trend in the scraper versus triangular point index (Boszhardt and McCarthy 1999; Hall 1962; Overstreet 1997). Prior to the use-wear analysis, Crescent Bay comfortably fit the expected trend for an Oneota site occupied from the 13th-14th century in southeastern Wisconsin (Figure 8.9). However, following the use-wear analysis, the site more closely resembles the ratio expected of either a later site or one located further to the west (Figure 8.10).
Figure 8.8 Types of micropolish identified on the tools from Crescent Bay Hunt Club

Figure 8.9 Scraper to projectile point index prior to microwear analysis

<table>
<thead>
<tr>
<th>Site Name</th>
<th>Date</th>
<th>Locality</th>
<th>No. Scrapers</th>
<th>No. Projectile Pts.</th>
<th>Scraper/Point Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pammel Creek</td>
<td>14th Century</td>
<td>LaCrosse</td>
<td>94</td>
<td>24</td>
<td>391.7</td>
</tr>
<tr>
<td>Tremaine</td>
<td>15th-16th Century</td>
<td>LaCrosse</td>
<td>511</td>
<td>268</td>
<td>190.7</td>
</tr>
<tr>
<td>Pipe</td>
<td>13th-14th Century</td>
<td>Grand River</td>
<td>13</td>
<td>24</td>
<td>54.2</td>
</tr>
<tr>
<td>Walker-Hooper</td>
<td>13th-14th Century</td>
<td>Grand River</td>
<td>18</td>
<td>78</td>
<td>23.1</td>
</tr>
<tr>
<td>Crescent Bay 2004</td>
<td>13th-14th Century</td>
<td>Koshkonong</td>
<td>11</td>
<td>48</td>
<td>22.9</td>
</tr>
<tr>
<td>Bornick</td>
<td>13th-14th Century</td>
<td>Grand River</td>
<td>2</td>
<td>15</td>
<td>13.3</td>
</tr>
<tr>
<td>Carcajou Point</td>
<td>11th-12th Century</td>
<td>Koshkonong</td>
<td>5</td>
<td>20</td>
<td>25.0</td>
</tr>
</tbody>
</table>

Figure 8.10 Scraper to projectile point index following microwear analysis
There are a few conclusions one can reach after noting the difference in the scraper/point index this additional information makes.

1. The scraper/point index at all of these sites may be incorrect, as none of them have been subjected to a microwear analysis at this time. Until the unidentified tools at each of the sites are identified with regard to use, their scraper/point ratio is suspect.

2. The Crescent Bay Hunt Club site was, in fact, a later occupation and this explains its new placement in the scraper/point continuum. This conclusion is unlikely as the radiocarbon data do not support occupation after A.D. 1400. And it is impossible that Crescent Bay has suddenly moved further west.

3. The scraper/point index pattern is not as significant as previously thought and upon further analysis of the previously unidentified tools from other Oneota site assemblages, may be determined to be insignificant entirely.

The microwear data from one field season at Crescent Bay alone is not sufficient to make more than tentative conclusions, but it seems to undermine the present utility of the point/scraper index. It does support the claim that a microwear analysis of the flake tools at other Oneota sites may alter previous conceptions about the functional tool types represented at these sites. Subsistence-related bison bones have been recovered in small numbers at Crescent Bay (Edwards 2010; Jeske, et al. 2006) The larger number of tools with hide polish suggests that there was a greater amount of hide processing occurring at the site than previously thought—although currently it is not possible to determine if the wear comes from some combination of deer, elk, bison and other animals.

Hide processing was not the only function of the tools examined by the use-wear analysis. Six of the tools had developed advanced plant polish from use in a longitudinal motion. Another five tools showed wood polish from transverse motions. The smooth pitted polish on four tools, in addition to other microwear traces such as rounding and microflaking, show evidence of use in longitudinal motions on hard substances such as
wood, antler, or bone. One definitive case of bone polish from a transverse motion was identified, as well as one tool with reed polish from a transverse motion.

Overall, transverse motions seemed to be more common than all others (Figure 8.11). However, the type of motion does appear to correlate with the worked material (Table 8.2). For instance, almost all tools used on hide are used in transverse motions. All tools used on plants are used in longitudinal motions. All tools with wood polish are used in transverse motions. However, the relatively large proportion of cells with n>5 makes the any statistical significance less noteworthy.

![Frequencies of Tool Use Motions](image)

Figure 8.11 The dominant tool motions exhibited by the tools from Crescent Bay.

<table>
<thead>
<tr>
<th>Polish Type</th>
<th>Transverse</th>
<th>Longitudinal</th>
<th>Unknown</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hide</td>
<td>33</td>
<td>3</td>
<td>1</td>
<td>37</td>
</tr>
<tr>
<td>Plant</td>
<td>0</td>
<td>6</td>
<td>0</td>
<td>6</td>
</tr>
<tr>
<td>Wood</td>
<td>5</td>
<td>0</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>Total</td>
<td>38</td>
<td>9</td>
<td>1</td>
<td>48</td>
</tr>
</tbody>
</table>

Although the statistical significance may or may not be important in this case, the real world significance is evident. It is difficult to imagine a situation in which one would be
performing a transverse motion such as scraping or planing plants. Evidence of longitudinal movement by tools exhibiting plant polish is to be expected. As wood typically only produces diagnostic polish if the tool is used in a transverse motion (Vaughan 1985), it also makes sense that the tools with wood polish would only exhibit traces of use in transverse motions. Nevertheless, these data support the relationship between diagnostic polish type and dominant tool motion.

The micropolish present on some of the triangular points also indicates that these points may have served multiple purposes. Three triangular points displayed evidence of use in transverse motions on hide, indicating that they may have been recycled and used as scrapers once their use-life as projectile points was over. It is also possible that they may have been multi-purpose tools throughout their use-life, which provides an interesting addition to the debate about the function of the humpback bifaces noted in Jeske (1992a). These specimens were first described as crude or unfinished projectile points by Fowler (1952), then as humpback scrapers by Brown (1961), and later as humpback knives by Munson and Munson (1972). Jeske (1992a) avoids the ambiguity of their function by simply referring to them as humpback bifaces. While only one of the three triangular bifaces displayed the humpback created by step fractures, likely produced during bipolar reduction (Jeske 1992a), the micropolish displayed on these three tools suggests that some triangular points may have been used as multipurpose tools as part of an economizing effort. These data support Jeske’s (1992a) statement that humpback bifaces may not be a separate functional class but rather a result of energetically efficient production methods.
Conclusions

In many ways, the data from the 2004 Crescent Bay Hunt Club lithic assemblage fit the expectations for an Oneota site occupied from A.D. 1200-1400 in southeastern Wisconsin. Tools are made from fair to poor quality local raw materials with a few exceptions. Many of the tools display no retouch at all and do not fit into traditional morpho-functional categories. A use-wear analysis of a sample of the assemblage shows that these expediently made tools were used for a variety of tasks: cutting plants, whittling wood, scraping hides. The debitage from the site indicates that all stages of production were practiced at the site and bipolar reduction was utilized as a way of quickly creating several blanks from which tools could be knapped.

Some of the data from the assemblage do not entirely match the expected values. Most of the formal tools displaying retouch through flaking are triangular tools, often referred to as Madison Points. However, the microwear analysis of the tools indicates that a large number of tools are used as hide scrapers. Three of the triangular tools analyzed in the microwear analysis appear to be multipurpose tools, or tools with a purpose different from that indicated by their morpho-functional category. All of these observations suggest that further analysis of the lithics from the 2004 field season, in addition to the other field seasons is necessary to form a more complete picture of the lithic economy at the site. The lithic assemblage from Crescent Bay has the potential to contribute a great deal not only to understanding the site and the people who lived there but also Oneota settlements in Wisconsin as a whole.
CHAPTER 9: CONCLUSIONS

The goals of this thesis were largely to characterize the lithics from Crescent Bay Hunt Club through an assemblage based approach, supplemented by a functional analysis of a sample of tools from the site. The larger macroscopic analysis of both the debitage and lithic tools from the 2004 field season at Crescent Bay Hunt Club was completed with the intention of answering questions relating to energetic efficiency and the part it played in the lithic economy at the site. This concept was addressed by asking questions about the quality and locality of the raw materials utilized by site residents, the prevalence of economizing methods such as thermal alteration and bipolar reduction, and the degree of refinement of bifaces. The stages of reduction occurring at the site were determined utilizing data about the size grades of debitage present and the amount of cortex on both debitage and tools.

The use-wear analysis was conducted for the purpose of answering questions about the relationship of form and function illustrated by the assemblage. Questions specific to Crescent Bay were asked of the data. What type of micropolish was most commonly found on tools from the assemblage? Were more tools used on hard substances or soft substances? Were transverse motions more prevalent than longitudinal motions? What was the predominant use of the unretouched flake tools that dominate the assemblage? However, more general questions that apply to Oneota sites as a whole were also posed. Are triangular bifaces only used as projectile points? Do tools placed in the morpho-functional category of scrapers actually exhibit evidence of use as scrapers? The intent of this comprehensive use-wear analysis was largely to point out the
utility of a functional analysis in interpreting the data from a late prehistoric lithic assemblage.

The macroscopic analysis of the 2004 Crescent Bay lithic assemblage indicated that the site residents were using mostly local, fair quality raw materials to produce their tools, a pattern also seen at other Oneota sites in Wisconsin such as Pammel Creek, Carcajou Point, the Tremaine site, and the OT site (Hall 1962; O’Gorman 1993, 1995; Rodell 1989; Rosebrough and Broihahan 2005). The incidence of bipolar cores at Crescent Bay is slightly higher than that at other Oneota sites, as is the prevalence of heat treatment. Due to the small sample of bipolar cores from the 2004 field season (n=9), this cannot be considered a significant difference between sites. However, if information from other field seasons at Crescent Bay provides the same percentages as the 2004 season then a higher incidence of bipolar production at the site may be assumed. The percentage of heat treated pieces at Crescent Bay (25-27%) is significantly higher than the 10% from the Tremaine site. It is relatively similar to the 20% recorded at the neighboring Carcajou Point site. The appearance of heat alteration on over one quarter of the tools at Crescent Bay supports the use of economizing efforts by the site’s residents (Lurie 1989; Rick 1978). The prevalence of bipolar pieces in the assemblage also suggests that energetically efficient methods of tool production were being utilized at the site (Jeske 1992a; Jeske and Lurie 1993).

The range of debitage size grades encountered in the assemblage, in addition to the 28% of pieces that displayed cortex indicates that all stages of production were taking place at Crescent Bay. It also indicates energetically efficient production, as site residents were not taking the time to remove cortex from their tools.
A variety of tool forms were produced, the majority of which were edge-only tools. The high incidence of edge-only tools and tools modified only by use-wear with no retouch at all provides further support for the suggestion that energetically efficient production methods were being employed at Crescent Bay.

The microscopic analysis of the 2004 Crescent Bay lithic assemblage yielded information specific not only to the tasks being undertaken at the site, but also carried implications for trends between other Oneota sites. The majority of tools examined in the use-wear analysis were identified as having been used in transverse motions on hide. This revelation has implications both for Crescent Bay and the wider trend the scraper to projectile point ratio seen at Wisconsin Oneota sites (Boszhardt and McCarthy 1999; Hall 1962; Lambert 2001; Overstreet 1997). It most certainly implies that hide scraping was a common activity at Crescent Bay. It also indicates the inadequacy of morpho-functional typologies in accurately predicting the function of tools. The majority of tools identified as hide scrapers through the microwear analysis were edge-only tools that did not fall into the morpho-functional category of scrapers. This augmentation of the number of scrapers at Crescent Bay also distorted the projectile point/scraper ratio at the site. Following the use-wear analysis, this ratio no longer fit the larger geographic and temporal trend of Wisconsin Oneota sites. Given that a comprehensive use-wear analysis has not been conducted at other comparable Oneota sites, this suggests that the projectile point/scraper ratio at those sites may also be susceptible to inaccuracy due to reliance on the morpho-functional identification of tools.

In addition to providing functional information about tools which were previously unidentified with regard to use, the microwear analysis also indicated that some tools had
multiple functions. It is clear that a direct correlation between form and function cannot be assumed. This analysis also provides additional support for the claim that morpho-functional typologies are of limited utility when examining late prehistoric assemblages where large numbers of tools do not fit into any formal category. The amount of variation within the classes such as Madison points where some tools are bifacial, others are edge-only, some are modified by flaking and others by battering and the only constant is the triangular shape of the tool suggests that further consideration of the current categories is necessary. The flaking exhibited on Archaic and Paleoindian points is considered when identifying diagnostic types, perhaps a similar approach should be applied to late prehistoric points. Where there is no difference in the general shape of the piece, other defining characteristics should be determined.

This study has made great strides toward further understanding the lithic economy at Wisconsin Oneota sites and Crescent Bay in particular. However, it only considers one field season of seven. There is considerably more material to be analyzed in order to form a better picture of the economic efforts of the site residents. While analysis of the lithic material from the 1998 and 2002 field seasons has been conducted, no extensive description of these data has been published yet (Jeske 2003a; Lambert 2001). The analysis of the materials from the 2004 field season provides an avenue to some interesting information about the site and its place in the wider Oneota network but only further analysis of the lithic materials from Crescent Bay can confirm the statistical significance of the findings in this thesis.

The microwear analysis included in this study provides an entirely new avenue of analysis for the lithic materials from Crescent Bay Hunt Club. While the use-wear
analysis opens several new doors with regard to tool use and function, it is limited in several ways. Although blind tests were performed prior to the analysis of the archaeological lithic materials in this study, the number of tests was small in comparison to other studies. Vaughan (1985) completes 249 experiments, Kamminga (1982) completes 444 experiments, even Keeley (1980) includes 15 blind tests in his study. While this microwear analysis relied on the identifying criteria laid out by these studies and others (Odell 1981; Odell 2004), an increase in the number and variety of blind tests in this study would add to its reliability.

One of the advantages of this use-wear analysis is that it provides functional information about many of the edge-only tools that do not fit into morpho-functional categories. However, due to the domination of the sample by such pieces, the number of bifaces and unifaces included in the sample was small. The utility of this particular use-wear analysis is limited by sample size and representativeness when considering questions of multifunctionality of tools. Nevertheless, general trends may be established that provide directions for future research.

Additional research on Oneota lithics, and specifically those from Crescent Bay, will include much larger samples derived from other field seasons at the site. A more in depth analysis of the variety encountered in Madison points could provide identifiable patterns with regard to methods of modification that may allow us to establish discreet groups within the overwhelmingly large category of Madison points. Further use-wear analysis on the assemblages from other field seasons at Crescent Bay will also provide a great deal of information about the lithic economy at the site. Use-wear analysis of a larger sample of formal tools would test the significance of morpho-functional typologies
and establish the prevalence of multifunctionality among tools that have been previously identified with regard to use through their morphology.

Use-wear analysis of both the formal tools and particularly the edge-only or flake tools at other Wisconsin Oneota sites would provide comparative data for the work done at Crescent Bay. If similar findings regarding hide scrapers are encountered, the projectile point/scraper ratio trend may be entirely discredited. The use-wear data from Crescent Bay cannot be considered typical of Oneota sites or not until compared with similar data from similar sites.

As a whole, late prehistoric lithics must be given further consideration than has previously been the norm. While these tools are expediently made, often crude, not particularly aesthetically pleasing and show little identifiable variation across the northeastern United States, they should not be discounted as a valuable source of information about the cultures they represent. Whether one simply gathers information about the energetic efficiency of the lithic economy at these sites or considers the functional qualities of the variety of formal and informal tool classes encountered in the assemblages, this is data not available from other archaeological sources of information. As long as late prehistoric lithics are passed over in favor of ceramics or other data, a valuable source of information about late prehistoric sites, and Oneota in particular, is being overlooked.
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APPENDIX A

Mass Analysis Schema for Debitage (after Jeske and Lurie 1990)

A. Provenience

B. Type
   1. Flake
   2. Flake-like
   3. Non-flake

C. Size grade
   1. < 8 mm
   2. 8 mm to 12.5 mm
   3. 12.5 mm to 25 mm
   4. > than 25 mm

D. Count per size grade

E. Weight per size grade

F. Number of pieces with cortex per size grade

G. Number of bipolar pieces per size grade

H. Number of pieces with heat treatment per size grade
APPENDIX B

Lithic Schema and Documentation for Stone Tools (after Jeske and Lurie 1990)

A. Provenience: All artifacts are given a unique number which identifies site and location within the site.

B. Catalogue Number: The catalogue number is an arbitrary number assigned as a short code for the provenience.

C. Tool Number: Each tool is given a unique number within its provenience.

D. Raw Material: Raw material is identified using the comparative collection at the UWM archaeological laboratory. Identification is done by visual comparison, with low power magnification (if necessary) to aid in fossil identification.
   1. Unknown
   2. Galena Chert
   3. Silurian Chert (Niagara Formation)
   4. Maquoketa Chert
   5. Upper Prairie du Chien Chert (Shakopee Formation, oolitic)
   6. Lower Prairie du Chien Chert (Oneota Formation)
   7. Platteville Formation Chert
   8. Cochrane/Chocolate Chert
   9. Unknown Silicified Sandstone
  10. Hixton Silicified Sandstone
  11. Alma Silicified Sandstone
  12. Arcadia Silicified Sandstone
  13. Baraboo Quartzite
  14. Barron County Quartzite
  15. Barron County Pipestone
  16. Quartz
  17. Rhyolite
  18. Basalt
  19. Knife River Flint
  20. Burlington Chert
  21. Unknown Quartzite
  22. Moline Chert
  23. Wyandotte Chert/Harrison County
  24. Unknown Chalcedony
  25. Flint Ridge Chert
  26. Pecatonica Chert
  27. Excello Shale
  28. Silurian Chert (Joliet Formation)
E. Raw Material Quality: This variable is also defined using comparative samples. Inclusions, fossils, fracture planes, and grain size are used to determine quality.
1. Good
2. Fair
3. Poor
4. Cannot Determine
5. Not Applicable (for non-chert flaked artifacts)

F. Amount of Cortex: For flake artifacts this variable refers to the percent of the dorsal surface which is covered with cortex or patina. For bifacial and multifacial artifacts the variable refers to the percent of cortex or patina on all surfaces. Patina which has accumulated since the manufacture of the artifact, that is, patination covering flake scars is ignored.
1. 0
2. <50
3. >100<50
4. 100

G. Heat–Alteration: This variable is recorded for all artifacts. The criteria used to identify heat altered chert are taken from Rick (1978). It should be noted that Rick’s experiments were primarily done with Burlington chert, and that his criteria may not apply to all types of chert. In assessing heat-alteration it is necessary to have samples of both the unaltered and altered materials for comparison. Heat alteration attributes were scored as follows:
1. Heat Treatment Present
2. Heat Treatment Possible
3. Heat Treatment Absent
4. Burned
5. Cannot Determine

H. Technique of Manufacture: Two manufacturing techniques are distinguished. Free-hand is any technique in which a hand-held core is struck with a hammer to produce flakes. Bipolar refers to a technique in which the core is placed on an anvil and struck with a hammer.
1. Free-Hand
2. Bipolar

I. Basic Form: This variable is recorded for each artifact.
1. Edge or Functional Unit Only – No attempt has been made to shape the body of the piece, but one or more edges have been retouched and/or used. Occasionally a small surface area rather than an edge will be modified through use.
2. Unifacial – The body of the piece has been shaped on one side. There must be at least one flake scar which does not originate on the edge of the shaped face.
3. Bifacial – Both faces of the piece have been shaped. There must be at least one flake scar which does not originate on the edge of the piece on both sides of the piece.
4. Multifacial – The body of the piece exhibits intentional flake scars creating more than two faces. The pieces often have a blocky appearance. They may or may not have functional units.

5. Nonfacial – These are rounded pieces with no well defined faces of edges. They are usually produced by battering and are often formed through use rather than intentional modification.

6. Prismatic Blade or Bladelet – Flake with parallel edges and at least one ridge running the length of the dorsal surface of the piece. It is usually much longer than it is wide. The piece may or may not show wear.

7. Unknown – These are fragments that have been flaked or battered on a face or edge, but are too incomplete to assign to any of the above categories.

J. Edge Modification: This variable classifies the type of edge modification as bifacial, unifacial, or both bifacial and unifacial.
   1. Unifacial – Retouch scars, battering, or use appear on one side of an edge or edge segment
   2. Bifacial – Retouch scars or use are on both sides of an edge or edge segment. Modification must occur on both sides of the same edge or edge segment for pieces with more than one edge or edge segment.
   3. Unifacial and Bifacial – The piece has more than one edge or edge segment. At least one is unifacially modified and one bifacially modified.
   4. Not Applicable – Pieces without edges are scored not applicable.

K. Method of Modification: Applies to both the edges and bodies of all pieces.
   1. Flaked – The piece has been intentionally flaked on the body or edge of the piece.
   2. Battered – An edge or surface has been altered by pounding. Pounding will produce flake scars and crushing. When flake scars are not distinct, the alteration is considered battering.
   3. Flaked and Battered – The piece has been altered by both flaking (leaving distinct flake scars) and by battering.
   4. Use-Wear Only – A functional unit (usually an edge) shows traces of microflaking, edge grinding, polishing, or rounding.
   5. Not Applicable – Small problem pieces are scored here.

L. Refinement: This variable applies to pieces scored 3 (bifacial) for Basic Form. Scores for refinement are based on comparison with sample pieces. Size of flake scars along edges, regularity of tool outline and thickness of transverse cross-section are basic criteria in the selection of sample pieces.
   1. Crude
   2. Medium
   3. Refined
   4. Cannot Determine (pieces too incomplete to be scored)
   5. Not Applicable (pieces scored something other than 3 for Basic Form)
M. Completeness of Functional Unit: For some studies, particularly functional analysis of tools, the appropriate unit of inquiry is the functional unit rather than the whole tool. This variable records the condition of functional units.
1. Broken – One or more functional units on a tool are interrupted by a break.
2. Whole – All functional units are complete. If there are two functional units, one whole and one broken, the piece is scored as broken.
3. Cannot Determine – Sometimes a functional unit will end at a break, but the break may not have interrupted the functional unit; i.e., the functional unit was created after the break occurred and is whole. This situation is difficult to determine in practice. This attribute is assigned to questionable pieces.
4. Not Applicable – Fragments without functional units are not scored for this variable.

N. Element Present: This variable focuses on the entire tool rather than the functional unit.
1. Distal End – The distal end of a flake is the termination end, the end opposite the striking platform and bulb of percussion. For non-flakes the distal end is the working end of the tool if this can be determined.
2. Mid-Section – There is no end present.
3. Proximal End – The proximal end of a flake is the end which contains the striking platform or bulb or percussion. Haft elements and butt ends of bifaces (if this can be determined) are considered proximal ends. Proximal ends may contain part of the mid-section.
4. End Section – An end section is present but it is not possible to determine if it is the distal or proximal end.
5. All Elements Present – The tool is essentially whole. Small edge sections may be missing, but the end outline of the piece can be determined without guess work.
6. Cannot Determine

O. Reworking or Reuse: Tools are often resharpened if an edge becomes dull, or reworked and reused if the tool is broken. Resharpened tools may have remnants of flake scars from the original edge. Tools may becomes progressively asymmetrical as they are resharpened. Retouch or use on a broken edge and abrupt change in tool outline are also use as indicators of reworking and reuse.
1. Present
2. Possible
3. Absent

P. Distal End Morphology: This variable applies only to those pieces with identifiable distal ends.
1. Blunt – The major portion of the distal end is perpendicular to an axis drawn through the striking platform and bulb of percussion or perpendicular to the longest axis of the piece if platform and bulb are present.
2. Pointed – Pointed ends may be rounded or accumulate.
3. Not Applicable – Pieces without distal ends are scored not applicable.
4. Cannot Determine
Q. Position of Retouch or Use: This variable establishes where retouch or use has occurred on a tool.
   1. End – The retouched or used edge is perpendicular to an axis drawn through the striking platform and bulb of percussion or through the longest axis of the piece if platform and bulb are absent.
   2. Side – The retouched or used edge is parallel to an axis drawn through the striking platform and bulb of percussion, or parallel to the longest axis if platform and bulb are not present.
   3. End and Side – A continuous modified edge is both perpendicular and parallel to the axis. If more than one edge exists, at least one is perpendicular and one parallel to the axis.
   4. Cannot Determine
   5. Not Applicable

R. Number of Edges: Records the number of distinct edges identified on the piece.

S. Edge Angle: Edge angles are measured for all edge functional units. A piece may have more than one edge functional unit. Three measurements are taken for each functional unit and the mode is taken to represent the edge as a whole. Measurements are taken with a goniometer. Measurements are taken 5 mm back from the edge, measuring the production angle. Up to four distinct edges can be measured on the form. For pieces with more than four edges, a note is made in Comments.
   1. 0-45 degrees
   2. 46-75 degrees
   3. Greater than 75 degrees
   4. Not Applicable (pieces without edges are scored not applicable)

T. Edge Configuration: Edge configuration in plan view is recorded for all edges except edges on hafting elements.
   1. Smooth – There are no regular indentations or projections in plan view.
   2. Serrated – There are regular indentations along the edge; the indentations are up to 2 mm deep and up to 2 mm apart. There must be at least two and one half indentations present.
   3. Notched – There is a single indentation or a series of non-contiguous indentations on an edge. There indentation(s) must show retouch or use within their boundaries. Notches for hafting are not scored here.
   4. Not Applicable – Pieces without edges are scored not applicable.
U. Hafting Elements: This variable applies to whole or almost whole pieces and broken pieces with obvious hafting elements.
   1. Present – Hafting elements are defined by marked constrictions or notches.
   2. Possible – Possible hafting elements are defined by slight constrictions, or wear or polish on the lateral margins toward the base.
   3. Absent – There are no indications of hafting.
   4. Not Applicable – Fragments without obvious hafting elements are scored not applicable.
   5. Modification for Hafting by Thinning and/or Grinding the Tool Base

V. Projections: This variable applies to whole pieces, broken pieces with projections, or projections alone (i.e. broken drill bits). The projections are defined by intentional retouch or by wear on an unretouched area that extends out from the body of the piece.
   1. Present
   2. Absent
   3. Not Applicable (tool fragments without projections are scored not applicable)

W. Modification on Projections: Applies only to pieces with projections.
   1. Present
   2. Absent
   3. Not Applicable (pieces without projections are scored not applicable)

X. Length (mm): The longest axis of the piece regardless of orientation was measured as length.

Y. Width (mm): The longest axis perpendicular to the long axis was measured as width.

Z. Thickness (mm): The greatest axis perpendicular to both length and width was measured as thickness.

AA. Weight (g): Weight was recorded only for whole pieces.

BB. Comments: Written comments accompany unusual pieces. The comments have been grouped into six categories.
   1. Thinning Flake – Thinning flakes are flakes exhibiting dorsal flake scars and some sort of edge preparation. These items are usually products of bifacial manufacture and are not in themselves shaped for an intentional use.
   2. Unusual Raw Material – Any comment about raw material that is not covered in the main body of the scheme is recorded as a written comment on the original recording forms.
   3. Dubious Artifact – Flake scars may have been caused by some natural agent, and therefore, the item may not be an artifact.
   4. Unusual Artifact Form, General – The artifact shape is in some way unique.
5. Unusual Artifact Form, Specific – The artifact shape is similar to a particular form which is in some way characteristic of the site. A written comment can be found on the original recording sheet.

6. Association – The item under consideration is linked to another item. This link may be refitting, items from the same core, or spatial relationship.

7. More than Four Edges – Edge angle and configuration records for these artifacts can be found on the original recording sheet.

8. Other

CC. Comment 2: Written comments

DD. Projectile Point and Lithic Tool Type
   1. Madison
   2. Levanna
   3. Fort Ancient
   4. Nodena Elliptical
   5. Contracting Stemmed Point
   6. Unclassified (or Unidentified) Projectile Point
   7. Bipolar Projectile Point (or Biface)
   8. Bipolar Core
   9. Drill
   10. Awl (or Piercer)
   11. Unidentified Tool (Broken or Dubious)
   12. End Scraper
   13. End and Side Scraper
   14. Knife
   15. Core
APPENDIX C

USE WEAR DATA RECORDING SHEET

SITE ________________________________
TOOL NUMBER_______________________
TOOL MATERIAL_______________________

EDGE NUMBER_______________________

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<td>rectangular</td>
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<td>Microflake termination</td>
<td>feather</td>
<td>hinge</td>
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<td>high points</td>
<td>high and low points</td>
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<td>NO</td>
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PLAN VIEW OF ARTIFACT:

```plaintext

```
APPENDIX D

Plate 1. Diagonal striations from a longitudinal motion at 200x magnification

Plate 2. Perpendicular striations from a transverse motion at 200x magnification
Plate 3. Parallel striations from a longitudinal motion at 200x magnification

Plate 4. Edge rounding and striations at 50x magnification
Plate 5. Edge rounding and plant polish at 50x magnification

Plate 6. Edge rounding and plant polish at 50x magnification
Plate 7. Edge rounding and hide polish at 50x magnification

Plate 8. Wood polish at 200x magnification
Plate 9. Wood polish at 500x magnification

Plate 10. Smooth pitted polish at 200x magnification
Plate 11. Plant polish at 200x magnification

Plate 12. Plant polish at maximum development known as “sickle gloss” at 200x magnification
Plate 13. Hide polish at 200x magnification

Plate 14. Hide polish at 200x magnification
Plate 15. Hide polish at 200x magnification

Plate 16. Hide polish at 50x magnification
APPENDIX E

T-test of metric variables as they relate to basic form (cited page 93)

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<tr>
<th>Group Statistics</th>
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<tbody>
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<td>Basic Form</td>
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<td>Levene’s Test for Equality of Variances</td>
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<td>F</td>
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<td>Length</td>
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<tbody>
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<td>t-test for Equality of Means</td>
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<tr>
<td>Sig. (2-tailed)</td>
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<td>Upper</td>
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<th>Std. Deviation</th>
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#### Independent Samples Test

**Levene's Test for Equality of Variances**

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**95% Confidence Interval of the Difference**

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**Independent Samples Test**

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**Independent Samples Test**

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**Independent Samples Test**

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APPENDIX F

Flow chart for the determination of the dominant use of stone tools.

1. Use-wear
   a. Present…….(go to 2)
   b. Absent…….(unidentified)

2. Contact Material Hardness
   a. Soft Substance…….(go to 3a/b)
   b. Medium-Soft Substance…….(go to 3c)
   c. Medium-Hard Substance…….(go to 3d)
   d. Hard Substance…….(go to 3e/f)

3. Micropolish
   a. Hide…….(go to 4a/b)
   b. Plant…….(go to 4c/d)
   c. Green Wood…….(go to 4e/f)
   d. Antler…….(go to 4g/h)
   e. Bone…….(go to 4i/j)
   f. Wood…….(go to 4k/l)

4. Dominant Motion
   a. Transverse motion on hide…….(hide scraping)
   b. Longitudinal motion on hide…….(butchering)
   c. Transverse motion on plant matter…….(extraction of fibers)
   d. Longitudinal motion on plant matter…….(harvesting plants)
   e. Transverse motion on fresh wood…….(whittling/planing wood)
   f. Longitudinal motion on fresh wood…….(sawing wood)
   g. Transverse motion on antler…….(carving antler)
   h. Longitudinal motion on antler…….(sawing antler)
   i. Transverse motion on bone…….(scraping bone)
   j. Longitudinal motion on bone…….(sawing bone)
   k. Transverse motion on hard wood…….(whittling/planing wood)
   l. Longitudinal motion on hard wood…….(sawing wood)