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SPATIAL ORGANIZATION OF LITHIC TECHNOLOGY AT THE MATHER-
KLAUER LODGE SITE: A TERMINAL WOODLAND OCCUPATION ON
GRAND ISLAND, MICHIGAN

Andrew L. Mallo

239 pages

The Mather-Klauer Lodge site is a Terminal Woodland (ca. AD 600- AD 1600) occupation of the west side of Grand Island, Michigan, where Echo Creek empties into Lake Superior. Excavations by Illinois State University field schools and the Commonwealth Cultural Resources Group identified a buried, compact, greasy living surface containing four hearth features, a storage pit, and over 20,000 pieces of lithic debitage. Analysis of the lithic assemblage shows that the organization of lithic technology at the Mather-Klauer Lodge site utilized the bipolar reduction technique to reduce locally available quartz cobbles with the goal of producing flakes of various shapes and sizes. Those that fit the technological needs of the inhabitants were then selected for use as utilized flakes or for further modification into triangular arrowheads or scrapers. Although local chert was present at the site, it is represented by low numbers of tools and debitage, suggesting chert tools were brought to the site, used, and maintained, but not manufactured there. Spatial analysis of the piece-plotted lithics using ArcMap's Hot Spot Analysis Tool (Getis-Ord G_i^*) to determine statistical clustering identified three spatially distinct reduction localities, situated in close proximity to hearth features. Lipid

analysis of the living surface soil produced evidence of fresh water fish, plant greens, roots, and berries (Malainey and Figol 2014). The results of these analyses, combined with ethnographic evidence, suggests that the Mather-Klauer Lodge site represents at least a spring-summertime occupation focused on exploiting the spring fish spawns and preserving some of their catch for later use in the summertime. The selection of hyper-local lithic raw materials and the expedient nature of the tool kit suggest that the population was seasonally sedentary and had a restricted range of mobility in their subsistence activities. These data fit regional trends observed during the Terminal Woodland period (Cleland 1989; Martin 1989; McHale Milner 1991).

KEYWORDS: Archaeology, GIS, Grand Island, Lithic Technology, Spatial Analysis, Upper Peninsula

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KLAUER LODGE SITE: A TERMINAL WOODLAND OCCUPATION ON
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ANDREW L. MALLO

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

MASTER OF SCIENCE

Department of Sociology and Anthropology

ILLINOIS STATE UNIVERSITY

2016

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ANDREW L. MALLO

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James M. Skibo, Chair

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Much in the way a stratified site provides a diachronic view of the past, so too I would like to structure my acknowledgements, because it is not one person or event, but rather a series of them that shape who we are, and who we are to become. First and foremost I would like to thank my family, especially my parents, who have been a constant source of inspiration and motivation for me throughout my life. Second, I would like to thank my undergraduate professor Dr. Alex Ruuska, whose guidance and patience prepared me for the rigors of grad school. Next, my ISAS family, specifically Dave Nolan, Tim Boyd, and Rob Hickson, as well as others who are too numerous to name, but are all equally important in my growth as an archaeologist and as a person. To my fellow Illinois State University graduate students, specifically Ian Fricker, Cori Rich, and Montana Martin, whose friendship has kept me sane. Finally, to my committee members, whose guidance through this process has been invaluable. Dr. John Kostelnick has been an immense help with many of the technical difficulties I encountered during the data processing and has always been a friendly face to talk with. Dr. Jim Skibo and Eric Drake found me as a 16 year old high school student and helped me grow into the archaeologist I am today. Their enthusiasm, guidance, and comradery were what solidified my desire to become a professional archaeologist, and they have helped me through the process.

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CHAPTER I

INTRODUCTION

The organization of lithic technology has been shown to provide insights into prehistoric access to raw material (Andrefsky 1994a, 1994b) and group mobility (Binford 1979; Odell 1994; Parry and Kelly 1987). This paper uses these theoretical frameworks to examine the lithic assemblage at the Mather-Klauer Lodge site, a Terminal Woodland (AD600- AD1600; Drake and Dunham 2004) occupation at the mouth of Echo Creek on Grand Island, Michigan. The temporal affiliation of the site was determined by the presence of Sand Point stick-wrapped sherds (Dorothy 1980), as well as Terminal Woodland triangular arrowheads (Dorothy 1980; Dunham et al. 2010), and is further supported by two AMS radiocarbon dates falling between cal. AD1170-AD1280 (Beta-348784; Dunham et al. 2010). Excavations by Illinois State University (ISU) field schools were focused on exploring a compact, buried Terminal Woodland living surface created during one or multiple spring/summertime occupations of the locality. This assertion is derived from the presence of an aquatic tuber found during the 2009 excavations by the Commonwealth Cultural Resources Group (CCRG), lipid analysis of the soil, analysis of the site's lithic assemblage, and a spatial analysis of the thousands of piece-plotted artifacts collected during the two field seasons using the ArcGIS mapping program. The results of these analyses were further used to describe the lithic technology

and its spatial organization at the Mather-Klauer Lodge site and to place it into the broader social and political context of the Woodland Period in the Upper Great Lakes (Brose and Hambacher 1999; Dunham and Drake 2004; Fitting 1975; Martin 1999).

This thesis encountered three major methodological issues that had to be overcome in order to accomplish the aforementioned goals. They include: (1) how to successfully analyze the thousands of piece-plotted artifacts recovered during ISU's excavations; (2) how to apply these analyses to a quartz-dominated lithic assemblage; and (3) how to use the resulting data to examine the spatial organization of lithic technology, site structure, and site function of the Mather-Klauer Lodge site. Although the majority of the paper focused on the resolution of these three issues, the primary focus of this thesis was to use the data gathered from these analyses to place the Mather-Klauer Lodge site within the context of the Terminal Woodland period in the Upper Great Lakes. More specifically, this paper attempts to use the data from the Mather-Klauer Lodge site to address unresolved questions about the shifting mobility and subsistence strategies observed in the Upper Great Lakes region during the Terminal Woodland period (Cleland 1992; Dunham 2009, 2014; Dunham and Drake 2004; Martin 1984, 1989).

The first issue, how to successfully analyze thousands of piece-plotted artifacts, was resolved using a variety of lithic analysis techniques. Not only were there a large number of piece plotted artifacts ($n = 5,866$), but the assemblage also contained an additional 18,587 artifacts that were recovered in concentrations or during the screening process. Given the large number of artifacts, mass analysis techniques seemed most

appropriate (i.e. Alher 1989; Stahle and Dunn 1984). However, the individually bagged artifacts made it so that a large number of them had to be handled individually and thus an individual flake analysis equally efficient. It was decided to combine the approaches and conduct an individual flake analysis for the piece-plotted artifacts, using the measured metric and weight data to create debitage profiles that will serve a comparative dataset for future Upper Great Lakes lithic assemblages. If this technique is used at enough sites, patterns of lithic technology will emerge from the debitage that may allow archaeologists to successfully identify the age of lithic scatters that are void of temporally diagnostic artifacts.

The second issue, how to apply these techniques to a quartz-dominated assemblage, was an iterative process that began with a literature review of quartz studies. While only a handful of studies have focused on the analysis of quartz debitage and the identification of traditional flake attributes (e.g. Ballin 2008; Barber 1981c; Bisson 1990; Driscoll 2011, 2012; Tallavaara et al. 2010), a recent article by Holdaway and Douglass (2015) changed the way that quartz debitage was treated towards the end of this thesis. The selection-based method of quartz utilization described by Holdaway and Douglass (2015) in New South Wales, Australia seemed applicable to the Mather-Klauer Lodge assemblage. That is, quartz was smashed to produce debitage of varying shape and size, and from the debris, knappers selected pieces that fit their technological needs (Ibid). This method of discussing lithic reduction differs from the traditional “staged” reduction sequences often used to discuss the lithic technology of finer cryptocrystalline materials (c.f. Callahan 1979), but has been documented in several ethnographic accounts of lithic

technology (see Hayden 1979; LeBlanc 1992; Parry and Kelly 1987). Therefore, the analysis of the pieces selected for further modification is of more importance than the analysis of the unaltered debitage.

The third major issue encountered during the course of this analysis was how to display, summarize, and analyze the thousands of piece-plotted artifacts collected during ISU's investigations. This is intertwined within a larger issue: the use of Geographic Information Systems (GIS) in archaeological analysis (i.e. Ebert 2004; Kvamme 1999). Although GIS has been used in a variety of ways to look at archaeological data on the regional level (e.g. Healan 1995; Seeman 1994; Vullo et al. 1999), aside from refitting studies (e.g. Morrow 1998) few analyses beyond simple distributional analyses have been conducted at the intrasite level. Although piece-plotted data is often collected during the course of archaeologist's investigations in hopes that it will create a great dataset to work with in the lab, few archaeological have conducted higher-level statistical analyses of artifact distributions in order to examine assemblages. Exceptions to this trend however, include some use of the K-means cluster analysis (Whallon 1974) and spatial autocorrelation analysis (Whallon 1973).

The presentation of data is a powerful analytical tool that has been used for decades based largely on the visualization of simple artifact distributions. With the addition of robust statistical tools to basic GIS mapping programs, it is now possible to statistically classify these data, helping archaeologists to more accurately describe and compare both intra- and inter-site artifact distributions. In order to classify data at the Mather-Klauer Lodge site, this thesis utilized ArcGIS's Optimized Hot Spot tool that

statistically maps clustering using Getis-Ord G (ESRI 2014a). This provides a semi-impartial way to classify artifact clusters without resorting to simple visual inspection.

When conducting such analyses, however, an artifacts' entire behavioral chain must be considered, including the procurement of the raw material used to make it, its manufacture, use, maintenance, discard, and any post-depositional processes that may have affected it prior to its entrance into the archaeological record (Schiffer 1972, 1976, 2002; Skibo and Schiffer 2008). This means that the position in which an artifact is found does not always equate to the position in which it was manufactured, used, maintained, or discarded (Behm and Behm 1983; Binford 1980; Schiffer 1976). Only when these theoretical observations are combined with the statistical analysis, will archaeologists be able to accurately discuss site structure, the spatial distribution of artifacts, and be able to use these data to discuss how individual sites fit into the regional picture. To this end, the following paragraphs briefly summarize the contents of the succeeding chapters.

Chapter 2 reviews previous studies on quartz-dominated lithic assemblages, including those from Africa (Bisson 1990; Cornelson 2003), New England (Barber 1981c), and Scotland (Ballin 2008). Additionally, studies on the fracturing properties of quartz (De Lombera 2009; Driscoll 2010, 2011, Tallavaara et al. 2010) and use-wear studies conducted on quartz artifacts (Derndersky and Ocklid 2001; Vaughn 1985) were reviewed with the goal of figuring out what attributes to look for when analyzing the Mather-Klauer Lodge assemblage. The focus of the chapter then shifts to a review of the bipolar reduction technique (Binford and Quimby 1963), the most common reduction technique employed at the Mather-Klauer Lodge site. More specifically, it summarizes

the debate over *pieces esquillées*, or bipolar lithics, which has been an ongoing discussion in archaeology for a number of years (LeBlanc 1992; Ranere 1975; Shott 1989). This thesis concludes that a single interpretation for *pieces esquillées* is not plausible, given their wide geographic distribution and that they likely reflect a combination of both exhausted cores and wedges, depending on the context in which they were found. Finally, the theoretical framework for the remainder of the paper is outlined at the end of Chapter 2. In short, the quantity, quality, and form of a raw material have a large effect on the type of lithic technology (i.e. expedient vs. curated) employed at a given site (Andrefsky 1994a, b). Additionally, it has been shown that the type of lithic technology employed at a site is also tied to the relative mobility of a population (Binford 1977; Odell 1994, 1996; Parry and Kelly 1987). In all likelihood a combination of these factors affected the organization of lithic technology at the Mather-Klauer Lodge site.

In order to provide a backdrop over which to present the data from the Mather-Klauer Lodge site, Chapter 3 reviews the Initial Woodland period (AD0- AD600) and Terminal Woodland (AD600- AD1600) periods in the Upper Great Lakes. Of primary focus, are previous lithic studies at the large costal sites that defined much of the archaeology in the region (e.g. Brose 1970a; Cremin 1980; Dorothy 1980; Fitting 1968; Janzen 1968; Mason 1966, 1967; McPherron 1967), but also lithic studies stemming from smaller sites (e.g. Marcucci 1988; Drake et al. 2009), and studies of lithic identification and distribution (e.g. Clark 1995; Julig 1992; Luedtke 1976). The diachronic focus of the chapter helps highlight the shifting subsistence strategies from shallow-water localities that exploited spring-spawning fish in the Initial Woodland to deeper-water localities that

facilitated the harvesting of fall-spawning fish during the Terminal Woodland (Cleland 1982; Dunham 2008, 2014; Martin 1985, 1989). Concomitant with this shift was an increased localization of groups as identified by a proliferation of similar, but stylistically different pottery styles (McHale-Milner 1991), and a reduced distributional range of lithic raw material (Luedtke 1976) during the Terminal Woodland period.

Chapter 4 provides an overview of the investigations at the Mather-Klauer Lodge site, including a summary of the excavations conducted by the Commonwealth Cultural Resource Group (CCRG) in 2009, and the two years of fieldwork conducted by ISU's field schools. The chapter then goes on to describe the methodology employed to analyze the site. After a review of previous quartz research in Chapter 2, it was decided that employing CCRG's methodology of analysis for the material excavated in 2009, with a few tweaks, was most appropriate (Dunham et al. 1997; Dunham et al. 2010). Not only did CCRG's methodology seem well suited to a quartz-dominated assemblage, but it facilitates easy comparisons to the numerous additional assemblages excavated in the Upper Great Lakes since the early 1990's.

Chapter 5 presents the results of the lithic analysis of the Mather-Klauer Lodge assemblage. Briefly summarized, the site's inhabitants primarily utilized bipolar reduction technology to split open and further modify quartz and chert cobbles that were turned into bipolar lithics and utilized flakes, along with three triangular arrowheads and four scrapers. The overwhelming use of expedient tool technology is seen as a function of the raw material available in the immediate vicinity of Grand Island, but also as an indicator of the group's relative mobility, which appears to be extremely localized.

Attempting to analyze the lithic assemblage in a vacuum without considering other archaeological evidence recovered from the site would hamper the ability to consider the full range of behavioral activities that created those artifacts. For this reason Chapter 6 begins with a stratigraphic analysis of the site, outlining the processes that formed each of the zones observed during excavation, followed by a summary of the five cultural features observed at the site. These include four hearth features and one storage pit. Following these summaries, the chapter delves into the spatial organization of lithic technology at the site. Using the Optimized Hot Spot Analysis tool available in ArcGIS's ArcMap program (ESRI 2014a), four statistically significant hot spots of chipped-stone debris were identified, three of which thought to represent an area of initial cobble reduction based on significant clustering of small debitage and the presence of hammerstones and anvils used in bipolar reduction (HS2, HS3, and HS 4). The fourth hot spot (HS 1) corresponded to an area containing a statistically significant cluster of fire cracked rock (FCR), and was located adjacent to the boundary of a hearth feature (F 5). This hot spot was thought to consist of secondary deposits, created through hearth cleaning, a process described ethnographically (Kohl 1985). An additional hot spot of fire cracked rock FCR was identified, one of which did not correspond to the chipped-stone clustering. The close spatial organization of several chipped-stone facilities in close association with hearth features and a greasy lipid-filled living surface soil horizon was thought to be indicative of organized fish cleaning and preserving activities, an act documented ethnographically by Grant (1890, cited in Kinietz 1947).

Chapter 7 summarizes the results of the previous two chapters and presents the data in conjunction with the results of the lipid analysis of Zone Ib (the compact living surface) that was the focus of ISU's investigations. The results of the lipid analysis found evidence of fish, and 'low fat content plant' lipids such as those that are produced by plant greens, roots, and berries. Absent from the lipid analysis results was evidence of acorns, which have been shown to play a pivotal role in Terminal Woodland subsistence (Dunham 2009; 2014; Skibo et al. 2009). These data, combined with the identification of a charred aquatic tuber from the 2009 investigations (Dunham et al. 2010) suggest a spring/summertime occupation of the Mather-Klauer Lodge Site. Given the location of the site next to a deep-water locality off the west side of the Island and the documented importance of the fall fishery in regional archaeological subsistence models (e.g. Cleland 1989; Dunham 2014; Martin 1989), it is possible that the Mather-Klauer Lodge was occupied during the Fall as well. Evidence for a Fall occupation may well exist in unexcavated portions of the site, or in sections that have since eroded into Lake Superior, but based on the current assemblage the claim cannot be substantiated using archaeological data from the site itself.

The remainder of the chapter places the site into the context of the Terminal Woodland Period in the Upper Great Lakes. The expedient nature of the tool assemblage and the localized selection of lithic raw material suggest that the inhabitants of the Mather-Klauer Lodge site were seasonally sedentary and had a restricted range of mobility during their occupation of the site that may have been geographically restricted to Grand Island itself. This follows the general pattern of restricted mobility during the

Terminal Woodland period, as described above. The data to support the aforementioned assertions can be found in the chapters below.

CHAPTER II

LITERATURE REVIEW AND THEORETICAL FRAMEWORK

“Quartz more than any other stone inspires fear and loathing in the archaeologist.”

- Russell J. Barber (1981: 1)

The above quotation by Barber (1981) sums up many archaeologists’ attitudes towards quartz as an archaeological raw material. Many of those sentiments derive from quartz’s poor fracturing properties and its ubiquity on the landscape, making it both difficult to analyze and to source. As such, comparatively little work has been attempted on quartz-dominated lithic assemblages, including the one from Grand Island, Michigan, selected for this study. Currently, there is a debate amongst archaeologists about whether or not lithic assemblages dominated by quartz should be analyzed with a separate methodology (Cornelissen 2003), or by similar methodologies for finer cryptocrystalline silicate dioxide material such as flint and chert (Ballin 2008). For the purposes of this analysis, the answer lies somewhere in-between. While the fracturing properties of quartz do introduce additional variables to be considered when analyzing certain flake attributes, typologies can be created that prove useful for analyzing both types of assemblages such as the one utilized by this thesis (Dunham et al. 1997). This chapter seeks to examine both sides of this debate by examining previous archaeological research on quartz as a raw material, as well as the theoretical frameworks that can be used to contextualize its

presence and function at the Mather-Klauer Lodge site located on Grand Island, Michigan.

Quartz Characteristics

Quartz is a silicon dioxide (SiO_2) and is among the most common minerals on earth. It is a significant component in many metamorphic, igneous, and sedimentary rocks that form the earth's crust (Driscoll 2011). It exhibits conchoidal fracturing properties and is a hard, yet brittle material that makes it well suited for stone tool manufacture. As a general rule, quartz can be divided into two categories: macrocrystalline and cryptocrystalline (Driscoll 2011).

Cryptocrystalline quartz is a fine crystalline silica whose crystals are not visible to the naked eye. It often has a minutely radiating fibrous or granular structure (Börner 1962). Cryptocrystalline quartz fractures conchoidally at the micro-scale within the individual quartz crystals and also at the macro-scale, following a fractal pattern (Idorn 2005). The cryptocrystalline quartz category includes many raw materials found archaeologically such as flint, chert, jasper, chalcedony, and agates. These raw materials were highly valued for their conchoidal, isotropic fracturing properties, allowing flint knappers to determine the shape of their stone tools by controlling how the material breaks.

Macrocrystalline quartz includes crystalline silica and coarsely granular quartzes. These are characterized by quartz crystals that are visible to the naked eye and include types such as rock crystal, amethyst, smoky quartz, rose quartz, and sapphire quartz, to name a few (Börner 1962). Macrocrystalline quartz is most commonly formed through

the cooling of hydrothermal solutions or molten rock. It can further be divided into two subcategories: automorphic or xenomorphic, depending on the conditions under which the macrocrystalline quartz cools (Driscoll 2011).

Automorphic quartz indicates that quartz crystals have formed into a recognizable shape, and thus transparent rock crystals are formed. Xenomorphic quartz, on the other hand, is formed when the quartz crystals were not able to form into a recognizable shape and formed through an aggregation of several microcrystals and yet have a macroscopically solid structure (de Lombera Hermida 2009). Xenomorphic quartz occurs in fine-grain and coarse-grain varieties depending on the size of the aggregation and anhedral structure of the crystals that form it.

All of the quartz material analyzed for this study is xenomorphic, macrocrystalline quartz that ranges from coarse- to fine-grained. It occurs in the form of beach cobbles that have eroded out from a conglomerate formation within the Cambrian-age sandstone outcrops around Grand Island, Michigan, and the surrounding region (see the *Geologic Resources* section in Chapter 4).

For the remainder of this study, the term “quartz” will be used to refer to xenomorphic quartz, while chert, jasper, and other cryptocrystalline quartz materials will be identified specifically by their common names. Finally, a third broad category of raw material, quartzite, will also be specified. Quartzite is formed through the metamorphosis of sandstone. Cobbles of quartzite are ubiquitous on the shores of Grand Island and derive from the same conglomerate as the quartz cobbles.

Quartz Research

Both cryptocrystalline and macrocrystalline quartz raw material have been utilized for the manufacture of stone tools as early as the Lower Paleolithic, appearing in archaeological deposits associated with *Homo erectus* in China (Breuil and Lantier 1937), and lasting until the contact period in North America. Evidence of its utilization is as geographically diverse as it is temporally. Quartz tools have been found in Europe, Asia, North America, Africa, and Australia (Rogers 1981). In North America, the presence of archaeological artifacts made of quartz was noted as early as the late-nineteenth century (e.g. Holmes 1919; Jones 1873).

During the processual movement in archaeology in the late 1960's through the 1970's, archaeologists became increasingly concerned with the scientific method, hypothesis testing, and reproducibility of results (Binford 1962). Led by François Bordes and Donald Crabtree, there was an attempt to revive the lost art of stone tool manufacture--flint knapping (Crabtree 1967). This wave of experimental archaeology was predicated on the assumption that the same methods and techniques used to create stone tools in the past can be rediscovered through experimental research and identified in the archaeological record (Odell 2004). Experimental flint knapping, however, has primarily utilized flint, chert, and other fine cryptocrystalline raw materials with more predictable fracture properties to conduct research into prehistoric knapping technologies. Thus, a large knowledge base was compiled on the fracturing properties and reduction sequences for flint and chert. Until recently, little archaeological research has focused on

the technology of quartz reduction and its associated properties, despite its widespread use and long-term recognition as a raw material used for stone tool manufacture.

Lagging sufficiently behind cryptocrystalline material research, the first systematic analysis of quartz lithic technologies in North America was conducted when Russell J. Barber (1981) compiled a number of papers on quartz research in New England. Included in the compilation were analyses of quartz reduction sequences (Boudreau 1981, Ritchie 1981); variation in lithic debitage as a result of material type, reduction sequence, reduction stages, and cultural preferences (Ludtke 1981); the effects of heat treatment on quartz raw material (Leveillee and Souza 1981); and general characteristics of quartz as a lithic raw material (Barber 1981b; Callanan 1981). However, since the initial push to understand quartz lithic technology was made in 1981, literature on the subject has dwindled in the continental United States. A surprising amount of literature has been published on quartz assemblages in West Africa (e.g. Bisson 1990; Cornelisen 2003; David et al. 1981), Scotland (Ballin 2008; Driscoll 2010, 2011), Australia (Holdaway 2014); Japan (Kobayashi 1975), and the Nordic region (Broadbent 1973; Callahan 1987; Knutsson 1988), as well as more general studies of quartz fracturing properties (Callahan et al. 1992; Driscoll 2010; 2011; Tallavaara et al. 2010), and use-wear studies involving quartz tools (Broadbent 1975; Sussman 1985).

Returning to the debate on how to successfully analyze a quartz-dominated assemblage, Ballin's (2008) analysis of the variability in raw material composition, reduction technology, spatial patterning, and chronology with regards to quartz and other lithic materials in prehistoric Scotland, argues against using separate typologies for each

raw material on the basis that separate typologies will inhibit the analysts' ability to compare lithic debitage between raw material types. On the other hand, Cornelisen (2003) notes that a number of West African archaeologists frequently note the problems of applying a standard typology to quartz assemblages (Casey 1993; David et al. 1981; MacDonald 1997: 171-172: cited in Cornelisen 2003: 11-12). The authors propose a variety of alternatives to deal with quartz assemblages, ranging from creating a localized typology (Shaw and Daniels 1984), to adapting a local typology to local conditions (MacDonald 1997 cited in Cornelisen 2003; Cornelisen 2003), to simply ignoring the quartz completely (David et al. 1997: cited in Cornelisen 2003). Bisson (1990), also working in Africa, developed a local typology to analyze changes in quartz reduction sequences over time only to find that no obvious differences in debitage or reduction technology were observable at the site in question.

More recently, Tallarva et al. (2010) and Driscoll (2010; 2011) have tried to systematically determine the fracturing properties of quartz. In a test of Callahan et al.'s (1992) quartz fracture analysis, Tallarva et al. (2010) suggests that the fragmentation of quartz and the resulting fracture profiles, which were created based on Callahan et al.'s (1992) study, varied significantly according to the type of percussion used to knap the quartz (i.e. hard hammer versus soft hammer percussion), and the individual knapper themselves. They suggest that the variability in quartz fragmentation, especially when compared to the fracturing of flint-like materials, should be addressed when analyzing quartz. The experimental analyses conducted by Driscoll (2010, 2011) support Tallavara et al.'s (2010) assertions that quartz fracturing properties are highly variable, and difficult

to analyze. Driscoll (2011: 744) points out that a general flake fragment baseline with which to analyze quartz assemblages is difficult to create. Although there are certain differences in fracturing properties by percussion type that were observable in Driscoll's controlled experimental analysis in which the debris from each strike was bagged separately, these differences would be extremely difficult to observe in the archaeological record where such control is not possible.

As Holdaway and Douglass (2015) point out, archaeologists often denigrate quartz as a raw material choice because of its poor knapping qualities. Those archaeologists who take this viewpoint are assuming that knapping quality is the primary reason for selecting raw materials. Tools, however, were made to be used, and tools made from quartz are just as useful as those made from any other raw material. Their analyses of sites within Fowler's Gap, Australia show that the differential production potentials of the silcrete and quartz raw material manifested themselves differently in the archaeological assemblages. The silcrete cobbles had knapping qualities comparable to that of obsidian or flint and thus were able to be more easily flaked, allowing for more intensive reduction of the cobble thereby producing more silcrete flakes per core when compared to the number of flakes driven from the smaller quartz cobbles. As a result of their fracturing properties, quartz cobbles were less intensively reduced and produced fewer useable flakes per core. To an archaeologist looking at these assemblages through a traditional framework, it would appear as though silcrete was a much more desirable and important raw material given the intensity of its reduction. Using cortical proportions to assess the transport of flakes and cores to and from the site, Holdaway and Douglass

(2015) found that a large number of quartz flakes, both cortical and non-cortical, were removed from the sites. The removal of large quantities of quartz flakes, assumedly for use as tools, shows that quartz was utilized just as intensively as the silcrete, even though the cobbles themselves were not as intensively reduced.

Part of the reason that archaeologists have had issues ferreting out these data from the archaeological record stems from the overemphasis on the “constrained process of lithic artifact production” (Holdaway and Douglass 2015: 8), while not factoring in the less rigid selection of the byproducts created by this process. That is, a large portion of research into lithic technology is concerned with classifying lithic assemblages, often comprised of both tools and debitage, into progressive stages of manufacture (i.e. Callahan 1979) that result in the manufacture of a formal tool. Experimental work using the concept of reduction stages (e.g. Morrow 1998) has demonstrated the byproducts of the episodic manufacture of stone tools do produce artifacts that are similar to those encountered archaeologically, lending credence to the theory of staged manufacture. Studies such as these are centered on the specialized production of formal tools such as projectile points or hoes (e.g. Cobb 2000). As such, Holdaway and Douglass (2015: 8) state that it is a waste of time to apply these “constrained processes of lithic artifact production” to a dominantly expedient tool technology derived from low-quality quartz.

Alternatively, Holdaway and Douglass (2015) suggest that instead of starting out with an end product in mind and progressing through various stages of manufacture (i.e. Callahan 1979), quartz cobbles were reduced using specific techniques that produced flakes of varying shape and size. From these byproducts, prehistoric inhabitants chose

flakes that met their technological needs. Holdaway and Douglass (2012) provide ethnographic evidence of Australian Aborigines utilizing this selection technique to provide a certain flexibility that was otherwise not afforded to them through the rigid sequential reduction process of a poor-quality raw material such as quartz. Thus, according to Holdaway and Douglass (2015), it is the selection and use of the byproducts rather than the method by which they were created that tells us the most about low-quality raw materials such as quartz.

Although the selection and use of the byproducts may be the most important variables when analyzing the behavior of prehistoric inhabitants, the processes by which the cobbles were reduced, referred to as the “constrained processes of lithic reduction” by Holdaway and Douglass (2015:8) do create technological signatures that, in theory, should be identifiable in the archaeological record. Many times, these processes of lithic reduction vary across time and space, and although they may differ depending on the raw material being reduced, if these signatures are indeed unique, they could provide archaeologists with a way to identify the temporal affiliation of sites that are otherwise devoid of temporally diagnostic artifacts. In the study area, sites containing solely lithic debitage are commonplace. The ability to place them within the spatial and temporal parameters of the region has the potential to inform archaeologists about group mobility and subsistence strategies.

Holdaway and Douglass (2015) are not the only archaeologists to point out the purposeful selection of quartz and as a raw material. Bisson’s (1990) work (described above) found that quartz was the preferred raw material for the early occupants of the

Luano Springs's site in Zambia who relied on a microlithic tool technology. Quartz continued to dominate at the site until the introduction of bifacial tool technology to the region necessitated the use of higher quality cryptocrystalline raw material. In another study, quartz was shown to have ritualistic value (Bradley 2000), and was the preferred raw material for the manufacture of stone axes at the Pike O' Stickle site in Cumbria, England. At this site quartz veins located on high cliff faces were purposely selected for quarry locations, even when quartz was ubiquitous in the region. The amount of energy that was expended to reach those resources suggests that the traditional theories of raw material procurement do not apply and that the quarries had some intrinsic value that the author interpreted as being ritualistic (Bradley 2000).

In summary, this section has shown that the fracture properties of quartz make it a difficult material to knap and to analyze. However, this did not dissuade prehistoric peoples from utilizing, and even purposely selecting for quartz as a raw material. As Andrefsky (1994a) points out, lower quality materials like quartz, regardless of abundance were primarily used for informal tool technologies, as was the case in Holdaway and Douglass' (2015) study. This is in contrast to materials with higher quality knapping qualities, which when scarce, were used for primarily formal tool technologies, but when abundant they were used in both formal and informal tool technologies (see below for a more in-depth discussion of the model).

Although there has yet to be a tried-and-true method for the analysis of quartz, a handful of observations have been made concerning the prehistoric utilization of quartz that appear to apply to a wide variety of archaeological assemblages across time and

geography. Two of these generalities, use-wear studies and the utilization of bipolar reduction, will be reviewed below.

Use Wear Studies

The selection and utilization of flakes made on poor quality raw material has been shown, at least in once instance (Holdaway and Douglass 2015), to be of more analytical value than the methods used to reduce the cobbles. The identification of use-wear on poor-quality raw material such as quartz, like the analysis of quartz debitage, proves difficult but as research has shown, it is not impossible. The concept of use-wear on stone tools was first introduced to the broader archaeological community by Semenov's (1964) experimental analysis of edge wears on metal artifacts. Despite the widespread recognition by archaeologists, very few use-wear studies were conducted in the years immediately following its publication (see Odell [2003] for a more in-depth discussion of the history of use wear). Since then, entire books have been authored on the subject of edge-wear and polish on stone artifacts (e.g Hayden 1979; Vaughan 1985). Similar to the typological studies described above, most use-wear studies have focused primarily on flint, chert, or other fine-grained cryptocrystalline raw materials such as obsidian. For some time, it was thought that the hardness of quartz and its poor fracturing properties precluded it from displaying use-wear characteristics (i.e. Leaf 1979). Unlike the debate over quartz typologies however, the debate over whether use-wear could be identified on quartz was definitively concluded by Broadbent's (1975) analysis of experimental quartz scrapers from Sweden, and by Sussaman's (1985) analysis of experimental quartz flakes. Since then, a small number of quartz use-wear studies have been conducted on

archaeological assemblages (i.e. Kutsson 1995; Kuttson 1998a: cited in Derndarsky and Ocklind 2001). More recently, Derndarsky and Ocklind's (2001) utilized dye with florescent color and florescent lighting in conjunction with a confocal laser scanning microscope to observe different wear striations, on experimentally produced and archaeologically derived quartz artifacts.

Despite the demonstrated presence of use-wear on both quartz and finer cryptocrystalline artifacts, use-wear continues to be an avenue of study that is not often included in archaeological analyses. In the review of the literature, only one such study could be found that dealt with Upper Great Lakes assemblages. Brose (1970a) in his excavations on Summer Island was the first and only lithic study in the Upper Great Lakes region to incorporate the analysis of use-wear in his examination of the sites' lithic assemblage. In addition to his classification of the debitage, cores, tools, and ground stone artifacts, he conducted use-wear studies of several different categories of chert tools including: bipolar wedges (*pièces esquilles*), scrapers, utilized flakes, and bladelets, as well as bipolar cores. Various forms of use-wear were discovered as a result of his analysis (Brose 1970a: 95-119). Various forms of use-wear were discovered as a result of his analysis (Brose 1970a: 95-119). Table 1 describes the type of artifact, the type of use-wear observed by Brose (1970a), and the interpreted function of those artifacts.

Although all of the artifacts were made of chert, their use-wear characteristics represent the only known use-wear study of an Upper Great Lakes assemblage. The types of tools and cores studied by Brose (1970a) are found throughout the region, including on Grand Island.

Table 1. Results of Brose's (1970a) Use-Wear Analysis at Summer Island. Table Created from Text.

Artifact Type	N. Containing Use-wear/ N. Analyzed Artifacts	Use-Wear: Striations	Use-Wear: Polish	Use-Wear: Flaking	Interpreted Function
Opposed-Point Core	2/7	Parallel Longitudinal striations along the axis of the core from one end for about 1/3 of the distance along the axis	None	None	Possibly used as awl or punch
Point-Ridge Core	3/7	None	Slight gloss on ridges of the ridge end and define crushing of the point end	None	None given
Point Area	0/7	None	None	None	N/A
Ridge-Area	0/7	None	None	None	N/A
Bifacial Scrapers	0/12	None Observed	None Observed	None Observed	None Observed
Unifacial End Scrapers	6/10	Faintly transverse striae	None Observed	None Observed	End Scrapers
Unifacial Side Scrapers	3/3	Faintly transverse striae	Slight polish on unchipped surfaces	None Observed	End Scrapers which may have been hand-held

Table Continues

Bifacial Choppers	2/ 2	-N. 1/2 show striae on both faces parallel to the long axis of the edge -N. 1/2 show short striae perpendicular to existed edge	Hand polish on proximal end on almost all high ridge, extending halfway down the faces	None	Handheld tools that were used to cut into resistant material
Opposed Ridge	12/50	-Faint Longitudinal striae extending about ¼ of the distance down face of core -1/12 exhibited transverse striae with oblique light	4/12 slight gloss along one or 2 high ridge facets on the “outside” face	Crushing and very small pressure flake driven off the concave face along one ridge	Similar to a burin pattern which hasn’t been subjected to much pressure, edge and concave side show pattern similar to end scraper
Bladelets	30/88	1). 13/88 had Faint overlapping to parallel transverse striae extend from the edge to the midline along one or both faces 2). 7/88 had Transverse striations on both faces paralleling one of the edges of the artifact and extend from that edge about ½ the distance to the mid-line ridge	3). 13/88- Had some degree of gloss or polish on both faces. Especially noticeable on higher ridges of the flake scars	4). 20/88 exhibited crushing and resolved flakes removed from one surface only along one edge	Various Functions: 1). Wood Scrapers of planes for a short time, or used with heavy pressure to cut across a rather unyielding object 2). Cut through some material, or scrap wood or bone 3). Knives used to cut meat 4). None given

Thus, the results of Brose's use-wear analysis will be used to infer a range of possible functions for similar classes of artifacts found on Grand Island, given that an individual use-wear analysis of the Grand Island assemblage was not conducted for this thesis. While it is recognized that the chert artifacts from Summer Island may differ in function from the quartz artifacts of Grand Island, the dearth of other studies necessitates this comparison. Even given the difference in the raw material, it is more likely that artifacts of similar classes from Summer Island and Grand Island were utilized in similar ways than it is that quartz artifacts from Grand Island were used like the Scandinavian quartz artifacts which have been subjected to use-wear analyses, as described in the section above.

The Bipolar Reduction Technique

The bipolar reduction technique is often associated with quartz-dominated archaeological lithic assemblages (e.g. Ballin 2008; Barham 1987; Deiz-Martin et al. 2011; Fitting et al. 1968) and has been frequently encountered in Upper Great Lakes lithic assemblages (e.g. Brose 1970a; Fitting 1968; Janzen 1968; Mason 1966). Although the technique had been noted previously, it was first systematically described in the Upper Great Lakes by Binford and Quimby (1963) who identified it as the "placing of small pebbles on an anvil and directing the blow parallel to the vertical axis of the pebble" (Binford and Quimby 1963: 277). The resulting cores display crushing on opposing ends. Flakes driven from bipolar cores are identified by a "relatively un-curved ventral surface with crushing, compression rings, or other evidence of applied force origination from opposite ends" (Lyons 1994:23), although as Crabtree (1972:42) notes:

“Contrary to popular belief, bulbs of force are not present on both ends of bipolar flakes or blades. This technique causes the cone of force to be shattered or severed. The cone confined to one end and is sometimes sheared.”

Because the byproducts of bipolar reduction are noticeably different from those of freehand reduction, the bipolar reduction technique is often talked about as a side-note when discussing lithic reduction technology. The bipolar technique has been identified on several different continents and ranges from the Early Stone Age (2.3 to 1.3 million years ago; Diez-Martin et al. 2011) and persists through European contact in places such as Africa and Australia where ethnographic accounts of the technique have been documented (see Shott [1989] and Barnham [1987] for ethnographic citations).

When it is encountered in the archaeological record, the bipolar reduction technique is often interpreted as a stone-economizing technique that enables the reduction and utilization of raw material that would otherwise be inefficient or impossible to exploit using other reduction technologies. How that interpretation manifests itself in the archaeological literature, however, is dependent on the raw material resources available for reduction. That is, when the bipolar technique is used to reduce poor-quality, coarse raw materials like quartz, it is seen as a stone economizing adaption to the quality of the raw material (e.g. Andrefksy 1994a; Hayden et. al 1996:26-29). Indeed, the aforementioned studies of quartz fracture mechanics have shown that the utilization of the bipolar technique on quartz produced a greater number of larger, complete flakes that would likely have been selected for use as tools when compared to other reduction techniques

(Callahan et al. 1992; Barnham 2011; Driscoll 2011: 739; Diez-Martin et al. 2011; Tallavara et al. 2010).

More commonly, the use of the bipolar technique is interpreted as a stone-economizing adaption to the size of the available raw material (Andrefsky 1994b, 2005; Binford and Quimby 1963; Leaf 1989; Odell 2003; Shott 1989). This interpretation is often made when the bipolar technique is utilized on small cobbles of finer cryptocrystalline material. In these instances, the form in which the raw material is found often dictates the type of reduction technique necessary to produce useable byproducts (i.e. Andrefsky 1994b). It should also be noted that raw material form and quality may also necessitate the use of bipolar reduction, as is the case in the microlithic technology of Africa (Bisson 1990; Cornelisen 2003), where small cobbles of low-quality chalcedony and quartz were reduced to produce small, useable flakes.

By far the most controversial aspect of bipolar technology is the interpretation of bipolar artifacts known in the archaeological literature as *pièces esquillées*, bipolar objects, or bipolar wedges. The term *pièces esquillées* was coined by Bardon and Bouysonnie (1906; cited in Shott 1989) and refers to artifacts that are morphologically characterized as being quadrilateral in plan-view and lenticular in profile with opposed striking platforms that are chisel-like in profile. Bifacial flake removal is also a common feature (Barnham 1987:45). The controversy lies in the way these artifacts are interpreted. Do they simply represent exhausted cores that are shaped by the bipolar technique, or were they wedges that were used for splitting wood and bone?

In a review of archaeological and ethnographic evidence, Shott (1989) concludes that most *pièces esquillées* are in-fact exhausted cores based on their infrequent association with bone and wood artifacts (on sites whose preservation allows for the recovery of such artifacts) and the lack of ethnographic and experimental use-wear evidence for the utilization of exhausted cores. He goes on to say, however, that true stone wedges were utilized prehistorically, but they are thinner than the artifacts normally defined as *pièces esquillées* and bare bipolar faceting and crushing that rarely extends the length of the specimen. Shott's interpretation is supported by Barnham's (1987) review of African ethnographic accounts, as well as his brief experimental knapping with chalcedony and quartz stream-rolled pebbles. In this experiment, Barnham found that the simple reduction of the small cobbles using the bipolar technique produced artifacts that closely resemble *pièces esquillées* without any utilization.

In rebuttal to Shott's (1989) article, LeBlanc (1992) summarizes experimental studies conducted by Ranere (1975) and Keeley (1980; cited in LeBlanc [1992]) in which *pièces esquillées* were used for wood splitting. Additionally, in direct contradiction to Shott (1989), LeBlanc points out two sites located in the Northern Yukon Territory, Canada where *pièces esquillées* were recovered from the same archaeological level as worked bone. Given these conflicting interpretations of *pièces esquillées* it seems appropriate to echo LeBlanc's (1992:11) sentiment that interpretations about the function of artifacts termed *pièces esquillées* must be made on a case-by-case basis, or at the very least on a regional/temporal basis. They are present in assemblages that span the full range of human history and occur in widely dispersed geographic areas. Given this

variation, it would seem that any attempt to interpret a generalized function that applies to all *pièces esquillées* is doomed from the start.

Within the study region for this thesis, the utilization of the bipolar reduction technique and the presence of artifacts resembling *pièces esquillées* is frequently observed (Binford and Quimby 1963; Brose 1970a; Fitting 1968; Janzen 1968; Mason 1966). Binford and Quimby's (1963) description of lithic technology in the Upper Great Lakes identified three different percussion surfaces present on bipolar cores: (1) Area—a relatively flat, generally cortical surfaces from which flakes have been detached; (2) Ridge—the line of convergence of the two opposite cleavage faces; and (3) Point—the convergence of three or more cleavage face resulting in a pyramidal form. These platforms combined to form six different core classifications: (1) Ridge-Area, (2) Point-Area, (3) Ridge-Point; Right Angle, (4) Opposing Ridge, and (6) Opposing Point. They viewed the cores as representing different stages of production, with those exhibiting “area” percussion surfaces representing the earliest stages, “ridge” percussion surfaces the middle, and cores with “point” percussion surfaces being the last stage. Although they recognized their knowledge of the spatial and temporal extents of this technology was limited, they correctly identify four other sites across the Upper Peninsula and Wisconsin that contained evidence of the reduction technology.

Brose's (1970a) use-wear study has already been mentioned (Table 1), but it is interesting to note that the “Opposed Ridge” cores (after Binford and Quimby 1963) in Table 1 most resemble the *pièces esquillées* that have been reviewed in this section. Brose's analysis of 12 of the 50 opposed-ridge cores present at the Summer Island site

found faint longitudinal striations extending about $\frac{1}{4}$ of the distance down face of core. One of the 12 specimens exhibited transverse striations when observed under oblique light. Furthermore 4 of the 12 cores exhibited a slight gloss along one or two high ridges. Experimental accounts cited by LeBlanc have shown the level of polish to be indicative of wood working activities (Keely 1980 cited in LeBlanc [1992]). On another core, Brose recorded crushing, indicated by very small pressure flakes driven off the concave face along on ridge. This concave ridge has been referred to in the Upper Great Lakes literature as a “gouge end.” In Africa and Europe, artifacts exhibiting this type of end are called “*outils écaillés*,” and have been shown by Barnham (1987) to be a result of the differential flaking on one side of the core as a result of bipolar knapping. Brose interprets the use-wear on the opposed ridge cores as being similar to a burin pattern that has not been subjected to much pressure. Additionally the edges and concave sides show a pattern similar to an end-scraper.

The differential use patterns on these opposed-ridge cores from the same occupation of the same site only goes to show that generalizing their function across prehistory remains problematic. It is likely that some of these artifacts simply represent exhausted bipolar cores. At the same time, it is equally likely that some of them functioned as tools for splitting, scraping, or other uses. This thesis will take Brose’s analysis into account when determining the likely function for artifacts in the two assemblages selected for this study.

Further Upper Great Lakes Lithic Studies

Just as there is likely a wide range of geographic and temporal variation for the functionality of *pièces esquillées*, considerable variation exists in the composition and distribution of regional lithic assemblages. In the Upper Great Lakes these assemblages have been identified as being notably unique (Binford and Quimby 1963; Fitting 1968). In order to correctly identify and analyze the two sites in this study, it is imperative to have a basis for which to evaluate them. The previous sections sought to provide background as to the fracture mechanics of quartz and the use of the bipolar technique in order to guide the analysis of the quartz-dominated assemblages. The ensuing section will provide a look at the lithic studies that have previously been conducted in the Upper Peninsula of Michigan and the surrounding regions.

Early archaeological investigations in the Upper Great Lakes were almost exclusively focused on large coastal sites situated on the shores of Lakes Superior and Lake Michigan. The reports on these excavations were often in the form of Ph.D. dissertations and had little-to- no detailed analysis of the chipped-stone debitage encountered at the site. Aside from Binford and Quimby's (1963) aforementioned analysis of the bipolar technique in the Upper Great Lakes few studies even mentioned lithic debitage. Mason's (1966) report on two sites on the Door Peninsula of Wisconsin (see Figures 3 and 4 in Chapter 3) simply described the lithic tools recovered from his excavations. The same was true of Janzen's (1968) excavations at Naomikong Point, located on the south shore of Lake Superior (see Figure 3 and 4 in Chapter 3) and McPherron's (1967) report on the Jutonen site, located in the Straights of Mackinac.

Fitting's (1968) report on the lithic technology of Northern Lake Michigan, and Brose's (1970a) report on Summer Island (mentioned above), both contained information on chipped-stone debitage, cores, and lithic technology employed at the site. At both sites, there was evidence of the bipolar technique in the form of bipolar cores and lithic wedges (*pièces esquilles*), as well as a freehand reduction technique that did not utilize an anvil during core reduction. The term "free flaking" was used to describe this latter technique.

Binford and Quimby (1963) had originally thought that the use of the bipolar technology on small cobbles was a Woodland phenomenon, and that the larger "block cores," which were reduced by freehand percussion, were attributable to the preceding Archaic period. Fitting's (1968) review of the chipped stone cores and tools from nine sites along the Northern Shore of Lake Michigan, in addition to the aforementioned large costal Woodland sites, disproved that hypothesis based on the identification of both technologies at sites dating to the Woodland time period. Fitting (1968:128-129) notes that "recent studies seem to indicate that virtually all knapping techniques so far reported from the area were known from Paleoindian through Woodland times." He hypothesized that the presence of block cores at a site may only indicate that there were sources of raw material large enough to be reduced without the aid of the bipolar technique. Thus, he hypothesized that sites from different time periods representing similar activities may have similar lithic technologies, while sites occupied by the same group of people at different points in the seasonal economic cycle could contain vastly different industries.

Additional attention was paid to the bipolar technique of the Upper Lake Michigan in Leaf's (1979) testing of Binford and Quimby's (1963) hypothesis that cores

exhibiting the different percussion surfaces represent different stages of reduction. In a statistical analysis of the weight of cores in each category, Leaf compared the data from Northern Lake Michigan with tabular chert lithic industries of North Dakota. Leaf's findings corroborated Binford and Quimby's hypothesis that the cores could represent sequential stages of reduction. His study failed, however, to incorporate Brose's (1970a) use wear data, which clearly demonstrates differential use of certain core types.

Much in the same way that Fitting (1968) and Binford and Quimby (1963) described the lithic industries of Upper Lake Michigan, Clark (1986) describes the industry in the Ottawa National Forest, located in the western half of Michigan's Upper Peninsula. He found that, like the industries of Upper Lake Michigan, those in the Ottawa focused primarily on local materials which consist primarily of quartz, and utilized both the bipolar reduction technique and free-hand percussion. He notes that the reduction technology and raw material composition at sites in the Ottawa are relatively stable and stretch from the Archaic to the Woodland period. Clark (1989) provides evidence of the same reduction techniques during the Plano-Tradition (8000-6000 B.C), including the bipolar technique and free hand percussion. However, he highlights the utilization of Hixon Silicified Sandstone, an exotic raw material quarried in Wisconsin, as a frequently utilized raw material source for making bifacial tools in the Plano-tradition, which continued less frequently in the subsequent Archaic tradition.

For many years, Upper Great Lakes lithic studies focused on the basic description of assemblages and their geographic distribution. Given the paucity of the archaeological work conducted in that region, the data needed to conduct higher level analyses were

lacking. The rise of government-sponsored CRM programs, in addition to the university excavations of the 1960's and 1970's, had amassed sufficient data to allow for the observation of regional and temporal patterns.

One of the first such observations was made by Forest Service Archaeologist John Franzen (1998:71-78), when he noticed that assemblages occurring at or above 188 m above sea level had lithic assemblages comprised of over 92 % quartz and quartzite. Sites with elevations between 185 m and 187 m had lower proportions of quartz and quartzite and higher percentages of chert. A subsequent analysis by Drake et al. (2009) separated the quartz and quartzite assemblages and developed a chronological model intended to identify the relative age of archaeological assemblages based on their raw material compositions. Drake et al. (2009) analyzed the lithic assemblage composition from sites with known temporal affiliations and concluded that sites containing over seventy percent quartzite debitage belonged to the late Archaic time period (ca. 8000 BC- A.D. 0), while sites containing 30 percent or less of quartzite largely belonged to the Woodland Period (ca. A.D. 1-1650). Those sites falling somewhere between 30 and 70 percent quartzite were often multi-component.

Per Franzen (1998), Drake et al. (2009) also refined the correlation between the raw material composition of a site's chipped-stone assemblage and its elevation above sea level. The majority of Archaic, quartzite-dominated assemblages were present at 189 m above sea level and up, while most of the Woodland period sites containing higher percentages of quartz and chert were located below 189 m. This basic chronological

model is useful when analyzing the myriad of lithic scatters found throughout the Upper Peninsula that are often devoid of temporally diagnostic artifacts.

Drake et al. (2009) found that most lithic assemblages on Grand Island are dominated by quartz and quartzite, though some chert-dominated assemblages are present. This pattern is likely caused by the respective availability of quartz and quartzite. Cobbles of each raw material can be found eroding out of a basal conglomerate on the eastern portion of the island. Glacially deposited nodules of chert are by far the least common lithic raw material to be found in conglomerate (Hambill 1958), and yet the majority of the formal tools recovered from Grand Island archaeological sites are made from chert (Drake et al. 2009).

A majority of the chert tools recovered from Grand Island, both formal and informal, were manufactured from these locally occurring chert nodules. However, other chert sources in the region were also exploited. Secondary deposits of Hudson Bay Lowland cherts (Clark 1995), for example, would have been accessible to the prehistoric populations of Grand Island through their seasonal migration routes and trade networks. Additionally, the Niagara escarpment that runs from upstate New York through southern Ontario across the southern portion of the Upper Peninsula and down the Door Peninsula into Wisconsin contains a variety of chert from the Silurian age dolomites (Drake et al. 2009). Notable outcrops include Cordell chert from south central Chippewa County, Michigan; (Luedtke 1976: 214-217; M. Drake and Dunham 2008: 4-7; Dunham and Branstner 1998:95), Moss Lake from the Nahma and Garden Corners area, Burnt Bluff

chert from the southern Garden Peninsula (Drake et al. 2009), Bois Blanc chert from the Straits of Mackinac, and Onondaga chert from upstate New York (Clark 1995; Figure 1).

The sourcing of chert raw material types found in archaeological assemblages has traditionally been used to formulate hypotheses of group mobility, intra-regional trade, and technological organization.

Figure 1. Map of General Location of Selected Chert Outcroppings Mentioned in the Text.

The differential distribution of chert resources on the landscape and the variation in color, texture, and inclusions between chert types are traditionally much starker than

those possessed by quartz and quartzite and typically make chert much easier to source. In the study region, however, the similarities in the macroscopic appearance of the secondary nature of many of the utilized chert deposits as a result of glacial activity, and the ability to source chert to a particular location is notably difficult (e.g. Dunham et al. 1997; Dunham et al. 2010). Many of these difficulties stem from the fact that chert resources occurring in the Niagara Escarpment (mentioned above) display only a slight variability in texture, color, inclusions, and cortex over a wide geographic area. Thus the color and texture descriptions for Onondaga chert from New York fall within the range of variability of the descriptions for Cordell chert in the Upper Peninsula of Michigan (see Clark 1991; Holland 2004; and Luedtke 1976). Additionally, with the exception of the four aforementioned chert outcrops, the distribution of such resources on the landscape is still in its infancy.

Two studies have attempted to describe the macroscopic variation of regional chert resources. Clark (1991) provided descriptions for a number of regional chert resources commonly found on Isle Royale, Michigan based on color, texture, and the presence of inclusions. Holland (2004) conducted an expanded study of macroscopic chert identification, which included descriptions of the majority of archaeologically utilized cherts of Michigan. As cited above, several authors have noted the difficulty of visually identifying chert. In an attempt to improve the accuracy of regional chert sourcing; two major attempts were made to identify chert based on chemical properties (Julig et al. 1922; Luedtke 1976).

Luedtke's (1976) dissertation work utilized neutron activation analysis to quantify trace elements in a variety of chert samples collected from throughout the Upper and Lower Peninsulas of Michigan. The ability to identify the source of the raw material on a given archaeological site, Luedtke asserted, would help develop models of exchange and trade in a region where chert is exceptionally difficult to source. The results of the study identified the trace element composition for many of the region's most heavily utilized chert quarries. Following on the heels of Luedtke's study, Julig et al. (1992) utilized instrumental neutron activation analysis (INAA) to chemically characterize Hudson Bay Lowland (HBL) chert from the source region in Canada, as well as other cherts that appear visually similar to HBL cherts, including Knife River Flint (RF) from North Dakota and Gunflint Chert also from Canada. They then compared the chemical signature of these source locations to the HBL-like pebbles of chert from Lake Superior and Lake Michigan beaches, as well as those from a lithic cache at the McCollum archaeological site. They found that the small pebbles were most chemically similar to HBL chert, although they note that considerable visual variation and some chemical variation between the locations where the pebble chert is deposited.

A review of the previous archaeological work conducted on Grand Island, Michigan has identified two primary chert types based on macroscopic analysis, Section 16 Chert (formerly referred to as Moss Lake) which outcrops along the eastern edge of the Sturgeon River Valley in T40N, R19W, and Cordell Chert whose main outcrop is at Scott Quarry in Chippewa County, Michigan (Dunham et al. 1997; Dunham et al. 2010). Additional deposits include Bois Blanc chert from Bois Blanc Island in the Straits of

Mackinac, and Fossil Hill chert near the Carlton Creek Complex of sites in the St. Mary's River Valley (Dunham et al. 1997), although neither of these chert types were present in the two assemblages analyzed for this study. Glacially deposited cobbles/pebbles of chert, on the other hand, are well represented in the archaeological assemblages, but the secondary nature of their deposit makes them extremely difficult to source macroscopically. To further confound the matter, given the extent of glacial activity in the region (see Anderton 1999, 2004; Benchley et al. 1988) secondary deposits of Cordell and Section 16 chert are also possible.

Theoretical Framework

An understanding of raw material resources is vital to the comparison of the two lithic assemblages for this thesis. Differential access to varying qualities of raw material for stone manufacture has been shown to affect the types of reduction techniques employed at a site, as well as the types of tools produced. As Andrefsky (1994a) points out, a population's toolkit variability will be affected by the quality of raw material sources available to that population. A basic overview of his model is presented in the table below (Table 2):

This model states that if a high quantity of low quality raw material is available in a region, one would expect to see a higher proportion of informal tools in comparison to formal tools. If there was a low quantity of low quality raw material, informal tools would again be expected in higher proportions. Conversely, if the site has a low quantity of high quality material, one would expect there to be a high proportion of formal tools as opposed to informal ones. If there is a high quantity of high quality raw material, one

would expect to see both formal and informal tools made from that material. Thus, the proportions of formal and informal tools at a given site are not necessarily caused by differences in the availability of lithic material, but rather its quality. According to the model, low quality chert, no matter how abundant, should be favored for expedient, informal tool production. High quality raw material on the other hand, could be used for both formal and informal tool production if it were found in high abundance but would generally be used for formal tools when scarce.

Table 2. Contingency Table Showing the Relationship between Quality and Quantity of Raw Material and the Types of Tools Produced. Adapted from Andrefsky (1994).

	High Lithic Quality	Low Lithic Quality
High Abundance	Formal and Informal-Tool Production	Primarily Informal-Tool Production
Low Abundance	Primarily Formal-Tool Production	Primarily Informal-Tool Production

Formal tools, in this instance, are defined as flakes or cores exhibiting additional modification beyond their initial detachment from a parent piece of material. Examples of formal tools include projectile points, knives, scrapers, hoes, and adzes, to name a few. These are what Binford (1978a; 1979) calls “curated tools,” and are manufactured and carried in anticipation of future tasks. Informal tools, on the other hand, are those that are utilized without additional modification after they are removed from the parent material. Most often these types of tools are tabulated as utilized or retouched flakes in the archaeological literature.

Informal/expedient tool technology has been shown to reflect mobility on the landscape, acting as a risk-abating strategy to combat unpredictable lithic resources (Odell 1994; Parry and Kelly 1987). Sedentary populations, then, would have less uncertainty about the presence and/or quality of raw material available to them. In instances where material was abundant there would be no need to maintain a bifacial toolkit, and populations instead could choose to utilize an informal toolkit that takes less time and effort to manufacture. Andrefsky (1994a), however, presents an alternative view of this traditionally-accepted correlation. In his analysis of three sites in the Western United States, however, he found that in highly mobile hunter-gatherer groups, given abundant high quality raw material, would create equal proportions of formal and informal tools while sedentary groups with limited access to high quality raw material favored a formal tool technology, with the majority of their formal tools made of extra-local chert. Therefore, he suggests that quality and quantity of material are more important indicators of lithic technology than mobility. Likely, mobility and raw material resources both played a role in determining how a group's lithic technology was organized. This thesis will attempt to incorporate both viewpoints when analyzing the assemblage at Mather-Klauer Lodge.

Any archaeologist who has experienced a quartz-dominated assemblage will tell you that quartz is a low quality raw material, with "quality" being defined as semi-brittle, fine grained, and isotropic (Odell 2003). In the area immediately surrounding Grand Island, Michigan, both quartz and quartzite are ubiquitous, while higher quality chert nodules are much less common. Thus, according to this model, lithic assemblages

collected from sites within the study area should display a quartz/ quartzite-based informal tool technology given the abundance of low quality material, with formal tools manufactured from the higher quality, but less abundant chert.

However, raw material quality and availability are not the only intrinsic properties that affect toolkit variation. The size and shape of the raw material source also plays a role in determining the type of lithic technology practiced and the morphology of tools made (Andrefsky 1994b). As Alher (1989:89) notes, lithic technology is a reductive technology, and thus no tool can be created that is bigger than the piece of parent material from which it was created. Although it often goes unstated, this basic premise underlies all of lithic analysis. The size and form of the parent raw material (i.e. cobble, vein, etc.) has been shown to have an effect on both the reduction technique use to knap the raw material (e.g. Andrefsky 1994b) and the final morphology of the tool (e.g. Conielson 2003).

The behavioral school of archaeology (Schiffer 1976; 1999; 2002, Skibo and Schiffer 2008) is centered on the principle that the entire “behavioral chain” must be considered when analyzing an artifact. Links in the behavioral chain include the procurement of the raw material, the manufacture of the artifact, its use, maintenance, re-use, its deposition, and the post-depositional processes that occur between when the artifact was deposited into the archaeological record and the time of archaeological recovery (Skibo and Schiffer 2008). Along these same lines, Andrefsky (2009) defined a specific behavioral chain for lithics that includes procurement, production, reduction, maintenance, and discard. The overarching goal of these behavioral chains is to

determine the manner in which humans organize their lives and activities with regard to the technology in question. The manner in which lithic tools and debitage are designed, produced, recycled, and discarded is intimately linked to forager land-use practices, which in turn are often associated with environment and resource exploitation strategies.

To this effect, the ways in which artifacts are discarded at a site have the potential to inform the analyst about the site type, the duration of settlement, and the spatial organization of lithic technology (e.g. Binford 1978b, 1979; Schiffer 1976). Schiffer (1972, 1976) identifies two basic methods of refuse disposal, primary and secondary. Primary refuse is that which is discarded at its location of use, whereas secondary refuse is systematically removed to another location and discarded. In addition, Binford (1978b) has identified various methods of primary refuse disposal, differentiating between toss and drop zones.

Patterns of refuse disposal have also been shown to be effected by the organization of lithic technology (e.g. Binford 1978b, 1979). Curated tools, described above, are usually items of personal gear that are manufactured and carried in anticipation of future tasks. Conversely, informal or expedient tools are manufactured and used to accomplish immediate tasks (Binford 1979). By definition, expedient tools are utilized and discarded with relative high frequency in accordance to the intensity of the activity being performed. Their distribution more accurately reflects the location in which these tools were used. Similarly, the spatial distribution of non-utilized debitage created during the manufacture and maintenance of these tools often represents areas primary refuse deposition (e.g. Behm and Behm 1983; Nolan and Hansen 1998; Van Nest

1998). Conversely, in the spatial distribution of curated tools is more indicative of tool replacement rates and not of the frequency of specific activities (Binford 1977).

The identification and analysis of how lithic technology is organized at any given site is not only dependent on resource availability and population mobility, it is also largely affected by the procurement of those raw materials, the manufacture of tools, the use of those tools, the way in which they were discarded, and any additional processes that effected the site after they were deposited.

With these factors in mind, the aim of this thesis is to explore the organization of lithic technology at the Mather-Klauer Lodge site, with a particular focus on its spatial organization. The results of these analyses will be used to address questions of group mobility, site structure, and site function. However, it is important that they are not taken out of the context of the regional and social climate during which the creators of the assemblage lived. Although the assemblage from the Mather-Klauer Lodge represents a single Terminal Woodland component, in order to incorporate the results of this analysis within the broader historical context of the Upper Great Lakes, the succeeding chapter will present a cultural overview of both the Initial Woodland and Terminal Woodland time periods, including their respective lithic and ceramic technologies, the geographic distribution of social groups, and the socio-political interactions between these groups as defined to the best of the abilities of archaeologists who have worked in the region

CHAPTER III

UPPER PENINSULA REGIONAL ARCHAEOLOGY

The term “Woodland” generally has been used in the field of archaeology to identify the time period during which prehistoric ceramic technology was adopted. In much of the Midwest, the Woodland period is divided into three separate temporal periods: Early, Middle, and Late Woodland. The temporal designations for the Woodland in Upper Peninsula of Michigan, however, are broken into just two periods, as a result of the late introduction of ceramic technology to the region and the absence of ceramic wares such as Marion or Schultz Thick attributed to more southerly Early Woodland groups. The two periods and their associated dates are as follows: the Initial Woodland (ca. AD 0- AD 600); and the Terminal Woodland (ca. AD 600- AD 1600) (Brashler et al. 2000, Brose and Hambacher 1999, Drake and Dunham 2004, Fitting 1975, Mason 1981).

The archaeology of the Upper Peninsula, like the study of quartz, has received relatively little attention compared to surrounding regions. The lack of urban development, heavily forested landscapes and the paucity of large, well-stratified sites have all contributed to the overall dearth of archaeological work done in the region. Many of the early archaeological studies in the region focused on the copper resources of the Keweenaw Peninsula and Isle Royale (i.e. Foster and Whitely 1850; Holmes 1901; West 1929). During the late 1960’s- early 1970’s, University of Michigan students,

under the direction of James B. Griffin, excavated a number of large costal sites on the shores of Lake Michigan (Brose 1970a, 1970b; Fitting 1968; Mason 1966), Lake Superior (Janzen 1968), and the Straits of Mackinac (McPherron 1967). Data from these excavations greatly influenced regional subsistence and settlement models, as well as early archaeological overviews of the Michigan Archaeology (i.e. Cleland 1982; Fitting 1975; Mason 1981; Wright 1967; see also Kooiman 2012). Since Griffin's retirement, academic-based excavations focused on the prehistory of the Upper Peninsula have decreased, although there are notable exceptions (e.g. Anderton 2004, Brashler et al. 2000; Buckmaster 2001, 2002, 2004; Drake and Dunham 2004, Drake et al. 2009; Dunham 2014; Kooiman 2012; McHale Minler 1991; Skibo et al. 2009). A substantial amount of the subsequent archaeological work in the region has been conducted as part of survey and mitigation of National Forest Service lands (see Figure 2; Anderton et al. 1991; Dunham 2000, 2014; Dunham and Branstner 1995; Dunham and Hambacher 2002; Dunham et al. 1997, 2000, 2010; Franzen 1998; S. Martin 1977; Robinson et al. 1991).

This chapter will provide a brief review of the Initial and Terminal Woodland time periods as they manifested themselves in the Upper Great Lakes Region. Additional attention will be paid to the Lakes Phase Terminal Woodland tradition associated with the Sand Point site, because of the probable presence that cultural component at the Mather-Klauer Lodge site.

Figure 2. Forest Service-Owned Lands in the Upper Peninsula of Michigan.

Initial Woodland (ca. AD 0 - AD 600)

The Initial Woodland period in the Northern Great Lakes is roughly contemporaneous with the Middle Woodland periods of Lower Michigan, Ohio, and Illinois (Brashler et al. 2000). Throughout much of the eastern United States, the Middle Woodland period is marked by the introduction of cultural expressions associated with the Hopewell culture (Griffin 1965). These include an extravagant mortuary complex and ornately decorated pottery. Although Northern-Hopewell cultures resided in Carolinian

Biotic Province portions of Michigan's Lower Peninsula (defined below) and the archaeological record provides evidence of cultural interactions between the Northern-Hopewell and Non-Hopewellian groups in Michigan, their interactions appear to be reciprocal, with the non-Hopewellian groups exerting as much influence on the Hopewell as the reverse (Brashler et al. 2000).

The ritualistic use of Lake Superior copper by the Hopewell funerary tradition suggests some degree of interaction between the two groups (Martin 1999). Additionally, the presence of an obsidian core at the Riverside Cemetery Site in the southwestern Upper Peninsula (Griffin 1965), and the discovery of a southern-looking Middle Woodland projectile point and six obsidian flakes sourced to Obsidian Cliff 150 Group in Yellowstone Park found at the Naomikong Point site located on the southern shore of Lake Superior (Janzen 1968), further illustrate that the northern groups did have some interaction with the Hopewell interaction sphere (Brashler 2000; Fitting 1975).

Despite these few artifacts, however, the extravagant funerary rituals and ornate pottery that define the Hopewell cultural expression were not part of the northern Non-Hopewellian traditions to any large degree. Some evidence exists for Hopewellian influence on the prehistoric ceramic and lithic traditions such as the high frequency of the bank stamping decoration on pottery found at Summer Island (Brose 1970a: 84-94), but at a time where there was much interaction between cultural groups, the Hopewellian influence on these traditions was no more prevalent than that of other surrounding Initial Woodland groups (Brose and Hambacher 1999).

The remainder of this section will explore the non-Hopewellian cultural expressions that existed in the Upper Great Lakes during the Initial Woodland. Fitting (1975: 129-142) coined the term “Lake Forest Middle Woodland,” after the forest association designated by Weaver and Clements (1939) and Potzeger (1946), to refer to the non-Hopewellian Initial Woodland complexes that existed in the glacial lake-pocked portions of the Canadian biome (Fitting 1975: 129). Further to the west, in Wisconsin, Mason (1981) coined the terms “Middle Tier” and “Northern Tier” to identify Initial Woodland groups that existed contemporaneously in the same Province. Together, these terms are used to refer to a number of different cultural expressions associated with a related group of ceramic technologies that can be defined broadly by the utilization of reduced-firing to harden grit-tempered, sub-conoidal ceramic vessels constructed of tenoned coils. Decorations varied between cultural expressions, but consisted largely of oblique or horizontal panels of massed simple motifs of stamped elements (Brose and Hambacher 1999). Several ceramic traditions have been defined within the Lake Forest Middle Woodland/ Initial Woodland, including Laurel, North Bay, Saugeen, Point Peninsula, and Nokomis (Brose 1970a; Brose and Hambacher 1999; Drake and Dunham 2004; Fitting 1975; Janzen 1968; Mason 1981; Wright 1967). This thesis will use the term “Lake Forest Middle Woodland” and “Initial Woodland” interchangeably to refer to the above-defined cultural expressions.

Site 03-754 has previously been identified as a Laurel Tradition Site based on the ceramic assemblage that was recovered from the site during the initial testing (Dunham et al. 1997). The Laurel Tradition was first identified by Wilford (1941) in Minnesota, but

cultural artifacts indicative of the tradition have since been observed in a broad geographic area ranging from Northeastern Ontario to Northeastern Saskatchewan and from Northern Minnesota to the edge of the Hudson Bay Lowlands (Reid and Rajnovich 1991). Much of what we know about the Laurel tradition and its interaction with the other contemporaneous cultural manifestations of the Initial Woodland period comes from work conducted in Minnesota (Stoltman 1973) and Canada (e.g. Reid 1991; Reid and Rajnovich 1991), along with the previously described excavations of the University of Michigan (e.g. Mason 1966, Janzen 1968) and CRM investigations of the Forest Service Land (e.g. Dunham et al. 2010; Robinson et al. 1991).

An attempt to identify the variation within Laurel Tradition ceramics was undertaken by Wright (1967) in his survey of the Middle Woodland in Canada, and later expanded upon by Janzen (1967) in his summary of excavations at the Naomikong Point Site, by Brose in his summary of excavations at Summer Island (1970), and by Stoltman (1973) in his general survey of the Laurel Culture in Minnesota. In general, Laurel ceramics are grit tempered and are identified by the presence of pseudo-scallop shell, dentate stamped, linear stamped and incised body and rim shreds, as well as the presence of punctuates. As Brose (1970a) and Janzen (1968) note, early archaeological work on Initial Woodland pottery lacked a standard nomenclature for identifying decoration types on the ceramics, and that many of the decorations on Laurel ceramics are similar to those from other ceramic traditions such as the Saugeen, North Bay, and Au Sable wares.

In the Upper Peninsula, it was Janzen's (1968) excavations at Naomikong point that first expanded the geographic area covered by the Laurel Tradition to include the

Southern Shore of Lake Superior. It is unknown whether the introduction of Laurel Tradition ceramics involved a population influx to the region or simply a diffusion of ceramic technology. As Skibo et al. (2009) point out, although ceramic technology exists in the regions surrounding Upper Peninsula, it is likely that the subsistence activities and high degree of residential mobility practiced by the local populations were not conducive to adopting such a technology. Traces of acorn residue in the form of fatty acids have been identified on pieces of FCR used for stone-boiling that date to the pre-ceramic Archaic period (ca. 4200 B.P -2000 B.P.; Anderton 1993; Dunham and Anderton 1999; Dunham and Branstner 1995). These same fatty acids are also present in early Laurel Tradition pottery sherds from Grand Island, suggesting that at least one of the factors spurring the adoption of ceramic technology was the superior performance characteristics of pottery over those of stone-boiling technology for long-term boiling of water used to boil acorns in order to extract their fat (Skibo 2013: 175-178; Skibo et al. 2009). The act of boiling acorns also leaches out natural toxins, making them suitable for human consumption, although this was likely a secondary benefit of extracting the fat by boiling (Skibo et al. 2009). If ceramic technology was indeed introduced by population influx to the region, then it is masked in the archaeological record by the paucity of Late Archaic/Initial Woodland populations and their high residential mobility (Brose and Hambacher 1999).

Lithic technology associated with Laurel Tradition does not lend itself to a succinct definition. A definitive temporal chronology of Laurel projectile point styles has yet to be completed, largely because deeply stratified Laurel sites are scarce and because

point styles vary over the expansive geographic area covered by the Laurel tradition. There are, however, general characteristics of the projectile points that can place them within the Laurel tradition. Janzen (1968) and Brose (1970a) have each identified multiple varieties of corner-notched, side-notched, and stemmed projectile points from their excavations at Naomikong Point and Summer Island. Similar projectile point styles were also identified at the Laurel components along the North Shore of Lake Superior (Wright 1967), Northern Lake Michigan (Cleland and Peske 1968, Fitting 1968, Mason 1991), and in Minnesota (Webster 1973). However, in each of the aforementioned citations the researchers developed their own classification system based on point size and morphology to classify the projectile points found at their respective sites. Even though many of these sites were among the first in their respective regions to be formally written up, the plethora of point names and styles have yet to be synthesized. This task is somewhat complicated by observations such as those made by Reid and Rajnovich (1991), in which they identified nine separate point styles (as identified using MacNeish [1958] and Kehoe's [1973] typologies) within three households at the Ballynacree site. They suggest that this is evidence that projectile point form is not related to chronology, and may instead be related to function, making the idea of a chronological sequence irrelevant (Reid and Rajnovich 1991: 202).

Laurel lithic reduction strategies appear to be as varied as the projectile point styles. It does appear, however, that the majority of the raw material found in Laurel assemblages comes from local sources (Fitting 1968; Janzen 1968; Reid and Rajnovich 1991, Wright 1967). As noted above, there is evidence of exotic raw material use but it is

the exception on most sites (e.g. Janzen 1968). Utilization of the bipolar technique on small, river-rolled chert cobbles has been noted at sites located along the southern shore of Lake Superior (Janzen 1968), the northern shore of Lake Michigan (Binford and Quimby 1968; Brose 1970a; Fitting 1968; Mason 1968), as well as sites located in Minnesota (Webster 1973). Bipolar wedges, or *pieces esquilles*, are present on Laurel sites, though they are not diagnostic of the Laurel Tradition. The use of the bipolar technique and the presence of bipolar wedges are present during the preceding Archaic period (e.g. Marcucci 1988), as well as the subsequent Terminal Woodland Period (e.g. McPherron 1967, Dunham et al. 2010).

Scrapers and utilized flakes are the next two most common lithic tools found at Laurel sites (Janzen 1968, Brose and Hambacher 1999:184). Both side and end scrapers were identified in large amounts at the Namoikong Point site (Janzen 1968), as well as other Laurel sites excavated in Minnesota (Webster 1973). While these artifacts are not diagnostic in themselves, their presence at a site would help solidify a Laurel Tradition association. Also present at Laurel sites are blades, utilized flakes, bone tools (where archaeologists are fortunate enough to have faunal preservation), net sinkers, and copper implements such as awls and fish hooks.

Subsistence. Many of the subsistence and residential mobility patterns associated with the Initial Woodland Period of the Upper Great Lakes region have been explained in terms of environmental factors (C. Branstner and Cleland 1994; Brose and Hambacher 1999; Fitting 1975; Mason 1981). Fitting and Cleland (1969: 289) identified three distinct biotic communities that occur in Michigan and relate to settlement patterns

(Figure 3). From south to north they are: (1) the Carolinian Biotic Province (2) Carolinian-Canadian Transition, and (3) the Canadian Biotic Province. Each biotic community is associated with a separate land settlement adaptive pattern (Fitting 1975; Fitting and Cleland 1969; Mason 1981) and is described below:

1. The Carolinian Biotic Province is located in parts of southern-Wisconsin, the southern half of the Lower Peninsula of Michigan, and beyond (Figure 3). It is characterized by moderate winters with relatively light snowfall and hot summers, though the heat of summer is moderated along the shores of the lakes. The Carolinian province consists of a mature drainage and a great variety of deep, rich soils. Flora resources include oak, hickory, maple, beech, walnut, butternut, elm, tulip, ash, basswood, sycamore, cottonwood, cedar, tamarack, white pine in the northern reaches, and a large number of plants. The faunal resources include a variety of birds and both small and large mammals, including deer and buffalo, among others (Mason 1981).
2. The Canadian Biotic Province encompasses most of the Lake Superior basin and the northern parts of Lake Michigan and Lake Huron basins and beyond (Figure 3). It is characterized by long, cold winters and summers are shorter and cooler than in the Carolinian Province. Much of the province occurs in heavily glaciated country in which many of the soils are derived from glacial tills, old lake beds, and outwash plains. The forest type of the Province is the Lake Forest, which includes enclaves of true boreal forests consisting of cedar, white and red pine, Norway pine, alder, Yellow birch, beech, elm, hemlock, aspen, basswood, and sugar maple. Faunal resources are similar to those of the Carolinian Province but large mammals include caribou and moose in place of buffalo (Mason 1981).
3. The Carolinian-Canadian transition zone occurs between the two aforementioned provinces, occurring in parts of Northern Wisconsin including the Door Peninsula and in Michigan's Lower Peninsula along the shores of Lake Michigan and portions of

the “thumb,” and beyond (Figure 3). The transition zone includes aspects of both zones’ flora and fauna resources.

The Lake Forest Middle Woodland complexes, by definition, occur within the Carolinian-Canadian transition zone and the Canadian Biotic Provinces. There is still little agreement on the specifics of Lake Forest Middle Woodland residential mobility and subsistence patterns. Some models posited spring-fall aggregations on coastal villages near stream mouths or shallow bays allowing for the exploitation of seasonally spawning fish (Cleland 1966, 1992, Fitting 1975, Mason 1981) and the inland dispersal of small family groups in the winter. Other models (e.g. Lovis 1990) propose a continuation of Late Archaic settlement patterns with seasonal aggregation at large inland basecamps during the winter and dispersal during the spring-fall months. Additional models involve the seasonal aggregation of people for the spring sturgeon and sucker spawns, and a shift to a mixed economy based on fishing, hunting and gathering during the summer and winter (Brose 1970b; Cleland 1992).

Martin (1985, 1989) cites fishing as a central feature in determining residential mobility, whereas Cleland (1982, 1992) does not believe that the intensive harvesting and inland shore fishery as an adaptive feature occurred until the subsequent Terminal Woodland period. A good summary of these debates as they relate to the study area of this thesis (discussed below) has been compiled by Drake and Dunham (2004). Much of the archaeological data used to form the initial descriptions of the Lake Forest Middle Woodland time period (Fitting 1975, Mason 1981) came from large coastal sites excavated in the 1960’s and 1970’s such as Summer Island (Brose 1970a, 1970b), Naomikong Point (Janzen 1968), and the Winter site (Richner 1973).

Figure 3. Biotic Provinces (After Mason: 1981: Map 2.2).

In the years since, many smaller interior sites have been excavated, providing more data from which to develop settlement models and answer questions about subsistence (Figure 4). Within the Central Upper Peninsula such sites include the Nina Site (20DE528), located along the Fishdam River in Delta County (Anderton et al. 1996: 41, 83:86), Fat Snake (20DE311) located at the south end of the Norway Lake Drainage (Dunham and Branstner 1993: 100; Robinson et al. 1991), Gooseneck Lake 4 (20DE44), located on the upper reaches of the Fishdam River (Franzen 1986, 1987:21), the Vincent Prince Site (20C1308), located on the southwest shore of Soldier Lake (Dunham et al.

1994:115), the Trout Point I Site (Benchley et al. 1988), as well as site 03-754 located on Grand Island (Drake et al. 2009; Drake and Dunham 2004; Dunham et al. 2010; Skibo et al. 2004). Smaller sites such as these have been used to develop a more holistic picture of prehistoric settlement patterns and subsistence strategies (e.g. Dunham 2009, 2014).

Figure 4. Selected Lake Forest Middle/Initial Woodland Sites Mentioned in Text (after Hambacher and Brose 1999).

Terminal (Late) Woodland (ca. AD 600 - AD 1600)

The shift from Initial Woodland to Terminal Woodland, like any prehistoric temporal designation, occurs along a continuum that varies by location. In the Upper

Peninsula of Michigan, the shift to the Terminal Woodland period occurs circa AD 600-AD 1600 (Drake and Dunham 2004; S. Martin 1999; Skibo et al. 2004). The Terminal Woodland Period is probably the best documented period in Michigan (Dunham et al. 2010; Fitting 1975; S. Martin 1999), yet the associated complexes differ east to west to some extent, and thus generalities about the time period have to be derived from the region's geographic margins (S. Martin 1999). As with the Initial Woodland time period, much of what was known about the Terminal Woodland period resulted from the excavation of large coastal sites on the Great Lakes. Such excavations include Mason's (1966, 1967) excavations on the Door Peninsula, Cleland (1966) and McPherron's (1967) work in the Straits of Mackinac, and excavations at the Sand Point Site (Cremin 1980; Dorothy 1980; Hoxie 1980; Martin and Rhead 1980; Wyckoff 1981; Figure 5).

Archaeological data recovered from these excavations and subsequent investigations suggest that there were at least two distinct populations within the Upper Peninsula during the Terminal Woodland period. Populations in the western Upper Peninsula were culturally associated with the Oneota populations to the west and south in Wisconsin (Dunham et al. 2010; Martin 1999; Mason 1966, 1967) while those in the Eastern Upper Peninsula, Straits of Mackinac, and Northern Lower Peninsula populations appear to have shifted cultural affiliations over the course of the Late Woodland period from more northern Blackduck affiliations during the early Terminal Woodland to generally eastern Iroquoian affiliations during the late Terminal Woodland (Martin 1999; McPherron 1967).

Figure 5. Selected Terminal Woodland Sites in the Upper Peninsula Mentioned in the Text (after Martin 1999).

Analyses of the geographic distribution of Terminal Woodland ceramic styles in the Eastern Upper Peninsula and the Northern Lower Peninsula (McHale Milner 1991) and general Woodland subsistence patterns (Cleland 1992) suggest that Terminal Woodland groups became more socially and geographically localized around specific hunting grounds and fisheries than the preceding Initial Woodland inhabitants. According to these researchers, this localization coincides with an increase in population, the intensification of the use of the fall fishery, and the need to demarcate smaller social units as a mechanism for dealing with economic uncertainty and food shortages (Cleland

1992, McHale Milner 1991). This argument is discussed in greater detail below, but an exhaustive analysis of the debate is beyond the scope of this thesis.

The Mather-Klauer Lodge site, was unable to be definitively attributed to a specific ceramic ware type. Dunham et al. (2010) suggested a possible affiliation with the Sand Point Chord-wrapped Object type ware defined by Dorothy (1980: 56-59). This certainly seems plausible, given that ceramic sherds affiliated with that type have been identified at FS 09-10-03-821, located across Echo Creek from the Mather-Klauer Lodges site, where they occurred along with a Madison Folded Lip sherd (Robinson et al. 1991; see also Dunham 2000b; Figure 7). These ceramic styles are associated with the Lakes Phase Terminal Woodland.

The Lakes Phase is defined by pottery similar to Madison wares, a reliance on local quartz for lithic industries, the utilization of native copper, and locations chosen mindful of the distribution of wild rice habitat (Martin 1999; Salzer 1974). Lake Phase sites vary in size and in site locational characteristics, suggesting a diverse subsistence strategy based on foraging. They often contain ceramics, such as Blackduck pottery that are typically found in more northern regions, as well as those from ceramics that are associated with the Straits area, Wisconsin's Door Peninsula, and Effigy Mound Culture of Wisconsin archaeological cultures. At the Sand Point site, one of the best-known Upper Peninsula sites containing a Lakes Phase component, the presence of numerous shell-tempered sherds representing seven Mississippian ceramic vessels, including one similar to the ceremonial Middle Mississippian Ramey Incised pottery type, suggests a wide range of interaction (Dorothy 1980; Martin 1999).

The lithic industry associated with the Lake Phase Terminal Woodland is similar to that of other Terminal Woodland groups. It focuses heavily on the exploitation of local raw material sources, although as mentioned above, Lake Phase lithic assemblages consist primarily of quartz, especially in the Western Upper Peninsula (Martin 1999; Hill 1995). The introduction of the triangular projectile point is seen as being diagnostic of the Terminal Woodland period, although as Reid and Rajnovich (1991) observe, the points have also been found in association with Laurel-type ceramics. As in the preceding periods, lithic reduction strategies included the use of the both bipolar and non-bipolar reduction technologies to create chipped stone tools, which in addition to triangular projectile points, include bipolar wedges (*pieces esquilles*) and utilized flakes. None of these aspects of the lithic technology is specifically diagnostic to the Lake Phase culture, as it is also present in other Terminal Woodland archaeological cultures (i.e. McPherron 1967). On Grand Island, Drake and Dunham (2004: 155) note that apart from the differences in projectile point styles, Initial and Terminal Woodland lithic assemblages are indistinguishable from one another.

Subsistence. Returning to the debate over the subsistence patterns and residential mobility, some models have identified the Terminal Woodland as the incipient period for the development of the gill net and exploitation of deep-water spawning fish in the fall (Cleland 1982). Using faunal evidence of increased utilization of fall-spawning fish such as whitefish and lake trout, Cleland (1982) argues that the resulting increased food supply enabled population growth that led to the establishment of large coastal villages whose inhabitants became more geographically localized around specific inland fisheries.

Conversely, Susan Martin (1985, 1989) has argued for a greater continuity between the Initial and Terminal Woodland. She suggests that increased site size in the Terminal Woodland could be attributable to the continual use of those localities throughout the Woodland period (Martin 1989). Indeed, as Drake and Dunham point out (2004), the temporal designation for the Terminal Woodland spans four hundred years longer than that of the Initial Woodland. In her analysis of Woodland settlement patterns, Martin found that the location of Initial Woodland sites trend slightly towards shallow-water localities while Late Woodland sites trend slightly towards deep-water localities. However, she also notes that many Late Woodland sites include both Initial and Late Woodland components and are situated in locations conducive to the exploitation of both fish resources.

Dunham (2002) identifies two discontinuities between the Initial and Late Woodland settlement and subsistence patterns. The first is a noticeable decrease in the frequency of coastal sites relative to the number of interior sites from Initial to Terminal Woodland. Secondly, Dunham (2002) notes that the density of Terminal Woodland period sites decreases in shallow-water localities such as the Bay de Noc region and Drummond Island that contained an appreciable number of Initial Woodland sites. Simultaneously, Terminal Woodland site densities in deep-water localities such as the Straits of Mackinac stayed consistent with the Middle Woodland and even increased in places such as Grand Island. Additionally, greater numbers of Terminal Woodland sites have been identified in interior settings, specifically along the Indian River and inland lakes (Dunham 2002; Franzen 1983, 1987).

Milner (1991; 1998) analyzed the temporal and spatial distribution of stylistic styles of the Terminal Woodland Juntunen Ware (see McPherron 1967 for a description of the pottery style) and found that the wide geographic range covered by the ceramic type suggests an increased social interaction in the Late Woodland time period. She interprets this increased interaction to be an effort to reduce the effects of resource variability and food shortages. In this view, she sees the multiple stylistic expressions of Juntunen ware as an avenue through which local, inter-group relationships between people living in areas where there was a high risk of food-shortages could be defined. The establishment of localized groups, Milner states, facilitated the development of extralocal ties through practices such as exogamous marriage. The greater social demarcation was a mechanism employed to diminish the effects of environmental variability and food shortages (Milner 1991).

Drake and Dunham (2004) have used data from sites excavated on Grand Island, Michigan to revisit this debate. Given the lack of faunal evidence from the majority of the sites, they used site size, location, and temporal designation to determine which model applies to the region. They found that sites attributable to both temporal designations were situated in locations that allowed for exploitation of both shallow and deep water fish. Additionally, they tentatively state that site size does not dramatically change from the Initial to the Terminal Woodland, although they note that site size is difficult metric to accurately measure as a result of the palimpsest effect, caused by repeated occupations of single localities over thousands of years, that plagues regional archaeology. Thus, they concluded that Martin's model (1985, 1989) applies most directly to Grand Island.

However, they went on to cite the need for a multi-scalar approach, stating that the same trends that apply to Grand Island do not necessarily apply to the broader region.

CHAPTER IV

SITE DESCRIPTION AND METHODS OF ANALYSIS

The manifestation of the Woodland Period on Grand Island is part of a long cultural history which, according to current archaeological dates, begins roughly AD 0 (Drake and Dunham 2004). Although the geography of Grand Island has changed considerably over time as a result of fluctuating lake levels, it has continued to remain a seasonally inhabited location for the past 4,000 years. This chapter will provide a brief overview of the study area, the history of archaeological investigations at the site chosen for this study, and the field and laboratory methodologies used to its material assemblage.

Study Area

Grand Island is the 2nd largest island on the south shore of Lake Superior (Figure 6), measuring 13 km North-South by 8 km East-West and has a total shore line of roughly 40 km. It is located approximately 600 m off the northern shore of Alger County in the Upper Peninsula of Michigan. Generally speaking, the island is comprised of three parts: a smaller eastern region that was once an island referred to as the “thumb;” a larger western portion; and a low, narrow isthmus referred to as the “tombolo.” Elevations on the island range from 300 m above sea level to roughly 183 m above sea level where the island meets Lake Superior.

Figure 6. Grand Island, Michigan.

Figure 7. Land Cover on Grand Island, Michigan (after USGS 2013).

The Island is located within the Canadian Biotic Province, as described in Chapter 3. Presently, the primary vegetation cover on the Island is Lake Forest boreal forest though the island was heavily logged in the 1950's. Echo Creek, a small stream runs through the center of the island. A beaver dam constructed at approximately AD 800 created Echo Lake, the largest and deepest of the two interior lakes on the Island. The other is Duck Lake, a shallow lake located just to the west of the Tombolo. Wetland habitats surround these bodies of water, with additional wetland areas located on the low-lying areas of the Tombolo (Figure 7). Combined with the pine stands located on the slightly higher portions of the Tombolo closer to Trout Bay, the variety of vegetation types would have provided access to a multitude of resources that include, but are not limited to, acorns, wild blueberries and raspberries, maple sugar, tubers such as cattails, and a variety of terrestrial mammals which frequent these locations to exploit similar resources (Dunham et al. 2010; Mason 1981).

Geology and Resources

An understanding of the island's geologic resources is particularly important given that the majority of the raw material comprising the chipped-stone assemblages on the island can be found eroding from the sandstone formations that constitute the bedrock geology of the island (Hamblin 1958: 73; Marcucci 1988).

Hamblin (1958) identified three separate geographic formations. Listed from youngest to oldest they are the Autrain dolomitic sandstone, the Munising Cambrian Sandstone, and the Jacobsville Late Pre-Cambrian/ early Cambrian Sandstone (Table 3). Hamblin's map (1958: Plate 2) shows all three formations present on the western part of

the island, while his map only identifies the Munising and Autrain Formations on the “Thumb.” The basal conglomerate, from which much of the archaeological quartz and quartzite beach cobbles are thought have originated, is part of the Munising Cambrian Sandstone formation. It outcrops near the water on the east side of the island, most accessibly on the “Thumb” along the east side of Trout Bay (Anderton 2004; Hamblin 1958: 66, Figure 35).

Table 3. Grand Island Bedrock Geology in Stratigraphic Order (After Hamblin 1958 and Anderton 2004).

Formation	Age	Rock Type	Units
Au Train	Ordovician	Dolomitic Sandstone	None
Munising	Cambrian	Fine-textured, light-gray sandstone	Minor’s Castle member, Chapel Rock member Basal Conglomerate
Jacobsville	Late Pre-Cambrian/ Early Cambrian	Coarse Red Sandstone	None

Quartz and quartzite constitute the majority of the cobbles that form the conglomerate on Grand Island. Small amounts of chert, slate, iron formation, basalt, granite, and sandstone are also present, although the composition of the conglomerate varies by geographic location (Hamblin 1958: 73). Further to the east, for example, where the Munising formation outcrops at the Chapel Falls and Sable Falls exposures (Hamblin 1958: Plate 2), brown oolitic chert cobbles occur in higher percentages (20% and 12.6% respectively; Drake et al. 2009; Hamblin 1958:30, Table 3).

Archaeological Resources

Grand Island was first available for human occupation as early as 9,200 B.C. when the glaciers had permanently retreated (Anderton 2004), although currently the oldest archaeological resources on the island date to 2100 ± 50 B.C (Dunham and Anderton 1999). Fluctuating lake levels have produced a variety of shorelines on which prehistoric populations dwelled (for a full discussion of the shorelines see Anderton [1993, 2004] and Drake et al. [2010]). By the Initial Woodland time period (0-AD 600), the lake had retreated to approximately its current level, although a transgressive trend occurred between 1200 and 1000 B.C caused by a rise of the Sault outlet due to isostatic uplift that triggered a slight rise in the lake level (Anderton 2004). The transgression has submerged many Early and Middle Archaic archaeological resources, as well as certain costal Woodland sites, especially around Murray Bay where water-worn artifacts have been found at and just below modern lake levels at the head of the Bay (Anderton 2004).

Currently, there have been 15 Woodland-Period Sites identified on Grand Island (Figure 8). Drake and Dunham (2004) have provided an overview of the locations and associated assemblages. Their study analyzed the changes that occurred from the Initial to Terminal Woodland period, including shifts in site location, size, and assumed function. They then related this data to the Inland Fishery Model developed by Cleland (1982) and critiqued by Martin (1985; 1989). Their findings indicate that the distribution of Woodland period sites on Grand Island itself does not reflect the subsistence and settlement pattern changes that purportedly occurred throughout the most of the Upper Peninsula. Many of the sites on Grand Island have been interpreted as short-term,

seasonally occupied sites that were revisited annually on seasonal migration routes to exploit the fall and spring fish spawns, as well as the fall acorn harvest (Drake and Dunham 2004; Skibo et al. 2009). This thesis will analyze the Mather-Klauer Lodge site (FS 09-10-03-820/20AR358), a Terminal Woodland habitation at the mouth of Echo Creek. A description of the site, and the methodology used in its analysis are presented in the succeeding sections.

Figure 8. Woodland Period Sites on Grand Island (after Drake and Dunham 2004).

The Mather-Klauer Lodge Site (FS 09-10-03-820/20AR358)

The Mather-Klauer Lodge Site is located just to the east of the mouth of Echo Creek, which empties from Echo Lake into Lake Superior (T47N R19W, Section 4). The

site contains a Terminal Woodland component, as well as a historic component associated with the standing Mather-Klauer Lodge and outbuildings recently purchased by the United States Forest Service.

The site, as well as the rest of Grand Island, is located within the Grand Marais Sandy End Moraine and Outwash Sub-Section of the Luce Subsection (Albert 1995 cited in Dunham et al. 2010). The soils are classified as Carbondale, Lupton, Tawas soils, all of which are poorly drained mucks and/or peats that typically form in depressions on outwash plains. However, the well-drained sands observed at the site do not fit this description. It is likely that the soils at the Mather-Klauer Lodge Site correspond with the Croswell series, or either the Kalkaska or Paquin Sands that are included as minor components of the Carbondale, Lupton, Tawas soils complex (Dunham et al. 2010).

The habitat classification for the Croswell sand is Acer-Quercus-Vaccinium (AQV) and Acer-Tsuga-Dryopteris, Dryopte (ATD-D) for Kalkaska and Paquin Sand. The AQV habitat identifies red maple and red oak as possible dominant climax species, with white pine and red pine represented in the earlier stages. The ATD-D habitat is potentially dominated by sugar maple and hemlock. The pre-1800 forest is described on the historic GLO maps as Beech-Sugar Maple-Yellow Birch (Comer et al. 1994). The site is approximately 190 m above sea level (623.4ft). It sits within the Mather Lodge Beach Ride Complex, which are a series of Nipissing age (ca. 6000 BP to 4000 BP) depositional shorelines occurring from 195 m to 189 m associated during the regression of Lake Nipissing. As the Lake Nipissing level dropped from an estimated height of 192 m (629

ft.) to the current Lake Level of 183.5 m (602 ft.), new shorelines would have been formed (Anderton 1993, 2004; Dunham and Anderton 1999).

The Mather-Klauer Lodge site was discovered by the Forest Service (FS) in 2002 during a Phase I survey of the yard around the Mather-Klauer Lodge conducted in response to a proposed construction project (Figure 8). Shovel testing revealed a low-density scatter across the area of potential effect (APE) (Figure 8). The site was subjected to further Phase II testing in 2009 by the Commonwealth Cultural Resources Group (CCRG; Dunham et. al 2010), which excavated eleven 1 x 1 m test units (TUs) and additional shovel tests, designed to fill in the areas that were not explored by the FS in 2002 (Figure 9).

Test units placed in the south yard revealed a fair amount of stratigraphic variation, but followed a general pattern (Dunham et. al 2010: 5-61). Excavations revealed evidence of a historic layer of fill which overlaid most of the site. The thickness of the layer varies by the location of the test unit, but extends from 5 to 30 cm below the present-day ground surface. It is thought to have been deposited as a result of landscaping activities associated with the construction, and subsequent improvements of the Mather-Klauer Lodge based on the presence of twentieth century artifacts in the fill. Directly below the historic fill is a semi-compact layer of gray fill which contains a mix of prehistoric and historic artifacts. It is likely that this layer too is associated with construction and early occupation of the Mather-Klauer Lodge based on the recovery of historic artifacts.

Below the gray fill is a very dark gray/ black, very compact buried soil horizon that contains the majority of the prehistoric artifacts found at the site. The soil horizon was typically 2 to 5 cm thick and is similar to one interpreted as a living floor at FS-03-10-03-803 (*Gete Odena*), also located on Grand Island (Dunham et al 2010:5-61, Dunham and Branstner 1995; Skibo et al. 2004).

CCRG's Phase II excavations at the site produced an artifact assemblage that included 269 ceramic sherds, 39 chipped stone tools, 58 cores, 1,380 chipped stone flakes and 408 pieces of fire cracked rock (FCR) (Dunham et al. 2010). The prehistoric ceramics were constructed of very friable, silty paste with a laminar structure and exhibit very low amounts of medium to fine felsic (i.e. granitic) grit temper. The majority of these were in poor condition. Only two sherds displayed decoration, which was characterized by portions of apparently obliquely oriented cord-wrapped stick edge impressions placed on a smoothed exterior surface. Additionally, one of the decorated sherds had a small portion of two narrow, closely spaced, horizontal cord impressions placed below the cord-wrapped stick impression. The use of chord-wrapped stick edge impressions, the presence of well-smoothed surfaces, and the general temper/paste characteristics are suggestive of a Terminal Woodland affiliation at the Mather Lodge Site (Dunham et al 2010: 5-69: 5-71). An AMS radiocarbon date of 780 to 670 BP [AD 1170 to AD1280]; Dunham et al. 2010; Appendix H) taken from food residue charred onto one of the ceramic sherds found in feature 1 supports this finding. While a specific affiliation with a known ceramic ware was not possible, Dunham et al. (2010) cited a

possible relationship to the Sand Point Cord-wrapped Object type ware (Dorothy 1980:56-58).

The chipped stone assemblage is dominated by the use of quartz as a raw material (93% of the overall debitage assemblage), with quartzite, chert, and silicified sandstone comprising 4%, 2%, and 1% of the assemblage, respectively. The relative composition of the assemblage fits within the chronological lithic raw material model developed by Drake et al. (2009) for the Woodland Period (see above). The tool assemblage recovered from the site was sparse, and included a biface/point tip, an end scraper, a possible spokeshave, a retouched flake, two bifacially retouched flakes, and 32 bipolar lithics/wedges. All the tools were made from quartz, with the exception of the scraper, which was made from Hudson Bay Lowland chert (Dunham et al. 2010).

Fifty-eight chipped stone cores and one groundstone tool were also recovered at the site made from the quartz and quartzite cobbles that erode from the aforementioned sandstone formations around the island. The presence of the cores in association with tools and debitage suggests that the full range of lithic reduction occurred at the site including early and later stages of core production, tool manufacture, and tool maintenance (Dunham et al. 2010: 5-74).

Figure 9. Overview of CCRG Phase I Survey at the Mather-Klauer Lodge Site (from Dunham et. al 2010: Figure 5.4-3).

Figure 10. Overview of CCRG 2009 Phase II Investigations at The Mather-Klauer Lodge Site (from Dunham et al. 2010: Figure 5.4.1-1).

Figure 11. Overview of ISU's Investigations at the Mather-Klauer Lodge Site.

In 2012 and 2013 ISU, in conjunction with the Hiawatha National Forest Service, conducted two, month-long archaeological field schools at the Mather-Klauer Lodge Site. The excavations were focused on exposing the densest part of the site containing the buried surface, as identified by CCRG's 2009 Phase II survey (Figure 10). Sixteen 1 x 1

meter test units were excavated in the south yard of the Mather-Klauer Lodge, where CCRG determined the densest scattering of artifacts was located.

ISU's excavations (Figure 11) piece plotted an additional 6,667 artifacts, which upon preliminary analysis included 6,345 pieces of chipped stone debitage, 2 copper awls, 32 pieces of pottery, and 300 pieces of FCR, along with a variety of historic artifacts. The chipped stone assemblage was comprised of 99 percent quartz, with chert and quartzite accounting of roughly one percent of the total assemblage by count. Four formal tools were identified in the field, including one quartz arrowhead, one chert arrowhead, and two chert scrapers. Each artifact that was recovered during ISU's excavations was given a northing, easting, and elevation value in relation to a unit datum. The artifacts were then bagged individually, allowing for extreme spatial control.

An AMS radiocarbon date that was run on a piece of wood charcoal recovered from a small hearth feature (Feature 4) identified during ISU's excavations returned a date of 790 ± 30 BP (Beta No. 348784; cal. AD 760 BP to 670 BP [cal AD 1210 to 1280]). This date further strengthens the Terminal Woodland affiliation reported by CCRG.

Field Methodology at the Mather-Klauer Lodge Site

Over the course of the 2102 and 2013 field seasons, ISU's field schools excavated a total of 16 1 x 1 meter test squares. Each was based on a datum located in one of the corners of the unit (primarily the southwest corner). The unit datum locations were recorded with a total station tied into the NAD1983 UTM Zone 16 by use of a high-powered Trimble GPS. The units were dug using a combination of arbitrary five centimeter levels, and after the site stratigraphy was recognized, natural levels. Each

artifact recovered during the course of the excavation was piece plotted, and received a northing, easting, and depth measurement in relation to its respective unit datum, then bagged separately. Excess dirt was screened through 1/4 inch hardware cloth and the artifacts were picked out by hand and placed into a general screen bag.

There were four areas of intense clustering of quartz artifacts that were discovered during 2012 field season in unit 515N 498E that were too dense to plot individually. These flake concentrations were mapped in plan-view, removed as “quartz concentrations,” and screened through a 1/16th inch mesh shaker screen. All of the material found in the screen of a particular concentration was bagged together for further analysis in the lab.

Sampling Methodology at the Mather-Klauer Lodge Site

The analysis for the Mather-Klauer Lodge site focuses on the main portion of the site, where the largest block of test units was excavated. A preliminary analysis of the two outlying units (unit 502N 490E and unit 537N 495E) suggest that they were not associated with the main portion of the site due to the composition of their assemblage (see Figure 11). Unit 502N 490E had a much higher frequency of the chert than the rest of the site, while unit 537N 495E contained no chipped-stone artifacts and appeared to be heavily disturbed by the construction of the Mather-Klauer Lodge. It is possible that these localities represented different activity areas of the same occupation that is present in the main portion of the site, but for the purposes of this thesis, they will be treated as occupations and will be excluded from further analysis.

Each piece-plotted chipped-stone artifact recovered from the main portion of the site was subjected to analysis using the methodology described below, as was every chipped-stone artifact located in the quartz concentrations. Material recovered from the screens was subjected to a preliminary analysis in which artifact type (chipped-stone debitage, FCR, ceramic, etc.) and material type (chert, quartz, quartzite) was identified. All artifacts of the same artifact and material type were counted and weighed as a whole.

Laboratory Methodology at the Mather-Klauer Lodge Site

The primary focus of this thesis, as described above, is the lithic tools and debitage recovered at each site. For consistency's sake, the definitions and methodology for classifying each category will follow CCRG's lithic analyses that were completed in 2009 at site 03-820, and outlined in the resulting site report (Dunham et. al 2010). Because the field methodologies for ISU's collections differed slightly from those of CCRG and the questions this thesis is hoping to answer are more specific, additional attributes will be recorded for the assemblages recovered by ISU.

Tools. For both sites, tools will be subdivided into five groups according to the morphofunctional categories described by CCRG (Dunham et al. 2010: 3-7 through 3-8). The groups will include: (1) bifacial tools, (2) formal unifacial tools, (3) expedient or informal tools, (4) bipolar lithics, and (5) ground and other coarse tools.

Bifacial tools will be identified by the presence of retouch on both faces on a tool. Unifacial tools will be identified by the presence of retouch on a single face of the tool. Furthermore, formal unifacial tools will be defined as those which exhibit some additional shaping whereas expedient or casual tool forms are simply represented by

retouched and edge-damaged flakes. Flake tools will be further categorized on the location of the retouch per Andrefsky (2005: 78-80). He makes a distinction between unimarginal tools-- those exhibiting retouch on either the dorsal or ventral sides, and bimarginal flake tools-- those exhibiting modification on both the ventral and dorsal surfaces at the same location on the flake. If it is the case that a single flake tool exhibits unimarginal modification in more than one location, it will be typed as unimarginal. Likewise, if more than one location on a single flake exhibits bimarginality in more than one location, it will be considered bimarginal. If a flake exhibits unimarginal modification in one location and bimarginal modification in another, it will be classified as a combination flake tool.

In order to avoid confusion, formal bifacial and unifacial tools will be assigned to categories based on the traditional morphological definition of the tools (i.e. scrapers, wedges, projectile points) as defined by earlier work in the region (e.g. Brose 1970a; Janzen 1968; McPherron 1967). Although some of these categories were proved to be accurate by Brose's (1970a) functional analysis of the tools from the Summer Island site, tools from this analysis may be placed into categories that do not reflect their actual use at the aforementioned sites.

One of the most frequent formal artifacts recovered from the Mather-Klauer Lodge site were bipolar lithics, or *pieces esquillées* (LeBlanc 1992; Shott 1989). Bipolar lithics are characterized by battering and multiple step and hinge fracturing on opposite ends. They have traditionally been interpreted as tools that were used to split bone or wood, though there has been a debate as to whether or not these pieces were really just

end products of the bipolar reduction technique (Binford and Quimby 1963; Brose 1970a; Flenniken 1980; MacDonald 1968; Robertson 1987; 1993). However, evidence of wood polish found on *pieces esquillées* in Michigan's Lower Peninsula in the Archaic and Terminal Woodland (Robertson 1987; D. Sabo cited by Holman 1987), suggests that some of these artifacts were used as tools. The extent of the crushed ends of each bipolar lithic will be measured. Additionally, the maximum metric dimensions (width, length, and thickness) will be recorded for each tool, along with its raw material type.

Use-Wear Analysis. In order to keep the focus of this thesis more narrowly defined, a comprehensive microscopic analysis of formal and informal tools from each site was not performed. Instead, the use-wear analysis of the aforementioned assemblages was limited to macroscopic and hand-powered microscopic (5x) observation of the edges of each piece of chipped-stone material. At low powered magnifications, it was possible to observe obvious retouching of quartz and chert chipped-stone artifacts in the form of small micro-flakes that had been removed from the edge of the flake due to post-removal modification or use. For expedient flake tools, the ventral surface of the flake was placed facing the researcher, and using that orientation the margin on which the retouched had occurred was recorded (i.e. left or right margin). It is probable that this type of analysis resulted in some retouched flakes being put into the one of the debitage categories. No additional use-wear analysis was conducted on formal tools such as end scrapers, bifaces, or projectile points other than to record striations, polish, or crushing that was macroscopically observable. A more intensive use-wear analysis would be an ideal avenue of inquiry for anyone who wishes to continue to research these assemblages.

Cores. Cores are stones from which one or more flakes have been intentionally removed (Odell 2004: 45). As per Dunham et al. (1997) the cores will be subdivided into bipolar and free-hand/block varieties. Being that most of the cores were created from the quartz and quartzite cobbles that can be found around the Island, Dunham et al. (1997) utilized Marcucci's analysis of cobble cores from the Trout Point I site (Marcucci 1988: 67-86). Marcucci defined two types of cobble cores, which are identified by their reduction technique, System I and System IA cores. Although none of these core types were recovered from the Mather-Klauer Lodge assemblage, they are reviewed below because they were included in the classificatory scheme used to analyze the site.

The reduction of a System I core began by selecting an area from which a primary decortication flake can most easily be removed (Figure 12). Usually, the end of the cobble was struck off perpendicular to the long axis of the cobble, allowing the cobble to be tested for suitability and to be set up for further reduction. The core was then rotated and the flake removal processes continued down the length of the cobble using the cortex as the striking platform.

These cores tend to have a steep-flaked face relative to the exterior of the cobble and frequent display multiple platform areas. System IA cores were interpreted by Marcucci as being an advanced stage reduction, of a System I core, after it was exhausted. System IA cores involve the rotation of a System I core so that the flake removal can continue to proceed around the entire periphery of the cobble, resulting in a pyramidal shape with cortex retained along the distal end of the core (Dunham et al. 1997: 96).

Several other varieties of cores were identified by Dunham et al. (1997: 96) in addition to the System I cores, each representing a varying method of core reduction. One type consisted of primarily angular chunks of quartz or quartzite from which flakes were opportunistically removed. These cores generally lack any cortical surfaces, or only retain cortex on one or two surfaces, possibly representing advanced stages of reduction. Another type of core involved the initial splitting of a cobble, with subsequent episodes of flake removal taking place across the interior surface of the cobble using the cortex around the periphery of the cobble as the striking platform.

The final core type that will be identified in this study is the bipolar core, which appears to be the most prevalent one at the Mather-Klauer Lodge Site judging by the preliminary analyses. Bipolar technology will be discussed more extensively in the thesis, but the specifics have been extensively discussed in the literature (Binford and Quimby 1963; Brose 1970a; Marcucci 1988; McPherron 1967). In general, the technique involves placing the objective piece on an anvil, and then striking it with a hammer stone in order to produce useable flakes (Figure 13). As a result, bipolar cores often exhibit crushing, or battering, on both ends. As interpreted by the aforementioned literature, this technique is often thought to be employed in the reduction of small chert pebbles, or recycling worn out or broken tools.

Figure 12. System 1 Core Reduction.

(1) Core preparation and removal of first flake. (2) Core is tilted downward and second flake is removed. (3) Reduction of Core. Flakes are struck from the surface opposite the primary flake using the cortex as the striking platform. (4) Exhausted System 1 core and a flake with cortex on the striking platform and lateral edge from aboriginal assemblage (From Mariucci 1988).

The bipolar cores were further subdivided by the outline set forth by Binford and Quimby (1963). They identify six different types of bipolar cores whose definitions are

based on roughly the sequence of reduction as the proximal and distal ends are reduced from an area of percussion to a point of percussion. Areas of percussion are defined as the relatively flat, generally cortical surface from which flakes have been detached along the edges. Further reduction results in a ridge of percussion, which is formed by the line of convergence of the two opposite cleave faces. It is normally characterized by a straight, considerably battered edge, with many small hinge fracture scars on the cleavage faces directly below the ridge. Usually, the flake scars exhibit negative bulbs of percussion.

The last sequence of reduction identified by Binford and Quinby is the point of percussion, which is formed by the convergence of three or more cleavage faces. The resulting point is the apex of the cone of percussion, and if a core reaches this stage, no further reduction can occur without altering the striking angle. From these three types of platform, the core types are as follows: (1) ridge and basal area, (2) point and basal area, (3) ridge and basal point, (4) right-angled ridges, (5) opposing ridges, and (6) opposing points (Figure 13, 14).

Figure 13. Bipolar Reduction Technique and Binford and Quimby's (1963) Bipolar Core Types (Figure adapted from Binford and Quimby 1963).

Debitage. All chipped-stone artifacts that do not fit the above-described categories of a tool or a core will be defined as debitage. Debitage consists of the discarded and unused detached pieces of material which result from the reduction of an objective piece (Andrefsky 2005: 82). As with the cores and tool categories, for consistency's sake, the debitage will be analyzed according to CCRG's methodology of analysis which is described below. However, because the flakes which were recovered during the 2012-2013 ISU field school investigations were collected using different

methods, slight modifications will be made to their methodologies as described below. The four major debitage categories will remain consistent with the CCRG methodology. They are: (1) shatter, (2) decortification flakes, (3) blocky secondary flakes, and (4) flat secondary flakes (Figure 14).

Divisions will be made within each of the major flake categories per the CCRG methodology based on the condition and extent of the preparation of the striking platform (if present). Simple (unfaceted) and complex (faceted) platforms will be identified (Robinson 1993:41-42). Simple platforms are typically flat, unground, lack faceting, and tend to be oriented horizontally or at only slightly acute angles. Complex platforms tend to be smaller, multifaceted, frequently ground, which tend to exhibit lipping of the bulb of percussion, and are usually oriented at sharply acute angles. In addition to the two platform types described in the CCRG report, the presence or absence of cortex will be noted for each platform per Andrefsky (2005: 94-98).

Shatter will be defined as irregular, angular pieces of raw material which lack any clear evidence of flake removal (Binford and Quimby 1963). All shatter that was not bagged individually will simply be counted and weighed *en masse*. Due to time constraints, no attempt to distinguish raw material type for non-piece plotted material was made.

While there has been some debate over using the amount of cortex to identify a flake's stage in reduction (see Andrefsky 2005: 115-118), it is generally accepted that decortification flakes represent the initial stages of reduction. These flakes have over a minimum of one-third of the dorsal surface covered by cortex. Because small cobbles and

pebbles form the majority of the primary source material, no distinction will be made between primary and secondary decortication flakes. The decortification flakes will be further subdivided based on their relative thickness, size, and cross-section into blocky and flat types. Flat decortification flakes are generally smaller, and tend to have thinner biconvex, lenticular, or flat cross-sections. Blocky decortification flakes are relatively large with thick, angular cross-sections. They invariably have simple striking platforms whereas flat decortification flakes may exhibit complex striking platforms, though it is rare for them to do so. The presence of cortex on flakes was recorded using a coded system whose scale is present in Table 4.

Table 4. Cortex Codes Used for the Analysis of Chipped-Stone Debitage.

Code	Cortex
4	100 % cortex present on dorsal surface
5	Between 33% and 99% cortex present on dorsal surface
6	Less than 33% cortex present on dorsal surface
7	Cortex present on striking platform
8	Cortex present on one or more of the flake margins

Blocky secondary flakes represent the middle stages of reduction (Dunham et al 1997). They will be identified by relatively thick, angular cross sections; large, robust, unprepared or minimally prepared striking platforms; and prominent bulbs of percussion (Brose 1970a; Dunham et al. 1997; Robertson 1993: 41). The dorsal surface of this flake type exhibits few, but large flake scars, which often are oriented parallel to the long axis of the flake. Morphologically, blocky secondary flakes only differ from blocky decortication flakes based on the percentage of cortex found on the dorsal surface of the flake.

Flat secondary flakes are relatively small, and have thin, scalene, lenticular, or flat cross-sections with small striking platforms and bulbs or percussion. Both simple and complex platforms can occur on flat secondary flakes.

For the individually bagged artifacts at the Mather-Klauer Lodge Site, each artifact will be weighed. Due to time constraints and the order in which the artifacts were processed, only the artifacts recovered during the most recent field season (2013) will be measured for maximum length, maximum width, and maximum thickness per Andrefsky (2005:98-102). Additionally, each artifact will be defined as a flake, a broken flake, or shatter. A flake must contain a striking platform and a portion of single interior surface. Broken flakes, on the other hand, will be identified as those that exhibit a single interior surface, but lack a striking platform.

Figure 14. Analysis Flow Chart for Cores and Debitage.

Raw Material Identification. The range of raw materials analyzed for this assemblage is relatively small. The chipped-stone assemblages analyzed for this thesis consist primarily of three raw material categories: (1) Quartz, (2) Quartzite, and (3) Chert. Quartz is the primary raw material type represented in both assemblages. This raw material is found in abundance on the beaches in the form of river cobbles eroding from the conglomerate, as identified above (Hamblin 1958). A variety of colors of quartz cobbles are represented in the conglomerate including: translucent, white, rosy, and smoky.

Although quartzite only constitutes a small percentage of the assemblage, it is also present in the conglomerate and is classified by color, including: white, red, purple, gray, brown, and golden brown. Prehistoric populations did utilize the Mesnard quartzite quarry, located approximately 40 miles west of Grand Island in Marquette County, Michigan (Buckmaster and Ruggles 1991, cited in Dunham et al. 2010), however the recovery of quartzite cobble cores from a variety of sites on Grand Island suggests that the cobbles were the primary source for the quartzite debitage found there (Dunham et. al 1997, 2010; Drake et. al 2009; Marcucci 1988; Neubauer 2008).

Chert is the most variable of the three primary raw materials recovered from the sites. Cobbles of chert do exist in the conglomerate, but at a much lower frequency than those of quartz or quartzite and are most concentrated in the outcrops located to the west of Grand Island (Hamblin 1958; see above). Native groups would have had access to variety of other chert sources other than those eroding from the conglomerate, including secondary deposits of Hudson Bay Lowland cherts (Clark 1995), and a wide variety of

cherts from the Surilian age dolomites associated with the Niagara escarpment, which runs from upstate New York, through Southern Ontario, across the southern portion of the Upper Peninsula, and down the Door Peninsula into Wisconsin (Drake et al 2009; Luedtke 1976). Local outcrops include Cordell Chert in south-central Chippewa County, Michigan (Luedtke 1976: 214-217; M. Drake and Dunham 2008:4-7; Dunham and Branstner 1998:95; Drake et al. 2009), as well as Section 16 chert (formally referred to as Moss Lake Chert) from the Nahama and Garden Corners area, and Burnt Bluff Chert from southern Garden Peninsula (Cleland and Peske 1968: 46; Dunham and Hambacher 2002: 16; Drake et al 2009). Bois Blanc chert from the Straights of Mackinac area and Onondaga chert from upstate New York also may have been available to populations on Grand Island (Clark 1995; Drake et al. 2009; Luedtke 1976).

Chert raw material was classified using a slightly modified typology which was used to conduct GLRA's analysis of site 03-754 (Dunham et al. 1997: 99). The original typology is quoted verbatim below, and the modifications are subsequently explained:

- Type 1 cherts are typically lustrous with a fine-grained texture and exhibit a wide range of mottled gray colors. Some specimens also exhibit grayish brown and brown mottling. Fossil inclusions and clouding of the chert is infrequent. This chert is considered to be a high quality chert.
- Type 2 cherts are also fine-grained and lustrous, and are considered to be a high quality chert. This type differs from Type 1 chert in that they are typically uniform gray in color, only occasionally exhibiting some cream or tan-colored mottling. Type 2 cherts also occasionally exhibit small fossils in their matrix. These cherts bear

closest resemblance to Cordell chert, as defined by Luedtke (1976: 214-217), and to Cleland and Peske's (1968: 46) Type 2 chert.

- Type 3 cherts are typically dull, opaque, have medium texture and range in color from gray to light gray and grading into a dull off-white color. Quartz and fossil inclusions in these cherts are infrequent. This chert type is considered to be a medium to good quality chert because of the uniformity of its texture. It appears to roughly correspond to Brose's (1970a: 9) Type B chert, which was the predominant variety at the Summer Island Site. Bedrock outcrops of this chert were located along the eastern edge of the Sturgeon River valley in T40N, R19W, Section 16 (Dunham et al. 1994: 49-57).
- Type 4 cherts are coarse-grained, limy, white to light tan-colored cherts. These cherts are considered to be lower quality cherts because of the coarseness of their texture and the frequent presence of inclusion and cavities. Evidence from the prehistoric sites and the bedrock outcrop located in the vicinity of the bedrock outcrops in the Sturgeon River valley indicated that, at least in that area, Type 4 cherts represent one end of the range of variability exhibited by this chert.
- Type 5 cherts are defined as a residual category of cherts which do not conform to any of the above varieties.

Based on the raw material type collections held at Illinois State University, an additional type was added to Dunham et al.'s (1997) typology which sought to specifically identify the small, river-rolled chert cobbles found in certain localities along the beaches of Lake Superior. The two localities of most concern to this thesis

are Bay Furnace and Powell Point, located on the southern shore of the lake, within view of Grand Island. The type described below stems from a combination of the material observed in the assemblage and material present in the type collection.

- Type 6 cherts are typically fine-grained to coarse-grained and yellowish brown to brown in color. These cherts have numerous small, white fossil inclusions and a yellowish brown or red smooth, water-worn cortex (when present).

Chert artifacts were also classified into one of four raw material sources based on comparisons to the raw type collection donated to ISU by Forest Service archaeologists John Franzen and Eric Drake. The four different sources are as follows:

- Cordell chert- Although the type system described above identifies Type 2 chert as being close to Cordell, there is a wide range of variation in the Cordell chert as identified in the type collections from Scott's Quarry and from along highway US-2 in Schoolcraft County, Michigan. Chert from these localities could plausibly be typed as either Type 1 or Type 2 chert categories as defined above. Additionally, the limy white cortex on some of the specimens from Scott's Quarry could possibly be identified as flakes of Type 4 chert. The primary determining factor in identifying a chert as Cordell versus cobble chert is its bluish gray tint. Grey mottled chert cobbles are also present in the glacial till collected from the Powell Point and Bay Furnace localities, but those cobbles have what could be described as a grayish-green tint to them.

- Section 16 Chert - Section 16 chert, formerly identified as Moss Lake chert, was identified from the type collection collected from T40N R19W Section 16 in Michigan as described in the Type 3 chert above. It ranges from gray to light gray and grading into a dull off-white color with a purplish tint to it.
- Cobble Chert- Any chert with a smooth river-rolled cortex was identified as being a cobble chert. Additionally, any chert that contained yellowish brown streaking, similar to that described in the Type 2 chert above, or were yellowish brown in color such as those described in Type 6 were consider to come from cobbles. It should be noted that this classification does not necessarily mean that these were cobbles found on the shores of the Great Lakes. They could also have been collected from any of the numerous rivers or streams in the region.
- Unknown Chert- this serves as a residual category for any chert that could not be identified as coming from any of the three aforementioned sources.

Spatial Analysis

Spatial patterning of archaeological activities has been a subject of archaeological research since the start of processual archaeology (Binford 1962). Early attempts to identify the processes that shaped the spatial distribution of artifacts recovered in the archaeological record pointed at a variety of factors, both behavioral (e.g. Shiffer 1972; 1983), technological (e.g. Fritz and Plog 1970). These studies provided a basis for a variety of subsequent spatial patterning studies which utilized a variety of techniques to determine the depositional and post-depositional processes which shaped how the archaeological record was formed (e.g. Binford 1983).

There have been a number of spatial studies dealing with lithic artifacts have focused on raw material procurement and its effects on prehistoric mobility (see Andrefsky 2005, Chapter 9). These studies have focused on the macro-scale and often look at the simple distribution of projectile points or temporally-affiliated sites on the landscape. Recently, however, there have been archeologists who have begun analyzing lithic distribution at the intra-site level.

Seeman (1994) utilized lithic refitting to determine individual clusters of Paleo-Indian chipped stone material within a large lithic scatter in Ohio. It is assumed that reoccupation of a site decreases the likelihood of making refits from the assemblage, thus areas in which refits were located constituted discrete clusters attributable to specific occupations. Furthermore, Healan (1995) identified clustering of activity areas using sized-graded obsidian macrodebitage. He mapped the frequency of small lithic artifacts (microdebitage) recovered from flotation samples of discrete areas to identify distinct archaeological loci for a site in Tolla, Mexico. This method was repeated by Vullo et al. (1999) who utilized Geographic Information Systems (GIS) to plot the quantitative distribution of different classes of lithic tools (e.g.debitage, cores, tools, microlithic tools, microburins) in an attempt to determine activity areas based on the assumed function of those tools for two Mesolithic sites in the Italian Alps.

These studies have help show that the spatial organization of lithic technology is often as important as the individual attributes of thedebitage which results from its application. Using ArcMap 10.2, an application of ESRI's ArcGIS program, this thesis will utilize the Optimized Hot Spot tool that statistically maps clustering using Getis-Ord

G (ESRI 2014a). Statistically significant, or insignificant spatial clustering as identified by these analyses will provide quantifiable data that may help identify activity areas and inform us on the distribution of lithic reduction at these sites. Additionally, individually bagging each artifact at the Mather-Klauer Lodge Site will allow the individual artifacts to be linked to their recorded spatial location, enabling spatial analyses to be run based on the aforementioned debitage/ tool attributes.

Research Goals

Debitage from quartz-dominated assemblages displays relatively few attributes when compared to those displayed by cryptocrystalline debitage. It is for this reason that a portion of this thesis serves as a methodological study for the aggregate analysis of quartz debitage in hopes to better identify an efficient, yet thorough method for analyzing mass quantities of quartz debitage. In addition this study will look to:

1. Classify and compare the lithic technology at the Mather-Klauer Lodge site with other lithic studies that have already been conducted in the region, including the debitage and tool assemblages.
2. Analyze the spatial organization of lithic technology using spatial statistical methods in GIS.
3. Present the results of these classifications and analyses within the context of the broader archaeological patterns that have been observed in the region.

CHAPTER V

MATHER-KLAUER LODGE SITE LITHIC ANALYSIS

The results of Illinois State University's 2012 and 2013 excavations are presented below. Where possible, the artifacts from CCRG's 2010 excavations were included in this analysis, although as discussed above, the methodologies used to analyze the ISU's material represent a slightly altered version of the ones used to compile CCRG's final report, so there may be some discrepancies. The primary focus of this chapter is the analysis of the chipped-stone lithic technology recovered from ISU's excavations, although this chapter does summarize the entire artifact assemblage recovered during the two field seasons. To summarize, the lithic debitage recovered at the Mather-Klauer Lodge site is largely attributable to bipolar reduction of water-worn quartz cobbles that can be found eroding out of the conglomerate around Grand Island, although a small amount of chert and quartzite reduction did occur at the site. The assemblage is characteristic of an expedient tool technology that resulted in the manufacture, use, and discard of a comparatively high number ($n=40$) of unimarginally utilized flake tools. Although three Terminal Woodland triangular projectile points and three scrapers were recovered from the site, all of these tools were produced from flakes, further supporting the interpretation of the technology as expedient. The full lithic analysis is presented below

Lithic Assemblage

In total, 20,047 lithic artifacts were analyzed from ISU's 2012-2013 excavations. This number represents roughly 80% of the lithic artifacts that ISU recovered from the site (n=24,453). The additional 4,405 artifacts were recovered while screening excess dirt and were subject to only a basic analysis, including recording their raw material type, count, and cumulative weight of each raw material type. Of the lithic artifacts that were analyzed, 5,866 of them were piece-plotted and have northing and easting values as well as elevations recorded in relation to their unit's datum.

Three primary classes of artifacts were found within the lithic assemblage: debitage, cores, and tools. Table 5 below displays the general composition of the artifacts that were subjected to a more intensive analysis (n=20,047). As is common with sites where lithic reduction occurred, debitage comprises the majority of the artifacts, accounting for 99.08% of the lithic assemblage (n=19,862) by count but only 59.49% by weight. This is followed by cores (n=100) which account for 0.50% and 37.86% of the count and weight of the total assemblage, and by tools (n=85) which make up 0.42% of the assemblage by count and 2.65% by weight. The discrepancy in the relative percentage of the cores' count and weight is to be expected, given that cores, by definition, are the parent pieces of material from which flakes are struck and thus are expected to be larger and weigh more than the debitage which derives from their reduction.

Additionally, Table 5 highlights the raw material composition of the lithic artifacts recovered from the site. Three primary raw materials were present at the Mather-

Klauer Lodge site, including, chert, quartzite, and xenomorphic, macrocrystalline quartz (herein referred to as quartz). Table 5 shows that quartz makes up 99.36% of the assemblage by count (n=19,918) and 96.04% by weight, with chert and quartzite combining for less than 1% each of the assemblage by count and 0.31% and 3.65% of the assemblage's weight, respectively. When the additional debitage that was collected in the screens is factored in, these numbers stay relatively consistent, as shown in Figure 15, where quartz accounts for 99.32% of the count 95.92% weight, with chert and quartzite comprising 0.49% and 0.19% of the count and 0.32% and 3.73% of the weight, respectively.

Table 5. General Composition of the Analyzed Lithic Artifacts from the Mather-Klauer Lodge Site by Raw Material Type.

Artifact Type	Count			Weight (g)			Total Count	Total Weight (g)
	Quartz	Chert	Quartzite	Quartz	Chert	Quartzite		
Debitage	19,744	81	37	9,353.69	30.34	188.91	19,862	9,572.94
Cores	95	2	3	5,687.24	7.45	398.57	100	6,093.26
Tools	79	7	-	413.62	12.8	-	85	426.42
Grand Total	19,918	90	40	15,454.55	50.59	587.48	20047	16,092.62

The presence of cores, debitage, and tools made of quartz and chert suggest that the full range of lithic reduction occurred for all raw materials at this site. That is, the raw material was transported to, or found at the site in their raw form (in this case water-worn cobbles), and then reduced at the site until they produced useable tools. The tools were then discarded at the site. In behavioral terms, the Mather-Klauer Lodge site represents, at minimum, the manufacture and depositional links on the behavioral chain (Skibo and Schiffer 2008). In Andrefsky's (2009) terms, this site represents the production,

reduction, and discard-links on the chain. It is highly likely that lithic artifacts were used and maintained here as well (the use and maintenance links in the behavioral chain) given the presence of the thick midden-like buried surface described above, the lack of faunal and floral preservation, however, makes it difficult to tell if these artifacts were used at the site or if they were simply discarded there after being used elsewhere.

Figure 15. Graph Showing Relative Frequencies of Raw Material Composition by Count (Left) and Weight (Right).

The following analysis will focus on debitage and core classes to understand the organization of this technology. The tools will also be analyzed, in particular the utilized flakes and bipolar lithics, artifacts that appear in abundance at the Mather-Klauer Lodge Site.

Cores

In order to accurately analyze the debitage from an assemblage, it is beneficial to know the type of reduction that took place at a site. While many studies have shown that

this is possible from solely analyzing debitage (see Andrefsky 2005, chapter 6), examining cores, and the way flakes were removed from them can provide the analyst with the information needed to know how they were reduced. As previously noted, three primary raw material types were recovered from the Mather-Klauer Lodge site (quartz, quartzite, and chert). Within these three primary types, multiple unique raw material types were identified based on color, texture, and inclusions. Table 6 provides a general overview of the core assemblage by primary raw material type, while the remainder of the analyses will focus on the raw material sub-types.

Five classes of cores were identified at the Mather-Klauer Lodge site based on reduction technology. They include, (1) Bipolar, (2) Bipolar/Multi-Directional, (3) Multi-Directional, (4) Type Indeterminate (T.I.), and (5) Tested. Bipolar cores have been reviewed at some length above (i.e. Andrefsky 2005; Binford and Quimby 1963; Leaf 1979; Odell 2004), but generally involve crushing on opposing ends of the core from being reduced using the hammer and anvil technique. Bipolar/Multi-directional cores contain evidence of bipolar reduction on two separate sets of opposing poles on the core. That is, the cobble was placed on an anvil so that one pole of the long axis was touching the anvil, then the cobble was struck with a hammerstone on the opposite pole until it broke open. Subsequently, that same cobble was flipped on its side so one pole of the short axis was now touching the anvil, and then the cobble was struck on the opposite pole. This technique created two sets of opposing poles that were present on the same cobble but the direction of force created by smashing along the long axis was perpendicular to the force created by smashing it on the short axis. Multi-Directional

cores are those that do not display any evidence of bipolar reduction and whose flake removal patterns are randomly oriented throughout the core. Tested cores are defined as cores that contain the majority of their cortex and have evidence of one or two flake removals. Finally, type indeterminate (T.I.) cores are those that could not be placed into one of the aforementioned categories.

Additionally, six sub-classes of cores were recognized within the five classes of cores mentioned above. They are, (1) Cobble, (2) Split Cobble (3) Nucleus, (4) Pebble Core, (5) Fragment, and (6) Tested. Cobble cores are simply cores made from water-worn cobbles. These are identified by their general ovular shape and often still contain areas of cortex. Split cobbles are cobbles that are split in half, or into fourths. Technically, these cores could be considered blocky decortification flakes given that they contain no evidence of flake removal past the initial splitting of the cobble, but for technological purposes they were included in the core category. They are identified by a flat interior surface (or surfaces if they are quarters of a cobble) with no additional evidence of modification, and a completely cortical exterior. Core Nuclei are defined as exhausted cobble cores with little to no cortex present and multiple flake removals. They are often much smaller than cobble cores. Pebble cores are simply cores whose parent material is a small-medium size pebble. For the purposes of this thesis, pebble cores were defined as those being smaller than the approximate size of a chicken egg. Fragmented cores are the only sub-category of cores that are specific to bipolar technology. They are defined as any core that displays a lateral break perpendicular to the direction of force bipolar force. Finally, tested cores are listed as a sub-category of bipolar cores based on the presence of

crushing on opposing ends of the core, but less than 3 flake removals off of the cortical surface of the cobble.

Table 6. General Composition of Core's Recovered from ISU's Excavations.

	Chert		Quartz		Quartzite		Totals	
	Ct.	Wt. (g)	Ct.	Wt. (g)	Ct.	Wt. (g)	Ct.	Wt. (g)
Bipolar	1	2.15	83	4623.95	1	31.63	85	4657.73
Cobble			34	2373.12			34	2373.12
Split Cobble			26	1110.63			26	1110.63
Nucleus	1	2.15	7	47.47			8	49.62
Pebble Core			7	119.3			7	119.3
Fragment			5	379.73			5	379.73
Tested			4	593.7	1	31.63	5	625.33
Bipolar/ Multi- Directional			4	369.99	1	270.1	5	640.09
Cobble			4	369.99	1	270.1	5	640.09
Multi- Directional			5	279.48			5	279.48
Flake Core			1	24.54			1	24.54
Cobble			3	245.18			3	245.18
Nucleus			1	9.76			1	9.76
T.I.	1	5.3	3	413.82	1	96.84	5	515.96
Cobble	1	5.3	2	408.54	1	96.84	4	510.68
Nucleus			1	5.28			1	5.28
Grand Total	2	7.45	95	5687.24	3	398.57	100	6093.26

As shown in Table 6, Bipolar cores (n=87) dominate the assemblage, constituting 85% of the cores recovered during ISU's excavations. Multi-directional cores (n=5) make up the next highest percentage with 5%, followed by Bipolar-Multi-directional (n=5) with 5%, and type-indeterminate cores (T.I.; n=2) with 5% of the overall assemblage. Quartz

cores (n=95) constitute 95% of the core assemblage, followed by chert cores n=2 and quartzite cores (n=3) which make up 2% and 3%, respectively. These percentages are slightly varied from the overall relative percentages of the raw material described above. The discrepancy is likely caused by the fracturing properties of quartz versus those of quartzite and chert. A single strike on a quartz piece is likely to produce more debitage than a similar blow on quartzite or chert (Driscoll 2010) and thus when the debitage is included in the count, the relative percentage of quartz rises.

A comparison of the average weight of cores in each class and sub-class shows trends that would be expected given the technological basis for classifying the core sub-types (Table 7). For example, on average quartz core nuclei weigh much less than quartz cobble cores, which conforms to what would be expected given that the nuclei sub-class is supposed to represent exhausted, highly reduced cores displaying little-to-no cortex. Additionally, quartz bipolar-split cobbles are roughly half the average weight of cobble cores, while tested cobbles' average weight is roughly twice as much. These averages make intuitive sense given that split cobbles are unmodified cobble halves and quarters, while tested cobbles represent those that have only started to be reduced.

While it is acknowledged that the extremely small sample of chert and quartzite cores make it hard to draw statistically valid conclusions that have a possibility of relating to other Terminal Woodland sites, the average weight of the two chert cores is markedly less than those for quartz and quartzite. This observation fits with what is known of the local lithic resources found in the conglomerate that outcrops on the island. Chert occurs infrequently in small nodules while larger cobbles of quartz and quartzite

occur more frequently (Hamblin 1958), suggesting that lithic reduction activities that occurred at the Mather-Klauer Lodge utilized primarily local lithic resources. Chert cores are further explored below.

Table 7. Average Weight of Cores by Primary Raw Material Type.

	Chert	Quartz	Quartzite	Total
	Avg. Wt. (g)	Avg. Wt. (g)	Avg. Wt. (g)	Avg. Wt. (g)
Bipolar	2.15	55.71	31.63	54.80
Cobble		69.80		69.80
Split Cobble		42.72		42.72
Nucleus	2.15	6.78		6.20
Pebble Core		17.04		17.04
Fragment		75.95		75.95
Tested		148.43	31.63	125.07
Bipolar/ Multi- Directional		92.50	270.10	128.02
Cobble		92.50	270.10	128.02
Multi- Directional		55.90		55.90
Cobble		24.54		24.54
Nucleus		81.73		81.73
Flake Core		9.76		9.76
Tested	5.30	137.94	96.84	103.19
T.I.	5.30	204.27	96.84	127.67
Cobble		5.28		5.28
Grand Total	3.73	59.87	132.86	60.93

Chert Cores. Only two chert cores were recovered from the site. They include one core nucleus that was reduced using the bipolar technique and one indeterminate (T.I.) core that was unable to be typed based on the flake removal patterns observed (Table 8). The cores were made from Type 4- Section 16 chert (formerly Moss Lake chert), and

Type 6-cobble chert respectively. Cobble chert, as previously noted, can be found on the beaches on or within the vicinity of Grand Island, while the only known outcrop of Section 16 chert is located in Delta County, Michigan near the town of Nahma (Figure 1, Chapter 2). Traditionally, archaeologists have used two models to explain the presence of raw materials that are directly local to the site/region; direct procurement and down-the-line trade (Andrefsky 2005). Given our inadequate knowledge of the distribution of lithic resources, it is hard to be certain how this core came to be deposited on Grand Island, but the most likely possibility is that it was obtained by the population who inhabited the Mather-Klauer Lodge site who procured the material from its source, be it an outcrop, stream-bed, or a beach, and then transported it to Grand Island where it was reduced until it was of no further use.

Table 8. Chert Cores.

Core Type	Count		Weight		Totals	
	Type 4	Type 6	Type 4	Type 6	Total Count	Total Weight
Bipolar	1		2.15		1	2.15
Nucleus	1		2.15		1	2.15
T.I.		1		5.3		
Cobble		1		5.3	1	5.3
Totals	1	1	2.15	5.3	2	7.45

The inability to determine the type of reduction of the Type 6-chert core inhibits the ability to compare reduction techniques; functionally the cores both represent the same artifact; a core from which flakes were driven until the reduction no longer proved viable to remove flakes.

Quartz Cores. Quartz cores out-number both chert and quartzite cores combined 19-to-1. While it has been noted that the similarities of quartz make it hard to distinguish one source from another (Holdaway and Douglass 2015), all of the quartz cores appear to be derived from the water-worn cobbles eroding from the conglomerate that outcrops on Grand Island based on the general shape, size, and presence of water-rolled cortex. However, as described in the methodology section above, various colors of quartz were identifiable within the assemblage. Table 9 breaks down the distribution of various quartz core types based on the observable colors, as described in the methodology.

Three quartz colors were identified, Smoky (n=2), Translucent (Trans.; n=2), and White (n=95) quartz. As is evident, white quartz dominates in all core categories. This is likely a product of the general composition of the quartz cobbles eroding from the conglomerate. General, albeit unsystematic, observations made during multiple field schools indicate that white quartz is ubiquitous on the present-day beaches, while smoky and translucent quartz cobbles occur less frequently. No functional or significant technological differences were observed in the reduction of quartz cobbles of different colors. Bipolar reduction was utilized on at least one core of each color of quartz, and although the smoky and translucent quartz cores weigh less on average than white quartz cores (Table 10), the small sample size makes it difficult to assign much significance to these discrepancies.

Table 9. Quartz Cores Separated by Raw Material Color.

	Count			Weight (g)			Totals	
	Smoky	Trans	White	Smoky	Trans	White	Total Count	Total Weight
Bipolar	1	2	79	26.39	96.2	4,145.96	82	4,268.55
Fragment			5			379.73	5	379.73
Nucleus			7			47.47	7	47.47
Pebble Core		1	6		3.6	115.7	7	119.3
Split Cobble			26			1,110.63	26	1,110.63
Tested			3			441.5	3	441.5
Cobble	1	1	32	26.39	92.6	2,050.93	34	2,169.92
Bipolar/ Multi- Directional			3			346.69	3	346.69
Cobble			3			346.69	3	346.69
Multi- Directional			5			279.48	5	279.48
Flake Core			1			24.54	1	24.54
Nucleus			1			9.76	1	9.76
Cobble			3			245.18	3	245.18
Tested			4			787.24	4	787.24
T.I.	1			5.28			1	5.28
Nucleus	1			5.28			1	5.28
Core	2	2	91	31.67	96.2	5,559.37	95	5,687.24

Quartzite Cores. Only three quartzite cores were recovered from ISU's 2012-2013 excavations at the Mather-Klauer Lodge site. Of these, one was a bipolar tested cobble, one was a bipolar/multi-directional cobble, and one was unable to be typed. Given the presence of so few cores, along with no quartzite tools shows that quartzite was not a primary raw material used by the prehistoric inhabitants of the site. When utilized, however, it was reduced using the same techniques as the quartz cobbles on the site. From Table 5, we see that very few flakes and no tools were made of quartzite. It is likely that the reduction of quartzite cobble was conducted for a purpose, but there is no

evidence of utilization on any of the byproducts (Table 5 above), nor is there much debitage. This suggests that the cobbles were not intensively reduced, and if any of the byproducts were used, they were either transported from the site and discarded elsewhere, or they were used for tasks so expedient that no macroscopic evidence of use-wear was visible.

From what we know of the temporal trends of raw material use (Drake et al. 2009; Franzen 1998), the lack of quartzite on this Terminal Woodland site is not surprising. For reasons still unknown to archaeologists, a major shift away from the use of quartzite occurred during the start of the Woodland period, and lasted through contact. Based on this, it was originally thought that the presence of quartzite might have been indicative of an Archaic component that underlays the Woodland-period occupation based on the field observations that quartzite seemed to be more frequent at the lower levels. This is still certainly plausible given the close proximity of site 03-913, a Late Archaic site located less than 300m south of the Mather-Klauer Lodge site at roughly the same elevation above the current lake level.

However, a look at the average depth of the all of the piece plotted lithic artifacts shows that there is only a 2 cm difference in the average depth at which quartzite artifacts were recovered, when compared to quartz artifacts, and only a 6 cm average difference compared to chert artifacts (Table 11). Given the woodland setting and sand soil matrix these figures fall well within the range of variation of the elevation of the original living surface, and thus are not significant enough to warrant assigning the quartzite to a previous occupation based on stratigraphic position alone.

Table 10. Average Weight of Quartz Cores.

	Smoky	Trans	White	Total
Bipolar	26.39	48.10	52.48	52.06
Fragment			75.95	75.95
Nucleus			6.78	6.78
Pebble Core		3.60	19.28	17.04
Split Cobble			42.72	42.72
Tested			147.17	147.17
Cobble		92.60	64.09	63.82
Bipolar/ Multi-Directional			115.56	115.56
Cobble			115.56	115.56
Multi-Directional			55.90	55.90
Flake Core			24.54	24.54
Nucleus			9.76	9.76
Cobble			81.73	81.73
Tested			196.81	196.81
T.I.	5.28			5.28
Nucleus	5.28			5.28
Core Average	15.84	48.10	61.09	59.87

It should be noted here that the majority of fire cracked rock (FCR) that was recovered from the site was made of quartzite, while none of it was made of quartz. This shows a clear delineation in the use of quartz as a raw material for knapping but not for use as fire-lining stones, while quartzite was used for both. The presence of knapped quartzite may simply be a byproduct of the fact cobbles of quartzite were present at the site for intended use as FCR and reduced to produce expedient flakes that were only used so infrequently that no use-wear was observable. It is also possible that the lack of large numbers of quartzite flakes are attributable to the fact that once these cobbles were initially cracked open and the prehistoric inhabitants realized they were not made of

white quartz, they were discarded. Unsystematic experimental knapping of beach cobbles during the field school made it clear to the author that it is not always easy to tell the color or composition of the raw material simply based on the cortical surface of the cobble. Therefore, the quartzite cobbles may have been opened accidentally, which could explain why tools made of quartzite were not recovered from the site.

Table 11. Average Depth for All Piece-Plotted Artifacts.

Raw Material	Average Depth (amsl)
Chert	191.54
Quartz	191.58
Quartzite	191.60
Total	191.58

Bipolar Cores. All of the Bipolar and Bipolar/Multidirectional cores were classified using Binford and Quimby's (1963) percussion surfaces as discussed in Chapter 2. The results are displayed in Table 12. Area-Area dominate the assemblage, although it should again be noted here that this table excludes bipolar lithics or *pieces esquillées*, many of which have opposing ridges and could be considered cores.

Fragmented cores aside, when the average weights of each bipolar core type are compared we see that cores with "Ridge" and "Point" percussion surfaces weigh less, on average, than those cores with "Area" surfaces. This observation seems to fit Leaf's (1979) observations that percussions surfaces represent various stages of manufacture, with an 'area' percussion surface representing the least intensely reduced core type and "ridge" and "point" representing sequentially more intensive reduction, respectfully.

Table 12. Bipolar Core Types after Binford and Quimby (1963).

	Count	Weight (g)	Avg. Weight (g)
Area-Area	55	3992.62	72.59
Ridge-Area	8	339.56	42.45
Ridge-Ridge	2	28.31	14.16
Right Angle Ridges	2	81.69	40.85
Point-Area	4	67.34	16.84
Point-Ridge	7	129.1	18.44
Fragmented	12	943.29	78.61
Grand Total	90	5581.91	62.02

The high frequency of Area-Area bipolar cores suggests that the majority of the cores were not subjected to intense reduction. This is likely a factor of the ubiquity of quartz as a raw material. Quartz cores account for 87 of the 90 bipolar cores that were analyzed. However, as noted by Holdaway and Douglass (2015) this may also be a factor of the fracturing properties of quartz. They found that quartz cores, on average, produce fewer complete, useable flakes than finer quality cryptocrystalline materials, and thus are subjected to less-intense reduction. This also fits with what Driscoll (2010, 2011) and Tallavaara et al.'s (2010) studies concluded about the fracturing properties of quartz.

When compared to the sites analyzed by Binford and Quimby (1963: 300), area-area cores accounted for the majority of complete bipolar cores at the Point Detour Bay and Scott Point sites (43% and 54% respectively). However, comparisons of the salient metric attributes (length, width, and maximum thickness) show that bipolar cores at the Mather-Klauer Lodge site are much larger than those analyzed by Binford and Quimby (1963: 292; Table 12). This is likely because Binford and Quimby's (1963) specimens

were all made from pebble chert resources, while the majority of cores from the Mather-Klauer Lodge site are made from larger, quartz cobbles. Thus, it is evident that, in the Upper Great Lakes, the bipolar reduction technique serves both as a way in which to utilize scarce chert resources that are unable to be systematically reduced using freehand percussion, as well as a way to maximize the usefulness of poor-quality resources such as quartz cobbles. Indeed, Driscoll (2010) found that the bipolar technique, when applied to quartz cobbles, produced a greater number of useable flakes than did any of the other reduction techniques.

It is also evident that the replicative systems analysis conducted by Marcucci (1998) for the Archaic occupation of Trout Point does not apply to this site. However, due to the seemingly random fracturing properties of the quartz cobbles, a full replicative systems analysis of the reduction technology at the Mather-Klauer Lodge site is difficult to compile. We do know that ovular cobbles were selected and reduced parallel to the long axis of the cobble using the bipolar technique. At this point, it appears that Holdaway and Douglass' (2015) outlook on quartz (discussed in detail in Chapter 2) is most applicable; in summary, a cobble is broken open and the shape and size of the resulting pieces determined how, or if, they were going to be selected for further reduction. An analysis of the debitage below will examine the byproducts of that reduction, and the conversation into the reduction technique will continue below.

Debitage

The numbers and figures presented in this section derive from the portion of debitage assemblage that was subjected to the full analysis as described in the

methodology section above (n=19,862). This number represents 81.12% of the total amount of debitage recovered during ISU's excavations including the artifacts recovered from the screen and only identified by their raw material type (n=24,453). As per the methodology, five major categories of debitage were recorded, including, Blocky Decortification, Flat Decortification, Blocky Secondary, Flat Secondary, and Shatter. Figure 16 details the relative percentages of each flake category within their respective primary raw material types.

As shown in Figure 16, the debitage profiles for chert and quartzite fall within the same range of variability, while the profile for quartz artifacts is markedly different. The primary difference is the high occurrence of quartz shatter, which accounts for 80.61% of the quartz assemblage. The same category only constitutes 27.16% and 21.62% of chert and quartzite, respectively. There are two primary reasons for this discrepancy. The first is the fracturing properties of quartz as a raw material.

As described in Chapter 2, experimental analyses of quartz fracturing mechanics show that even when quartz is reduced and analyzed in a controlled setting, up to 70% of the debitage is unclassifiable and falls into the shatter or debris category (Driscoll 2011). It is also possible that this is simply a product of the small sample size of chert and quartzite debitage, which number 81 and 37 artifacts, respectively. When these numbers are compared to those of quartz (n=19,744) they pale in comparison.

Figure 16. Graph Showing the Relative Frequencies of the Count (Top) and Weight (Bottom) of the Five Major Flake Categories by Raw Material Type.

Decortification Flakes. The presence of decortification flakes, alongside cores, secondary flakes and shatter signifies the full range of lithic reduction occurred at the site for all three of the aforementioned raw materials. Andrefsky (2005: 104-106) reviews a

number of studies that used cortex as a proxy for reduction stage of tools. Categorically using cortex to determine reduction stage/sequence was cautioned against by Sullivan and Rosen (1985) due to the lack of consideration of reduction technology. Parent material shape and size is also an issue affecting the use of cortex as a proxy for reduction. Using geometric principles to determine cortical ratios, Dibble et al.'s (2005) study finds that as the parent material (in this case the water-worn cobbles) become more spherical, the ratio of cortical flakes to non-cortical flakes decreases due to the inverse relationship between cortical surface area to the volume non-cortical interior of the cobble. Thus, lower ratios of cortex should be present in the debitage from the assemblage, especially considering that the amount of cortex remaining on the cores was not precisely measured, though with the exception of core-nuclei, all cores contained some cortex.

While it can generally be stated that flakes containing large amounts of cortex on their dorsal surface, were detached early in the reduction process, the majority of such studies are conducted to investigate a bifacial core/tool technology on fine cryptocrystalline material (e.g. Odell 1989:185). As discussed in Chapter 2, archaeologists working with a quartz-dominated material or bipolar reduction technology must be cautious of categorically applying such to analyze their assemblages. In this particular instance, it seems appropriate to reiterate the sentiments of Holdaway and Douglass (2015) in saying that the idea of staged reduction sequence may be foreign to quartz reduction technology.

Table 13. Relative Percentages of Cortical Flakes by Count (Above) and Weight (Below) Excluding the Shatter Category.

	Chert		Quartz		Quartzite		Totals	
	Ct.	% of Ct.	Ct.	% of Ct.	Ct.	% of Ct.	Ct.	% of Ct.
100% Cortex	5	8.47%	266	6.95%	3	10.34%	274	6.99%
33-99%	2	3.39%	171	4.46%	1	3.45%	174	4.44%
< 33%	48	81.36%	2817	73.55%	18	62.07%	2883	73.58%
Cortex on Platform	1	1.69%	391	10.21%	5	17.24%	397	10.13%
Cortex on Margin	1	1.69%	179	4.67%	1	3.45%	181	4.62%
Not Recorded	2	3.39%	6	0.16%	1	3.45%	9	0.23%
Total	59	100.00%	3830	100.00%	29	100.00%	3918	100.00%

	Chert		Quartz		Quartzite		Totals	
	Wt. (g)	% of Wt.	Wt. (g)	% of Wt.	Wt. (g)	% of Wt.	Wt. (g)	% of Wt.
100% Cortex	3.04	10.02%	991.01	10.58%	4.74	2.51%	998.79	10.42%
33-99%	3.55	11.70%	375.01	4.00%	110.24	58.36%	488.8	5.10%
< 33%	19.39	63.91%	6646.29	70.96%	38.13	20.18%	6703.81	69.94%
Cortex on Platform	0.39	1.29%	562	6.00%	5.24	2.77%	567.63	5.92%
Cortex on Margin	3.3	10.88%	612.33	6.54%	27.92	14.78%	643.55	6.71%
Not Recorded	0.67	2.21%	179.05	1.91%	2.64	1.40%	182.36	1.90%
Total	30.34	100.00%	9365.69	100.00%	188.91	100.00%	9584.94	100.00%

At the Mather-Klauer Lodge site, the relatively small percentage of decortification flakes when compared to the secondary flakes is logical given that the parent material for this debitage were water-worn cobbles. The ovular water-worn cobbles that appear to have been selected for then should have relatively low cortex ratios compared with non-cortical debitage, as is evident from Figure 16. It is important to point out that the figure does not include the cortical surfaces left on the cores themselves. As

noted in the core section above, quartz cores especially were not subjected to intense reduction and therefore most retained at least a portion of their cortical surface.

Complete flakes were coded based on the presence of cortex according to the methodology outlined above (Table 13). Shatter was not coded due to time constraints. While only a small percentage of the complete flakes contain enough cortex on the dorsal surface to be considered decortification flakes (11.86%, 11.41%, 12.79% for chert, quartz, and quartzite respectively), flakes containing cortex on their platform and/or the margins constitute a greater percentage than do the decortification flakes for quartz and quartzite debitage (14.88% and 20.69%, respectively).

Flakes with cortical margins are a byproduct of the use of the bipolar reduction technique to reduce cobbles that have already been split, and contain a non-cortical interior surface (i.e. a split cobble). Striking the cobble in the same location will produce a flake which runs parallel to the long axis of the cobble and contains non-cortical ventral and dorsal surfaces, but it will have cortex on the margin where it intersects the exterior of the cobble.

The ratio of cortical flakes containing 100% cortex to cores for each material type is as follows, chert- 2.5: 1; quartz-2.8:1; and quartzite-1.0: 1. This measure is particularly important on sites such as the Trout Point Site (Marcucci 1988), where, based on the replicative systems analysis, only a single fully cortical flake per core could be possible. The even ratio of non-cortical artifacts to cortical artifacts demonstrates that this technique was not used at the Mather-Klauer Lodge site. The ratio of chert and quartz

more than doubles that of quartzite, which is indicative of a more intense utilization of each raw-material when compared to quartz.

Secondary Flakes. Combined, block and flat secondary flakes account for 64% and 67% of chert and quartzite debitage, respectively, while accounting for only 17% of quartz debitage. The same considerations of fracturing properties and intensity of reduction must be considered when analyzing these numbers. Experimental data has already been presented (Driscoll 2010, 2011; Tallavaara 2010) that states that fewer complete flakes will be produced from quartz due to its relative lack of isotropic integrity. Secondary flakes containing cortex on their platforms are present in numbers that equal, and even supersede those of completely cortical flakes (Table 13).

Shatter. The extremely large proportion of shatter at present at the Mather-Klauer Lodge site (80.61% of the assemblage by count and 37.65% by weight) is a product of quartz reduction. In experimental studies (Driscoll 2010, 2011) noted that up to 85% of the debitage produced during the reduction of quartz consists of small fragments of quartz that were classified as debris. The presence of immense amounts of shatter, therefore, signals that cobbles were reduced at this locality.

Size-Grade Analysis. The problem then becomes how to classify this large amount of debitage. Numerous methods for dealing with large assemblages have been proposed, some of which deal with individual flake attributes (i.e. Sullivan and Rozen's [1985] interpretation-free method), while others have proposed mass-analysis techniques (i.e. Alher [1989] and Stahle and Dunn's [1984] size-grade technique). There are certainly benefits associated with each technique, but as it has been shown neither technique is

intrinsically better than the other (Andrefsky 2005; Odell 2004). Lithic analysts must choose which technique(s) to use based largely on the question they are interested in answering, but also based on the data they have available to them.

To this end, the Mather-Klauer Lodge site presented an interesting problem. Based on the sheer number of flakes, it seemed logical to use a mass-analysis technique such as the size-grade analyses outlined by Alher (1989) and Sthale and Dunn (1984). However, the fact that most of the artifacts were in individual bags, using the size-grade analysis would still require each flake to be handled individually, and thus it was equally efficient to conduct an individual flake analysis. As described in the methodology section above, it was determined that an individual flake analysis would be conducted and each flake would be weighed. All of the piece-plotted debitage recovered from the 2013 excavations was then measured for maximum length, width, and thickness with the goal of relating the weight of artifacts to their maximum dimension. The 2012 debitage was excluded from this form of analysis because it had been processed the previous year and time was of the essence.

Table 14. Size-Grade Measurements after Table 4 in Alher (1989:100).

Size Grade	Nominal Designation	Actual Diagonal Opening Size (mm)
1	One-inch	35.9 mm
2	Half-inch	17.2 mm
3	Quarter-inch	8.01 mm
4	Eighth-inch	3.79 mm
5	Sixteenth inch	1.88 mm

a.

b.

c.

d.

Figure 17. Comparison of Measured and Calculated Size-Grade Analyses.

Size grade analyses based on weight have been conducted (see Andrefsky 2005:131-140), but they were all focused on classifying chert-dominated assemblages. As has been demonstrated throughout this paper, quartz fractures differently than chert and thus it was determined that the size-grades based on weight for chert would not be as applicable to this assemblage. Therefore, using the measured sample of flakes, the maximum dimension of each flake was calculated, and based on that dimension, the debitage was then categorized into five separate size grades (SG1-SG5) according to Alher's hardware-cloth size grades (1989:100; Table 14).

The mean and median weight for the artifacts within each size grade was then calculated and compared to the measured sample. This data is presented in the Figure 17 above. Of primary focus was the quartz assemblage, since quartz dominates the sites' assemblage and because the sample size of chert (n=56) and quartzite (n=14) were so small that they were more likely to be prone to statistical errors than quartz artifacts. As is evident, the relative percentages of artifacts falling into SG5 are much higher than those of the measured sample. This, unfortunately, is a product of the scales used to weigh the artifacts. The scale was only accurate to 0.01 g and thus variation within the smaller flakes was not as intensely recorded. Although the debitage profiles created by using mean and median weights vary from the measured sample, they both conform to the general pattern for the measured sample: smaller artifacts are more common than the larger ones, but there is a sharp drop off when it comes to the smallest size grade.

Table 15. Weight Range for Determining Size Grades.

Size Grade	Quartz (g)	Chert (g)	Quartzite (g)
1	23.18- Max	n/a	96.85-Max
2	1.96-23.179	2.20-5.3	1.87-96.84
3	0.22-1.959	0.14-2.19	0.53-1.869
4	.030-0.219	0.04-0.139	0.04-0.529
5	0.00-0.029	0.00-0.009	0.00-0.04

Based primarily on these data, it was decided that the median weights of each size grade should be used to classify each of the remaining unmeasured lithic artifacts. The median weight was favored for two primary reasons. First, when the assemblage was classified using the median weight values for each size grade, the relative percentage of artifacts within each size grade more closely mirrored those of measured sample than when the mean weights were used, particularly SG2 (Figure 17a). Secondly, the median score is resistant to outliers, and given the large standard deviation of the weights (up to 130% of the mean), outliers were common in the dataset. The median weights that will be used to determine size grade are described below (Table 15).

The resulting relative percentages are represented in the graph below (Figure 18). The profiles for chert, quartz, and quartzite are markedly different. Furthermore, these profiles vary from the measured sample profiles depicted above. The primary reason for this is the addition of the root concentration to the dataset. As mentioned above, the root concentration contained close to 12,500 pieces of debitage, most of them being small pieces of shatter, which bolstered the number of artifacts within the smallest size grade category (SG5).

Figure 18. Relative Percentage of Artifacts by Size Grade Based on Weight.

We see that the general profile of quartz contains a low relative percentage of large, SG1 artifacts (cores, decortification flakes, and large flakes), with the number of artifacts in the smaller size grades increasing gradually in frequency as the size grades get smaller until the smallest size grade (SG5), where it has been mentioned that the relative percentage increases dramatically (71.06%).

Nearly half of the chert artifacts (42.82%), on the other hand, fall within the parameters for SG3, with a decline in the numbers of artifacts falling into SG4 and SG5, along with SG2. It again should be reiterated here that this debitage profile is conducted on a very small sample of chert artifacts ($n=90$), and thus is subject to some skewedness if the profile will be used to make inter-site comparisons. However, because the profile is based on the Mather-Klauer Lodge assemblage, it is statistically valid to make intra-site comparisons based on those percentages.

The graph highlights what was shown to be true above. The lack of chert artifacts in SG1 mirrors the observation that chert cores were much smaller than quartzite cores and thus the resulting debitage is also smaller. The low relative percentage of SG1 quartz artifacts (0.36%) does not seem to highlight this discrepancy, but we know from the individual attribute analysis that the reason for diminutive presence of large quartz artifacts has to do with the high relative percentage of small pieces of shatter (35.67% of the assemblage by weight). Comparatively, quartzite cobbles have a much higher relative percentage of artifacts in the SG1 category (7.50%), which as previous analyses noted, is because it was the least intensively used at the site, and primarily occurs in larger pieces. Unfortunately, further analyses of the size grade data as presented by Stahle and Dunn (1984) and by Alher (1989) were based on experimental datasets created and analyzed by the researchers. Unfortunately, no such dataset exists in this case and those used by the aforementioned researchers focused on chert bifacial technology, a reduction strategy that we know was not employed at the Mather-Klauer Lodge site based on the analysis of the cores. Still, this profile serves as a way to summarize the massive amount of chipped-stone debitage encountered at the site and will be useful in future research as a comparative metric.

Platform Analysis. As described in the methodology, platforms were analyzed for the presence of cortex and existence of faceting. Those that exhibited neither were designated as flat platforms. In a traditional dataset concerned with bifacial tool production, flakes containing cortical platform are indicative of early stage cobble/core reduction, while faceted platforms are produced during later-stage reduction, thinning,

and shaping of artifacts (Andrefsky 2005:91-94). At the Mather-Klauer Lodge site, 10.09% of the debitage that contained a platform (n=3894) exhibited cortex on the platform (n=393). This number is not surprising given that both cores and decortification flakes were present in the assemblage, suggesting that the early stages of reduction occurred at the site.

Interestingly, no faceted platforms were observed during the course of analysis. There is a slight possibility that a few flakes with faceted platforms were present at the site but were not recognized due to the high instance of quartz as a raw material, but the lack of bifacial core technology and the dearth of bifacial tools seem to indicate that no bifacial reduction occurred at the site. The lack of faceting suggests that artifacts, primarily made of quartz, were subjected to a very similar process as described by Holdaway and Douglass (2015), as well as other researchers (Parry and Kelly 1987). That is, cobbles were smashed open and useable artifacts were selected from the resulting debitage based on the shape and size of the artifact, as well as the needs of the knappers. Any additional modification that did occur at the site was not bifacial in nature.

Platform width and thickness were recorded for a sample of artifacts. The sample consisted of all artifacts from unit 516N 497E. This unit was selected because upon preliminary analysis it was determined that it contained the most representative sample of debitage. Indeed, the relative percentages of major flake categories in the sample closely mirror those found on the entire site, if shatter is not included in the calculations. In total 224 platforms were measured (5.75% of the artifacts containing platforms). Of those, 209 flakes were made from quartz, 10 were made from chert, and 6 were quartzite. Ideally,

all platforms should have been measured, but given time constraints, only a portion of them were able to be recorded and thus sampling error may be a problem in the following conclusions.

Additional platform types were recorded for this sample of flakes, which in addition to cortical (19.11% of the measured sample) and faceted (none of which were present) included flat and crushed. Flat platforms were defined as non-cortical platforms that did not exhibit any faceting, crushing or grinding. These made up the majority of the platforms in the sample (68.00%). Flat-angled were flat platforms that exhibited an angle greater than 45° with the interior surface of the flake (4.89%). Crushed platforms were those that exhibited crushing on the surface (8.00%).

Table 16. Mean and Median Thickness of Measured Platforms by Platform Type.

Platform Type	Ct.	Relative %	Mean Thickness	Median Thickness	Mean Width	Median Width
Cortical	43	19.11%	4.57	3.85	11.33	9.93
Crushed	18	8.00%	2.32	2.18	6.99	6.69
Flat	153	68.00%	2.48	1.85	5.58	5.05
Flat-Angled	11	4.89%	3.56	2.35	7.06	5.70
Total	225	100.00%	2.92	2.34	6.86	5.70

The mean and median lengths and widths of the platforms for each platform type are presented in the table above (Table 16). As expected, that cortical platforms are, on average, the thickest and widest of the platform types, with mean measurements of 4.57mm and 3.85 mm, respectively. While crushed platforms fall between flat and flat-angled platforms with a mean thickness of flat and flat-angled platforms (see table below). The significance of flat-angled platforms is not entirely known without

conducting a full replicative systems analysis of the lithic technology at the site (i.e. Marcucci 1988), but it is likely that these flakes are analogous to thinning flakes in bifacial technology (Andrefsky 2005: 91-94), and were struck from a flat edge at an angle so as to thin core. However, given the fracturing properties of quartz discussed throughout this paper, these could very well simply be the byproduct of random reduction. Further experimental work needs to be conducted before a conclusive answer is reached.

Table 17. Mean and Median Thickness of Measured Platforms by Flake Type.

Flake Type	Ct.	Relative %	Mean Thick. (mm)	Median Thick. (mm)	Mean Width. (mm)	Median Width. (mm)
BD	21	9.38%	4.59	5.13	7.66	10.83
BS	74	33.04%	4.17	3.12	9.01	7.44
FD	19	8.48%	2.70	2.12	6.69	3.87
FS	110	49.11%	1.82	1.55	5.33	4.98
Total	224	100.00%	2.93	2.34	6.88	5.70

When separated by flake type, blocky flakes have platforms that are, on average, two-times thicker than flat flakes (mean measurements of 4.38 mm and 2.26 mm, respectively; Table 17). Likewise, the mean widths of platforms on blocky flakes are larger than those measured for flat flakes (8.34 mm vs. 6.11 mm, respectively). These measurements fit with what is expected of flake types per their definition. Block flakes are likely removed first, and also likely removed with greater force, both of which should equate to a wider, thicker platform.

Again, these measurements in and of themselves are not particularly informative, but if this analysis is used on other Upper Great Lakes lithic assemblages of known temporal affiliations, it is possible that temporally specific trends will emerge that could potentially serve as a temporal guideline for identifying sites lacking diagnostic artifacts.

Tools

A total of 86 chert tools were identified during the Phase III investigations at the Mather-Klauer Lodge site (Table 18) including 57 bipolar lithics, which as mentioned above could be included in the bipolar core category or the tool category depending on one's interpretation of the bipolar lithic per the discussion in Chapter 2. The subsections below will discuss each major tool category and provide more detailed analyses of each subtype of tool.

Table 18. Tools Recovered During Phase III Investigations at the Mather-Klauer Lodge Site.

	Ct.	Wt. (g)
Chert -(33)	11	20.62
Projectile Point	1	0.27
Bipolar Lithic	4	10.38
Scraper	3	3.84
Utilized Flake	3	6.13
Quartz -(34)	99	811.87
Projectile Point	2	1.41
Bipolar Lithic	59	337.16
Scraper	1	2.05
Utilized Flake	37	471.25
Grand Total	110	832.49

Projectile Points. The three straight-based triangular projectile points recovered during ISU's Phase III investigations represent the only formal tools recovered from the Mather-Klauer Lodge site. Two of the projectile points are made from white quartz (Plate 1a,c), while one is made from Type 1 chert (Plate 1b). Morphologically, the two quartz projectile points are roughly equilateral triangles, with basal widths that are nearly equal to the length of their sides. One of the quartz projectile points (515N 498E) is made on a decortification flake, and only exhibits unifacial retouch on its ventral side (Plate 1c). The second quartz arrowhead (515N 497E) exhibits bifacial flaking across both faces of the arrowhead, and has possible indications of re-sharpening on one of its sides (Plate 1a). The chert arrowhead, on the other hand, is more of an isosceles triangle, with the basal width being roughly half of the length of its sides. It is flaked across both faces of the arrowhead (Plate 1b).

Triangular projectile points are temporally diagnostic of the Terminal Woodland period, and their appearance is generally thought to coincide with the introduction of the bow and arrow (Fitting 1968). At the Juntunen site, these points were named Juntunen points (McPherron 1967:148-153), while at the Mero and Heins Creek sites they were simply referred to as 'triangular arrowheads' (Mason 1966). Projectile points from all three sites display the same morphological variation as seen at the Mather-Klauer Lodge site, which appears to simply be a product of manufacture and is not particularly diagnostic in any way. Although this could be taken to mean that all three sites shared a lithic technology that resulted in the manufacture of morphologically similar points, it is more likely that the bow and arrow technology simply required points to fall within a

certain metric range in order to function properly as an arrow tip, and that the specific stylistic and morphological attributes of those points were not particularly important so long as they fell within said range.

The salient metric attributes of each arrowhead are listed in Table 19 below. The measurements for the Mather-Klauer Lodge Projectile points fall within the range of variation for the similar metric attributes at other regional Terminal Woodland sites. At Juntunen the metric attributes for Juntunen Points fell within the following ranges: Mean Length = 27 mm, s.d = 12 mm; Mean Width = 17 mm, s.d. = 7 mm (McPherron 1967). The “triangular projectile points” at Mero range in length from 15 to 40 mm with a mean of 27 mm, in width from 10 to 50 mm with a mean of 16 mm, and in thickness from 2 to 7.5 mm with a mean of 5 mm (Mason 1966: 56). Meanwhile, triangular projectile points at Heins Creek range in length from 22 to 45 mm, in width 13 to 28 mm, and in thickness 3 to 6 mm.

Table 19. Metric Attributes of Points Recovered from the Mather-Klauer Lodge Site.

Unit	Level	Artifact Number	Material	Basal Width (mm)	Length (mm)	Thickness (mm)	Weight (gm)
515N 497E	5	87	White Quartz	16.78	14.84	3.17	0.72
515N 498E	3	284	White Quartz	13.01	15.95	2.76	0.69
516N 497E	8	Screen	Type 1 Chert	10.37	19.47	3.04	0.27

Scrapers. Three scrapers and one scraper fragment was recovered from ISU's Phase III investigations (Plate 1d-g). Two classes of scraper are represented in this assemblage, (1) End Scrapers, and (2) Side Scrapers, with the scraper fragment from ISU's investigations being too fragmented to classify.

Two complete end scrapers, along with one end scraper fragment were recovered from the Mather- Klauer Lodge site. Of these, two were made from Hudson Bay Lowland Chert (Type 6; Plate 1d, g), while one was made from white quartz (Plate 1f). The quartz end scraper (515N 497E, Lvl 5, #114) was made on a flat secondary flake whose cortical platform is still visible on the proximal end of the flake. The scraper is semi-rectangular in shape, with the distal end of the flake exhibiting slight retouch on the distal end to form a steep-angled edge. The left margin of the flake also contains some retouch on the dorsal surface, creating a much more acute-angled edge that was likely used for cutting. The second complete end scraper (516N 497E, Lvl8, #96) has an irregular tear-drop shape and was manufactured from a blocky secondary Type 6 cobble chert flake (Plate 1d). The platform of this flake is also still visible, with retouch on the distal end of the flake forming a steep angle similar to the one observed on the quartz scraper. No additional retouch of the margins was present on this end scraper.

The side scraper (515N 497N, Lvl 8, #15) was made from a flat secondary Type 2 chert flake (Plate 1 g). The scraper is semi-rectangular in shape and displays slight retouch along the left and right margins along the dorsal surface of the flake, creating a moderately steep angle suitable for scraping activities.

Table 20 displays the salient metric attributes of the three complete scrapers. Based on the relatively small size of these scrapers, it seems likely that they were hafted. However, no haft element was visible during measurement, and thus no metric attributes for hafting were recorded. Similar classes of scrapers were identified at Terminal Woodland sites such as Mero (Mason 1966) and Juntunen (McPherron 1967), although as mentioned in chapter 3, scrapers of these forms are not diagnostic of any particular Woodland phase. Their presence at the Mather-Klauer Lodge site likely indicates that animal processing activities were occurring at or near the site. The unfortunate lack of faunal material from the site makes it hard to verify whether the activity took place at the site, or whether the scrapers represent exhausted discarded tools from scraping activities that occurred elsewhere.

Table 20. Salient Metric Attributes of Complete End Scrapers.

Unit	Lvl	Artifact Number	Type	Material	Width (mm)	Length (mm)	Thickness (mm)	Bit Width (mm)	Bit Thick. (mm)	Weight (gm)
515N 497E	5	114	End Scraper	White Quartz	16.95	18.90	5.50	16.72	3.58	2.05
516N 497E	8	96	End Scraper	Type 6 Chert	16.04	17.01	5.18	16.04	4.92	1.39
516N 497E	8	15	Side Scraper	Type 2 Chert	13.67	22.10	4.97	-	-	1.42

Utilized Flakes. A total of 40 utilized flakes were recovered from the site. Three of the flakes were made of chert, while the remaining 37 were made from quartz. They were identified with the aid of an eye loop capable of 10X magnification, based on the presence of small, uniform flake removals from the edges, as well as rounded edges, which experimental work with quartz artifacts identifies as a marker of utilization on

quartz pieces (e.g. Sussman 1985). The location of utilization on each flake was recorded, but an analysis of the data showed no correlations between location of utilization and the flake type. As such, in an attempt to better synthesize and present the data, utilization was recoded to just include three categories. They are as follows: (1) uni-marginal (i.e. the left margin or distal end of the flake); (2) bi-marginal- occurring on more than one margin of the flake (i.e. distal end and left margin, or right and left margins, etc.); and (3) wedge- on the interior ridge of the flake created during its detachment from the flake. With the exception of two bifacially retouched flakes (Plate 1i), all of these flakes exhibit unifacial retouch. Considerable morphological variability exists within the utilized flake assemblage, which includes the overall size of the flakes selected for use, as well as the types of flakes which were chosen. The graph below (Figure 19) shows the frequency of each flake type and the location of retouch on each flake type.

Blocky secondary flakes represent the most-used flake type (46.15% of the overall assemblage; n=18). One of these flakes was detached using the bipolar method, as evidenced by crushing on opposing ends of the flake. Perhaps not surprisingly, none of the blocky secondary flakes are made from chert.

As described above, chert nodules and cores are both smaller and scarcer than cobbles of quartz. Based on the size of the chert chipped-stone artifacts recovered from the Mather-Klauer Lodge site, a blocky secondary flake of chert would almost definitely be further reduced to create numerous smaller flakes that could in turn be utilized. The same is true of blocky decortification flakes, which are not represented by a single chert artifact, although only three quartz blocky decortification flakes were utilized.

Figure 19. Flake Type Selected for Utilized Flakes (Top) and Location of Utilization on Various Flake Types (Bottom).

Flat secondary flakes are the second most-frequently utilized flake type (38.46%; n=15). Two of these flakes are made from chert, while the other 13 are made from quartz. One of the chert flakes was detached using the bipolar technique, as is one of the quartz flakes. Additionally, three flat decortification flakes displayed utilization, one of which was a linear chert flake, while the other two were made from quartz.

Uni-marginal utilization is the most frequently encountered type of utilization (74.36%; n=29), however it accounted for 100% (n=3) of the utilization on chert flakes. Similar, utilization on the 'wedge' of a flake is only present on blocky flakes (secondary and decortification), however, this was somewhat expected given that flat flakes, by definition do not possess wedges. Bi-marginal utilization occurs with relatively similar frequencies (10-30%) across all flake categories except for flat decortification flakes, in which it is absent.

Few morphological similarities exist between the flakes that were selected for utilization (see Plate 1 m-p for a variety of flake shapes), even within each flake category, with one exception. Four utilized quartz flakes were identified that exhibited a cutting edge that was opposed by a cortical surface. These were interpreted as handheld, 'backed' knives. That is, the cortical surface provided an unsharpened surface on which the user was able to place their hand. These knives were all made on block flakes, with two being made on secondary flakes and two on decortification flakes (Plate 1m, p). Although only five decortification flakes were selected for utilization, two-thirds of the utilized flake assemblage (n=26) contained some cortex, whether it was on the dorsal surface (n=5), platform (n=10), or flake margin (n=11). The presence of cortex further,

combined with the high instance of uni-marginal utilization bolsters the assertion that these flakes were the product of a primarily expedient technology. These artifacts did not exhibit any evidence of curation (cf. Binford 1971), and likely were not manufactured for use outside of the particular site area. Their close geographic association with cores and debitage suggest they were created, used, and discarded at the site during the course of the occupation at the Mather-Klauer Lodge site.

The salient metric attributes were taken for each utilized flake, along with their weights. The summarized data is presented in Table 21. The high relative standard deviations of all of the measured attributes are a good indicator of the high morphological variation within the assemblage. With the exception of the thickness measure of FD flakes (0.71 mm), all of the standard deviations are above 7 mm, with some ranging to as many as 26 mm. The same is true for the weights of the flakes, but the data seems more uniform with St. Dev for flat flakes ranging from 3-6 g, and those for blocky flakes varying considerably more (13-20 g).

Given this variation, the median score is likely a better descriptor of BS and FS flakes given that it is less sensitive to statistical outliers. However, it should be noted that the low sample size for BD and FD flakes ($n=3$ for each) makes either the median or mean score a poor descriptor of the data. As such, the median scores will be discussed briefly, with the caveat that the scores for FD and BD flakes may be slightly skewed. As is expected per the definition of the flakes, the average median thickness for utilized blocky flakes (11.64 mm) more than doubles that of flat flakes (4.89 mm). This data seems to correlate with the average median weights of the two categories of flakes, with

blocky flakes (average median weight= 13.16 g) more than doubling that of flat flakes (average median weight= 3.65 g). All of the flakes selected for utilization are, slightly longer (average median score= 30.04 mm) than they are wide (average median score= 21.76 mm). BS flakes are the longest flake type observed (40.93 mm), with FD representing the widest flake type (27.96 mm).

In and of themselves, these measurements do not tell us much. However, these measures provide a basis for comparison to other Late and Initial Woodland assemblages. Aside from the CRM reports that present the metric attributes of utilized flakes in summary tables (i.e. Anderton et al. 1991; Dunham 2000b; Dunham et al. 2010; Dunham and Branstner 1998), no discussion of utilized flake types could be found other than simply a description of their presence at the major costal sites (e.g. Brose 1970a; Mason 1966; McPherron 1967). While it may be true that utilized flakes do not vary in shape or form across time or geographic space, this has not been properly documented. Given the lack of temporally diagnostic artifacts found at sites in the Upper Peninsula (Drake et al. 2009), comparisons of the metric attributes of flakes could provide an additional marker with which to identify a site's temporal affiliation, assuming the size and quality of the parent raw material is comparable to that which was used at the Mather-Klauer Lodge site.

Table 21. Summarized Parametric Attributes for Utilized Flakes.

Length (mm)					
	Count	Mean	St. Dev	Median	Range
BD	3	32.31	14.43	29.44	19.53-47.95
BS	18	42.53	14.61	40.93	21.17-74.90
FD	3	39.25	9.46	39.21	29.82-48.73
FS	15	25.09	13.48	22.85	10.88-65.64
Total	39	35.04	15.65	30.04	10.88-74.90
Width (mm)					
	Number	Mean	St. Dev	Median	Range
BD	3	29.68	13.00	22.95	21.42-44.66
BS	18	28.29	12.41	23.96	13.15-54.84
FD	3	28.91	16.87	27.69	12.69-46.36
FS	15	25.15	26.20	16.30	7.39-112.76
Total	39	27.29	18.42	21.76	7.39-112.76
Thickness (mm)					
	Count	Mean	St. Dev	Median	Range
BD	3	14.35	10.03	11.18	6.29-25.59
BS	18	13.03	5.80	12.09	5.38-25.21
FD	3	5.99	0.71	5.88	5.34-6.75
FS	15	6.16	7.87	3.90	1.5-33.05
Total	39	10.05	7.02	7.09	1.5-33.05
Weight (g)					
	Count	Mean	St. Dev	Median	Range
BD	3	15.29	13.14	13.17	3.34-29.36
BS	18	19.64	20.87	13.15	1.11-74.76
FD	3	9.51	6.03	5.81	2.2-20.51
FS	15	2.87	3.56	1.49	0.64-13.64
Total	39	12.32	16.74	4.75	0.63-74.76

Bipolar Lithics. Bipolar lithics represent the most frequent tool association recovered from the Mather-Klauer Lodge site. ISU's excavation produced 57 bipolar lithics, the typified shape of which are displayed in Plate 1h, l. CCRG's excavations recovered an additional 33 bipolar lithics. Of the 60 bipolar lithics recovered, six were made of chert, with the rest manufactured from quartz. The function of these bipolar lithics is heavily debated (see chapter 2), with some researchers suggesting that they represent wedges used to split wood or bone, while others assert that they simply represent exhausted bipolar cores. As with the utilized flakes, the salient metric attributes for each flake was measured. The data is presented in the table below (Table 22).

Bipolar lithics made from quartz are on average bigger in all metric measures than those made from chert. Those made from quartz also display much greater ranges in length, width, thickness, and weight than those made from chert (Table 22). On average, both chert and quartz bipolar lithics recovered from the Mather-Klauer Lodge site fall within the range of variation for objects described in the ethnographic literature as wedges (Shott 1989: 6, Table 1). However, it should also be noted that Shott's (1989) review of ethnographic sources found that few wedges were primarily made from wood, bone, or antler, with only one instance of wedges being made from stone in the Australian Central Desert (Hayden 1970: 64-65). Both Shott (1989) and LeBlanc (1992) note that Hayden's (1970: 65-65) artifacts are up to 10x larger than those artifacts normally referred to as *pièces esquillées* in the archaeological literature. Thus, based on the literature, these objects should not be considered *pièces esquillées* in the traditional

sense, but could represent wedges used for wood-working, as described by Hayden (1979: 63-64).

While examining the bipolar lithics recovered from ISU's excavations, it was noted that slightly over half (50.79%; n=32) exhibited a flat edge that ran parallel to the direction of force, suggesting that these artifacts were broken during reduction/use (bipolar lithics recovered from CCRG's excavations were not analyzed for this type of break). The artifacts which exhibited this break contained, on average, 2-3 mm less area crushing on the ridges than those objects that contained no breaks (12.64 mm vs. 15.85 mm). Logically, they also measured 2 mm less in width than those not exhibiting the break (19.84 mm vs. 17.41 mm). Based on experiments conducted by Ranere (1975), that type of break is common on bipolar lithics when using them as wedges to split wood. However, it could have just as equally been created during the course of bipolar reduction, and then discarded

If these bipolar lithics did represent exhausted bipolar cores, it would be expected that the flakes removed from these cores would exhibit high instances of utilization, given the prevalence of the bipolar lithics at the site. It is likely that all of the utilized flakes were a product of bipolar reduction, based on an analysis of the core technology employed at the site. However, when the median metric attributes of the bipolar lithics are compared to those of the utilized flakes (Table 906 and Table 917, respectively), bipolar lithics are shorter and skinnier than utilized flakes, although the thickness for bipolar lithics falls within the range of variation for utilized flakes.

Table 22. Metric Data and Weight for Bipolar Lithics.

Length (mm)					
	Number	Mean	St. Dev	Median	Range
Chert	6	21.85	3.24	22.31	16.34-25.21
Quartz	90	28.12	9.79	26.94	9.30-60.97
Total	96	27.72	9.63	26.47	9.30-60.97
Width (mm)					
	Number	Mean	St. Dev	Median	Range
Chert	6	15.73	4.05	14.14	13.08-23.69
Quartz	90	20.87	8.17	19.20	10.36-58.22
Total	96	20.55	8.05	18.91	10.36-58.22
Thickness (mm)					
	Number	Mean	St. Dev	Median	Range
Chert	6	7.04	0.98	7.18	5.80-8.44
Quartz	90	9.95	7.53	8.95	10.36-73.80
Total	96	9.76	7.32	8.88	5.80-73.80
Weight (g)					
	Number	Mean	St. Dev	Median	Range
Chert	6	2.60	0.67	2.50	1.98-3.40
Quartz	90	5.81	4.65	4.78	0.86-23.47
Total	96	5.61	4.56	4.18	0.86-23.47

The results of the Brose's (1970a: 95-119) use-wear analysis (the only one conducted in the Upper Great Lakes region to date), however, do list opposing ridge cores (a category in which bipolar lithics could plausibly be included), as having evidence of a slight gloss on the high ridge facets on the "outside face" of cores, faint longitudinal striae extending $\frac{1}{4}$ of the distance down the face of the core, transverse striae with oblique light, and crushing and very small pressure flakes driven off the concave face along one ridge. He interprets this as being similar to a burin pattern which hasn't

been subjected to much pressure, with edge and concave sides displaying a pattern similar to an end scraper. However, it has been shown that wood working can produce similar patterns of use (Ranere 1975).

A binary view of the bipolar lithics recovered from the Mather-Klauer Lodge site seems to be too constricting. Based on a review of the literature, it is plausible that these objects could represent both cores, as well as wood/bone-working tools. Use-wear analysis would conclusively answer the question, but unfortunately it was not conducted for this thesis. It would be an ideal avenue of inquiry for anyone looking to further explore the site or the subject.

Additional Artifacts

Copper. Two copper awls were recovered from ISU's investigations at the Mather-Klauer Lodge site. Although no mineralogical analysis was conducted on the copper, based on the localized nature of the lithic assemblage, they were likely manufactured from secondary deposits of copper found in the streams and along the shore of Lake Superior. It is also possible that they were manufactured from copper quarried on Isle Royale, or in the Keweenaw Peninsula to the west (i.e. Clark 1995; Martin 1999).

Table 23. Metric Attributes of Copper Awls.

Unit	Level	Artifact Number	Length (mm)	Width (mm)	Thickness (mm)	Cross-Section	Type
514N 500E	2	Screen	46.07	2.76	2.34	Square	Two Pointed Ends
516N 497E	7	256	25.11	2.63	1.51	Lenticular	Two Pointed Ends

The use of copper has been well documented at other Terminal Woodland sites (i.e. Hoxie 1980), but is not temporally diagnostic of the Terminal Woodland period (i.e. Janzen 1968; Hill 1994). The metrics of the awls are presented in the table below (Table 23). They fit within the range of variability for awls found at the Sand Point site (Hoxie 1980: 34-35, Table 6).

Groundstone and Cobble Tools. Two groundstone tools, four cobble tools were recovered from ISU excavations at the Mather-Klauer Lodge site, with an additional two groundstone artifacts recovered from CCRG's investigations. Included in the total assemblage are four granitic hammerstones, one quartz hammerstone/mano combo, and two anvils. Many of these artifacts appear to have served multiple purposes, such as the two granitic anvils that were found in features which appear to have been reused as lining stones for the hearths and exhibit signs of heating in the form of spawls.

Granitic hammerstones were identified by the presence of battering/ chipping on the edges of the cobbles. They range in dimensions from 81.29 cm-165.26 mm in length, 24.6-113.34 mm width, and 39.86-77.13 mm in thickness. The salient metric attribute for each hammerstone are presented in Table 24 below. These hammerstones were not intentionally shaped in any way, and were likely picked up on the beach during the course of gathering the quartz cobbles.

The granitic two anvils were identified by the presence of pitting. The anvil recovered in 2009 was found at the base of F 2 (TU4), and weighed 2,861 g, while the anvil recovered by ISU near HS4 (518N 498E) and weighed over 4000 g. Both anvils displayed evidence of heat pops caused by differential heating of the rock, signifying that

they were recycled as hearth stones and turned into FCR. Traditionally pitted anvils (or metates) are associated with nut processing, an observation made by Dunham et al. (2010:5-73). Although acorn processing has been well documented on Grand Island (Skibo et al. 2009), based on the prevalence of the bipolar reduction technique, these stones could be true anvils on which cobbles were placed during the knapping process.

Table 24. Hammerstone Salient Metric Attributes.

Unit	Level	Artifact	Length (mm)	Width (mm)	Thickness (mm)
516N 497E	7	Granitic Hammerstone	165.26	113.34	77.13
517N 499E	4	Granitic Hammerstone	133.52	86.75	51.51
CCRG TU6	3	Granitic Hammerstone	110.8	24.6	58.9
518N 498E	5	Granitic Hammerstone	81.29	66.04	39.86
Average Metrics			122.72	72.68	56.85

The sole groundstone/cobble tool made of quartz was recovered from TU 517N 498E. It was a quartz water-worn cobble that contained pronounced battering on all of its edges, but also contained a small section of pitting near its center. It was split around the area of pitting, suggesting it was cracked during use and later discarded. It is likely that this artifact functioned as a combination hammerstone/anvil and was used to reduce quartz cobbles.

The presence of two anvils and a hammerstone from the conjoining units 517N 498E and 517N 497E, as well as the association of those units with HS4, further suggest

that it was a site of initial reduction of quartz cobbles. It is likely that the granitic anvils were also used for food processing, although associating them with nut processing (particularly acorns) may be overreaching (see discussion below). The fact that the cobbles were recycled could indicate that the occupation of the Mather-Klauer Lodge site could have spanned more than one season, and the anvils were repurposed after they were no longer needed to process a certain resource.

Discussion

The inhabitants of the Mather-Klauer Lodge site employed an expedient technology that relied on bipolar reduction to crack open locally-obtained water-worn quartz and chert cobbles and produce sharp-edged, usable flakes and bipolar lithics, in addition to scrapers and triangular Terminal Woodland projectile points. The near absence of bifacial technology at the site appears to be consistent with the informal nature of the tool assemblage in which expedient tools outnumbered formal tools, excluding bipolar lithics, by a ratio of 6.67:1.

Using Andrefsky's models (1994a, 1994b), the composition of the tool assemblage fits with what should be expected based on the low quality and ubiquity of the quartz raw material available for reduction. To reiterate, Andrefsky (1994a) predicts that when a high abundance of low quality material is present at a site, then the resulting tool assemblage should consist of primarily expedient tools. Additionally, the model states that if a low quantity of high quality material is present at a site, then it should be primarily used to create formalized tools. However, these tools will also be subject to limitations based on the size of their parent material and the size of the needed tool

(Andrefsky 1994b). Thus we see that the chert assemblage, while only numbering 90 total artifacts, contains 4 formal tools (a ratio of 15:1), while the quartz assemblage contains only 3 formal tools, one of which is made on an expedient flake, and contains 19,918 artifacts (a ratio of 6,639:1). Proportionally then, the higher-quality material (chert) is used to manufacture formal tools more often than the lower-quality quartz. No reduction sequence could be readily identified at the Mather-Klauer Lodge site (e.g. Callahan 1979; Marcucci 1988). The most plausible explanation for the lack of identifiable reduction stages can be attributed to the organization of expedient lithic technology employed by the site's inhabitants. The fracturing properties of quartz are such that when a cobble is broke open using bipolar technology, it is extremely difficult to control the shape and size of the resulting pieces (cf. Driscoll 2011, Tallavaara et al. 2010). Holdaway and Douglass (2015) caution that when dealing with an expedient tool technology that utilizes low-quality quartz as a raw material, one should not focus on the "constrained processes of lithic reduction" (Ibid:8), but instead focus on the selection of flakes. That is, prehistoric knappers did not smash a quartz cobble open with a specific end product in mind. Rather, the cobbles were opened, and based on the shape and size of the resulting debitage pieces were selected that fit the technological needs of the population. Therefore the focus of the reduction technology employed at the site was not tied to the reduction of the cobble itself so much as it was to the selection of the detached pieces. Several ethnoarchaeological examples of this process are represented in the literature (e.g. Hayden 1979; Holdaway and Douglass 2015; LeBlanc 1992; Parry and Kelly 1987).

At the Mather-Klauer Lodge site, this selection process is best understood by analyzing the flakes selected for utilization. As is evident from the utilized flake section above, the shape and size of the flakes selected for utilization display a great deal of variation, likely reflecting different technological needs of the populations. Few generalizations can be drawn from such a morphologically diverse tool assemblage, with the exception of the fact that all of the utilized flakes are large enough to be held in the hand, with median metric attributes as follows: length- 30 mm, width-22 mm, thickness-7mm, and weight-4.75 g (Table 21). Exploring the techno-function of these flakes, by way of a use-wear analysis would be an ideal avenue for future research. Although it is unfortunately beyond the scope of this paper, conducting such an analysis may shed light on the reasons behind the selection of such a morphologically variable flake assemblage. Non-utilized lithic debitage, as it turns out, seems to be a poor indicator of lithic technology. Although the absence of specialized waste flake types such as notch or thinning flakes (i.e. Morrow 1998) can inform the analyst about what is not prevalent in the assemblage (e.g. bifacial reduction or formal tool manufacturing), given the selection-based nature of the reduction system it seems more important to focus on the flakes that were selected for utilization as opposed to those that were rejected. Still, the analysis of debitage profiles (e.g. Figure 17a-d), if employed at a multitude of sites on a regional scale may still hold the key to defining trends in the selection process of debitage (i.e. finding out what is missing from an assemblage) and could still possibly serve as a temporal indicator for sites that lack diagnostic artifacts. This, however, is an assumption that still needs to be tested.

The proliferation of bipolar lithics recovered from the site (n=90) suggests that at least some of these objects were used as tools. Given the high abundance of quartz cobbles available for reduction, the intensive reduction of certain cobbles into bipolar lithics does not seem technologically beneficial unless they served some function, especially considering that the median and mean metric attributes for the bipolar lithics (Table 22) fall short of the same measurements for the utilized flakes recovered from the site (Table 21). This is another observation, however, that could benefit from use-wear analysis to test if these bipolar lithics display evidence of utilization. However, based on Brose's (1970a) use-wear analysis, it seems likely that such a study would indicate that some of these objects were utilized and some simply represent exhausted bipolar cores. While the effect of the quality and size of raw material resources on the tool kit assemblage at the Mather-Klauer Lodge site should not be understated, the relative mobility of populations have also been shown to have an effect on the organization of lithic technology (e.g. Binford 1979; Parry and Kelly 1987). Increasingly sedentary populations have been shown to utilize a progressively expedient toolkit, centering on the idea that the curated bifacial tools were manufactured as a risk-abating strategy to counteract the differential distribution of lithic raw material on the landscape (Odell 1994). Sedentary populations, then, would have less uncertainty about the presence and/or quality of raw material available to them. In instances where material was abundant there would be no need to maintain a bifacial toolkit, and populations instead could choose to utilize an informal toolkit that takes less time and effort to manufacture.

Binford (1979) has argued that lithic procurement was “embedded” into other social and subsistence activities. Additionally, he argues that the variability in proportions of raw material at a site is a function of the scale of the habitat exploited from that location (Binford 1979:260). Assuming this to be true, the overwhelming use of local quartz cobbles suggest that the subsistence activities at the Mather-Klauer Lodge site were hyper-focused on Grand Island and did not bring the Terminal Woodland groups into contact with the more abundant chert resources present in the southern or eastern Upper Peninsula (e.g. Drake et al. 2009; Luedtke 1976).

Although there continues to be some debate over prehistoric settlement patterns in the Upper Peninsula (see Dunham 2015; Drake and Dunham 2004, Cleland 1982; Martin 1985, 1989), all models agree that populations practiced some degree of seasonal mobility. The hyper-local raw material selection and the expedient tool kit employed at the Mather-Klauer Lodge site suggest that the population was, at the very least, seasonally sedentary and also had a restricted range of mobility in their subsistence activities. This fits with McHale-Milner’s (1991) analysis of pottery styles during the Terminal Woodland period, where she interpreted the proliferation of different styles of pottery, all sharing similar characteristics, as a mechanism for groups with restricted mobility to maintain social ties with other groups who could share resources in the event of a bad year. Similarly, Luedtke (1976), in her analysis of lithic material distribution patterns and interaction patterns during the Late Woodland in Upper and Lower Michigan found that the raw material resources present at a site became increasingly geographically

constricted during the Terminal Woodland period, suggesting increasing localization and restriction of territorial boundaries as population density increased.

Additional macro-regional site distribution studies (Cleland 1992; Dunham 2002, 2014; Martin 1985, 1999) identify a shift in the physical location of sites from shallow-water localities in the Initial Woodland period to deep-water localities in the Terminal Woodland. Although Drake and Dunham's (2004) analysis of the Woodland period on Grand Island found that there was no observable change in settlement patterning between the Initial and Terminal Woodland period occupations of the island, the lithic composition of the Mather-Klauer Lodge site seems to indicate restricted mobility which Cleland (1992), Martin (1999), and McHale Milner (1991) have associated with the formation of social identities and political boundaries on a macro-regional scale during the Terminal Woodland period.

In summary, the expediency of the toolkit of at the Mather-Klauer Lodge site was likely influenced both by the availability of raw material resources, as well as the increased sedentism and restricted political boundaries of the Terminal Woodland populations. Based on the analysis of the lithic assemblage and of ethnographic data of the region, the Mather-Klauer Lodge site likely represents a seasonally sedentary occupation of the locality. This interpretation is supported by the comparative lack of curated, formal tools at the site as well as the overwhelming use of locally-procured quartz and chert cobbles. Utilization of the bipolar reduction technique to reduce these cobbles was, in this case, less indicative of economizing behavior (cf. Odell 1996) and more of an adaption to the raw materials. The spatial organization of such a reduction

strategy, as well as its implications for the length of occupation and site function are explored in the following chapter.

CHAPTER VI

SPATIAL ORGANIZATION OF LITHIC TECHNOLOGY

This chapter focuses on intrasite spatial analyses of the artifacts recovered from the Mather-Klauer Lodge site in order to provide a glimpse into the organization of lithic technology. To view a single artifact class in a vacuum, however, inhibits the analyst's ability to identify and consider the full range of behavioral activities that lead to the manufacture, use, and deposition of those artifacts. For this reason, this chapter will begin with an overview of the site stratigraphy and cultural features that have been identified at the site, including three features excavated by CCRG's 2010 excavations. Descriptions of Features 1-3 are taken from Dunham et al.'s (2010) report (the citation of which will not appear in the text below for brevity's sake). A more in-depth look at the spatial distribution of lithic debitage based on the analyses summarized in Chapter 5 will follow.

Site Stratigraphy

The test units excavated by CCRG and by ISU at the Mather-Klauer Lodge site produced relatively similar stratigraphic profiles. As noted by Dunham et al. (2010:5-61), the profiles of the individual units display quite a bit of variability, but overall they followed a general pattern across the main portion of the site. Four distinctive layers were present over the majority of the excavation area, along with a conglomeration of other zones mixed into the stratigraphy of

the site. The upper-most fill-zone that overlaid the entire site was a dark yellowish brown (10YR 3/4) – to – pale brown sand (10YR 6/3) compact-to-loose sand. During ISU's excavations this layer was given the designation of Zone II (with subsets of IIa, IIb, and IIc demarcating subtle differences in the color of the zone). Based on the relatively high number of historic artifacts found within Zone II, it is interpreted as a historic fill layer that was deposited sometime in the mid-to-late 20th century, possibly in conjunction with the installation of the retaining wall and solar panel located on the western boundary of the site (see Figure 20 and Figure. 21). Material was very sparse in this zone, and included modern historic artifacts.

Somewhat counterintuitively, Zone I is located below Zone II, and is also separated into subsets of Ia, Ib, and Ic site (see Figure 20 and Figure. 21). Zone Ia consists of very dark gray (10YR 3/1) to dark gray (10YR4/1) loose-to-moderately-compact sand that contains the majority of the artifacts related to the occupation of the Mather-Klauer Lodge, including nails and glass. Thus, it is interpreted as the living surface during the construction and primary occupation of the lodge. A low frequency of prehistoric artifacts recovered from this layer seems to indicate some mixing of the zones, but as anyone who has ever walked in sand can attest, simply taking a step can leave a depression up to 10 cm deep and mix the sand. Thus, the prehistoric artifacts from this layer, likely originate from the zone directly below Zone Ia (Zones Ib and Ic).

Zone Ib underlays Zone Ia and is interpreted as the prehistoric living surface. It consists of a black (10YR 2/1) to very dark gray (10YR 3/1) very compact, greasy sand, and contains the vast majority of the prehistoric artifacts. Unlike Zones II, and Ia, Zone Ib

is not completely continuous over the entire site. In spots, large limestone rocks that were used in the construction of the retaining wall on the western edge of the site intrude into, and destroy Zone Ib. These large stones are distributed throughout Zone II and Zone Ia, and primarily end at the base of Zone Ia.

However, as evident in the 517N 497E North wall profile (Figure 21), the intrusion of the stones destroyed any remnant of Zone Ib that may have been present.

Zone Ib is by far the most compact layer at the site. As Duhnam et al. (2010) notes, the zone was so compact that it was impressed onto the artifacts, and could be removed as a sheet, leaving a cast of the artifact. Dunham et al. (2010) attributes the intense compactness of the zone to the machine work associated with building the retaining wall on the bluff edge. Similar surfaces are described at site 03-754 (Dunham and Branstner 1995; Skibo et al. 2009), and Gete Odena (Skibo et al. 2004) but they are much less compact.

Zone Ic represents a burned layer of soil, sometimes including small mottles of greenish- yellow clay (not present in the profile), that was interpreted by McPherron (1967: 239:241) at the Juntunen site as the remnants of ash. This layer consists of black (7.5YR 2.5) sand with common medium mottles of strong brown sand (7.5YR 5/6) and pinkish gray sand (7.5YR 6/2). It occurs sporadically around the site, most notably in 517N 498E, 515N 497E (around F 4), and 516N 497E (around F 3). Zone Ic is, for the most part, stratigraphically independent of Zone Ib. That is, with the exception of a 25 cm section in the north wall of 517N 597E, Zone Ic occurs in place of Zone Ib and does not overlay or underlay it. This suggests that Zone Ic simply represents a heat-altered version

of Zone Ib, and not a separate layer. Carbonized bone fragments found in Zone Ic represent the only faunal material recovered from the Mather-Klauer Lodge site, but material recovered from the zone was otherwise similar to that recovered from Zone Ib.

The entire site is underlain by Zone III, a predominately culturally-sterile layer of pale brown (10YR 7/4) fine sand. Artifacts sporadically occur within this zone, but are much less frequent than in the superseding zones and mainly consist of FCR. It is likely that these artifacts were simply transported into the soil due to some form of bio-turbation, although there is a slight possibility that they could reflect an earlier, unidentified component.

Figure 20. 515N Wall Profiles.

Figure 21. 517N Wall Profiles.

Cultural Features

A total of five prehistoric features have been identified at the Mather-Klauer Lodge site (Features 1-5; Figure 23). With the exception of one feature (F 1), all of them are interpreted as hearth features. Their descriptions, artifact compositions, and assumed function are described below:

Feature 1. Feature 1 (F 1) was identified by CCRG in TU's 2 and 4 approximately 20 cm below the modern ground surface. In plan, it was described as a very dark brown (10YR2/2) soil stain with dense clumps of pottery. It measured approximately 33 cm north-south and 30 cm in width (Figure 23). The feature was bisected and upon exposing its profile, was found to measure only 2-4 cm deep. The fill consisted of one zone that contained 73 artifacts (3% of the total artifact assemblage recovered by CCRG's 2009 excavations). Among those artifacts were 14 pieces of quartz debitage, 1 white quartz core, and 57 ceramic body sherds, all of which were either smooth and undecorated or type-indeterminate, save for two sherds that displayed cordwrapped stick impressed and cordwrapped stick and cord impressed decorations, respectively. One of these sherds was submitted for AMS dating and returned a date of 790 ± 40 BP (Beta-269591; calibrated 2 sigma range of 780BP to 670 BP [AD 1170 to AD 1280]).

No official interpretation of the feature's function was attempted by Dunham et al. (2010). Based on the profiles and pictures available from the report, and the artifacts recovered from the feature, F 1 likely represents the remnants of a storage pit filled with refuse when the site was abandoned or during its occupation. The lack of FCR and soil

oxidation in or around the feature suggests that it was not used as a processing pit or hearth feature. Additionally, the high number of fragmented ceramic sherds recovered from the feature (21% of the total ceramic assemblage recovered from the site) combined with the lack of ceramic artifacts found in non-feature contexts suggests that ceramic refuse was intentionally disposed in the pit. On the other hand, it is possible that the lack of ceramic artifacts found outside of features is a product of the preservation of non-lithic artifacts. As noted above, the acidity of the soil and freeze-thaw cycle can wreak havoc on ceramic materials. It is possible that the ceramic artifacts found in the feature were somehow protected from these effects.

Feature 2. Feature 2 (F 2) was defined approximately 28 cm below the modern ground surface in as a ring of dark soil (very dark brown 10YR2/2) sand around a lighter, grayish brown (10YR5/2) sand mottled with very dark gray sand (10YR3/1). It extended about 55 cm north/south and was roughly 50 cm wide. In profile the feature measured 25 cm in depth, at the base of which was a dense deposit of FCR and heated cobbles that appear to underlay the featured itself and extend into the sandy subsoil, forming a basin-like pit.

Two zones were identified in the profile (Figure 22). They include a very dark soil zone (Zone A) surrounding a lighted mottled sand zone (Zone B). Zone B was thought to be an intrusive fill zone that is at least partially related to the historic fill that caps the compact prehistoric living surface based on the recovery of historic metal objects within this zone, including two wire nails (Dunham et al. 2010: 5-80).

Material recovered from the F 2 accounted for nearly 19% of the total material collected during the 2009 excavations (n=469), including 384 pieces of debitage, 11 Cores, 12 tools chipped-stone tools, 1 groundstone platform, and 22 pieces of FCR. Quartz accounted for 89.58% (n= 344) of the debitage, 45.45% of the core assemblage (n=5), and 100% of the stone tools. Quartzite and silicified sandstone accounted for 4.62% of the debitage assemblage (n=18), and 54.55% of the cores (n=6). Chert made up the remainder of the assemblage accounting for 1.03 % (n=4) of the debitage assemblage, with no chert cores or tools recovered from the feature.

Figure 22. Feature 2 Profile (Picture taken from Dunham et al. 2010, Figure 5.4.1-6).

The groundstone platform is interpreted as a nutting-stone used to process acorns, an activity documented on Grand Island since the Archaic-period (Dunham et al. 2009; Skibo et al. 2009). Its presence at the base of F 2 suggests that it was no longer functioning as a nutting stone, but rather had been repurposed as a heated stone.

Dunham et al. (2010: 5-80 through 5-83) interpret F 2 as being a hearth, based on the rock lining of the pit and the carbonized remains found in the flotation sample. To support their claim, Dunham et al. (2010: 5-82) cite an example of an Archaic rock-lined nut-roasting pit recorded at the Butternut Lake Inlet site in northeastern Wisconsin (Bruhy et al. 1999: 31-33; cited in Dunham et al. 2010).

Additionally, the carbonized remains of an aquatic tuber were recovered in a flotation sample taken from the intrusive zone (Zone B) of the feature. Rock-lined tuber roasting pits have been identified at Late Woodland sites in Lower Michigan (Beld 1996; Cremin 1980b- both cited in Dunham et al. 2010), although F 2 is significantly smaller than those pits. A number of ethnographic representations exist that identify pits as servings as hearths or ovens (see Dunham 2000a).

Quartz tools consisted of bipolar lithics/wedges (n=10), a 'spokeshave' (n=1), and a single bifacially retouched quartz flake (n=1). These tools were primarily found during the excavation of first half of the feature in level 5 (n=7/12), which most-likely correspond to the intact-Zone A horizon. Artifacts from Zone A were likely deposited concurrently with the use of the pit as a hearth, although they could simply represent refuse put in the pit when the site was being abandoned. Ethnographic evidence suggests that these pits were partially cleaned out after use (Kohl 1985:300).

Figure 23.03-820 Excavations Showing Feature Distribution.

Feature 3. Feature 3 (F 3) is interpreted as another hearth feature. It was originally defined by CCRG's 2009 excavations at approximately 30 cm below the modern ground surface, along the east wall of TU 10. In plan, it was identified as a black (10YR2/1 soil stain with dense concentrations of pottery. It extended nearly 50 cm along and out from the east wall of CCRG's TU10, but also extended 35 cm into ISU's adjacent excavation unit 516N 497E, located directly east of TU10 (Figure 23 and Figure 24). In TU10's east wall profile, F 3 extended below of the base on the compacted living surface at approximately 25 cm below the modern-day ground surface and continued for approximately 15 cm into the sterile sand that underlays the site. During ISU's excavations, the other half of the feature was exposed in unit 516N 497E (Figure 23), although it was not identified until the 8th level, approximately 30 cm below the modern-day ground surface. From there, the feature extended an additional 10 cm into the subsoil, and contained large rocks that lined the outside of the pit, much like those that were described in F 2 above. One of the rocks recovered from just above F 3 in 516N 497E appears to contain some pitting that possibility indicates its use as a nutting stone or bipolar anvil.

Material from F 3 included a bipolar quartz core, a quartz split cobble, a bipolar chert core, 54 pieces of quartz debitage, four pieces of chert debitage, 177 ceramic pottery sherds, 42 pieces of FCR, a hammer stone, two quartz bipolar objects, and one chert scraper. Additionally, one copper awl was found in the screen in Level 7 of 516N 497E, the level directly above the feature. Artifacts were not evenly distributed throughout the feature. CCRG's excavation of the western ½ of the feature produced 176

of the 177 ceramic body sherds (99.43%), while 47 of the 58 pieces of debitage (81%) were recovered from ISU's excavations of the eastern half of the feature. Similarly, 38 pieces of FCR, weighing 632.44 g, were recovered from the western half of the feature, while only four pieces of FCR, weighing 1919.8 g were recovered from the eastern half. This differential distribution of artifacts is likely caused by the way the artifacts were discarded into the pit feature either during or after its use as a hearth feature. The pottery sherds presumably come from a single pot break that was discarded in to the western half of the feature, while the chipped stone artifacts were thrown into the western half.

Figure 24. Feature 3 Plan View (Left) and Profile (Right) from ISU's Excavations.

Even though ISU's excavations recovered an additional 47 pieces of debitage, the 58 total pieces recovered from F 3 pale in comparison to the amount of debitage recovered from F 2 (n=384). And while the recovery of several large pieces of FCR from the eastern half more than tripled the total weight of FCR recovered from F 3 (2552.24 g), that number is still less than half of the total weight of the FCR recovered from F 4 (4439.7 g). Although F 2 and F 3 do contain similar classes of artifacts, there is clearly a difference in the activities associated with each feature, or the intensity at which those activities were performed around the features.

Feature 4. Feature 4 (F 4) was identified in unit 515N 497E at the base of level 7, approximately 25 cm below the modern ground surface as a dark brown (10YR 3/3) soil stain on a black (10YR 2/1) soil matrix that makes up the living surface, as described above. The feature was bisected and the south half was excavated first. In profile, the feature consisted of a 5 cm thick strip of dark grayish brown (10YR 3/2) sand, that was underlain by light brown (7.5Y 6/4) oxidized sand layer that extended approximately 13 centimeters below the feature fill into the pale brown sterile sand (Figure 25).

Material from F 4 consisted of 19 pieces of degraded animal bone, 138 pieces of quartz debitage, 8 pieces of chert debitage, one quartz core, and 22 pieces of FCR. The burned area of soil represented one of the only locations at the Mather-Klauer Lodge site where bone was preserved. The oxidation of the soil in and around F 4 likely changed its acidity to allow for this preservation. Even as such, most of the bone consists of small unidentifiable fragments that are likely too degraded to be analyzed, although such an analysis has not been attempted.

Both the chert and quartz debitage contained decortification flakes as well as secondary flakes. The fact that these debitage profiles mirror the rest of the site suggests that F 4 did not represent any specialized reduction task. However, the presence of FCR and oxidized soil, both on the surface of the feature and below its base, indicates that F 4 is a hearth feature. The lack of a stone lining to F 4 may mean that it was utilized differently than F 2 and F 3, although based on the artifacts recovered from F 4 the exact nature of that task is difficult to define.

Figure 25. Feature 4 Profile.

Feature 5. Feature 5 was identified in the 4th level of unit 514N 497E as a black (10YR 2/1) on a pale brown (10YR 7/3) culturally-sterile sand matrix at approximately 30 cm below the modern ground surface (Figure 26). Unfortunately, it is referred to as Feature 2 in ISU's field notes and paperwork even though there was already a F 2 identified for the site. The feature was bisected and the south half was excavated first. In profile the feature contained a single zone, which consisted of black (10YR 2/1) sand (Figure 26). Like F 2 and F 3, F 5 is rock-lined with FCR and sandstone. Quartz flakes were distributed around the pit. Material from F 5, and from directly on top of it includes 84 pieces of quartz debitage, 4 pieces of chert debitage, and one bipolar lithic, along with 15 pieces of FCR.

Figure 26. Feature 5- Profile View (Left) and Plan View (Right).

Feature 5 is interpreted as yet another hearth feature. The concentrated presence of FCR within the pit suggests it was used in association for heating. However, the lack of oxidized sand around and below the pit would seem to indicate that F 5 was not frequently used as a hearth, or that the fires created within the feature did not reach a temperature high enough to oxidize the sand. F 5's location within a semi-circle of hearths at the southern edge of the site further strengthens its interpretation as a hearth, or hearth-related feature.

Root Concentration. An extremely dense concentration of white quartz debitage was identified in approximately 35 below the modern ground level in unit 518N 498E (Figure 27). The concentration followed a root running north-south along the boundary between 515N 498E and 515N 499E. Within the boundaries of this concentration, there were more quartz flakes than there was soil. Many of the larger artifacts were piece-plotted (n=99), but as a result of the density of the scatter, it was decided to remove the concentration in quarters, screen it through a fine screen (1/8 inch), and bag all the artifacts by quarter. In total 12,472 pieces of quartz debitage were collected from an area that measured 70 cm by 20 cm (.14m²).

The vast majority (92.61%) of those artifacts consisted of quartz shatter (n=11,551), although decortification flakes (n=92) and secondary flakes (n=806) were both well represented. Somewhat paradoxically, only 6 quartz cores were recovered from this area, including two core nuclei, two bipolar cobble cores, and two split cobbles. Sixteen tools were recovered from this locality (18.82% of all tools recovered during ISU's excavations). Tools included 11 bipolar lithics, one bifacially-worked flake, three

uni-marginally utilized flakes, and one triangular projectile point made on a decortification flake. All tools were made of white quartz.

Figure 27. Unit 515N 499E West Wall Showing Root Concentration (Left) and Plan View of Root Concentration in Unit 515N 498E (Right).

The density of artifacts within the concentration is unparalleled anywhere else on the site. Based on the large amount of shatter, along with the presence of the full range of lithic debitage, (i.e. cores, decortification flakes, and secondary flakes), this locality likely represents an initial processing station where quartz cobbles were cracked open and reduced. However, the amount of debitage from this area is far more than could have produced from the six cores recovered from the immediate vicinity. It seems likely that additional cobbles were reduced here, but they were removed from the site, possibly to be

reduced or utilized elsewhere. The uniformity of the raw material makes it evident that white quartz was selected for in this locality, but the reasoning behind the selection of this specific raw material over quartzite, which occurs in equal frequency in the conglomerate, remains unknown.

Optimized Hot Spot Analysis

Piece-plotting and individually bagging the majority of the artifacts from the Mather-Klauer Lodge site provided the necessary dataset from which spatial distribution of artifacts could be re-created in the lab using ArcGIS version 10.2. This allowed the author to show simple distributions of artifact types such as those presented in chapter 5 (i.e. cores, tools, etc.), as well as conduct more statistically robust analyses as described below.

The sheer number of piece-plotted artifacts recorded at the site makes it hard for the naked eye to discern patterning (Figure 28) and although the frequency of artifacts (represented by points) can be said to appear clustered, there is little that can empirically be said of these clusters. In an effort to categorize the clustering, the data were run through ArcGIS's Optimized Hot Spot tool that maps statistically significant clusters using the Getis-Ord G statistical test (ESRI 2014a).

Figure 28. All Piece-Plotted Lithics from Zone Ib.

Figure 29. Interpretation Chart for Z-Scores and P-Values.

The Optimized Hot Spot Tool is a relatively new addition to the suite of spatial statistics tools available in ArcGIS 10.2 and subsequent versions. For this particular dataset, which is made up of point locations, the Optimized Hot Spot Tool aggregates the incidents into weighted features by spatially joining the point data to a fishnet polygon layer that is created around all possible locations where the artifacts exist in the dataset. The cell size of the fishnet polygon is automatically determined by the distribution of artifacts. The value of each cell in the new weighted polygon is determined by how many artifacts fall within it. Finally, the tool outputs a layer where each cell is assigned a z-score and p-value that empirically determines whether artifacts are clustered, dispersed, or randomly distributed (Figure 29).

The tool starts with the assumption that artifacts are randomly distributed, and then upon analysis it assigns z-scores and p-values to cells based on the geographic distribution of the data. The z-scores and p-values are based on the normal distribution curve and represent confidence intervals for the clustering of data. They are summarized in Figure 29, although it should be noted that the color scheme in Figure 29 is reversed in the maps that will follow. For the maps, areas of red indicate statistically significant clustering (hot spots) of data and blue indicates significant dispersal (cold spots).

All of the aforementioned parameters can be manually imputed using the Hot Spot Analysis Tool (Getis-Ord G_i^*) tool (ESRI 2014b), which is still available alongside the Optimized Hot Spot Analysis tool. However, the Optimize Hot Spot Analysis tool was chosen because the fishnet it creates is based on the distribution of the artifacts (see Figures 30b-39b) and is not contiguous over the entire excavation area, thereby eliminating gaps in the analysis caused by un-excavated, or previously excavated test units (ESRI 2014a).

One thing that the reader will note is that the sizes of the fishnet cells vary depending on the frequency and distribution of the data (Figures 30b-39b). This variance is a product of the relative dispersion of the artifacts (ESRI 2014a). That is, the size of the cells is optimized so that each cell has at least one neighbor (where possible). Although using this tool does not allow the researcher to compare the significance of clustering of each artifact class with the significance of clustering of another artifact class, it was decided to utilize the Optimized Hot Spot Analysis instead of using a fishnet with a set cell size because the results of each analysis speaks to clustering within that artifact class

(ESRI 2014a). That is, it functions as a standalone analysis that takes into account the geographic distribution and count of each specific artifact class when determining the extent of clustering, and does not compare relative clustering of artifacts in relation to the entire assemblage. Intuitively, however, one can see that the larger the cell size, the more geographically dispersed the data layer.

Multiple iterations of the data were subjected to analysis using the Optimized Hot Spot Tool. However, only artifacts recovered from Zone Ib- the zone that CCRG identified as a living surface- were included in the analysis, as well as from the east half of F 3, and from the entirety of F 4 and F 5. Although there were artifacts recovered from above and below these levels, it was assumed that artifacts retaining their position within this layer would have more intact provenience in relation to the other artifacts within the same zone than it would have in relation to artifacts recovered outside of that zone.

It should be noted that because artifacts in the quartz concentrations were not piece-plotted, they were not included in any of the analyses. An attempt was made to randomly distribute the thousands of points into the quadrants of the root feature, but when the Optimized Hot Spot analysis was run, the thousands of points skewed the data in such a way that the subtleties of the clustering in the outlying areas of the site were not visible. Omitting the quartz concentration data was done with some trepidation on the part of the author, but it was thought to be justified because its exclusion brought out more discrete spatial patterning in the data, as described below. Furthermore, the density of the piece-plotted material in the area surrounding the quartz concentrations was

assumed to be dense enough to show statistical clustering, even without the addition of the thousands of artifacts found in them.

The analysis was run on several subsets of the piece-plotted data, all of which were queried out using specific attributes. An analysis for quartzite artifacts was attempted, but there were not enough artifacts recovered in order to produce a statistically valid sample from which to run the analysis (60 artifacts are needed). The results of each the Optimized Hot Spot Analyses for each of the iterations of the data are presented and discussed below. Appendix A lists the parameters at which each analysis was run.

Hot Spot Results. The Optimized Hot Spot Analysis was run on several iterations of the piece-plot dataset, including: all lithic artifacts (Figure 30a-b), cores (31a-b), tools (Figure 32a-b), artifacts retaining cortex (Figure 33a-b), quartz artifacts (Figure 34a-b), chert artifacts (Figure 35a-b), FCR (Figure 36a-b), Size-Grade 1-3 Debitage (Figure 37a-b), Size-Grade 4-5 Debitage (Figure 38a-b), and Size-Grade 5 Debitage (Figure 39a-b).

When the first analysis was run on all lithic artifacts, four discrete areas of statistically significant clustering were observed (Figure 30a-b). These were given arbitrary names, which included; Hot Spot 1 (HS 1) located in the southwest corner of unit 514N 497E; HS 2, located in the northeastern quarter of unit 515N 498E; HS 3, located in the northeast corner of unit 515N 498E, the northwest corner of unit 515N 499E, and the southwest corner of unit 516N 499E; and HS 4, located in the SW corner of unit 518N 499E (Figure 30b). Although the subsequent iterations of the dataset produced clustering in different areas, these four hot spots will be referenced as geographic markers when comparing subsequent results.

Three of these hot spots (HS 1, HS 3, and HS 4) were also present when the analysis was run on all quartz artifacts (Figure 34a-b). Although a large number of artifacts were present in the location of HS 2, they were not statistically clustered. Additionally, several 'cold spots' were identified in the quartz iteration of the piece-plot dataset. These cold spots indicate statistical dispersion, which is best illustrated in Figure 29, above. This dispersal of artifacts could be caused by any number of cultural or natural factors, but it seems the most plausible explanation is that it is the result of the bipolar knapping process itself. Cobbles are set on an anvil and then smashed in order to produce useable flakes. This process sends debris flying outward from the location of the anvil up to 2 m (Barham 1987). With multiple cobble reductions occurring on the same anvil, the outlying artifacts produced by the knapping process will become distributed over the periphery of the knapping radius, thus producing an area of dispersal, or a cold spot, as we see in Figure 34b.

When the same analysis was run on cores, the results show a statically significant clustering in the gap between HS 2 and HS 3. These cores, as defined above, are mostly bipolar and show evidence for flake removals. Thus, the statistically significant hot spot likely represents a secondary discard location where these cores were placed after attempts to reduce them ceased. Although they represent a secondary deposit, the fact that they are clustered suggests that they were discarded in what Binford (1978) terms the 'drop zone', and thus the initial knapping location is likely close by.

Like cores, artifacts that retain their cortex are thought to represent early stages of reduction (c.f. Andrefsky 2005:103-104). Although this assertion holds slightly less

weight when discussing a bipolar industry focused on quartz cobbles, the fact remains that the cortex of a cobble must first be removed before non-cortical artifacts are able to be manufactured. The clustering of such artifacts, then, would seem to signify those areas of initial reduction. Visually, these artifacts cluster around HS 4 and HS 3 (Figure 33a), but when the analysis is run we see that the clustering is only significant within HS 3, extending to the area between HS 2 and HS 3 (Figure 33b).

Figure 30. All Lithic Artifacts (a) Distribution; (b) Hot Spot Analysis Results.

Figure 31. Piece-Plotted Core (a) Distribution; (b) Hot Spot Analysis Results.

a.

b.

Figure 32. Piece-Plotted Tool (a) Distribution; (b) Hot Spot Analysis Results.

Figure 33. Piece-Plotted Artifacts Retaining Cortex (a) Distribution; (b) Hot Spot Analysis Results.

Figure 34. Piece-Plotted Quartz Artifacts (a) Distribution; (b) Hot Spot Analysis Results.

Figure 35. Piece-Plotted Chert Artifacts (a) Distribution; (b) Hot Spot Analysis Results.

Figure 36. Piece-Plotted FCR (a) Distribution; (b) Hot Spot Analysis Results.

a.

b.

Figure 37. Size Grade 1 – 3 (Large) Artifacts (a) Distribution; (b) Hot Spot Analysis Results.

a.

b.

Figure 38. Size Grade 4 -5 (Small) Artifacts (a) Distribution; (b) Hot Spot Analysis Results.

Figure 39. Size Grade 5 (Small) Artifacts (a) Distribution; (b) Hot Spot Analysis Results.

Similarly, the smallest size grades of artifacts have been shown to indicate areas of primary reduction of lithic artifacts (Andrefsky 2005; Barham 1987; Kvamme 1996; Newcomer and Seivking 1980). Barham (1987:48) made the only known observation of the spatial distribution of bipolar quartz reduction, and found that fine debris smaller than 1 mm was confined to a radius of 20 cm from the center of the anvil. Similar observations of the clustering of small artifacts around the origin of knapping origin were made by Kvamme (1997) during experimental analyses of the distribution of debris resulting from the bifacial reduction of finer cryptocrystalline material. At the Mather-Klauer Lodge site, this fine debris is represented by artifacts falling into SG 5, the smallest size-grade category. Figure 39b shows clustering of SG 5 in HS 2, HS 3, and HS 4, as well single statistically significant cell in HS 1.

The same analysis was also run for large artifacts (SG 1-3) (Figure 37a-b) and smaller artifacts (SG 4-5) (Figure 38a-b). The large artifacts are clustered between HS 2 and HS 3, in the same location as cores and cortical artifacts (Figure 37b), while the smaller artifacts cluster in the same locations as the first dataset described (compare Figure 38b to Figure 30b). The overlap in clustering of large and cortical artifacts is not surprising, because as we saw above, (Table 13, Chapter 5) artifacts retaining cortex are, on average, larger than non-cortical artifacts. Also, given that SG 4 and SG 5 artifacts constituted 62.53% of the lithic assemblage, it was equally probable that the clustered in similar areas as the entire lithic assemblage dataset (Figure 30b).

Chert artifacts (Figure 32a-b) did not display significant clustering, although the vast majority of the chert was present on the western edge of the excavation area with the

highest density of chert occurring within the units containing features (Figure 35a). The lack of significant clustering and the lack of chert artifacts within the largest area of clustering, along with the analysis of the chert assemblage (Chapter 5), suggests that chert artifacts were not subjected to the full range of lithic reduction in this locality, and that these artifacts were deposited as a result of maintenance and use activities. This fits with the findings described above. The comparative lack of chert cores and debitage suggest differential use of raw material by the inhabitants of the Mather-Klauer Lodge site. Most of the chert artifacts were likely brought to the site in finished form, where they were sharpened and maintained. It does remain possible that the manufacture of chert tools occurred in an unexcavated, or eroded portion of the site, but no evidence currently supports this notion.

A similar lack of clustering was found when analyzing the distribution of tools (Figure 35a-b). Because they are handled more frequently, the spatial distribution of tools is less likely to correspond to the location in which those tools were used, and more likely to represent the locations in which they were discarded (Binford 1978; Schiffer 1972, 1976, 1983). Ethnographic accounts of the Obijbwe (Kohl 1985) describe constant activity around hearth areas, with many different people performing a variety of tasks (e.g., cooking, fish/game processing, sewing, sleeping, etc.). The random distribution of tools at the Mather-Klauer Lodge site likely reflects this social aggregation, where multiple tasks were performed by a number of people and the tools were discarded after use.

Finally, the analysis of the distribution of FCR produced two significant clustering hot spots (Figure 36b). One is a linear cluster running diagonally northeast-to-southwest from the northern portion of 518N 498E to the NE portion of 517N 497E, and a second is in the southwest corner of 514N 497E, corresponding to the location of HS1. Both scatters likely represent the location of secondary discard produced by cleaning out the hearths (F 3 and F 4); a process described in mid-19th century ethnographic accounts in the Upper Great Lakes (Kohl 1985:300). The linear cluster of FCR also corresponds to the cold spot of quartz artifacts (Figure 34b), supporting the idea that this location represents the periphery of activities occurring around the hearth. The quartz artifacts represent that landed outside of the main knapping locus, while the clustering of FCR represents hearth-cleaning episodes.

Refits

In an effort to determine the spatial relationships at the site, all medium and large artifacts (SG1-3) were analyzed for refits. In total, 32 individual artifacts were refit to form 10 discrete artifacts. As seen in Figure 40, the majority of the refits consist of artifacts in relatively close geographic proximity to one another. The majority of the refits occur in association with HS 4 (units 517N 499E and 518N 499E) suggesting that the artifacts clustered in this locality relate to a single knapping episode. Refits occurring between units 515N 497E and 515N 498E support the idea that the clustering of cores and cortical artifacts in this area (Figure 31b and Figure 33b respectively) are associated with the clustering in HS 2 and HS 3 (Figure 30b).

Figure 40. Distribution of Lithic Refits at the Mather-Klauer Lodge Site.

The cross-site refit between units 515N 497E (Level 7, Artifact 9) and 520N and 499E (Level 4, Artifact 3) suggests that these artifacts at the site were deposited within a

short time of one another, and likely relate to one another, possibly signifying a single occupation, or repeated occupation of the same locality. It is recognized, however, that multiple different depositional, or post-depositional processes could account for the distance between the two refits, the most likely of which is removal and discard of the artifact by a prehistoric knapper (although it was not utilized), possibly as a result of a cleaning and dumping episode. Without going back in time, it is impossible to be certain how the two artifacts from the same core were found across the site from one another, but what has been made clear by refitting these two artifacts is that all of the chipped-stone debitage establishes the presence of a cohesive assemblage.

The close proximity of the remaining refits suggests that the horizontal distribution of the artifacts has been minimally affected by post-depositional processes. It seems that the addition of several fill layers above the artifact-bearing Zone Ib horizon protected the site from heavy disturbance during the construction of the retaining wall. The fact that the site sits in a clearing that has been void of tree cover since the construction of the Mather-Klauer lodge in the early 1900's, is another factor that has helped preserve the spatial integrity of the site. This provided the site with at least a 100 year reprieve from the continuous cycle of tree-tips and bioturbation caused by the growth root systems that can wreak havoc on the preservation of artifact provenience. Although some post-depositional disturbance has been identified at the Mather-Klauer Lodge site (see Stratigraphy Section above; Dunham et al. 2010), the horizontal distribution of artifacts remains remarkably well preserved for a site in Upper Great Lakes.

Discussion

When discussing intrasite spatial organization and patterning, not only is it important to take into consideration post-depositional processes that affected the distribution of material, but also the behavioral processes that first deposited the material. As Schiffer (1972, 1976, 1983) and Binford (1978b) note, the spatial distribution of material remains most fundamentally represents a record of refuse disposal and tool discard rather than activity areas. That being said, the sheer density of chipped-stone debris, combined with the statistically significant clustering of both large and small artifacts, including cores and debitage, combined with the relative tightness of lithic refits at the site, suggest that three of the clusters do represent the primary deposition of these artifacts that have been minimally affected by post-depositional processes. Likewise, the tightness of the refits suggests the assemblage retains much of its spatial integrity.

The distribution of tools, on the other hand is likely a much more complicated process that has to take into account each link in the behavioral chain for those tools (Skibo and Schiffer 2008). To this effect, Binford (1973, 1978b, 1979) has distinguished between the spatial integrity of curated and expedient tool distributions. To summarize curated tools are usually manufactured and carried in anticipation of future tasks while expediently made tools are used to accomplish immediate tasks (Binford 1979). Thus, the distribution of curated tools should be less indicative of the frequency of specific activities for which they were used and more of function of tool replacement. Expediently produced tools, on the other hand, show high rates of replacement and therefore their distribution should bear a closer relationship with the location in which they were used,

prepared, or discarded. Thus, the spatial relationships of an overwhelmingly expedient toolkit at the Mather-Klauer Lodge site then would seem to be a relatively accurate indicator of the spatial organization of the activities that were conducted at the site.

The precipitous drop in artifact density artifacts between the northern edge of HS 3 and the southern edge of HS 4 (Figure 30a) suggests the presence of a boundary. This boundary may represent the shadow of a knapper as they sat down to reduce the cobbles. Newcomer and Sievking (1980) have identified the presence of these shadows in experimental analysis. This gap may also represent an area of disturbance, caused by the intrusion of modern fill rocks into Zone Ib. Field notes indicate a moderate amount of these modern rocks in those units. However, Zone Ib was still mapped as extending across the feature. The fact that artifacts from within that lacuna refit to those in HS 4 (Figure 40) suggests that artifacts from within this area maintain some semblance of spatial integrity, although it is difficult to be certain.

The remainder of the site, however, has an unquestionably intact, albeit compressed, living surface (Zone Ib). The distributions of the artifacts in this zone display significant clustering. The following is a summary of the four hot spots defined above.

Hot Spot 1. Hot Spot 1 is defined by a statistically significant clustering of quartz artifacts that occurs on the southern and eastern rim of F 5, a hearth feature. Specifically, the area shows the most intense clustering of small artifacts (SG 4-5; Figure 38b), but when the same analysis is run on only the smallest size grade (SG 5), only one fishnet cell displays significant clustering (Figure 39b). HS 1 contains no significant clustering

of cores (Figure 31b), large artifacts (SG 1-3; Figure 38b), or cortical artifacts (Figure 33b), although all of these artifacts were present within the boundaries of HS 1 (Figure 31a, Figure 33a, Figure 38a).

The adjacent test unit to the east, TU4, was excavated by CCRG. It contains a relatively high amount of chipped-stone debitage ($n = 417$), along with a moderate amount of cores ($n = 13$), bipolar lithics ($n=11$), and utilized flakes ($n = 2$). The unit also contains another hearth feature (F 2) and part of another pit feature (F 1) (Figure 23). By comparison, the unit containing HS 1 (514N 497E) contained 671 pieces of debitage, five cores, and 10 tools, although it should be noted that ISU's collection methods allowed them to retain much smaller artifacts than would be caught in the 0.25 inch mesh screen used by CCRG.

Hot Spot 1 also overlaps with one of two statistically significant hot spots of FCR, located in the SW corner of 514N 497E (Figure 36b). The identification of a hot spot in this locality is a byproduct of the comparatively high density of FCR recovered from F 5 ($n = 15$) in the west half of unit 514N 497E. Ethnographic evidence (Kohl 1985) indicates that these hearths were cleaned out periodically, likely strewing some of their contents onto the ground directly around the hearth boundaries. This cleaning may have affected the distribution of chipped-stone in this locality as well, causing it to appear clustered.

Hot Spot 2 and 3. Hot Spot 2 and HS 3 appear to represent initial reduction localities on the boundaries of a single cluster of chipped-stone debris. On the western edge of this cluster, HS 2 is defined by a statistically significant cluster of small chipped-

stone debris (SG 5; Figure 39b). HS 3 shows similar clustering along the eastern edge of the cluster (Figure 39b). Additionally, HS 3 occurs in the same area as the root concentration (Figure 23), which as discussed above, contained close to 20,000 artifacts. Between the two significant clusters of small debris, there are statistically significant clusters of cores (Figure 31b), artifacts retaining cortex (Figure 33b), and large artifacts (SG 1-3; Figure 37b). Figure 40 shows artifacts that these latter clusters are related to both HS 2 and HS 3.

A relatively large amount of chipped-stone debris ($n = 470$), cores ($n = 15$), and tools ($n = 11$) were also collected from TU6, excavated by CCRG in 2010 that forms the 1 x 1 m gap in ISU's excavations. These artifacts were collected in arbitrary levels, not piece plotted, and as such it is difficult to definitively say if they were clustered within the unit. However, the presence of multiple cores and the large amount of debitage demonstrates continuity in the artifact composition from the units excavated by ISU along TU6's southern border (Figure 30ba).

A quartz anvil/hammerstone (Chapter 5) was recovered from within the boundaries of HS 3, along with a granitic hammerstone collected from CCRG's excavations in TU6. These hammerstones would have been used to smash open quartz cobbles that were situated on an anvil.

Based on this evidence, it seems that HS 2 and HS 3 both represent initial knapping localities where cobbles were placed on anvils and broke open to create usable flakes. It is not possible to say if these localities were used concomitantly or if they represent separate occupations of the Mather-Klauer Lodge site.

Hot Spot 4. Hot Spot 4 is located in the SW corner of 518N 499E. It is identified by the statistical clustering of all chipped-stone artifacts (Figure 30b), quartz artifacts (Figure 34b), and artifacts falling into the smallest two size grades (SG 4-5; Figure 38b and Figure 39b). HS 4 is also located adjacent to a statistical ‘cold spot’, or significant dispersal of quartz artifacts (see Figure 29 for a visual representation). Intermixed into this cold spot, is a significant clustering of FCR (Figure 36b) that occurs in the western half of unit 518N 497E. HS 4 did not correspond with significant clusters of cores (Figure 31b), cortical artifacts (Figure 33b), or large artifacts (Figure 37b), though these artifacts were present in the locality (Figure 31a and Figure 33a). However, a large, granitic stone with central pitting, and a granitic hammerstone were recovered from the unit containing HS 4 (518N 498E), suggesting that it represents a third location of initial cobble reduction.

Conclusions

The presence of multiple knapping stations, alongside multiple hearth features (F 2- F 5) suggests that the excavated area of the Mather-Klauer Lodge site represents a multiuse area where multiple tasks were performed in close proximity to one another. From the sheer density and diversity of the lithic assemblage, we know tools were being made, used, and discarded randomly at this location. The identification of additional tasks at the site, however, can be extrapolated from the ethnographic and archaeological literature.

In the Upper Great Lakes Region, the function of coastal sites are most often attributed to social aggregations of families coming together for the spring and fall

fishing seasons (e.g., Cleland 1982; Kinietz 1947; Martin 1989). Kinietz (1947) cites Grant (1890:330) in saying, “They sometimes have the precaution to preserve some for summer consumption, this is done by opening and cleaning the fish and then carefully drying it in the smoke or sun, after which it is tied up very tight in large parcels, wrapped up in bark and kept for use; their meat, in summer, is cured in the same manner.” Additionally, there is ethnographic evidence to suggest that fish were processed next to hearths, just before they were cooked (Gilfillan 1897:65-66, 78-79 cited in Kinietz 1947). Thus, the close association of multiple tool manufacture locations and hearths observed at the Mather-Klauer Lodge site could be indicative of such a site where fish were processed and preserved for later use.

Furthermore, the toolkit required to process large amounts of fish would likely be an expedient one, given the limited temporal range of fish spawns. Thus, a large amount of these tools would need to be produced, but could quickly be discarded at a site after the spawns were finished and attention turned to the gathering of other foodstuffs throughout the summer and remainder of the fall. This fits the pattern at the excavated portion of the Mather-Klauer Lodge site.

It also should be noted however, that ISU’s excavations, and subsequent spatial analysis, only uncovered a small portion of what is considered to be the site. The erosion of more than 50 feet of the site to the west of the excavation area (Eric Drake personal communication), as well as the disturbance caused by the construction of the Mather-Klauer Lodge itself may have already severely hampered chances to examine the full range of activities conducted at the site. However, from this small excavation, we

have produced a snap-shot of the prehistoric lifeways employed by the site's inhabitants. Further work at the site, if conducted, will only add to our understanding of the spatial and technological organization of the populations which inhabited the Mather-Klauer Lodge site.

CHAPTER VII

SUMMARY AND CONCLUSIONS

Analysis of the lithic assemblage and its spatial organization has shown that the artifacts recovered from Mather-Klauer Lodge site reflect a seasonally localized population that relied heavily on an expedient flake tool technology based on the reduction of quartz cobbles and the selection of flakes for the manufacture of tools. Studies in site formation processes (i.e. Binford 1978b, 1979, 1983; Schiffer 1975, 1983, 2002) and lithic technology (i.e. Andrefsky 1994a, 1994b, 2005; Torrence 1989; Odell 1994, 2004) have shown that a variety of factors affect the organization of lithic technology. These include, but are not limited to, seasonality/occupation span, site function, mobility, and the availability, quality, and size of lithic raw materials. The preceding chapters have explored a number of these topics as they relate to the occupation of the Mather-Klauer Lodge site. A summary of conclusions will be presented in the ensuing chapter in an attempt to tie these results into a discussion of Woodland settlement and subsistence.

Site Overview

The Mather-Klauer Lodge site was identified during Phase I survey of the area just to the south of where Echo Creek empties into Lake Superior. Excavations in 2010 by CCRG (Dunham et al. 2010) identified the site as Terminal Late Woodland based on the presence of a Sand Point chord-wrapped stick impressed ceramic sherd (Dorothy

1980) with a well-smoothed surface. These decorations in combination with the general temper/paste characteristics are suggestive of a Late Woodland affiliation at the Mather Lodge Site (Dunham et al 2010: 5-69: 5-71). An AMS radiocarbon date of 780 to 670 BP [AD 1170 to AD1280]; Dunham et al. 2010; Appendix H) taken from food residue charred onto one of the ceramic sherds recovered from a hearth feature (F 1), in addition to an AMS date of 790 ± 30 BP (Beta No. 348784; cal. AD 760 BP to 670 BP [cal AD 1210 to 1280] taken from wood charcoal recovered from the vicinity of a separate hearth feature (F 3), support this conclusion. Additional testing in the form of 16 1 x 1 m units was conducted by ISU in an attempt to investigate the buried surface (Zone Ib) that was identified by CCRG (Dunham et al. 2010). These excavations recovered over 20,000 lithic artifacts that form the dataset for thesis, the results of which are summarized below.

Lithic Technology

The Terminal Woodland inhabitants at the Mather-Klauer Lodge site employed an almost exclusively expedient tool technology focused around the bipolar reduction of locally available quartz cobbles (95.95% of the assemblage by weight) and the less intensive reduction of chert and quartzite cobbles (0.32% and 3.73% by weight, respectively). Concomitant with their different frequencies at the site, each of these raw materials as subjected to different intensities of reduction and utilization. Although quartzite is represented as a raw material, none of the flakes display utilization or evidence of further modification. It may be the case that quartzite cobbles were used as hammerstones and the resulting flakes were simply detached while striking quartz and chert cobbles. Chert, on the other hand, was not a predominant raw material, accounting

for less than 1% of material by weight and by count. Yet out of the 90 chert artifacts recovered from the site, 12% (n=11) were utilized as formal (n=4) or informal (n=7) tools. This represents a stark contrast with the 19,918 pieces of quartz, of which only 0.04% (n=99) displayed evidence of utilization (including bipolar lithics [discussed below]). The discrepancy in the tool to debitage ratios between the two raw materials is likely a byproduct of the different fracturing properties of those materials making it more difficult to produce useable flakes from quartz, as well as their respective abundance. The reduction of a quartz cobbles, found in high abundance eroding out the conglomerate (Chapter 3), is shown to produce up to 85% debitage (Driscoll 2010, 2011; Tallavaara et al. 2010), thereby increasing the count of debitage per useable flake. Conversely, the isotropic fracturing properties of finer cryptocrystalline materials such as chert, which is present in much smaller sizes and quantities in the vicinity of Grand Island, produce a much smaller flake to debris ratio.

The original goal of this paper was to examine the lithic debitage at the site in hopes that it could serve as a temporally diagnostic indicator for Terminal Woodland sites in the absence of formal tools. However, after analyzing the quartz-dominated assemblage, it seems most appropriate to echo the sentiments of Holdaway and Douglass (2015) who, in their analysis of quartz reduction in Western Australia, found that the process of lithic reduction used to knap quartz is secondary to the selection of the resulting pieces of debitage. That is, quartz cobbles are smashed open with no morphologically specific end product in mind and the resulting flakes/ pieces of debitage are selected for utilization or additional modification based on the technological needs of

the population. Thus it is not the debitage or cores which should be the focus of the analysis, but the selection of flakes. This behavior is supported by numerous ethnographic accounts of lithic technology (see Hayden 1979; Leblanc 1992; Parry and Kelly 1987; Shott 1989).

That being said, there are still things that can be learned from analyzing the debitage. For instance, at the Mather-Klauer Lodge site there was not a single flake that contained a faceted platform, which is an indicator of bifacial reduction (Andrefsky 2005). The idea of a curated toolkit (cf. Binford 1979) implies that some tools that were made at the site were removed when the populations abandoned it. By analyzing the debitage, it is evident that if tools were indeed removed from the site, they were not bifacial.

Of the 110 tools recovered from ISU's excavations, the formal tool assemblage was comprised of just only three scrapers (one quartz and three chert; Plate 1d, f-g) and one scraper fragment (made from chert; Plate 1e) and three Terminal Woodland triangular arrowheads (two of quartz and one of chert; Plate 1a-c). Utilized flakes were the second-most common tool type found at the site (n=40). These varied in size and shape, but blocky flakes (primary and secondary) were the most commonly selected (n=18; Plate 1: m-n,p). Unfortunately no obvious patterns of flake selection could be discerned from the assemblage, although all of the flakes appear to be large enough to be held by hand (Table 21, Chapter 5). While this paper was not successful in identifying trends of selection based on the analysis of a single site, if the metric data from this thesis is combined with a use-wear analysis of these flakes, it may provide a starting point for

which to compare this assemblage to other archeological assemblages and aid in determining the function of such an informal tool assemblage.

Bipolar lithics constituted the most common tool type at the site (n=63). Chapter 2 reviews the debate over the function of these artifacts, often termed ‘bipolar objects’ or *pieces esquillées*. Some researchers assert they represent wood or bone-working tools (Hayden 1979; LeBlanc 1992; Ranere 1975), while others think they simply represent exhausted bipolar cores (Shott 1989). It should be noted here that the bipolar lithics observed at the Mather-Klauer Lodge site are much larger than those normally referred to as *pieces esquillées* in the archaeological literature, but they do fit within the metric limits for the “bipolar wedges” identified by Hayden (1979; Shott 1989:6, Table 1).

Based on their proliferation at the Mather-Klauer Lodge site, and the fact that, on average, their metric attributes are smaller than the flakes selected for utilization at the site (compare Table 21 and Table 22, Chapter 5), it seems that at least some of these artifacts were purposefully manufactured and used, and do not simply represent exhausted bipolar cores. However, a blanket interpretation for every bipolar lithic recovered from the site, without employing a use-wear analysis of the objects, seems hasty. It is more likely that some of these bipolar lithics were utilized and others represent exhausted bipolar cores, a notion supported by Brose’s (1970a) use-wear analysis at Summer Island, although until a use-wear analysis is conducted, this merely represents a hypothesis in need of testing.

Finally, the overwhelming use of the bipolar reduction technique (Binford and Quimby 1963) at the Mather-Klauer Lodge site, as evident from an analysis of cores

(Table 6; Chapter 5), is an adaption to the form in which the raw materials occur (quartz cobbles) rather than their relative abundance. Traditionally, bipolar reduction is discussed as an economizing strategy that is employed when there is low abundance of raw material that needs to be conserved (e.g. Odell 1996). However, at the Mather-Klauer Lodge site quartz cobbles are ubiquitous, but are difficult to reduce using freehand percussion techniques. Therefore, at the Mather-Klauer Lodge site, the bipolar technique is an adaptive technique to allow the raw material to be utilized, and is not based on the availability of raw material. Additionally, experimental analysis of quartz fracturing properties show that the use of bipolar reduction technique on quartz results in the creation of larger, more complete flakes (Driscoll 2010).

Spatial Organization of Lithic Technology

The excavation methodology employed by ISU involved piece-plotting and bagging each artifact (n=5,866), providing an ideal dataset to examine the spatial organization of the lithic technology employed at the site. For the spatial analysis (Chapter 6), only artifacts found in the Terminal Woodland horizon (Zone 1b) were included in the analysis (n=5,043). In order to synthesize such a large dataset, this paper used GIS to conduct a hot spot analysis that statistically maps clustering using Getis-Ord G statistic (ESRI 2014a). The results of the analysis, presented in their entirety in Chapter 6, identified the presence of four statistically significant clusters of chipped-stone debris (HS 1-4), and two significant clusters of FCR (Figure 36b, Chapter 6). Based on the clustering of the smallest artifacts (SG 4-5), and the close association of anvils and hammerstones, it was determined that three of these locations (HS 2, HS 3, and HS 4)

represent locations of initial cobble reduction and tool manufacture. The presence of more than one reduction locality in close proximity to each other could signify multiple knappers working at the same time, a single knapper returning to the same area but working in multiple locations, or a combination of the two. The presence of statistical cold spots on the periphery of the knapping stations, indicating significant dispersion (Figure 34b), is likely a function of diminishing artifact density the farther away from the initial knapping loci (Kvamme 1997; Newcomer and Sievking 1980.)

No significant clustering of chert artifacts (Figure 35b) or tools (Figure 32b) was observed. Given that chert was not a primary raw material on the site, it is not entirely surprising that its reduction was not localized, as was the case with quartz (Figure 34b). The lack of clustering of the tool assemblage, meanwhile, is likely a function of the spatial organization of the tasks performed at the site. Although the tools may not represent the exact locality in which they were used, the discard of expedient tools in the vicinity of the location of their manufacture and hearth features, however, suggests all three are, at the very least spatially related, possibly temporally related as well. Ethnographic and archaeological accounts document the social aggregation of large groups of Woodland people at coastal sites to process spring and fall fish harvests. These sites would have been bustling, with a variety of people involved in the gutting, smoking, and packaging of fish. The tool distribution at the Mather-Klauer Lodge site is indicative of such a scene, where expedient tools were discarded in a variety of locations after they were used.

The concurrent clustering of FCR and lithic artifacts near HS 1 likely represents the remains of two separate processes. The FCR cluster was likely a result of the cleaning of F 5, a hearth feature, a process which may have affected the distribution of chipped-stone thereby causing it to cluster.

Thus, we see the methodology of piece-plotting artifacts makes it possible to discern discrete quartz reduction areas and provide some information on how lithic technology was organized. From these analyses, it can be determined that the lithic technology at the Mather-Klauer Lodge site was not restricted to a single locality, but rather a number of closely associated reduction stations. All of these stations were closely associated with one or more hearth features, suggesting that the reduction and subsequent processing activities were hearth-centered, and likely focused around creating a large amount of useable expedient tools to aid in the processing of fish.

Toolkit Composition and Mobility

Andrefsky (1994a, 1994b) has shown that the quality, quantity, and size of the raw material available to prehistoric populations effect the composition of the lithic toolkit. High quality raw materials, as defined by their isotropic fracturing properties (Odell 2004), if present in large quantities are used to manufacture both formal and informal tools. If present in low quantities, however, high quality raw materials are solely used to manufacture formal tools. Low quality raw materials, on the other hand, if present in high or low quantities, are always used to manufacture informal tools. Thus, the informal, expedient toolkit at the Mather-Klauer Lodge site can partially be explained by the abundance of low quality quartz cobbles.

Expedient toolkits have also been shown to be indicative of increasingly sedentary populations (e.g. Odell 1994, 1996; Parry and Kelly 1987). This assertion is centered on the idea that curated formal tools (cf. Binford 1979) were manufactured as a risk-abating strategy to counteract the differential distribution of lithic raw material on the landscape (Odell 1994). Sedentary populations then, with well-established sources of lithic raw material, had a decreasing need for a transportable, formal toolkit. On Grand Island, the seasonally sedentary nature of the populations is extrapolated from regional archaeological and ethnographic data which states that large groups aggregated in the spring and fall to take advantage of fall and spring fish spawns (Cleland 1989; Martin 1989). This pattern becomes increasingly apparent during the Terminal Archaic to Initial Woodland transition, as well as the Initial to Terminal Woodland transition, as groups remained in localities to exploit both the Spring and Fall fish spawns, thereby increasing the duration of their aggregation. Thus expediency of the toolkit at the Mather-Klauer Lodge site was likely equally influenced by the seasonally sedentary nature of the population, as it was by the form, quantity, and quality of raw material available to them.

Lithic Raw-Material Selection and Settlement Systems

As discussed in Chapters 3 and 5, all of the raw materials found at the Mather-Klauer Lodge site, with the possible exception of a few chert flakes, can be found eroding from the conglomerate around Grand Island. Binford (1979) has argued that lithic procurement was “embedded” into other subsistence activities. Additionally, he argues that the variability in proportions of raw material at a site is a function of the scale of the habitat exploited from that location (Binford 1979:260). Assuming this to be accurate, the

overwhelming use of local quartz cobbles suggest that the subsistence activities at the Mather-Klauer Lodge site were hyper-focused on Grand Island and did not bring the Terminal Woodland inhabitants into contact with the more abundant chert resources present in the southern or eastern Upper Peninsula (e.g. Ludeke 1976, Drake et al. 2009).

All models of prehistoric settlement in the Upper Great Lakes agree that populations practiced some degree of seasonal mobility, though there is still some disagreement on the exact nature of such patterns (see Cleland 1992; Dunham 2014; Drake and Dunham 2004; Martin 1985, 1989). Additionally, these models agree that a macro-regional shift in settlement patterns occurred from Initial to the Terminal Woodland periods, coinciding with the exploitation of deep-water, fall-spawning fish resources (Ibid). These shifts resulted in increased localization and restricted mobility of Terminal Woodland populations, which is thought to have been associated with the formation of social identities and political boundaries on a macro-regional scale during this period (Cleland 1992; Martin 1999; McHale Milner 1991).

This localization is visible in both the reduced geographic distribution of lithic material (Luedtke 1976) and the proliferation of regional ceramic styles (McHale Milner 1991) that occur during the Terminal Woodland. Although this shift is not visible on Grand Island based on the distribution of archaeological sites (Drake and Dunham 2004), these macro-regional patterns are visible in the lithic raw material resources present at the Mather-Klauer Lodge site. The hyper-local raw material selection and the expedient tool kit employed at the Mather-Klauer Lodge site suggest that the population was, at the very least, seasonally sedentary and that their mobility was restricted to Grand Island itself.

Although this is likely an oversimplification, the absence of other regionally available chert resources suggests that if these populations did travel, these trips were likely transitory in nature and were not aimed at the procurement of extra-local lithic resources.

Seasonality

The season during which a site was occupied is traditionally defined by the identification of seasonally specific flora and fauna remains. At the Mather-Klauer Lodge site, however, there is a lacuna in these assemblages caused primarily by the acidity of the soils and continuous freeze-thaw cycle. Despite these adverse conditions a very small flora and fauna assemblage was recovered from the site. CCRG's excavations (Dunham et al. 2009) recovered evidence of carbonized aquatic tuber in the disturbed zone (Zone A) of F 2. If these remains are indeed associated with the prehistoric component of the site, it suggests at least a spring/summertime occupation.

The lipid analysis of a soil sample taken from Zone Ib (Malainey and Figol 2014) supports this conclusion. Malainey and Figol (2014) identified 'medium fat content' lipids, which are produced by fresh water fish, *Rabdotus* snail, terrapin, or late winter fat-depleted elk, but also by corn, as well as 'Low fat content plant' lipids are produced by plant greens, roots, and berries. More importantly, the 'high fat content' lipids (represented by C18:1 and C18:2 isomers) attributable to acorns, such as the ones identified from within small crevasses in FCR used in the stone-boiling at the Popper site and the charred residue on the interior of ceramics at site 03-754 (Skibo et al. 2009), were absent in this sample.

Acorn processing and consumption has been shown to be central to prehistoric lifeways in the Eastern Upper Peninsula and on Grand Island specifically (Dunham 2009; 2014; Skibo et al. 2009). The absence of these lipids, which have been shown to survive in the acidic soils on Grand Island (Skibo et al. 2009), provides ample evidence to suggest that this area of the Mather-Klauer Lodge site was not utilized when such resources were available. However, based on the location of the Mather-Klauer Lodge site near deep water aquatic resources and the importance of the fall fishery in the Terminal Woodland period (Drake and Dunham 2004), it is plausible to assume that the site may have been occupied during the fall as well, and that evidence for traditional fall activities, such as acorn processing, may have occurred on unexcavated or destroyed portions of the site. However, we currently only have enough evidence to place the occupation of the Mather-Klauer Lodge in the spring/ summertime where prehistoric inhabitants could access the plant resources of Echo Lake (e.g. tubers), as well seasonally available berries such as raspberries, blueberries, and blackberries, in addition to the abundant aquatic resources of Echo Lake and Lake Superior.

Site Function

The Terminal Woodland Horizon (Zone Ib) at the Mather-Klauer Lodge site is thought to seasonally occupied living surface on which the inhabitants manufactured tools used to process the spring fish harvest. The presence of multiple knapping stations (HS 2, 3, and 4), in close proximity to hearth features suggests that tool manufacture and activities conducted around the hearth were functionally related. Ethnographic sources point to the processing and preservation of the spring fish harvest at such sites (Kinetz

1947) at spring and fall spawning localities. The presence of fish lipids, as well as the location of Mather-Klauer Lodge site on the coast of Lake Superior suggests that similar activities were performed in the excavated portion of the site.

It should be reiterated here, that the area excavated by ISU and CCRG represents only a fraction of the total boundaries of the Mather-Klauer Lodge site. The loss of more than 50 ft of the bank due to erosion may have already severely hampered chances to examine the full range of activities conducted at the site. However, from this small excavation, we have produced a snap-shot of the prehistoric lifeways employed by the site's inhabitants. Further work at the site, if conducted, will only add to our understanding of the spatial and technological organization of the populations which inhabited the Mather-Klauer Lodge site.

Summary and Conclusions

In summary, the Mather-Klauer Lodge site represents Terminal Woodland period (AD 600- AD 1600) living surface that was seasonally occupied, and possibly annually reoccupied, during the spring-summertime. The inhabitants utilized a nearly-exclusive flake tool technology centered on the bipolar reduction of quartz cobbles, and to a lesser-extent chert cobbles found eroding from the conglomerate around Grand Island. The expedient nature of the toolkit and the localized nature of raw material procurement are indicative of a seasonally sedentary group with restricted mobility on the landscape, traits which define the Terminal Woodland period in the Upper Great Lakes.

The primary goal of this thesis, to identify traits of cores and debitage that could serve as temporally diagnostic markers used to date lithic scatters void of formal tools

unfortunately went unfulfilled. In the course of analysis it was determined that the reduction of quartz is not a staged process that begins with an end product in mind and produces diagnostic debris. Rather, it is a process that involves breaking open cobbles to produce flakes of a variety of shapes and sizes, that are then selected based on the technological needs of the population (Holdaway and Douglass 2015). Metric data for the utilized flakes collected during the analysis may serve as a jumping-off point for future researchers to compare similar tools from other Terminal and Initial Woodland sites. Combined with use-wear analyses of such assemblages, it may yet be possible to identify temporally specific tendencies of quartz flake selection. Although this paper was unable to resolve such questions, the author hopes that the documentation of the lithic technology at the Mather-Klauer Lodge site and its spatial organization provides a useful addition to prehistoric research in the Upper Great Lakes.

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APPENDIX A

PARAMETERS FOR OPTIMIZED HOT SPOT ANALYSIS

Dataset	Figure #	Fishnet Size (m)	Scale of Analysis (m)
All Lithics	30b	0.0425	0.2287
Cores	31b	0.3691	0.6089
Tools	32b	0.2941	0.5214
Cortical	33b	0.0958	0.5176
Quartz	34b	0.0441	0.5008
Chert	35b	0.3159	0.6143
FCR	36b	0.1315	0.5532
SG1-3	37b	0.0739	0.6057
SG4-5	38b	0.0513	0.2225
SG5	39b	0.0	

APPENDIX B
ARTIFACT PLATE

APPENDIX C

AMS DATE