LATE WOODLAND SETTLEMENT AND SUBSISTENCE IN THE EASTERN UPPER PENINSULA OF MICHIGAN

By

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A DISSERTATION

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

Anthropology - Doctor of Philosophy

2014

ABSTRACT

LATE WOODLAND SETTLEMENT AND
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This research revisits the debate surrounding Late Woodland subsistence practices in Michigan's Upper Peninsula. The Late Woodland period in the Upper Great Lakes region (ca. A.D. 600 to 1600) is often characterized through models emphasizing the intensive use of a single, primary key resource, particularly maize, fall spawning fish, or wild rice. For example, current Late Woodland subsistence models for northern Michigan focus on the intensive harvest, creation of surplus, and consequent storage of fall spawning fish as the cornerstone of the settlement and subsistence strategy. New data suggests that the dominant settlement and subsistence model is incomplete, lacks explanatory value, and requires revision. This study tests the hypothesis that a suite of potential resources was both present and utilized, allowing for a more flexible set of strategies, i.e. one based upon multiple rather than a single primary resource. Archaeological evidence, ethnographic data, and pilot study results reveal that acorns, maize, and wild rice are likely resources to be incorporated into such a strategy; all can be harvested and stored in the late summer or fall as a buffer against a poor fish harvest. Each, however, also has spatial, environmental, and temporal constraints with implications bearing on archaeological site locations as well as the evidence from the sites themselves.

A spatial analysis of site locations and resource distributions, as well as the composition of site assemblages was conducted to determine what relationships, if any, can be found between resources and site locations. The results identified site location patterns relating to the

exploitation of fish as well the potential use of wild rice and acorns, and also revealed changing patterns of site location over time including an emphasis on coastal settings in the early Late Woodland and an increase in interior setting sites in the late Late Woodland. In addition, the study examines strategies for subsistence risk buffering and decision making by Late Woodland peoples and provides new perspectives on resource scheduling, patterns of mobility, social organization, and social interaction.

The nature of the data sets employed in the research, as well as the temporal and spatial scales involved led to the adoption of Resilience Theory as an organizing framework for this study. The application of Resilience Theory is relatively new in archaeology and in this case provides a useful contribution to this line of scholarship in a context which has need of greater theoretical diversity. While an important outcome of the research is a synthesis of our current understanding of the regional Late Woodland, it also contributes a robust understanding of the interaction of hunter-gatherers/marginal horticulturalists with their environment.

ACKNOWLEDGEMENTS

This dissertation could not have been completed without the support of numerous individuals and institutions. While it is impossible to single out everyone who provided some sort of support, there are some who deserve specific mention. I could not have completed this work without my guidance committee and I would like to thank Jon Burley, Robert Hitchcock, Jodie O'Gorman, Ethan Watrall, and especially William Lovis, for their support, advice, and prodding throughout the process. Much of the data used in this project came from cultural resource surveys conducted on the Hiawatha National Forest (HNF) and many of these were carried out through contracts with Commonwealth Cultural Resource Group, Inc. (CCRG). I owe debts of gratitude to many at CCRG including Donald Weir for allowing me to direct many of these contract projects, to James Montney for preparing many of the graphics that appear in this volume, and Michael Hambacher for our numerous discussions on the nuances of UP archaeology. I also need to express my deep appreciation to John Franzen and Eric Drake of the HNF for indulging my research as well as for sharing their wealth of knowledge concerning the archaeology of the north woods. Finally, I am indebted to my family for all their support through this arduous process: Thanks Mom, Dad, Caroline, Elaine, Paige, and Barron, and especially Jenn – all my love.

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1.0 INTRODUCTION

This research revisits the contentious topic and longstanding debate surrounding Late Woodland (AD 600 to AD 1600[1]) settlement patterns and subsistence practices in the Upper Great Lakes region (cf., Cleland 1982, 1989; Martin 1985, 1989; B. A. Smith 2004). Previous research in the eastern Upper Peninsula (hereafter UP) of Michigan has emphasized the Great Lakes fishery, especially the intensive harvest of spring and fall spawning fish. These models are primarily based on fieldwork conducted in the 1960s and early 1970s that focused on coastal sites and, therefore, may be skewing the subsistence trends towards aquatic species. More recent archaeological studies in the eastern UP have identified and tested numerous Late Woodland sites in both coastal and interior settings. These data as well as the results of pilot studies suggest that the existing settlement and subsistence model is incomplete and, therefore, not tenable. For the purpose of this study, the eastern UP is defined as Alger, Chippewa, Delta, Luce, Mackinac, and Schoolcraft Counties (Figure 1).

It is well understood that the cold winter in the Upper Great Lakes region poses a subsistence risk and that one mechanism by which to mitigate this risk is to set a portion of a resource aside for later use (i.e., storage). Existing models of Late Woodland subsistence focus on the intensive harvest, the creation of surpluses, and consequent storage of fall spawning fish as the cornerstone of such a risk buffering strategy (Cleland 1982). There is not a sufficient number and range of risk buffering mechanisms to allow the fall fishery to serve as an exclusive resource, although it was certainly a primary resource. This study tests the hypothesis that a suite of potential resources is present that allows for a more flexible set of alternative risk buffering strategies. Archaeological, ethnographic, and ethnohistoric data as well as the results

[1] Dates are presented in Western calendar format (BC/AD) or in years before present (BP) unless otherwise specified.

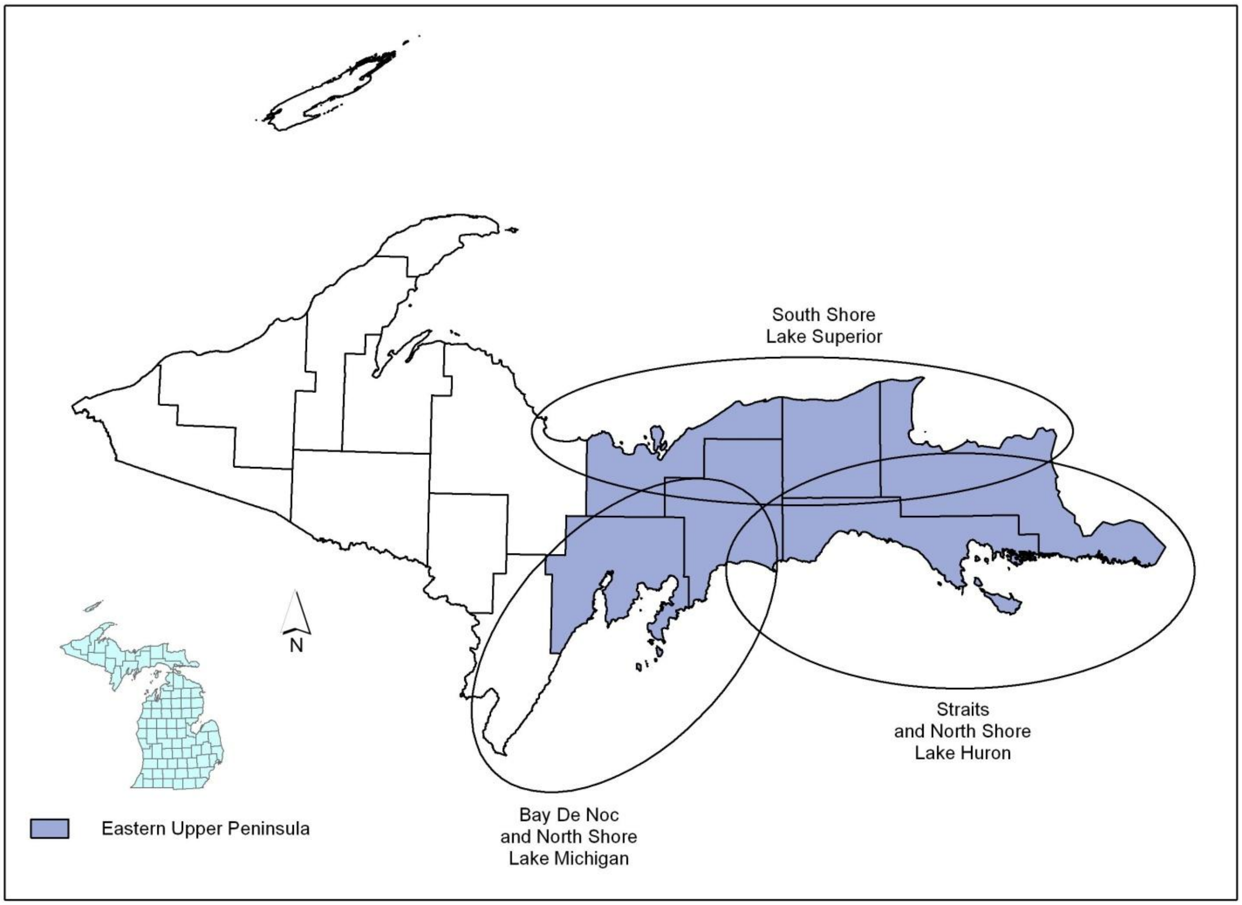


Figure 1: Location of the Eastern Upper Peninsula of Michigan.

of pilot studies provide evidence that acorns, maize, and wild rice are likely candidates for alternate resources that could be harvested and stored in the late summer or fall as a buffer against a poor fish harvest (Dunham 2008; 2009; O'Shea 2003).

1.1 Research Questions and Context

1.1.1 Research Questions

Based on the current models, a number of technological and social changes occur during the course of the Woodland period in the Upper Great Lakes region (AD 1 – AD 1600) that culminates in the development of the fall fishery (Cleland 1982; Martin 1985; McHale-Milner 1991). The current models and the processes behind them are more fully explored in Chapter

2.2, but it is important to highlight the fall fishery as critical to the research questions behind this study. The harvest of fall spawning fish became possible with the adoption of the gill net.[2] The gill net also facilitated the collection of high volumes of fall spawning lake trout and white fish which could be processed and stored in surplus and used to offset the diminished availability of resources over the cold UP winter.

The overarching question addressed in the current study is whether or not the development of the fall fishery provided a sufficient buffer to offset winter resource shortfalls. It is hypothesized that the integration of one or more alternate, highly productive food resources into the system would serve as a further buffer against such shortfalls as well as a buffer against poor fish harvests (see O'Shea 1989). The pilot studies mentioned above have shown that acorns, wild rice, or maize could have filled this niche, singly or in concert, creating an additional buffer (Dunham 2008, 2009; O'Shea 2003).

The adoption of the fall fishery is also viewed as a catalyst for social change in the Late Woodland period (Cleland 1982; McHale-Milner 1991; see also Chapter 2.2). The primary outcomes of this are perceived as increased population, as a result of diminished winter risk and more consistent food supply, and greater social organization and social integration brought about through the need to coordinate and schedule the fall fishery as well as to process the harvest of the high volume of fish (see also Braun and Plog 1982; Brown 1985; Schalk 1977; for an alternate perspective see S. Martin 1985; 1989).

Since the work of Cleland (1982) and S. Martin (1985) on this topic, there has been a significant amount of archaeological investigation in the eastern UP, largely driven by federally mandated compliance projects, that has expanded the body of data available to explore these

[2] A gill-net is defined as a "long, coarse, mesh net set to form an underwater 'curtain' in which fish become ensnared by their gills" (Cleland 1982:774).

questions. The results of these investigations have already begun to reshape the narrative concerning the development of the fall fishery in the Upper Great Lakes (see especially B. A. Smith 2004; see also Chapter 2.2]). Additionally, these projects have begun to reveal a broader settlement system that includes Late Woodland sites in the interior (Dunham 2002; Franzen 1987; S. Martin 1999).

In summary, the following questions will be asked throughout this study: 1) did Late Woodland people in the eastern UP use maize, acorns, and/or wild rice as a buffer against a poor yield of fall spawning fish?; 2) if so, what is the evidence to support the use of these resources?; 3) if not, were there other buffering mechanisms used to offset a poor fishing season? (see also Chapter 2 for additional context); 4) is there additional archaeological evidence to support the changing social dynamics proffered in the current models? (see Chapter 2.2 for additional context; and 5) what was the role of interior resources in the Late Woodland period in the eastern UP or why does it appear that there was greater use of the interior by Late Woodland people?

1.1.2 Research Context

The relationship between hunter-gatherers and their physical environment is a critical facet in the study of hunter-gatherers (Bettinger1987; Jochim 1991; Kelly 1995). An important theme throughout this dissertation is the interaction between humans and their environment. According to B. D. Smith (2007:1797), "Many animal species attempt to enhance their environments, and humans have been trying to make the world a better place to live – for themselves – for tens of thousands of years, often with unforeseen consequences." It is through their niche construction and niche maintenance that humans effectively manage resources, and it is this relationship which seems to set the stage for many discussions of hunter-gatherer subsistence systems which, in turn, play a significant role in all other aspects of hunter-gatherer societies (such as social structures, settlement patterns, and demography to name a few).

Access to subsistence resources is critical to hunter-gatherers. However, knowing that a resource is present and being able to successfully predict its occurrence is as critical to the discussion as access to that resource. The interaction between hunter-gatherers and their environment would lead to information about the location of resources as well as information about the availability of resources (Binford 1983; Davidson-Hunt and Berkes 2003; Kelly 1992; Whallon 2006). All the previous research concerning the Woodland period in the eastern UP assumes that the population was mobile and followed a seasonal subsistence round (see Brashler et al. 2000; Brose and Hambacher 1999; Buckmaster 1979; Franzen 1986; Holman 1978; S. Martin 1999). The locations of subsistence resources as well as the timing and potential returns from those resources are critical factors concerning hunter-gatherer mobility (see Binford 1983; Davidson-Hunt and Berkes 2003; Harpending and Davis 1977; Lovis et al. 2005; Morgan 2009). Mobility allows greater flexibility for accessing resources, especially if subsistence resources are aggregated in space and by season as they are in the Late Woodland in the eastern UP (see Chapter 2.2).

Certain plants and animals follow predictable seasonal patterns that can facilitate their reliable exploitation by hunter-gatherers. In the prevailing model for the Woodland period in the Upper Great Lakes region, the seasonal patterns of spring and fall spawning fish illustrates this well (c.f., Cleland 1982). In each instance, the resource has the potential to produce a high volume of food over a short period of time which, in turn, facilitates a more intensive exploitation of that resource. A byproduct of these highly productive systems is a surplus that aids in creating more reliable resources (see Ingold 1983; O’Shea 1981).

This type of pattern has been described as a more intensive use of specific resource (Binford 2001; Keeley 1995; B. D. Smith 2001). B. D. Smith (2001) explores the concepts of "intensification" and "resource management." Each of these terms reflects "deeper and more complex relationships of interaction with plant and animal communities" (B. D. Smith 2001:35) Management of resources is a method of facilitating their predictability and reliability (Hildebrand 2003; Keeley 1995; Miller and Davidson-Hunt 2010). Acorns, wild rice and maize each represent plant resources that can be, and are, managed by hunter-gatherers and low level food producers (*sensu* B. D. Smith 2001).

Storage is also an important factor in resource predictability and reliability. Storage can be used as a mechanism to stabilize or bridge unpredictable resources and periods of resource scarcity and shortfall, or as a method to facilitate resource scheduling (Binford 1983; Ingold 1983; O'Shea 1981; see also Bursey 2001; Dunham 2000a). Direct, or practical, storage involves setting a portion of a resource aside for later use which extends the availability of the resource and increases its reliability. Social storage, the generation of reciprocal sharing relationships often offset in time and space, encompasses a range of interactions, but establishes relationships between individuals and groups (see also Braun and Plog 1982; Holman and Lovis 2008; O'Shea 1981; Parkinson 2002). Resources and information are exchanged through this network that may provide alternatives in instances where resources are scarce or unreliable (see also Binford 1983; Davidson-Hunt and Berkes 2003; Whallon 2006).

This study examines strategies for subsistence risk buffering and decision making by Late Woodland peoples and will provide new perspectives on resource scheduling, patterns of mobility, social organization, and social interaction. It is posited that the distribution of Late Woodland archaeological sites in the eastern UP is patterned by the decisions of Late Woodland people in relation to environmental factors they considered culturally and economically important, specifically the location of subsistence resources. Fall spawning fish, acorns, maize, and wild rice each have spatial, environmental, and temporal (seasonal and inter-annual) constraints. Pilot studies as well as previously published research have shown relationships between each of these resources and their associated constraints (see for example, Cleland 1982; Dunham 2008, 2009; Franzen 1987; S. Martin 1985; Moffat and Arzigian 2000; O'Shea 2003; B. A. Smith 2004; Vennum 1988; Yarnell 1964). These constraints have implications concerning archaeological site locations as well as the archaeological evidence at the sites themselves.

1.2 Theoretical Orientation

The research relies on multiple data sets (cultural and environmental [see also Chapter 2]) that span approximately 1000 years (the Late Woodland period, ca. AD 600 to AD 1600) and encompass a large geographic area (eastern UP, ca. 6752 square miles [mi²] or 17,488 square kilometers [km]). The nature of the data as well as the temporal and spatial scales has led to the adoption of resilience theory as a framework for this study. The underlying element of Resilience Theory is that nested adaptive cycles can be viewed both synchronically and diachronically to observe continuity and change across time and/or geographic space (c.f., Redman and Kinzig 2003; Walker et al. 2006).

Resilience Theory originated in ecology (Holling 1973; see also Delcourt and Delcourt 2004). Inherent in this perspective is the notion that smaller, faster cycles and larger, slower cycles may interact and either amplify or dampen different effects to cause change or stability. Walker et al. (2006:13-2) define resilience as "the capacity of a system to experience shocks while retaining the same function, structure, feedback, and therefore identity." Stability within changing cycles can be classified as resilience and change can be viewed as reorganization or adaptation.

Another important component of Resilience Theory is the role and incorporation of information exchange and long term memory (Redman and Kinzig 2003; Walker et al. 2006). This element of Resilience Theory, along with the ability to move across spatial and temporal scales and multiple social and environmental variables, couples well with archaeology because of the ability of archaeologists to view the interaction between cultural and ecological systems over time (Redman and Kinzig 2003). Two recent studies show the utility of Resilience Theory in understanding the interplay between cultural and physical environments at a regional level and which explore mobility patterns and subsistence practices in times of environmental change/instability (Nelson et al. 2006; Thompson and Turck 2009; see also Minc 1986). The study by Thompson and Turck (2009) is particularly informative in that it addresses cycles of reorganization and resilience in relation to hunter-gatherer use of coastal environments.

Resilience Theory offers a useful heuristic framework within which to explore subsistence risk buffering, resource scheduling (including the potential for intensification of resource use), patterns of mobility, social organization, and social interaction. Such an approach acknowledges the dynamic nature of cultural processes and is capable of accommodating seemingly disparate cycles including the likely maintenance (resilience) of subsistence practices, such as harvesting spring spawning fish or acorns, along with the incorporation (reorganization) of new resources like fall spawning fish or maize into the system.

Resilience theory also has much in common with elements of social ecological systems, settlement ecology, and traditional ecological knowledge (Anschuetz et al. 2001; Davidson-Hunt 2000; Davidson-Hunt and Berkes 2003; Jones 2010; Trusler and Johnson 2008). Each of these approaches recognizes that landscapes are products of people's interaction with the environment. Information exchange and memory facilitate resilience or adaptation in a cultural system through knowledge, tradition, and institutions – each of which are critical components of social ecological systems and traditional ecological knowledge (Davidson-Hunt and Berkes 2003; Funk 2004; Johnson 2000; Miller and Davidson-Hunt 2010; see also Holman and Lovis 2008; Sobel and Bettles 2000; Whallon 2006). Settlement ecology provides an accessible archaeological framework addressing "issues of archaeologically observed patterns of land use, occupation, and transformation over time" (Anschuetz et al. 2001: 177). These perspectives are well suited to address questions of landscapes and site locations from ecological and cultural factors across space as well as over time.

1.3 Dissertation Organization

The dissertation research revisits the topic of settlement patterns and subsistence practices in the Late Woodland period of the eastern UP and evaluated it against the body of data generated over the past 25 years. If people were using fall spawning fish, acorns, wild rice, and/or maize, then their sites should be located to access these resources. Previous research in the Upper Great Lakes region has shown that many Late Woodland coastal sites are well placed to access fall spawning beds and include archaeological evidence (net sinkers and faunal remains) which confirm this activity (Cleland 1982; Holman 1978; Lovis and Holman 1976; Martin 1985; B. A. Smith 2004). In addition to fish habitat, pilot studies have shown potential relationships between the distribution of Late Woodland archaeological sites and habitats with potential oak (acorn) and/or wild rice (Dunham 2008; 2009).

A major focus of the dissertation research was to carry out a spatial analysis of Late Woodland site location as well as an analysis of the composition of site assemblages in an effort to determine what relationships, if any, can be found between resource distribution and site locations. While an important outcome of the research is a synthesis of our current understanding of regional Late Woodland archaeological research, it also contributes a more robust understanding of the interaction of hunter-gatherers with their environment.

The dissertation is organized into six chapters and is supported by references and multiple appendices. Following this introduction, Chapter 2 provides a review of the environmental background and cultural setting for the research conducted in this dissertation. These background sections are meant to provide context for the discussions in subsequent chapters.

Chapter 3 provides a review and synthesis of the available archaeological assemblage data for LW sites in the eastern UP. The review relied on previously completed studies and includes published and unpublished sources including the so-called "gray literature".[3] The archaeological data in Chapter 3 was summarized in tabular form to establish a format to compare the characteristics of each assemblage. Much of the archaeological site data that has been generated over the past 25 years has not been quantified or synthesized beyond the site specific level. In certain instances, such as the pilot studies cited above, patterns have been observed with significant implications for our understanding of the prehistory of the region. The broader regional synthesis of Late Woodland data should provide additional insights that will enhance our understanding of Late Woodland cultural dynamics.

Eighty-one Late Woodland sites were identified for this study. The data derived from these sites was collected in a variety of ways, including small scale surface collection, limited test excavations, and large scale excavations. Further, some of the sites where excavation has

[3] In this instance, gray literature refers to the technical reports prepared for federal compliance projects as well as other unpublished written sources. For a broader discussion of gray literature see Seymour (2010).

taken place revealed cumulative palimpsests.[4] To address such palimpsests as well as the scale and types of investigation a diversity use index was created as a measure to compare the various site assemblages (c.f., Kvamme 1985). This analysis also allowed the sites to be classified into categories that allowed sites to be characterized by their likely organizational structure (c.f., Binford 1980).

An inductive Late Woodland archaeological site predictive model was also created using the environmental characteristics of the Late Woodland site settings (Chapter 4). This aspect of the dissertation focused on 48 Late Woodland archaeological sites located in the Hiawatha National Forest. This approach was taken because of the consistent approach to archaeological survey used by the Forest as well as the emphasis on conducting archaeological survey in coastal and interior settings. Additionally, this data set included the highest proportion of interior Late Woodland sites. The results of this analysis allowed all 81 Late Woodland sites in the eastern UP to be classified as to the relative archaeological sensitivity of their site location.

Preliminary examinations of the environmental context of the eastern UP in the Late Woodland period were conducted as part of pilot studies (Dunham 2008; 2009). The pilot studies have also shown a statistically significant relationship between the location of Late Woodland archaeological sites in the eastern UP and habitats that were likely to include oak and/or potentially include wild rice (Dunham 2008; 2009). While these relationships do not demonstrate that people were using these resources, they offer the potential that people and these resources were occupying the same geographic space. An important outcome of Chapter 4 was testing the results of the pilot studies on a finer scale.

[4] According to Bailey (2007:204), "a cumulative palimpsest is one in which the successive episodes of deposition, or layers of activity, remain superimposed one upon the other without loss of evidence, but are so re-worked and mixed together that it is difficult or impossible to separate them out into their original constituents."

The results of the syntheses of the assemblages, the generation of the diversity use index, and the creation of the Late Woodland site predictive model were explored to see what trends might be identified concerning Late Woodland site location and resource use (Chapter 5). Additionally, an expedient catchment analysis of the site locales was also conducted to examine the environmental settings of the sites. The resulting analyses revealed trends that directly inform on the primary questions raised by this study. Late Woodland settlement patterns have spatial, temporal, and environmental components that can be identified and explored.

Finally, the results of the research and analyses are presented in Chapter 6. This chapter is divided into four subsections. The first discusses the potential for the use of wild rice, acorns and maize, as well as the fall fishery, for the Late Woodland period in the eastern UP. It also explores the temporal and spatial potentials of these resources from the context of site function. The second subsection discusses the potential for landscape management by Late Woodland people in the eastern UP and introduces the concept of persistent places to describe a small subset of the eastern UP Late Woodland sites (c.f., Schlanger 1992; Thompson 2010). The third subsection continues on the theme of persistent places and explores the distribution of ceramic types in time and space, and how this may reflect social organization. The final subsection provides an overview of the patterns observed in the context of continuity and change across time and space.

2.0 ENVIRONMENTAL AND CULTURAL BACKGROUND

The existing Late Woodland subsistence models for northern Michigan focus on the intensive harvest, creation of surplus, and consequent storage of fall spawning fish as the cornerstone of the settlement and subsistence strategy. The proposed research revisits the debate surrounding Late Woodland subsistence practices in Michigan's Upper Peninsula. New data suggests that the dominant settlement and subsistence model is incomplete, lacks explanatory value, and requires revision. This chapter provides a review of the environmental background and cultural setting for the research conducted in this dissertation. Additional information about each of these topics is presented in subsequent chapters. The intent here is to help contextualize the forthcoming more focused discussion.

2.1 Environmental Background

The environmental history of the UP begins with the retreat of the Wisconsinan ice sheet and the deglaciation of the region around 11,500 years before present (BP) (Dorr and Eschmann 1986). This period saw the origins of the modern Great Lakes, although in a significantly different configuration, which were fed by glacial melt water (Larson 1999). Great Lakes levels exhibited great variation over the next seven thousand years (through 4500 BP), as did the climate and vegetation (Futyma 1982; Kapp 1999; Larson 1999; Lovis et al. 2012). Forest communities similar to those of the present were established in the Upper Great Lakes region by 3000 years ago and modern levels of the Upper Great Lakes had been generally achieved by 2000 years ago. Therefore, modern lake elevations and configurations encompass much of the Woodland period (from ca. AD 0 to AD 1600) in the region (Anderton 1993; Brugam et al. 1997; Winkler et al 1986).

This does not mean that the UP's environment has been static for the last 2000 years, but rather that the regional environment was broadly resilient (*sensu* Resilience Theory), subject to localized changes resulting from disturbance regimes and climatic factors (see Baedke and Thompson 2000; Lovis et al. 2012; Ritchie 1986; Zhang et al. 1999). For example, the water levels of the Great Lakes regularly fluctuated by up to a meter on a fairly regular short term cycle and on a wider scale at a longer interval (Baedke and Thompson 2000). Additionally, temperature and relative moisture varied across the region and there were periods of dune activation and stabilization along the Great Lakes shores (Arbogast 2009; Bernabo 1981; Booth et al. 2004; Delcourt et al. 2002; Futyma 1982; Lovis et al. 2012). An attempt at illustrating these trends is presented in Figure 2.

The lake level and dune formation cycles may have been coupled to dynamic vegetation change in the littoral zones along the Great Lakes. Temperature and moisture change would also have the potential to alter vegetative patterns across the UP in general. The significant changes in forest composition over the past 150 years, namely the reduction of tamarack, hemlock and white pine and concurrent increase in red maple, sugar maple, and red oak, can serve as a useful example (Comer et al. 1995; Leahy and Pregitzer 2003; Nowacki and Abrams 2008; Nowacki et al. 1990; Price 1994; Van Deelen et al. 1996; Whitney 1986; Zhang et al. 2000). This reconfiguration of northern forests is the result of intensive logging and subsequent fires in the second half of the nineteenth century and most of the twentieth century (see Dey 2002). Oak benefited from the removal of canopy (it is not a shade tolerant species) as well as burning of subsequent understory (see Abrams 1992; Crow 1988), and most varieties of maple are aggressive colonizers in openings. Maple and oak also benefited from increased deer

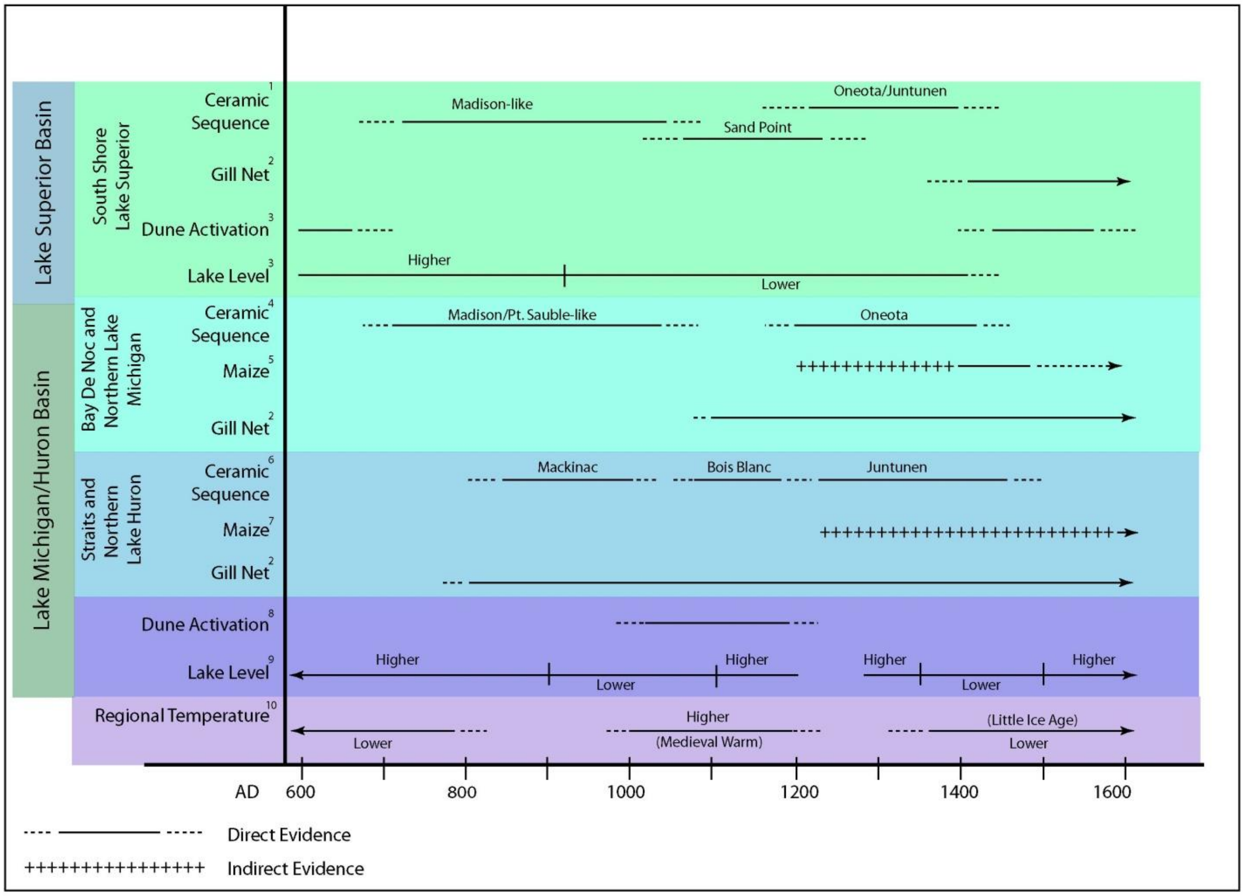


Figure 2: Timeline showing selected cultural and physical environmental variables relating to the EUP. The data is subdivided by three regions: The Straits of Mackinac (Straits) and Northern Lake Huron; Bay de Noc and Northern Lake Michigan; and the South Shore of Lake Superior (see Figure 1.0-1). Physical environmental variables are presented in terms of higher or lower than present day (in relation to Great Lakes level and relative temperature) or active/inactive (coastal dunes). Cultural variables are presented as present/absent based on direct or indirect archaeological evidence. The references for the data presented in the figure are as follows: [1](Drake and Dunham 2004; Dunham and Hambacher 2007); [2](B. A. Smith 2004; also see Cleland 1982; Martin 1985]); [3](Loope et al. 2004); [4](Dunham and Hambacher 2002); [5](Buckmaster 2004); [6](McPherron 1967); [7](O'Shea 2003); [8](Lovis et al. 2012); [9](Baedke and Thompson 2000); [10](Bernabo 1981).

populations, a species that also benefitted as a result of land clearing through logging. Deer browsing on sensitive species such as hemlock, yew, and cedar furthered their decline, while species less favored by browsing deer increased (Alverson et al. 1988; Van Deelan et al. 1996).

There is also variation in the ecosystems present across the geographic extent of the eastern UP (see Albert 1995). An ecosystem is a structure in which a community of living organisms (e.g., plants, animals [biotic community]) interacts with each other as well as the nonliving component of their environment (e.g., air, water, soil [abiotic components]). The interactions of these variables help to sustain one another in regular patterns. For example, maize is an exotic plant that was brought into the Upper Midwest by Native American people as a food resource (Hart and Lovis 2013). Maize requires a series of ecological variables including soil, rainfall, and frost free days to produce a reliable subsistence crop (Demeritt 1991; Hart and Lovis 2013; O'Shea 2003; Yarnell 1964). Modern maps showing growing season (frost free days) indicate that areas near the shorelines of Lakes Michigan and Huron have the required growing season, but most of the eastern UP does not (Eichenlaub et al. 1990; see also O'Shea 2003). Thus, variation in ecosystem characteristics can play a strong role in what plants (such as maize or red oak) or animals (such as deer) might be present.

The eastern UP is bounded on the north by Lake Superior and on the south by Lakes Michigan and Huron. There are numerous river drainage ways in the eastern UP (Figure 3). Most of these drain either north or south with important exceptions like the Tahquamenon River which flows generally east. Figure 3 illustrates that there are more drainages with larger watersheds that flow south into Lakes Michigan and Huron than into Lake Superior. The largest drainages are the Manistique (4564 km^2 [1762 mi^2]) which flows generally south into Lake Michigan and the Tahquamenon (2549 km^2 [984 mi^2]) which flows into Lake Superior. Each of these rivers drain the expansive Seney wetlands in the interior of the eastern UP (Appendix 2A). The Manistique watershed is also noteworthy in that the two largest inland lakes in the eastern

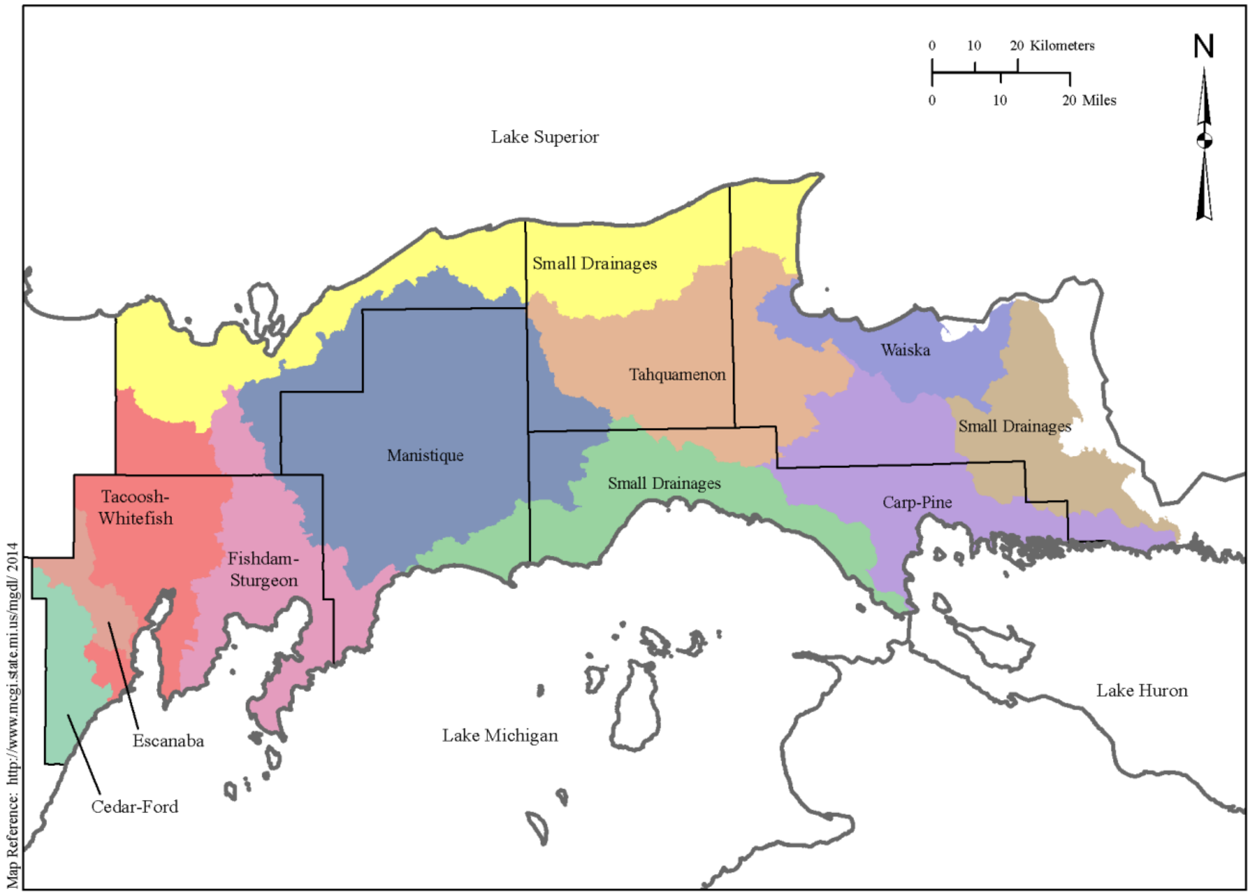


Figure 3: River Drainages in the Eastern Upper Peninsula.

UP are part of the watershed. Manistique Lake (10,130 acres) forms the headwaters of the Manistique River and Indian Lake (8,000 acres) is at the confluence of the Manistique River and its major Tributary, the Indian River. The Indian River drainage, which forms the western portion of the Manistique watershed, includes a watershed of approximately 453 km² (174.9 mi²) on its own.

2.2 Cultural Background

2.1.1 *General Overview of the Woodland Period in the Eastern UP*

Archaeologists have developed a broad chronological and cultural classificatory scheme to organize and describe the prehistory of eastern North America. The following subdivisions are broadly applicable, although there is regional variation both in chronology and culture (c.f., Fitting 1975a; Mason 1981; Snow 1976); Paleoindian (12,000 BC to 8,000 BC), Archaic (8,000 BC to 1000 BC), and Woodland (1000 BC to AD 1600). Throughout much of the Midwest the Woodland period is divided into three parts; Early Woodland (1000 BC to 200 BC), Middle Woodland (200 BC to AD 600), and Late Woodland (AD 600 to AD 1600). The standard hallmark for the beginning of the Woodland period is the introduction or inception of ceramics. In northern Michigan, including the eastern UP, the Archaic period persists about 1000 years longer than in more southerly parts of the Midwest (see Brose and Hambacher 1999; Robertson et al. 1999). Ceramics do not appear in the eastern UP until what is considered the Middle Woodland time period in the Midwest, and those are wares representing the Laurel and North Bay traditions (Brose 1970; Brose and Hambacher 1999; Fitting 1975a; Janzen 1968; Mason 1981). The temporal lag in ceramic introduction across the region has prompted some researchers to substitute the term “Initial Woodland” for this period; here, the standard Midwestern convention of Middle Woodland will be employed.

The Middle Woodland period (AD 1 to AD 500) in the Upper Great Lakes represents the first widespread introduction of ceramics in the Upper Peninsula. In general, Middle Woodland sites in the Upper Peninsula may represent Lake Forest (Fitting 1975a) or Northern Tier (Mason 1966) adaptations sharing material culture affinities with Laurel sites to the south, north, and west (Janzen 1968). Settlement and subsistence patterns suggest seasonal fishing, collecting, and hunting, with an increasing emphasis on exploitation of aquatic resources (Brose and Hambacher 1999; Cleland 1982). Sites such as Summer Island (Brose 1970), Winter (Richner 1973), and Naomikong Point (Janzen 1968) are interpreted as Middle Woodland warm season fishing villages. In the St. Ignace area a number of sites having Middle or Initial Woodland components are thought to have been satellite summer or winter camps (Fitting and Clarke 1974; Fitting [ed] 1974). Spider Cave on the Garden Peninsula may have been a ritual locale (Cleland and Peske 1968).

Other recognized Middle Woodland sites within the region include the Nina Site (Dunham and Hambacher 2002); the stratified Bark Dock site in Chippewa County (Dunham and Hambacher 2007); the Gooseneck Lake IV site (Franzen 1987), the Indian River site (Franzen 1987), the multicomponent Williams Landing locale (Dunham and Branstner 1995), and the Carp River site (Dunham et al. 1993). The Carp River site has been interpreted as a transitional Middle-Late Woodland fishing encampment at the mouth of the Carp River near the Mackinac Straits (Dunham et al. 1993). Faunal evidence from the Carp River site suggests an emphasis on spring-spawning species (e.g., sturgeon walleye, etc.), although fall spawning species (e.g., whitefish and lake trout) are also represented. The location of the site is also consistent with transitional Middle-Late Woodland fishing locales based on current regional settlement/subsistence models (Cleland 1982; S. Martin 1989; B. A. Smith 2004) as the mouth of the Carp River would provide excellent access to both river-spawning spring species and deep water-spawning fall species.

The Late Woodland period (AD 500 to AD 1600) is perhaps the best-documented cultural period in the northern Great Lakes and UP. The best known LW site in the eastern UP is the Juntunen site (20MK1; McPherron 1967). This stratified site is located on an island in the Straits of Mackinac and has provided the basic chronology for the LW in the region and beyond: Mackinac Phase, AD 800 to AD 1000; Bois Blanc Phase, ca. AD 1000 - AD 1200; and Juntunen Phase, AD 1200 - AD 1500. It also has produced a large artifact assemblage with the remains of more than 1600 ceramic vessels and 400 formal stone tools, a large faunal assemblage, and features, including structural remains. Not only is the Juntunen site the best known in the region, it is the basis for much of the Inland Shore Fishery model (Cleland 1966; 1982).

Four sites in the Bay de Noc region, at the northern end of Lake Michigan, provide interesting information concerning the settlement and subsistence of the region. There are two components of the Summer Island site that fall within the Late Woodland period (Brose 1970). The first can be generally classified as Oneota (Upper Mississippian) and was occupied ca. thirteenth and fourteenth century AD and included 16 ceramic vessels as well as ground stone and chipped stone tools. This component also included floral and faunal materials as well as evidence or refuse and storage pits (Brose 1970). The later component was occupied at the end of the Late Woodland period (ca. sixteenth century) and into the early historic period (Brose 1970). The late occupation is also evidenced by a small assemblage of European produced trade goods. This late component also included Oneota ceramics (13 vessels) and produced ground stone and chipped stone tools. Importantly, this component also produced evidence for a structure as well as squash seeds (Brose 1970).

The Ogontz Bay site, situated on the shore of Big Bay De Noc, has produced Sand Point ceramics (cf., Dorothy 1980), a variety of stone tools, and a very diverse faunal assemblage, including fish, mammals, and birds (Anderton et al. 1991). The faunal assemblage suggests a focus on spring-spawning fish species (especially walleye and bass). Other intriguing faunal data include a cache of black bear mandibles, human-modified painted turtle shell, beaver incisors, and a bald eagle talon. These finds may indicate specialized resource procurement and may, particularly in reference to the eagle claw, reflect ideological behaviors.

Archaeological testing indicated that the Bar Lake site, an inland lake site, was used as a hunting and fishing camp between AD 1100 and AD 1600 (Dunham and Hambacher 2002:71-

107). The remains of at least nine fragmentary Oneota vessels and a variety of stone tools were found, including projectile points and tools used for cutting, scraping, and grinding. A variety of animal bones was also found. The artifacts and animal bone indicate moose and beaver were hunted at the site. The 10 Mile Rapids site, situated inland on the Sturgeon River, has produced cordmarked ceramics, a triangular point, and a slate elbow pipe, as well as a faunal assemblage consisting primarily of sturgeon and beaver bone (Rutter et al. 1984). Both the site's location at a rapids and the recovered faunal assemblage indicate that it was a spring encampment focusing on spawning sturgeon.

In the Lake Superior Basin, few Late Woodland sites have been formally excavated. Naomikong Point contains a Late Woodland component (Janzen 1968). Ceramic styles across much of the eastern part of the Superior basin indicate an affinity towards the south and east, including Juntunen wares and Iroquoian motifs. In the central and western UP, along Lake Superior, the ceramic wares are more westerly in association. For example, the Sand Point site in Baraga County, which has produced Blackduck and Oneota-like ceramic assemblages, appears to represent a village and funerary mound (Cremin 1980). Similarly, the Gete Odena site at the Williams Landing locale on Grand Island has produced Madison points and Sand Point-like ceramics (Dunham and Branstner 1995; Robinson et al. 1991). The 1994 excavations at the latter site identified subsurface features and a possible former living floor associated with the Late Woodland occupation of the site (Dunham and Branstner 1995). One feature, a small pit, contained a miniature ceramic vessel as well as the carbonized remains of cherry and acorn. These excavations also revealed three grooved sandstone net sinkers, reflecting the use of the adjoining bay for deep water fishing. Similar fishing weights, as well as Oneota and Sand Point ceramics, have been recovered from the Bark Dock site in Chippewa County (Dunham and Hambacher 2007).

Standing models of Woodland settlement and subsistence in the eastern UP relate that Middle Woodland people (AD 1 – AD 600) were likely more residentially mobile than their Late Woodland descendants and had a broader diet breadth (Brose and Hambacher 1999; Cleland 1983; S. Martin 1985). As Late Woodland peoples (AD 600 – AD 1600) became more reliant on aquatic resources, specifically the integration of and intensification on the fall fishery, they became more territorially constrained and more socially integrated/organized (Cleland 1982; 1992a; McHale-Milner 1991; B. A. Smith 2004; see also Binford 2001). Change towards more circumscribed territories, more focused subsistence, and more complex social organization can be seen throughout the Midwest during the Late Woodland period (Mason 1981; McElrath et al. 2000; McHale-Milner 1991; Schroeder 2004; Seeman and Dancey 2000). In the eastern UP, the focus of this shift was the exploitation of the fall, deep-water fishery (Cleland 1982; B. A. Smith 2004; for an alternative discussion, see S. Martin 1989). This provided a seasonally abundant, storable food resource to offset the diminished food potential of the eastern UP over the course of the winter.

2.2.2 *The Late Woodland Period*

A number of cultural changes occur during the course of the Woodland period in the Upper Great Lakes region that warrant summarization. Residential sites become larger due to both reoccupation cycles and the size of residential groups, and technological innovations such as ceramics and new tools for fishing appear. Subsistence strategies consist of seasonal fishing, collecting, and hunting, with an increasing emphasis on aquatic resources. The prevailing model focuses on technological and social changes resulting from the exploitation of spring and fall spawning fish (Cleland 1982; B. A. Smith 2004). In simple terms, Middle Woodland (AD 1 to AD 600; also known as the Initial Woodland in the Upper Great Lakes region) fishing focused on spring-spawning species such as sturgeon and sucker. In the Late Woodland (sometimes also known as Terminal Woodland [AD 600 to AD 1600]) period people continued to follow a seasonal settlement and subsistence pattern, in many ways quite similar to that of the Middle Woodland, with the critical addition of deep water, fall-spawning fish such as whitefish and lake trout**.**

Cleland (1982) has constructed a technoeconomic model in which the development of gill net fishery technology represents the cornerstone of a series of changes in resource use and site placement as well as social transformations in the Late Woodland period. He hypothesizes that the adoption of deep water gill-nets to catch surpluses of fall-spawning fish, and the utilization of an effective storage technology increased the availability of food during the cold season, which in turn allowed for population increases, the development of larger settlements of increasing residential duration, and cooperation among social groups (inter- and intra-group). Other Late Woodland people in the region were focusing on maize and wild rice which, like fall-spawning fish, could be stored against winter shortfalls (Brashler et al. 2000; Cleland 1983; Gibbon and Caine 1980; Moffat and Arzigian 2000; Vennum 1988). Some have suggested the presence of an interdependent, or symbiotic, relationship between specialized interior hunter/foragers and coastal maize horticulturalist in parts of northern lower Michigan (O'Shea 2003; see also Howey 2006).

Cleland's (1982) model is largely based on evidence derived from archaeological sites situated on the Great Lakes shorelines, as well as ethnographic and ethnohistoric accounts which discuss the Great Lakes fishery as part of a seasonal settlement and subsistence round (see also Cleland 1983, 1992a). It is a coastal oriented model, but includes mechanisms that would allow people to use the interior. For example, it is commonly assumed that aside from logistic hunting and collecting forays, the interior was seasonally occupied by smaller groups of people who dispersed there during the winter (see Fitting and Cleland 1969; Quimby 1962; see also Holman and Lovis for a discussion of the ethnohistoric basis of the model). In basic terms, the subsistence round is centered on two axes - spring and fall fishing. The underlying logic is that people came together to harvest seasonally dense resources (spring and fall spawning fish) and dispersed when resources were more scarce such as in the cold season, or were more broadly distributed across the landscape (as in the warm season).

The shift towards the fall fishery was the result of new technologies and social practices – specifically deep-water gill nets, storage technology (drying and freezing), the development of larger settlements of increasing duration of occupation (permanence), and cooperation among social groups (intra- and inter-group) (Cleland 1982). The combination of gill nets, social cooperation, and storage are critical to the success of this process. In a Northwest Coast example Schalk (1977:240) highlights the difficulties in processing and storing anadromous fish referring to a "bottleneck effect of having to harvest *and* process at the same time" due to rapid rates of spoilage (emphasis in the original). The effort requires an increased level of social organization and this leads to a combination of practical and social storage (see Binford 2001; Ingold 1983; O'Shea 1981). In other words, the intensive group processing of fish for storage is carried out, in part, with the understanding that it will be available for future use by the group engaged in its processing (see Cleland 1982).

The Cleland model of the Late Woodland use of the Great Lakes deep fresh water fishery is compelling, but there are several constraints that are not fully explored. A primary constraint is related to the season of fall fishing. The harvest of fall spawning fish took place on the Upper Great Lakes primarily between mid-November and late December. Cleland's model requires that a portion of the fish caught and processed be dried and frozen for storage. Therefore, air temperature is a factor in storage preparation. If the temperature is too warm and the surplus fish cannot be frozen, it may be subject to spoilage. If the temperature is too cold, the lake may begin to freeze limiting or preventing access to spawning beds until the ice was thick enough to support net disbursement through the ice. Other factors, such as rough seas could also lead to a failure to collect fish. In this instance, the ability to generate a surplus of food and store it prior to winter is critical to nutritional success and survival over the winter.

One solution to the question of subsistence risk has been offered by Holman and Lovis (2008) who see a relationship between the highly flexible mobility strategies of Upper Great Lakes peoples along with integrating social mechanisms as a buffer for environmental variability. The type of mobility practiced as part of the so-called Chippewa and Ottawa patterns (see Fitting and Cleland 1969) appear to have a relationship with their respective environments. The cooperation between these groups facilitated movement into adjoining territories in times of subsistence stress as well as the sharing of territories/resources at other times (see also Holman and Kingsley 1996; McHale-Milner 1991). The combination of highly flexible mobility and social cooperation may mitigate some of the risk posed by environmental variability in the eastern UP, but likely not all of the risk.

An additional risk buffering mechanism is the integration of alternate, highly productive food resources into the system (O'Shea 1989; see also Gallagher and Arzigian 1994; Parker 1996). Cleland's (1982) model would similarly benefit from the presence of other highly productive, storable resources that could serve to buffer against a poor fish harvests. As noted above, maize and wild rice filled this niche in the regions immediately south and west of the eastern UP (Brashler et al. 2000; Cleland 1983; Moffat and Arzigian 2000; O'Shea 1989; Parker 1996). High carbohydrate plant resources such as wild rice and/or maize would complement the fish diet of Late Woodland peoples and provide a potential buffer to environmental risk in the eastern UP (Cordain et al. 2000; Speth 1991).

Pilot studies addressing broader settlement and subsistence patterns in the eastern UP suggest a shift in site locations from the Middle Woodland to Late Woodland periods (Dunham 2002; see also Buckmaster 1979; Drake and Dunham 2004). These findings reveal that access to deep water settings on the Great Lakes shorelines as well as site locations on the interior are of greater importance to Late Woodland people than they were in the Middle Woodland. This apparent shift is highlighted by an overall increase in the number of Late Woodland sites as well as a shift in site locations. The shift in Late Woodland coastal sites towards deep water locales is likely the result of the development of the fall fishery, whereas the shift towards greater use of interior settings may reflect changes in mobility strategy and/or landscape positioning keyed towards the adoption of new resources or intensification on existing resources. While the timing of the shift is not known, largely because of the low number of chronometrically well dated sites in the eastern UP, the data supports such a trend.

If it can be assumed based on Cleland's (1982; see also S. Martin 1985; B. A. Smith 2004) model that access to spring and fall spawning beds is an important factor in the occupation of coastal zones, what might the expansive interior areas of the eastern UP, largely ignored by these models (see Dunham 2002; Franzen 1986; 1987; Holman 1978), have to offer Late Woodland peoples? Holman (1978) observed that early Late Woodland (Mackinac Phase) coastal sites in northern lower Michigan, immediately south of the current area of interest, had high late fall resource potential because of the fall fishery, but relatively low winter resource potential. Interior sites, on the other hand, were situated in areas of high(er) winter resource potential. She concluded that early Late Woodland people chose to live in the interior over the winter to make use of the higher winter resource potential (Holman 1978:53: Lovis 2008). An important exception to this general pattern is the Juntunen site which had high resource potential year round (Holman 1978). While coastal and interior settings each had relatively high warm season resource potential, people may have more commonly lived in coastal areas for other social and economic reasons (Holman 1978; see also Holman and Lovis 2008).

Through recent pilot studies, Dunham (2008, 2009) has identified acorns and wild rice as likely resources used by Late Woodland peoples in the interior of the eastern UP. Likewise, O'Shea (2003) has suggested that microclimates associated with the ameliorating affects of Great Lakes coastal zones may have permitted localized maize horticulture. Wild rice and maize are not typically associated with eastern UP Late Woodland foodways largely due to perceived environmental constraints and acorns have often been overlooked because of their perceived low density and high processing costs (Cleland 1983; Dunham 2009; Yarnell 1964). The studies by Dunham (2008; 2009) and O'Shea (2003) demonstrate that wild rice, maize, and acorns may be abundant in specific niches and should be considered. Each of these resources is relatively predictable, can be stored, and compare favorably with one another in general nutritional characteristics (Dunham 2009; Kuhnlien and Turner 1991). They are also significant sources of carbohydrates which would complement fall spawning fish, and, importantly, the procurement of these plant resources would not conflict with the scheduling of fall fishing. Another important consideration for each of these resources, including fall spawning fish, is that they each have predictable spatial, environmental, and temporal (seasonal) constraints.

While a significant amount of archaeological research has been conducted in the eastern UP, a correspondingly proportionate data set relating directly to Late Woodland subsistence has not been generated (e.g., floral and faunal remains [see Chapter 3.5]). Two factors are largely responsible for this: 1) much of the data is the result of archaeological survey and limited test excavation (see Anderton et al. 1991; Dunham and Branstner 1998; Dunham and Hambacher 2002; Dunham et al. 2010; Franzen 1987); and 2) preservation of floral and faunal remains is typically poor in the region due to acidic soils and slow rates of soil development. There are exceptions to these trends. Sites that have had larger scale excavation and include floral and faunal remains (e.g., the Juntunen site [McPherron 1967; see also Cleland 1966; Yarnell 1964]). However in many cases the archaeological data are limited to lithic and ceramic assemblages. Thus, there are archaeological site locations without much corresponding information on the resources that were being used at these sites.

Some have approached the incongruity between Late Woodland site locations and subsistence in northern Michigan through models derived from environmental analyses coupled with ethnographic and ethnohistoric sources (see Cleland 1966, 1982, 1992a, 1992b; Dunham 2000a; Fitting and Cleland 1969; Franzen 1986; Holman 1978; B. A. Smith 1996; Yarnell 1964). The working assumption is that Native Americans in the historic period were interacting with environments broadly similar to those that Late Woodland people operated in and they were likely using the same subsistence resources (Franzen 1986; Holman 1978; Holman and Krist 2001; Holman and Lovis 2008; S. Martin 1985). The known pattern of seasonal and interseasonal mobility also demonstrates that Late Woodland people had the opportunity to access and use a wide variety of plant and animal resources across the landscape in addition to spring and fall spawning fish.

While the proposed study is geographically specific to the eastern UP, it is understood that more than one settlement and subsistence strategy may be present both spatially as well as temporally (inter-annually, intra-annually, etc.) in this region. Archaeological data suggest that there may be multiple cultural traditions/ethnic identities in the eastern UP (Figure 2). In the early Late Woodland period (ca. AD 600 to AD 1000) the ceramic assemblages are culturally more western oriented (Brose 1970; Dorothy 1980; McPherron 1967). In the Straits of Mackinac and northern Lake Huron basin ceramic trends follow the sequence derived from the Juntunen site where the more westerly influences of the early Late Woodland period are subsumed by more eastern, Ontario Iroquoian-like, influence during the later Late Woodland (McPherron 1967). The presence of Oneota wares in the Bay de Noc region suggests that this region is part of a different cultural system than the Straits by the late Late Woodland period (Brose 1970; Buckmaster 1979; Dunham and Hambacher 2002). The late Late Woodland assemblages along the south shore of Lake Superior include Sand Point, Oneota, and/or Juntunen related wares linking them to the east, west, and south (Dorothy 1980; Drake and Dunham 2004; Dunham and Branstner 1995; Dunham and Hambacher 2007; Dunham et al. 2010). Such patterns may reflect indicators of identity (e.g., tribal identity) and territoriality (see O'Shea and Mc-Hale-Milner 2002).

Other potential indications of cultural differences may be reflected in the relative size of sites, with potentially more nucleated sites (i.e. more constrained and denser occupations indicating focused spatial use) being located in the Straits of Mackinac and Bay De Noc regions and more dispersed settlement locales being utilized along the south shore of Lake Superior (Brose 1970; Drake and Dunham 2004; Dunham 2002; Lovis and Holman 1976; McPherron 1967). Further, the use of interior locations is significantly higher in the Bay de Noc region than either the Straits of Mackinac or Lake Superior regions (Dunham 2002).

Likewise, subsistence technology varied through the Late Woodland. A recent reevaluation of the data relevant to the fall fishery found that the increased reliance on fall spawning whitefish and lake trout began to appear around AD 800 at the Juntunen site, but after AD 1100 in northern Lake Michigan basin and as late as AD 1400 in the rest of the Upper Great Lakes region (B. A. Smith 2004). The geographically closest direct evidence for maize horticulture in the Late Woodland period comes from the Menominee River in the southern portion of the Bay de Noc region with directly dated maize cupules and a ridged field complex from about AD 1400 (Buckmaster 2004). These examples further illustrate the need to reassess our understanding of Late Woodland settlement and subsistence strategies.

In addition to archaeological data, there is a significant body of paleoenvironmental data for the eastern UP that includes studies of lake level variability and dune formation over the past two millennia (Anderton 1993; Baedke and Thompson 2000; Loope et al. 2004; Lovis et al. 2012); paleoclimatic data reflecting temperature variation (e.g., Medieval Climatic Optimum and Little Ice Age) and precipitation (Bernabo 1981; Booth et al. 2004; Delcourt et al. 2002); and paleoenvironmental data including long term pollen trends and pre-European settlement land cover (see Albert and Comer 2008; Bourdo 1954; Brubaker 1975; Davis et al. 2000; Delcourt and Delcourt 1996; Futyma 1982; Price 1994; Woods and Davis 1989; Zhang et al. 2000). Additionally, a recent study has found that taphonomic processes may have led to better preservation of archaeological sites in certain coastal zones around AD 1000 (Lovis, Monaghan et al. 2012). If this is the case, how might these better preserved sites enhance and/or skew our understanding of coastal settlement and subsistence dynamics in the middle part of the Late Woodland? Studies such as these, that explore the dynamic nature of the environmental context of the eastern UP during the Late Woodland period, are critical to this research.

The questions of whether, why, and how cultural and/or environmental changes occur fit well within the application framework of Resilience Theory. Multiple adaptive cycles seem to converge over the first half of the Late Woodland period (ca. AD 600 to AD 1100) (see Chapter 1.3; see also Figure 2). These include technological, social, and organizational changes as well as climatic and associated environmental changes each of which have the potential to affect multiple variables. Each of these changes may represent the completion of an adaptive cycle from the perspective of Resilience Theory (Redman 2005; Redman and Kinzig 2003; Walker et al. 2006). Resilience Theory, therefore, will serve as a useful heuristic framework for this project.

2.3 Background Discussion

The purpose of this chapter was to provide an overview of the environmental background and cultural setting for the research conducted in this dissertation. To summarize the cultural background, the existing models of Woodland settlement and subsistence in the eastern UP relate that Middle Woodland peoples (AD 1 - AD 600) were likely more residentially mobile than their

Late Woodland descendants and had a broader diet breadth (Brashler et al. 2000; Brose and Hambacher 1999; Cleland 1983; S. Martin 1985). As Late Woodland peoples (AD 600 – AD 1600) expanded their technological capabilities and became more reliant on seasonally abundant aquatic resources, specifically the integration of and intensification of the fall fishery into the subsistence round, they became more territorially constrained, more subsistence focused, and more socially integrated/organized at different scales (Cleland 1982, 1992a; Holman and Lovis 2008; McHale-Milner 1991, 1998; O'Shea and McHale-Milner 2002). It is unclear precisely when these changes occurred, but they appear to have taken place between AD 900 and AD 1100. The changes towards more circumscribed territories, more focused subsistence, and greater social organization can be seen throughout the Midwest, and the Eastern Woodlands, during the Late Woodland period (Brashler et al. 2000; Mason 1981; McElrath et al. 2000; McHale-Milner 1991; Seeman and Dancey 2000).

This dissertation revisits the topic of settlement patterns and subsistence practices in the Late Woodland period of the eastern UP and evaluated it against the body of data generated over the past 25 years. New data suggests that the dominant settlement and subsistence model is incomplete, lacks explanatory value, and requires revision. This study tests the hypothesis that a suite of potential resources was both present and utilized, allowing for a more flexible set of strategies, i.e. it is not based on a single primary resource (the fall fishery). Archaeological evidence, ethnographic data, and pilot study results reveal that acorns, maize, and wild rice are likely resources to be incorporated into such a strategy; all can be harvested and stored in the late summer or fall as a buffer against a poor fish harvest. Each, however, also has spatial, environmental, and temporal constraints with implications bearing on archaeological site locations as well as the evidence from the sites themselves.

The next two chapters explore these topics. Chapter 3 will explore the material remains recovered from Late Woodland sites in an attempt to glean if these sites were used for different purposes. Chapter 4 will examine the spatial distribution of the sites to determine if the sites were spatially proximate to particular resources. The Late Woodland period can be easily divided into two sub-periods as outlined above: an early Late Woodland (ca. AD 600 to AD 1000) and a late Late Woodland (ca. AD 1000 to AD 1600). The analyses carried out in Chapters 3 and 4 will consider the temporal variable (early and late Late Woodland) as well as broader geographic distribution in regard to settlement and subsistence patterns. Environmental data will be integrated into the discussion as yet another variable in understanding these trends.

3.0 ARCHAEOLOGICAL ASSEMBLAGES

The following chapter will provide a review and synthesis of the available archaeological data for Late Woodland sites in the eastern UP. The review relied on previously completed studies and includes published and unpublished sources including technical reports comprising the so-called “gray literature” (see Seymour 2010). As noted in Chapter 1, the eastern UP is defined as Alger, Chippewa, Delta, Luce, Mackinac, and Schoolcraft Counties (see Figure 1). That definition is, in part, an outcome of the organization of the archaeological site files at the Michigan State Historic Preservation Office (SHPO).

There are two LW data sets that are used in this study. The previously cited pilot studies (particularly Dunham 2002; 2009), identified some 76 archaeological sites in the eastern UP with at least one LW component. The current study has expanded this number to include 81 archaeological sites that include LW components that are listed in the archaeological site atlases and files at the SHPO and the Hiawatha National Forest (HNF) (Figure 4; Appendix B). The first data set includes 48 archaeological sites with Late Woodland components that have been discovered through archaeological survey on the HNF. The second, including 33 archaeological sites with Late Woodland components, is the balance of the 81 sites identified. The HNF set were discovered through relatively consistent survey methods (see Franzen 1986; Anderton et al. 1991; Dunham and Branstner 1998; Dunham et al. 2010; Rutter and Weir 1985), whereas the remaining sites have been identified in a variety of ways including formal survey, informant sources, etc.

The available reporting was reviewed for each of the LW sites in the eastern UP. The archaeological site data were summarized in tabular form to establish a format to compare the

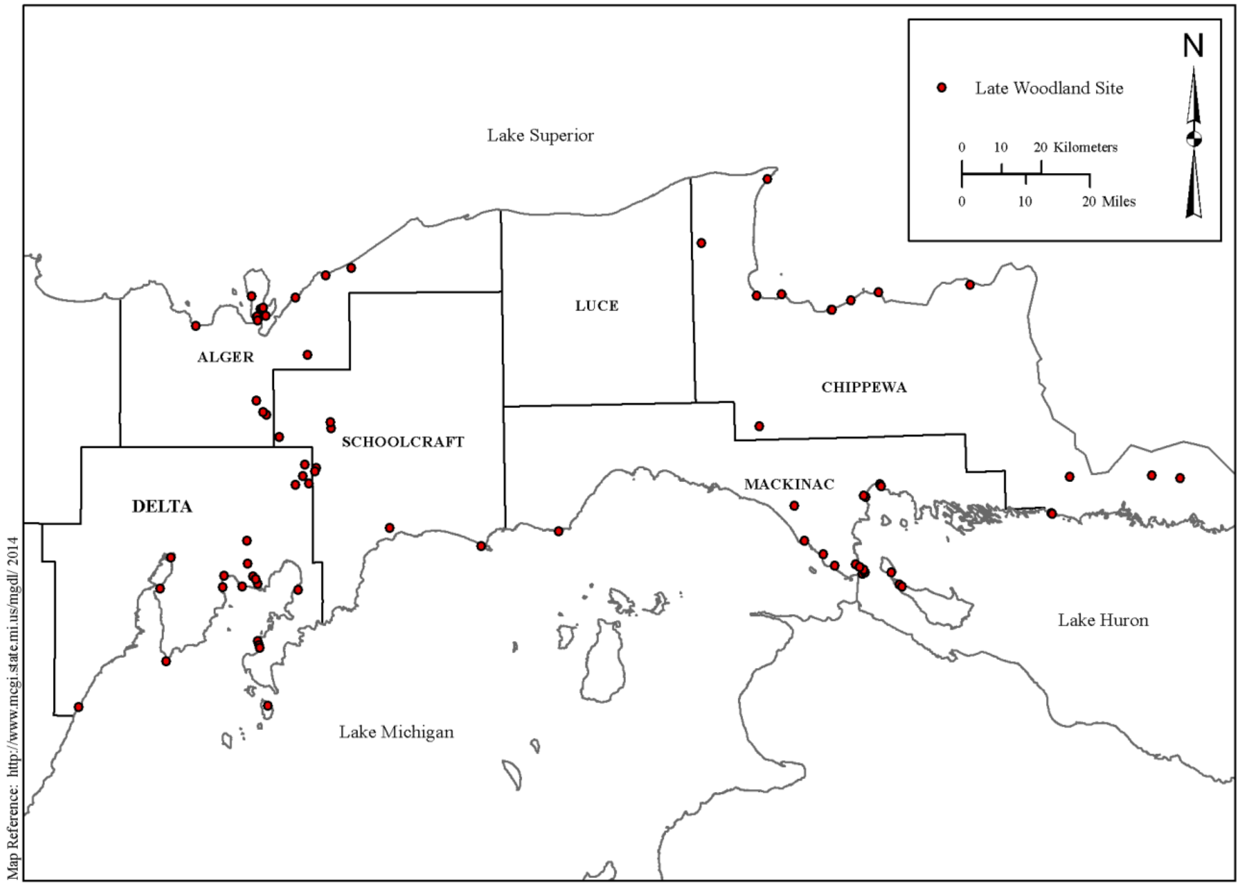


Figure 4: Locations of the 81 Late Woodland Archaeological Sites.

characteristics of each assemblage (Appendices B - I). This information includes, where possible, the site designation (number), site location (UTM coordinates), estimated size of the site (square meters [m²]), whether the site is known from survey or excavation, the number of components (single or multiple), and how much of the site has been excavated (m²).

Information was also collected on the LW assemblages at each site including: the chipped stone assemblage; ground stone tools; fire-cracked rock (FCR); ceramics; floral remains; faunal remains; features (Appendix B); and chronometric dates (Appendix B). The way that the individual assemblages were analyzed, coded, and recorded varied, so the terminology and techniques were not consistent. The analyses as presented by the original researchers were maintained and no new analyses of the artifact assemblages were conducted.

In some cases it was possible to reorganize data presented in these reports to better address the needs of this study. An attempt was made to present only the LW component of multicomponent sites, such as at the Bark Dock site (20CH95), which includes Middle Woodland and LW components (Dunham and Hambacher 2007) and Gete Odena site (20AR348) which includes Archaic, Middle Woodland and Historic components in addition to a LW component (Dunham and Branstner 1995; Robinson et al 1991; Skibo et al. 2004) (Appendix C). Likewise, when multiple LW components were present on a site, an attempt was made to differentiate them as separate components as well (e.g., the Juntunen and Summer Island sites [Brose 1970; McPherron 1967]). This was not always possible and depended on the reporting of the site. As a result, a small number of sites (n=7) were characterized as LW locales based on the recovery of LW artifacts, but where the LW component could not be differentiated from other components on the site (e.g., the palimpsest effect [see Bailey 2007]) (see Appendices B and C). In at least one case, 20AR338, the results of the analyses are ongoing and specific assemblage composition pertaining to the LW component of the site is not yet available (see Drake et al. 2009; Dunham et al. 1997; Skibo et al. 2009).

The data from the LW components has the potential to more fully elucidate subsistence resources used, site function, seasonality of use, and social relationships among other things. The quality of data ranges significantly from site to site in this sample. The information available for each site is variable as a result of the different level of investigation at each site. The data are derived from archaeological survey, small excavations, and larger excavations. As a result, it is not possible to classify the function, seasonality, or precise age of many of the sites.

3.1 Chipped and Ground Stone Artifacts

3.1.1 *Chipped Stone Tools*

For chipped stone artifacts, information was recorded for formal tools (such as projectile points, bifaces, and scrapers) and informal tools (retouched and edge damaged flakes), as well as debitage (flakes) (Appendix D). Where possible, the formal tools were typed following their original recordation. Debitage was minimally recorded by count. When reduction stage and raw material type were identified, this information was also recorded.

Nine hundred and seventy nine of the chipped stone artifacts are classified as formal tools and 919 as expedient tools. Expedient tools account for 48.4 percent of all the chipped stone tools. The remainder of this discussion will focus on formal chipped stone tools. Formal chipped stone tools were recovered from 54 LW sites or components (Appendix D). The Juntunen site (20MK1) produced the highest number of formal chipped stone tools (n=440), but only 161 could be securely placed in the three primary components (The Mackinaw, Bois Blanc, and Juntunen Phases). The Juntunen and Mackinac Phases of the Juntunen site (20MK1), along with the proto-historic component at the Summer Island site (20DE4) produced the highest number of chipped stone tools (n=70, 63, and 61, respectively) and fifteen LW sites produced only a single chipped stone tool.

The formal tools fall into five primary categories: projectile points; scrapers (end, side, and unspecified); bifaces; drills; and knives. Bifaces are characterized by the presence of retouch on both faces of the tool, but cannot be classified as another category, such as projectile points. Projectile points are the best represented formal tool type, appearing on 39 LW sites. Scrapers were recovered from 37 sites, but were not uniformly classified in the various reports. End scrapers were recorded on 31 sites and side scrapers on 11. Unspecified scrapers were recorded from six components including all the scrapers (n=245) from the Juntunen site. Thirty sites included bifaces. Four sites produced drills and one site a knife. The knife might be better classified as a biface, but the reporting was not clear enough to make this consclusion.

The various tool classifications can provide insight into tool function, although a given tool may be used for a wider variety of ways than these baseline attributions (Kooyman 2000). Projectile points are most commonly associated with hunting activity, so their presence on a site is indicative of hunting. Scrapers were mostly used for hide preparation, but may have had numerous other uses during their use life prior to discard. The presence of scrapers on a site reflects the processing of animals. Drills were used to perforate things and are usually associated with perforating harder objects. Bifaces may encompass cutting tools, chopping tools, or unfinished tools.

In many contexts, projectile points are a useful temporal indicator for dating archaeological sites or components of archaeological sites (see Justice 1987). Unfortunately, this is not always the case in the eastern UP. Triangular projectile points, sometimes broadly referred to as Madison points, are diagnostic of the Late Woodland period in the region and their presence on a given site or component is sufficient to define LW activity (Brose 1970; Fitting 1975a; Janzen 1968; McPherron 1967). Another form that is diagnostic to the LW is small flake points known as Juntunen points (McPherron 1967). Other points found in LW contexts are stemmed, side notched, or corner notched, characteristics which also appear in earlier Middle Woodland or Archaic assemblages (Brose 1970; Cleland and Peske 1968; Janzen 1968; McPherron 1967). For this discussion, points were classified as single tool type and were only used to designate the relative age of a site (LW) if the point(s) were triangular or so-called Juntunen flake points.

3.1.2 *Chipped Stone Debitage*

Fifty six of the LW components considered in this study produced debitage that are considered in this study (Appendix D). Four additional sites produced no debitage. The debitage assemblage of 21 of the LW sites cannot be formally discussed for a variety of reasons.

The LW components that produced debitage ranged in counts from a single flake (20CH433) to 14,900 flakes at the proto-historic component at the Summer Island site (20DE4). The sites that produced debitage had a mean count of 816.3 flakes and a median count of 140.5 flakes. Only eight sites exceeded the mean count, and the standard deviation is 2468.2, demonstrating the range and disparity in the assemblage sizes.

Raw material was documented at 41 of the sites (Appendix D). A recent study of the raw material composition of debitage has demonstrated a relationship between raw material type and the relative age of coastal archaeological sites in the Munising Bay area (Drake et al. 2009). Based on this study, Archaic sites typically include 70 percent or more quartzite in their lithic assemblage, whereas Woodland sites include less than 30 percent quartzite. The proportion of quartzite on multicomponent sites (Archaic and Woodland) falls between 30 and 70 percent. In fact, site 20AR338 which is explored in Drake et al.'s (2009) study illustrates the complexity of extrapolating site age from the raw material composition of multicomponent sites. It is not clear if this model holds true for interior sites or other geographic locales in the UP.

Chert comprised over 60 percent of the debitage assemblage on 32 of the 41 sites (78 percent of the sites where raw material was documented) and quartz was the best represented raw material (over 40 percent of the debitage) on three sites, all of which are on Grand Island (20AR348, 20AR353, and 20AR495). Quartzite was the most common (over 60 percent of the debitage) raw material at four sites (9.8 percent of the sites). Two of these sites are on Grand

Island (20AR359 and 20AR400) and the other two (20DE459 and 20ST227) are located in the Indian River drainage. Three of the four sites are known to be multicomponent (20AR359, 20AR400, and 20DE459). The results of this experiment suggest that Drake et al.'s (2009) model may have application for sites outside the Munising Bay region

The reduction sequence of the debitage is recorded for only 15 LW sites, each of these are on HNF lands (Appendix D). The first or primary stage of stone tool production is related to the initial testing of raw material and the earliest stages of core preparation. The secondary or middle stage of chipped stone tool production is typically associated with the manufacture of usable flakes and tool blanks as well as the early stages of bifacial reduction. The final stage is most closely associated with the later stages of core production, tool manufacture, tool maintenance. Thus the reduction sequence can provide insight into the activities carried out on a site (Robertson 1993). Sites with a balance of reduction stages were involved with all tool preparation activities, whereas sites where one activity is overwhelming present may reflect that stage of tool preparation and manufacture.

Two sites (20AR437 and 20MK261) have the highest percentage of late/final stage reduction indicating that finishing and maintaining tools was an important activity, though not the only activity, on these sites. Two sites (20AR398 and 20MK334) have the highest percentage of the first stage of reduction suggesting that the initial stages of tool production was an important activity on these sites. In fact, all the debitage from 20MK334 was from the initial stage of testing and reduction. The second stage of production was the best represented type on the remainder of the sites. Interestingly, 20MK261 and 20MK334 are situated proximate to one another at the mouth of the Carp River in Mackinac County and possibly reflect two spatially distinct activity areas of the same site.

3.1.3 *Ground Stone Tools*

One hundred and nineteen ground stone tools were collected at 24 LW sites or components (Appendix D). The Juntunen site (20MK1) produced 31 ground stone tools, but only seven could be securely placed in the three primary components (The Mackinaw, Bois Blanc, and Juntunen Phases). The Scott Point site (20MK22) had 25 ground stone tools and eight sites had a single ground stone tool.

The ground stone tool assemblages can be placed in nine functional categories or types as well as an unclassified category. Hammer stones are the most common ground stone tool appearing on 16 sites. Anvil stones and celts each appear on six sites and manos (grinding stones) and net sinkers each appear on four sites. The remaining categories only appear on one or two sites including: abraders (n=1); pestles (n=2); an adze (n=1); a piece of drilled slate (n=1), and unclassified ground stone (n=2). The adze was found at the Juntunen site, but could not be assigned to a specific component.

Hammer stones and anvils were likely used in chipped stone tool production, but could also be used in food processing (cracking animal bone or nuts). Net sinkers were used in fishing. Manos and pestles could be used in food processing as well as grinding other materials. The celts and the adze were likely used for woodworking and/or chopping, but other functions are possible.

3.2 Late Woodland Ceramics

Ceramics were recovered from 68 LW sites in the eastern UP (Appendix E). Sixty nine components will be directly discussed here – two components at the Summer Island site (20DE4) are presented in such a way that they can be presented as separate components, whereas elements of some of the other sites, namely Juntunen (20MK1), Scott Point (20MK22), Cloudman (20CH6), and 20MK169/457, are each multicomponent, but the details on the ceramics and individual components is not clear enough to address the components separately in this instance (Branstner 1995; Brose 1970; McHale-Milner 1998; McPherron 1967). The Juntunen site is especially frustrating in that primary ceramic types (Mackinac, Bois Blanc, and Juntunen wares) can be attributed to a component, but other varieties are not quantified in relation to specific components (McPherron 1967). Seven of the sites have not produced any ceramics and another six either include or likely include LW ceramics, but are either not well reported (or still being reported on) or are sites with multiple components where the best studied component is not LW (e.g., the Naomikong Point site [Janzen 1968]).

The 69 LW components include a minimum number of 2,308 ceramic vessels (MNV). The overwhelming majority of these, 1,656 (71.9 percent), are from the Juntunen site (20MK1) (McPherron 1967). The remaining 652 vessels were recovered from the remaining 68 LW components. Thirty sites include a single vessel and two sites, aside from the Juntunen site, include LW MNV counts of over 100 (n=136 at Cloudman [20CH6] and n=195 at Scott Point [20MK22]).

As many as 29 broad typological classifications are represented with most sites including one or two varieties and two sites, Juntunen (20MK1) and Getewaaking (20MK169/457), with 11 and 13 types respectively. The best represented ceramic types are Oneota-related wares (present on 21 sites), Juntunen wares (n=17 sites), Mackinac wares (n=15 sites), Sand Point wares (n= 8 sites), Bois Blanc wares (n=7 sites), and Iroquoian-related wares (n=6 sites). Untypeable miniature vessels were recorded from six sites. For this discussion, an additional category of “Wisconsinoid” ceramics was created subsuming early LW types best represented in Wisconsin into a single category (Madison wares, Point Sauble wares, and Heins Creek wares). The Wisconsinoid types appear on four sites.

There are some geographic trends associated with the ceramics (Figures 5 and 6). When the ceramics are considered from a north/south perspective, there are 29 northern sites and 40 southern sites (42 percent and 58 percent respectively). Sand Point wares are more likely to appear on northern sites, whereas Oneota-like, Bois Blanc, and Mackinac wares as well as Miniature vessels are better represented in the south. The distribution of Juntunen and Wisconsinoid ceramics are similar to the proportion of northern and southern sites. When considered from an east/west perspective (32 eastern sites [46 percent] and 37 western sites [54 percent]), Sand Point and Wisconsinoid wares are better represented on western sites and the other varieties are more easterly oriented. Bois Blanc and Mackinac wares are both strongly associated with sites in the east.

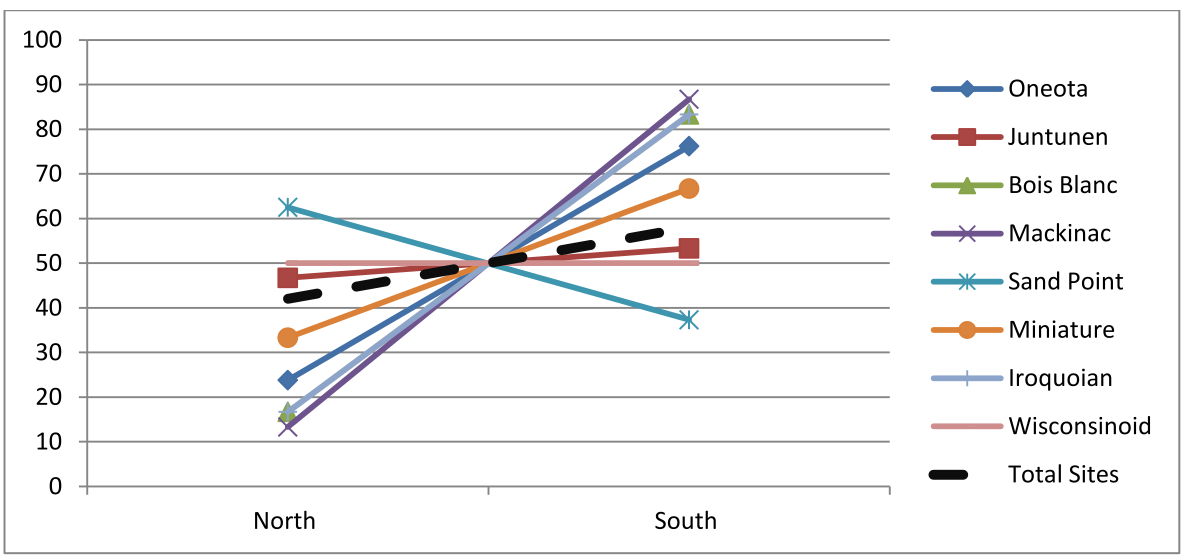


Figure 5: Percentage of ceramics by type (North/South).

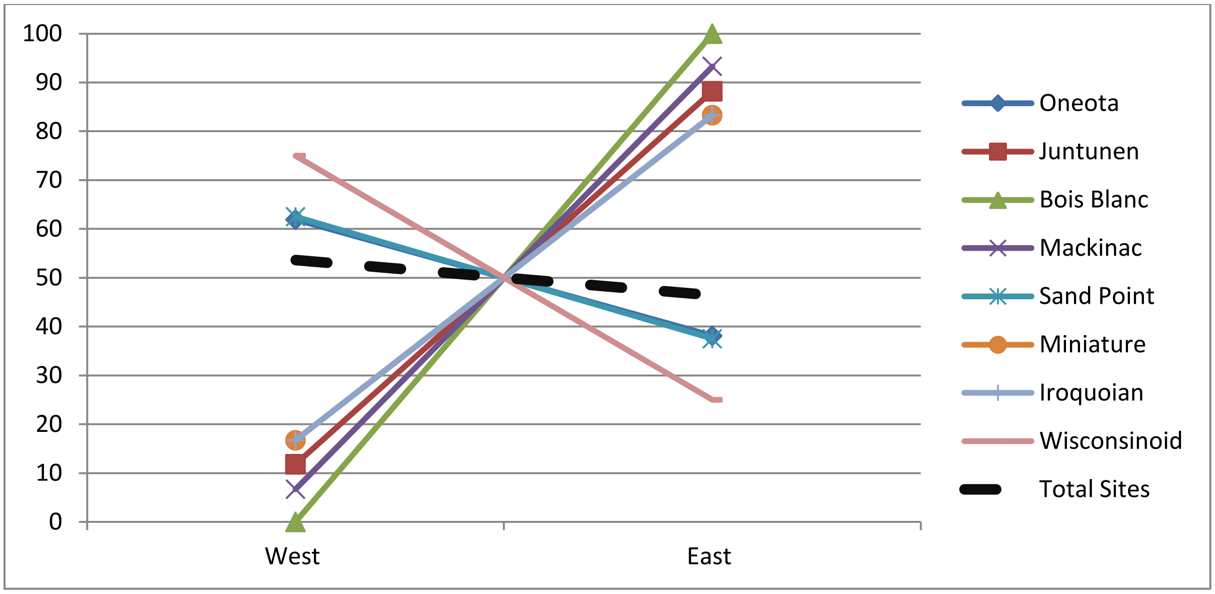


Figure 6: Percentage of ceramics by type (East/West).

Temporal trends are also apparent. The best represented ceramic types can be lumped into early LW (~AD 600 to AD 1000) and late LW groups (~AD 1000 to AD 1600). For example, Mackinac wares and Wisconsinoid wares are early LW types, whereas Oneota, Juntunen, Bois Blanc, Sand Point, and Iroquoian-related wares are late LW (Brose 1970; Dorothy 1980; Mason 1981; McHale-Milner 1998; McPherron 1967). Eighteen sites include early LW ceramics and 37 components include late LW ceramics. Early LW sites are better represented in the south and the east than the north or west (Figures 7 and 8). The spatial distribution of late LW sites is proportionally similar to the distribution of LW sites in general. This pattern suggests that early LW sites may have been focused on areas in the southeastern part of the UP, such as the Straits of Mackinac, and that late LW sites were more evenly distributed across the eastern UP.

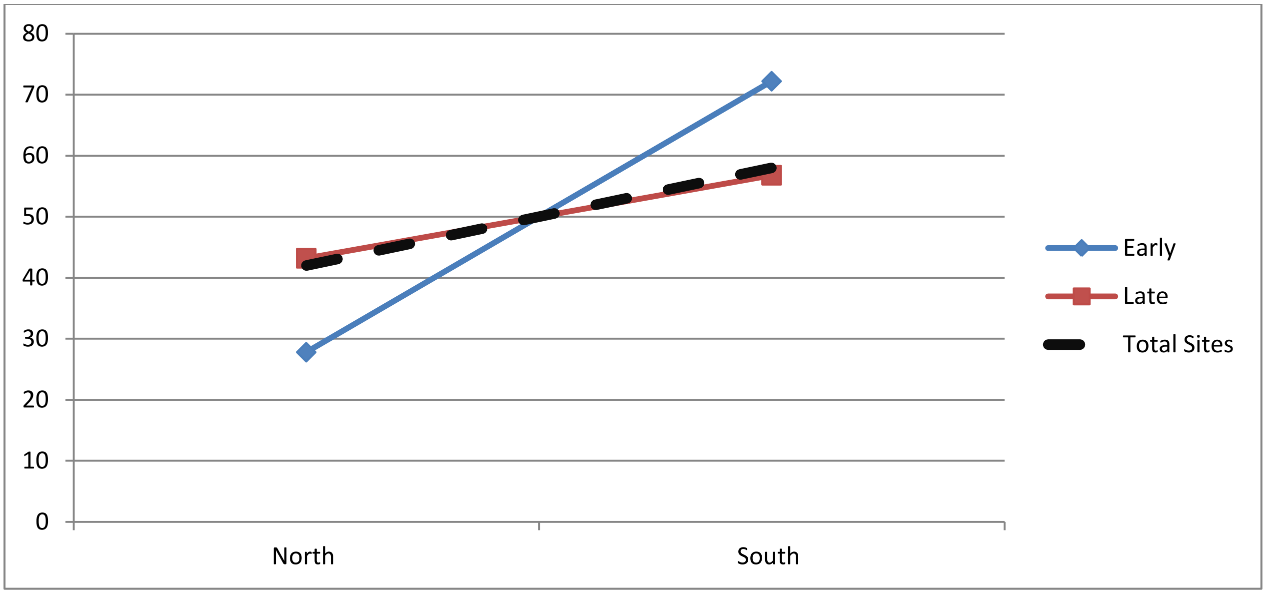


Figure 7: Percentage of ceramics by age (North/South).

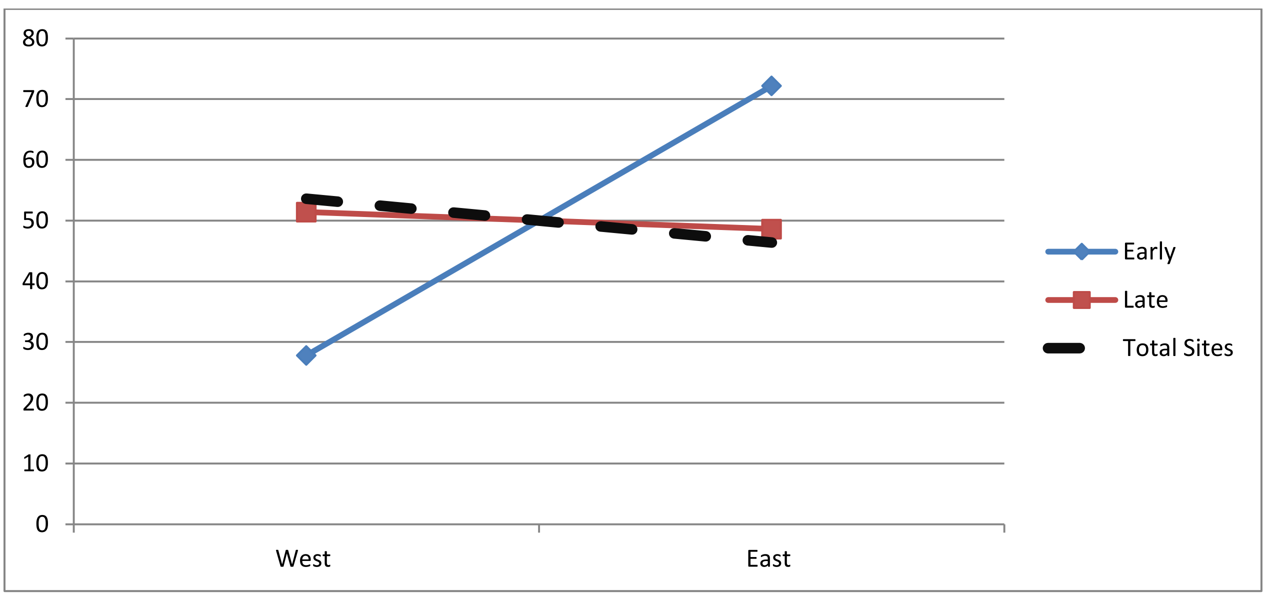


Figure 8: Percentage of ceramics by age (East/West).

3.3 Other Artifact Classes

In addition to the artifacts discussed above, a small number of sites included artifacts made of different raw material types (bone and copper) as well as artifacts that were not used for subsistence, tool maintenance, or other economic purposes such as pipes and beads (Appendix F).

Pipes have been found at 11 LW sites/components (98 pipes and pipe fragments) including all LW contexts at the Juntunen site. Pipes were made from clay (ten sites) and stone (two sites) with one of the sites having both stone and clay pipes (20ST1). The Juntunen site includes 65 pipes with ten associated with the Mackinac component, seven with the Bois Blanc component, and nine with the Juntunen component. The remaining 39 could not be placed into a specific component. The Getewaaking site (20MK169/457) produced two pipes. As mentioned above, the Ekdahl-Goudreau site (20ST1) produced both clay and stone pipes, but counts are not readily available. The remaining sites produced a single pipe or pipe fragment.

Copper artifacts were recovered from nine LW sites/components (141 artifacts) including all LW contexts of the Juntunen site. Awls are the most common copper tool (n=66) and appear on the most components (n=4). Copper beads and copper knives have been found at two sites. The remaining sites have produced cones/projectile points (n=1), an effigy (n=1), a pin (n=1), a ring (n=1), and a site with copper fragments.

Bone tools have been found at six LW sites/components (179 artifacts) including all LW contexts at the Juntunen site. The Cloudman site (20CH6) and the Oneota/LW component of the Summer Island site (20DE4) are the only other sites to produce bone artifacts. Like copper, bone awls are the best represented tool type appearing on five LW sites (117 artifacts). Bone harpoons have been found at four LW sites and projectile points at two sites. Needles, including netting needles, have been found at two LW sites. Chisels and bone tubes have each been found at one LW site.

3.4 Diversity Use Index

An underlying goal of this study is to determine if LW sites were used for different purposes. One way to assess that question is through the material remains found at those sites. As we have discussed, there is a range of materials found at LW sites in the eastern UP. The scale and types of investigation at the sites, as well as the nature of the sites themselves, have led to a disparate and diverse range of assemblages. The relatively high proportion (about a third) of known LW sites which had only been explored through archaeological survey or limited test excavation (10 m^2 or less [another third]) placed constraints on the interpretation of site function (Appendix B).

The number and diversity of the artifact assemblages on the LW sites in the eastern UP led to the adoption of a diversity use index (DUI; see Kvamme 1985). The index is based on the assumption that different tools are used for different activities and that a greater diversity of tools on a given site would reflect a greater range of activities. Conversely, a lack of tool diversity on a given site could suggest a more limited range in activities. In a sense, the DUI is a simple delineation addressing a greater or lesser range of activities on a site may help differentiate how that site was used. This approach helped smooth the disparate data sets making it more approachable, minimize bias, and facilitate interpretation.

Binford (1980) has conceptualized a framework to help understand hunter-gatherer settlement and subsistence strategies as well as how one might think about archaeological site formation resulting from these practices (see also Binford 1983). This model characterized *foragers* as residentially mobile and *collectors* as logistically mobile, but Binford (1980:12) states "… we are not talking about two polar types of settlement-subsistence systems, instead we are discussing a graded series … ." Residential mobility refers to the movement of an entire group from one location to another in pursuit of resources, whereas logistical mobility entails smaller groups leaving and returning to a residential camp with resources (see also Holman and Lovis 2008; Kelly 1992; Lovis et al. 2005; Whallon 2006). An expectation of such a system would be that one might observe a greater diversity of activity at a residential camp and a lesser degree of activities carried out at a logistical camp.

The DUI used in this study was calculated by multiplying the number of formal tools by the number of morphological types. The tool categories included chipped stone tools, ground stone tools, and ceramics (MNV). The resulting score for each site/component was used as a scale to estimate the diversity of activities on each site (Appendix G). A high score reflects a greater number and/or variety of tools, and a low score indicates the opposite. A greater number and variety of tools is interpreted to represent a greater range and diversity of activities. The DUI scores ranged from a score of one, for multiple sites, to a high of 3,024 for the Mackinac Phase component of the Juntunen site (20MK1). The mean of the DUI spread is 153.3 and the standard deviation 458.9.

An important caveat to this approach was discovered based on the different scales of excavation on the individual sites. A correlation was noted between the amount of excavation and the DUI score. Sites with higher scores typically had more excavation than sites with a low DUI score (Correlation Coefficient [r] = 0.79). In other words, more excavation is directly related to higher scores (e.g., Kintigh 1984). The Mackinac Phase component of the Juntunen site, for example, included over 400 square meters of excavation and produced the highest score (DUI=3,024). Conversely, many of the sites that produced a DUI score of one were known only from archaeological survey and included less than one square meter of excavation (Appendices B and G).

In an attempt to correct the DUI scores for the scale of excavation, the DUI score was divided by the number of square meters excavated on a given site (DUIrev). In cases where the site was known based on survey with a small number of shovel tests or limited surface collection, a minimum of one square meter was used to calculate the scale of excavation. This method effectively reduced the correlation ($r = 0.25$). The DUIrev scores range from one, for multiple sites, to a high of 46.5 at 20MK90 (Appendix G). The mean of the DUIrev spread is 5.2 and the standard deviation 7.7. Site 20MK90 produced an original DUI score of 108, but only included about 2.3 square meters of excavation. The DUI score of the Mackinac component on the Juntunen site dropped from 3,024 to a DUIrev score of 6.9 because of the 441 square meters of excavation.

The DUIrev score appears to address the relationship between more excavation and higher DUI score. It creates a mean DUI and this is a useful measure for comparing sites. A higher DUIrev might indicate a more intensive occupation with more activities (a higher range of diversity per square meter of excavation), where as a lower DUIrev might indicate less activity. However, it doesn't address the relationship between the spatial extent, or size, of a site and the potential DUI. It is possible that the same number of tasks and a comparable level of diversity might be dispersed across a larger site area. In this instance, a larger area of excavation would be required to recover the same range of activity. For example, the Juntunen site is much larger (7432 m^2) than site 20MK90 (500 m^2). Less than one percent of site 20MK90 and only about 6 percent of the Juntunen site have been excavated (the mean amount of excavation for all the LW sites in the eastern UP is 1.6 percent). The relatively low volume of excavation compared to the spatial extent of each site raises the question as to whether the DUIrev score reflects the density/intensity of occupation of the entire site or only that of the portion sampled.

The DUI and DUIrev scores were compared with the estimated spatial area of the sites (m^2) to explore this question (see Appendices B and G). Four sites that produced DUI scores did not have estimated horizontal sizes (20DE17, 20MK3/11, 20MK53, and 20MK239). Each of these sites had low DUI scores (≤ 5). The DUI scores had a weak correlation with site size ($r = 0.37$), and the DUIrev scores had virtually no relationship with site size ($r = 0.04$). This exercise suggests that the horizontal extent of a site isn't necessarily a factor in the assemblage diversity.

The two scales (DUI and DUIrev) were plotted against one another on a scatter plot graph (Figure 9). Additionally, the mean of each set was calculated and three DUI categories were established. The nine LW components (11.8 percent) that exceeded the mean in both scales were characterized as having a high level of, or extended, diversity. Those components that exceeded the mean in only one set or the other were classified as having intermediate diversity (19 components [25 percent]). The remaining 48 LW components (63.2 percent) that did not exceed the mean in either category were classified as having limited diversity.

The DUI categories presented above identify LW sites as having extended diversity, intermediate diversity, or limited diversity in their assemblages. The sites with extended diversity most likely represent residential sites. Residential sites would be expected to have a longer duration of occupancy as well as larger populations that include mixed gender and age groups that are involved with a wider number of activities (Binford 1980; 1983). Intermediate diversity sites could also represent residential sites, albeit with a smaller population or shorter occupation, or a logistical camp. Logistical camps are used for specialized purposes, by a potential age and/or gender exclusive group, for a shorter period of time (Binford 1980; 1983). In some instances, the same logistical camp location might be reoccupied and used by the same

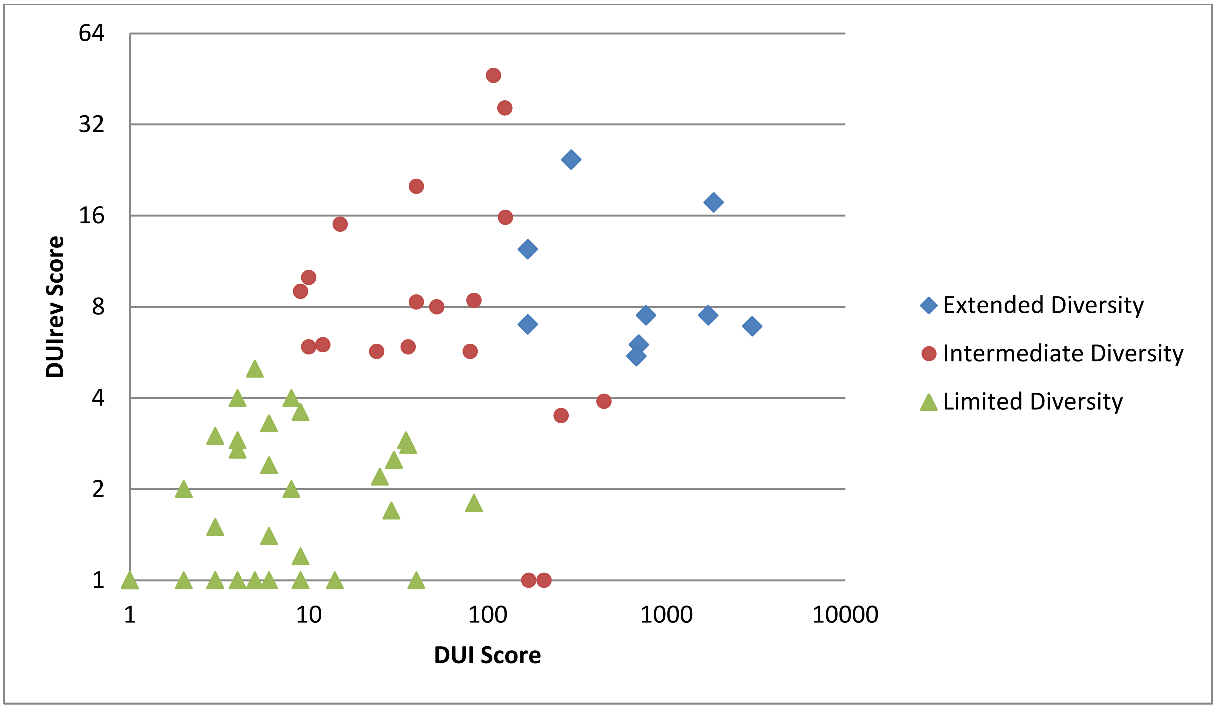


Figure 9: Scatter Plot DUI and DUIrev scores.

group over multiple seasons or years for the same or different logistic activities. Finally, LW sites with limited diversity likely represent logistical camps, although sites known from limited excavation or as a result of archaeological survey may reflect limited diversity as a result of the small sample size.

Not surprisingly, the nine sites with extended diversity have each been more extensively studied and include: the three main components of the Juntunen site (20MK1) (McPherron 1967); the protohistoric component of the Summer Island site (20DE4) (Brose 1970); the Cloudman site (20CH6) (Branstner 1995); the Scott Point site (20MK22); the Bark Dock site (20CH95) (Dunham and Hambacher 2007); the Gete Odena site (20AR348) (Dunham and Branstner 1995; Robinson et al. 1991; Skibo et al. 2004); and the Carp River site (20MK261) (Dunham et al. 1993). There is little question that each of these sites can be characterized as places where many activities were carried out by LW people.

The extended diversity sites are also geographically dispersed and all are in coastal settings (Figure 10; see also Figure 9). The Juntunen and Carp River sites are in the Straits of Mackinac area on Lake Huron. The Cloudman site is on Drummond Island near the head of Lake Huron. The Summer Island site is located in Bay de Noc in Lake Michigan. The Scott Point site is situated between Summer Island and the Straits of Mackinac on the Lake Michigan shore. Gete Odena is on Grand Island in Lake Superior. Bark Dock is on Lake Superior on Whitefish Bay.

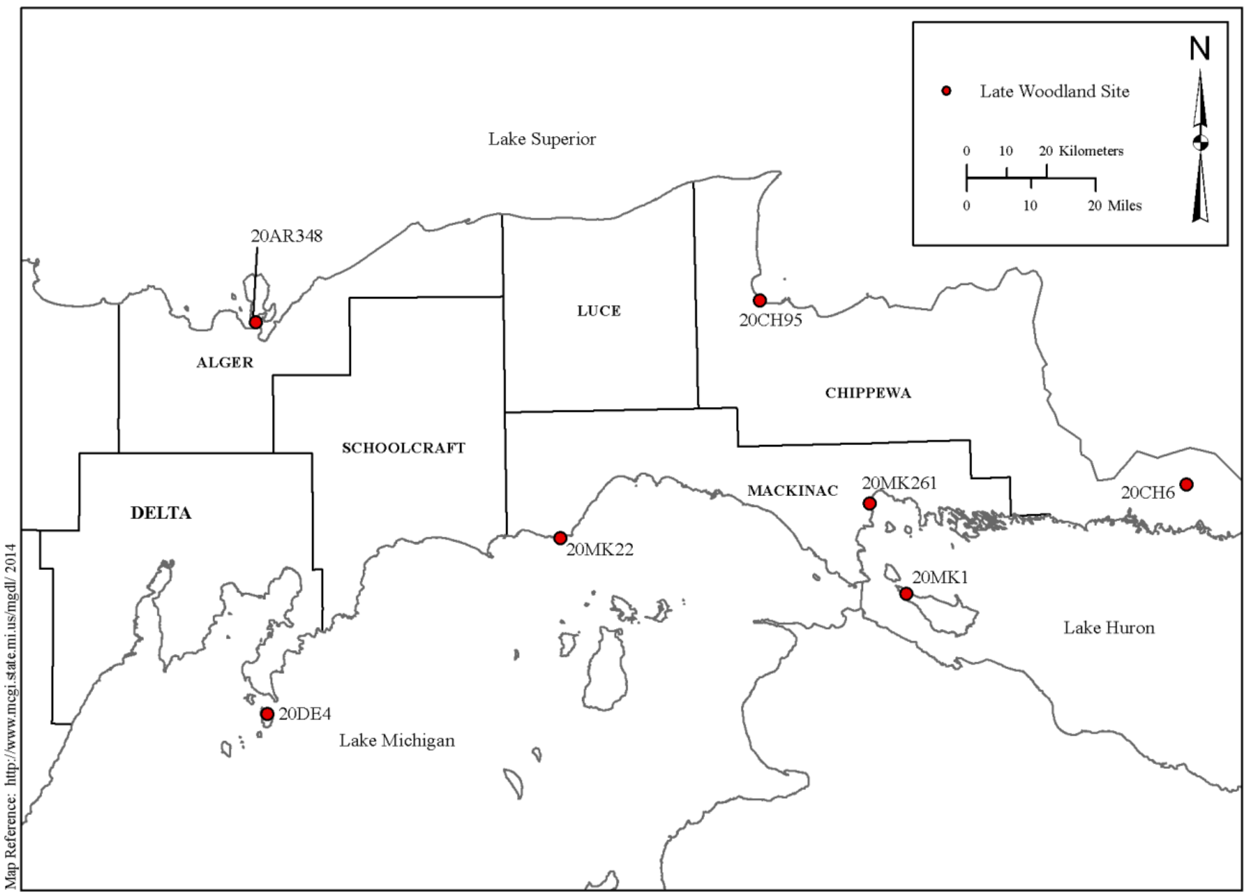


Figure 10: The Locations of Late Woodland Sites with Extended Diversity.

The temporal affiliation of the extended diversity sites is such that Gete Odena, Juntunen, Scott Point, and Cloudman each include both early and late LW components. The Carp River site includes an early LW component, but no evidence of late LW activity. Finally, the Bark Dock site and the Summer Island site include late LW components without evidence for early LW occupations.

The intermediate diversity sites exceed the mean score of either the DUI or DUIrev, but not both. Four sites exceed the mean for the DUI set and 15 exceed the mean for the DUIrev set. The LW sites in the intermediate diversity category illustrate some of the shortcomings of the two scales as well as how they complement one another. For example, the two sites with the highest DUIrev scores, 20MK90 and 20DE296, are both coded as having intermediate diversity. Both these sites have had very little excavation (2.3 and 3.4 m^2, respectively). Conversely, two of the highest DUI scored sites in the intermediate category, the LW component of the Naomikong Point site (20CH2) and the Getewaaking site (20MK169/457), each had a relatively large amount of excavation (255 and 177 m^2, respectively) leading their DUIrev scores to be reduced to one. The intermediate diversity category includes sites where many activities have taken place (particularly those that exceeded the DUI mean) as well as sites that had more intense occupations (particularly those that exceeded the DUIrev mean).

The intermediate diversity category includes 19 LW components, and five of these are known only from archaeological survey (20CH171, 20DE7, 20DE93, 20DE333, and 20DE378). Thirteen of the intermediate diversity sites are in coastal settings and six are in interior settings. The coastal sites follow the same basic spatial distribution as the extended diversity sites with four on Bay De Noc, four in the Mackinac Straits area, three on Grand Island or Munising Bay, one on Whitefish Bay, and one between the Straits and Bay de Noc on Lake Michigan. The interior sites are situated in locales which drain towards Bay de Noc (n=3), northern Lake Michigan and/or Bay de Noc (n=2), and the Straits of Mackinac (n=1).

Six intermediate diversity sites include evidence for early and late LW activity. Two sites only include evidence for early LW occupation (20DE7 and 20MK90). Four sites only have evidence for late LW components (20AR437, 20DE296, 20DE333, and 20ST109/110). The remaining sites did not produce evidence that would allow anything more than a LW assignation.

The limited diversity category includes 48 LW components or 63.2 percent of the LW sites. This category represents sites with the fewest activities represented. Based on the DUI scores, 16 components (21 percent) scored one (a single tool in a single category). Nine of these are known from archaeological survey and seven from small scale excavation. When the DUIrev scores are examined, there are 27 sites (35.5 percent) that scored one (including all 16 of the sites that scored a DUI of one). Eleven of these are known from archaeological survey and the other 16 from small scale excavations.

The sites in the limited diversity category are well distributed across the eastern UP. A much higher proportion of sites are located in the interior (18 of the 48 sites [37.5 percent]) than in the preceding categories. Twenty eight sites produced evidence for site age with 6 including evidence for both early and late LW activity, three with evidence for only early LW use, and 19 with only evidence for late LW occupation. One interior site was used in both the early and late LW, and seven sites in the interior only had evidence for late LW activity.

3.5 Subsistence Remains

In addition to the artifact classes discussed in the previous sections, some of the LW sites produced subsistence remains. Subsistence remains represent the plants and animals that were eaten or used by the inhabitants of these sites. These remains have the potential to inform about LW diet and the ecosystems LW people were obtaining these resources from as well as the time of year they were using them. The purpose of this section is to provide a summary of the subsistence remains recovered in the eastern UP to provide data that may enhance the DUI analysis presented above as well as the environmental data presented in the subsequent chapters.

As noted in Chapter 2.2, there is not a proportionate data set for subsistence remains in relation to all LW assemblages. The two primary constraints to subsistence remains reflect excavation strategy and taphonomic factors (poor preservation due to acidic soils, severe freeze thaw cycles, and weathering [T. Martin et al. 1993]). In regard to excavation strategy, the primary limitations reflect the lack of consistency in how the remains were collected and, if they were collected at all. Subsistence remains are not typically recovered from archaeological surveys. They are more typically recovered from archaeological excavations, but provision to collect such data is not always part of the excavation strategy. In this instance, earlier excavations such as at Juntunen (20MK1) and Summer Island (20DE4) recovered subsistence remains as part of the standard excavation (Brose 1970; McPherron 1967). This typically involved screening soil with ¼ in (0.64 cm) screen, "…except when particular caution was indicated …" (McPherron 1967:25). When one considers that most seeds and fish bone are smaller than a quarter inch, recovering a reasonable sample of subsistence remains was difficult.

In more recent excavations, finer scale sampling techniques such a flotation were used specifically to recover such remains (see Anderton et al. 1991; Branstner 1995; Dunham and Branstner 1995; Dunham et al. 1993). The finer recovery techniques mitigated some of the bias of the earlier excavations, but only when those techniques were used. More recently, residues adhering to pottery and FCR have been recovered (see Kooiman 2012; Skibo et al. 2009). This approach has great potential. Not only does it potentially better address recovery techniques, it has the potential to mitigate some of the problems with poor preservation of bone and plant remains (Malainey 2007).

3.5.1 *Faunal Assemblages*

Faunal remains have been recovered from 43 LW sites, or individual components of LW sites, in the eastern UP. Twenty seven of these have produced identifiable faunal remains (Appendix H). These include mammals, fish, birds, reptiles, and a small number of mollusks and gastropods. The numbers of identified species varies significantly by site and typically reflect the scale of excavation at the site, although taphonomic factors and recovery techniques are also critical factors. This discussion focuses on the number of identified species, as opposed to other metrics.

Two LW sites (30AR338 and 20CH2) in the study area included lipid analyses which provided basic information on faunal species cooked in ceramic vessels. One of the LW vessels from the Naomikong Point site (20CH2) produced a high amount of animal fat and it is unlikely that any of the Naomikong vessels were used to cook fish (Kooiman 2012). Some animal fat was noted at 20AR338 associated with a likely LW vessel, however the lipid remains from that site were mostly plant based (Skibo et al. 2009). For the purposes of this discussion, the focus will be on the identified faunal data.

The LW components with identifiable fauna range from one identified species to 34 identified species from four taxonomic classes (mammal, fish, reptile, and bird) (Figure 11). The Mackinac Phase component of the Juntunen site (20MK1) includes the highest number of species and includes: 11 species of mammal; 15 species of fish; seven species of bird, and one species of reptile. Each of the three LW components at the Juntunen site, a mixed LW component from 20MK169/457 on Mackinac Island, the Bois Blanc component of the Scott Point site (20MK22), and 20DE296 on Big Bay de Noc had the highest number of identified

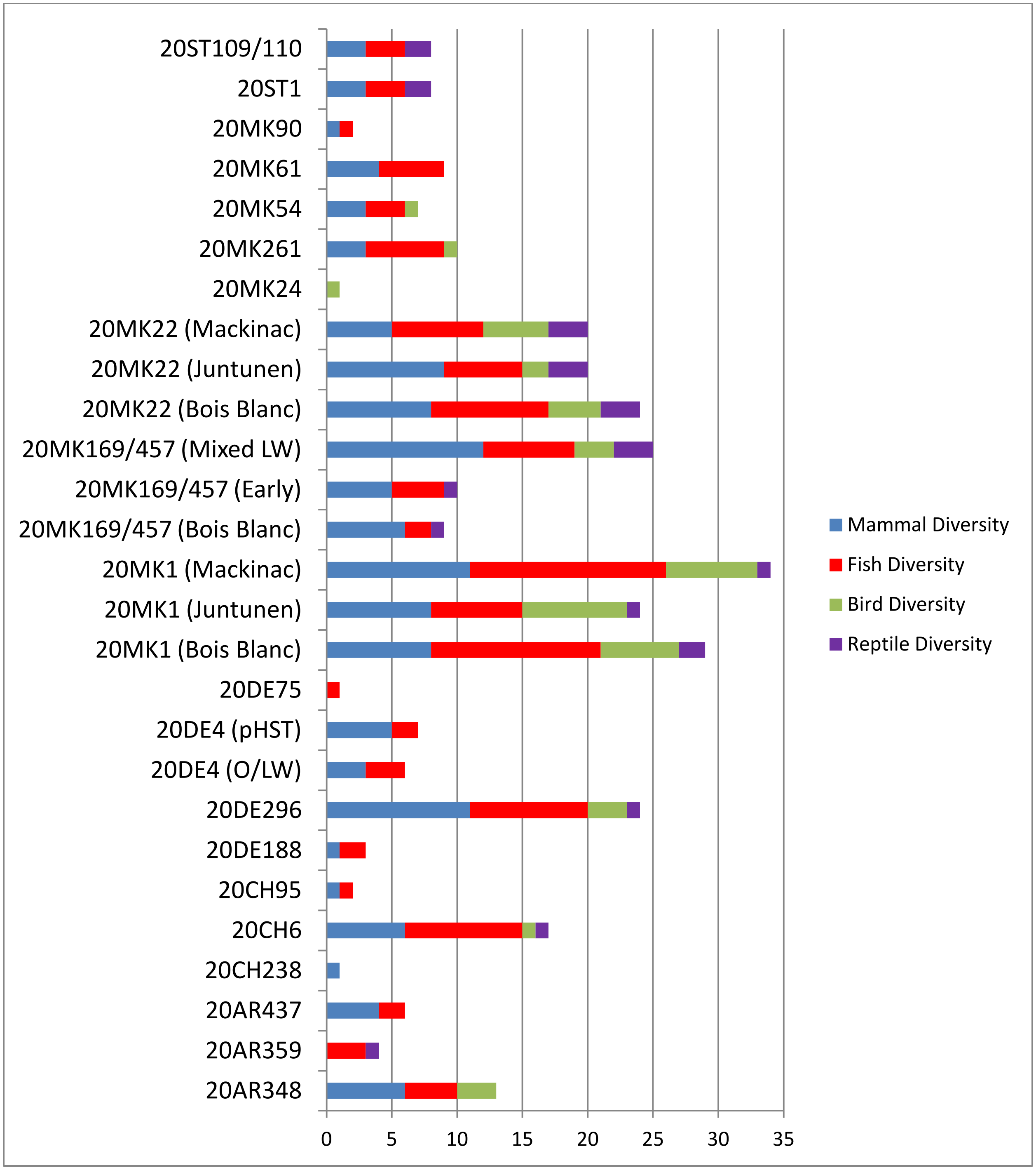


Figure 11: LW components with identifiable fauna.

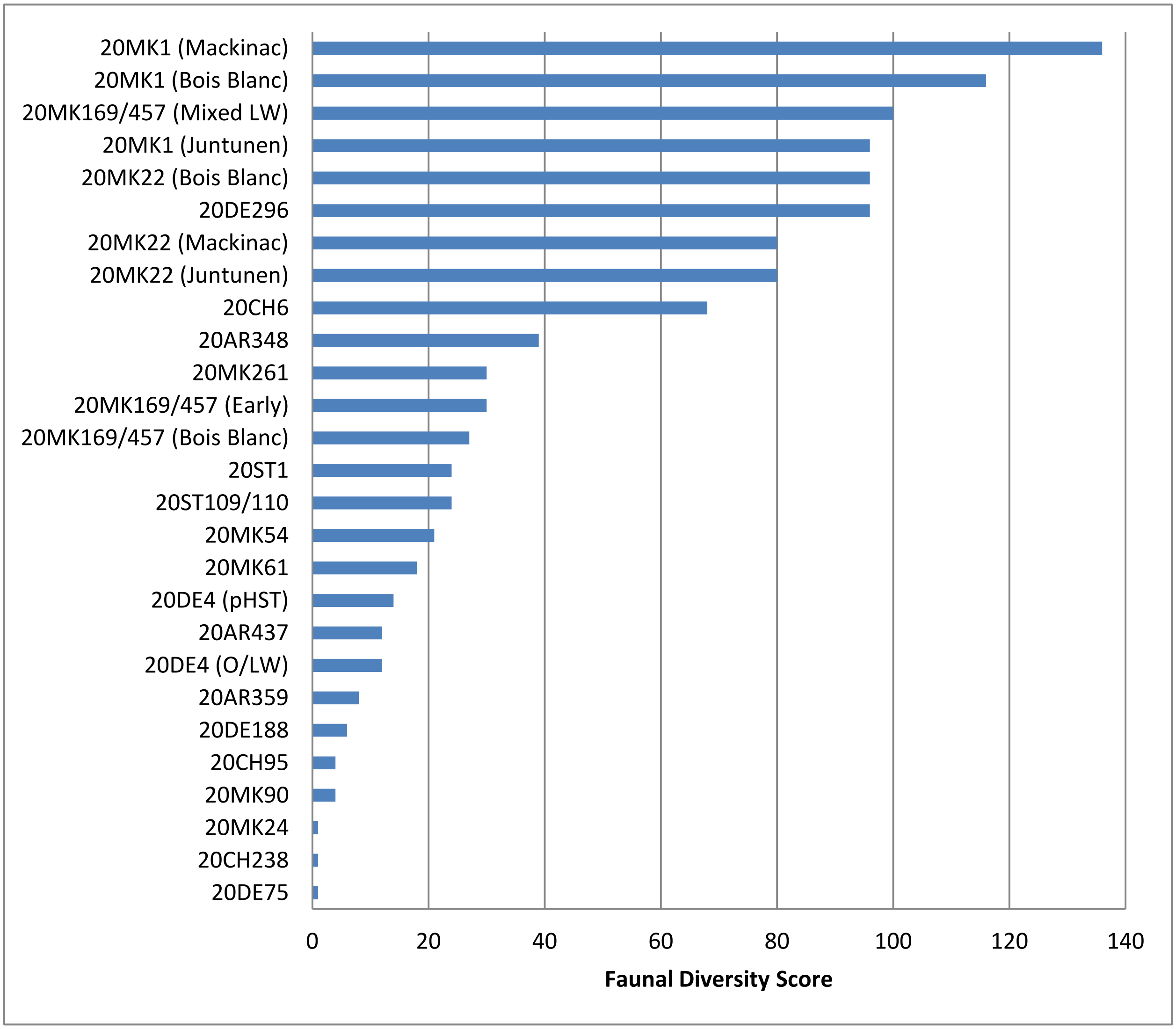


Figure 12: Faunal Diversity Score.

species. A diversity index for faunal species was created by multiplying the number of identified species by the number of varieties (mammal, fish, bird, and reptile). The Mackinac Phase component of the Juntunen site has the highest diversity score of 136 (Figure 12; Appendix H).

Using the number of identified species and diversity score, some general observations can be made about the LW sites in the eastern UP (Table 1). When all the components are considered, the mean number of identified mammals and fish is higher than the mean number of identified reptiles or birds. An equal mean number of fish and mammals are represented and birds are nearly twice as well represented as reptiles. It can also be observed that a wider range of species are present on coastal sites as opposed to those in the interior (Coastal Mean Diversity 50.0 and Interior Mean Diversity 8.8), although the general relationship between the mean number of represented species remains consistent (fish and mammal are about the same, and the mean of birds is higher than reptiles). The overall discrepancy probably reflects the fact that there are 22 coastal sites and only five interior sites with identifiable fauna. Likewise, nearly all the coastal sites with identified fauna are multicomponent, multiple occupations and all the interior sites appear to be single component and probably much shorter duration occupations. In other words, bigger sites with more activity result in a wider range of represented species. The consistency in the general proportions of represented species suggest a similarity in use patterns of faunal species and the differences are more likely a result of the scale of use of the sites themselves.

Fauna	**Mean ID Species**	**Mean ID Mammal**	**Mean ID Bird**	**Mean ID Reptile**	**Mean ID Fish**	**Mean Diversity**
All LW Sites	12.0	4.7	1.7	0.9	4.7	42.4
Coastal	13.9	5.4	2.0	1.0	5.4	50.0
Interior	3.8	1.8	0	0.4	1.6	8.8
Early	13.0	4.9	1.8	0.9	5.3	45.9
Late	12.2	5.1	1.6	1.0	4.6	42.9
East	14	5.2	2.2	1.2	5.4	51.7
West	8.0	3.7	0.7	0.4	3.2	23.6

Table 1: Mean number of identified fauna and mean diversity score.

When sites with early LW components are compared to sites with late LW components there are similarities and differences. The early and late categories overlap one another with twelve sites having early LW components and 20 having late LW components (six of these have both late LW and early LW components). The mean number of identified species is similar for early LW and late LW (n=13.0 and 12.2, respectively) and the early LW appears to have a slightly greater mean diversity than the late LW (45.9 early LW and 42.9 late LW). The most striking difference is a modest shift in the ratio of mammals to fish. For all components, this is a 1:1 relationship, whereas it is a ratio of 4.9:5.3 for the early Late Woodland and a ratio of 5.1:4.6 in the late Late Woodland. While not a statistically significant difference ($\chi^2 = 0.07$, df = 1, p = 0.449), it offers the potential that late LW peoples were using a wider variety of mammals than early LW peoples, and that early LW peoples made use of a wider variety of fish than late LW people. A pattern of greater use of mammals has been observed at the late LW components at the Scott Point and Juntunen sites (T. Martin 1982; Cleland 1966).

When the LW components are separated by the broad geographic categories of east and west a parallel set of trends can be observed. There are 18 components with identifiable faunal remains in the eastern half of the study area and nine in the western half. The mean number of species as well as the mean diversity score is significantly higher for the eastern sites than the western sites (14/7.8 and 51.7/23.6, respectively). This likely reflects the coastal/interior distribution of the components as four of the nine western sites are in the interior and only one of the 18 eastern sites is in the interior. However, where the general mean proportion of mammals to fish was about 1:1 for both coastal and interior sites, western sites have a slightly higher mean number of mammal species than fish species (3.7:3.2), and eastern sites have a slightly higher proportion of fish compared to mammal species (5.2:5.4). This may indicate regional difference in mammal to fish use, but it also may reflect a higher proportion of early LW components in the eastern portion of the study area (11 of the 18 sites with identifiable fauna in the east have an early LW component and only one of the nine in the western portion has early LW components).

In addition to examining the diversity of species represented at individual components and sites, the relative ubiquity of individual species were examined across the twenty seven LW components that produced identifiable fauna. This discussion centers around how many components include a given species, in a presence or absence sense. This is not an attempt to determine the relative importance of individual species to the diet, but rather to determine what resources were appearing on the most LW sites or LW components. This, in turn, may provide an insight into the habitats hunted and fished to procure these animals.

Beaver appears on the most sites (n=22) followed closely by lake sturgeon which appears on 20 sites. Figure 13 is a bar graph that illustrates those species that appear on at least eight (ca. 30 percent) of the 27 LW components. These 15 species are considered the most ubiquitous. Figure 13 also includes seven species that are notable and will be discussed later in this section.

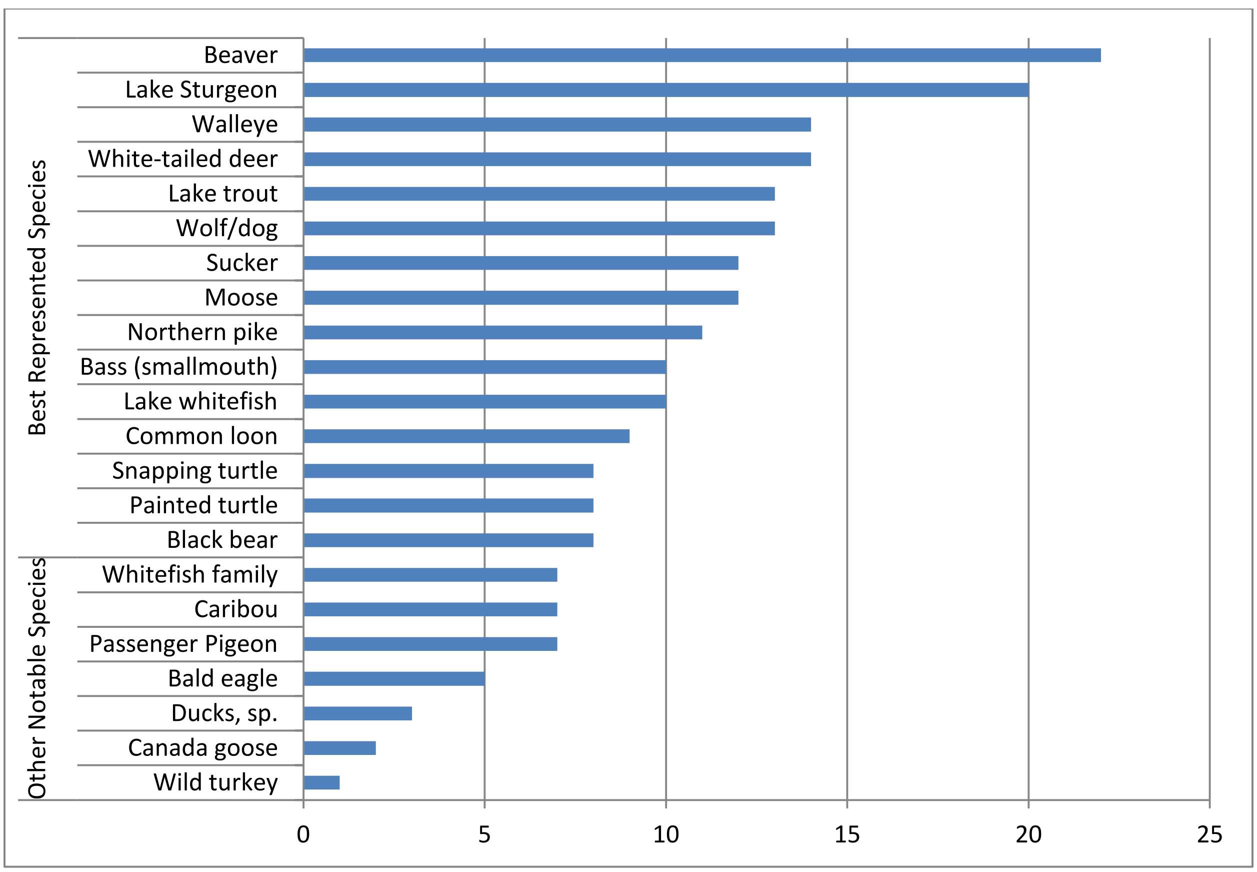


Figure 13: Best represented and other notable species.

The best represented species are primarily mammals and fish along with one species of bird (loon) and two varieties of turtle (reptiles). Whitetail deer, along with sturgeon and beaver, are well represented. Fall spawning lake trout and whitefish are also present on the list with lake trout recovered from 13 components and whitefish from 11. Spring spawning walleye, sucker and pike were each found on more than 11 components. Moose, the largest animal in the region, was recovered from 12 components.

Whitetail deer, sturgeon, and beaver are common on LW sites in the region and expected because of the size or density of the bone (deer and beaver) or the diagnostic character of sturgeon dermal plates (or scutes). These also happen to be the most ubiquitous species on eastern UP LW sites.

The differences in diversity of species between coastal and interior sites are also apparent in reviewing the most ubiquitous species. Figure 14 shows the relative percentage of each of the species by coastal and interior setting. Each species, with the exception of northern pike, appears on a higher proportion of coastal sites than interior sites. Further, bear, loon, whitefish, bass, wolf/dog, lake trout, and walleye only appear on coastal sites in the eastern UP. While these differences may reflect different subsistence patterns on the interior, it more likely reflects the smaller number of interior sites as well as the more intensive use of coastal sites over longer periods of time.

Lake trout and whitefish are endemic to the Great Lakes, but not the UP's interior lakes. For these fish species to appear in interior assemblages would require people to bring them to the interior locales. The absence of walleye, smallmouth bass, bear, loon, and wolf/dog is curious, as there is no reason these species should not be present on inland sites. In fact, B. A. Smith (1996) identified bear as one of the more important species for people on Lake Superior Interior

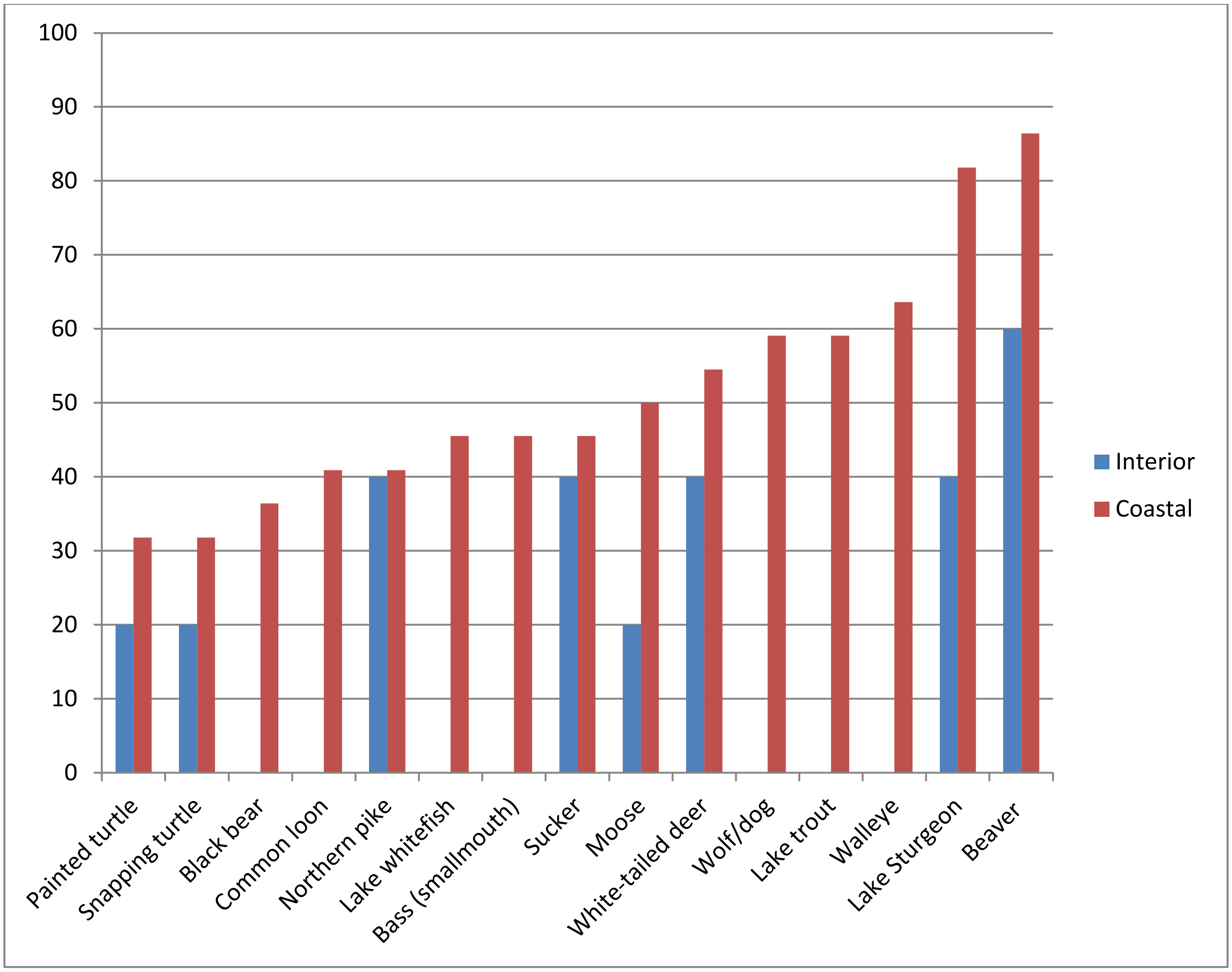


Figure 14: Relative percentage of the best represented species by coastal & interior setting

sites in Ontario, an area adjoining the eastern UP to the northeast. While loons would have been present on inland lakes, it is possible that loons were more likely captured when they entangled themselves in nets (Cleland 1966; McPherron 1967; B. A. Smith 1996).

Figure 15 shows the relative percentage of the most ubiquitous species comparing early LW and late LW components. As the graph indicates, late LW sites include a slightly higher proportion of most species, although early LW components have a higher proportion of lake trout, wolf/dog, walleye, sturgeon, and beaver. When the specific differences are examined, wolf/dog, walleye, and sturgeon appear on a higher proportion (> 9 percent) of components in

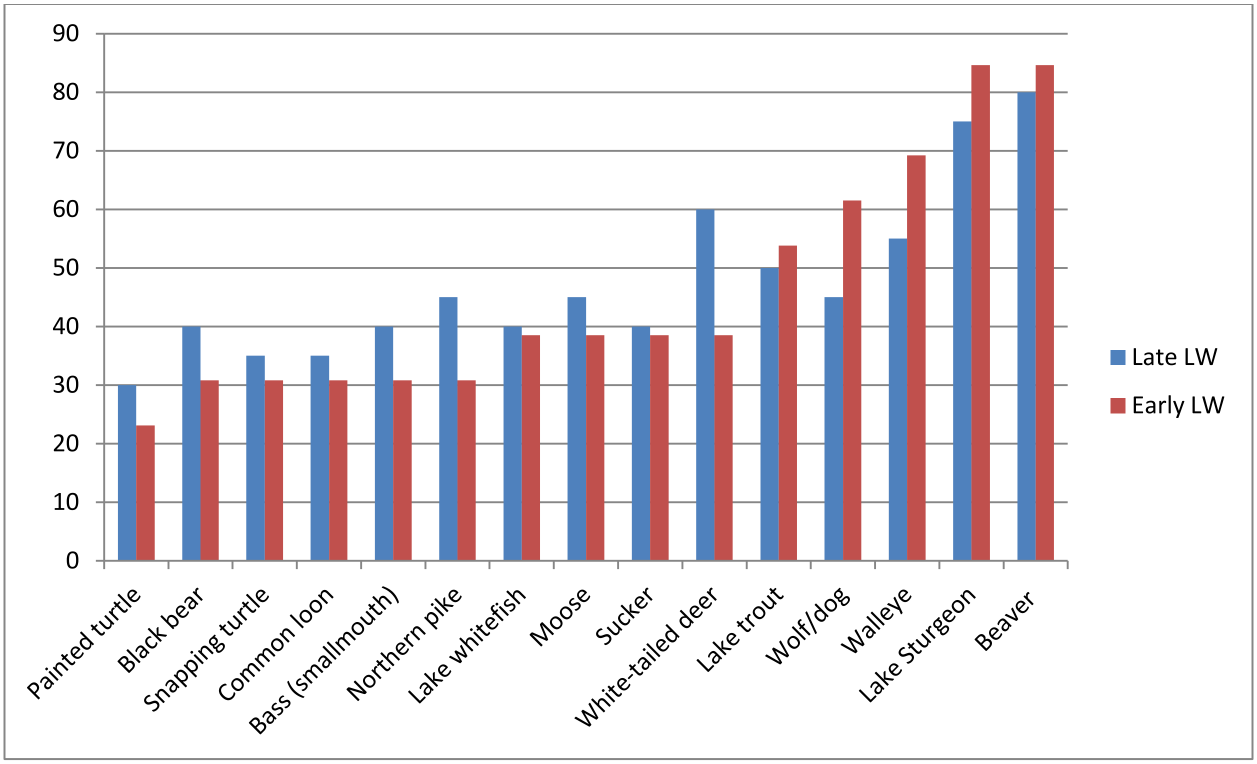


Figure 15: Relative percentage of the most ubiquitous species comparing early LW and late LW components.

the early LW, and bear, bass, pike, and deer appear in a higher proportion (> 9 percent) in the late LW. The increased percentage of late LW components that include deer, bear, and moose (6.5 percent) may reflect a greater reliance on mammals for subsistence, a trend also suggested by the diversity discussion above.

A comparison of the relative percentage of the most ubiquitous species by eastern and western portions of the project area also reveals some noteworthy differences (Figure 16). First, caribou and wolf/dog only appear on eastern sites. Second, all the species that are proportionally better represented in the western part of the project area (deer, bear, pike, and painted turtle) are less than 6 percent better represented than on the eastern sites. Third, lake trout and whitefish are nearly 40 percent better represented on eastern sites. Fourth, moose,

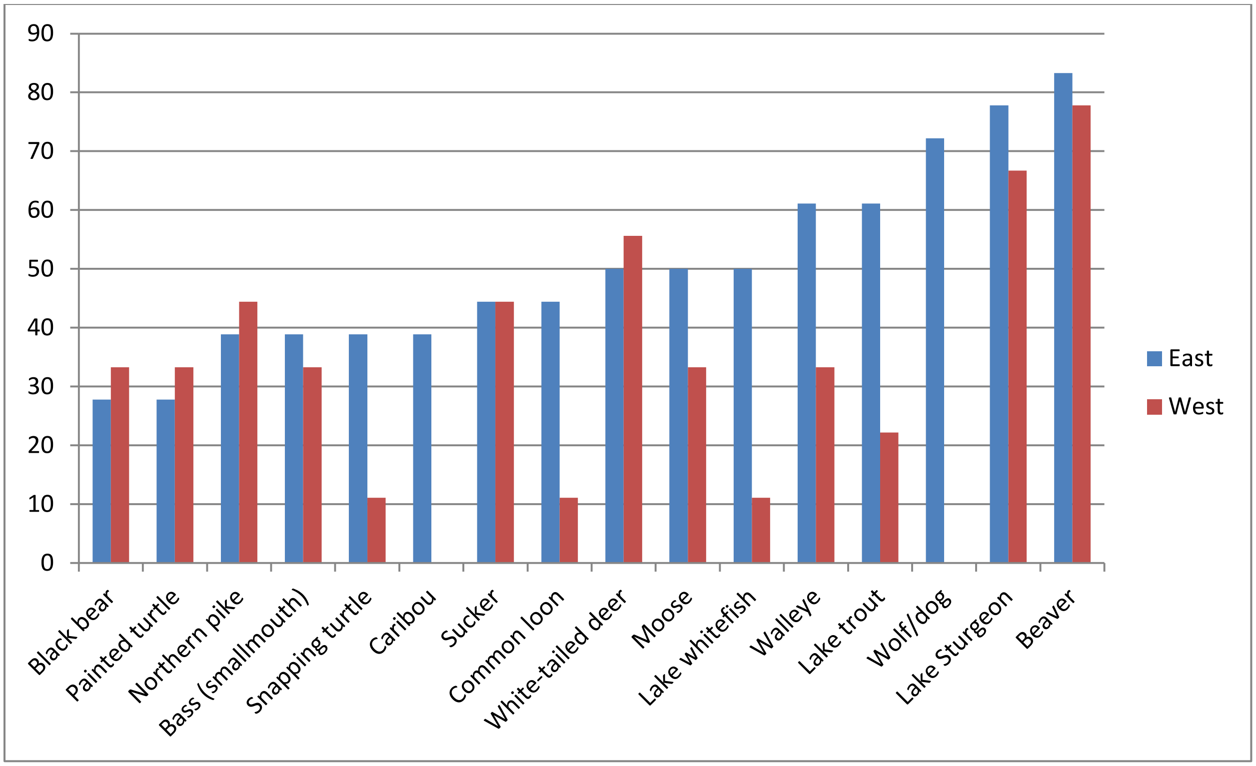


Figure 16: Relative percentage of the most ubiquitous species by east and west.

walleye, snapping turtle, and loon are each over 10 percent better represented on eastern components.

As noted above, some of these differences may relate to the higher proportion of larger, multicomponent coastal sites in the eastern region leading those sites to have a wider diversity of species represented. The larger, multicomponent sites are more likely to have longer duration and more repeated occupations (seasonal and inter-annual), have larger populations of mixed age and gender allowing for a larger range and greater diversity of resources collected. Additionally, there may be factors relating to habitat and animal range (caribou), variation in subsistence strategy such as a greater emphasis on fall spawning lake trout and whitefish in the east (this may also account for loon), or different cultural practices such as ritual use of dogs (see below).

In addition to showing the most ubiquitous species, Figure 13 also includes a seven other notable species recovered from LW components in the eastern UP. These include fish remains that were identified as relating to the whitefish family (*Coregoninae*), but that could not be specifically identified to species. While these could represent shallow water spawning cisco or another whitefish relative, they could also represent lake whitefish which could increase the number of sites where that species appears by as many as two. Caribou is noted because it appears on seven sites (25.9 percent of the sites) and is a large mammal. Canada goose and ducks are noted because they appear on so few LW sites in the eastern UP despite their ubiquity today. The identification of wild turkey at Juntunen (MNI=6, five from the Bois Blanc component) is noteworthy because it is probably outside its native range suggesting they were brought to the site (Cleland 1966; Brewer et al. 1991).

Bald eagle is recorded here because it likely does not represent a food resource, but rather is related to cultural practices. Eagle burials were recorded as part of the Juntunen component of the Juntunen site and an eagle talon was recovered from 20DE296 (Cleland 1996; T. Martin 1991). A dog burial and dog remains in an apparent medicine bundle were recovered from the Juntunen site as well, suggesting an ceremonial or ideational role for dogs, although butchered dog remains, for apparent subsistence, were also recovered from the Juntunen site, site 20MK457, and the Cloudman site (20CH6) indicating their role as a food resource (Cleland 1966; T. Martin and Perri 2011; Cooper 1996).

The shells of turtle species, such as the painted turtle, appear to have been used culturally to make rattles or containers (Cleland 1966; T. Martin 1980; 1991; T. Martin and Perri 2011). This doesn’t mean that turtles weren’t used for food as well, only that they were also used for non-subsistence cultural purposes.

B. A. Smith (2004) has posited that the increased reliance on fall spawning whitefish and lake trout began around AD 800 at the Juntunen site, after AD 1100 in northern Lake Michigan basin, and as late as AD 1400 in the rest of the Upper Great Lakes region. Of the 22 LW components on coastal sites in this study that included faunal remains, fifteen (68 percent) included fall spawning fish (Table 2). Five components with fall spawning fish remains could not be attributed to an early or late LW context, or included evidence for each of these periods. Three are early LW in age (pre AD 1000) and seven are late LW (post AD 1000). If this data were presented as percentages, then 50 percent of the early LW coastal components include fall spawning fish and 70 percent of the late LW sites do as well. Despite the small size of the eastern UP sample, this generally supports B. A. Smith's (2004) observation that the fall fishery increased in importance as a subsistence resource over the course of the LW period.

Site	**Early LW**	**Late LW**	**Lake Trout**	**Whitefish**
20AR348	E	L	x	-
20AR359	-	L	-	x
20DE296	-	L	x	-
20MK1 (Mackinac)	E	-	x	x
20MK1 (Bois Blanc)	-	L	x	x
20MK1 (Juntunen)	-	L	x	x
20MK22 (Mackinac)	E	-	x	-
20MK22 (Bois Blanc)	-	L	x	x
20MK22 (Juntunen)	-	L	x	x
20MK54	E	L	-	x
20MK61	E	L	x	-
20MK169/457 (Early)	E	-	x	x
20MK169/457 (Bois Blanc)	-	L	x	x
20MK169/457 (Mixed LW)	E	L	x	x
20ST1	E	L	x	-

Table 2: Fall Spawning Fish Recovered from Coastal Sites.

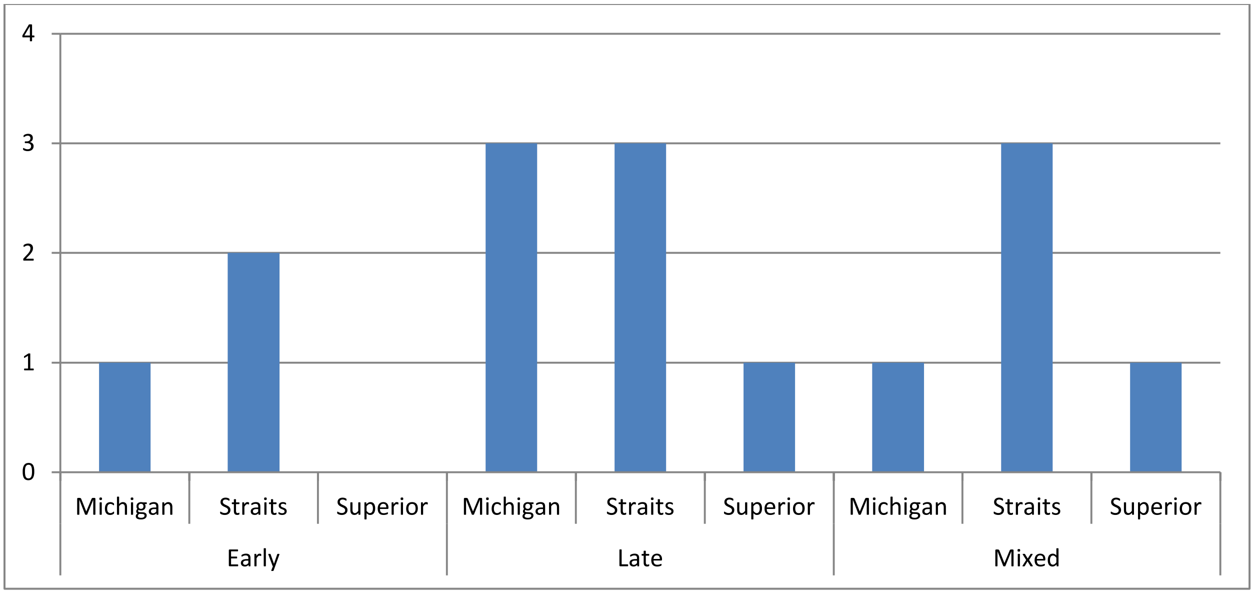


Figure 17: Number of sites with fall spawning fish by broad region.

The evidence is less clear from a geographic perspective. The sites with fall spawning fish remains are located in three broad geographic areas: northern Lake Michigan (including Bay de Noc); the Straits of Mackinac; and Lake Superior (Figure 17). Two early LW components in the Straits area and one on northern Lake Michigan included fall spawning fish remains. Three sites on the Straits, three on northern Lake Michigan, and one on Lake Superior included fall spawning fish remains in the late LW. Of the five sites that could not be placed in either the early or late LW, one is located on northern Lake Michigan, three on the Straits, and one on Lake Superior. Thus, evidence of the fall fishery is best represented in the Straits region in all periods, and the use of fall spawning fish is seemingly more prevalent in each region in the late LW.

When the discussion is expanded to include the most ubiquitous spring spawning fish species, sturgeon, walleye, and sucker, the data demonstrates that spring spawning fish remains appear on more coastal sites than fall spawning fish (19 of 22 sites with faunal remains [86 percent]). Five early LW sites (83 percent) have spring spawning fish and eight late LW sites (80 percent) include spring spawning fish (Figure 18). The remaining six sites, with unidentified

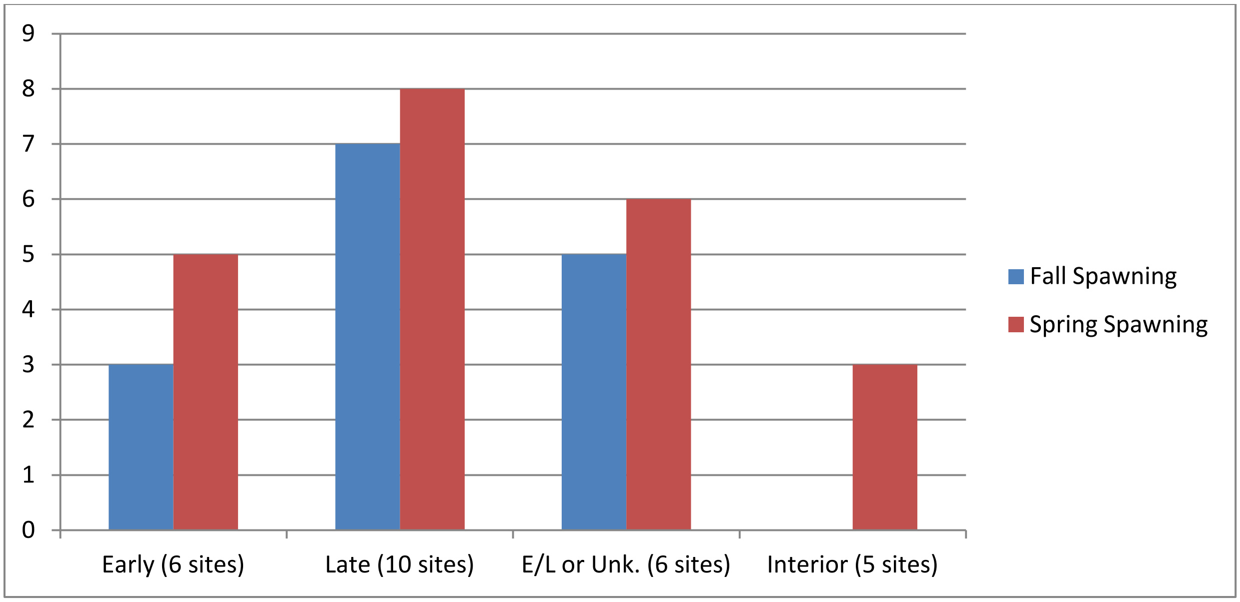


Figure 18: Number of sites with spring and fall spawning fish

or mixed LW components, also include spring spawning fish remains. Thirteen sites included both fall and spring spawning fish which is 86.7 percent of the 15 sites that include fall spawning remains. Spring spawning fish remains are also present on interior sites as well (3 of 5 interior sites with faunal remains) which further illustrates their greater ubiquity in LW subsistence practices.

The relative importance of large herbivores (whitetail deer, moose, and woodland caribou) can also be explored in comparison with fall and spring spawning fish (Figure 19). Large herbivores appear in 16 of the 22 (72.7 percent) coastal faunal assemblages (one more than fall spawning fish) and three of the five interior assemblages. As such, large game is more ubiquitous on LW sites than fall spawning fish and less ubiquitous than spring spawning fish. Ninety percent of the late LW sites include large game in their faunal assemblages, as compared to 80 percent spring spawning fish and 70 percent fall spawning fish (Figure 20). Only 50 percent of the early LW sites include large game which supports the observation discussed above that mammals are better represented on late LW sites than early LW sites (Figure 3.5-20).

The most ubiquitous species appearing on LW sites in the eastern UP have a fairly limited range of preferred habitats. All the fish species as well as the turtles, beaver, moose, and loon each live in the water or lands adjacent to lakes, rivers, streams, or marshes (Tables 3

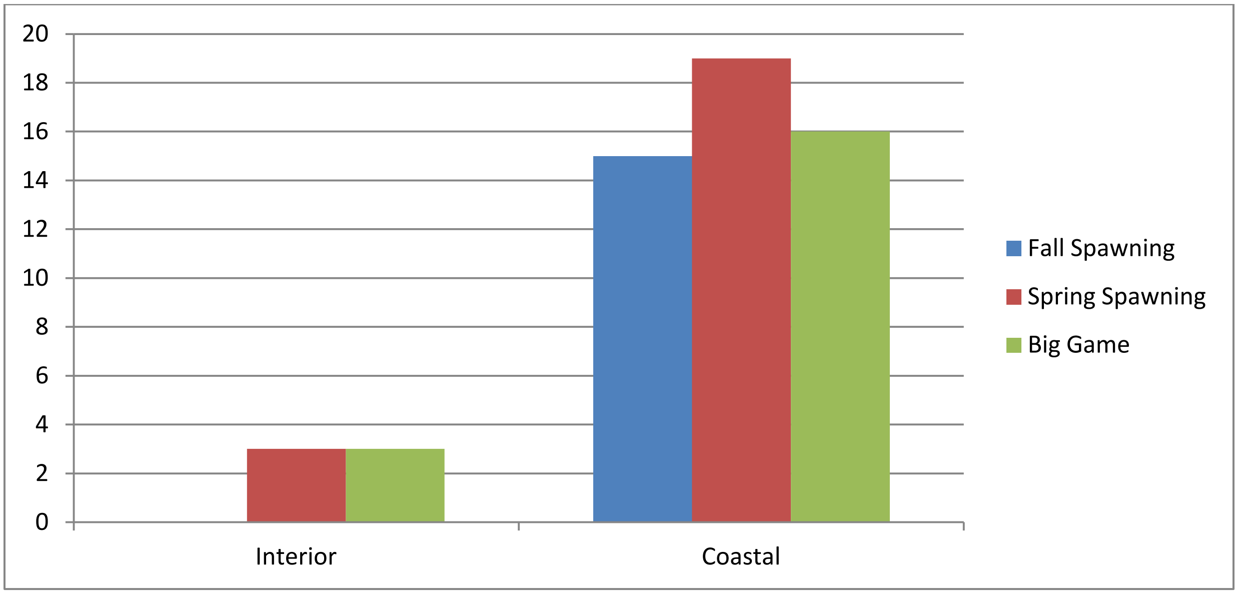


Figure 19: Comparison of fall spawning fish, spring spawning fish, & big game by count.

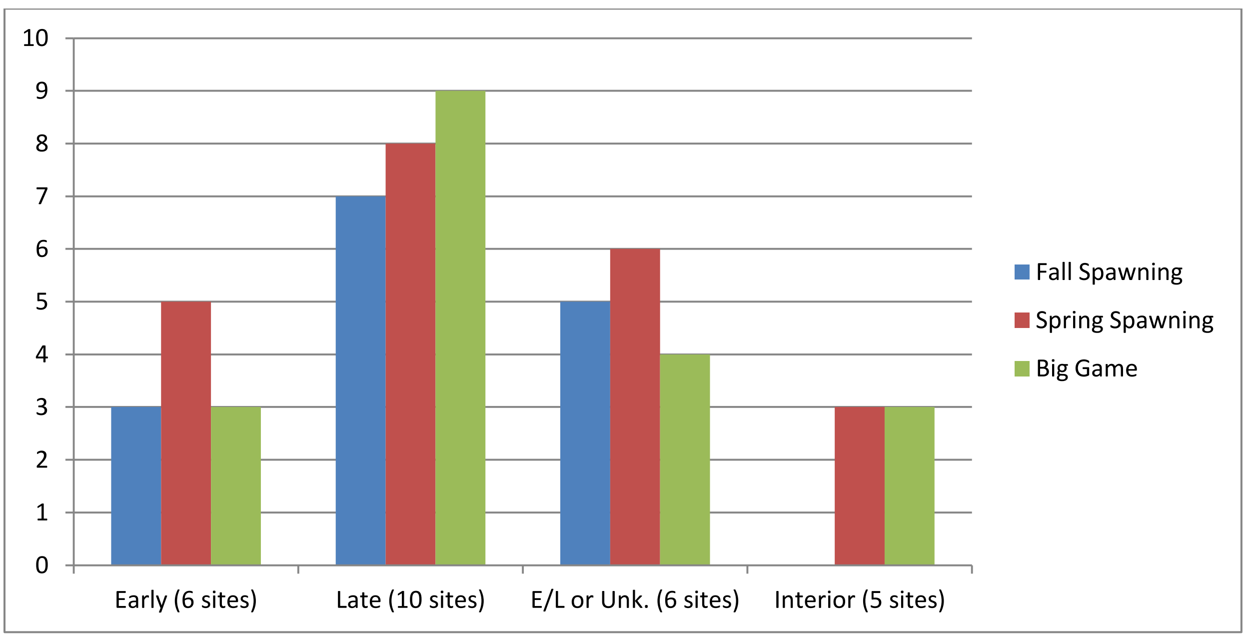


Figure 20: Comparison of fall spawning fish, spring spawning fish, & big game by age.

and 4). The remaining species – deer, bear, and the canines need access to water for drinking, but are not constrained to the water itself or littoral zones. Most of the species are also available throughout the year. Further, beaver, moose, and deer require habitats with early successional growth as part of their range. Thus, the majority of the most ubiquitous species habitat preferences would place them in locations that are most likely to include LW sites (within 240 m of a source of water and/or in mixed pine habitats [see Chapter 4]). This would also pertain to dogs whose primary habitat is in association with human settlement.

Despite these commonalities, there are some differences. The first relates to seasonal availability. While most of the species are available throughout the year, there are times when a given species is “more available,” or available in greater numbers than in others. This is well illustrated by spring spawning fish such as sturgeon, walleye, sucker, and northern pike. While each of these could be conceivably caught at anytime during the year, they all appear in larger numbers and greater density during their spring spawning runs (Becker 1983; Cleland 1982; B. A. Smith 1996). Spawning takes place in shallow waters where the fish can be speared or caught in dip nets. Fish running in streams can be caught in weirs or traps as well as in nets. A local legend relates that a person could walk across the Sturgeon River near Nahma (Bay de Noc) across the backs of sturgeon during the spawning run (Dodge 1973:91).

Species	Preferred Habitat	Seasonal Availability	Reference
Sturgeon	Great Lakes, inland lakes, rivers/streams	Year round, although concentrated during spring spawning	Becker 1983; Cleland 1982
Walleye	Great Lakes, inland lakes, rivers/streams, and marshes adjoining streams and lakes	Year round, although concentrated during spring spawning	Becker 1983
Lake Trout	Great Lakes	Fall spawning	Becker 1983; Cleland 1982
Lake Whitefish	Great Lakes	Fall spawning	Becker 1983; Cleland 1982
White Sucker	Great Lakes, inland lakes, rivers/streams	Year round, although concentrated during spring spawning	Becker 1983
Northern Pike	Great Lakes, inland lakes, rivers/streams, and marshes adjoining streams and lakes	Year round, although concentrated during spring spawning	Becker 1983

Table 3: Habitat and seasonal summary for the most ubiquitous fish.

Species	Preferred Habitat	Seasonal Availability	Reference
Beaver	Early succession growth adjacent to slow moving streams, rivers, and inland lakes	Year round, although ethnographic sources indicate late winter & early spring as optimal time	Baker 1983; B. A. Smith 1996
Whitetail Deer	Warm season: mosaic of forest edges, early successional growth, and forest openings. Cold season: Lowland conifer swamp (esp. white cedar)	Year round, although they yard in larger groups in the winter	Baker 1983; Van Deelan et al. 1996
Moose	Subclimax forest and herbaceous openings adjacent to swamps, marshes, lakes	Year round	Baker 1983
Woodland Caribou	Mature coniferous forest adjacent to swamps and bogs	Year round	Baker 1983
Black Bear	Multiple environments	Year round, although black bears hibernate from late November-early April. Ethnographic sources indicate bears were hunted while in hibernation	Baker 1983; B. A. Smith 1996
Wolf	Multiple environments	Year round	Baker 1983
Dog	With humans	Year round, although enthnographic sources note ritual use in mid-winter	B. A. Smith 1996

Table 4: Habitat and seasonal summary for the most ubiquitous mammals.

3.5.2 *Floral Remains*

Macrobotanical floral remains have been recovered from fifteen components from fourteen LW sites in the eastern UP (Appendix I). The floral remains include carbonized seeds, nutshell, nutmeats, wood charcoal, as well as other plant remains such as aquatic tuber and birch bark. At least 30 types of nuts and seeds are represented and a dozen varieties of tree. The approach taken here is to consider ubiquity, or in how many components is a given species represented. Few of the sites have produced large nut and seed assemblages, the Cloudman site (20CH6) and the Juntunen site (20MK1) are exceptions, so this seems a useful strategy to ascertain broader evidence of plant use in the eastern UP.

Lipid residues extracted from the fabric of pottery has also indicated plant use at a site on Grand Island (20AR338) and at the LW component of the Naomikong Point site (20CH2) (Kooiman 2012; Skibo et al. 2009). The results of these analyses are interesting, but do not provide a lot of insight into specific plant remains. A LW vessel from the Naomikong Point site had been used to cook animals and low fat content plants (Kooiman 2012:163). The apparent LW vessel examined from 20AR338 produced evidence for nut oil, likely acorn (Skibo et al. 2009).

Twelve sites, including 13 LW components, produced carbonized seeds, nutshell and/or nut meats. Eight sites produced wood charcoal. The LW components with floral remains range from one identified species to 17 identified species (Figure 21). The two sites with the highest number of identified plant remains have no identified wood charcoal (20CH6 and 20MK1). Wood charcoal identification was not carried out for all sites including 20CH6 and 20MK1.

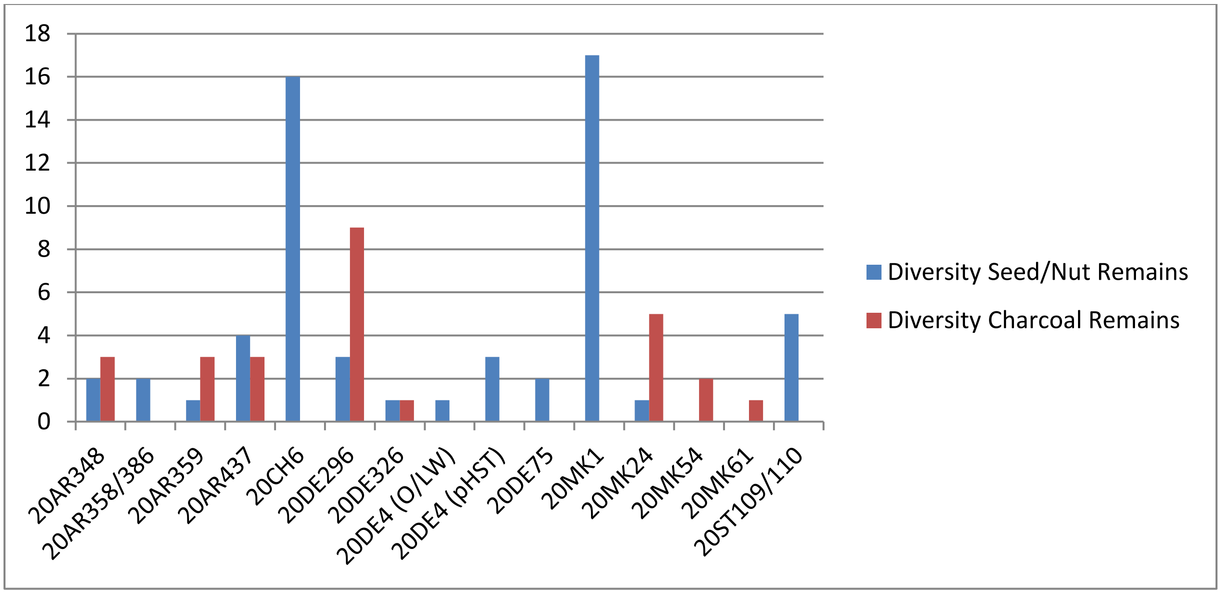


Figure 21: Diversity of floral assemblages (seed/nut and charcoal) by site

Acorn is the best represented nut or seed appearing on 46 percent (6 of 13) of the LW components that produced these remains. Hazelnut and cherry appeared on 38.5 percent of the sites (5 of 13). All the other seed and nut remains appear on less than a quarter of the sites. Notable among these were plants that were important food resources to the south (southeast and southwest) of the eastern UP including: maize which appeared on three sites (23 percent); wild rice on one site; squash on one site; and likely butternut (*Juglans* sp.) on one site. In addition to these resources, two sites also produced evidence for aquatic tubers although the species could not be identified.

Acorns, hazelnut, and butternut are mast resources and nuts have played an important role is human subsistence in eastern North America throughout prehistory (Gardner 1997; Scarry 2003; Yarnell 1964). Acorns and hazelnuts, along with beech nuts, are the best represented nuts in the eastern UP, whereas butternut is more localized and rare (Comer et al. 1995; Dunham 2009; Voss and Reznicek 2012). Hazelnuts and butternut are oily nuts and acorns are starchy (Kuhnlien and Turner 1991; Scarry 2003). This difference has nutritional outcomes with acorns comparing more favorably to grains, such as maize or wild rice, than to other nuts (Dunham 2009; Kuhnlien and Turner 1991; Scarry 2003). Butternut (*Juglans* cinerea) is currently the only variety of *Juglans* present in the eastern UP and is recorded in Chippewa, Delta, and Mackinac County as well as appearing in pre-European settlement forest descriptions (Comer et al. 1995; McPherron 1967; Voss and Reznicek 2012). Its presence on the Cloudman site, 20CH6, with one of the most diverse botanical assemblages, is not a surprise (Branstner 1995; Egan-Bruhy 2007).

The squash and maize represent cultigens which were important crops to the south of the eastern UP (Hart and Lovis 2012; McElrath et al. 2000; Parker 1996). Prehistoric maize is assumed to require 140 frost free days to produce a reliable subsistence crop (Demeritt 1991; Hart and Lovis 2013; Yarnell 1964). As noted in Chapter 2.1, areas in the Lake Michigan and Lake Huron littoral zone currently exceed 140 frost free days (Eichenlaub et al. 1990; O'Shea 2003). All the sites where maize was recovered as well as Summer Island (20DE4) where the squash was found currently exceed 140 frost free days.

Wild rice was an important resource in the western Upper Great Lakes and parts of Ontario (Jenks 1900; Johnson 1969; Mather and Thompson 2000; Vennum 1988). It only appears on a single site in the eastern UP, the Cloudman site (20CH6), and only as a single macrofossil (Egan-Bruhy 2007). The Cloudman site is situated in close proximity to a modern wild rice patch and generally reliable nineteenth century historical records place wild rice in the general vicinity as well (Dunham 2008). The recovery of a single grain is not conclusive evidence that the inhabitants of the Cloudman site collected the wild rice locally, it may have come to the site through exchange, but it raises the possibility that wild rice was used in the eastern UP.

Also notable was the low incidence of fleshy fruits with the exception of cherry. Blueberries, raspberries, and grapes as well as wild plums only appeared on one or two of the sites that produced edible plant remains. Even in the case of cherries, different varieties (pin, choke and unspecified) were lumped together which achieved a higher number of total sites. One would expect to see a higher proportion of fleshy fruits in these assemblages based on their prominence in the ethnographic literature (Densmore 1974; Dunham 2000a; Kuhnlien and Turner 1991; Moncton 1992). One factor that may explain this is the processing of fleshy fruits, specifically drying, did not involve heating with fire, thus limiting the potential for carbonization of the seeds (Dunham 2000a).

Site 20MK1, the Juntunen site, includes three distinct components as well as transitional zones and the majority of the floral remains were found in occupation strata assigned to the Juntunen Phase component (McPherron 1967; Yarnell 1964). Only maize, hazelnut, birch bark, and an unidentified tuber were identified in earlier contexts. Eleven of the 15 maize kernels (73.3 percent) that were found in assigned components were found in the Juntunen component.

The Cloudman site, 20CH6, is a multicomponent site with Middle Woodland, Late Woodland, and early historic components (Branstner 1995). The floral assemblage was fairly extensive, but the remains discussed herein are limited to LW features. Five varieties of fleshy fruit, 3 varieties of nuts, wild rice, and maize were all recovered (Appendix I; Egan-Bruhy 2007).

The charcoal remains provide insight into the types of wood burned in fires by LW people as well as species that occurred in closer proximity to occupations (Appendix I). The best represented type of wood was birch (*Betula* spp.) which is present on 62.5 of the sites with wood charcoal. Maple (*Acer* spp. and *A.* saccarum) and ash (*Fraxinus* spp. and *F.* americanus) are present on half of the sites. Pines (*Pinus* spp., *P*. strobus, and *P*. resinosa) appear on three sites. None of the other varieties of wood charcoal are present on more than one or two sites.

A couple of unusual wood charcoal specimens are worth noting. Two sites (20DE296 and 20MK54) produced hickory (*Carya* spp.) which is an uncommon species in the eastern UP (Voss and Reznicek 2012). Hickory is an important mast resource to the south and raises the potential for use of this mast source in the region despite hickory not appearing in the nut remains above (Gardner 1997; Scarry 2003). Shagbark hickory (*C.* ovate) is recorded in the recent past in Delta and Mackinac counties which correspond to the locations of these two sites (Voss and Reznicek 2012). The Delta County shagbark hickory is considered a natural occurrence, but no additional information is available for the specimen from Mackinac County (Voss and Reznicek 2012:650). The other unusual specimen is identified as swamp white oak (*Quercus* bicolar) at site 20MK54 (Brunette cited in Fitting and Clarke 1974). Swamp white oak is not thought to extend north of mid-Michigan raising the possibility that the specimen was misidentified (Voss and Reznicek 2012).

3.6 Discussion

One of the goals of this study is to determine if LW sites were used for different purposes. The DUI scores provide a useful means for exploring this question. In this chapter, three DUI categories were created: extended diversity, intermediate diversity, and limited diversity (Appendix G). The sites classified as extended diversity most likely represent residential sites. Intermediate diversity sites may also represent residential sites, albeit with a smaller population or shorter occupation, or a logistical camp. Finally, LW sites with limited activity scores likely represent logistical camps.

Most of the sites examined were scored as having limited diversity (n=48 [63.2 percent]) and only 9 components (11.8 percent) were determined to be extended diversity. The nine components with extended diversity can each be characterized as places where many activities were carried out by LW people. The extended diversity sites are geographically dispersed across the eastern UP and each are situated along a Great Lakes Shoreline (see Figure 10). Two of the components are early LW, 4 are late LW, and three of the sites include mixed deposits. The two early LW components are in the Straits of Mackinac region and the 4 late LW components are located on Lakes Michigan, Huron, and Superior. The extended diversity sites are also more likely to include floral and faunal remains than the other sites and two-thirds of them also include subsurface features (Figure 22). These sites are likely residential locales with longer duration of occupation as well as larger populations that include mixed gender and age groups that are involved with a wider number of activities. The extended diversity sites likely represent the seasonal aggregation sites described by Cleland (1982) where spring and/or fall fishing took place. Each of the extended diversity sites, with the exception of the proto-historic component of 20DE4, includes spring or fall spawning fish remains (Appendix H).

Intermediate diversity sites could also represent residential sites, albeit with a smaller population or shorter occupation, or logistical camps. As residential sites, they may represent the locales occupied during periods of population dispersal, such as cold season camps, as described by Cleland (1982; 1992a). As logistical camps, these sites would represent locales used for specialized resource procurement purposes. There are 19 LW sites in the intermediate diversity category and they are spatially dispersed across the eastern UP. Most of them (n=13) are located along Great Lakes shorelines, but there are six situated in the interior. Intermediate diversity

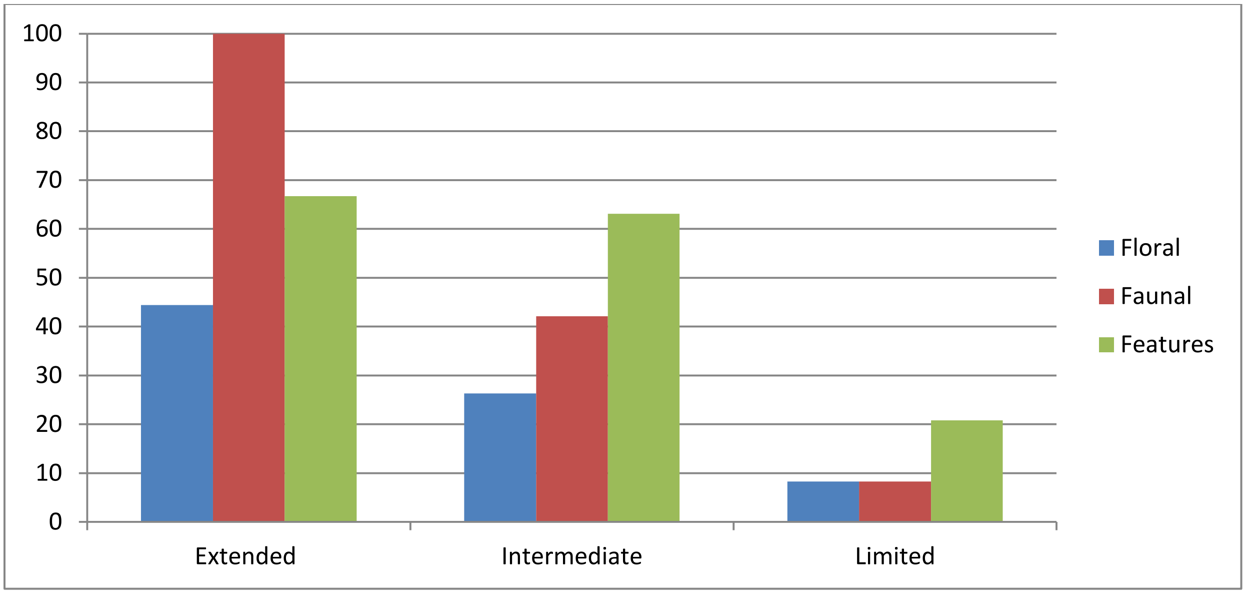


Figure 22: Percentage of sites by category with floral remains, faunal remains, or subsurface features.

sites are less likely to include floral and fauna assemblages, but have a similar chance to include features as extended diversity sites (Figure 22).

The limited diversity sites have the fewest activities and probably represent logistical camps used by smaller groups for limited periods of time, for specific resource procurement activities. The sites in the limited diversity category are well distributed across the eastern UP and a much higher proportion of sites are located in the interior (18 of the 48 sites [37.5 percent]) than in the preceding categories. The most striking evidence for concerning the age of limited diversity sites is that the sites that only included early LW components (n=3) were located on the Great Lakes coastline, whereas seven of the eight dated interior sites were late LW in age and the other site included both early and late LW materials. This is suggestive that use of the interior was more prevalent in the late LW than in the early LW. Limited diversity sites are less likely to include subsistence remains or features (Figure 22).

The diversity index appears to have established a framework in which to consider LW sites in the eastern UP. This framework supports the contention that LW sites were used differently. There is also evidence for spatial and temporal patterning with larger, extended diversity sites being situated in coastal settings and interior settings only including intermediate and limited diversity sites. It also appears that interior sites are more likely to have been used in the late LW period. In the next chapter, Chapter 4, the spatial distribution of sites will be considered in relation to a series of environmental variables to further assess LW settlement and subsistence in the eastern UP.

4.0 LATE WOODLAND ARCHAEOLOGICAL SITE PREDICTIVE MODEL

This chapter will outline the development of a Geographic Information System (GIS) predictive model of LW site locations on the Hiawatha National Forest (HNF). GIS is defined as a set of computer tools for collecting, attributing, storing, transforming, and displaying spatial data (Burrough and McDonnell 1998). The goal of this exercise was to identify settings or locations of greater archaeological sensitivity, especially in regard to the environmental setting of the LW sites. The ecological settings could be used to predict the potential occurrence of LW archaeological sites in other parts of the Forest as well as the eastern UP of Michigan.

Archaeological surveys have been conducted on the HNF since the late 1970s leading to the discovery of over 3,000 archaeological sites. Despite the relatively high number of archaeological sites, there is often little specific information about the sites aside from location and a limited assessment of age. Five hundred and seventy eight of the sites discovered on the HNF are solely prehistoric or have a prehistoric component. Forty-eight of these can be attributed to the LW period or include a LW component (Appendix J). The HNF sample includes 59 percent of the LW sites in the eastern UP. In many cases the identification of a LW component in the HNF or the eastern UP is based on the presence of diagnostic projectile points and/or ceramics. Thus, we have archaeological site locations without much corresponding information on specific resources that were being used at these sites.

The HNF includes approximately 898,980 acres (ac) (363,804 hectares [ha]) of land, in two large swaths across the eastern UP (about 20 percent of the eastern UP land base) (Figure 23). These lands extend from Lakes Michigan and Huron in the south to Lake Superior in the north and appear to serve as a viable proxy for the range of environments likely to be encountered in

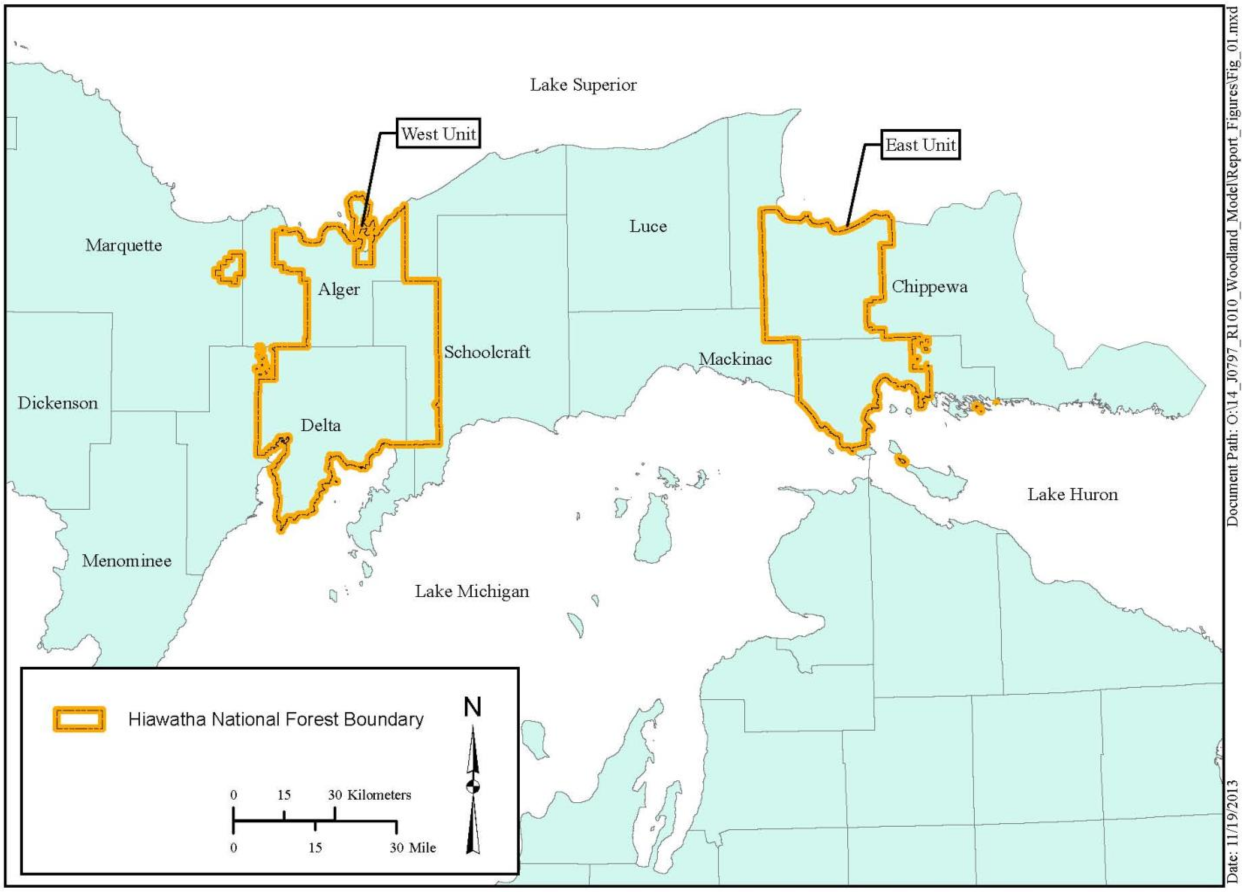


Figure 23: Hiawatha National Forest.

the eastern UP. The HNF is divided into an East Unit (EU) of approximately 396,943 ac (160,637 ha) and a West Unit (WU) that includes some 502,037 ac (203,167 ha). These figures reflect lands owned by the HNF, whereas the areal boundaries of the forest are larger including approximately 1,298,205 ac (525,589 ha).

4.1 Development of the Model

The study of regional settlement patterns has a long history in archaeology (Flannery 1968; Trigger 1968; Willey 1953). Early on it was apparent that the distribution of sites on the landscape could provide insight into how the sites were used and how the sites might interact with one another. An outgrowth of this was the idea that the location of archaeological sites could be predicted based on the attributes of known archaeological sites (Jochim 1976; Kohler and Parker 1986). The advent of GIS technology and its application to understanding regional settlement patterns has streamlined the process of integrating spatial, environmental, and archaeological data (see Westcott 2000).

GIS-based archaeological modeling is the process of comparing geospatial data to other variables and to forecast where people from the past used the landscape with sufficient intensity to leave an archaeological signature (Dalla Bona 2000; Ebert 2004; Wescott 2000). It has been defined as, “a technique to predict, at a minimum, the location of archaeological sites or materials in a region, based either on the observed pattern in a sample or on assumptions about human behavior” (Kohler and Parker 1986:400). The most prominent factors used to create these models are environmental variables, such as the distance from a site to a particular resource or the topography within a site location.

Predictive models make certain assumptions in order to operate. These assumptions are quantified, compiled, and assessed as part of the modeling process. The first assumption in this model is that the locations of known LW archaeological sites are representative of all the existing LW sites in the HNF. A second assumption is that the LW sites are/were located in relation to particular geographic or ecological features (e.g., topography, soils, distance to water, vegetation, etc.). The second assumption is based on the expectation that the locations of LW archaeological sites are correlated to the location of resources important to LW people.

For the current study, it was hypothesized that Late Woodland site settings, or locations of increased LW archaeological sensitivity, could be predicted based on the environmental settings of the LW sites already located on the Hiawatha. This sort of archaeological modeling has been characterized as an inductive approach (Ebert 2004; Gibbon 2002; referred to as empiric-correlative approach by Kohler and Parker 1986). This approach assumes that non-cultural characteristics of a site location, in this case environmental characteristics, are useful predictors of site location. In other words, we are relying on currently available information about LW archaeological site locations on the HNF to develop generalizations or predictions about other, currently unknown LW site locations on the HNF. Inductive models are the most commonly used in archaeology (Ebert 2004; Gibbon 2002; Kohler and Parker 1986; Kwamme 1985). The other type of model, deductive models, rely on general theory concerning past human behavior to hypothesize the locations of archaeological sites. Deductive models are less often used in archaeology because they are more often based on more general and subjective criteria as well as being more difficult to operationalize (Ebert 2004; Kohler and Parker 1986).

The existing model for LW settlement and subsistence in the eastern UP was derived from a relatively small number of archaeological sites (as many as 29) located on the Great Lakes shoreline and emphasizes the reliance on spring and fall spawning fish (the Inland Shore Fishery model [Cleland 1982; see also Martin 1985; B. A. Smith 2004; Chapter 2.2]). The HNF archaeological surveys have found coastal as well as interior LW sites adding an important new dimension to our understanding of eastern UP LW settlement patterns (Dunham 2002; Dunham and Branstner 1998).

More recently, pilot studies have shown that LW peoples used certain site settings and habitats more extensively than others, including a greater use of interior locales than previously expected (Dunham 2002, 2008; 2009; Franzen 1986, 1987; Martin 1999). While it can be assumed that the distribution of LW sites reflects the location of resources used by LW peoples, the distribution of sites is not entirely random and suggests other, likely cultural, factors play a role in the selection of site locations.

Based on the results of the pilot studies, a more detailed analysis of LW site location on the HNF was carried out and a GIS predictive model of LW site location on the Forest was created (Figure 24). The goal of this exercise was to identify settings or locations of greater archaeological sensitivity, especially in regard to the ecological setting of the LW sites. The environmental settings were then used to predict the potential occurrence of LW archaeological sites in other parts of the Forest as well as the eastern UP as a whole.

If we assume that archaeological sites are not randomly placed on the landscape, and that their placement is an outcome of decision making by the people who used them, then the spatial patterning should be observable (Ebert 2004; Gibbon 2002; Kvamme 1985; Warren and Asch 2000). A set of spatial and environmental variables were selected to better understand the parameters of LW locations in the HNF. These variables -- aspect, distance to water, slope, elevation, habitat classification, pre-1800 forest, potential growing days, and distance to potential wild rice patches -- were considered to have potential predictive value based on our knowledge of site distributions and LW adaptations.

There are 48 archaeological site locations with LW components that are included in the HNF site files (Figure 25). Thirty-six of the LW sites on the HNF are found in the WU and the other 12 in the EU. Most of these sites have been discovered through archaeological (cultural resource) surveys on the HNF, although a small number have been found through other survey efforts (Appendix J). Not only were they discovered through HNF surveys, they were found using relatively consistent survey methods (Appendix K). For the purpose of this model, these LW sites are considered a representative sample of the range of LW sites on the HNF.

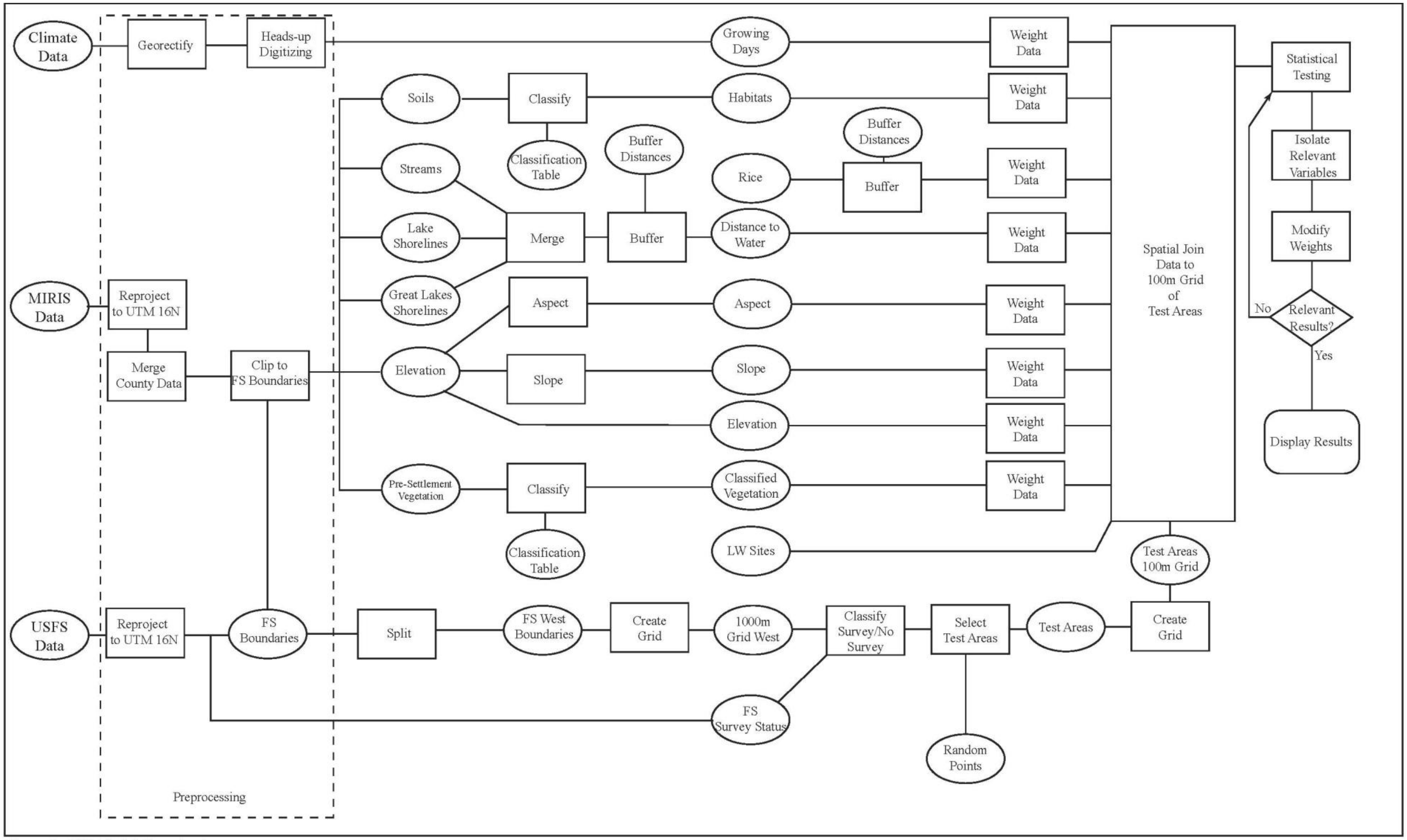


Figure 24: GIS Model Flowchart.

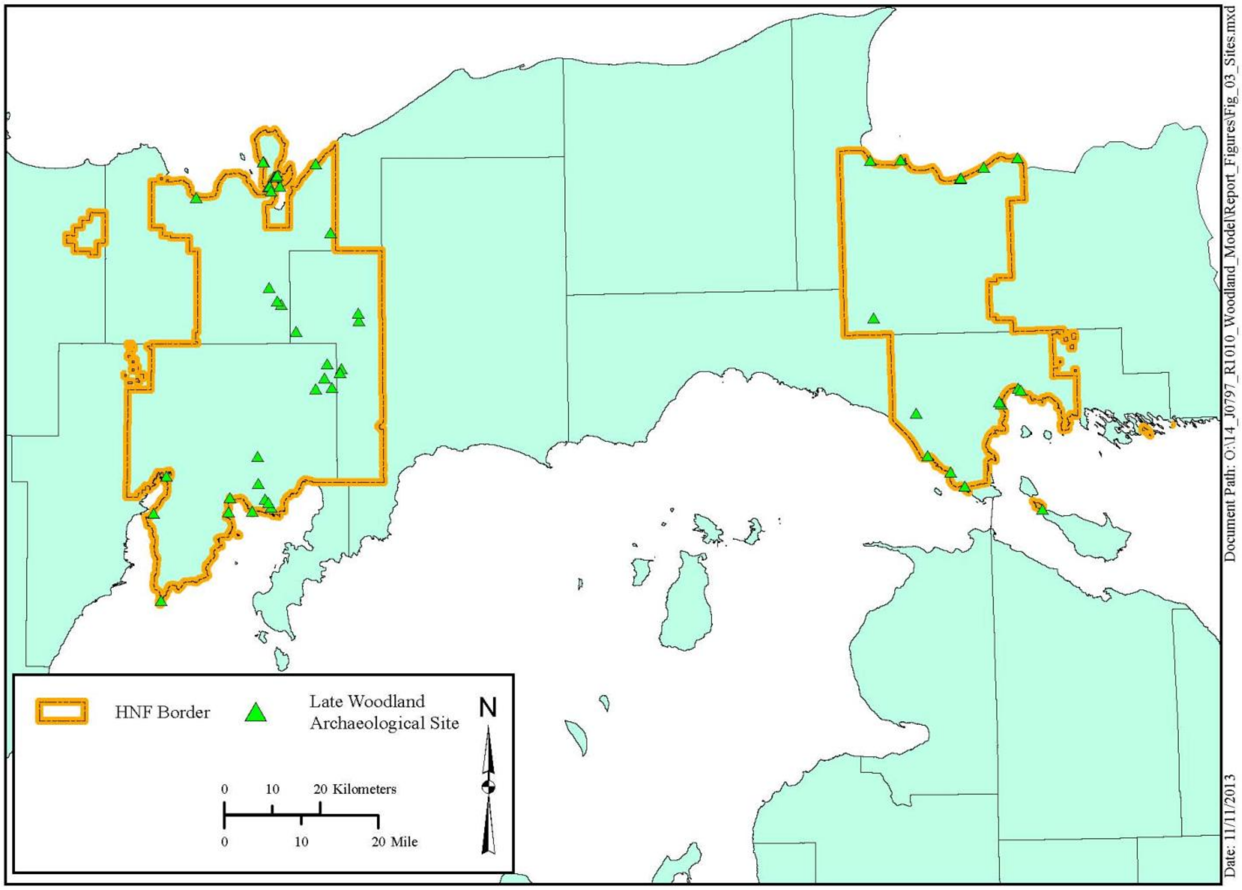


Figure 25: Late Woodland Site Locations on the Hiawatha National Forest.

This a small sample of LW sites, but it represents the <u>entire set</u> of known LW sites on the HNF from which to explore environmental setting. The use of modern environmental variables may raise concerns. On the one hand, these can be considered proxy variables and that LW site locations may co-occur with these variables, rather than correlate with them. However, the major environmental variables explored in the study have currency in the Late Woodland period. For example, forest communities similar to those of the present were established in the Upper Great Lakes region by 3000 years ago and modern levels of the Upper Great Lakes had been generally achieved by 2000 years ago (Anderton 1993; Brugam et al. 1997; Winkler et al 1986).

The original plan was to carry out a logistic regression analysis in the GIS to build a model of the environmental variables that influenced Late Woodland site locations (Ebert 2004; Warren and Asch 2000). However, the spatial scale of the HNF (898,980 ac) and small number of LW sites (48) made such an analysis untenable. Thus, a decision was made to use the West Unit LW site sample as the baseline for the construction of the model because of the higher density of LW sites (502,037 ac and 36 sites) as well as the contiguous nature of the land base.

Unfortunately, a logistic regression analysis in the GIS for LW sites in the WU also proved impractical. Although such an analysis could have been conducted, the spatial scales would not have been fine enough for meaningful results (105 square kilometer quadrats [see Chapter 4.1]). These constraints led to the development of a ranked model of site sensitivity (Della Bona 2000; Ebert 2004).

There are an additional 33 LW sites in the eastern UP that are not located on HNF lands, but are listed in the archaeological site files maintained at the SHPO. Five of these fall within the aerial boundaries of the HNF, but are located on state land, private land or, in one case, the Pictured Rocks National Lakeshore (Appendix J). The sites not listed in the HNF files have been identified in a variety of ways including formal survey, informant sources, etc. Although these sites, as well as the twelve LW sites on the EU, were not used as part of the model building, the environmental variables derived from them were used in other aspects of this analysis. The sample of LW sites from outside the HNF was not collected in as consistent a fashion as the HNF sample, however it is still useful in that it supplies LW site data from additional site locations to the study.

The spatial and environmental data were derived from GIS shapefiles and each of the LW sites was plotted as a point with GIS. The spatial and environmental data pertinent to each site locale were then generated for each archaeological site via GIS. Each of the LW sites was entered as a point into the GIS, using Universal Transverse Mercator **(**UTM**)** coordinates for the center point of the site. This rendered the site location as a 30 meter (m) × 30 m raster. A 30 × 30 m raster covers a 900 m² area. While this is not a large area, it is the same size as the median area of the LW sites in the eastern UP. Thus, half of the sites are larger and the other half are smaller than the GIS-generated raster used in our study. The median site area in the WU sample is 650 m². Coastal sites on the WU are a little larger with a median area of 1,000 m² and interior sites are smaller at 625 m².

4.1.1 *Distance to Water*

Most analyses of prehistoric site location accept that access to water sources is a critical factor in archaeological site location, and proximity to water is understood as an important variable in northern Michigan and Upper Midwest (Ebert 2004; Franzen 1986; Gibbon 2002; Kvamme 1985; Martin 1977; Peters 1986). Using the Michigan Geographic Data Library (MiGDL) line and polygon hydrography datasets for lakes, ponds, rivers and streams, a Euclidean distance raster was created at a 30 m × 30 m resolution (MiDGL 2013a, 2013b, 2013c). Using this dataset, the distance to water value was extracted to the LW site dataset, allowing for the calculation of the distance to water. The resolution created a continuous scale measurement in 30 m × 30 m increments (0 m, 30 m, 60 m, 90 m, etc.), but because these units are square, some distances were calculated along the hypotenuse of multiple squares (0, 42.43, 67.08, 90.87, etc.). Regardless, the outcome simply describes a distance to water value. A site listed as 0 m is directly adjacent to the source of water (the raster intersects the water), a site listed as 30 m is within 30 m of a water source, etc. This method allows for the use of the output as either continuous or categorical data.

4.1.2 *Elevation*

In northern Michigan, elevation has often been used as a guide in determining the relative age of sites (Archaic or Woodland), specifically in relation to former and current Great Lakes shorelines (Anderton 1995; Anderton et al. 2009; Lovis et al. 2012). The general premise is that site locations varied with the past elevations of shorelines. Although elevation is not assumed to be a reliable gauge of the relative age of coastal sites in the current study (diagnostic artifacts and chronometric dating provide more secure dating), this variable may provide insights into broader land use. The elevation of the archaeological sites was also generated through the MiGDL Digital Elevation Model (DEM) (MiGDL 2013d). The elevation of each site locale is documented in feet above mean sea level (amsl) based on the maximum elevation.

4.1.3 *Slope*

The slope, or steepness of ground, associated with a site is also a commonly used environmental variable in archaeological site location models (Ebert 2004; Gibbon 2002; Kvamme 1985, 1992; Martin 1977). Most models for archaeological site location assume that residential sites are typically on level ground as opposed to steeply sloped areas, although specialized activities and habitation locales may be situated in steeply sloped areas. The slope of a given site locale in degrees was generated using the MiGDL DEM (MiGDL 2013d). Slope is also based on a 30 m × 30 m resolution in the DEM and the steepest element represents the slope of the raster.

4.1.4 *Aspect*

The aspect, or exposure, of a given locale has been considered an important variable in archaeological site location (Ebert 2004; Franzen 1986; Gibbon 2002; Kvamme 1985). It is understood that a southerly exposure in northern Michigan offers greater potential for warmth, whereas more northerly and westerly exposures would be more susceptible to cold and potentially more affected by prevailing winds (from the west-northwest) (Franzen 1986). The aspect of each site locale was generated using the MiGDL DEM (MiGDL 2013d). The output was presented in compass degrees (0.0-359.9 degrees). Site locations in level areas without a discernible exposure were not included (4 sites) in the statistical analysis because they could not be coded as 0.0-359.9 degrees. These sites are coded as -1 degree in Appendix L.

4.1.5 *Growing Days*

The adoption of maize horticulture is an important topic in the discussion of LW subsistence in the Midwest (Brashler et al. 2000; Cleland 1983; Hart and Lovis 2013; O'Shea 2003; McElrath et al. 2000). Prehistoric maize is typically assumed to require 140 frost free days to produce a reliable subsistence crop, though it does mature in a shorter period (Demeritt 1991; Hart and Lovis 2013; Yarnell 1964). Microclimates along the Great Lakes shoreline can extend the growing season, and in areas with a growing season of 120 to 140 days, maize is certainly possible (O'Shea 2003). Summer heat, or growing degree days (GDD), is also a factor (Demeritt 1991).

A shapefile was created in the GIS that identifies the growing season (frost free days or growing days) for the eastern UP (Figure 26). The shapefile was created through the georectification of maps from Eichenlaub et al.'s (1990) climate atlas, depicting growing days in increments of ten days (≤ 100, 100-109, 110-119, 120-129, 130-139, 140-149). This map is a depiction of frost free days, but does not incorporate growing degree days into its zones. The site locations were integrated within the shapefile and the estimated growing days for each site were extrapolated The growing days variable, along with aspect, may provide an insight into the placement of sites if potential maize horticulture was a factor. Each of the LW sites (20CH6, 20MK1, and 20MK24) that have produced maize remains are situated in the 140+ day zone (see Chapter 3.5).

4.1.6 *Distance to Potential Wild Rice Stands*

Wild rice is not generally associated with Native American subsistence in the central or eastern portion of Michigan's UP, despite its well documented use in Wisconsin, Minnesota, and Ontario (Brashler et al. 2000; Cleland 1983; Jenks 1900; Jenness 1935; Vennum 1988). It is presently unknown to what extent LW cultures in the HNF area may have relied on wild rice gathering. Despite this, there are at least 40 locations in the eastern UP where wild rice can be documented in the nineteenth and twentieth centuries (Dunham 2008). The locations of these

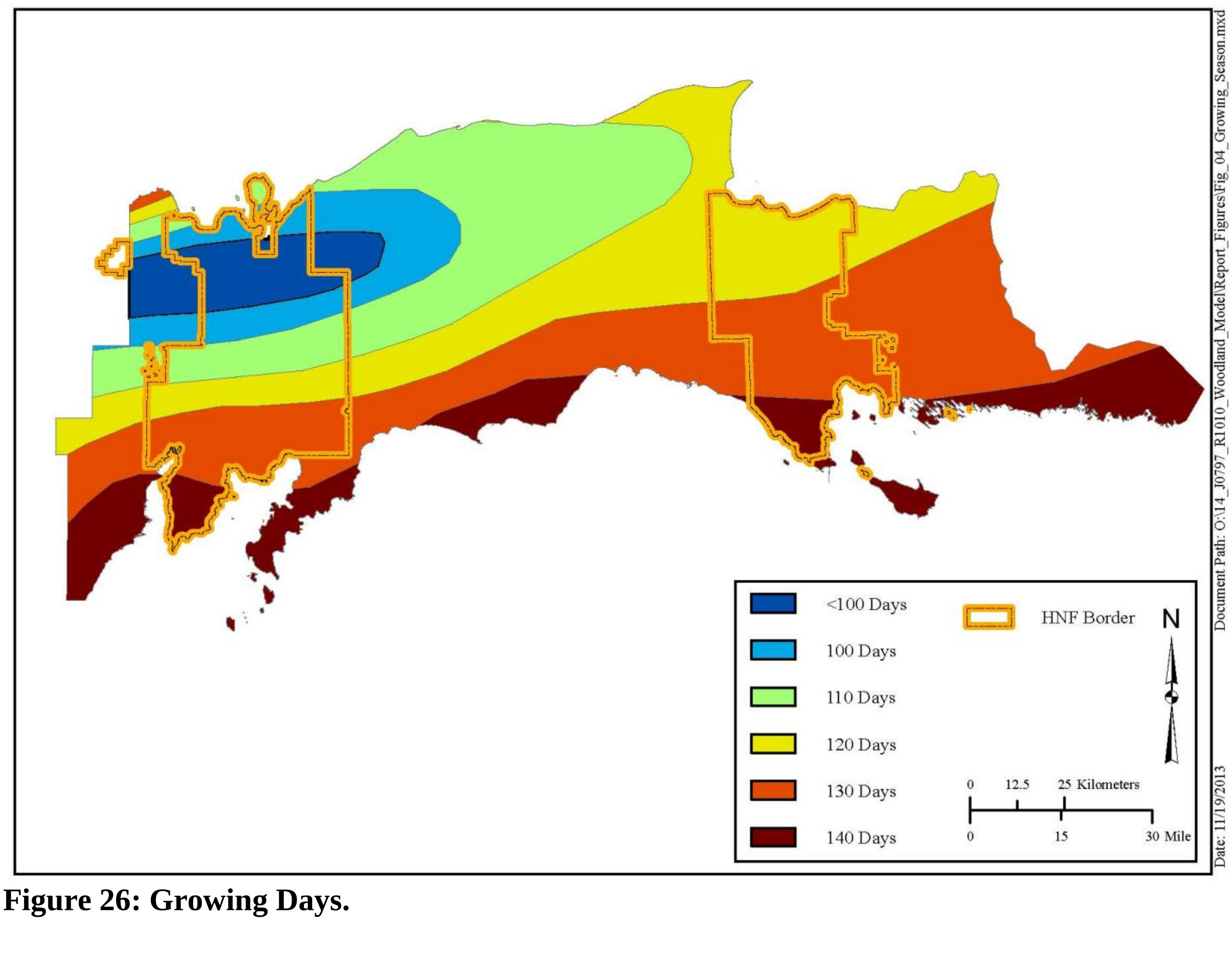


Figure 26: Growing Days.

wild rice locales correlate with the distribution of LW sites based on a previously completed pilot study (Dunham 2008)

The locations where wild rice was documented were derived primarily from early twentieth-century United States Forest Service and Michigan Department of Conservation studies (HNF 1938; MDNR c. 1949; Miller 1943; Pirnie 1935); university herbarium collections (Edman 1969; MSU Herbarium nd); and historical sources (especially Jenks 1900; Schoolcraft 1966:201; 1975:115). Further refinement of the locales was also gleaned from more recent research conducted by the Great Lakes Indian Fish and Wildlife Commission and the Bay Mills Chippewa Tribe (Brown 1999; Lu and Waller 1996).

A buffer was created around modern lake shoreline polygons in the GIS for locations where wild rice was documented in the nineteenth or twentieth century (Figure 27). The buffer was expanded at 100 m intervals to 1,500 m. The use of 1,500 m was somewhat arbitrary, but based on the assumption that sites greater than 1,500 m from a potential wild rice patch were less likely to have made significant use of that resource. The 1,500 m radius can be considered the maximum distance one might travel from a residential camp to a wild rice processing or storage locale. A 700 m radius was also considered, half of the 1500 m radius rounded down to the nearest 100, as a more conservative distance for travel from a residential site to a wild rice patch. Wild rice is a bulky item that ethnographically was processed and stored on near-shore landforms overlooking the wild rice stand (Johnson 1969; Mather and Thompson 2000; Vennum 1988).

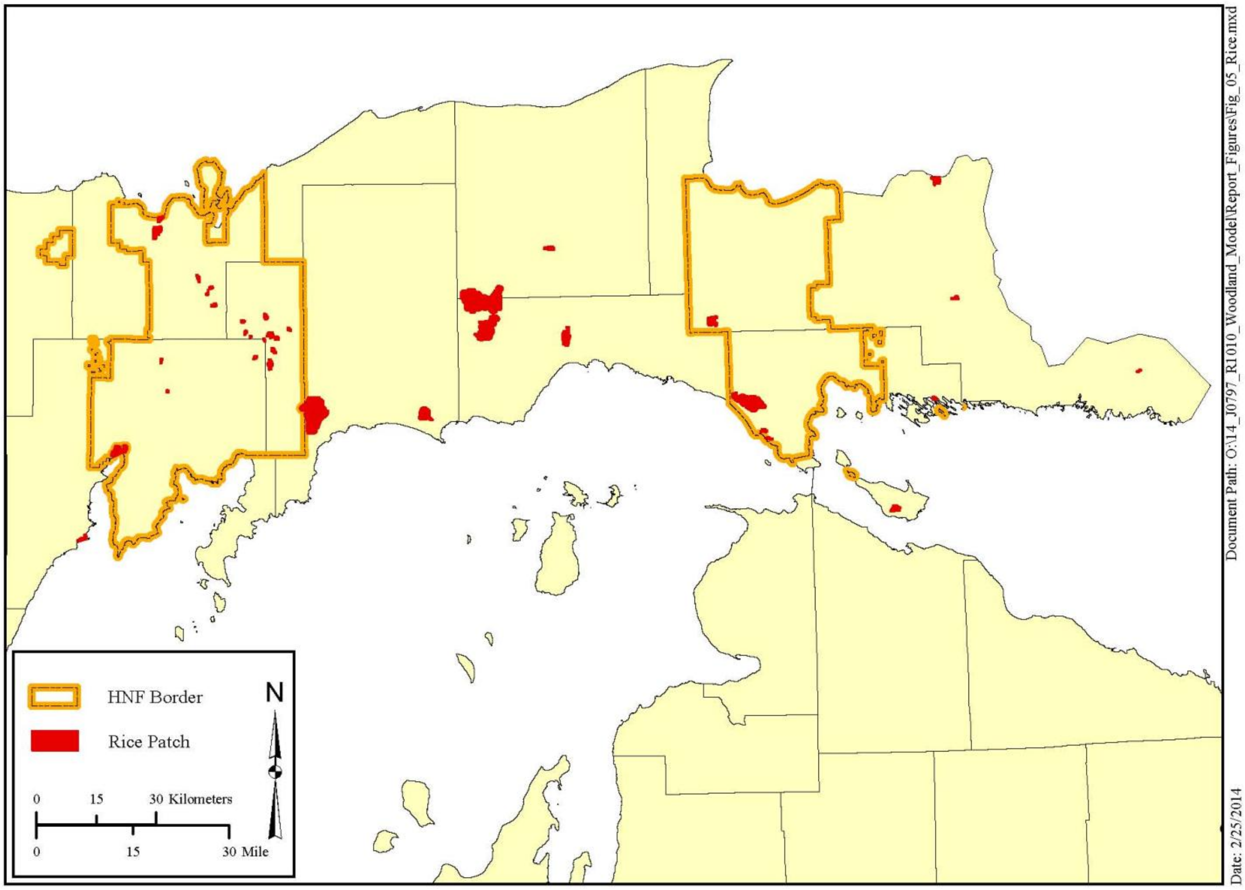


Figure 27: Location of Wild Rice Patches.

4.1.7 *Pre-1800 Vegetation*

Given the recentness of the LW period and the generalized stability of the UP environment from the LW through the present, models of the pre-1800 vegetation can serve as proxies for the vegetative communities likely present in the LW (Brugam et al. 1997; Dunham 2009; Winkler et al 1986). Several recent studies of pre-1800, or pre-European, settlement forest composition in the eastern UP have been undertaken that have relied on data derived from General Land Office (GLO) surveys (Comer et al. 1995; Delcourt and Delcourt 1996; Zhang et al. 2000). The reconstruction of the forest types is based on the identification of witness and bearing trees during the original land surveys between the 1820s and 1850s (Albert and Comer

2008; Delcourt and Delcourt 1996). The study by Comer et al. (1995) also digitized the data in a GIS format (MiGDL 2013e).

The range of vegetation was grouped in the following categories and treated as a categorical variable: unclassified; jack pine; mixed pine; mixed upland conifer forest (hemlock dominated); northern hardwood; lowland conifer; lowland hardwood; and wetland/marsh. These categories were broadly derived from the codes developed by Comer et al. (1995:9) as well as from information presented in Kost et al. (2007) and Coffman et al. (1980). The categories provide a continuum characterizing vegetation types from the driest (jack pine) to wettest (wetland/marsh). Areas that were not attributed in Comer et al. (1995) are coded as unclassified (Appendix M).

4.1.8 *Habitat Classification System*

The GLO based pre-1800 vegetation models work well to determine an aggregate sample of forest composition, but is not well suited to identify specific patches or stands on the landscape. The Habitat Classification System is based on the understanding that plants are usually found in predictable patterns or communities that are often associated with particular soil types (Burger and Kotar 2003; Coffman et al. 1980; Kotar 1976). The habitat system is an ecological model predicting the likely succession pattern and climax species in a given niche, whereas the GLO derived data is historical, a snapshot of the forests as the existed in the mid-nineteenth century. The benefit of the habitat data is that it provides a more fine-grained setting for the site itself, whereas the GLO data provides a coarser-grained view of the broader trends in forest composition (Dunham 2009).

The soils in the eastern UP have been classified using the Habitat Classification System and the soils data are available in GIS (MiGDL 2013f; Coffman et al. 1980). This data set is a digital soil survey and generally is the most detailed level of soil data available. The Habitat Classification System has shown great potential in previous studies of UP prehistoric archaeology (Dunham 2009; Franzen 1986). There is a reasonable expectation that modern soils reflect the general conditions that were prevalent in the LW (see Dunham 2009). Like the pre-1800 vegetation, the range of habitats was grouped in the following categories: unclassified; jack pine; mixed pine; mixed upland conifer forest (hemlock dominated); northern hardwood; lowland conifer; lowland hardwood; and wetland/marsh (Appendix N).

4.1.9 *Site Setting*

Interpretations of Late Woodland settlement suggest that site function and seasonality varied with location relative to the Great Lakes shore. This study considers two broad environmental settings in relation to each site: Great Lakes Coastal (or simply Coastal) and Interior. This simply refers to the site being located along or near one of the Great Lakes (Michigan, Huron, or Superior) or in the interior of the eastern UP. This variable was more subjectively assessed and not determined through the GIS because the diversity and nature of Great Lakes littoral settings could not be simply quantified as a distance from the shore of a modern Great Lake (Albert 2003; Kost et al. 2007; Lovis et al. 2012). Each site was coded and the variable added to the analysis. The site setting variable has shown potential for exploring changes in settlement and subsistence strategies (Dunham 2002; 2008; 2009).

4.1.10 *Random Points*

In addition to the 36 LW site locations on the WU of the HNF, 50 locations were also randomly generated across the WU (random points) within the GIS (Figure 28). The same spatial and environmental variables considered for the archaeological sites were also generated for each of the random points. This allowed for the comparison of known LW site locations and associated environmental attributes, with those of a randomly generated dataset of broadly comparable size. That is, the attributes for the 50 random sites could be considered representative of the total study area, and this allowed for a statistical comparison of attributes of site-bearing locations and attributes of the generalized study area.

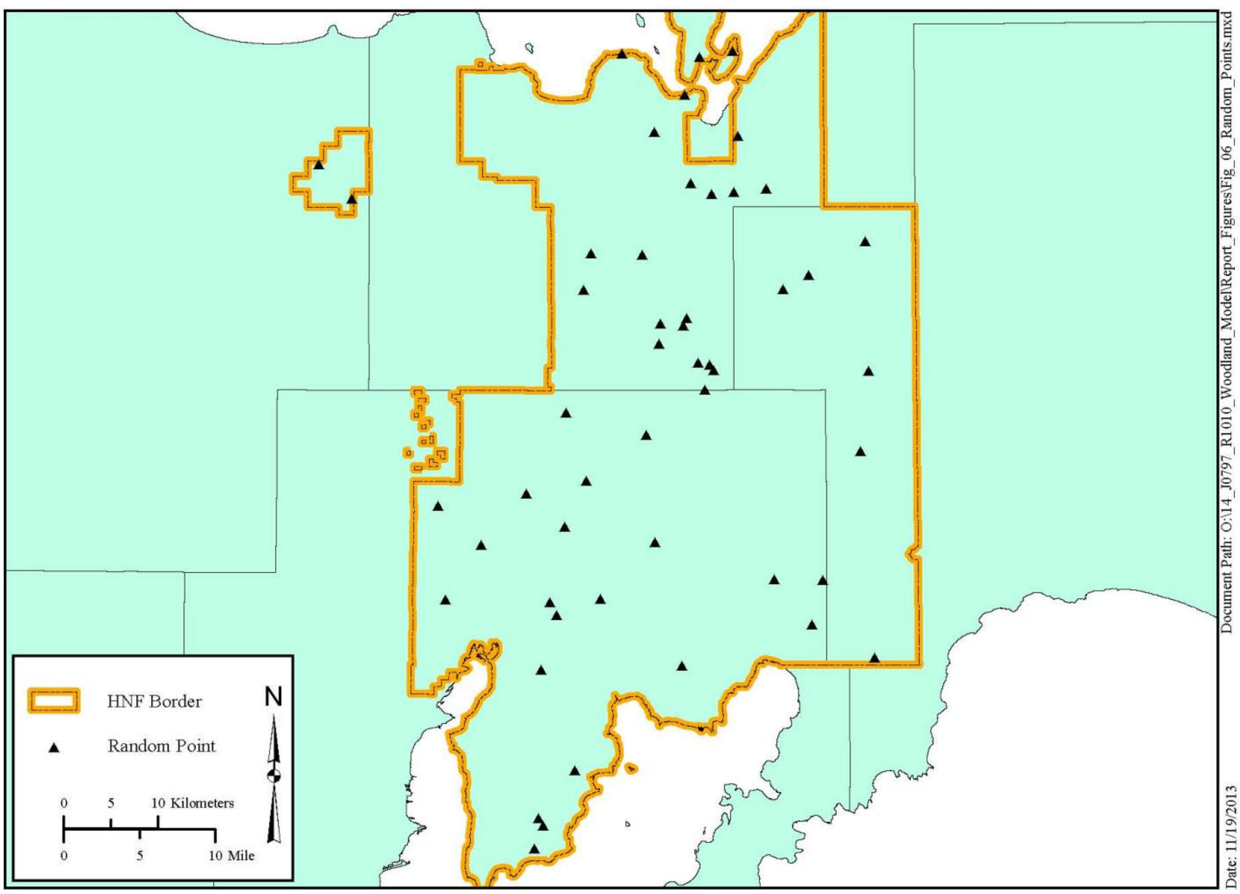


Figure 28: Random Points on the West Unit of the Hiawatha National Forest.

4.2 Statistical Analysis

The exploration of the distribution of LW and random points was begun by carrying out summary statistics for each set of data and for each variable (Appendix J). Each of the continuous variables was compared to one another with Pearson's correlation coefficient (Table 5). None of the variables had a statistically significant correlation with one another which indicates their independence and permits model building. Three primary statistical tests were used to analyze the data: Welch's Approximate t-Test, Kolmogorov-Smirnov Two Sample Test, and Chi-Square Test of Independence.

Variable	Slope	D. to Water	Elevation	Aspect	Growing Days
Slope	-	-0.010	-0.028	0.335	0.046
D. to Water	-0.010	-	0.106	-0.084	-0.087
Elevation	-0.028	0.106	-	0.130	-0.406
Aspect	0.335	-0.084	0.130	-	-0.173
Growing Days	0.046	-0.087	-0.406	-0.173	-

Table 5: Pearson's Correlation Coefficient.

4.2.1 *t-Test*

Welch's approximate t-Test was used to compare archaeological site and random site locations where the variables were continuous (distance to water, slope, elevation, aspect, and growing days) (Sokal and Rohlf 1995:404-406). Welch's t-Test is a useful mechanism to compare the means of two samples in which the variances are assumed to be different. This experiment tests the hypothesis that archaeological sites and random points are similarly distributed around the sample mean (H_0) or are differently distributed (H_1).

The results of the t-Tests comparing LW sites and random points are presented in Table 6. These tests were each conducted at a 0.1 confidence level. The null hypothesis was rejected for three variables (distance to water, elevation, and slope), and was not rejected for either aspect or growing days. The results of the tests of the aspect and growing day variables suggest there is not a significant difference in the distribution of LW sites or random points on the landscape and that these variables may be less important in archaeological site location selection. The comparison of the mean distance to water between these LW and random points shows that LW sites are situated more closely to water than random points. Likewise, LW sites are distributed at lower elevations than random points. The slope variable test indicates that the random points are more likely to be located in areas with less degree of slope than LW sites.

LW Sites v. Random Points	**Observed t Statistic**	**Critical Value @ 0.1 (two-tailed)**	**P Value (two-tailed)**	**Statistically Significant**
Distance to Water	7.530	1.674	0	**Yes**
Slope	-2.291	1.681	0.027	**Yes**
Elevation	5.008	1.665	0	**Yes**
Aspect	1.150	1.666	0.254	**No**
Growing Days	-0.428	1.669	0.679	**No**

Table 6: Summary of t-Tests.

4.2.2 *Kolmogorov-Smirnov Test*

The Kolmogorov-Smirnov two sample test (KS test) was used for the continuous variables as well as the categorical variables for pre-1800 vegetation, habitat, and setting. This test compares the difference between two distributions. The null hypothesis (H_0) assumes that the two samples are dispersed identically. While the KS test is considered more appropriate for continuous variables (Sokol and Rohlf 1995:434-439), recent studies have used this test for categorically arranged data (Ebert 2004; Thompson and Turck 2009; Whitcomb et al. 2002). It is considered a conservative test when used with categorical data.

The results of the KS tests comparing LW sites and random points are presented in Table 7. These tests were each conducted at a 0.1 confidence level. The results of the tests on continuous data were largely comparable to the t-Tests with the null hypothesis rejected for distance to water, elevation, and slope and were not rejected for either aspect or growing days. When the categorical data were explored through KS-tests, pre-1800 forest appeared to have similar distributions for LW sites and random points, whereas habitat and setting (coastal/interior) did not.

LW Sites v. Random Points	**Observed KS D Statistic**	**Critical Value @ 0.1**	**P Value (two-tailed)**	**Statistically Significant**
Distance to Water	0.817	0.267	0	**Yes**
Slope	0.291	0.267	0.054	**Yes**
Elevation	0.531	0.267	0	**Yes**
Aspect	0.270	0.119	0.285	**No**
Growing Days	0.166	0.267	0.586	**No**
Habitat	0.574	0.267	0	**Yes**
Pre-1800 Forest	0.260	0.267	0.111	**No**
Coastal/Interior	0.452	0.267	0	**Yes**

Table 7: Summary of Kolmogorov-Smirnoff (KS) Test of Site Frequency Distribution.

KS-tests were also carried out for the habitat and pre-1800 forest variables comparing them with the distributions of habitat types and pre-1800 forest types for the WU of the HNF (Tables 8 and 9). The proportion of each variable for the WU as a whole was calculated through GIS. The distribution of random points was not statistically different than the proportion of habitats and pre-1800 forest types in the WU. The distribution of LW sites and pre-1800 forest types was not statistically significant. A comparison of LW sites and WU habitats did reject the null hypothesis.

Random Points v. West Unit	Observed K-S D Statistic	Critical Value @ 0.1	Critical Value @ 0.2	Statistically Significant
Pre-1800 Forest	0.081	0.211	0.185	**No**
Habitat	0.090	0.211	0.185	**No**

Table 8: Summary of Kolmogorov-Smirnoff (KS) Test of Site Frequency Distribution.

LW sites v. West Unit	Observed K-S D Statistic	Critical Value @ 0.1	Critical Value @ 0.2	Statistically Significant
Pre-1800 Forest	0.210	0.237	0.208	**No**
Habitat	0.574	0.237	0.208	**Yes**

Table 9: Summary of Kolmogorov-Smirnoff (KS) Tests.

4.2.3 *Chi-Square test*

The chi-Square (χ^2) test of independence is employed to test the difference between an actual sample and another, hypothetical or previously established distribution. In this case, the chi-square test was used to test the differences between the distributions of LW sites and random points. Previously completed pilot studies relied on chi-square tests to explore the differences in site distributions (Dunham 2008; 2009). The null hypothesis (H_0) assumes that the two samples share a common distribution. Chi-square tests were used to assess the distance to water variable, distance to wild rice variable, the site setting variable, and the habitat variable because the results of the t-Tests and KS-tests showed these to be the most critical variables.

In addition to the comparison of WU LW sites and random points, the results of chi-square tests comparing all the LW sites in the eastern UP (81 LW sites) and a separate set of eastern UP random points (80 random points) are also presented on Table 10. This was done to provide additional comparative data for the generation of the predictive model because of the small sample of LW sites.

LW Sites v. Random Points	Observed χ^2 Statistic	Critical Value @ 0.1	P Value	Statistically Significant
D. to Water (EUP)	121.75	4.605	0	**Yes**
D. to Water (WU)	48.118	4.605	0	**Yes**
D. to Wild Rice 1500 m (EUP)	4.596	2.706	0.032	**Yes**
D. to Wild Rice 1500 m (WU)	0.803	2.706	0.370	**No**
D. to Wild Rice 700 m (EUP)	7.174	2.706	0.007	**Yes**
D. to Wild Rice 700 m (WU)	1.531	2.706	0.216	**No**
Habitat (EUP)	16.930	2.706	0	**Yes**
Habitat (WU)	30.071	2.706	0	**Yes**
Coastal/Interior (EUP)	64.571	2.706	0	**Yes**
Coastal/Interior (WU)	23.203	2.706	0	**Yes**

Table 10: Summary of Chi-Square Tests.

As with the KS-test, the chi-square test of the site setting variable confirmed that there is a significantly greater correlation between LW sites and coastal settings than there is between random points and coastal settings. Nearly half (47.2 percent [17 of 36]) of the WU LW sites are in coastal settings and only one of the 50 random points (2 percent) is in a coastal setting. For the eastern UP as a whole, 69.1 percent (56 of 81) of the LW sites are in coastal settings and only 7.5 percent (6 of 80) of the random points are in coastal settings.

The distance to water variable was set as three categories: 0-119 m; 120-239 m; and 240+ m. Thirty three of 36 WU LW sites (91.7 percent) and 87 percent (71 of 81) of all the sites in the eastern UP are located within 120 m of a source of water. Conversely, 66 percent (30 of 50) of the WU random points and 87.5 percent (70 of 80) of all the eastern UP random points are greater than 240 m from water. Based on these tests, an overwhelming number of LW sites can be expected to be found within 120 m of a source of water. Most of the random points are located over 240 m from a source of water. The results of these tests, along with the t-Tests and KS-tests, demonstrate that LW sites have been most frequently encountered within 120 m of water.

The KS-tests on the habitat variable demonstrated that LW sites have been more frequently found in mixed pine habits than other habitats. This fact, and to allow for a valid chi-square test, led to a comparison between LW sites and mixed pine habitat v. other habitats for the WU and for the eastern UP. The results of both these tests are statistically significant reflecting a greater use of mixed pine habitats by LW people than expected. About two-thirds (24 of 36) of the WU LW sites are situated in mixed pine habitats, whereas only about 12 percent of WU habitats are mixed pine habitats. For the eastern UP as a whole, 39.5 percent (32 of 81) of the LW sites are in mixed pine habitats and these habitats comprise only 8.4 percent of the eastern UP.

The distance to wild rice variable was initially derived from a comparison of LW sites and the eastern UP as a whole. About 14.8 percent (12 of 81) of LW sites are located within 1,500 m of a twentieth century wild rice patch and about 13.6 percent (11 of 81) of them are within 700 m of one. Although this does not seem significant, only one (1.25 percent) of the eastern UP random points falls within 700 m of a wild rice locale and only 3 (3.8 percent) fall within 1,500 m of one. The chi-square test shows both to be significant results. When the same variables are compared on the WU, the proportion of random points increased to 6 percent (3 of 50) within 700 m and to 8 percent (4 of 50) within 1,500 m. Despite a proportional increase of LW sites to 16.7 percent (6 of 36) within 700 m and 1500 m on the WU, the chi-square test does not reject the null hypothesis.

4.3 Quadrat Analysis

A spatial overview of the WU LW sites was performed using quadrat tests with a 1000 × 1000 m (1 square kilometer [km]) quadrat as the basic unit of analysis. The decision to use a 1 km^2 unit was made after calculating the optimal size of a quadrat and coming up with a figure of nearly 105 square km (Quadrat Size = 2A/r; where A = the area of the study area [1,888.44 km^2] and r = the number of points in the distribution [36 LW sites on the HNF WU] [Wong and Lee 2005]). While 105 km^2 is a similar size to the quadrats used in the pilot studies (36 mi^2 [93.2 km^2] [Dunham 2008; 2009]), it is too coarse of a scale for meaningful analysis for the purposes of generating a predictive model for archaeological sites.

The 1 km^2 quadrats were placed over the WU and focused on lands owned by the HNF (the boundaries of the WU include state, county, private, and other federal lands). There are 2641 one kilometer square quadrats that comprise this area (Figure 29). Some of the quadrats extend beyond the HNF owned lands as well as onto the Great Lakes which leads to an increased number of quadrats. The finer scale quadrats are also problematic because archaeological sites are only present in 28 of them (about 1 percent of the quadrats), but it was hoped the finer scale would be more useful for identifying meaningful trends in the environmental data.

Thirty five LW sites fall on HNF lands in the WU. One site, 20DE106, is located on private land, but listed in the HNF files (FS 09-10-01-076). This site was used as part of the statistical analyses, but is not part of the quadrat analysis because it did not fall within a quadrat. The 35 remaining LW sites on the WU of the HNF fall within 28 quadrats (Figure 29). One quadrat includes four sites, one includes three, and two include two sites. The quadrats with four and three sites, as well as one of the quadrats with two sites are located on Grand Island. Seven

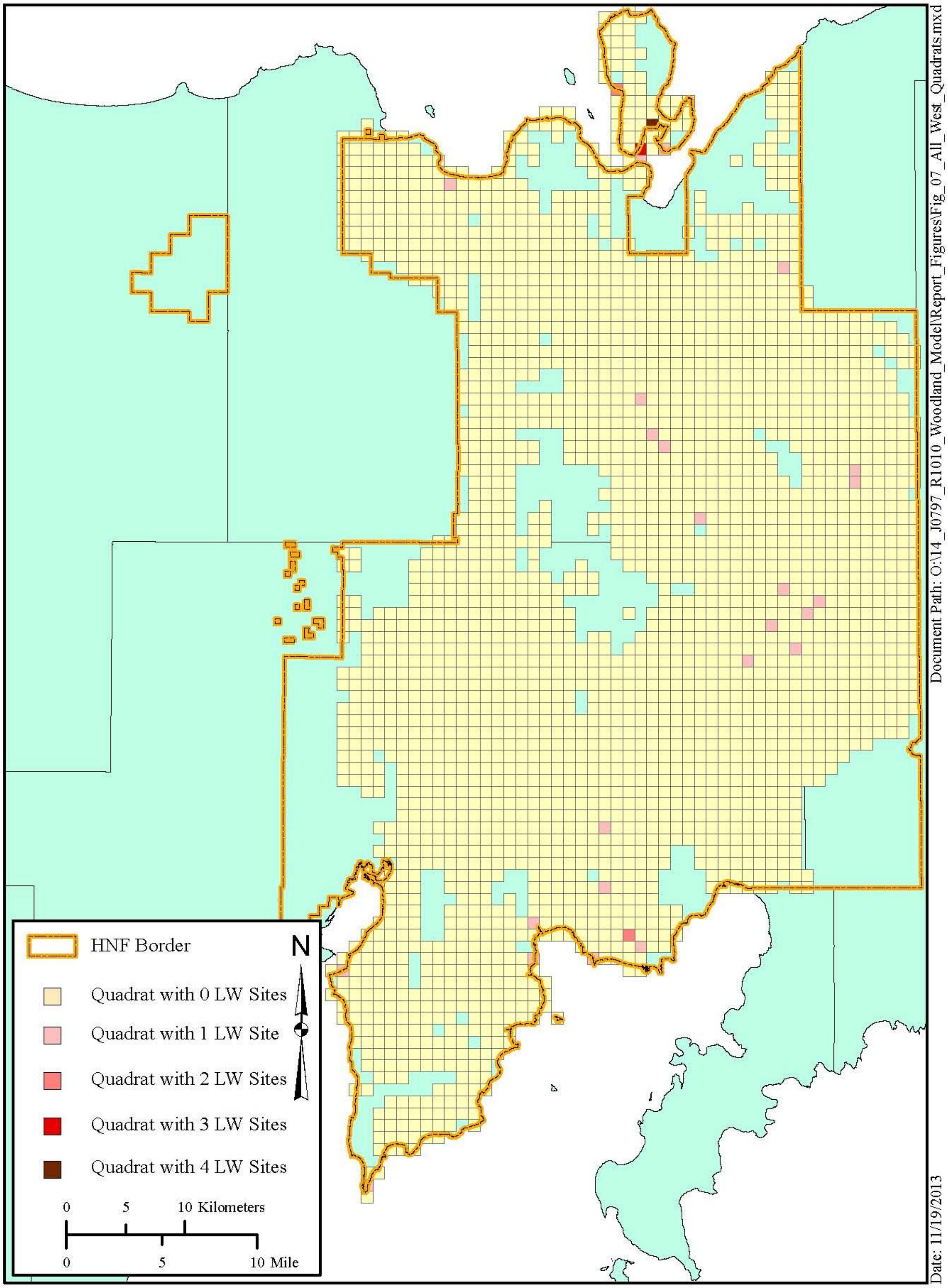


Figure 29: West Unit Quadrats.

of the sites are located on Murray Bay on the south side of the island and the other two at the mouth of Echo Lake Creek on the west side of the island. The other quadrat with two sites is situated on the lower Sturgeon River upstream from Nahma. The remaining 24 quadrats include a single LW site.

The fifty random points generated for the WU were also examined and each is situated within a single quadrat. One of these quadrats includes a LW site as well as a random point. Two thousand five hundred and sixty four quadrats do not include either LW sites or random points.

While the spatial outcomes of the quadrat tests were of somewhat limited value, a review of the environmental variables was quite enlightening. For the most part the quadrat data provides a generalized background for the WU of the HNF that can provide part of the baseline for these analyses. Beginning with elevation, the pooled means of the 2641 quadrats generated a mean elevation of 751.3 ft (median 753.6 ft). This includes a range of elevations from 581 ft (the elevation of Lake Michigan/Huron), to a maximum elevation of 1079 ft. This compares well to the mean elevation of the random points, but not to the LW sites (Table 11).

As shown in Table 11, the LW sites are at a lower mean elevation than the quadrats or the random points. This is because about half of the WU LW sites are situated on or near the shores of the Great Lakes (ca. 582 ft for Lakes Michigan and Huron and ca. 602 ft for Lake Superior). The relatively low elevation of the Great Lakes shorelines in relation to the eastern UP as a whole skews the mean elevation of the LW sites to a lower elevation. There is a relationship between site location and Great Lakes Coastal locations, but this relationship can be subsumed under the occurrence of LW sites and all sources of water (e.g., distance to water).

Elevation	All Quadrats	Random Points	LW Sites
Mean	758	748	658
Median	759	752	619
Minimum	581	594	582
Maximum	1079	921	856

Table 11: Elevation in Feet amsl.

When slope is considered (Table 12), the slope of the pooled mean of the quadrats and the mean slope of the random points were low (6 and 8 degrees respectively), whereas the mean slope of the archaeological sites was higher (14 degrees). The quadrat data shows that there is not a lot of topographical relief in the WU and the ground surfaces are generally relatively level. The explanation for the higher elevations of LW sites is more fully detailed below, but the basic rationale relates to the relationship between site locations and bodies of water.

Slope	All Quadrats	Random Points	LW Sites
Mean	8	6	14
Median	6	3	6
Minimum	0	0	0
Maximum	85	35	82

Table 12: Slope in Degrees.

The aspects of LW sites and random points were not statistically different from one another. The quadrat test provides support for the conclusion that the lands in the WU, and the eastern UP in general, are oriented in a southeasterly manner (Table 13). The LW sites have a mean aspect of 163 degrees (median 165 degrees), the random points have a mean of 160 degrees (median 161 degrees), and the pooled mean of the quadrats is 165 degrees (median 154 degrees). If we assume a southerly aspect is between 120 degrees and 240 degrees, then the mean of all three sets fall comfortably within that range. This suggests that southerly, and

Aspect	All Quadrats	Random Points	LW Sites
Mean	165	160	163
Median	154	161	165

Table 13: Aspect in Degrees.

specifically, southeasterly (120 to 180 degrees), aspects are well represented in the eastern UP. Aspect does not appear to be a critical variable in predicting site location in the region.

The growing days variable was also examined. The pooled mean growing days of the quadrats as well as the means of the random points and LW sites were each 115 days or less (Table 14). The results, along with the previous statistical studies, suggest that LW site locations were not solely selected based on the potential to carry out horticulture (minimally 120 growing days, but more likely 140+ growing days). The quadrat data informs us that areas with optimal growing days for maize are uncommon in the eastern UP. Of the 2641 quadrats in the WU, only 173 include areas with 140+ growing days (6.5 percent).

Growing Days	All Quadrats	Random Points	LW Sites
Mean	115	113	114
Median	110	110	110

Table 14: Growing Days.

The quadrat approach is more effective in discussing some of the other environmental variables, such as the relationship between LW sites, water sources, and habitats. As previously discussed, the distance to a source of water is a critical variable in determining LW site locations. Quadrats that include LW sites have a mean minimum distance to water of 63 m, whereas quadrats with random points, and all the WU quadrats, have a mean minimum distance of greater than 300 m to water (Table 15).

	All Quadrats	Random Points	LW Sites
Mean Distance to Water	444.16	316.78	62.50
Habitat Diversity	3.1	3.1	3.6

Table 15: Mean Distance to Water and Habitat Diversity.

The habitat variable provides another measure of assessing site selection on the landscape. We have seen that LW sites are most commonly associated with mixed pine habitats. The quadrat study confirms this observation and also illustrates that LW peoples were selecting areas with greater habitat diversity than other areas (Table 15). Quadrats that include archaeological sites have a density of 3.6 habitats per quadrat, whereas the quadrats with random points as well as for all the quadrats, have a diversity of 3.1 habitats per quadrat. Mixed pine, northern hardwood, lowland conifer, and open wetland habitats were each present in over 70 percent of quadrats with LW sites (Figure 30). Only northern hardwood and lowland conifer were present in over 70 percent of the quadrats with random points as well as the entire set of WU quadrats. Northern hardwood and lowland conifer habitats are the best represented habitats in the WU and in the eastern UP as a whole (WU 37.7 and 36.8 percent respectively, EUP 30.3 and 42.6 percent), whereas mixed pine and open wetland habitats are not (WU 12.1 and 3.6 percent respectively, EUP 8.4 and 7.6 percent).

Wild Rice patches appear in only 67 quadrats. For perspective, interior lakes appear in 998 quadrats. Using an *a priori* probability approach and the wild rice variable we predict that wild rice would be found in 0.025 quadrats in the WU (67 of 2641 quadrats). LW Sites are currently known in 28 quadrats, thus one would expect wild rice in less than 1 (0.7 quadrats) of the quadrats with a LW site. Wild rice and LW sites appear in 5 quadrats which is a ratio of about 7:1 observed to expected. A chi-square test confirms the statistical significance of this

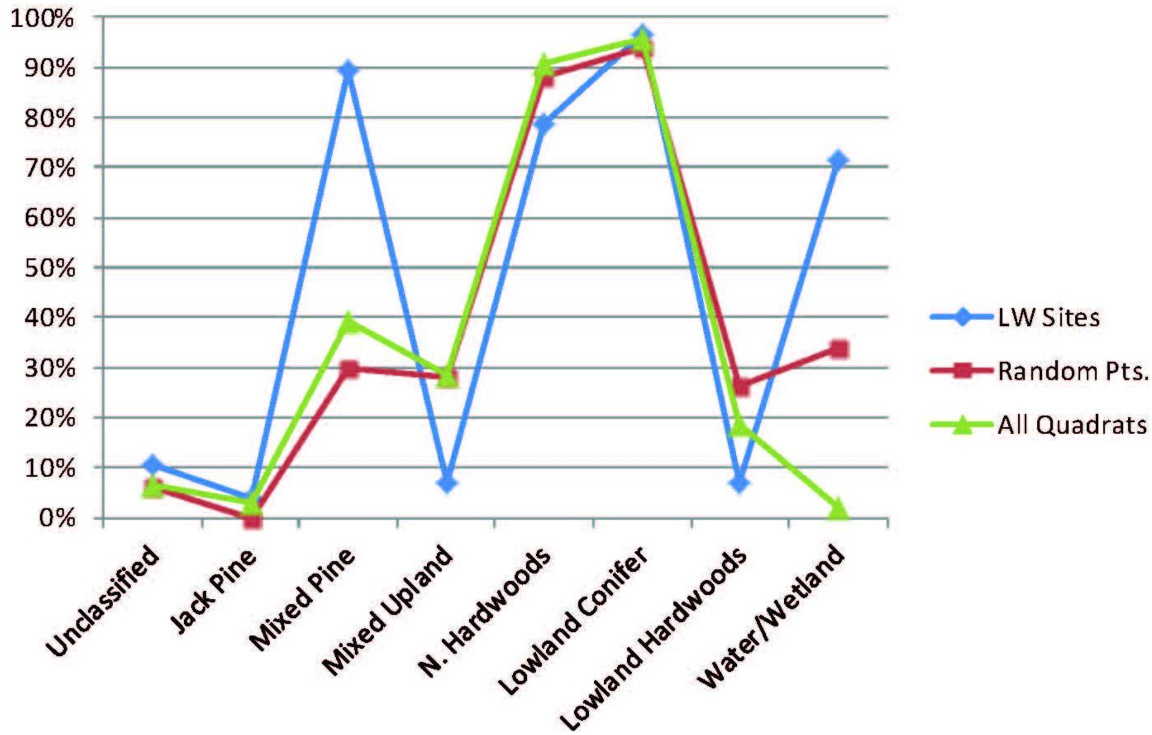


Figure 30: Comparison of Quadrat Habitats.

difference (Table 16). For random points (50 quadrats), one would expect 1.25 quadrats to have wild rice. Wild rice and random points appear in 3 quadrats (a ratio of 2.4:1). While the higher than expected number of quadrats with both wild rice and random points appears significant, the chi-square test does not confirm this interpretation (Table 12).

Wild Rice	Observed χ^2 Statistic	Critical Value @ 0.1	P Value	Statistically Significant
LW Sites	6.776	2.706	0.009	Yes
Random Points	0.377	2.706	0.539	No

Table 16: Wild Rice in West Unit Quadrats (Yates Correction).

4.4 Review of the Variables

The following discussion examines the results of selected statistical tests, focusing on those variables that were significant (distance to water, slope, elevation, habitat, site setting, and wild rice).

4.4.1 *Site Setting*

The Inland Shore Fishery model assumes the importance of LW coastal sites for access to spring and fall fishing grounds (Cleland 1982; Martin 1985). Therefore, one would expect a high degree of coastal setting sites. A pilot study has shown that LW coastal sites outnumber LW interior sites by a ratio of a little more than 2:1 for the eastern UP (Dunham 2002). The KS-tests and chi-square tests show a greater proportion of LW sites (observed) in coastal settings than random points (expected). These tests confirm that coastal sites outnumber interior sites by a little over 2:1 for the eastern UP as a whole, but also show that this ratio is slightly over 1:1 favoring interior sites for the WU of the HNF (19 interior to 17 coastal).

The first response to the difference in ratios is that the WU of the HNF has included a significant amount of archaeological survey on interior areas, whereas many other parts of the eastern UP have not. However, interior locales in the East Unit of the HNF have been similarly surveyed and the ratio is 7 coastal LW sites to 1 interior LW site (14 coastal to 2 interior). A χ^2 test comparing WU LW site settings and the settings of the remainder of the eastern UP LW sites indicates that the pattern on the WU is distinct and statistically significant (Observed $\chi^2 = 14.583$, Critical Value @ 0.1 = 2.706, P Value = 0). This suggests that LW people are making greater use of the interior in the WU than in other parts of the UP. Additional archaeological survey for

LW sites in the eastern UP, aside from the West and East Units of the HNF, may clarify this difference.

Martin's (1985) study of Woodland coastal settlement within the Upper Great Lakes, with particular reference to the eastern UP and the Straits of Mackinac, found that site location was most closely related to local fish habitat conditions, with most site locations displaying complex shorelines (especially associated with embayments). Archaeological field work in the HNF generally confirms these studies, associating prehistoric sites with former and modern barriers, spits, embouchures and other complex landforms associated with embayments (Anderton 1993, Anderton 1995; Dunham and Branstner 1998). The sensitivity of coastal settings is further demonstrated through the observation that nearly 32 percent of 173 prehistoric sites recorded and tested between 1992 and 1997 were associated with modern or paleoshorelines (Dunham and Branstner 1998:165-167). Nearly all of these sites are associated with complex landforms associated with embayments and river/stream mouths.

4.4.2 *Distance to Water*

By all measures, distance to water is a critical factor in LW site location in the eastern UP. An overwhelming majority of LW sites (87 percent of all LW sites) have been found within 120 m of a source of water. Most of the random points (87.5 percent of all random points) are located over 240 m from a source of water. The quadrat test also found that quadrats with LW sites were closer to water than other quadrats. The results of these tests, along with the t-Tests and KS-tests, demonstrate that known LW sites are located in close proximity to water.

4.4.3 *Elevation*

The statistically significant differences in elevation between the random points and LW sites is the result of the high proportion of LW sites being located along or near a Great Lake shoreline (ca. 582 ft for Lakes Michigan and Huron and ca. 602 ft for Lake Superior). The relatively low elevation of the Great Lakes shorelines in relation to the eastern UP as a whole skews the mean elevation of the LW sites to a lower elevation. This can be illustrated by comparing the means of coastal and interior setting LW sites for the entire eastern UP. The mean elevation of coastal setting LW sites is 602 ft (minimum elevation of 582 ft and maximum of 630 ft). There is only a difference of 48 ft separating the highest and lowest elevation for coastal setting LW sites and coastal sites comprise 69 percent of the LW sites in the eastern UP sample. Interior LW sites have a mean elevation of 693 ft (minimum elevation of 583 ft and maximum of 856 ft) and a spread of 303 ft from the highest to the lowest. Further, only one of the 50 WU random points is located in a coastal setting which further effects the distribution of elevations, since 49 of the random points are located in the interior.

Elevation is clearly a significant factor because of the high proportion of archaeological sites situated in coastal settings. However, the distance to water is a more sensitive variable in relation to site location and, by default, coastal settings are all closer to water than the WU random points. The mean distance to water for random points is 459.4 m.

4.4.4 *Slope*

It seems counterintuitive that random points would exhibit less slope than LW sites. One tends to associate level areas with habitation locales. However, when we consider how LW sites are dispersed across the landscape, this can be explained by topography and the terms of measurement in the GIS system. First, LW sites are typically located in close proximity to water such as a Great Lake, an interior lake, or an interior river or stream. Each of these settings is often associated with a bank or terrace that is situated above the body of water.

For example, the Williams Annex site (20AR353 [FS 09-10-03-811]) is situated at the base of a steep Nipissing era wave cut bluff on a lower surface overlooking Lake Superior and the Widewaters site (20AR245 [FS 09-10-03-667]) is situated on a terrace above the Indian River (Franzen 2000; Robinson et al. 1991; Rutter and Weir 1985). The 30 m square raster used to measure slope in the GIS takes the highest value within the 30 m square. The Nipissing bluff is the basis of the 84 degree slope at the Williams Annex site and the terrace along the Indian River is the cause of the 23 degree slope for the Widewaters site, despite the fact that each of these sites is situated on relatively level ground. In other words, the LW sites are often located on relatively level ground in areas with high locale relief (see also Kvamme 1992). For the reasons enumerated above, slope, as measured in the GIS, is not considered a critical variable in LW site location.

4.4.5 *Habitat*

Previously completed pilot studies have shown a statistically significant relationship between the location of known LW archaeological sites in the eastern UP and mixed pine habitats (Dunham 2009; 2012). Similarly, Franzen's (1987) study found that most interior lake sites were associated with pine-oak forests (generally equivalent to the mixed pine forest category used by Dunham [2009; 2012]). The current study demonstrates that about 66.7 percent of WU LW sites and 49.5 percent of LW sites in the eastern UP are located in mixed-pine habitats. These habitats comprise about 12 percent of the WU and less than 10 percent of the habitats in the eastern UP. The statistical tests presented above indicate that this is not the expected distribution of sites and habitats and that there is a positive correlation between LW sites and mixed pine habitats.

The mixed-pine habitats provide a variety of resources that were attractive to Woodland peoples in the region. The succession pattern in these forests is conducive to beaver, moose, and warm-season deer habitat because of the regular creation of openings, especially through fire, and a high incidence of aspen and other habitats preferred by these herbivores (Dunham 2012; Franzen 1986, 1987). Such habitats also include a higher incidence of certain fruits, such as blueberries as well as other resources, such as acorns, that were utilized as food by Native Americans as well as by the animals they hunted (Anderton 1999; Dunham 2000a; 2009; Chapter 3.5).

4.4.6 *Wild Rice*

A pilot study exploring the modern distribution of wild rice and the distribution of Woodland period archaeological sites found a spatial relationship between the archaeological sites and places where wild rice grows (Dunham 2008). Chi-square tests were employed in the pilot study to compare the relationship between townships (93.2 km^2 quadrats) that have wild rice and archaeological sites. The results of the chi-square test showed a statistically significant relationship between townships that have wild rice and archaeological sites as well as for townships that do not include either (Dunham 2008).

As part of the current study, a statistically significant relationship was found between LW sites within 1500 m and within 700 m of a modern wild rice stand as opposed to random points for the eastern UP as a whole. This relationship was also supported in the comparison of WU

LW site locations as part of the quadrat analysis. The data from the pilot study and the eastern UP portion of the current study support the potential significance of the wild rice variable, though the variable does not seem as important in LW site location dynamics as habitat or distance to water.

4.5 Model Construction

The preceding statistical analyses indicated that distance to water and habitat were the most sensitive variables in regard to WU LW site location. Distance to potential wild rice stands was also found to have a statistically significant relationship with the location of LW sites, but not across all levels of analysis. The distance to water variable and habitat variable were explored through a multiple regression formula. The results of this test showed that the combination of these two variables was more likely to predict LW site locations than either of the variables individually (Appendix O). This supports the utility of the model.

A working framework was developed in which distance to water and habitat were ranked and assigned point values. Categories were developed for each variable from the statistical tests: distance to water - 0-120 m, 121-240 m, and 240+ m (the 120 m scale allowed for more efficient processing in GIS); habitat – unclassified, jack pine, mixed pine, upland conifer, northern hardwood, lowland conifer, lowland hardwood, and marsh/wetland; and the conservative measure for wild rice – 0-700 m and 700+ m. The point values were generated by treating the WU LW site set and the eastern UP LW site set as two distinct sets, though they overlap. The two sets combined to include 117 LW sites. Mean scores were generated by assessing the number of LW sites in each category and dividing by the total. These scores were then rounded up or down to a whole number (Table 17). The wild rice score was determined as presence or absence, with sites situated within 700 m of a patch receiving points and sites greater than 700 m from a stand receiving no points. The distance to water, habitat, and wild rice scores were then combined to generate a score for each site. In the same manner, scores were also generated from random points.

The scores in Table 17 are values reflecting the currently understood occurrence of LW sites within that category. For example, since approximately 90 percent of the LW sites have been found within 120 m of a source of water, it is hypothesized that like areas will produce 90 percent of the LW sites to be discovered. Combining the scores from each of the three variables provides a weighted score with the assumption that the higher the score, the more likely an area is to include a LW site.

Locations within 120 m of a source of water and located in mixed pine habitats were determined to represent the areas of highest potential for LW sites (Table 18). Combining the distance to water score and habitat score, a score of 140 is achieved for these locations. If one of these locations was also within 700 m of a wild rice stand, then the score would be increased to 155. Medium sensitivity areas were defined by scores between 59 and 139. The base-line of 59 points is the value of a location in a mixed pine habitat between 120 m and 239 m of a source of water. Low sensitivity areas have scores of less than 59 points.

4.6 Review of the Model

The archaeological predictive scores were then applied to the sample of LW sites to observe the distribution of the scores in relation to the sites (Appendix P). When the scores are compiled against the LW sites in the WU, 63.9 percent fall within the high category, 33.3 percent in the medium category, and 2.8 percent in the low category. In other words, 97 percent of the

Variables	Score
Distance to Water	
0-120 m	90
121-239 m	9
240+ m	1
Habitat	
Unclassified	4
Jack Pine	8
Mixed Pine	50
Upland Conifer	2
Northern Hardwoods	15
Lowland Conifer	18
Lowland Hardwoods	0
Marsh/Wetland	3
Wild Rice	
0-700 m	15
700+ m	0

Table 17: Late Woodland Site Predictive Model Point Scales.

Archaeological Sensitivity	Sensitivity Score
High	140+
Medium	59-139
Low	0-58

Table 18: Late Woodland Site Archaeological Predictive Scores.

known WU LW sites have been found in areas of either high or medium sensitivity for LW sites. The WU random points fall in a nearly inverse pattern with 2 percent in the high category, 28 percent in the medium category, and 70 percent in the low (Table 19).

Archaeological Sensitivity	WU LW Sites (%)	WU Random Points (%)
High	63.9	2
Medium	33.3	28
Low	2.8	70

Table 19: West Unit Late Woodland Archaeological Sensitivity.

The results are different when the scores are applied to the entire eastern UP set of LW sites (Appendix P). In this case, 37 percent of the LW sites are identified in high sensitivity locales, 57 percent in medium sensitivity locales, and the remaining 6 percent in low sensitivity areas. Despite the flip in the relative proportion of LW sites in high and medium sensitivity locales, 94 percent of the LW sites can be classified in high or medium sensitivity locales. None of the random eastern UP points fell within the high category, 21 percent are in the medium category, and 79 percent are in low sensitivity areas (Table 20).

Archaeological Sensitivity	EUP LW Sites (%)	EUP Random Points (%)
High	37	0
Medium	57	21
Low	6	79

Table 20: Eastern UP Late Woodland Archaeological Sensitivity.

Summary statistics highlight the differences between the LW site scores and the random point scores (Table 21). Both the WU and eastern UP LW site sets have significantly higher mean and median scores than the random points. The mean and median scores of the WU and eastern UP sites supports the differences observed in the previous paragraph.

Chi-square tests comparing the LW site predictive scores in the WU and the eastern UP with random point predictive scores show statistically significant differences in their distributions (Table 22). However, a comparison of the WU and eastern UP sites also

Summary Statistics	WU LW Sites	EUP LW Sites	WU Random Pts.	EUP Random Pts.
***n*=**	36	81	50	80
Mean	125.8	112.1	37.7	28.6
Median	140	108	19	19
St. Dev.	30.9	32.6	35.1	26.3
Minimum	9	9	3	1
Maximum	155	155	140	108

Table 21: Summary Statistics Comparing Archaeological Predictive Scores.

Chi-Square Tests	Observed χ^2 Statistic	Critical Value @ 0.1	P Value	Statistically Significant
WU LW sites v. WU Random points	48.978	4.605	0	**Yes**
EUP LW sites v. EUP Random points	92.817	4.605	0	**Yes**
WU LW sites v. EUP LW sites	7.508	4.605	0.023	**Yes**
WU Random points v. EUP Random points	2.448	4.605	0.294	**No**
WU Interior sites v. EUP Interior sites	0.276	2.706	0.599	**No**
WU Coastal sites v. EUP Coastal sites	5.220	4.605	0.074	**Yes**

Table 22: Summary of Chi-Square Tests.

demonstrates a statistically significant difference in the distribution between these sets of sites. Conversely, there is not a statistically significant difference in the distribution of the WU and eastern UP random points. The site data indicates that there is a difference in the locations selected for sites in the LW between the WU and the eastern UP as a whole. The random point data suggests that the range of potential locations is similar in the WU and the eastern UP.

We already have discussed that there is a higher proportion of interior known LW sites on the WU and a higher proportion of coastal known sites for the entire eastern UP. All of the sites classified within low sensitivity areas are in coastal settings (there are no known LW sites in low sensitivity locales in the interior). Interior sites have a higher mean predictive score (128.6 [140 median]) than coastal sites (104.8 [105 median]) (Table 23). The higher proportion of interior sites, therefore, may be skewing the overall predictive score in the WU. When the score of interior setting sites are compared, there is not a statistically significant difference in their distribution (Table 22), but there is a statistically significant difference between the sets of coastal sites. One interpretation may be that access to spawning beds at coastal sites may outweigh other environmental factors, such as terrestrial habitat classification. Martin's (1985) study of Woodland coastal settlement found that site location was most closely related to fish habitat. Alternately, and potentially related to this interpretation, the WU may simply have more optimal interior setting habitat for LW sites than the rest of the eastern UP.

Summary Statistics	**Interior Sites**	**Coastal Sites**	**Lake Huron Sites**	**Lake Michigan Sites**	**Lake Superior Sites**
***n*=**	25	56	18	16	22
Mean	128.6	104.8	89.6	108.3	114.7
Median	140	105	105	108	108
St. Dev.	22.1	33.9	30.6	37.3	30.8
Minimum	92	9	9	24	9
Maximum	155	155	108	155	140

Table 23: Summary Statistics by Site Setting.

Another observation can be gleaned through a comparison of coastal sites by Great Lake. Summary statistics show that the sites on Lake Huron have a lower mean and median predictive score than coastal sites on Lakes Michigan or Superior (Table 23). Further, no sites on Lake Huron have high predictive scores and Lake Huron has the highest proportion of low scoring sites (16.7 percent) (Figure 31). Habitat seems to be the key variable in this discussion. No coastal site on Lake Huron is situated in mixed pine habitats. Mixed pine is the best represented

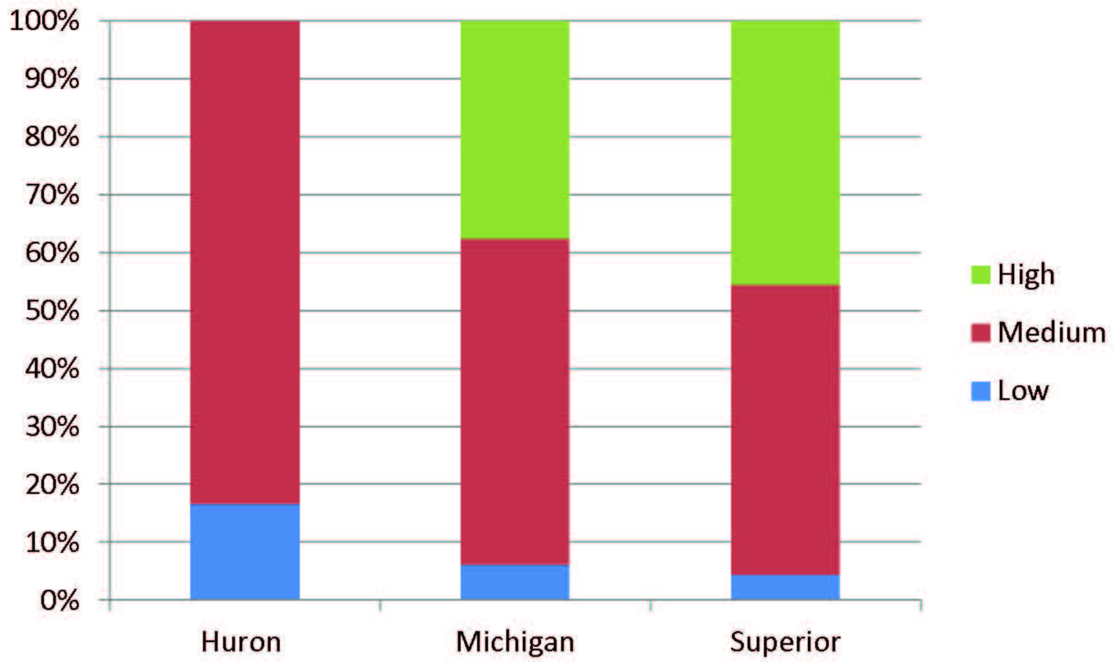


Figure 31: Archaeological Sensitivity of Coastal Late Woodland Site Locales by Great Lake.

for interior sites (56 percent) and for coastal sites on Lake Superior (45.5 percent) and Lake Michigan (50 percent). Northern hardwood habitat is the best represented (44.4 percent) for Lake Huron sites.

4.6.1 *Application of the Model*

The next step in the process was to apply the model to a series of sample areas in the HNF to gain a better understanding of the models functionality. It was determined that a 100 × 100 m (1 ha) quadrat would serve as the basic unit of analysis in the model. The 100 × 100 m quadrat was used because it is sufficiently fine grained for useful analysis, yet coarse enough to efficiently calculate in the GIS. The sample areas included the random generation of ten one kilometer squares on both the East and West Units, subdivided into one hectare squares, as well as the subdivision of the 2011 and 2012 HNF cultural resource survey parcels into one hectare squares.

The LW site predictive model was applied to ten randomly selected 1 km × 1 km quadrats on the WU of the HNF to assess the relative archaeological sensitivity of the WU (Figure 32). Each of the 1 km² quadrats was subdivided into one hundred 100 × 100 m squares. The 100 × 100 m square quadrats were coded in the same manner as the sites and random points. However, their larger size than the site points or random points created the potential that the square could include more than one habitat or have portions at more than one distance to a source of water. The least distance from water was used to generate the score for the square. So if a square straddled 120 m, the score would reflect less that 120 m. Each 100 × 100 m square was coded for the presence or absence of the eight habitat categories as well as for wild rice. Each habitat present was assigned a score and the results were added together for the habitat score. Thus, 100 × 100 m squares with greater habitat diversity (greater number of habitats) have a higher habitat score.

One thousand 100 × 100 m quadrats were generated within the ten 1 km² quadrats in the WU. A review of the summary statistics for the 100 × 100 m quadrats shows a mean predictive score of 60.3 (39 median) with a high score of 176 and a low of 11 (Table 24). Nearly 10 percent of the 100 × 100 m quadrats were classified as high sensitivity areas for LW sites, while 45.8 percent were classified as low sensitivity (Table 25).

The model was also applied to eight areas surveyed in the WU in 2011 (Dunham and Jeakle 2012). This is not a random sample, rather it is a biased sample derived from archaeological surveys conducted in advance of planned HNF activities (timber sales, wildlife

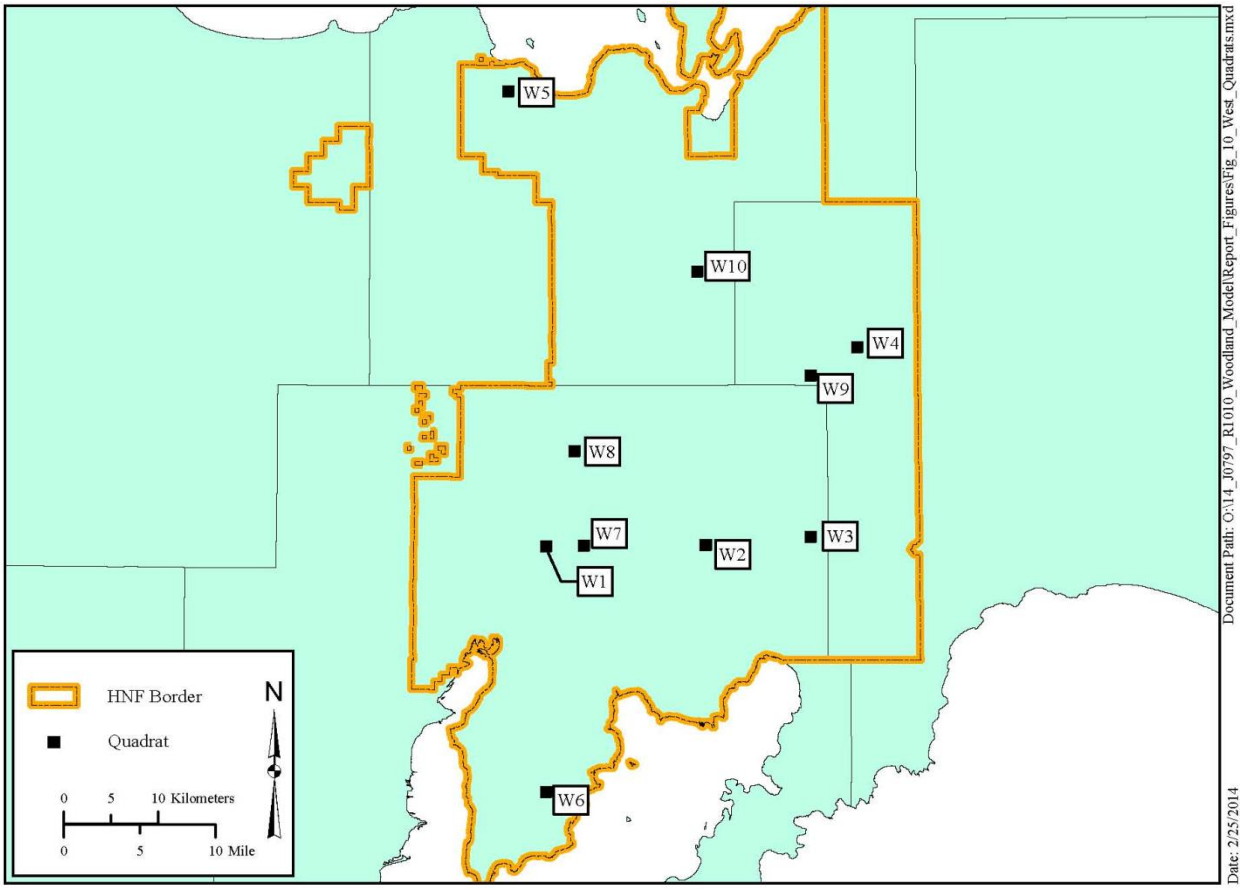


Figure 32: Location of the Randomly Selected West Unit Quadrats.

Summary Statistics	WU Random Quadrats	WU 2011 Survey Areas	EU Random Quadrats	EU 2012 Survey Areas
***n*=**	1000	1983	1000	2488
Mean	60.3	64.6	30.5	51.0
Median	39	51	19	51
St. Dev.	45.0	43.9	29.4	32.9
Minimum	11	1	3	1
Maximum	176	191	158	173

Table 24: Summary Statistics Comparing Test Areas.

Archaeological Sensitivity	WU Random Quadrats (%)	WU 2011 Survey Areas (%)	EU Random Quadrats (%)	EU 2012 Survey Areas (%)
High	9.8	14.7	0.4	7.1
Medium	44.4	28.1	12.3	10.8
Low	45.8	57.2	87.3	82.1

Table 25: Comparison of Late Woodland Archaeological Sensitivity.

management, road improvement, etc.) (Figure 33). The survey areas were not equal in size and combine to include 1983 one hectare quadrats. These have a mean predictive score of 64.6 (51 median) with a high score of 191 and a low of one (Table 24). Two hundred and ninety two (14.7 percent) are classified as high sensitivity, 557 (28.1 percent) as medium sensitivity, and 1134 as low sensitivity (57.2 percent).

When the 2011 survey data set is combined with the random WU 1 km² quadrat data, a data set of 2983 100 × 100 m quadrats was generated. This set includes 390 high sensitivity quadrats (13.1 percent), 1001 medium sensitivity quadrats (33.5 percent), and 1592 low sensitivity quadrats (53.4 percent) (Table 26).

Sensitivity Score	WU Test (%)	EU Test (%)
High	13.1	5.1
Medium	33.5	11.2
Low	53.4	83.6

Table 26: Comparison of Late Woodland Archaeological Sensitivity.

Two LW sites were identified in the 100 × 100 m quadrats examined in this study. Site 20AR310 (FS 09-10-03-728) is situated in a high sensitivity locale (score 173) in W10 and has been archaeologically tested (Figure 34) (Dunham 2013; Franzen 1998). Site 20ST283 (FS 09-10-02-576) is located in 2011 Survey Area 2 in a medium sensitivity setting (predictive score

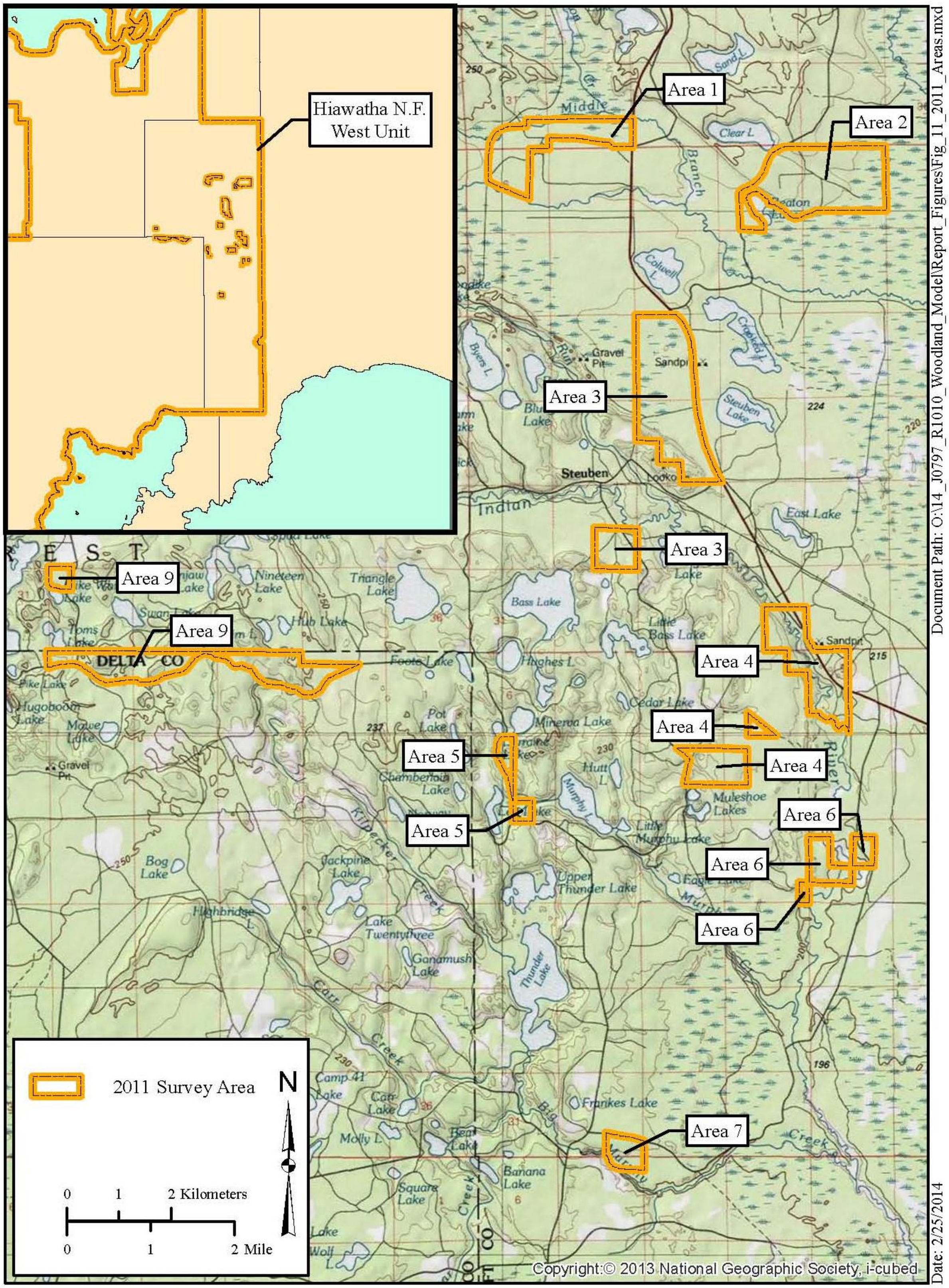
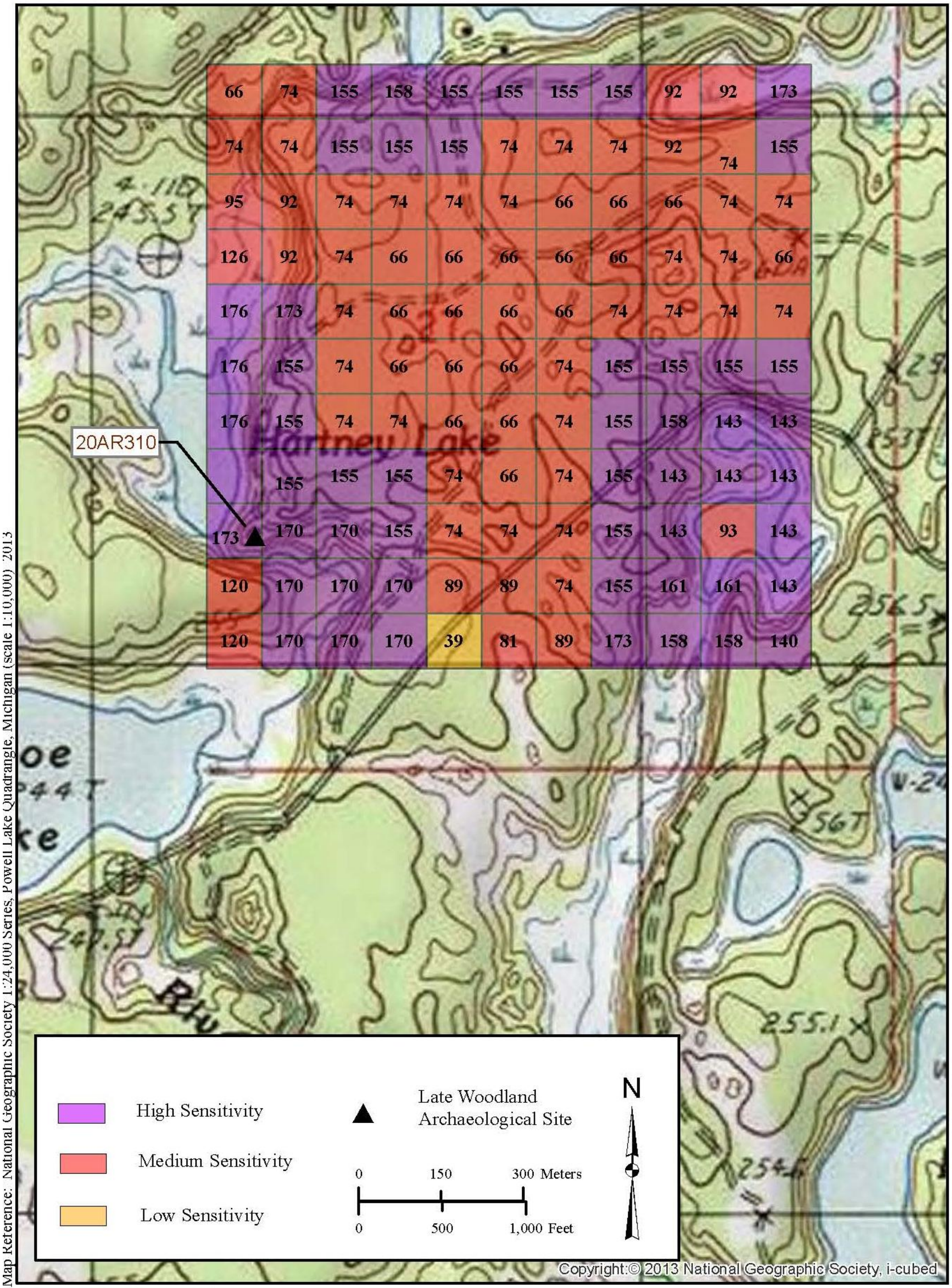


Figure 33: Location of 2011 Survey Areas.



Map Reference: National Geographic Society 1:24,000 Series, Powell Lake Quadrangle, Michigan (scale 1:10,000) 2013

Figure 34: Quadrat W10.

105) (Figure 35). Site 20ST283 is known based on archaeological survey data, but was only discovered to be a LW site during this phase of the analysis after the LW archaeological site data set statistical analyses (Dunham and Jeakle 2012).

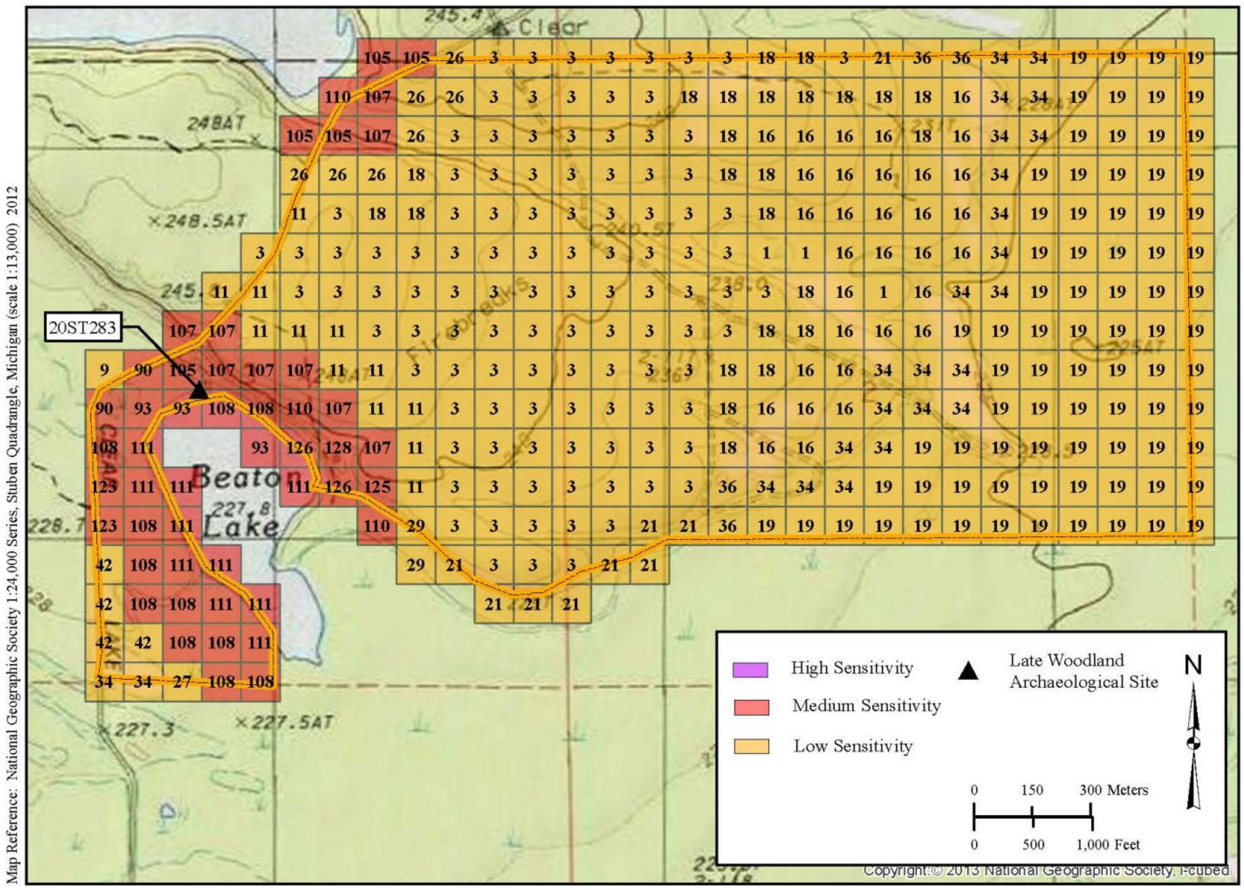


Figure 35: 2011 Survey Area 2.

4.6.2 *East Unit Test*

Ten 1 km × 1 km quadrats were also randomly selected on the EU of the HNF to characterize the relative archaeological sensitivity of the EU. As with the WU sample, each of these was subdivided into 100 m × 100 m squares (a total of 1000 quadrats) (Figure 36). These were coded with a predictive score like the WU quadrats. One thousand 100 × 100 m quadrats were generated within the ten 1 km² quadrats in the EU. A review of the descriptive statistics for the EU 100 × 100 m quadrats shows a mean predictive score of 30.5 (19 median) with a high score of 158 and a low of 3 (Table 20). Four of the 100 × 100 m EU quadrats were classified as high sensitivity areas for LW sites (0.4 percent), 123 (12.3 percent) were medium sensitivity, and 873 (87.3 percent) were classified as low sensitivity.

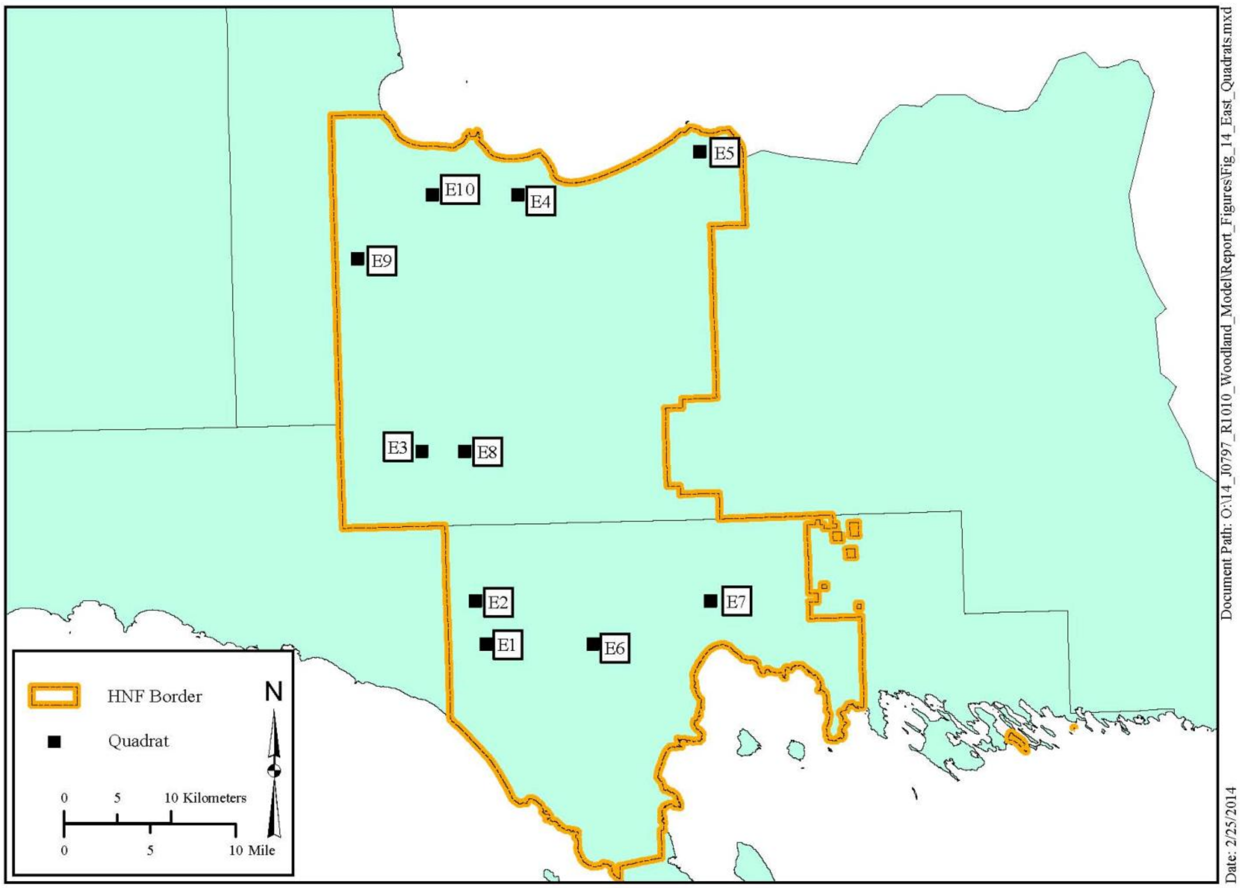


Figure 36: Location of Randomly Selected East Unit Quadrats.

Seven survey areas examined in 2012 (Dunham 2013), that include 2488 one hectare quadrats, were also explored with the model (Figure 37). The survey areas were not equal in size and were selected based on planned HNF activity as opposed to the randomly selected 1 km² quadrats. These have a mean predictive score of 51.0 (51 median) with a high score of 173 and a low of one (Table 24). One hundred and seventy six (7.1 percent) are classified as high sensitivity, 269 (10.8 percent) as medium sensitivity, and 2043 as low sensitivity (82.1 percent).

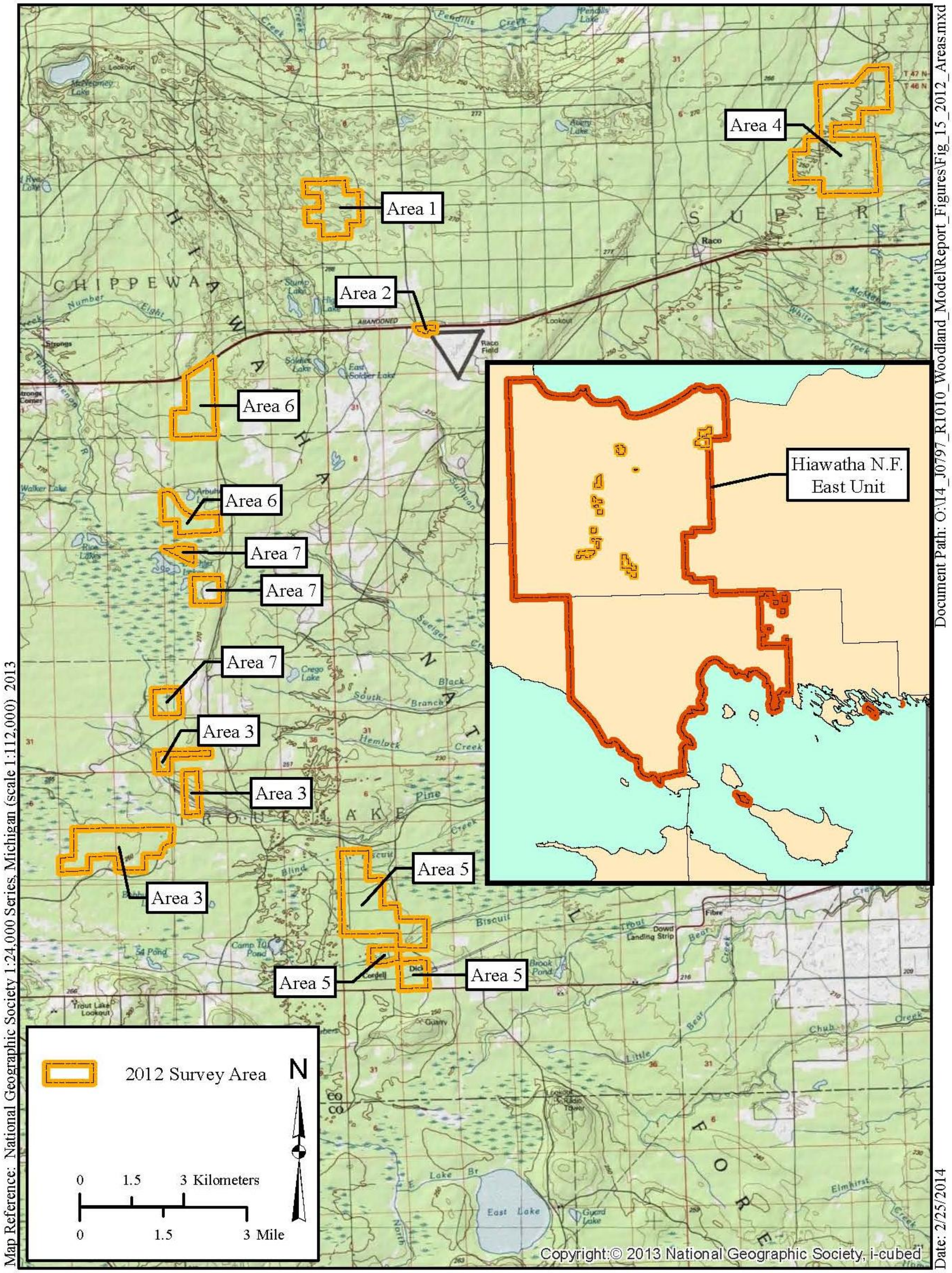


Figure 37: 2012 Survey Area Locations.

Three thousand four hundred and eighty eight EU quadrats were examined in this study and include 180 high sensitivity quadrats (5.1 percent), 392 medium sensitivity quadrats (11.2 percent), and 2916 low sensitivity quadrats (83.6 percent) (Table 22). None of these quadrats included a LW site.

4.6.3 *Discussion*

From a practical standpoint, The WU random test quadrats provide some useful illustration of some of the potential weaknesses of the model. For example, Bishop Lake Creek is not coded as a stream within the GIS on W7, so the areas along it are not coded as near a body of water and the areas are depicted as low sensitivity (Figure 38). Similarly, there are medium sensitivity areas in W6 which are in Little Lake 16 and should not have sensitivity for LW sites (Figure 38). These quadrats are within 120 m of the lakeshore, but are also under water. Each of these examples highlights the importance of field truthing locations and traditional prefield background review of survey areas as opposed blind reliance on the model.

The application of the model also illustrates some potentially significant trends in the WU and the EU as well as between these two parts of the HNF. The 2011 and 2012 survey samples include higher proportions of high and medium sensitivity areas than their random test quadrat counterparts, and a lower proportion of low sensitivity areas (Table 25). The best explanation of this is that the 2011 and 2012 survey samples were drawn from the cultural resource surveys carried out by the HNF in advance of their planned activities. One of the most important activities on the HNF is timber management, including the harvesting of timber. The management and harvest of pine for pulpwood and lumber is the most significant activity in timber management. Both the 2011 and 2012 survey areas included large areas of pine

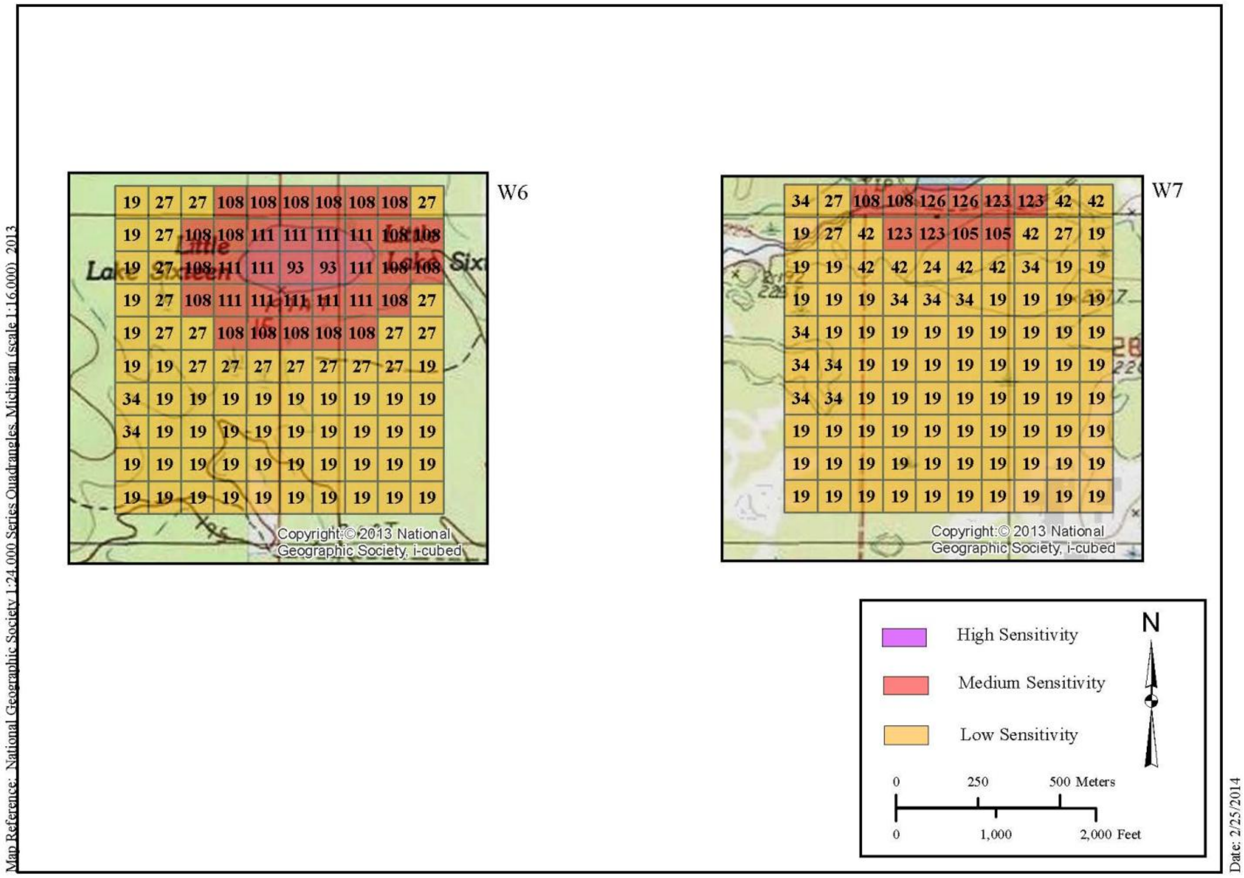


Figure 38: Quadrats W6 and W7.

plantation (Dunham and Jeakle 2012; Dunham 2013). While pine plantations are not always in mixed pine habitats, that habitat is optimal for red and white pine, and it is possible that survey areas selected by the FS are skewed towards habitats more conducive to pine management. Higher predictive scores may be seen in FS generated survey areas as a result.

When the WU and EU samples are compared, there are significantly higher proportions of high and medium sensitivity quadrats identified in the WU and a higher proportion of low sensitivity quadrats in the EU (Table 26). The mean predictive scores are also higher for the WU than the EU (Table 24). These data suggest that high and medium sensitivity areas for LW sites are better represented on the WU than the EU and this is likely the critical factor in the higher number of sites on the WU.

4.7 Application of the Model to the HNF

The final step in the development of the LW site predictive model for the HNF was to apply the model to the entire Forest. The entire HNF was subdivided into 100 × 100 m squares (1 hectare quadrats). The quadrats were scored in the same manner as presented in the preceding section (Figures 39 and 40). When the model is applied to the entire WU and EU areas 530,593 one hectare quadrats are observed.

Based on the predictive scores, some of the areas included are likely open water (inland lakes, as per the example of Little Lake 16 above, and portions of the Great Lakes along the coasts). Overall predictive scores of 1, 9, or 90 were deleted as likely water, providing they did not include terrestrial habitats. When the areas that are open water are removed, the number of quadrats is reduced to 523,400 including 318,557 quadrats on the WU and 204,843 quadrats on the EU.

The WU has proportionally greater archaeological sensitivity than the EU (Table 27). The WU, overall, includes proportionally more high and medium LW sensitivity areas (4.0 and 26.2 percent, respectively), as well as a higher mean score (49.4 mean, 27 median), than the EU (2.6 and 23.6 percent, 45.8 mean and 24 median).

An examination of the WU quadrats that included LW sites parallels the distribution of the LW site points. About two-thirds (67.6 percent) of the WU LW sites in high sensitivity areas, 29.7 in medium sensitivity areas, and 2.7 in low sensitivity areas. In the EU, 31.3 percent are in high sensitivity area, 68.7 in medium sensitivity areas, and no sites in low sensitivity areas. For the entire HNF, 56.6 percent of the LW sites are in high sensitivity quadrats, 41.5 percent in medium sensitivity quadrats, and 1.9 percent in low sensitivity quadrats.

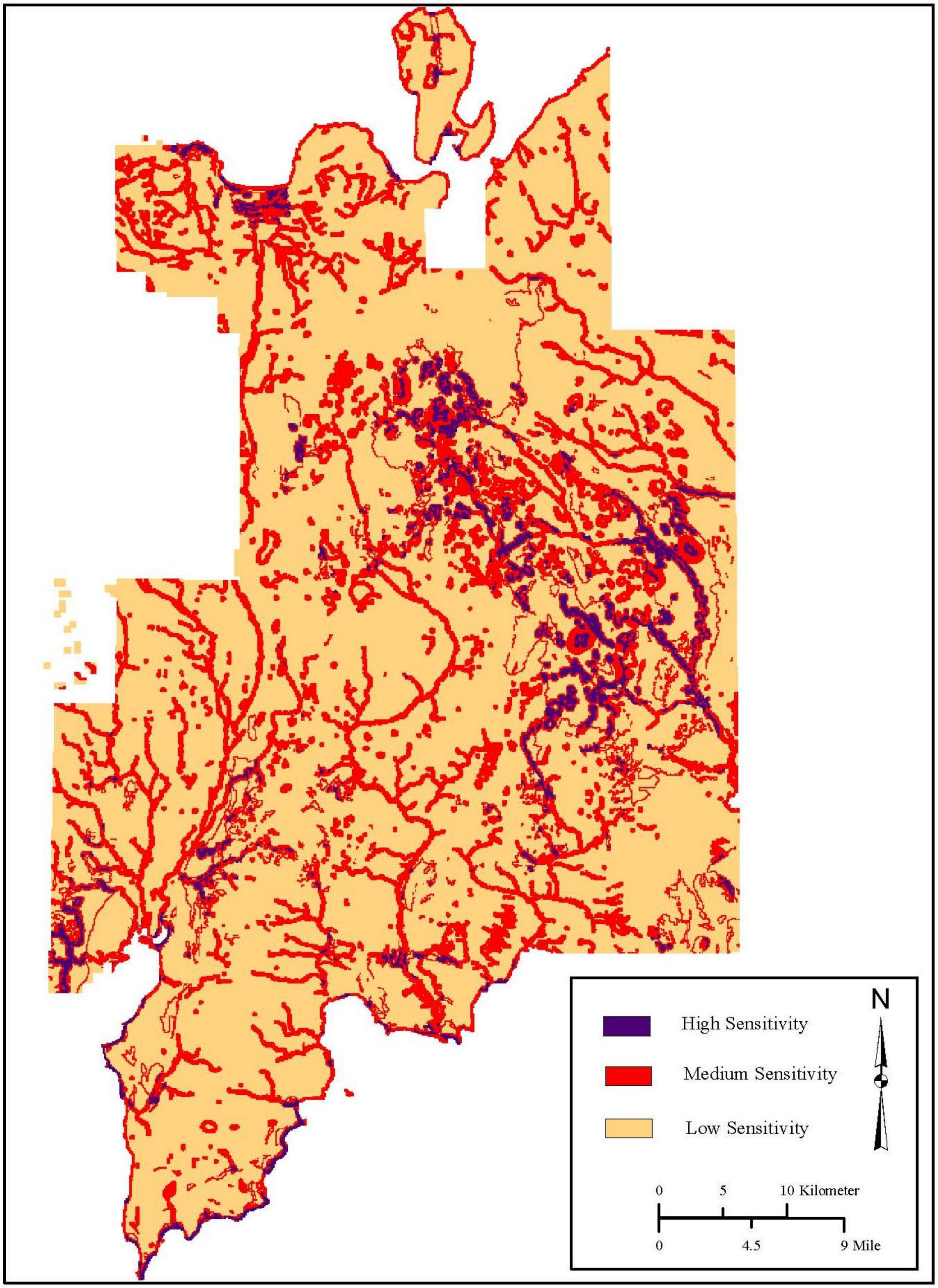


Figure 39: West Unit Archaeological Sensitivity.

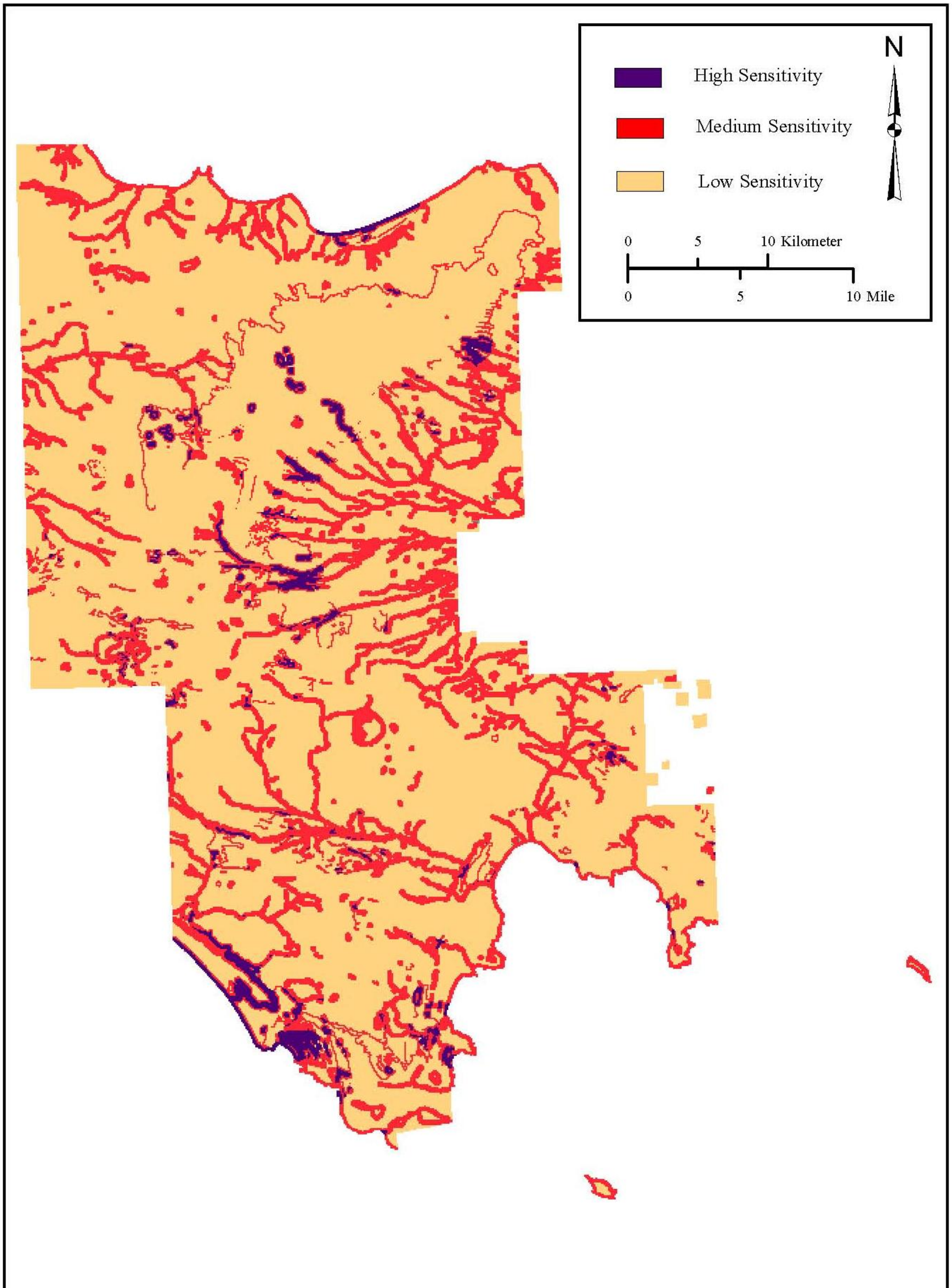


Figure 40: East Unit Archaeological Sensitivity.

There is also a higher density of known LW sites in the WU compared to the EU. Thirty seven LW sites are present in the WU and 16 LW sites are present in the EU. When land area is considered, LW sites occur at a 1.5 times greater rate on the WU than the EU. When we compare the probability based on the relative sensitivity of a quadrat, one is about twice as likely to encounter a LW site in a high sensitivity area on the WU and 1.7 times more likely in a medium sensitivity area on the EU than corresponding areas on the WU. The probability of finding a LW site on the WU of the HNF are less than a quarter percent in a given high sensitivity quadrat or only about 1 site per 504.9 high sensitivity quadrats/hectares (Table 28). If these figures are representative of the LW site sensitivity on the HNF and the eastern UP, LW sites are a rare commodity.

Sensitivity Score	West Unit (%)	East Unit (%)	HNF (%)
High	4.0	2.6	3.4
Medium	26.2	23.6	25.2
Low	69.8	72.8	71.4

Table 27: Archaeological Sensitivity by HNF Unit and Overall.

Sensitivity Score	WU Sites per Quadrat	WU Quadrats per Site	EU Sites per Quadrat	EU Quadrats per Site
High	0.00197	504.9	0.00093	1069.6
Medium	0.00013	7588.7	0.00023	4389.1
Low	-	222,457	-	-

Table 28: Likelihood of Encountering a Late Woodland Site.

The difference in the distribution of high, medium, and low sensitivity areas in the EU and WU is statistically significant (Observed χ^2 = 1284.686, Critical Value @ 0.1 = 4.605, P Value = 0). This suggests that the WU includes a greater proportion of favorable locations for

LW site placement and this is borne out by the higher proportion of LW sites on the WU. A puzzling factor in this discussion is the higher density of LW sites in medium sensitivity areas on the EU.

4.8 Discussion

Phase I surveys on the HNF have discovered LW sites, but most of the information involves location and the presence of LW diagnostic artifacts. The goal of the current chapter was to develop a predictive model for LW sites in the HNF that would allow the determination of spatial patterns of archaeological sites at a regional scale and to develop a ranking system to assess those patterns. It was concluded that a correlation does exist between specific environmental variables (distance to water, habitat, and proximity to wild rice locales).

The application of the model successfully plotted the location of 67.6 percent of the known West Unit LW sites in high sensitivity areas with 29.7 in medium sensitivity locales and 2.7 in low sensitivity areas. Although the model was not as successful for predicting known sites on the EU, when the model is applied to the entire HNF it accounted for 56.6 percent of known LW sites in high sensitivity areas, 41.5 percent in medium sensitivity locales, and 1.9 percent in low probability areas. For the eastern UP, 37 percent of the LW sites are identified in high sensitivity locales, 57 percent in medium sensitivity locales, and the remaining 6 percent in low sensitivity areas. Although the model was not an ideal fit for the entire eastern UP, it does demonstrate that 37 percent of all LW sites in the eastern UP are situated in areas that make up only 3.4 percent of the estimated UP land base (if we can use HNF lands as a proxy).

The observation that the WU has a higher proportion of LW sites than the EU as well as a higher proportion of high and medium sensitivity quadrats, was not entirely unexpected based on more generalized observations of prehistoric site distributions on the HNF, but had not been systematically quantified prior to this study (see Dunham and Branstner 1998; Franzen 1983). However, the higher incidence of LW sites in medium sensitivity areas on the EU, and the eastern UP in general, raises an interesting series of questions. This raises the possibility that there are cultural factors or currently unrecognized environmental factors which effect the placement of sites beyond the natural environmental variables explored as part of this site location model. These differences could also reflect Forest Service management strategies. The relative proportion and relative quality of archaeological survey has been comparable on the East and West Units. Despite this, only 6 EU LW sites have had test excavations carried out on them (50 percent of the LW sites on the EU), whereas 27 WU LW sites have had test excavation (75 percent o the LW sites on the WU). It would be worthwhile to target some high sensitivity areas on the EU and medium sensitivity locales on the WU for additional archaeological survey. Also, known prehistoric sites on the EU that have not produced diagnostic artifacts could be further investigated to obtain additional archaeological evidence as to the age of the sites.

The model also provides an assessment tool for more fully exploring the setting of known sites. A modified form of catchment analyses can be easily derived from the scored 100 x 100 m squares. Using the LW site point as the center of the catchment, scores for each of the squares included within the catchment can be generated. In addition to the predictive scores, it is possible to observe the proportion of each habitat type within the catchment and provide a measure of habitat diversity. These data, combined with the DUI scores from the previous chapter (Chapter 3) will be explored in the following chapter (Chapter 5) in an attempt to understand the dynamics of the LW settlement and subsistence system(s) in the eastern UP.

5.0 DIVERSITY USE INDEX AND LATE WOODLAND SITE PREDICTIVE MODEL

Late Woodland site assemblages were summarized in Chapter 3 and the environmental settings of those sites were discussed in Chapter 4. In this chapter these analyses are combined to explore LW settlement dynamics at three scales. The first is a comparison of the diversity use index (DUI) and LW site predictive model (LWPM) at the site level. The second and third carry out a sort of catchment analysis using the DUI and LWPM as well as a site sensitivity and habitat diversity (SS&HD) measure developed in this chapter. The catchments used in this analysis are 150 m radius and 1500 m radius. The goal of this chapter is to explore how the settings and assemblages of LW sites may facilitate our understanding of the LW settlement patterns.

5.1 Combining the Diversity Use Index and Late Woodland Site Predictive Model

The analyses carried out in the previous chapters created two scales for assessing LW archaeological sites. The DUI developed three ranked classes of LW sites reflecting the range of diversity in the artifact assemblages. Sites with extended diversity included the greatest diversity of artifact types in their assemblages. The sites with extended diversity most likely represent residential sites which are expected to have a longer duration of occupancy as well as larger populations that include mixed gender and age groups that are involved with a wider number of activities (c.f., Binford 1980; 1983). These sites are most likely the seasonal aggregation sites described by Cleland (1982) where spring and/or fall fishing took place (see also S. Martin 1985).

Limited diversity sites exhibit the fewest activities and probably represent logistical camps used by smaller groups for limited periods of time (c.f., Binford 1980, 1983). These sites likely would have been used for specific resource procurement activities or for specialized purposes by a potential age and/or gender exclusive group. Intermediate diversity sites could also represent residential sites, albeit with a smaller population or shorter occupation, or logistical camps.

The LWPM created a three tiered ranking to identify settings or locations of greater archaeological sensitivity for LW sites in the Hiawatha National Forest. This model concluded that a correlation exists between specific environmental variables and site locations (distance to water, habitat, and proximity to wild rice locales). Although the model was not an ideal fit for the eastern UP as a whole, it does demonstrate that 37 percent of all LW sites are situated in habitats that make up only about 3.4 percent of the eastern UP land base. The DUI and LWPM scales measure two different aspects of LW settlement, but can be used in concert to better understand LW settlement dynamics in the eastern UP.

Table 29 shows the raw counts per DUI and LWPM rank classifications. Not all the LW sites examined have both DUI and LWPM scores and only where a site has both was it counted in the table (n=76) (see also Appendix Q). LW sites in medium sensitivity areas and limited diversity sites are the best represented categories. When the proportion (percentages) of sites are compared by category it is evident that high sensitivity areas are best represented among limited

	High LWPM	**Medium LWPM**	**Low LWPM**
Extended DUI	2	6	1
Intermediate DUI	6	13	0
Limited DUI	20	25	3

Table 29: Late Woodland Sites per Diversity Use Index (DUI) and Predictive Model (LWPM)

diversity sites and least well represented among extended diversity sites (Figure 41). Medium sensitivity areas are the best represented for all DUI categories. Finally, low sensitivity areas are only found with extended diversity and limited diversity sites.

When the LW sites are examined by coastal or interior settings, these trends become more evident (Figure 42). First, there are no extended diversity sites on the interior, which was discussed in Chapter 3. Second, there are no interior sites in low sensitivity areas (see Chapter 4). Finally, medium sensitivity locales are best represented for all DUI categories except interior limited diversity sites, where high sensitivity areas are best represented.

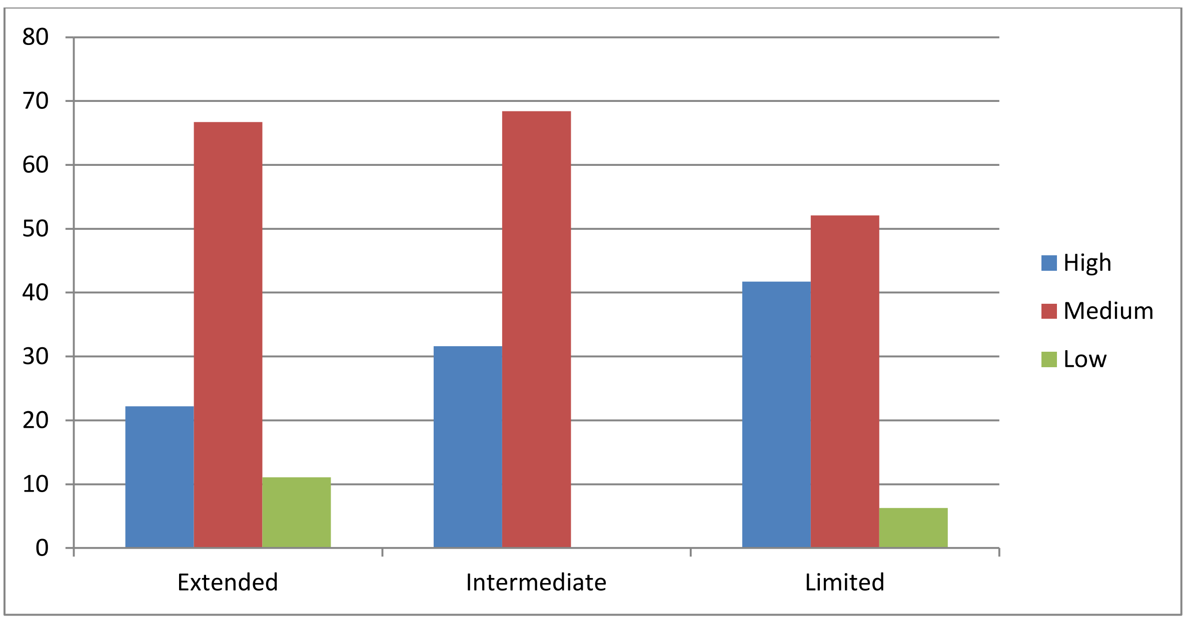


Figure 41: Comparison of Diversity Use Index and Late Woodland Site Predictive Model by Category (percent).

Limited diversity sites make up the largest proportion of the LW site sample (63.2 percent). With the assumption that limited diversity sites are most likely logistical camps, then it stands to reason that interior logistical camps are targeting locations with the best access to resources. All high sensitivity locales are proximate to water (within 120 m) and are situated in mixed pine habitats. In general, these habitats would have access to a wide range of resources that were attractive to LW peoples as well as the animals they hunted (see Chapter 4.1.3). Fish live and spawn in water, and some of the best represented mammal species, such as beaver and moose, require direct access to water. High sensitivity locales seem to best exemplify the setting of a "site for all seasons" described by S. Martin (1999) where multiple resources could be hunted, fished, or gathered at multiple times of the year.

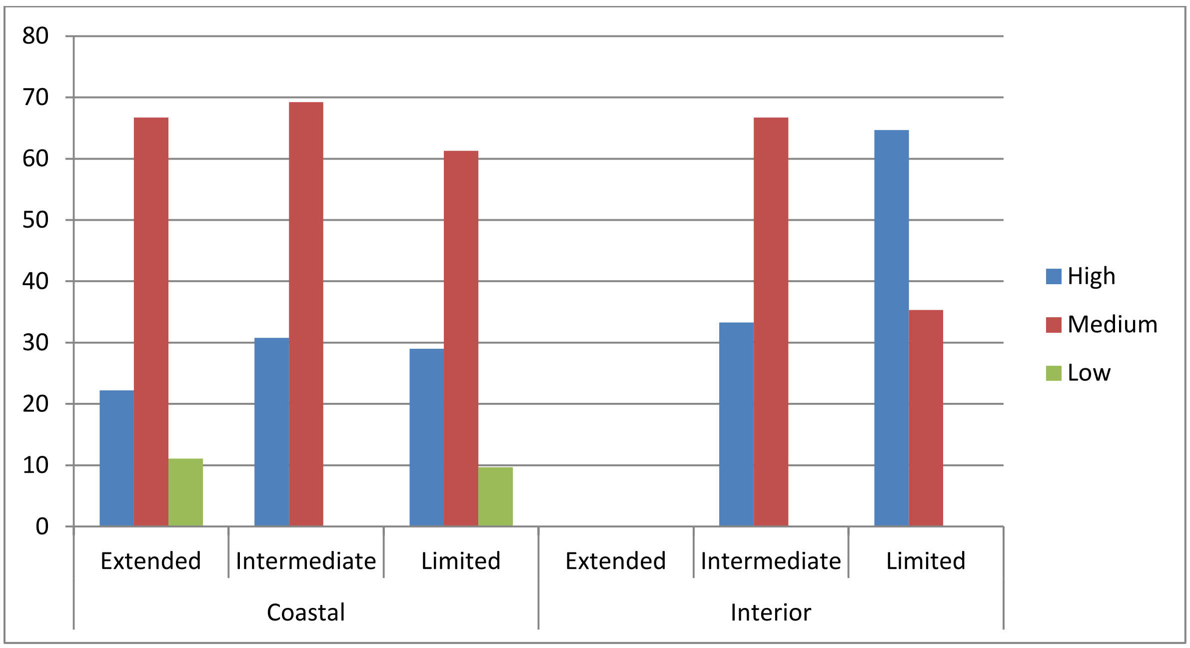


Figure 42: Comparison of Diversity Use Index and Late Woodland Site Predictive Model by Category and Site Setting (percent).

The relationship between the higher incidence of low sensitivity areas and coastal sites was explored in Chapter 4, but is worth revisiting. It seems reasonable that access to spawning beds at coastal sites may be more important than access to terrestrial habitats. Coastal LW site location is thought to be closely related to fish habitat (S. Martin 1985). This may also be supported by comparing interior sites situated on lakes and rivers. The interior sites are nearly equally distributed between lakes and streams (12 and 11, respectively). They are also similarly distributed amongst intermediate and limited diversity sites (25 percent intermediate/75 percent limited and 27.3 percent intermediate/72.7 percent limited). The difference is that 75 percent of interior lake LW sites are found in high sensitivity areas, whereas 63.6 percent of LW sites on rivers are found in medium sensitivity locales (Figure 43). In other words, interior lake sites are most often situated in mixed-pine habitats in close proximity to water and interior river sites are typically situated in other habitats.

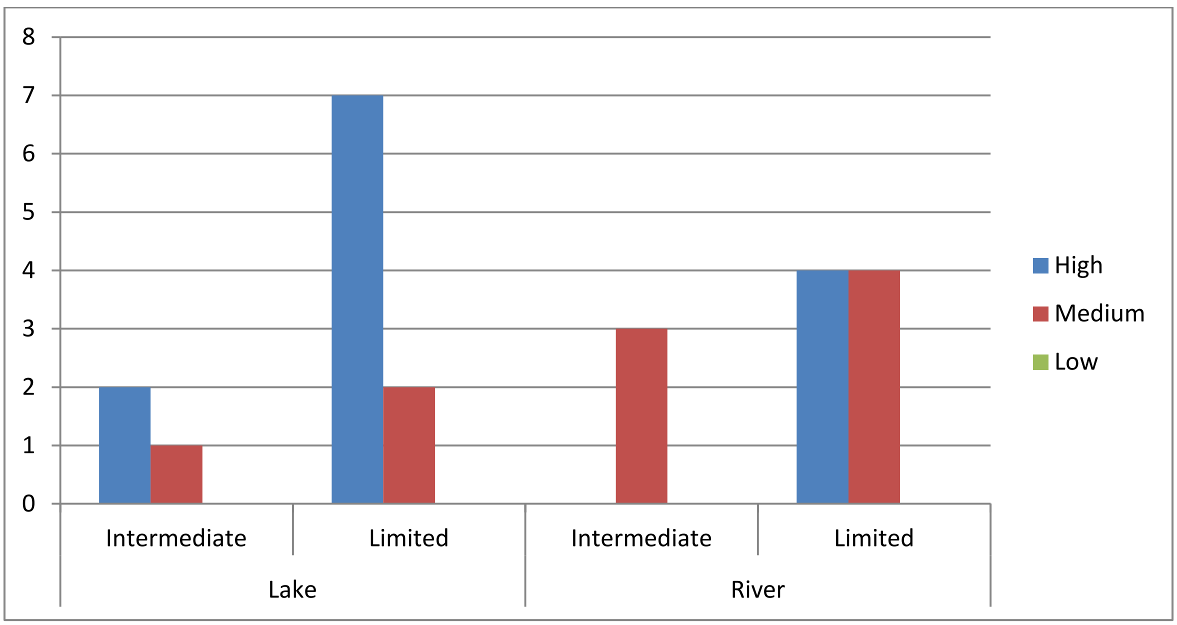


Figure 43: Comparison of Diversity Use Index and Late Woodland Site Predictive Model by Category and Interior Site Setting (count).

Franzen (1987) identified some general trends concerning prehistoric interior setting sites in the eastern UP, although his study is not specific to the LW period. He hypothesized that interior sites on rivers were likely used for spring fishing. The presence of a river, as the source of spring-spawning fish, was the primary factor in site placement (Franzen 1986; 1987). His study also found that most prehistoric sites on interior lakes were associated with pine-oak forest which is directly comparable to the mixed pine habitats used in this study (Franzen 1987;

Dunham 2009). The forest succession pattern in the pine-oak forests is conducive to beaver, moose, and warm season deer habitat because of the regular creation of openings, especially through fire, and a high incidence of aspen and other habitat classification preferred by these herbivores (Franzen 1986, 1987). The primary resource draw for the interior river sites was spring-spawning fish, not necessarily the surrounding habitat of the locale. Interior lakes, on the other hand, would not have been as optimal for spring fishing as river locales, but offered habitats conducive to other potential resources. This pattern appears to be repeated in the current study. Thus, lower sensitivity settings, both on the Great Lakes coasts and in the interior, may reflect an aquatic orientation (access to spring and fall spawning fish). Higher predictive scores may reflect a broader range of resource procurement, especially for interior sites and limited diversity (logistical) sites.

Further trends can be gleaned when the relative age of the sites are compared. Based on the set of LW sites that includes both LWPM and DUI ranks, there are 20 sites that include an early LW component, 43 that include a late LW component, and fourteen of the sites overlap with both early and late LW components (Appendix Q). Table 30 presents counts in each DUI and LWPM category and Figure 44 displays these as percentages. The most striking difference is that early LW extended diversity sites are more proportionally balanced compared to the more proportionally dispersed late LW extended diversity sites. Related to this is a higher proportion of high sensitivity locales for early LW extended diversity sites and a lower proportion of medium sensitivity areas for the intermediate sensitivity sites (the same site, 20CH6, represents the low sensitivity proportion for both early and late LW extended diversity categories). Another important distinction between the early LW and late LW sets is that the late LW also includes low sensitivity areas in the limited diversity category.

When the early and late LW data is compared by coastal and interior settings, some of these trends become increasingly clear and new trends appear (Table 31). The first thing to note

	High LWPM	Medium LWPM	Low LWPM
Early LW (n=20)			
Extended DUI	2	2	1
Intermediate DUI	1	6	0
Limited DUI	2	6	0
Late LW (n=43)			
Extended DUI	2	4	1
Intermediate DUI	3	8	0
Limited DUI	10	13	2

Table 30: Early and Late Late Woodland (LW) sites per Diversity Use Index (DUI) and Site Predictive Model (LWPM).

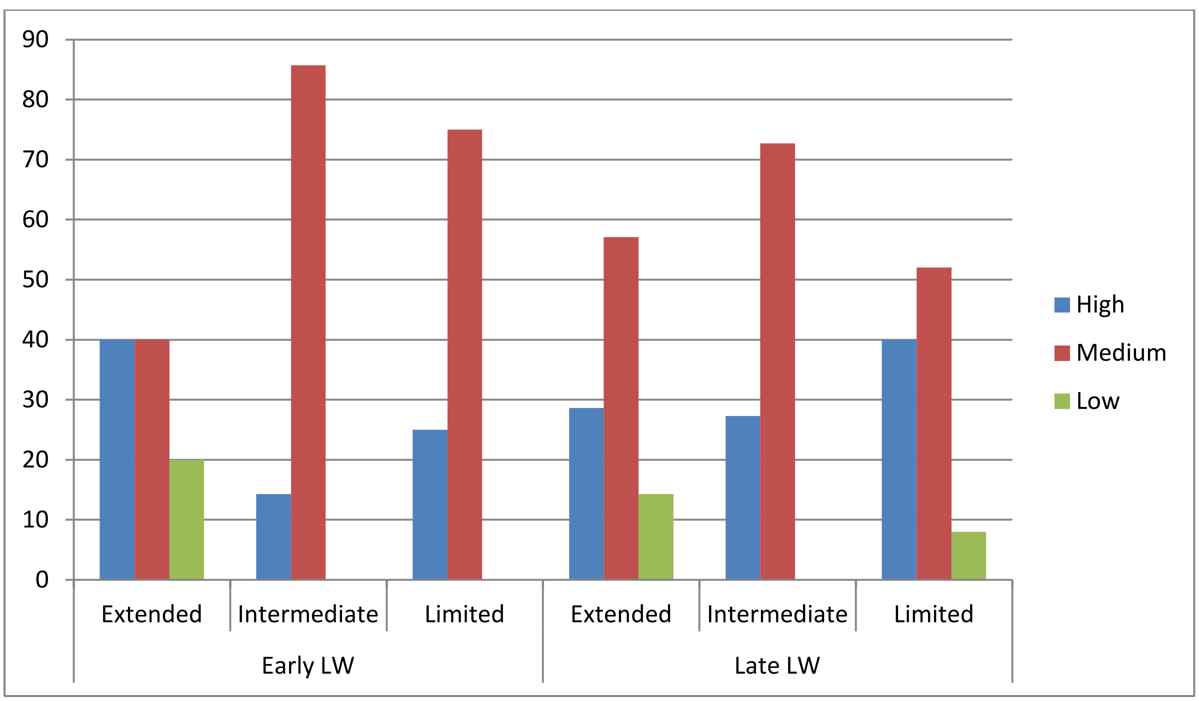


Figure 44: Comparison of Diversity Use Index and Late Woodland Site Predictive Model by Category and Relative Age (percent).

is that there is only one early LW site (20DE378) in an interior setting, and that there are ten late LW sites located on the interior. The second is an increase in the proportion of medium sensitivity areas and a decrease in high sensitivity locales for late LW intermediate and limited diversity coastal sites (Figure 45). The proportions of the extended diversity coastal sites remain constant as there are no extended diversity sites on the interior. Late LW interior sites include a higher proportion of high sensitivity areas and do not include any low sensitivity areas.

		High LWPM	**Medium LWPM**	**Low LWPM**
Early LW (n=20)	**Coastal**			
	Extended DUI	2	2	1
	Intermediate DUI	1	5	0
	Limited DUI	2	6	0
	Interior			
	Extended DUI	0	0	0
	Intermediate DUI	0	1	0
	Limited DUI	0	0	0
Late LW (n=43)	**Coastal**			
	Extended DUI	2	4	1
	Intermediate DUI	1	7	0
	Limited DUI	4	12	2
	Interior			
	Extended DUI	0	0	0
	Intermediate DUI	2	1	0
	Limited DUI	6	1	0

Table 31: Early and Late Late Woodland (LW) sites per Diversity Use Index (DUI) and Site Predictive Model (LWPM) and by Site Setting.

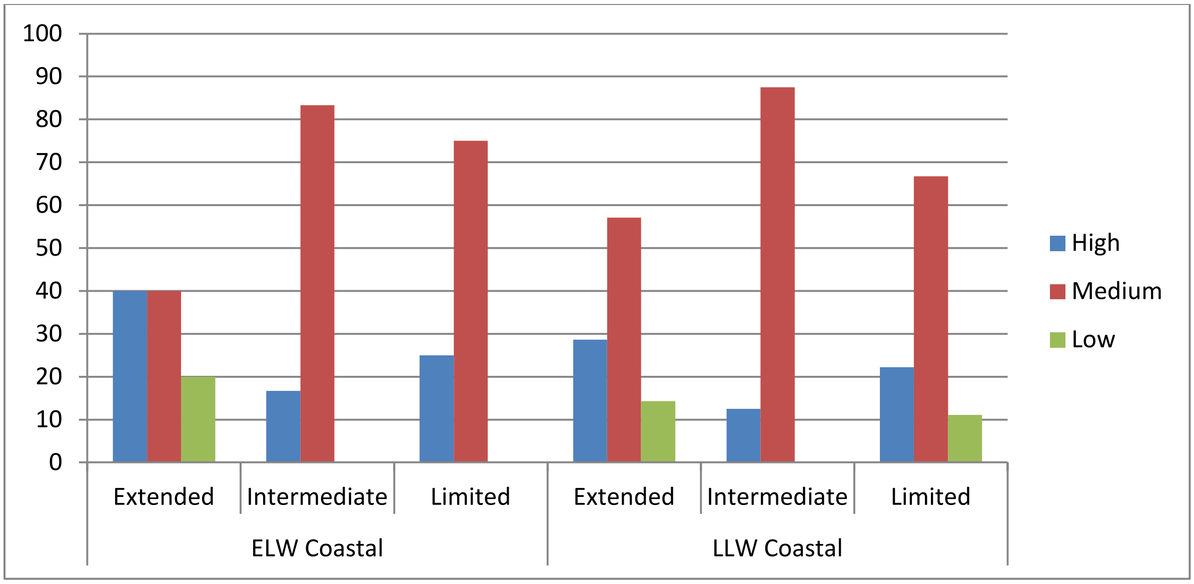


Figure 45: Comparison of Diversity Use Index and Late Woodland Site Predictive Model Coastal Sites by Category and Relative Age (percent).

The preceding discussion adds onto the results of Chapters 3 and 4 to illustrate a set of trends relating to LW settlement practices in the eastern UP. The results of these comparisons support the relationship between lower sensitivity areas and coastal sites. It also indicates that greater use of the interior is more common in the late LW than the early LW. There are a higher proportion of extended and intermediate diversity early LW sites and a lower proportion of limited diversity sites compared to late LW sites (Figure 45; Table 31). This pattern may reflect a greater reliance on residential mobility by early LW people and a greater use of logistical mobility by late LW people. A chi-square test does not support a statistically significant difference between the distribution of early and late LW sites, but the graph in Figure 45 suggests a greater use of limited diversity sites by late LW people. (Yates $\chi^2 = 1.812$, df 2, α 0.1 $= 4.605$, $P = 0.404$). These themes will continue to be explored through the catchment discussion that follows.

5.2 Late Woodland Site Predictive Model and Habitat Diversity Catchments

The predictive model for LW sites developed in Chapter 4 can also be used as an analytical tool. For example, catchment analyses can be easily derived from the scored 100 × 100 m squares. “In broad outline, site catchment analysis delimits a territory or set of concentric territories surrounding a site and assesses the resource potential contained within that area” (Roper 1979:122). Catchment analysis has been effectively used in archaeological studies in northern lower Michigan and the eastern UP (c.f., Buckmaster 1979; Franzen 1987; Holman 1978; Martin 1977). Holman’s (1978) study evaluated resource potential in the site catchment areas by season and compared the results of that analysis with archaeological data recovered from early Late Woodland sites (Mackinac Phase). Another important outcome of this research was that the seasonal resource potential of the catchment areas along with the data derived from the archaeological assemblages generally corroborated assumptions concerning seasonal resource selection and patterns of mobility gleaned from the ethnohistoric record (Holman 1978; see also Holman and Krist 2001).

Using the LW site point or Random point as the center of the catchment, scores for each of the squares included within the catchment can be generated. Because of the “squares”, and the fact that the site point is not typically centered in a hectare square, the total number of squares included is not consistent for each catchment area. This can be corrected for by calculating a mean predictive score (MPS) for the catchment.

In addition to the predictive score, it is possible to observe the proportion of each habitat type within the catchment. This can also be constructed as a habitat diversity index by multiplying the number of habitat types by the number of quadrats containing each habitat type.

Like the mean predictive score, it can then be rendered as a mean habitat diversity index (MHDI) for the catchment.

Two sizes of catchment were examined: 150 m and 1500 m radius. These were selected as proxies for what can be described as “site specific zones” (150 m) and “primary zones of exploitation” (1500 m) (cf., Rogers and Rogers 1976). The site specific zone is the area where the site is situated and most site related activity likely took place, whereas the primary zone of exploitation refers to the area that is readily accessible to the occupants of the site and where it is presumed that a significant amount of direct procurement took place. The catchments are limited to sites within the HNF boundaries which were formally coded and ranked for site sensitivity (Chapter 4). In cases where site catchments significantly overlap, they were considered the same catchment and the MPS or MHDI generated for the combined catchment. The catchment analysis included in this study will provide a baseline description of habitats types present around the LW sites. It does not explicitly measure the extractive value of the habitats in general or by season. The following analysis is an expedient tool to assess the range of habitats and relative LW site sensitivity of the site catchments.

5.2.1 *150 m Radius Catchments*

Descriptive statistics show that LW site catchments have higher predictive scores and habitat diversity as well as a greater number of habitats per catchment than Random points (Table 32). Additionally, t-Tests support these findings and demonstrate that Random points and Late Woodland sites are derived from different populations (Table 33).

	Random MPS	Random MHDI	LW Site MPS	LW Site MHDI
***n*=**	1390	97	650	47
Mean	50.9	2.9	116.1	53
Median	34	2.7	123	4.6
Maximum	173	8.3	188	18
Minimum	1	1	3	1

Table 32: Descriptive Statistics of the 150 m Radius Catchments for Random Points and Late Woodland Sites Addressing Mean Predictive Score (MPS) and Mean Habitat Diversity Index (MDHI).

		Observed t Statistic	t Critical Value @ 0.1 (two-tailed)	P value (two-tailed)	Statistically Significant
Random Point v. LW site	**Predictive Score**	33.788	1.646	0	Yes
	Habitat Diversity	4.041	1.671	0	Yes
Coastal v. Interior	**Predictive Score**	-1.889	1.686	0.067	Yes
	Habitat Diversity	-2.969	1.692	0.005	Yes
River v. Lake	**Predictive Score**	1.882	1.812	0.089	Yes
	Habitat Diversity	0.743	1.740	0.467	No

Table 33: Results to t-Tests for 150 m Radius Catchments.

Not only do the site catchments include a greater diversity of habitats, the habitats associated with the LW sites are also structurally different than those associated with Random points. Figure 46 illustrates the differences and shows that the LW site catchments are more likely to include mixed pine habitats, wetland/marsh habitats, and wild rice habitats than the Random point catchments.

There are forty seven 150 m radius site catchments used in this study, including 4 clusters of multiple sites (Appendix R). Each of the clusters is situated along the shore of Lake Superior and three of these are on Grand Island (Figure 47). The Grand Island clusters include: 20AR338, 20AR398, and 20AR400 which are each located at the head of Murray Bay;

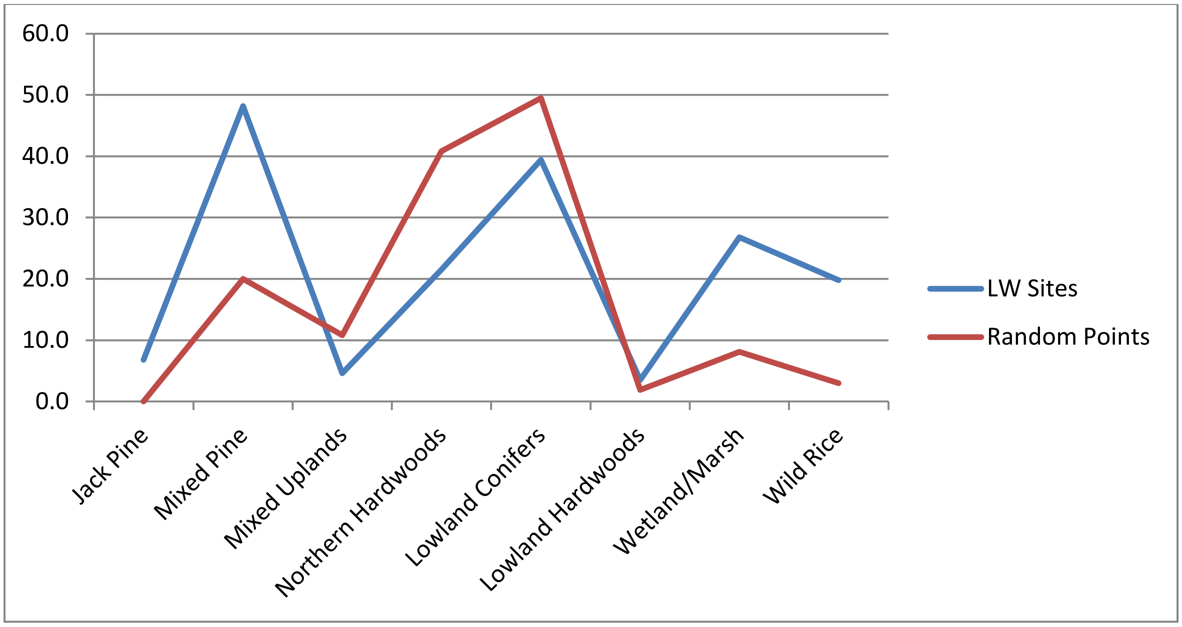


Figure 46: Comparison of the habitat composition between Random Points and Late Woodland sites in the 150 m radius catchments (percent).

20AR348, 20AR350, and 20AR353 which are located at Williams Landing; and 20AR358/386 and 20AR359 which are located at the mouth of Echo Lake Creek. The final cluster is comprised of sites 20CH32 and 20CH433 which are located along the shore of Whitefish Bay.

The 150 m radius site catchments include a mean area of 13.8 ha (14 ha median) with a minimum area of 9 ha (2 sites) and a maximum area of 25 ha for the 20AR338 cluster (Appendix R; Table 34). The pooled mean of the predictive scores within the catchments is 114.8 (118.6 median) with a minimum of 31.7 (20AR173/174) and a maximum of 154.1 for the Bar Lake site (20AR437) (Appendix R; Table 34; Figure 47). The pooled mean of the habitat diversity index for the catchments is 5.3 (4.6 median) with a minimum score of one for seven catchments and a maximum score of 18 at the Widewaters site (20AR245) (Appendix R; Table 34; Figure 47). It is worth noting that the Bar Lake site and the Widewaters site are situated about 1 km apart on the same stretch of the Indian River. If the same predictive scoring is applied to the mean score of the 150 m catchments, then nine are high sensitivity (19.1 percent), 36 are medium sensitivity (76.6 percent), and two are in low sensitivity catchments (4.2 percent).

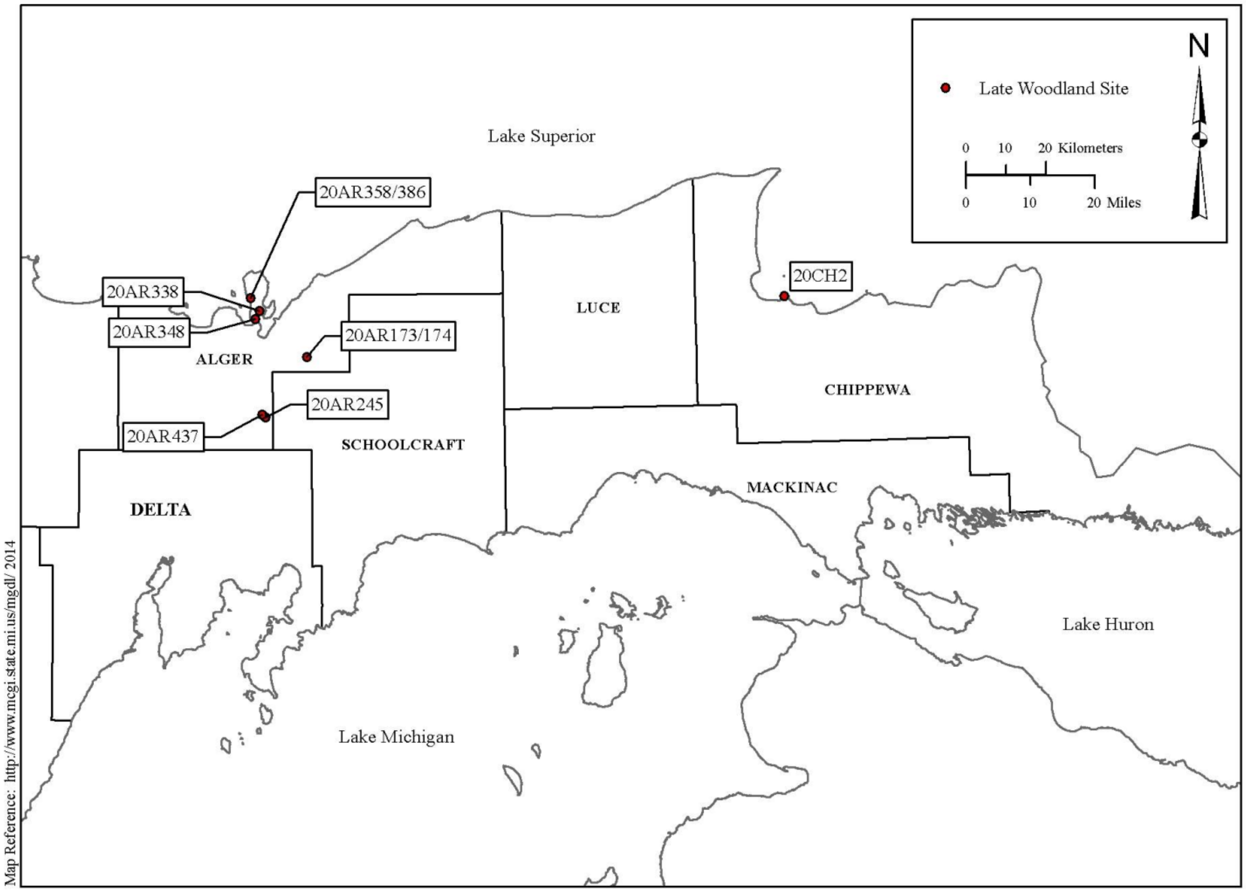


Figure 47: Map showing the locations of the 150 m radius Late Woodland site clusters as well as selected Late Woodland sites noted in text.

	150 m Site Catchments			Coastal Catchments		Interior Catchments	
	MPS	**MHDI**	**Area**	**MPS**	**MHDI**	**MPS**	**MHDI**
***n*=**	47	47	47	26	26	21	21
Mean	114.8	5.3	13.8	108.5	3.9	122.6	7.1
Median	118.6	4.6	14	108	39	123.5	5.8
Maximum	154.1	18	9	148.4	12.3	154.1	18
Minimum	31.7	1	25	57.7	1	31.7	2.6

Table 34: Descriptive Statistics for 150 m Radius Catchments Addressing Mean Predictive Score (MPS), Mean Habitat Diversity Index (MDHI), and Catchment Area

When the site catchments are compared there are interesting results. Figure 48 compares coastal and interior setting sites. In general, the interior sites have higher mean predictive scores and greater mean habitat diversity than coastal sites. T-tests confirm the statistical significance of these trends (Table 33). An intriguing observation is that all the sites with a mean habitat diversity of 1.0 are all situated on the coast. These are sites where there is only a single habitat present within the catchment or, in other words, sites with no terrestrial habitat diversity. When one considers the Inland Shore Fishery model, the fishery is the critical resource and site placement on the Great Lakes shoreline reflects access to the fishery and not terrestrial habitats.

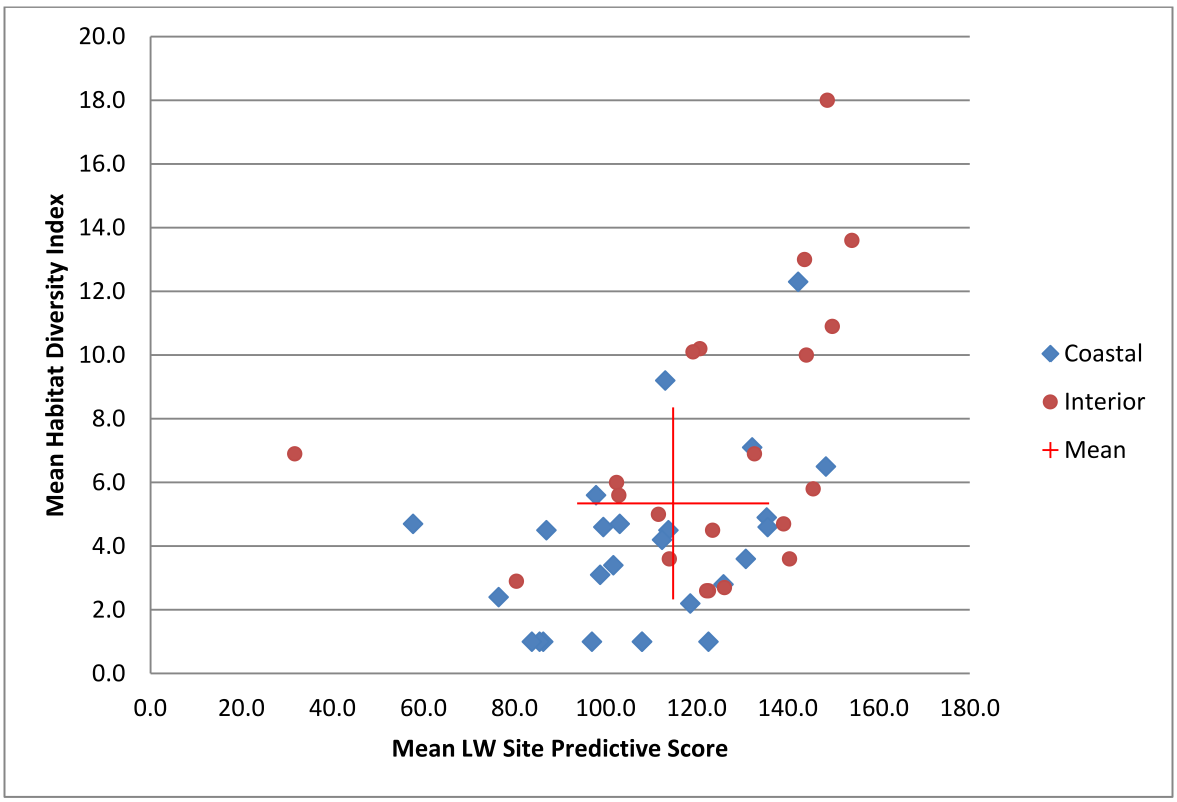


Figure 48: Scatter plot comparing coastal and interior LW sites by Mean Predictive Score (MPS) and Mean Habitat Diversity Index (MHDI) for 150 m radius catchments.

Figure 49 shows the presence/absence in percent of seven habitats within the 150 m site catchments for coastal and interior sites. This distribution shows the greatest diversions in jack pine habitats, wetland/marsh habitats and wild rice habitats. Jack pine is best represented on coastal sites, in fact none of the interior sites include this habitat. Wetland and wild rice habitats are better represented on interior sites.

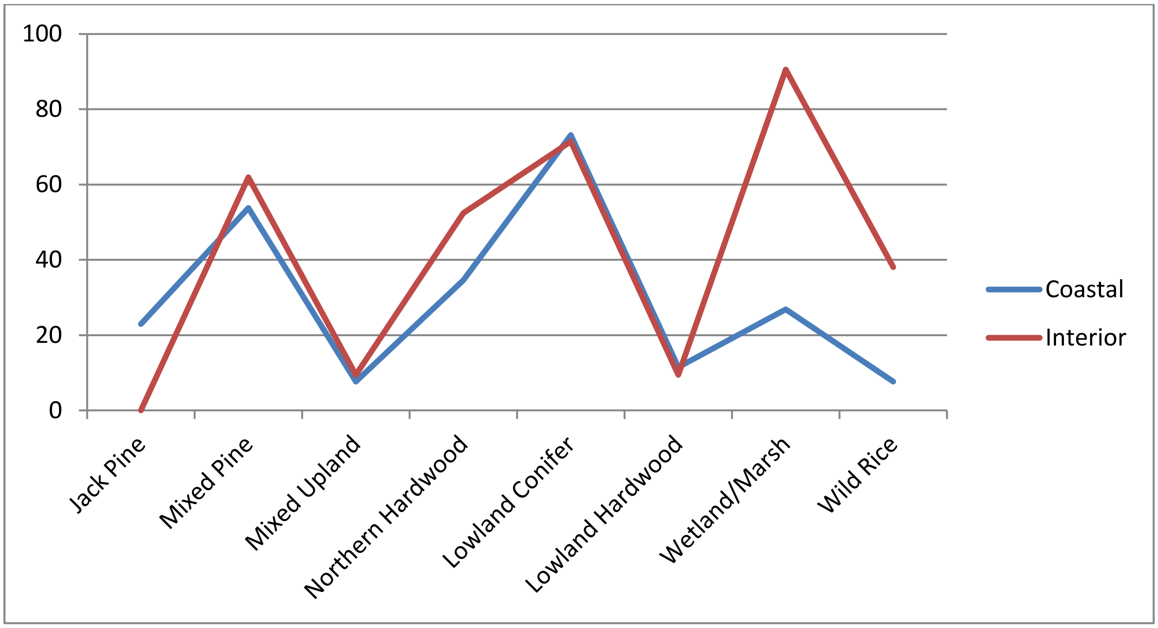


Figure 49: Comparison of the habitat composition between Coastal and Interior Late Woodland sites in the 150 m radius catchments (percent).

If we consider interior LW sites, and compare sites located on rivers or streams and sites on inland lakes, we find that interior lake sites have higher mean predictive scores and slightly higher mean habitat diversity (Table 35). T-tests show a statistically significant difference in the MPS, but do not for the MHDI (Table 33). This pattern may also be related to fishing. As noted in the last section, Franzen (1987) hypothesized that interior sites on rivers were likely used for spring fishing, thus the presence of a river, as the source of spring-spawning fish, was the primary factor in site placement. A secondary factor for interior river sites may include access to winter deer yards, a hypothesis derived from the association between these sites and lowland conifer environmental settings (Franzen 1987; see also Van Deelan 1996). He also hypothesized that interior lake sites were more generalized use locales reflecting more diverse hunting and gathering activities. The 150 m radius catchments generated through the model seem to confirm these observations for site specific zones in the Late Woodland.

	Lake Site Catchments		River Site Catchments	
	MPS	**MHDI**	**MPS**	**MHDI**
***n*=**	11	11	9	9
Mean	134.0	7.9	109.7	6.5
Median	132.7	10	111.6	5.6
Maximum	154.1	13.6	148.7	18
Minimum	119.2	2.6	31.7	2.9

Table 35: Descriptive Statistics for 150 m Catchments Addressing Mean Predictive Score (MPS), Mean Habitat Diversity Index (MDHI) for Interior Sites.

Interior lake catchments are more likely to include mixed pine, wetland/marsh, and wild rice habitats, whereas river site catchments are more likely to include wetland conifer habitats (Figure 50). Interestingly, wetland/marsh and lowland conifer habitats appear in over half of the catchments of both river and lake site categories. The mixed pine and wild rice habitat associated with interior lakes sites corresponds with the broad resource potential for interior lake sites (Dunham 2008, 2009; Franzen 1986, 1987; see also S. Martin 1999). The association between interior river catchments with lowland conifer habitat supports Franzen's (1987) contention that interior river sites were placed to access winter deer yards as well as spring-spawning fish.

The increased incidence of wetland/marsh habitats associated with interior site catchments is also significant. While this relationship may be simply a factor of many LW sites being proximate to sources of water, water that might be bounded by wetlands, the importance of

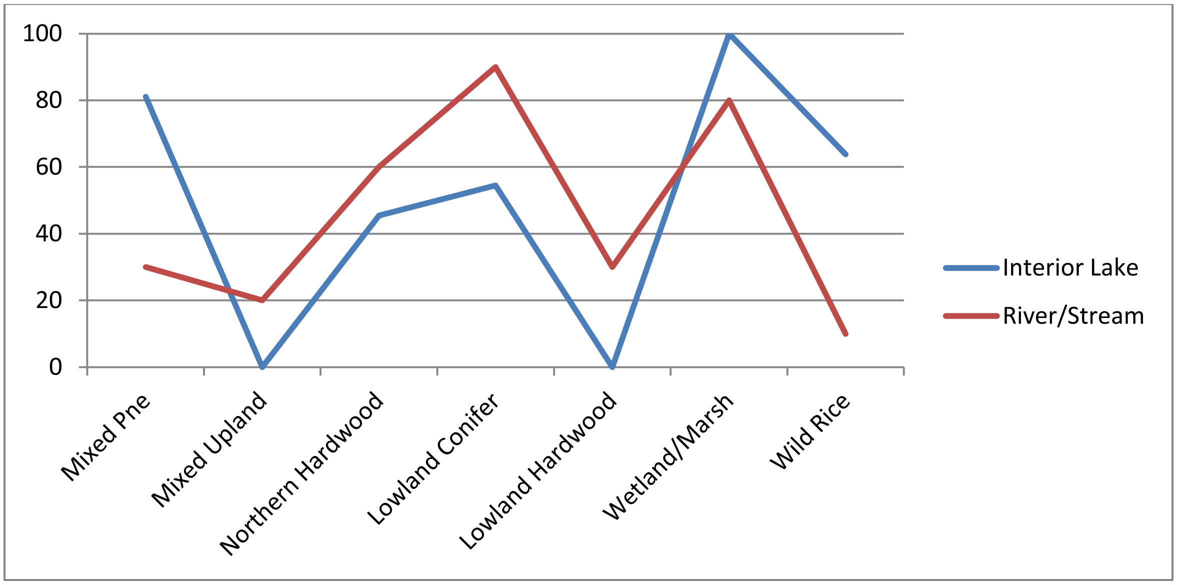


Figure 50: Comparison of the habitat composition between Interior Lake Late Woodland site catchments and River/Stream Late Woodland 150 m radius site catchments (percent).

wetland resources in hunter-gather and low-level food producer subsistence is well known (Gallagher and Arzigian 1994; Lovis et al. 2001; Nicholas 2006). This pattern was noted in the one km² quadrat analysis in Chapter 4.3, but is more explicit as a result of the catchment. Marsh habitats attract a wide variety of wildlife including waterfowl, muskrat, beaver, moose, and some varieties of spring spawning fish to name a few (see Tables 33 and 34). These habitats are also rich in certain plant resources including aquatic tuber, cranberries, and, in some cases, wild rice.

5.2.2 *150 m Radius Catchments and DUI*

The MPS of the catchments and the MHDI measure two different sets of variables. The MPS reflect how the individual 100 × 100 m quadrats score within the catchment, assessing habitat and distance to water (LWPM), whereas MHDI is a measure of the diversity of habitats within the catchment. These two scales are weakly correlated (r = 0.47), but this reflects the assumption that a higher predictive score is likely to result from a greater number of habitats (see Chapter 4.6). Conversely, if all the 100 × 100 m quadrats in a given catchment were within 120 m of water and all included mixed pine habitat, then the MPS would be 140 (a high score based on the LWPM). However, the MHDI of the catchment would be 1.0, signifying the presence of only a single habitat type and no habitat diversity (a low score). As we noted previously, LW sites tend to have a greater diversity of habitats than Random points, so it would be expected that higher predictive scores combined with higher habitat diversity would be an attribute of LW site catchments.

The two scales were plotted against one another on a scatter plot graph to examine the interrelationship between LW site catchments (see Figure 48). Additionally, the mean of each set was calculated and three categories were established (Appendix R). Site catchments that exceeded the mean in both scales (MPS and MHDI) were considered to have increased site sensitivity and habitat diversity (SS&HD) (12 catchments [25.5 percent]). Those catchments that exceeded the mean in only one set or the other were classified as having moderate SS&HD (18 catchments [38.3 percent]). The remaining catchments, those that did not exceed the mean in either scale were classified as having minimal SS&HD (17 catchments [36.2 percent]).

The SS&HD ranks can be compared to the DUI categories. The original DUI categories from Chapter 3 were carried over for this analysis, despite a smaller set of LW sites and site catchments. The 150 m catchment and DUI comparison follows the same trends as the DUI and site location comparisons (Figure 51). Extended diversity sites favor catchments with moderate and minimal SS&HD. Intermediate and limited sensitivity site locales include intermediate SS&HD catchments as well as moderate and minimal catchments.

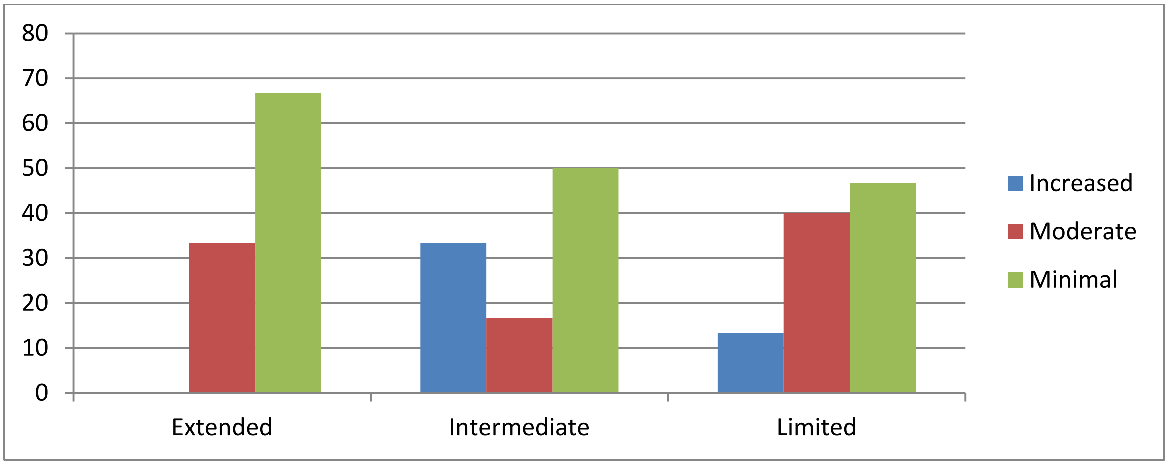


Figure 51: Comparison of Diversity Use Index and Site Sensitivity & Habitat Diversity by Category in the 150 m Radius Site Catchments (percentage).

When the 150 m catchments are compared by coastal and interior settings, the patterns once again parallel the DUI and site location comparisons (Figure 52). All the extended diversity sites are on the coast. Catchments with minimal SS&HD are the most common in each of the coastal DUI site categories. Increased SS&HD catchments comprise half of the interior intermediate diversity site catchments and over 40 percent of interior limited diversity site catchments. A comparison of interior lake and river settings reveals that sites on interior lakes favor increased SS&HD catchments, whereas catchments on interior rivers include lower SS&HD catchments (Figure 53).

5.2.3 *1500 m Radius Catchments*

As with the 150 m catchment, Random points and LW sites were compared for 1500 m radius catchments. The 1500 m radius catchments were calculated on two occasions, one for the predictive scores of LW sites and Random Points and again for the habitat diversity of LW sites and Random points. The size of the catchments varied in the two analyses. The mean size for a 1500 m LW site sensitivity catchment is 531.3 ha (521.5 ha median) and for a habitat diversity

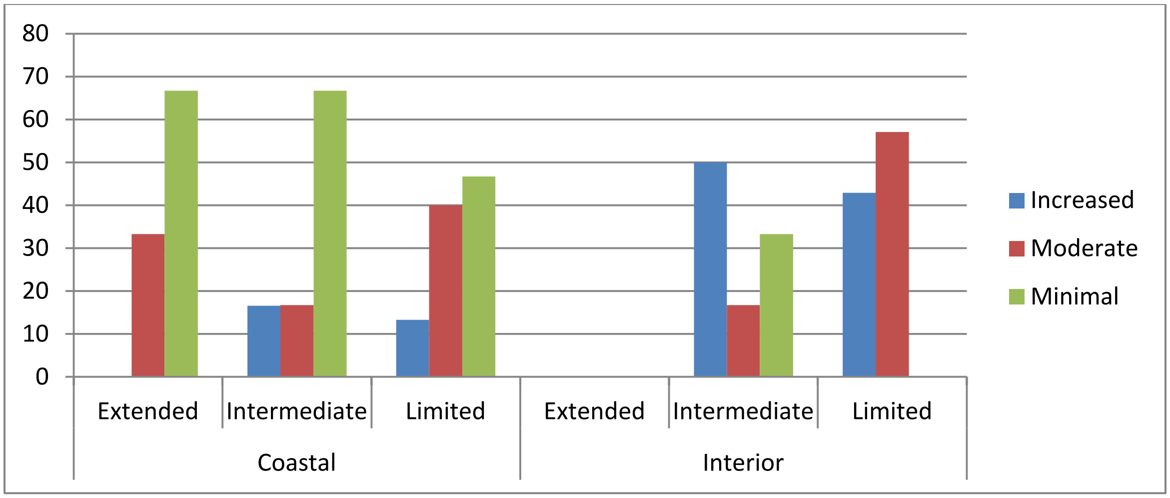


Figure 52: Comparison of Diversity Use Index and Site Sensitivity & Habitat Diversity by Category and Site Setting, 150 m Radius Site Catchments (percentage).

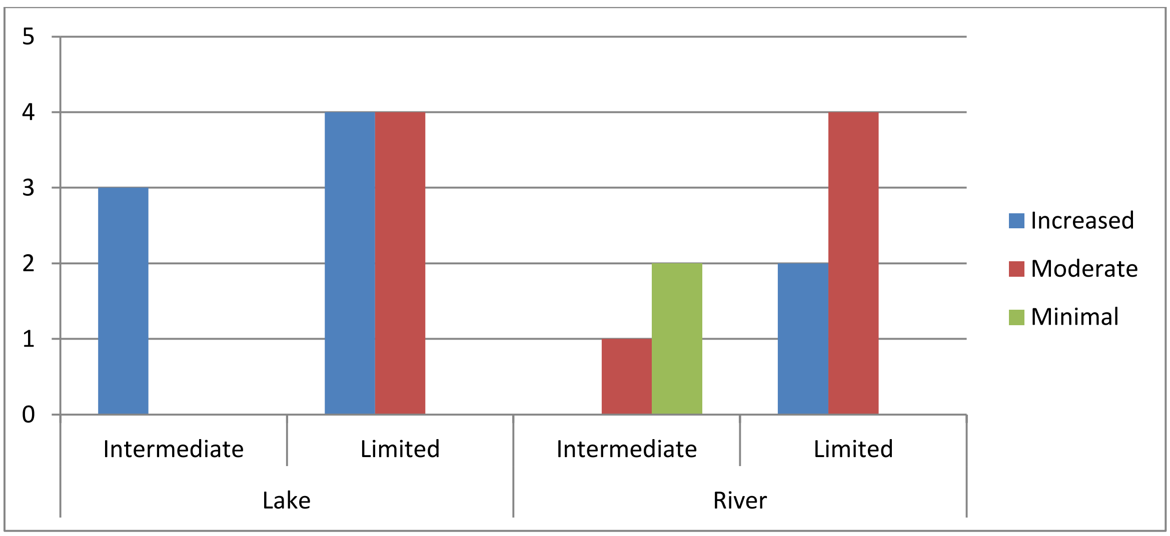


Figure 53: Comparison of Diversity Use Index and Site Sensitivity & Habitat Diversity by Category and Interior Site Setting, 150 m Radius Site Catchments (count).

catchment is 624.9 ha (601.5 ha median). A t-Test comparing the distribution of the means of these sets did not identify a statistically significant difference, so the seperate calculations were maintained (Table 36).

Descriptive statistics show that the LW site catchments have higher predictive scores and habitat diversity as well as a greater number of habitats per catchment (Table 37). Once again, LW sites have higher MPS and higher MHDI than Random points. Finally, t-Tests demonstrate

		Observed t Statistic	t Critical Value @ 0.1 (two-tailed)	P value (two-tailed)	Statistically Significant
Catchment Area	**Predictive Model v. Habitat**	-1.638	1.666	0.106	No
	Coastal v. Interior	-6.161	1.711	0	Yes
Random Point v. LW site	**Sensitivity Score**	73.408	1.645	0	Yes
	Habitat Diversity	2.974	1.675	0	Yes
Coastal v. Interior	**Sensitivity Score**	-1.804	1.697	0.081	Yes
	Habitat Diversity	-1.824	1.690	0.038	Yes
River v. Lake	**Sensitivity Score**	1.736	1.771	0.106	No
	Habitat Diversity	0.708	1.796	0.493	No

Table 36: Results to t-Tests for 1500 m Radius Catchments.

	Random MPS	Random MHDI	LW Site MPS	LW Site MHDI
***n*=**	67409	89	20188	34
Mean	44.8	6.1	72.9	7.9
Median	27	6.2	66	7.1
Maximum	176	12.1	191	20.7
Minimum	1	1	1	2.9

Table 37: Descriptive Statistics of the 1500 m Radius Catchments for Random Points and Late Woodland Sites Addressing Mean Predictive Score (MPS) and Mean Habitat Diversity Index (MDHI).

that the predictive scores of Random point catchments and Late Woodland site catchments are derived from different populations (Table 36).

Not only do the site catchments include a greater diversity of habitats, the habitats associated with the LW sites are also structurally different than those associated with Random points. Figure 54 illustrates the differences and shows that the LW site catchments are more likely to include mixed pine habitats, wetland/marsh habitats, and wild rice habitats than the

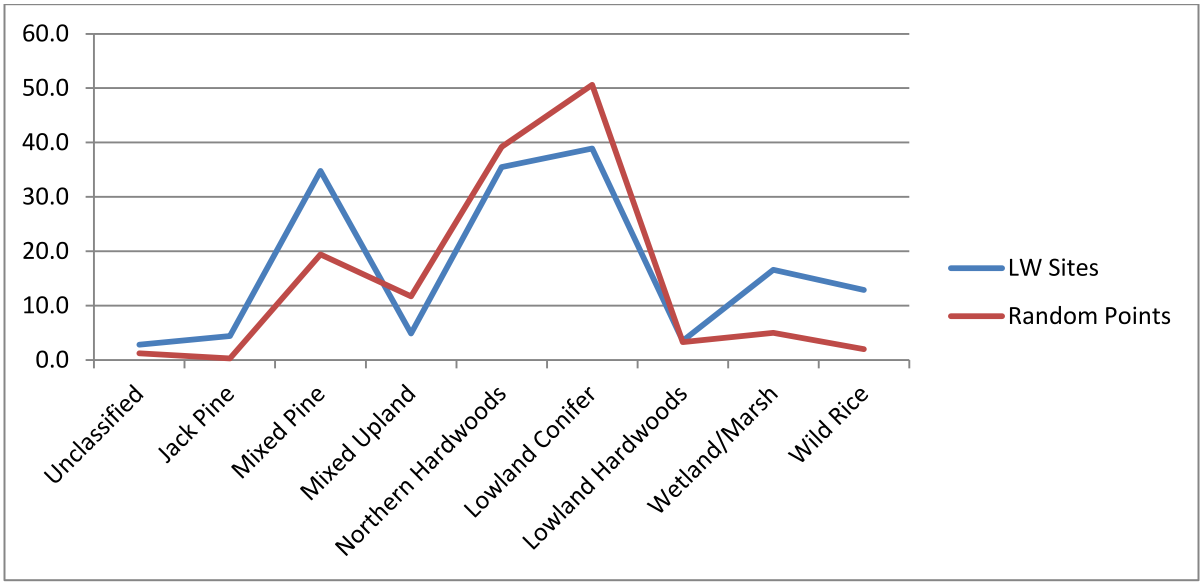


Figure 54: Comparison of the habitat composition between Random Points and Late Woodland sites in the 1500 m radius catchments (percent).

Random point catchments. This parallels the results of the 150 m radius catchment test, but the differences are less pronounced at the 1500 m scale which makes sense as the larger aggregate area of the catchment is more likely to level itself out than the smaller 150 m catchment.

There are thirty eight 1500 m radius site catchments (Appendix S). These include ten site clusters including (Figure 55): 20AR338, 20AR398, 20AR400, and 20AR406 at the head of Murray Bay on Grand Island; 20AR348, 20AR350, 20AR353, and 20AR6 at Williams Point on Grand Island as well as on Powell Point on the mainland; 20AR358/386 and 20AR359 at the outlet of Echo Lake Creek; 20AR245 and 20AR437 on the upper Indian River; 20CH32 and 20CH433 on Whitefish Bay; 20DE93; 20DE167, 20DE294 on the lower Sturgeon River; 20ST14 and 20ST233 on Crooked Lake; 20ST109/110 and 20ST262 on Thunder Lake; 20MK58 and 20MK375 near the mouth of the Pine River; and 20MK159 and 20MK261 at the mouth of the Carp River.

The pooled mean of the habitat diversity index for the 1500 m radius catchments is 7.8 (7.2 median) with a minimum score of 2.9 (20DE326) and a maximum score of 20.7 at 20DE106

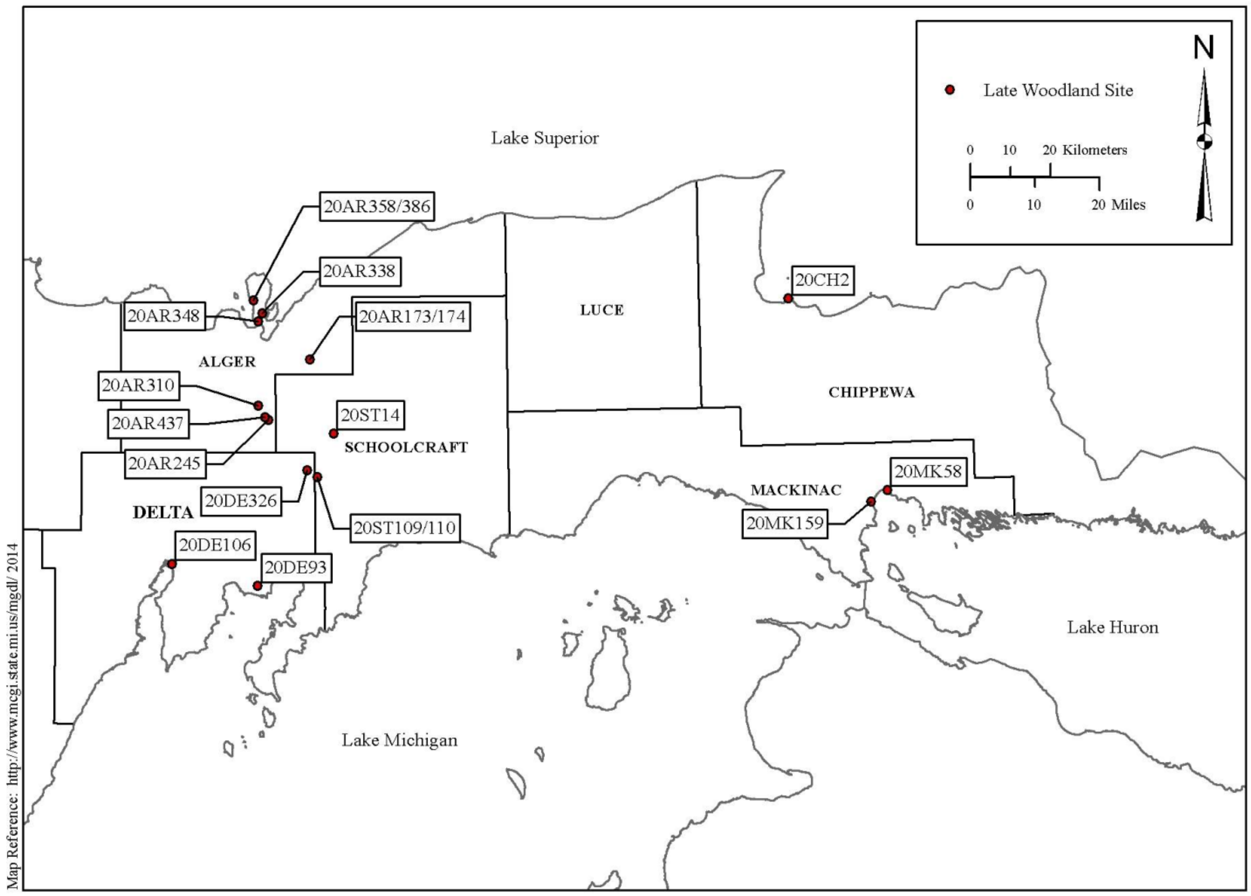


Figure 55: Map showing the locations of the 1500 m radius Late Woodland site clusters as well as selected Late Woodland sites noted in text.

(Appendix S; Table 38; Figure 55). The pooled mean of the LW site predictive scores is 71.5 (72 median) with a minimum score of 28.7 (20AR173/174) and a maximum score of 109.4 (20AR310) (Appendix S; Table 38; Figure 55). Applying the LWPM scoring to the 1500 m catchments identifies 24 as medium sensitivity catchments (63.2 percent) and 14 as low sensitivity (36.8 percent) with no catchments scoring as high sensitivity.

When these figures are compared to the 150 m radius catchments the 1500 m radius predictive scores are lower and the 1500 m radius habitat diversity scores are higher. As noted above, the larger aggregate area of the 1500 m radius catchment is more likely to have a lower MPS as it encompasses a greater number of 100 ×100 m quadrats. This is because the HNF is mostly comprised (71.4 percent) of low sensitivity areas (see Chapter 4 [Table 27]). Conversely, the habitat diversity score is likely to be higher in the 1500 m radius catchment because the larger area is more likely to include more habitats.

	1500 m Site Catchments			**Coastal Catchments**		**Interior Catchments**	
	MPS	**MHDI**	**Area**	**MPS**	**MHDI**	**MPS**	**MHDI**
N=	38	38	38	22	22	16	16
Mean	71.5	7.8	531.3	65.8	7.0	79.3	9.0
Median	72	7.2	521.5	59.3	6.7	87.7	8.2
Maximum	109.4	20.7	1248	108.4	20.7	109.4	13.9
Minimum	28.7	2.9	139	37.1	2.9	28.7	4.9

Table 38: Descriptive Statistics for 1500 m Radius Catchments Addressing Mean Predictive Score (MPS), Mean Habitat Diversity Index (MDHI), and Catchment Area.

Figure 56 compares coastal and interior setting site catchments (see also Table 38). In general, the interior site catchments have higher mean predictive scores and greater mean habitat diversity than coastal sites. This observation is also supported through t-Tests (Table 36). This pattern continues to support the premise that the critical resource for the coastal sites is the Inland Shore Fishery, whereas interior sites typically are placed in areas with a broader set of resource potentials as measured through site sensitivity and habitat diversity. The difference in the relative proportion of habitats is similar to that of the 150 m radius catchments, but they are not as distinct in the 1500 m catchments (Figure 57). Mixed pine, wetland/marsh and wild rice habitats are better represented for interior site catchments, and jack pine is more prevalent in coastal catchments. Other habitats, including lowland conifer habitats, are similarly represented in coastal and interior 1500 m catchments.

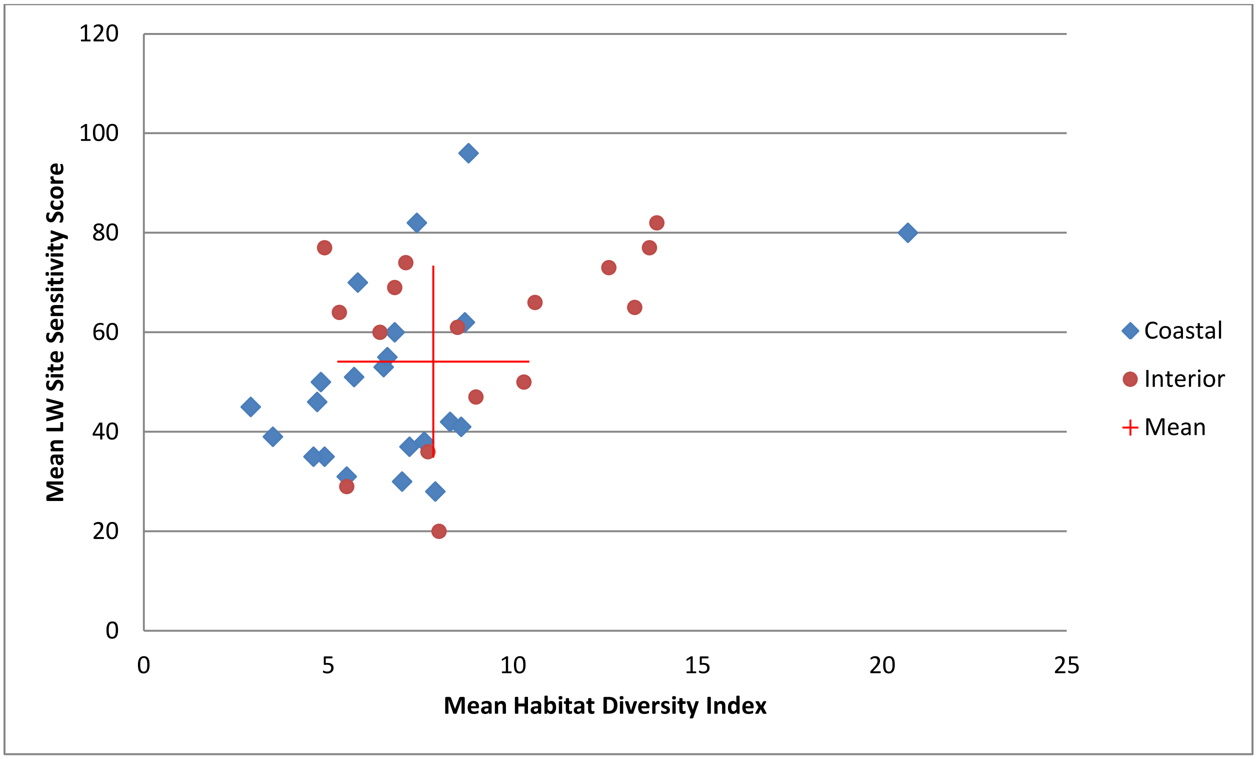


Figure 56: Scatter plot comparing coastal and interior LW sites by Mean Predictive Score (MPS) and Mean Habitat Diversity Index (MHDI) for 1500 m radius catchments.

Another observation concerning coastal and interior sites is the relative size of the 1500 m radius catchments. As noted above, the mean size of all the 1500 m site catchments is 531.3 ha based on the predictive score catchments. Coastal sites have a mean area of 385.5 ha and interior sites a mean area of 731.8 ha. A t-test shows this to be statistically significant (Table 36). This difference can be explained when the setting of coastal sites is considered. A significant part of the 1500 m catchment at coastal sites will include open waters of a Great Lake. The site with the smallest 1500 m radius catchment is 20MK3/11 which is situated on a point on a small island (Round Island) (Figure 55). The catchment is small because of the large amount of open water surrounding the site. Open waters of the Great Lake fall outside of the model and do not produce predictive scores. While interior sites may be located on interior

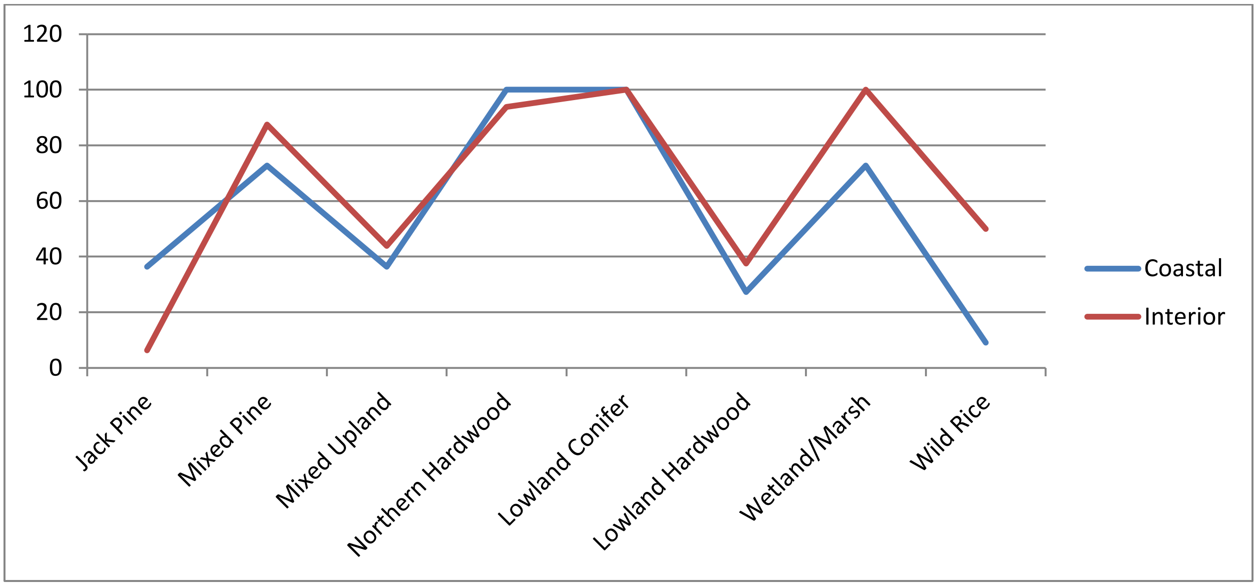


Figure 57: Comparison of the habitat composition between Coastal and Interior Late Woodland site 1500 m radius site catchments (percent).

lakes or have their catchment include interior lakes, their presence does not reduce the size of the catchment like a Great Lake.

Interior lake site catchments have a higher MPS and higher MHDI than interior site catchments on rivers and streams (Table 39). However, neither of these distributions are statistically significant (Table 36). Once again, this probably reflects the larger size of the catchment and the greater potential for increased habitat diversity as well as decreased site sensitivity. The trends outlined above concerning interior lake and river sites may be generally supported in the 1500 m radius catchment. Importantly, however, the MHDI increases with catchment size demonstrating the potential importance of the primary zone of exploitation in leveling the resource potential of a given site catchment area.

1500 m	Lake Site Catchments		River Site Catchments	
	MPS	MHDI	MPS	MHDI
N=	9	9	7	7
Mean	87.9	9.4	68.3	8.4
Median	88	8.5	72.4	8
Maximum	109.4	13.9	88.7	10.6
Minimum	32	4.9	28.7	6.4

Table 39: Descriptive Statistics for 1500 m Catchments Addressing Mean Predictive Score (MPS), Mean Habitat Diversity Index (MDHI) for Interior Sites.

5.2.4 *1500 m Radius Catchments and DUI*

In this section the MPS and MHDI are combined and scaled as they were for the 150 radius catchments. Once again, the MPS and MHDI scales are weakly correlated (r = 0.4) for the 1500 m catchments. The two scales were plotted against one another on a scatter plot graph to examine the interrelationship between LW site catchments (Figure 56). Additionally, the mean of each set was calculated and three categories were established (Appendix S). Site catchments that exceeded the mean in both scales (MPS and MHDI) were considered to have increased SS&HD (11 catchments [28.8 percent]). Those catchments that exceeded the mean in only one set or the other were classified as having moderate SS&HD (12 catchments [31.6 percent]). The remaining catchments, those that did not exceed the mean in either scale were classified as having minimal SS&HD (15 catchments [39.5 percent]).

There are thirty six 1500 m radius catchments that include LW sites and DUI scores (Appendix S). The highest site DUI score was used for the catchment if there were multiple scores in a cluster. Extended diversity sites do not appear in catchments with increased SS&HD (Figure 58). Intermediate diversity sites are well represented in increased as well as minimal sensitivity and diversity catchments. Finally, limited diversity sites are represented in all three types of catchment and the largest proportions of limited diversity sites appearing catchments with moderate and minimal SS&HD.

The three extended diversity sites are situated in coastal settings (Figure 59). Intermediate diversity sites are better represented in catchments with increased SS&HD in the interior and in minimal SS&HD on the coast. There are no intermediate diversity sites in moderate SS&HD catchments on the coast. Limited diversity sites appear more frequently in

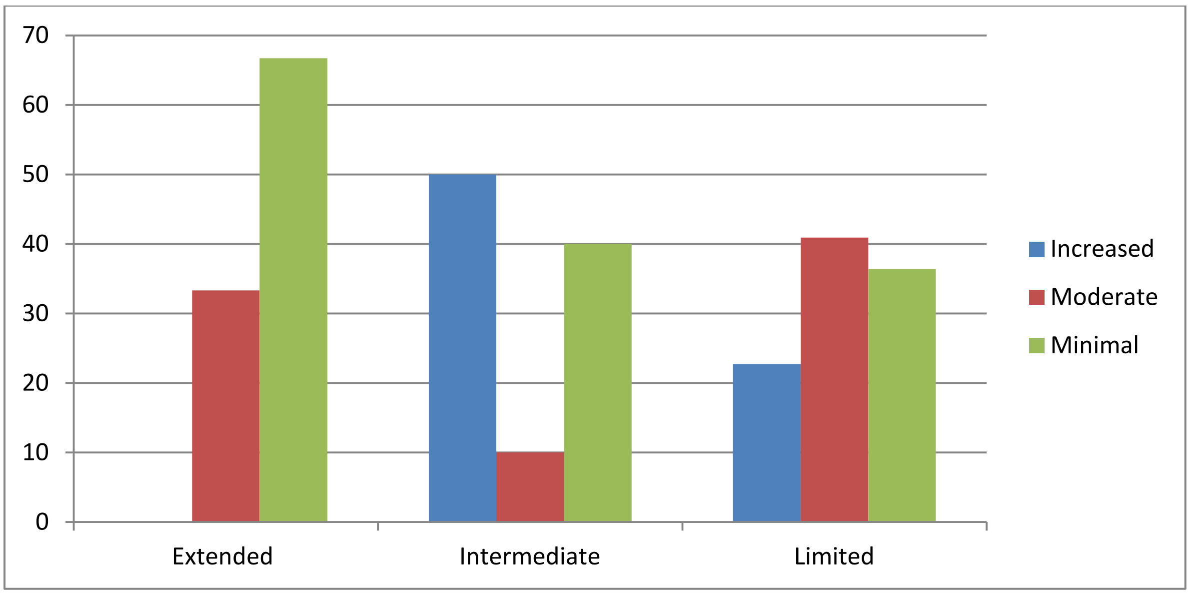


Figure 58: Comparison of Diversity Use Index and Site Sensitivity & Habitat Diversity by Category in the 1500 m Radius Site Catchments (percentage).

catchments with minimal SS&HD on the coast and in moderate SS&HD catchments in the interior. When interior LW sites on rivers and lakes are compared, we once again see a higher proportion of intermediate and minimal diversity interior lake sites in increased SS&HD catchments than interior river sites (Figure 60).

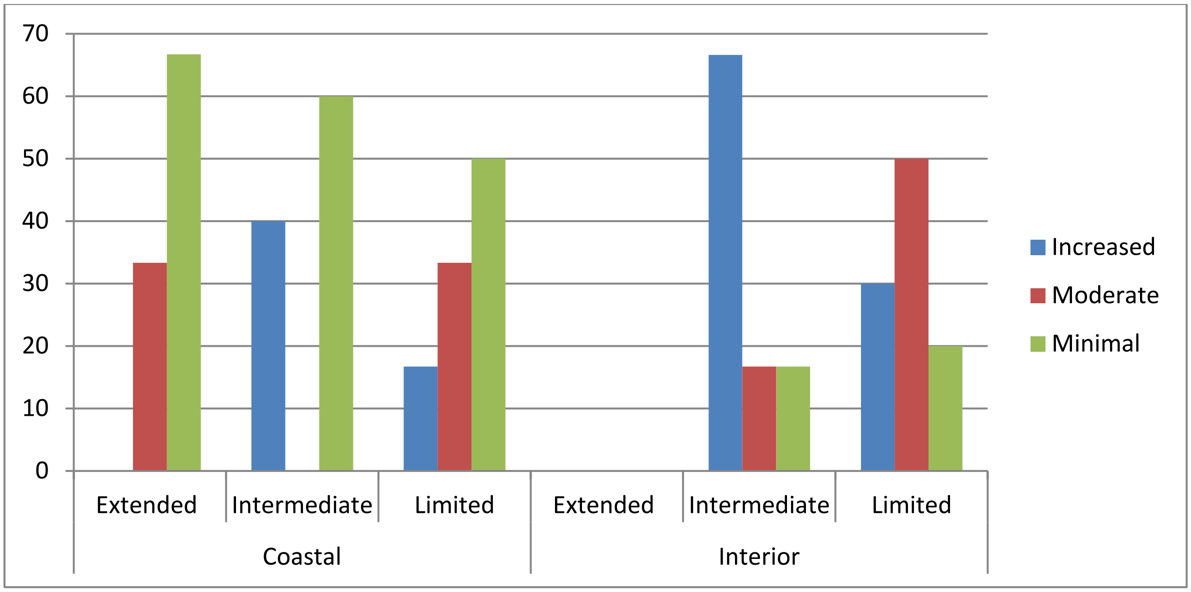


Figure 59: Comparison of Diversity Use Index and Site Sensitivity & Habitat Diversity by Category and Site Setting, 1500 m Radius Site Catchments (percentage).

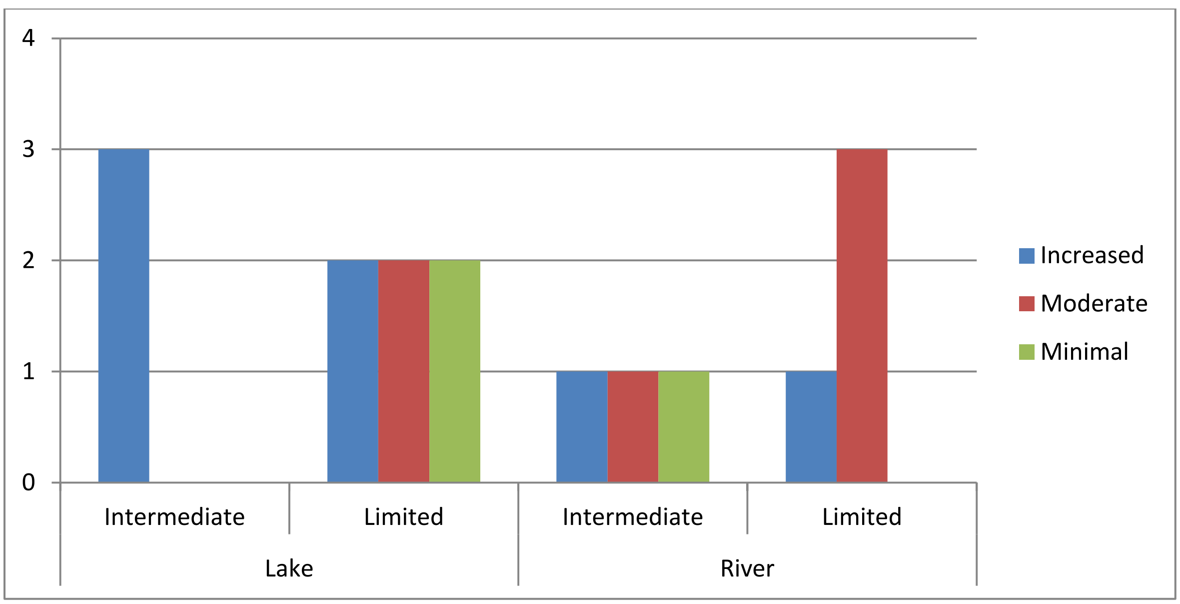


Figure 60: Comparison of Diversity Use Index and Site Sensitivity & Habitat Diversity by Category and Interior Site Setting, 1500 m Radius Site Catchments (count).

5.3 Discussion

The goal of this chapter was to explore how LW site settings and assemblages could aid in our understanding of LW settlement dynamics. The analyses discussed above identified patterns and trends that do provide insight into these processes. Some of the more distinct patterns will be summarized as follows. The comparison of the DUI and LWPM ranks at the site level found that the proportion of LW sites in high sensitivity areas increased as DUI decreased. Further, limited diversity interior LW sites are the most likely to be situated in high sensitivity areas. Limited diversity sites are thought to represent small, logistical camps where resources might be collected, hunted, or gathered by a small group over a short period of time. High sensitivity locales are situated adjacent to water and in mixed pine habitats, both of these variables offer a range of subsistence related resources.

Extended diversity sites, the sites that produced evidence for the widest range of activities, are only situated in coastal settings. These sites are interpreted to be larger, residential sites that were occupied by a larger number of people for longer periods of time. Most of the extended diversity sites are located in medium sensitivity areas, however extended diversity sites include the largest proportion of sites in low sensitivity areas and the smallest proportion of sites in high sensitivity areas when compared with intermediate or limited diversity sites. These trends are also present in the catchment analyses (150 m radius and 1500 m radius) where none of the extended diversity site catchments were classified as having increased site sensitivity and habitat diversity.

The results of these analyses set up an interesting dichotomy, less diverse interior sites associated with higher sensitivity areas and more diverse coastal sites located in lower sensitivity areas with less environmental diversity. It is posited that the extended diversity coastal sites represent the locations where LW peoples came together to harvest and process spring and/or fall spawning fish (see Cleland 1982; see also S. Martin 1985). As such, these sites would have had a larger population of people representing mixed age and gender groups for at least the spring and fall spawning seasons. These people would have needed food and shelter while occupying the site as well as the facilities to harvest and process the fish. Therefore, a diversity of tasks would be performed at these sites. Although these sites have an extended level of diversity, the location of these sites was dependant on access to these fisheries (aquatic habitats) and not terrestrial habitats.

A review of the placement of interior sites supports this observation. There are no extended diversity sites in the interior. Interior sites are located both on interior lakes as well as rivers and streams. The sites on rivers are more oriented towards medium sensitivity locales at the site level and more towards minimal and moderate areas of site sensitivity and habitat diversity in the 150 m radius catchments. Interior LW sites on lakes are associated with high sensitivity areas and catchments with increased site sensitivity and habitat diversity. Franzen (1986) hypothesized that prehistoric sites on interior rivers were well placed for procuring spring spawning fish. It seems that access to fish spawning habitat, whether a site is on the coast or the interior, is a critical factor in site placement if the primarily use was harvesting spawning fish. In this instance, coastal extended diversity LW sites and interior LW sites on rivers can be hypothesized to have been used for fishing.

Another observation concerning the use of the landscape can be derived from the examination of the relative age of the LW sites. The most obvious pattern associated with relative age is the greater use of the interior by late LW people. Twenty three percent of the late LW sites are located in interior settings, whereas only 5 percent (a single site) of early LW sites are in the interior. Eighty percent of the late LW interior sites are in high sensitivity areas. In addition, a smaller proportion of late LW coastal sites are classified as extended or intermediate diversity sites and a higher proportion of late LW coastal sites are classified as limited diversity sites when compared to the early LW (Figure 61). These trends are suggestive of a greater use of logistical camps by late LW peoples, both on the coast and especially in the interior.

An important factor in this discussion is mobility. In Chapter 3, Binford's (1980) framework of hunter-gatherer settlement strategies was outlined in the discussion of site DUI. This model characterizes foragers as residentially mobile and collectors as logistically mobile. Residential mobility refers to the movement of an entire group from one location to another in pursuit of resources, whereas logistical mobility entails smaller task groups leaving and returning to a residential camp with resources (see also Binford 1983; Kelly 1992; Lovis et al. 2005; Morgan 2009; C. Smith 2003; Whallon 2006). The increase in archaeologically visible limited diversity sites on the coast and in the interior by late LW people is evidence of a higher reliance on logistical mobility.

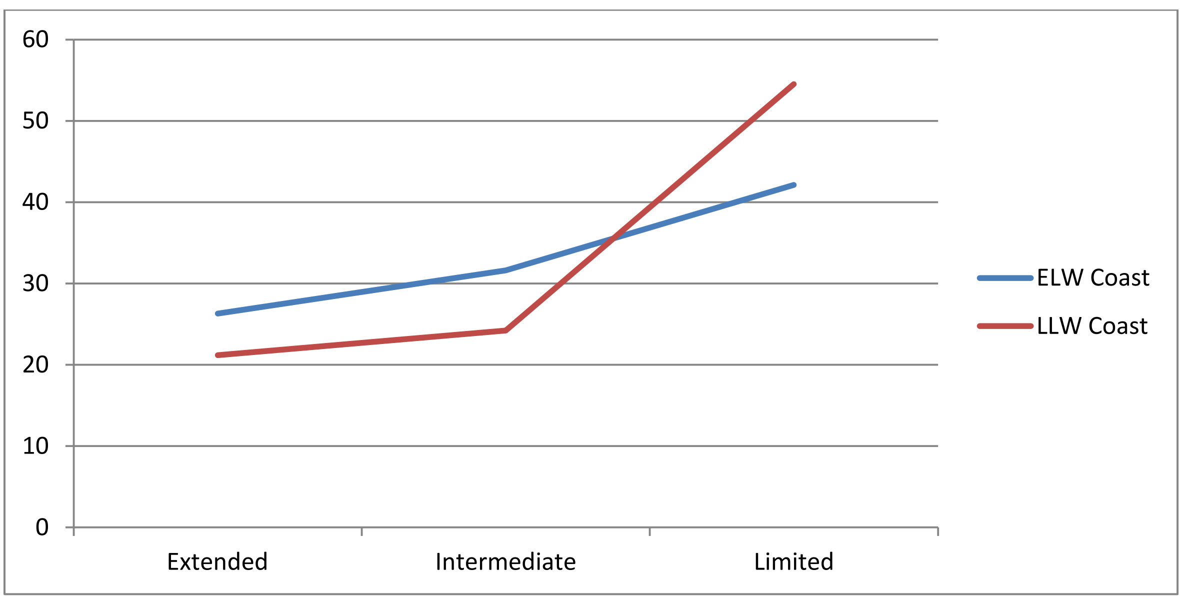


Figure 61: Comparison of Diversity Use Index by Relative Age of Coastal Late Woodland Sites (percent).

Binford (1980; 1983; 2001) presents hunting-gathering as a successful subsistence strategy with mobility serving as an effective security measure resulting from resource and information procurement and as a buffering strategy to mitigate over exploitation of resources in a given location (see also Davidson-Hunt and Berkes 2003; Whallon 2006). This way of thinking leads into the third trend observed from the analyses presented above relating to the leveling effect of the larger (1500 m radius) catchments. For example, the larger area of the 1500 m radius catchment is more likely to include more habitats. Likewise, the farther a quadrat is from water, the lower the predictive score is likely to be. The habitat diversity should increase and the relative site sensitivity should drop as a catchment expands.

This pattern has the potential to mitigate the environmental disparity between sites in different settings. This may be best exemplified through interior lake and river sites. At the site level and in the 150 m radius catchments, there was a statistically significant difference in the terrestrial habitats (diversity and site sensitivity) associated with these sites. In the 1500 m radius catchment, the statistical differences were no longer significant. In other words, interior sites, regardless of riparian or lacustrine setting, have similar resource potential (as measured by site sensitivity and habitat diversity). This demonstrates an acute awareness of the environmental variables that make site specific zones (150 m radius catchments) preferable to other places (such as a Random point), while considering the implications of the primary zone of exploitation (1500 m radius catchment) to overall site setting.

In this chapter the analyses from Chapters 3 and 4 were combined to explore LW settlement dynamics in the eastern UP. The resulting analysis revealed trends that directly inform on LW settlement patterns that have spatial, temporal, and environmental components. Sites where spring and fall fishing took place were typically in areas with lower site sensitivity and habitat diversity than other sites. Interior sites were much more important during the late LW than they were in the early LW. The interior sites were typically low or intermediate diversity which indicates they were likely logistical sites. The increase in the importance of logistical sites has important implications for how the settlement system operated in the late LW. Finally, the discovery of the role of the primary zone of exploitation (1500 m radius catchment) as a mitigative or buffering mechanism for LW sites in different environmental settings adds a new dimension to our understanding of the selection of site locales. Additional discussion of these topics as well as others will be presented in the following chapter.

6.0 CONCLUSIONS

Previous research on the LW in the eastern UP has emphasized the Great Lakes fishery, especially the intensive harvest of spring and fall spawning fish. This study has revisited this topic and integrated the results of more recent archaeological research as well as pilot studies on these topics. The results have illustrated a series of trends concerning LW settlement and subsistence in the region that provide a fuller picture of LW settlement and subsistence dynamics.

Eighty one LW sites have been identified in the eastern UP and these were quantified and summarized in tabular form and a diversity use index (DUI) was created. The diversity index established a framework in which to consider and compare the LW sites in the eastern UP. The DUI framework supports the contention that LW sites were used differently than the previous models indicated. Additionally, a LW archaeological site predictive model was created (LWPM) that demonstrated a correlation between specific environmental variables (distance to water, habitat, and proximity to wild rice locales) and the location of LW sites. The data from the DUI and LWPM was combined and the results revealed trends that directly inform on LW settlement patterns that have spatial, temporal, and environmental components.

One of the themes to arise included a distinct pattern in which sites where fishing took place were located in areas with lower site sensitivity and habitat diversity than other sites. This indicates that the location was selected for access to the fishery as opposed to other resources. A second trend was that interior sites were more visible in the late LW than the early LW. In a related point, sites on the coast typically had higher DUI and a lower LWPM score than interior sites. Finally, it was also determined that the locations selected for sites tend to become more similar as the catchment zone around the site expands. As the catchment expands, the relative sensitivity and habitat diversity becomes more similar. These trends, as well as others, are discussed below.

6.1 Fish, Acorns, Wild Rice, and Maize

It was posited in Chapters 1, 2, and 4 that distribution of LW archaeological sites in the eastern UP is patterned by the decisions of LW people in relation to environmental factors they considered culturally and economically important, specifically the location of subsistence resources. We know that access to the fisheries requires access to water, and that the fall fishery is only accessible on the shores of the Great Lakes. Other resources examined in Chapter 4, acorns, maize, and wild rice also have spatial, environmental, and temporal (seasonal and inter-annual) constraints.

Fall spawning fish can only be accessed from deep water locales on the Great Lakes (the rapids at Sault Ste. Marie being a notable exception). Fall spawning begins as early as October, but typically peaks between mid-November and late December (Cleland 1982). Wild rice can occur in slow moving rivers or sheltered locations near Great Lakes shorelines, but is most commonly found in interior lakes with stable water levels (Aiken et al. 1988; Vennum 1988). Wild rice typically ripens in late August or early September. Maize, in reference to the eastern UP, is most likely to succeed in areas near the Great Lakes because of the extended growing season in the lake effect zone (O'Shea 2003; Yarnel 1964). Maize begins to ripen in August, but can be stored on the stalk for a period of time before harvesting. Oak occurs in a variety of habitats in the eastern UP, but are best represented in mixed pine habitats (Dunham 2009). Acorns begin to ripen in late summer, depending on variety, and continue to do so through October. Based on this information, nearly any of these resources may be accessed from locales on the Great Lakes coast. Wild rice and acorns could alternately be collected from interior locales. These constraints may facilitate a better understanding of settlement and subsistence dynamics in the region.

6.1.1 *Fall Fishery*

The trends outlined in Chapter 5.3, as well as those documented in Chapters 3 and 4, directly address the basic goals of this dissertation. The inverse relationship between site diversity and site sensitivity seems to support the premise that extended diversity coastal sites were places where fall and/or spring spawning took place. A similar pattern is noted with interior sites, where sites on rivers are most associated with moderate site sensitivity suggesting that these locales were used for spring fishing. With the exception of the proto-historic component of 20DE4, all the extended diversity sites include faunal evidence for spring and/or fall spawning fish. Sites 20AR348, 20CH95, and 20MK1 also include stone net weights further supporting the act of fishing on these sites. Two of the interior river sites, 20DE75 and 20DE188, produced spring spawning sturgeon remains.

Two of the extended diversity site components are early LW, four are late LW, and three include both early and late LW components that cannot currently be differentiated based on existing reporting (Appendix T). An exception to this is the faunal remains from the Scott Point site (20MK22) that have been divided into three components (Mackinac, Bois Blanc, and Juntunen Phases), although comparable information was not available for the lithic assemblage to prepare DUI scores (T. Martin 1982). Thus, 11 sites/components are represented.

Spring spawning fish remains are present on each of the extended diversity components, except for the proto-historic component at 20DE4. Fall spawning fish remains were recovered from seven components and possible gill-net sinkers from another site (20CH95). The remains of a whitefish variety, though not identified by species, were also recovered from 20MK261 offering the possibility that a many as nine components include evidence for the harvest of deep water fall spawning fish. The Mackinac Phase components of 20MK1 and 20MK22 (early LW) include fall spawning fish and if the whitefish remains at 20MK261 are lake whitefish, then each of these early LW components include fall spawning fish. Sites 20MK1 and 20MK261 are both situated on Lake Huron at the Straits of Mackinac and 20MK22 is located along the north shore of Lake Michigan.

The four late LW extended diversity components that produced fall spawning fish remains are associated with two sites (20MK1 and 20MK22). Site 20CH95, where net weights were recovered, is located on Lake Superior on Whitefish Bay. Site 20AR348, located on Grand Island, is the only other site to produce fall spawning fish remains, but the assemblage cannot be divided into early or late LW components.

An additional 13 components from eleven sites have produced either fall or spring spawning fish remains (Appendix T). Ten of these are in coastal settings and three in interior settings. Twelve are intermediate diversity and one is a limited diversity site located in the interior. Twelve of these have produced spring spawning fish, including all three interior sites. Fall spawning fish were found on eight components, all of which are on the coast.

When we consider intermediate and limited diversity coastal components with fall spawning fish remains, there is an early LW component, three late LW components, and four components that include mixed or undetermined early and late LW components (Appendix T). Site 20MK169/457, which includes early, late, and mixed LW components, is located at the Straits of Mackinac on Mackinac Island. The other two late LW components are located on Bay de Noc (20DE296) and Grand Island (20AR359). Two of the remaining three early/late components are at the Straits of Mackinac (20MK54 and 20MK61) and the last one, 20ST1, is located at the north end of Lake Michigan.

Only five of the sites (or 7 components) with fall or spring spawning fish remains are in high sensitivity locales (29 percent). Two of these are on Grand Island, two are in the interior, and the fifth is located along the north shore of Lake Michigan. Twenty one of the LW components with spring or fall spawning fish remains are located on the Great Lakes coast and three are in the interior. Eleven of the coastal components are extended diversity and ten are intermediate diversity. One of the interior sites is limited diversity and the other two are intermediate.

With the exception of 20MK22, all of the early LW components that have produced fall spawning fish are in the Straits of Mackinac and 20MK22 is geographicall proximate to the Straits. There is no definitive evidence for the harvest of fall spawning fish in the early LW period outside of the Straits and northern Lake Michigan. It is worth noting that T. Martin (1982, 1991) has observed that the faunal assemblages from 20MK22 and 20DE296 are less oriented towards the fall fishery than the Juntunen site (20MK1) and include a greater proportion of mammals in their assemblages. Similarly, neither of the late LW components at 20DE4 includes fall spawning species (Brose 1970). This parallels the discussion in Chapter 3.5 where sites in the western portion of the study area, like 20DE4, 20DE296, and 20MK22, have a higher ratio of mammals compared to fish in their assemblages. This may indicate a decreased emphasis on the fall fishery in the northern part of Lake Michigan including Bay de Noc.

As noted previously, a recent reevaluation of the data relevant to the fall fishery found that the increased reliance on fall spawning whitefish and lake trout began around AD 800 at the

Juntunen site, after AD 1100 in northern Lake Michigan basin, and as late as AD 1400 in the rest of the Upper Great Lakes region (B. A. Smith 2004). The evidence reviewed here and in Chapter 3.5 suggests that northern Lake Michigan (e.g., 20MK22) apparently included fall spawning fish prior to AD 1100, but that it may not have been as important there as it was in the Straits of Mackinac region (T. Martin 1982). The recovery of possible gill-net weights from strata at 20CH95 dated to ca. AD 1294 – AD 1411, suggest that the deep water fall fishery was being harvested there before AD 1400, but still supports a later time-frame for this technology compared to the Straits of Mackinac. This data, while not conclusive, appears to support B. A. Smith's (2004) contention that the adoption of the gill-net and the expansion of the deep water fall fishery took place from south to north over the course of the Late Woodland period.

6.1.2 *Maize*

Maize was directly recovered on three LW sites in the eastern UP (20CH6, 20MK1, and 20MK24). Prehistoric maize is typically assumed to require 140 frost free days to produce a reliable subsistence crop, although it does mature in a shorter period (Demeritt 1991; Hart and Lovis 2013; Yarnell 1964). Each of the sites that produced maize is located in the most climactically mild part of the eastern UP with over 140 frost free days based on modern temperatures (Chapters 3.5 and 4.1; Eichenlaub et al. 1990). At this point, it is unclear if the evidence represents maize grown on-site or if the recovered kernels represent grain exchanged into the area.

The closest direct evidence of maize planting and growing in the UP is an extensive ca. AD 1400 to AD 1500 ridged field complex situated on the Menominee River along the Wisconsin border in Menominee County, south of the current study area (20ME61 [Buckmaster

2004]). This area exceeds 140 frost free days (Albert 1995; Eichenlaub et al. 1990). Maize cupules were recovered in flotation samples from the ridged field features support their function (Buckmaster 2004; Mulholland 2000). Similar ridged fields in Wisconsin are generally associated with Oneota occupations (Bruhy and Egan-Bruhy 2014; Gallagher et al. 1985; Moffat 1979; Overstreet 2009; Sasso 2001). No ridged fields have been recorded in the eastern UP.

The maize recovered in the eastern UP is not well dated in regard to relative age in the LW. The best discussion is from the Juntunen site (20MK1), where eleven of the 15 maize kernels (73.3 percent) that were found in strata assigned to the late LW Juntunen component, one kernel from the late LW Bois Blanc component, and two kernels from the early LW Mackinac component (McPherron 1967:189; Yarnell 1964). The contexts of the recovered maize from the Cloudman site (20CH6) and 20MK24 doesn't allow a finer assignation than Late Woodland. A growing corpus of data is showing that a fuller scale adoption of maize in the Upper Great Lakes region is later than previously accepted (Hart and Lovis 2013; O'Gorman 2007).

Isotopic evidence from human remains from Juntunen Phase ossuary contexts at the Juntunen site includes $\delta\ ^{13}C$ values that are suggestive of maize consumption (Brandt 1996:70-71). This study cautions that the reliance on Great Lakes fish, especially walleye, as well as the dietary use of domestic dog can falsely increase the estimation of maize use (Brandt 1996; see also Katzenberg 1989; see also Chapter 3.5). Brandt (1996:71), however, believes that the mean -18.0 $\delta\ ^{13}C$ value at the Juntunen site likely represents maize consumption. Despite this, it is not clear if the maize was grown on-site, if it came in through exchange, or if the tested individuals consumed maize at another site(s). The location of the eastern UP on the periphery of viable maize horticulture and the evidence from the Juntunen site suggest that the late LW would be the most likely time frame for maize horticulture in the eastern UP in the LW.

The spatial analyses carried out in Chapter 4 have shown that only about 6.5 percent of the WU of the HNF falls within areas with over 140 frost free days. Additionally, a comparison of Random points and LW sites did not find a statistically significant difference in their distributions relative to frost free days in the WU of the HNF and only 5.7 percent of LW sites on the WU fall within areas with more than 140 frost free days. It should be noted, that despite this figure about a third of all the LW sites in the eastern UP fall within the 140+ zone. Over half of these sites (51.9 percent) are located at the Straits of Mackinac and the remainder along the north shore of Lakes Michigan and Huron.

The frost free day variable is probably not the only factor in successful maize horticulture in the eastern UP. Maize also requires a long enough period of warm temperatures (growing degree days) for successful maturation (Demeritt 1991; Hart and Lovis 2013). Modern temperature data can serve as a useful proxy for past temperatures as the temperatures during the Medieval Climatic Optimum may not have been much warmer than modern temperatures, whereas temperatures during the Little Ice Age were certainly cooler (Bernabo 1981). O'Shea (2003) notes the extreme levels of interannual fluctuation in maize yields in northeastern lower Michigan in the historic period as well as the high incidence of maize crop failure among the Huron (every three to six years) who lived in a more climatically mild area in southern Ontario (see also O'Shea 1989:63; O'Shea and McHale-Milner 2002). In the early eighteenth century, during the Little Ice Age, Antoine-Denis Raudot wrote of the Chippewa of Sault Ste. Marie, as well as peoples on the north shore of Lake Huron, that they gathered maize green because it didn't fully ripen (Kinietz 1965:322). Raudot attributed this to the "fog," although it seems like the lack of adequate growing degree days was more likely a factor.

6.1.2 *Wild Rice*

The Cloudman (20CH6) site is the only site to have produced direct evidence for wild rice, a single grain, in the eastern UP (Egan-Bruhy 2007; See also Chapter 3.5). The potential for LW wild rice use is based on the continued presence of wild rice in the region as well as a correlation between locations where wild rice was documented in the nineteenth and twentieth centuries and the locations of LW sites (Dunham 2008; see also Figure 27). As part of the current study, a statistically significant relationship was found between LW sites and modern wild rice stands for the eastern UP as a whole as well as a quadrat analysis of the WU of the HNF (Chapter 4.1). The location of modern and historic wild rice beds was included as a variable in the Late Woodland site model developed in Chapter 4.

Most of the LW sites that are situated proximate to wild rice beds are in the interior (Appendix U; Figure 62). There are three exceptions: 20CH6; 20DE106; and 20MK90. The wild rice stands associated with 20CH6 and 20MK90 are situated inland from the sites. The wild rice bed associated with 20DE106 is known from a herbarium source that places it in the shallow waters of Little Bay de Noc (Edman 1969). When the age of the sites can be established, most include late LW components. The exception is 20MK90 which has an early LW age based on ceramic typology. Site 20CH6 includes both early and late LW components.

The combination of late LW sites in interior settings is striking when considered with the trend that interior sites become more visible in the late LW. Further, most of the sites associated with wild rice are limited diversity. Ethnographic sources describe wild rice camps as locations where families came together to harvest and process the grain (see Lofstrom 1987; Vennum 1988). Wild rice camps can be thought of as smaller aggregation locales than coastal fishing sites. The rice camp would include a multi-generation extended family group. It is

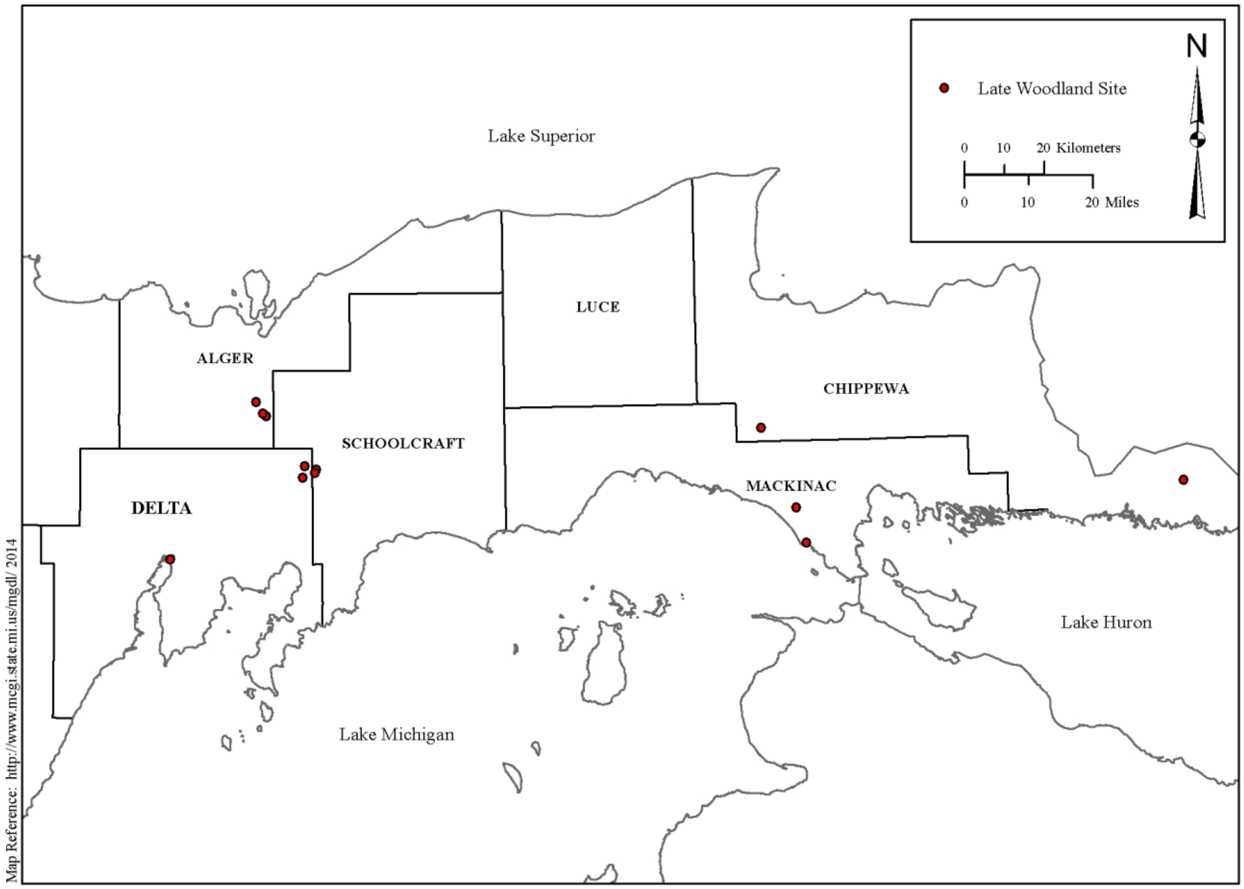


Figure 62: Distribution of Late Woodland sites associated with wild rice habitats.

noteworthy that three of the interior sites associated with wild rice locales (33.3 percent) are coded as intermediate diversity and that each of these exceeded the mean DUIrev score suggesting an increased intensity of occupation (Appendix U). These sites, 20AR437, 20CH171/172, and 20ST109/110 represent the most likely wild rice camps.

Most of the LW sites associated with wild rice patches are in high sensitivity areas (75 percent). Only one site, 20CH6 is situated in a low sensitivity area. Interestingly, the two sites located in medium sensitivity areas are both situated on interior lakes in the East Unit of the HNF and represent the <u>only</u> interior sites in that part of the National Forest (20CH171/172 and 20MK334). With the exception of these two sites, all the other interior sites associated with wild rice are in the Indian River drainage which is a major tributary of the Manistique River (Chapter 2.1).

The spatial observations are worth discussing. The two interior sites on the East Unit, as noted above, are the only two interior LW sites known in that part of the eastern UP. Likewise, they are associated with the only interior lakes in the East Unit that had documented wild rice. The lower proportion of high sensitivity areas in the East Unit was discussed in Chapter 4. It is possible that the increased resource draw of wild rice in these lakes, assuming it was present in the LW period, is related to the placement of sites at these locations.

The association with the Indian River is also significant. About half the documented wild rice beds in the eastern UP are within the Indian River basin as are about half of the known interior LW sites (Dunham 2008). All the LW sites associated with wild rice locales in the Indian River drainage are late LW and when they include identifiable ceramics it is predominately Oneota-related, although site 20AR245 produced Point Sauble ware. Both Point Sauble wares and Oneota-related ceramics are best represented in what is today Wisconsin, to the south and west of the current study area. There is direct archaeological evidence for the use of wild rice by Oneota and Point Sauble peoples in Wisconsin (Arzigian 2000; Moffat and Arzigian 2000; Overstreet 1997).

There is reasonable evidence to hypothesize that wild rice was a potential resource collected by LW peoples in the eastern UP by the late LW. It seems most likely that this resource was utilized in the Indian River drainage, but there is evidence placing the grain in the St. Mary's River and northern Lake Huron as well.

6.1.4 *Acorns*

The most compelling evidence for an alternate starchy food resource in the eastern UP relates to acorns. Acorns are the best represented botanical remain on LW sites in the eastern UP, appearing in 46 percent of the floral assemblages, and acorns are well represented in the ethnographic literature of the Upper Great Lakes region (see Chapter 3.5; Appendix I; see also Dunham 2009 for a broader discussion of this topic). Acorn lipid residue has also been recovered from LW ceramics suggesting formal processing of this resource (Skibo et al 2009). Additionally, red oak is an important part of the successional sequences in mixed pine habitats, which have the highest correlation with LW site locations (see Chapters 4 and 5; see also Dunham 2009).

Mixed pine habitats are directly associated with 39.5 percent of LW sites (Figure 63; Appendix V). They also appear in 57.4 percent of the 150 m site catchments and 78.9 percent of the 1500 m site catchments (Figure 63; Appendix V). When the relative age of the sites is considered, a higher proportion of late LW sites include mixed pine habitats. Mixed pine

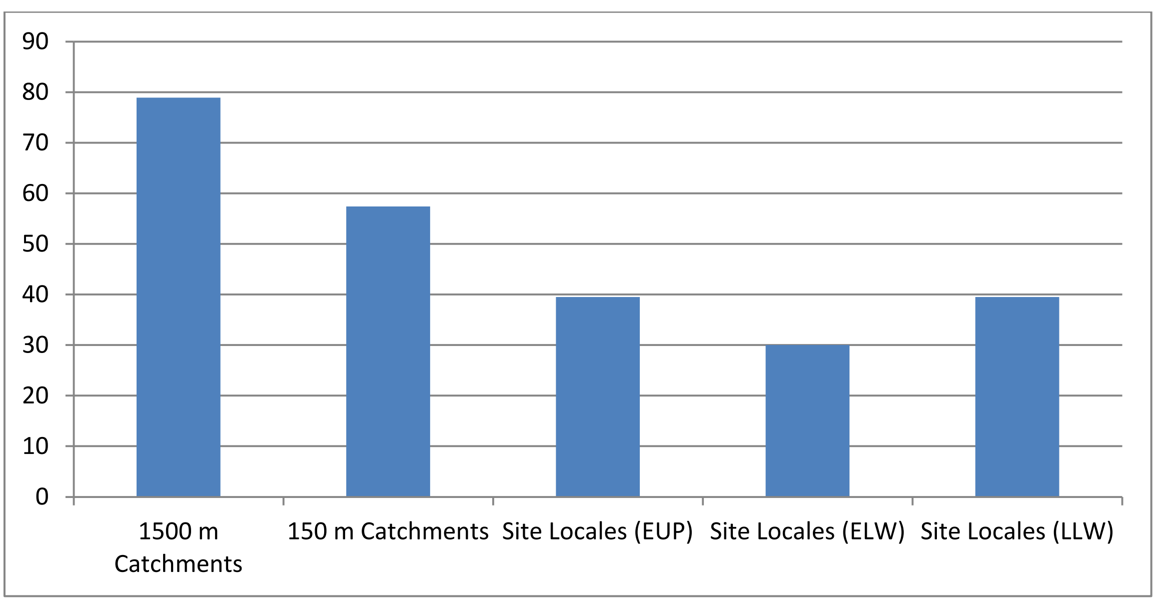


Figure 63: Percentage of LW Sites with Mixed Pine Habitat.

habitats are better represented at interior sites, with the exception of early LW sites (there is only a single early LW site in the interior and it is not in a mixed pine habitat) (Figure 64). The largest proportion of interior late LW sites is in mixed pine habitats (80 percent). There are no LW sites in mixed pine habitats in the Lake Huron basin (Appendix V).

The area of the mixed pine habitats varies within the catchments. Table 40 shows the mean area of mixed pine habitat for all the site catchments. At 150 m, there is a mean of 6.7 ha of mixed pine habitat and a mean of 217.4 ha for the 1500 m site catchments. While red oak is the best represented oak species in the eastern UP it is not common, comprising less than one percent of the forests (Bourdo 1954; Price 1994). A rough estimate of the number of oak trees per hectare of mixed pine habitat is possible (2.43 red oak trees per hectare of mixed pine habitat [see Dunham 2009; after Price 1994]) (Table 40). This demonstrates that LW sites were well positioned to access acorns, despite the relative scarcity of oak in the forests.

The floral assemblages that include oak come from mixed LW assemblages as well as late LW assemblages. At the current time, it is not possible to assign an early or late LW date to the acorn remains recovered from 20AR348, 20AR359, and 20CH6. Sites 20DE75 and

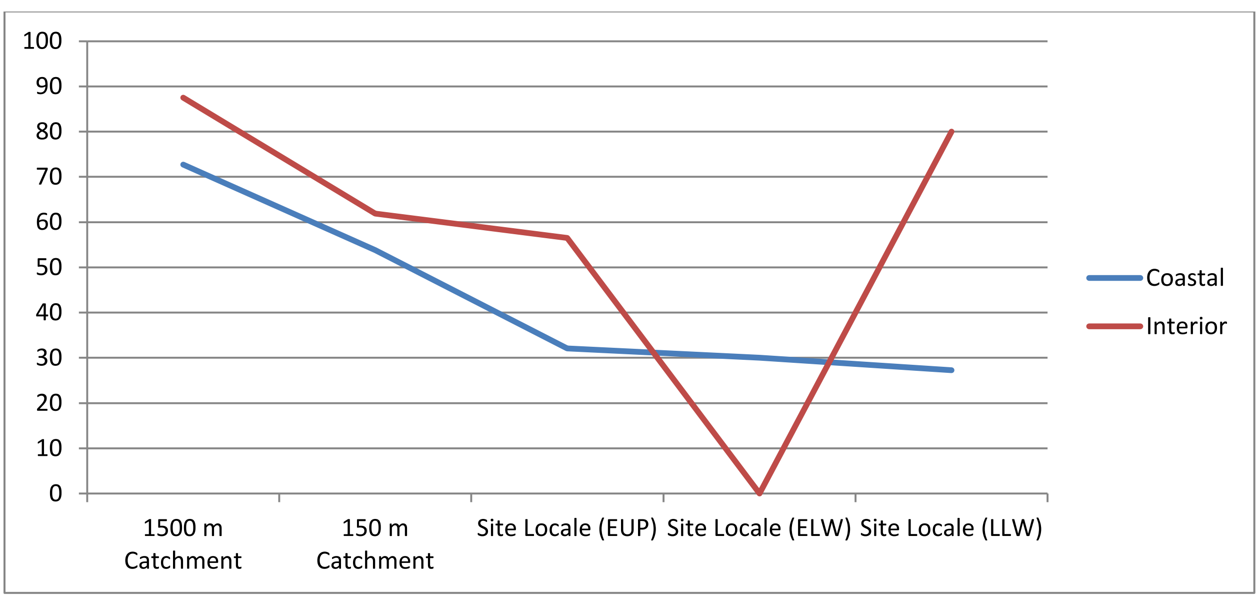


Figure 64: Comparison of Coastal/Interior Sites by Percentage of Mixed Pine Habitat.

20ST109/110 are both late LW sites. Likewise, the acorn remains from the Juntunen site are all attributed to the Juntunen Phase component (McPherron 1967:188). This evidence as well as the evidence presented in Figures 63 and 64 suggests acorns were more commonly used in the late LW.

Half the sites that have produced acorn remains are extended diversity sites (20AR348, 20CH6, and 20MK1). The remaining sites are intermediate diversity (20ST109/110) and limited diversity (20AR359 and 20DE75). There are 30 LW sites located in mixed pine habitats and only 2 (6.7 percent) are extended diversity sites (including 20AR348), whereas 70 percent of them are in limited diversity sites (Figure 65). With limited diversity sites interpreted as logistical camps, it makes sense that these sites would be placed to access a resource like acorns. The higher proportion of acorn remains on extended diversity sites also makes sense with the assumption that resources gathered at logistical camps would be brought to extended diversity residential camps.

6.1.5 *Discussion*

The results summarized above, as well as in the previous chapters, demonstrate the importance of spring and fall spawning fish in the diet of LW peoples in the eastern UP (see also Cleland 1982; S. Martin 1985; B. A. Smith 2004). The evidence also suggests the potential for integration of alternate, highly productive food resources such as wild rice and acorns into the system, as well as the importance of large game. Likewise, there is little evidence to support the premise that maize was a widespread part of the subsistence system of LW people in the eastern UP.

		Hectares	Estimated Red Oak
150 m Catchment	**Mean**	6.7	16.3
	Coastal Mean	6	14.6
	Interior Mean	7.8	18.9
	Maximum	23	55.9
	Minimum	5	12.2
1500 m Catchment	**Mean**	217.4	528.3
	Coastal Mean	87.6	212.7
	Interior Mean	395.9	962.0
	Maximum	798.0	1939.1
	Minimum	7.0	17.0

Table 40: Estimation of the number of red oak trees per hectare in Mixed Pine Habitats (after Price 1994).

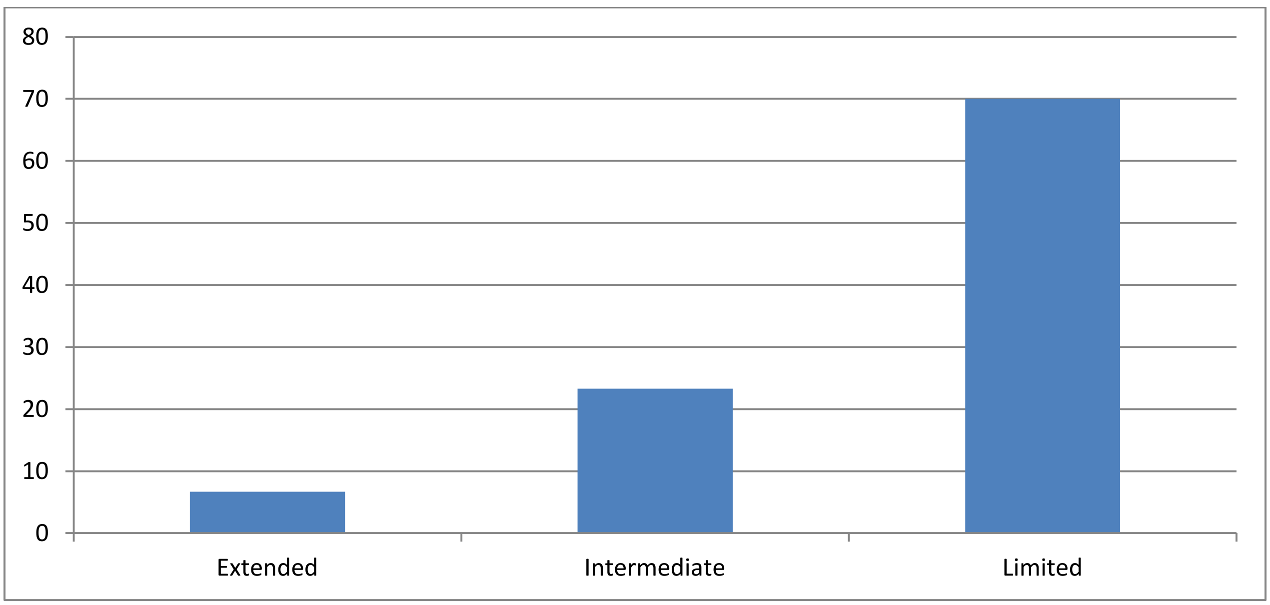


Figure 65: Distribution of Late Woodland sites in Mixed Pine Habitats by Diversity Index.

The known pattern of seasonal and interseasonal mobility also demonstrates that Late Woodland people had the opportunity to access and use a wide variety of plant and animal resources across the landscape in addition to spring and fall spawning fish. The procurement of acorns and wild rice fits well with the seasonal subsistence round proposed by earlier scholars without conflicting with the scheduling of fall fishing and provide a reliable buffer against the potential failure of the fall fishery. Additionally, the role of interior sites and coastal logistical sites can be integrated into the regional model and thought of as an integral part of a broader pattern of resource use across the landscape. The combination of an interior resource such as wild rice, a coastal resource like fall spawning fish, and a patchy resource like acorns may have provided an opportunity to gather, process and store for winter consumption as well as a practical hedging mechanism if one or more were not available in a given year.

A key component to this line of reasoning is the role of storage. Storage provides a "means of extending the use-life of acquired resources from periods of relative abundance to periods of scarcity" (Bursey 2001:180; see also Dunham 2000a; Holman and Krist 2001; Ingold 1983). According to Kelly (1995:120), "resources become more aggregated in space and more constrained in seasonal availability from the equator to the arctic." In the context of this discussion - people who are mobile, who can access aggregated resources, and have the ability to store surplus are at a nutritional advantage (Dunham 2000a; Holman and Krist 2001; see also Binford 2001; Cunningham 2011; Morgan 2012). Cleland's (1982) model explicitly identifies storage as a critical component of the fall fishery, and ethnographic sources similarly relate the importance of stored wild rice and acorns (see Dunham 2009; Vennum 1988).

Related to this discussion is the association of limited and intermediate diversity sites with mixed pine and wild rice habitats. These sites, presumably representing logistical camps, are the places where these resources are collected and likely where initial processing took place. The increase in likely logistical camps in the late LW includes the expectation that there was an increased reliance on storage of the resources obtained at these camps (Binford 1980, 2001).

These resources can be stored at residential camps, at logistical camps, or at places physically distinct from these - so called caches (see Dunham 2000a; Morgan 2012). Evidence for caching and storing in pits has been presented for the LW in northern lower Michigan (Hambacher and Holman 1995; Holman and Krist 2001; Howey and Parker 2008).

The surface depressions, or cache pits, described by Howey and Parker (2008) and Holman and Krist (2001) are asserted to be late LW in age, rather than established as such. However, cache pit complexes provide a potential measure of storage activity since they are visible and well documented in the ethnographic and ethnohistoric literature of the region (see Dunham 2000a). Surface depressions are not well documented in the eastern UP and none can be conclusively linked to the LW period (Dunham and Branstner 1998:171-172; Dunham 2000a). Notable surface depression complexes are physically proximate to LW sites, such as 20DE108, 20MK90, 20AR348, and 20AR437, but the age and function of these features is not known (Anderton et al. 1995:62; Dunham and Branstner 1995:121-126, 1998:171; Dunham et al. 1994:35-36; Dunham et al. 2010:4-18-4-21).

The variables discussed above – logistical mobility, DUI, site sensitivity, acorns, wild rice, maize, and fish – are well illustrated by the Cloudman site (20CH6) located on Drummund Island. The Cloudman site is an extended diversity site situated in a low sensitivity locale. It is the only site to have produced direct evidence for maize, wild rice, and acorns. This site also has one of the highest diversities of plant an animal remains in this study (Chapter 3.5). The Cloudman site represents an important residential site that was likely an aggregation point for harvesting spring spawning fish. The diversity of the floral and faunal assemblages appears to reflect the function of a residential site within a logistical system, where resources are brought to the site. The following section continues the exploration of extended diversity sites and their setting.

6.2 Extended Diversity Sites, Persistent Places, and Anthropomorphic Landscapes

The seven sites with nine extended diversity components have been identified as the most likely candidates for the larger, residential sites that were used as seasonal aggregation locales where spring and/or fall fishing took place. Each of these sites is also multicomponent sites with earlier and/or later occupations and/or multiple LW occupations (Appendix W). For example, the Native American occupation sequence begins at least 4000 years ago and continues through the historic period for the Williams Landing locale on Grand Island (20AR348, 20AR350, and 20AR353) (Dunham and Anderton 1999; Dunham and Branstner 1995: Robinson et al. 1991; Skibo et al. 2004). Likewise, the Juntunen site (20MK1) has produced evidence for Native American occupation from about 2000 years ago to the seventeenth or eighteenth centuries (McPherron 1967).

The long term occupation at these sites is one of the basic attributes of a persistent place. A persistent place, as defined by Schlanger (1992:93) is “a place that is used repeatedly during the long-term occupation of a region.” According to Thompson (2010), persistent places include locations where there is a high concentration of desirable resources, include natural or cultural features that structure reuse, and/or are created and maintained over an extended period of time (see also Moore and Thompson 2012). Persistent places can also provide temporal continuity, an anchor if you will, in an archaeological landscape where all the sites, and even all the LW sites, are not contemporaneously occupied (c.f., Dewar 1986). If we assume that the extended diversity sites are associated with fishing, their location on Great Lakes shorelines gives them access to a high concentration of a desirable resource (the Inland Shore Fishery) along with their long term occupation/regular reuse makes them well qualified as persistent places.

Further, when the social significance of coastal aggregation sites is considered (e.g., Cleland 1982; Holman and Lovis 2008; McHale-Milner 1991), then these become more than simply resource procurement locales. The Middle Woodland component of the Juntunen site also includes burials and the Juntunen Phase component includes ossuary burials which adds to the social importance of the locale, beyond resource potential (McPherron 1967). In the late Late Woodland and early historic period, ossuaries are associated with important integrative rituals, such as the Feast of the Dead (Cleland 1971; Hickerson 1960; see also Holman and Lovis 2008; McHale-Milner 1991). None of the other extended diversity sites have the same level of evidence of formal mortuary behavior as reported for the Juntunen site, although the lack of such does not diminish these sites as persistent places.

Another aspect of persistent places is that the long term human occupation of the locale can alter the physical environment. Considering the Juntunen site once again, the site locale is interpreted to have been cleared and covered by meadow soils by AD 1050, followed by a period of erosion and deflation, partially caused by human activity, and the development of a meadow soil about AD 1300 (Wright as cited in McPherron 1967:37-38, 189). While not an extended diversity site, 20DE296 may reflect a similar history. Site 20DE296 has a high DUIrev score, suggesting an intensive occupation during the late LW period. The soils at 20DE296 are identified as a likely boroll (Anderton et al. 1991:101). Borolls are a suborder of Mollisols which are archetypal prairie/grassland soils (Anderton et al. 1991; Buol et al. 1989; Grunwald 2013). These environments are often influenced by fire and pedoturbation, including human disturbance. Thus, the environmental setting of both Juntunen and 20DE296 may exhibit evidence for human influenced or anthropomorphic landscapes.

If we consider the results of the catchment data in light of the potential of anthropomorphic landscapes, there are some interesting possibilities. The sensitivity scores drop as the area around a site expands. The smallest area of consideration, the one hectare quadrat which includes the site, typically has the highest predictive score associated (Figure 66). As the area around the site expands to 150 m radius and 1500 m radius catchments, it was observed the proportion of the mean catchment scores in medium and low sensitivity areas increases. This is in part related to a general leveling of the relative sensitivity brought about by expanding the catchment. Another interpretation may reflect land use in the vicinity of the site.

This pattern is well illustrated by LW site locations on Grand Island (Figure 67). Note that the LW sites are clustered in areas with high archaeological potential. The farther one might go from the site, the lower the sensitivity. The site location and the site specific zone (the 150 m

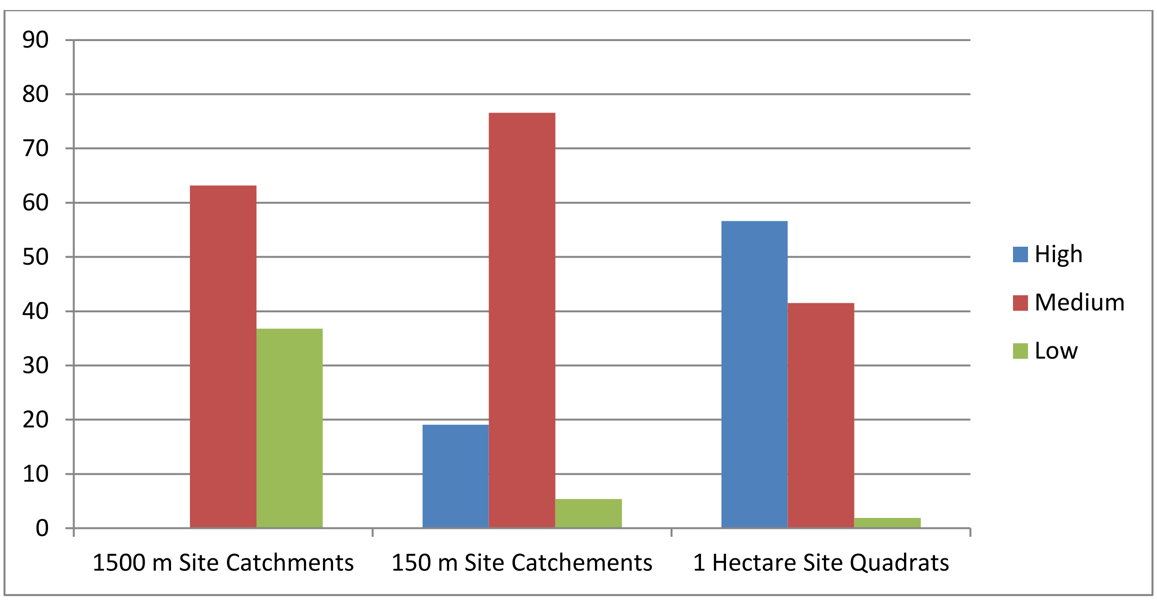


Figure 66: Proportion of High, Medium and Low Sensitivity Areas by Percent.

radius catchment) include the greatest level of human activity. Is there a relationship between the increased human activity and areas that are coded as high sensitivity locales?

There are numerous examples of how human activity can modify the landscape (Abrams and Nowacki 2008; Delcourt and Delcourt 2004; Terrell et al. 2003). Small scale plant management (Hildebrand 2003; Trussler and Johnson 2008; Raymond and DeBoer 2006), patterns of residential mobility (Politis 1996), or certain landscape management practices (Miller and Davidson-Hunt 2010) have the potential to create heterogeneous habitat mosaics which may increase the potential for subsistence resources.

Mixed pine habitats, one of the critical factors in LW site location, are the most likely to be affected by natural disturbances and also share many of the attributes of anthropomorphic landscapes. Native Americans in the Upper Great Lakes region, and elsewhere, effected the composition of forests through the use of fire (Abrams and Nowacki 2008; Albert and Minc 1987; Black and Abrams 2001; Dorney 1981; Dorney and Dorney 1989; Loope and Anderton 1998; Ruffner and Abrams 2002). Low intensity fires occurring at fairly frequent intervals shaped forest composition around settlements. The areas that were burned contained higher incidences of mast and fruit producing species that were commonly utilized as food. These species tend to be either fire resistant or thrive in disturbed, including burned, environments. For example, oak forest flourished at the expense of hemlock, sugar maple, and beech in some locations as a result of the burning (Albert and Minc 1987; Dorney and Dorney 1989; Ruffner and Abrams 2002). While many of these studies suggest forest and understory clearing for horticulture as a primary rationale for the burning, habitat improvement for wildlife and other resources, such as nuts and berries, are other likely candidates (Anderton 1999; Miller and Davidson-Hunt 2010).

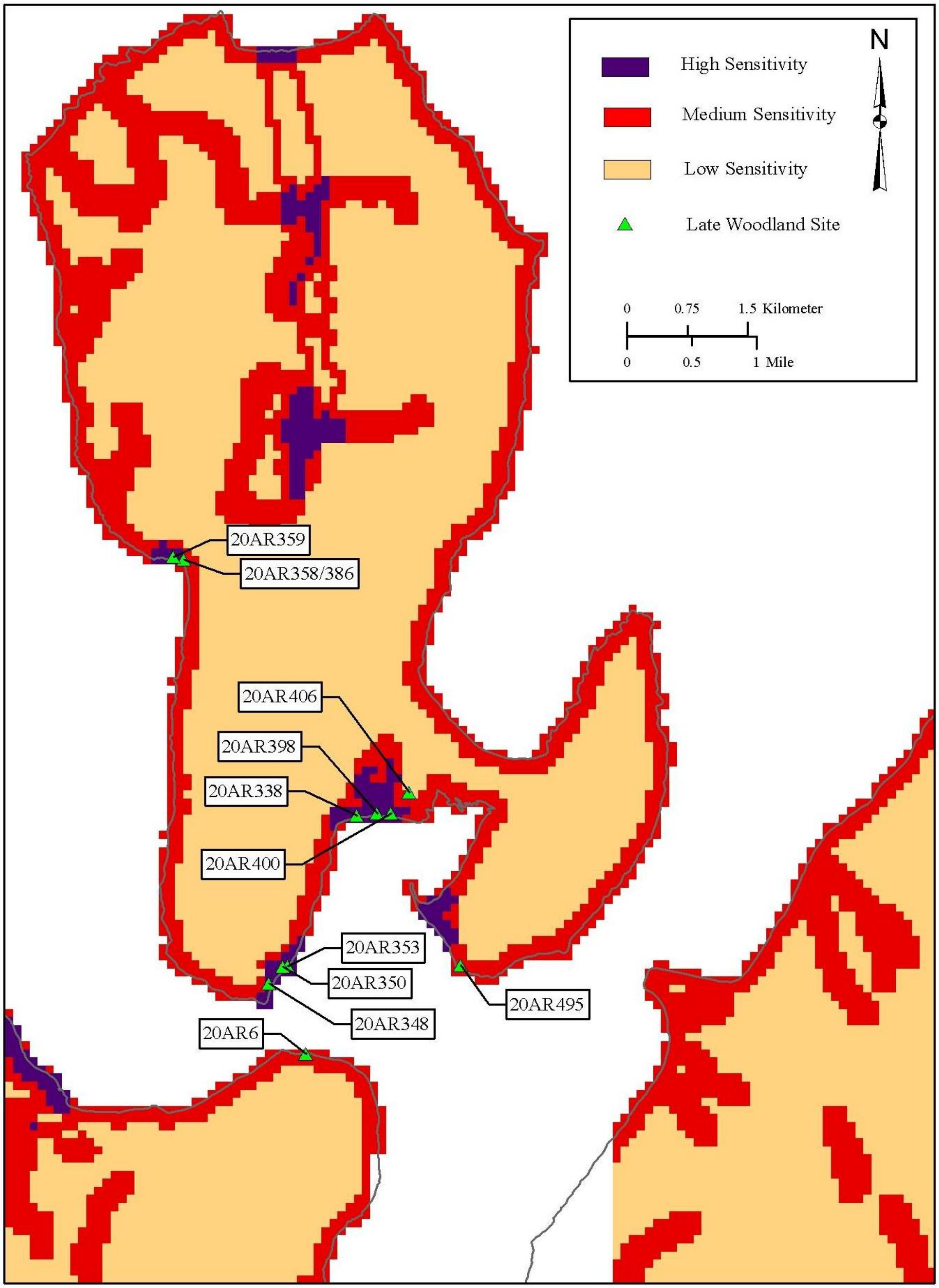


Figure 67: Location of Grand Island Sites in Relation to Site Sensitivity.

There is direct evidence for historic burning in northern Michigan by Native American peoples. A study conducted by Albert and Minc (1984) demonstrated that modern stands of red oak at Colonial Point were established as a result of Anishinaabek agricultural practices in the 1840s and 1850s. Charcoal recovered from plots within these stands was predominately beech and sugar maple, indicating that the original forest had been northern hardwoods, and that Native American burning to clear land for planting fostered the transition to oak.

Similarly, Loope and Anderton (1998) have demonstrated a much higher incidence of fire in coastal pine stands in northern Michigan than interior stands in the eighteenth century through early twentieth century. The fire intervals in the interior stands seem to correspond with naturally occurring fire regimes, where the coastal pattern is interpreted to reflect Native American land use practices – possibly associated with the maintenance of berry patches near settlements. Andrew Blackbird's (1897:10-11) childhood recollection of Cross Village in the 1830s appears to reflect such a fire altered environment:

> "My first recollection of the country of Arbor Croche, . . . there was nothing but small shrubbery here and there in small patches, such as wild cherry trees, but most of it was grassy plain: and such an abundance of wild strawberries, raspberries and blackberries that they fairly perfumed the air of the whole coast with the fragrant scent of ripe fruit."

Recent studies of Anishinaabek traditional landscape management practices in Ontario show that fire was, and is, used for a variety of purposes (Davidson-Hunt 2003; Miller and Davidson-Hunt 2010). Fire is used to clear undergrowth for gardens, to facilitate vegetation growth (such as berries and other resources like birch bark) and for habitat improvement for wild game. Importantly, fire is seen by these people "… as beings which possess agency and who intentionally create order in landscapes" (Miller and Davidson-Hunt 2010:401).

The evidence outlined above shows that Native Americans in the Upper Great Lakes region were actively modifying their landscape throughout the post-European contact period (post AD 1600). Likewise, the evidence from Grand Island, as well as the Juntunen site and

20DE296, make a strong case for the similar practices in the Late Woodland period. This begs the question of whether LW peoples were drawn to these environments or did they create them, as at the Juntunen site and Colonial Point? The question cannot be answered for all sites at this time, but a strong case for the role of anthropomorphic landscapes around extended diversity sites, and possibly around intermediate diversity sites, can be made. Thus, the location of the site becomes a more desirable as a resource procurement locale over time as well as becoming a normative cultural landscape for the inhabitants. As such, it reinforces the persistent place status of these sites.

6.3 Extended Diversity Sites and Ceramics

In Chapter 2 the potential for multiple settlement and subsistence strategies, both spatially as well as temporally, was raised. Likewise, ceramic evidence for different traditions in the late LW was cited as an example of the potential for multiple cultural traditions/ethnic identities in the eastern UP (see Figure 2). The discussion of persistent places as well as increased use of logistic mobility also contributes to this line of thinking.

The apparent increase in or shift towards logistical mobility in the late LW has implications for both economic and social organization (Binford 1980; 2001). Likewise, the adoption of the fall fishery also carries similar implications (Cleland 1983; McHale-Milner 1991). Each of these perspectives is reflecting a need for an increased level of social organization as a result of changing economic patterns. These changes are also related to increased reliance on both practical and social storage. The relationship between extended diversity base camps, where intensive fishing takes place, and dispersed logistical camps, where and from which other resources are procured, is reminiscent of Hickerson's (1962:48-49) discussion of the role/function of the village in traditional Chippewa society.

Each of the extended diversity sites had multiple occupations over a prolonged period of time. It is hypothesized that these represent the large seasonal aggregation sites used for fall and spring fishing in the LW period. When the distribution of extended diversity sites is plotted on a map, it is clear that the sites are well dispersed from one another, especially when compared to the distribution of all the LW sites (see Figures 3 and 10). The distribution of identified ceramic types is also revealing.

An illustration of this can be see when the identified ceramic types are plotted (Figures 68 and 69). In this case, the predominant early LW and late LW types from a given site are shown. On the map depicting early LW, the majority of the sites include Mackinac Ware as the best represented ceramic type (Appendix X). Notable exceptions are 20AR348 (Madison Ware), 20DE7 (Heins Creek Ware), and 20MK24 (Spring Creek Ware). Interestingly, Madison, Heins Creek, and Mackinac wares were formerly subsumed under the classification of "Lake Michigan Ware" and Spring Creek ware could also be categorized as such under the older typology, which suggest a general similarity in these types (Baerreis and Freeman 1958; Fitting 1968a; Mason 1966; McKern 1931; McPherron 1967). This illustrates the broad similarity in ceramic types during this period and appears to correspond with more generalized regional expression of material culture.

The distribution of late LW ceramics is quite different, showing a wider range of ceramic types. Part of this is temporal, in that certain wares precede or post date others, but it also reflects different ceramic traditions. For example, Bois Blanc and Point Sauble Collared wares

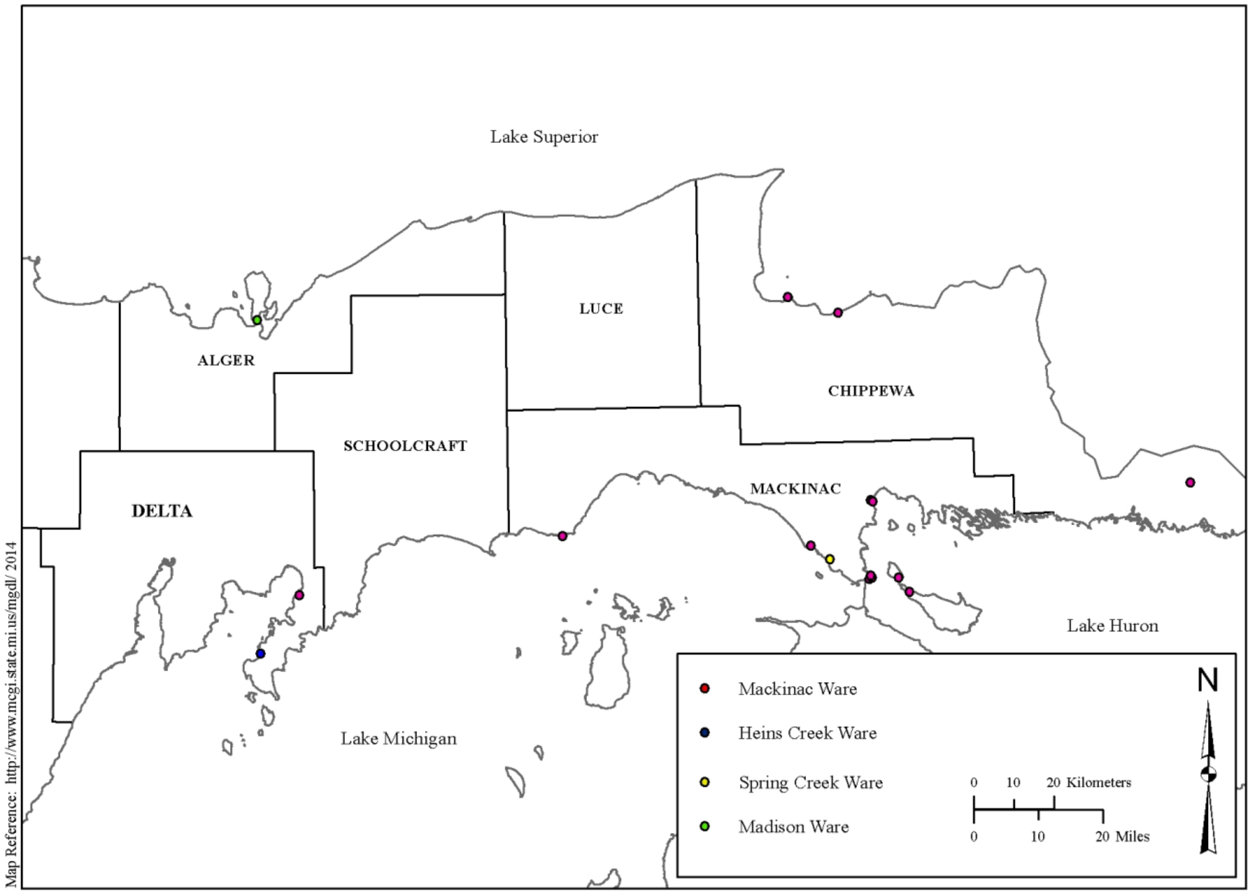


Figure 68: Distribution of early Late Woodland Ceramics.

both fall early in the late LW sequence, but conform to the broad regional distribution of the later wares. Point Sauble ware is from Wisconsin and Bois Blanc ware is part of the Juntunen ceramic sequence. The three larger groupings, Juntunen wares, Sand Point wares, and Oneota related-wares form fairly distinct geographic distributions, although there is some degree of overlap.

An important secondary observation is that most of the extended diversity sites, such as 20CH95, 20CH6; 20MK1, and 20MK22, as well as some of the smaller sites, such as 20AR437, include multiple late LW pottery types (Appendix E). The maps simply show the most common

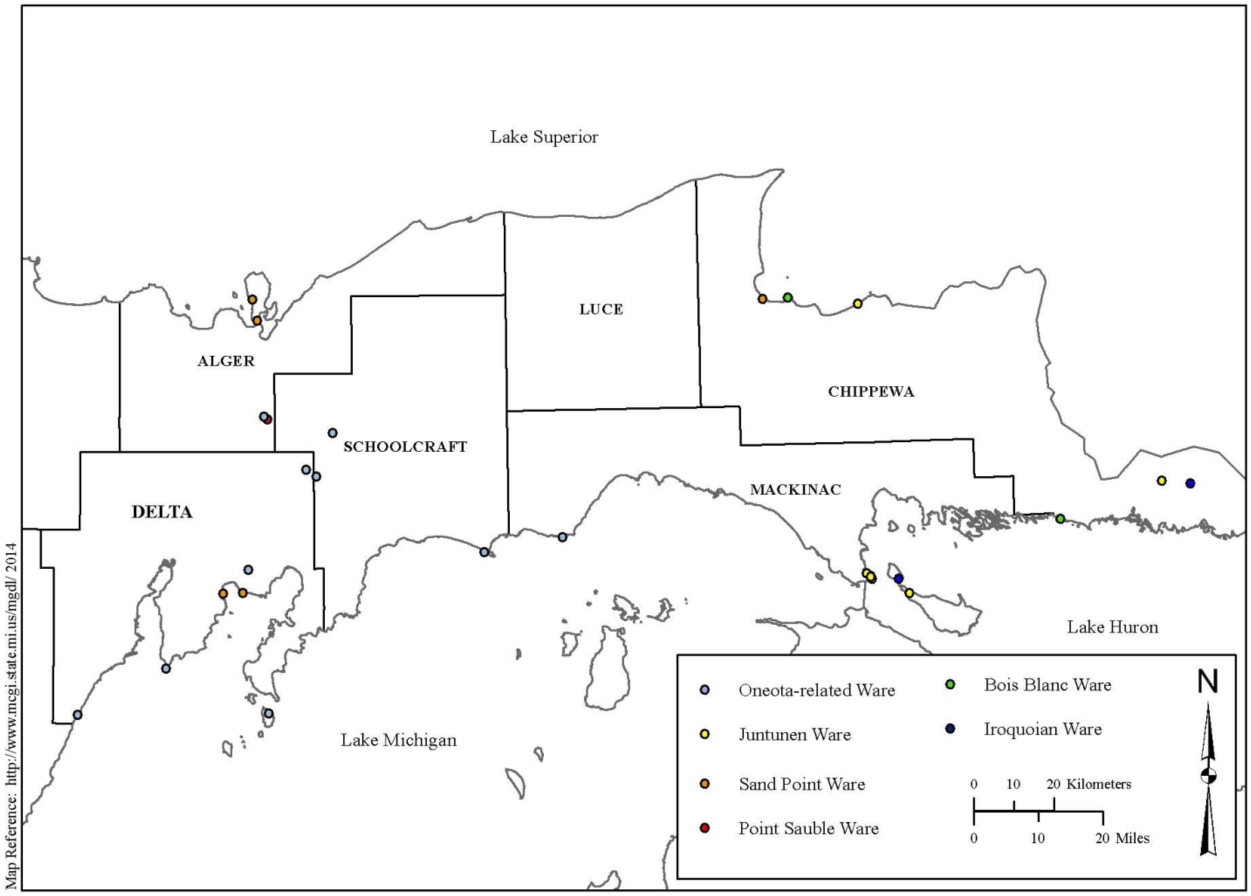


Figure 69: Distribution of late Late Woodland Ceramics

identified varieties at each site. The multiple ceramic types seen at the extended diversity sites imply interaction between these ceramic traditions. For example, 20CH95 includes Juntunen wares, Sand Point wares, and Oneota-related wares in its assemblage, and 20AR437 includes Juntunen wares and Oneota-related wares. Likewise, sites 20CH6 and 20MK22 both include a high proportion of Juntunen wares in addition to the Iroquoian-related (20CH6) and Oneota-related wares (20MK22) found at those sites. The point being that multiple ceramic types are appearing on these sites and they are not simply reflective of a single variety.

The ceramic trends outlined above support the premise that more bounded tribal territories had emerged by the late LW (McHale-Milner1991; O'Shea and Milner 2002; see also Parkinson 2002). Likewise, the consistent appearance of multiple ceramic forms on most of the extended diversity sites indicates exchange and interaction between these groups. It can be assumed that some of the social networks that operated in the historic period may have originated during the late LW (Holman and Lovis 2008). Finally, the distribution of late LW sites by DUI category is very similar to the distribution of nineteenth century Ojibwa, Ottawa, and Menominee villages and territories depicted by Cleland (1992a, 1992b) (Figure 70).

A final observation that can be gleaned from the distribution of late LW sites is the coastal orientation of sites with Juntunen and Sand Point ceramics and the combination of coastal and interior settings for Oneota-related sites. This suggests different settlement patterns and different resource use. The Juntunen site was integral to the development of the Inland Shore Fishery model as well as the subsequent reevaluation, so the coastal orientation of Juntunen Phase sites is not unexpected (Cleland 1982; B. A. Smith 2004). The Sand Point sites appear to parallel the coastal orientation of the Juntunen Phase sites, although the advent of fall fishing appears to be later (Dunham and Branstner 1995; Dunham and Hambacher 2007; Robinson et al. 1991; B. A. Smith 2004).

Previous studies of the faunal remains at two of the Oneota-related coastal sites (20MK22 and 20DE296) include evidence for a subsistence strategy that was less reliant on the fall fishery (T. Martin 1982, 1991; T. Martin et al. 1993). Likewise, no evidence for fall spawning fish was recovered at 20DE4, another Oneota-related site (Brose 1970). The results of the current study found that late LW sites in the western part of the study area had a higher proportion of large game in their assemblages than those in the east, possibly supporting the same sort of trend. Additionally, the current study identified acorns and wild rice as other resources that could be more intensively harvested and stored and the Oneota-related interior sites are present in likely habitats for these resources.

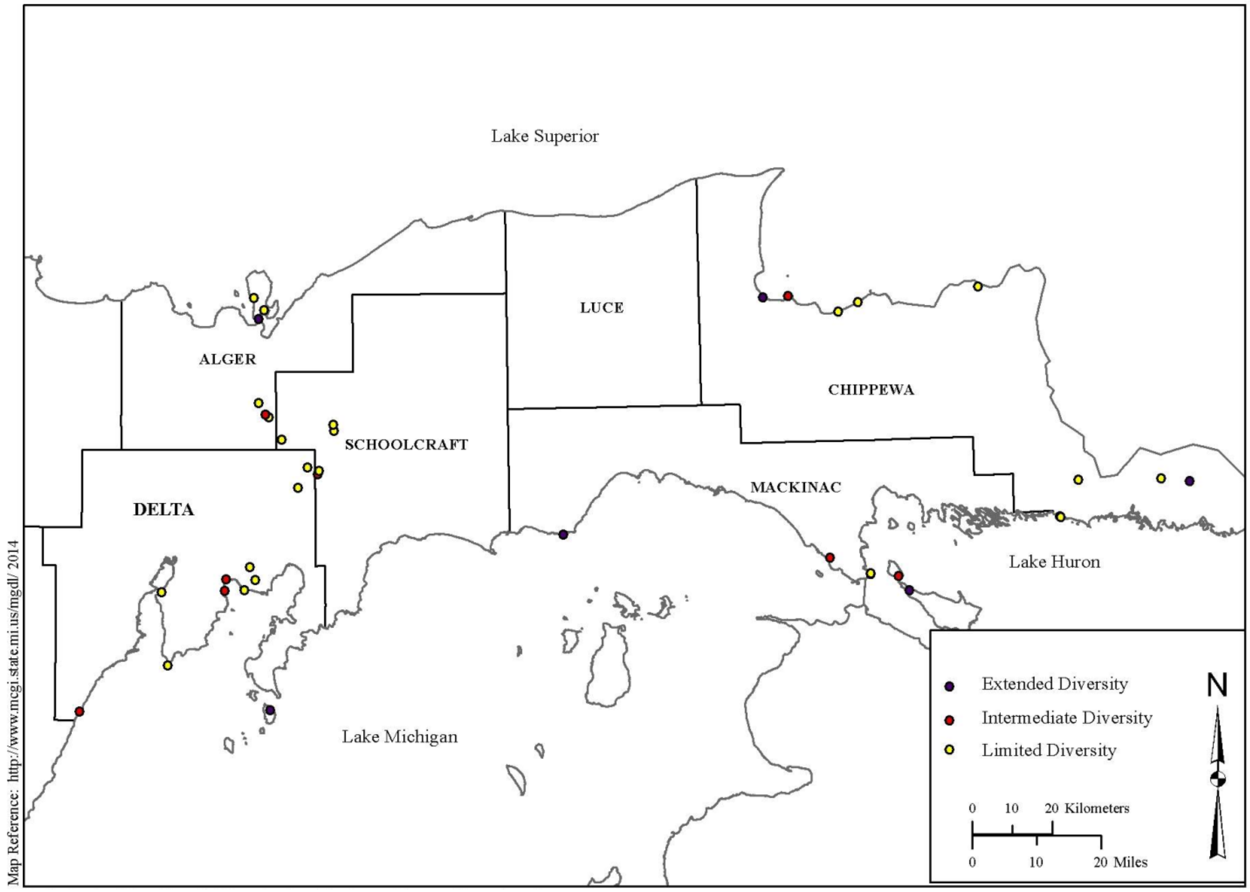


Figure 70: Distribution of late Late Woodland sites by Diversity Use Index.

Previous studies of the faunal remains at two of the Oneota-related coastal sites (20MK22 and 20DE296) include evidence for a subsistence strategy that was less reliant on the fall fishery (T. Martin 1982, 1991; T. Martin et al. 1993). Likewise, no evidence for fall spawning fish was recovered at 20DE4, another Oneota-related site (Brose 1970). The results of the current study found that late LW sites in the western part of the study area had a higher proportion of large game in their assemblages than those in the east, possibly supporting the same sort of trend. Additionally, the current study identified acorns and wild rice as other resources that could be more intensively harvested and stored and the Oneota-related interior sites are present in likely habitats for these resources.

6.4 Concluding Thoughts

The shift towards harvesting deep-water fall fish in the Upper Great Lakes region and greater use of the interior may reflect reorganization (*sensu* Resilience Theory) of the settlement and subsistence patterns in response to environmental instability relating to more dynamic variation in relative lake levels, especially in the Lake Michigan-Huron basin, after AD 900 which also broadly corresponds with the timing of the Medieval Climatic Optimum and substantial coastal dune reactivation along the Lake Michigan shore (Figure 2; Lovis et al. 2012; Lovis, Monaghan et al. 2012). The appearance of gill nets may also coincide with coastal dune formation in the Lake Superior basin ca. AD 1400, but overall temperatures were cooling at this time (Figure 2). These combined changes in the physical environment may have contributed to near coastal resources becoming less predictable. Interior resources and deep water resources, such as fall spawning beds, were potentially less affected by these trends than the near coastal resources and, therefore, maintained their relative predictability (resilience).

The environmental instability in the near coastal zones was a potential catalyst for cultural responses (release *sensu* Resilience Theory) that created greater stability of subsistence resources through intensification and storage as well as greater inter- and intra-group social networks as risk buffering strategies (reorganization/renewal *sensu* Resilience Theory) (see Holman and Lovis 2008; O'Shea and Milner 2002; on differing interpretations of the inter- and intra-group dynamic; see also Whallon [2006] on hunter-gatherer information networks and Braun and Plog [1982] on the necessity of increased regional social interaction as the result of local environmental unpredictability). Such an interpretation is supported by regional ceramic trends which show a greater degree of similarity in the early LW and more diversity in the later

Late Woodland which are interpreted to reflect emerging social identities (c.f., McHale-Milner 1991; 1998).

Further, the more residentially mobile and more immediate return oriented economy of the early LW was gradually supplanted by a more logistically oriented, delayed return economy in the later LW (c.f., Binford 1980; 2001; O'Shea 1981). Increased logistical mobility has been shown to reduce subsistence risk, including risk resulting from environmental uncertainty, through increasing diet breadth and the ability to access multiple resource patches (Binford 1980; Grove 2009; Lovis et al. 2005; Morgan 2009). The addition of acorns and wild rice from interior patches to the LW diet demonstrates a form of resource diversification resulting from increased logistical mobility (growth/exploitation *sensu* Resilience Theory). Increased logistical mobility and intensification on fall resources may also reflect greater social integration and complexity.

Evidence for these patterns appears to manifest itself differently in time and space across the eastern UP. For example, the time/space framework offered by B. A. Smith (2004) for the adoption of gill net technology suggests people in the Straits of Mackinac region were using gill nets before people along the south shore of Lake Superior. Similarly, evidence for greater social integration is also more apparent earlier in the Straits than in other regions (McHale-Milner 1991; Drake and Dunham 2004). Both appear to be time transgressive south to north. I am suggesting reorganization along the lines of a tactical shift involving the pragmatic use of fall season subsistence resources, such as fall spawning fish, acorns, and wild rice that can be harvested in surplus and stored to offset winter shortfalls. The surplus should not be thought of solely as increasing production, but rather as a strategy to extend food availability and broaden the subsistence base during the cold season when resources are scarce and/or more constrained (see Wills 1992; Lovis et al. 2001; O'Shea 1981; O'Shea and Halstead 1989).

The persistent places also exhibit the active role of niche creation by LW hunter-gatherers in the eastern UP. This can be viewed as a form of conservation or resilience within the system (*sensu* Resilience Theory) in that the prolonged use of these locales makes them increasingly attractive to the people using them. The human occupation and activity fosters the growth of economically beneficial plants such as berries and mast producing trees, has the potential to attract wildlife, and figures into the formation of normative perceptions of the landscape (Abrams and Nowacki 2008; Davidson-Hunt 2003; Delcourt and Delcourt 2004; B. D. Smith 2007). The long term use of the Juntunen site and Williams Landing, as well as the the other extended DUI sites, appear to reflect these trends and demonstrate the importance of niche construction in hunter-gatherer society.

An important outcome of this study is a synthesis of LW archaeological research in the eastern UP. Much of the recent archaeological research in the eastern UP has been derived from Federal compliance projects and this synthesis makes this data, which is currently part of the so-called "grey literature" (Seymour 2010), available to a wider audience. The syntheses, along with the analysis of settlement and subsistence patterns, is a significant contribution to hunter-gatherer studies, particularly the archaeology of the Upper Great Lakes region in terms of moving away from monolithic regional models. This synthesis also provides further perspective into the role that aquatic resources, and more intensive use of them, play in the transformation of social organization, mobility and territoriality (Binford 2001; Cleland 1982, 1992a; Lovis and Holman 1976; McHale-Milner 1991; Schalk 1977; Thompson and Turck 2009).

More specifically, the results of the study provide new insights into the settlement and subsistence practices of the Late Woodland peoples in the eastern UP. While no one has claimed that Late Woodland people in the Upper Great Lakes region only ate fish, spring and fall spawning fish are emphasized as critical or key resources. Further, the coastal orientation of the Late Woodland settlement and subsistence model, relating to both economic and social factors, has been the dominant discourse in the region. The results of this study, as well as previously completed pilot studies, identify acorns and wild rice as likely resources for use by Late Woodland peoples (Dunham 2008; 2009). Each of these resources fits well with the seasonal subsistence round proposed by earlier scholars without conflicting with the scheduling of fall fishing, yet also provides a reliable buffer against the potential failure of the fall fishery. Such resource based buffering strategies can, and do, effectively act in tandem with socially based buffering systems. Additionally, the role of interior sites is more fully integrated into the regional model and included as an integral part of a broader pattern of resource use across the landscape. The hypothesis that Late Woodland people may have used a suite of subsistence resources as a buffer against winter risk reorients us towards a more holistic view of Late Woodland land-use and better contextualizes the broader based economy of these people.

APPENDICES

Appendix A:

Eastern UP Landscape Ecosystems

Eastern UP Landscape Ecosystems

The modern landscape ecosystems across the UP, and the Upper Great Lakes region, have been classified by Albert (1995) and these can be used to present an overview of the ecological variation in the eastern UP. The basic premise behind the landscape ecosystem classification is to distinguish appropriately sized ecosystems that are distinct from one another in abiotic and biotic characteristics (Albert 1995). In this scheme, the eastern UP is included within a single ecosystem section (Albert 1995): Section VIII, *Northern Lacustrine-Influenced Upper Michigan and Wisconsin.* In turn Section VIII is subdivided into three subsections: Subsection VIII.1, *Niagaran Escarpment and Lake Plain*; Subsection VIII.2, *Luce;* and Subsection VIII.3, *Dickinson*. Each subsection includes 2 to 3 sub-subsections that are present in the current study area. The following discussion provides a context for subsequent discussions concerning archaeological sites and environments in the eastern UP.

Subsection VIII.1, the Niagaran Escarpment and Lake Plain, forms the southern and most eastern portion of the study area along the Lake Michigan, Lake Huron, and St. Mary's River littoral and adjoining inland areas (Albert 1995). This subsection is primarily underlain by Silurian and Ordovician limestone and dolomite bedrock (Dorr and Eschmann 1984). The Niagaran Escarpment forms a prominent feature arching across the landscape from Bay de Noc to Drummond Island. This feature is also important as a source of chert which was used as a raw material for chipped stone tools in the region (Luedke 1976).

A variety of glaciolacustrine landforms are present in Subsection VIII.1 including lake plain, sandy deltaic deposits, and dune fields (Albert 1995; Lovis et al. 2012). Ground moraine is also locally present. The soils in the lake plain are either lacustrine sands or lacustrine clays. The sands range from excessively well drained to very poorly drained soils, whereas the clays tend to be poorly drained. In some areas, especially near the Lakes Michigan and Huron shoreline, bedrock is close to the surface and the overlying soils are quite thin. Elevations range from 177 m to 317 m (580 ft to 1,040 ft). The average mean level of Lakes Michigan and Huron is currently 177 m (580 ft).

The annual precipitation is 71 cm to 86 cm (28 in to 34 in) in Subsection VIII.1. The growing season ranges from 128 days in the north to 175 days in the south, and south of the eastern UP, especially along Lake Michigan (Eichenlaub et al. 1990). Prior to European settlement, much of the subsection was lowland conifer swamp (Comer et al. 1995). Northern white cedar was common in areas with limestone close to the surface; tamarack and black spruce were common on poorly drained sandy soil; and a more diverse hardwood and conifer swamp forest was found in areas of clay soil. Northern hardwood, especially beech maple forest, was common on better drained soil. Red and white pine was locally common on sand dunes and well drained sandy soils. Extensive marshes were present along the Lakes Michigan and Huron shoreline as well as along the St. Marys River.

The Luce subsection, Subsection VIII.2, forms the northern two-thirds of the study area and includes the zone along Lake Superior as well as the extensive wetland complex in the interior of the eastern UP (the Seney Sand Lake Plain) (Albert 1995). This subsection is underlain by Ordovacian dolomite and sandstone with includes an east-west trending Cambrian Age sandstone escarpment which forms the Pictured Rocks and over which flows Tahquamenon falls (Dorr and Eschmann 1984).

The area along Lake Superior includes lake plain, pitted outwash, and end moraine (Albert 1995; Schaetzl et al. 2013). The inland, Seney Sand Lake Plain area includes poorly drained outwash plain, deltas, and sand lake plain (Albert 1995; Schaetzl et al. 2013). The soils in the lake plain, moraines and outwash along Lake Superior are generally sands. The poorly drained areas associated with the Seney region are peats and poorly drained sands. Excessively well drained sands are present on lake plains in these interior areas. The poorly drained areas also include tracts of interconnected transverse dune ridges. These are large sand dunes that were formed in the mid-Holocene, beginning as early as 5000 BC, and stabilized after 2800 BC (Arbogast et al. 2002). These dunes have excessively well drained soils. Some of the poorly drained peat bogs were once a series of lakes which have in filled with peat over the last 3000 to 4000 years (Futyma 1982).

Elevations range from 183 m to 378 m (602 ft to 1,240 ft). The average mean level of Lake Superior is 183 m (602 ft). The annual precipitation is 81 cm to 86 cm (32 in to 34 in) in Subsection VIII.2. The growing season ranges from 130 days along Lake Superior in the north to less than 100 days in the interior (Eichenlaub et al. 1990). The interior portions of this subsection had extensive areas of wetland and swamp, including both conifer and hardwood-conifer swamp prior to 1800 (Comer et al. 1995; Zhang et al. 2000). The areas along Lake Superior had extensive areas of northern hardwood forest on uplands as well as areas of lowland conifer swamp. The subsection also included large, excessively drained areas with pine-barrens. Pine was also well represented on the interior transverse dunes (Arbogast et al. 2002; Rist 2008).

The Dickinson Subsection, Subsection VIII.3, forms the westernmost portion of the study area extending from the southwestern corner to Lake Superior (Albert 1995). The bedrock geology is split, with the northern third, near Lake Superior, underlain by Cambrian sandstone and the southern part by Ordovician limestone and dolomite bedrock (Dorr and Eschmann 1984). The Dickinson subsection includes two primary landforms: a broad till plain of ground moraine in the south; and sandy ridges and sandstone outcrops in the north (Albert 1995; see also

Schaetzl et al. 2013). There is also a sandy lake plain area along Lake Superior. The soils on the till plain are mainly loamy sands and sands predominate in the northern areas. There are localized areas of poorly drained mucks and peats as well. The elevation in this subsection ranges from 183 m to 396 m (602 ft to 1300 ft) with the greatest variation found in the northern section. The average mean level of Lake Superior is 183 m (602 ft).

The growing season is about 130 days in the southern areas and along Lake Superior, and less than 100 days in the interior (Eichenlaub et al. 1990). Annual precipitation is 76 cm to 86 cm (30 in to 34 in). Pre European settlement vegetation was primarily northern hardwood forest, with sugar maple, hemlock and beech well represented (Comer et al. 1995). Pine was locally well represented as were lowland conifer forests.

Appendix B:

Baseline Site Data

FS Number	State Number	UTM Northing	UTM Easting	Site Size (M²)	M² Excavated	Phase	Component(s)	Reference
-	20AR013	5149257.67	535088.78	5200	8.0	Excavation	Multiple	Clark 1993; Jones 1993
03-028/029	20AR173/174	5134852.35	538224.97	100	3.0	Excavation	Single	Branstner et al. 2000; Dorwin et al. 1980
-	20AR210	5156752.92	549130.24	7000	6.0	Excavation	Single	Clark 1993; Jones 1993
03-667	20AR245	5119839.77	527828.47	400	7.6	Excavation	Single	Rutter and Weir 1985
03-728	20AR310	5123436.44	525291.85	600	12.2	Excavation	Multiple	Dunham 2013; Franzen 1998; Rutter and Weir 1990
-	20AR330	5154937.51	542750.35	600	1.0	Survey	Multiple	Anderton et al. 2011; Clark 1993
03-754	20AR338	5146491.63	526348.95	-	-	Excavation	Multiple	Drake et al. 2009; Dunham et al. 1996; Robinson et al. 1991; Skibo et al. 2009; Skibo personal communication
03-803	20AR348	5144412.40	525265.19	5625	23.8	Excavation	Multiple	Dunham and Branstner 1995; Robinson et al. 1991
03-825	20AR350	5144616.21	525434.34	14400	-	Excavation	Multiple	Anderton 1993; Dunham and Anderton 1999; Dunham and Branstner 1995; Robinson et al. 1991
03-811	20AR353	5144624.53	525499.51	900	4.3	Excavation	Multiple	Franzen 2000; Robinson et al. 1991
03-820/913	20AR358/386	5149659.72	524214.96	625	11.4	Excavation	Single	Dunham et al. 2010
03-821	20AR359	5149693.35	524085.18	1325	17.4	Excavation	Multiple	Dunham 2000b; Robinson et al. 1991
03-929	20AR398	5146518.10	526604.31	700	9.4	Excavation	Single	Dunham et al. 1997; Goltz 1992
03-931	20AR400	5146520.25	526774.42	200	0.5	Survey	Multiple	Goltz 1992
03-937	20AR406	5146776.49	526998.36	100	0.3	Survey	Single	Goltz 1992
03-974	20AR435	5142180.06	510033.61	100	1.1	Excavation	Single	Dunham et al. 1997; Dunham and Hambacher 2002
03-976	20AR437	5120528.54	527087.89	200	6.5	Excavation	Single	Dunham et al. 1997; Dunham and Hambacher 2002
03-832	20AR495	5144639.66	527632.17	500	8.0	Excavation	Multiple	Franzen and Drake 2005
03-004	20AR6	5143539.76	525723.79	375	2.0	Excavation	Multiple	Bigony 1968; Franzen and Drake 2005
-	20CH171	5116978.90	651811.22	1500	1.0	Survey	Single	Anderton 1987 (letter)
04-001	20CH2	5150114.90	657434.60	2000	255.0	Excavation	Multiple	Janzen 1968
-	20CH238	5104191.16	729894.48	900	2.0	Survey	Single	Demers 1991
-	20CH27	5179076.56	653879.42	200	1.0	Survey	Single	Bigony 1968; Luedke 1976
04-010	20CH32	5146178.07	669845.61	2900	1.8	Survey	Multiple	Drake and Dunham 2007
-	20CH41	5162940.31	637266.49	100	1.0	Survey	Single	Franzen 1975
-	20CH43	5095124.60	725302.25	225	1.0	Survey	Multiple	Franzen 1975
04-455	20CH433	5146244.92	670042.45	800	0.5	Survey	Single	Drake and Dunham 2007

Table 41: Baseline Site Data

Table 41: (cont'd)

FS Number	State Number	UTM Northing	UTM Easting	Site Size (M²)	M² Excavated	Phase	Component(s)	Reference
-	20CH45	5104567.14	750448.51	800	1.0	Survey	Single	Franzen 1975; McHale-Milner 1998
-	20CH46	5094883.36	725530.19	900	1.0	Survey	Single	Franzen 1975
04-417	20CH492	5148580.61	674872.06	100	0.1	Survey	Single	Dunham 2000b
-	20CH6	5103877.78	757655.66	20000	102.0	Excavation	Multiple	Branstner 1995; Cooper 1996
-	20CH77	5152581.31	704844.05	1000	9.3	Excavation	Multiple	Fitting 1975b
04-023	20CH86	5150567.00	681827.02	700	1.5	Excavation	Multiple	Rutter and Weir 1989; Dunham 2013
04-012	20CH95	5149875.66	651121.91	2400	13.5	Excavation	Multiple	Dunham and Hambacher 2007
-	20DE1	5061947.97	526047.09	-	-	-	-	UMMA files
01-076	20DE106	5084015.21	503802.25	900	1.0	Survey	Multiple	HNF CRI form nd
01-080	20DE108	5076603.47	521821.67	8000	2.0	Survey	Multiple	Dunham et al. 1994
01-292	20DE167	5079162.36	524538.74	1400	9.9	Excavation	Single	Anderton 1993: Rutter and Weir 1986
-	20DE17	5075813.79	535875.51	-	-	-	-	Bianchi 1974; Richner 1973
02-366	20DE188	5088081.22	522882.31	1000	6.1	Excavation	Single	Rutter et al. 1984
-	20DE19	5062882.70	525644.07	-	-	-	-	Halsey personal communication
01-312	20DE236	5057902.38	502676.80	400	3.4	Survey	Single	Rutter and Weir 1989; 1990
01-334	20DE294	5077402.40	525732.21	100	1.0	Survey	Single	Anderton et al. 1991
01-328	20DE296	5076411.83	516806.79	800	3.4	Excavation	Multiple	Anderton et al. 1991
02-414	20DE326	5107360.53	537484.96	600	4.0	Excavation	Multiple	Anderton et al. 1991
-	20DE333	5046353.92	480588.40	1400	1.0	Survey	Single	OSA files
01-367	20DE378	5079415.24	517205.16	1600	1.7	Survey	Multiple	Dunham and Branstner 1993
-	20DE4	5046611.99	528207.10	6690	116.0	Excavation	Multiple	Brose 1970
02-035	20DE43	5102189.82	535152.56	800	13.0	Excavation	Multiple	Dunham et al. 2010; Franzen 1979; Rutter and Weir 1989
02-549	20DE459	5102532.69	538508.33	1200	9.2	Excavation	Multiple	Dunham and Branstner 1997; Dunham et al. 2010
02-015	20DE50	5104485.42	536961.58	400	2.5	Excavation	Single	Franzen 1987
-	20DE7	5061233.37	526165.62	200	1.0	Survey	Single	Fitting 1968a; Luedke 1976
01-072	20DE75	5082414.68	523134.83	1250	23.7	Excavation	Single	Buckmaster 1983; Martin and Martin 1980
01-061/62	20DE85	5076146.47	501187.27	8750	2.5	Excavation	Multiple	Rutter and Weir 1986
01-069	20DE93	5078489.37	525215.44	3600	2.0	Survey	Multiple	Anderton 1993; Franzen 1998; Weir 1981
-	20MK1	5076598.08	687719.60	7432	441.3	Excavation	Multiple	McPherron 1967; Fitting 1975a; McHale-Milner 1998
-	20MK102	5080666.99	678119.46	1000	11.9	Excavation	Multiple	Fitting 1978
05-305	20MK159	5099439.78	678056.59	4500	4.3	Survey	Multiple	Rutter and Weir 1986

Table 41: (cont'd)

FS Number	State Number	UTM Northing	UTM Easting	Site Size (M²)	M² Excavated	Phase	Component(s)	Reference
-	20MK169/457	5080250.09	684990.60	10000	177.0	Excavation	Multiple	Andrews 2011; Martin and Perri 2011; Prahl 1986
-	20MK19	5079866.63	677727.98		46.5	Excavation	Multiple	Holman 1978; Martin 1985; Smith 1983
-	20MK22	5090459.89	601396.86	-	104.0	Excavation	Multiple	Hambacher personal communication; Martin 1982; McHale-Milner 1998
-	20MK239	5080867.08	677988.97	0	-	-	-	McHale-Milner 1998
05-075	20MK24	5084786.32	667927.26	4000	14.0	Excavation	Multiple	Lynott 1974
05-322	20MK261	5099106.43	678506.73	9900	12.0	Excavation	Multiple	Dunham at al. 1993; Rutter and Weir 1989
05-072	20MK3/11	5077107.65	687096.29	-	-	-	-	Drake, personal communication
05-361	20MK334	5097050.66	660679.55	200	0.2	Survey	Single	Dunham and Branstner 1992
-	20MK375	5101860.73	682526.54	1000	4.0	Excavation	Multiple	Mayry 1995
-	20MK51/82/99	5082298.16	676027.22	-	-	-	-	Branstner 1991; Fitting 1980; Fitting (ed.) 1976
-	20MK53	5081498.99	676954.41	-	51.0	Excavation	Multiple	Fitting and Lynott 1974; McHale-Milner 1998
-	20MK54	5080153.72	678393.50	1415	73.0	Excavation	Multiple	Fitting and Clarke 1974
-	20MK58	5102377.83	682069.88	200	14.0	Excavation	Single	Fitting and Fisher 1975
-	20MK6/7	5081907.67	670793.70	-	-	-	-	Martin 1979
-	20MK61	5080736.59	678093.36	1000	113.0	Excavation	Multiple	Fitting and Cushman 1974
05-014	20MK90	5088147.80	663117.76	500	2.3	Excavation	Multiple	Martin and Martin 1979
-	20ST1	5086841.87	581924.02	2787	10.0	Excavation	Multiple	UMMA files; Martin 1985
02-220/221	20ST109/110	5105541.53	540105.17	650	4.8	Excavation	Single	Franzen 1983; Franzen 1987
02-038	20ST14	5116496.45	544059.58	500	4.0	Excavation	Single	Franzen 1979; 1998; Goltz 1992; Rutter and Weir 1988
-	20ST2	5091422.10	558893.78	-	-	-	-	OSA files
02-435	20ST227	5114163.12	531017.53	300	7.8	Excavation	Single	Dunham et al. 1993; Goltz 1992
02-442	20ST233	5118031.92	543956.56	1000	1.4	Survey	Single	Franzen 1998; Goltz 1992
02-445	20ST262	5106413.48	540391.63	500	11.5	Excavation	Single	Dunham et al. 1993; Goltz 1992

State Number	Count	Hearth	Refuse Dump	Refuse Pit	Storage Pit	Basin	Roasting Pit	Living Floor	Small Pit	Net sinker concentration	Midden	Clay concentration	Dwelling	Animal Burial
20AR173/174	1	1												
20AR310	x													
20AR338	x													
20AR348	4	1	1					1	1					
20AR350	1					1								
20AR358/386	3						1	2						
20AR359	2	2												
20AR398	1	1												
20AR437	1		1											
20AR495	2					1				1				
20CH2	x													
20DE167	1		1											
20DE188	1													
20DE296	1					1								
20DE333	1	1												
20DE4 (O/LW)	8	2		5	1									
20DE4 (pHST)	9	3		3	2								1	
20MK1 (Bois Blanc)	3	1							1					
20MK1 (Juntunen)	10	4							3		1		1	1
20MK1 (Mackinac)	10	4			2				3		1			
20MK169/457	20?	x							x		x	x		
20MK22	x													
20MK24	1	1												
20MK51/82/99	?													
20MK53	1						1							
20MK54	15													
20MK6/7	?													
20MK61	10						1		1					
20MK90	2	1				1								
20ST1	?													
20ST109/110	1													
20ST227	1	1												

x = present

Table 42: Features

State No.	Site Name	Phase	Type	14C age BP	Cal Range AD	median prob AD	14C Early	14C Late	# of ranges	relative area	Sample Reference
20AR013			14C	1130 ± 50	778-997	913	E	-	2	0.99	Beta-46966
20AR310			14C	950±50	1013-1208	1096	-	L	2	0.99	Beta-74502
20AR350	Popper		14C	1230±350	78-1409	789	*	*	1	1.00	WISC-2242
20AR358/386	Mather Lodge		AMS	790±40	1174-1281	1239	-	L	1	1.00	Beta-269591
20CH95	Bark Dock		AMS	600±40	1294-1411	1349	-	L	1	1.00	Beta-214550
20DE167			14C	1100±200	583-1280	925	E	L	1	1.00	WISC-2244
20DE4	Summer Island	Upper Mississippian	14C	660±100	1174-1442	1325	-	L	1	1.00	M-2071
20DE4	Summer Island	Upper Mississippian	14C	660±200	964-1666	1312	-	L	3	0.99	M-2072
20DE4	Summer Island	Proto Historic	14C	330±100	1410-1695	1575	-	L	6	0.86	M-2014
20MK1	Juntunen	Bois Blanc	14C	890±75	1020-1265	1136	-	L	4	1.00	M-1140
20MK1	Juntunen	Bois Blanc	14C	820±120	990-1328	1185	-	L	2	0.94	M-1817
20MK1	Juntunen	Juntunen	14C	630±75	1263-1432	1345	-	L	1	1.00	M-1188
20MK1	Juntunen	Juntunen	14C	620±75	1268-1433	1348	-	L	1	1.00	M-1391
20MK1	Juntunen	Mackinac	14C	1050±75	808-1158	983	E	L	2	0.99	M-1141
20MK1	Juntunen	Mackinac	14C	1225±75	662-904	801	E	-	2	0.90	M-1142
20MK1	Juntunen	Mackinac	14C	870±120	945-1310	1130	E	L	3	0.97	M-1815
20MK1	Juntunen	Mackinac	14C	890±120	932-1299	1146	E	L	3	0.97	M-1816
20MK22	Scott Point	Late	AMS	860±40	1147-1261	1180	-	L	3	0.76	Beta-237014
20MK22	Scott Point	Late	AMS	870±40	1118-1255	1170	-	L	2	0.75	Beta-237015
20MK22	Scott Point	Mackinac	AMS	1240±40	680-882	772	E	-	1	1.00	Beta-237016
20MK24	Ferrier		14C	1020±90	855-1215	1017	E	L	3	0.97	N-1724
20MK24	Tamlin		14C	900±85	994-1270	1128	-	L	1	1.00	N-1725
20MK53			14C	310±85	1430-1691	1581	-	L	3	0.87	N-1727
20MK54	Beyer		14C	680±90	1179-1429	1312	-	L	1	1.00	N-1726
20ST1	Ekdahl-Godreau	Upper	14C	870±120	945-1310	1146	-	L	3	0.97	M-2311
20ST1	Ekdahl-Godreau	Lower	14C	1290±30	663-775	716	E	-	1	1.00	M-2312

Table 43: Chronometric Ages

Appendix C:

Additional Site Data

Additional Site Data

As noted in Chapter 3, the available reporting was reviewed for each of the LW sites in the eastern UP. The archaeological site data were summarized in tabular form and is presented in Appendices B through I. The analyses as presented by the original researchers were maintained and no new analyses of the artifact assemblages were conducted. In some cases it was possible to reorganize data presented in these reports to better address the needs of this study.

An attempt was made to present only the LW component of multicomponent sites, such as at the Bark Dock site (20CH95), which includes Middle Woodland and LW components (Dunham and Hambacher 2007) and Gete Odena site (20AR348) which includes Archaic, Middle Woodland and Historic components in addition to a LW component (Dunham and Branstner 1995; Robinson et al 1991; Skibo et al. 2004). The interpretations of the authors were used for these sites.

Likewise, when multiple LW components were present on a site, an attempt was made to differentiate them as separate components as well (e.g., the Juntunen and Summer Island sites [Brose 1970; McPherron 1967]). This was not always possible and depended on the reporting of the site. As a result, a small number of sites (n=7) were characterized as LW locales based on the recovery of LW artifacts, but where the LW component could not be differentiated from other components on the site (20AR013, 20AR338, 20DE1, 20DE19, 20MK375, 20MK51/82/99, 20MK6/7).

Finally, an estimation of the LW component was derived from the original reporting for a small number of multicomponent sites based on data in the original reports. For example, the southern loci of site 20DE75 included LW artifacts and no diagnostic materials were noted in the northern loci (Buckmaster 1983). Thus, data from the southern loci was used in this analysis.

Likewise, the Tamlin portion of 20MK24 was used in this study (Lynott 1974). LW features at 20CH2 were used to extrapolate diversity index values (Janzen 1968; Features 7-67, 31-67, 3-67). A similar process was used for 20CH6 using Features 18, 20, 21, 22, 23, 25, 26, 27, 30, 31, 37, 38, 39, and 40 (Branstner 1995).

Appendix D:

Chipped and Ground Stone Artifacts

State Number	Tool Count	Formal	Expedient	Point	Scraper	Biface	Drill	Knife	Escraper	Sscraper
20AR173/174	1	1		1						
20AR245	10	2	1			1	1			
20AR310	12	4	1	1	1	1			1	1
20AR330	1	1		1						
20AR348	42	15	1	1	1	1			1	
20AR353	6	4	1	1	1	1			1	
20AR358/386	6	2	1		1	1			1	
20AR359	14	10	1	1		1				
20AR437	4	3	1	1	1				1	
20AR495	7	6	1		1	1			1	
20AR6	5	5		1	1				1	
20CH171	5	4	1		1				1	
20CH2	13	11	1	1	1				1	
20CH32	2	1	1			1				
20CH41	4	0	1							
20CH6	26	18	1	1	1	1				
20CH77	14	4	1		1	1			1	
20CH86	1	1			1				1	
20CH95	13	9	1	1	1	1			1	1
20DE108	4	1	1	1						
20DE167	5	1	1			1				
20DE188	16	8	1	1	1	1			1	1
20DE236	1	0	1							
20DE296	15	7	1	1	1	1			1	1
20DE326	2	1	1	1						
20DE333	1	1		1						
20DE378	3	2	1		1				1	
20DE4 (O/LW)	126	34	1	1	1	1			1	1
20DE4 (pHST)	178	61	1	1	1	1			1	1
20DE43	14	5	1		1	1			1	

Table 44: Chipped Stone Tools

Table 44: (cont'd)

State Number	Tool Count	Formal	Expedient	Point	Scraper	Biface	Drill	Knife	Escraper	Sscraper
20DE459	3	1	1	1						
20DE50	5	2	1	1		1				
20DE7	3	3		1	1					1
20DE75	9	1	1			1				
20DE85	3	3		1	1				1	
20DE93	4	4		1	1	1			1	
20MK1	660	443	1	1	1					
20MK1 (Bois Blanc)	59	28	1	1	1					
20MK1 (Juntunen)	120	70	1	1	1	1				
20MK1 (Mackinac)	93	63	1	1	1	1				
20MK102	3	3		1						
20MK159	3	1	1		1				1	
20MK169/457	42	7	1	1	1	1			1	
20MK19	28	7	1	1	1	1		1	1	
20MK22	25	10	1		1	1			1	1
20MK24	2	1	1		1				1	
20MK261	43	31	1	1	1	1	1		1	1
20MK54	77	24	1	1	1	1	1		1	1
20MK58	2	2		1	1				1	
20MK61	39	10	1	1	1				1	1
20MK90	68	15	1	1	1	1	1		1	
20ST1	40	21	1	1	1				1	
20ST109/110	12	4	1	1		1				
20ST227	2	1	1	1						
20ST233	1	1		1						
20ST262	1	1				1				

		Reduction Sequence (%)			Raw Material (%)		
State Number	Count	First	Second	Third	Chert	Quartz	Quartzite
20AR173/174	0	-	-	-	-	-	-
20AR210	119	-	-	-	99.2	0.8	0
20AR245	382	-	-	-	61.8	0	36
20AR310	553	24	23.6	3	86.6	4.7	8.7
20AR348	851	25.3	31	4.7	28.6	51.1	20
20AR353	159	-	-	-	27	54	19
20AR358/386	1378	33	36.4	0.8	2	93	4
20AR359	761	20.5	34.4	16.9	13	24	63
20AR398	144	55	14	4	57	16	27
20AR400	56	-	-	-	16.1	12.5	67.9
20AR406	0	-	-	-	-	-	-
20AR435	0	-	-	-	-	-	-
20AR437	81	25.9	17.3	35.8	91.4	6.2	1.2
20AR495	632	-	-	-	29	41	30
20AR6	192	-	-	-	78.6	15.6	5.2
20CH171	44	-	-	-	-	-	-
20CH238	65	-	-	-	98.5	0	1.5
20CH27	24	-	-	-	95.8	0	4.2
20CH32	23	4.3	43.5	21.7	100	0	0
20CH41	53	-	-	-	-	-	-
20CH43	19	-	-	-	-	-	-
20CH433	1	-	-	-	-	-	-
20CH46	3	-	-	-	-	-	-
20CH492	0	-	-	-	-	-	-
20CH77	68	-	-	-	-	-	-
20CH86	8	-	-	-	62.5	37.5	0
20CH95	137	15.3	54.8	8.8	93.4	5.1	1.5
20DE108	77	10.4	62.4	18.2	97.4	2.6	0
20DE167	4281	-	-	-	96.8	0.8	2.4

Table 45: Debitage

Table 45: (cont'd)

State Number	Count	Reduction Sequence (%) First	Second	Third	Raw Material (%) Chert	Quartz	Quartzite
20DE188	367	-	-	-	95	0	5
20DE236	81	-	-	-	63.6	36.4	0
20DE294	4	-	-	-	100	0	0
20DE296	258	-	-	-	92.5	3.8	1.3
20DE326	69	-	-	-	94.1	2.9	2.9
20DE378	20	-	-	-	95	0	5
20DE4 (O/LW)	12150	-	-	-	-	-	-
20DE4 (PHST)	14900	-	-	-	-	-	-
20DE43	642	19.7	34.4	9.4	95.9	0.6	3
20DE459	167	17.6	32.9	12.9	22.7	7	69.8
20DE50	35	-	-	-	88.6	5.7	5.7
20DE7	204	-	-	-	-	-	-
20DE75	241	-	-	-	97.9	0.4	0.8
20DE85	48	-	-	-	93.8	0	6.3
20DE93	737	-	-	-	-	-	-
20MK159	25	-	-	-	100	0	0
20MK169/457	152	-	-	-	-	-	-
20MK19	876	-	-	-	-	-	-
20MK24	74	-	-	-	99	-	-
20MK261	1982	5.9	21.8	24.9	97.6	2.1	2.1
20MK334	8	100	0	0	100	0	0
20MK54	371	-	-	-	98.4	0	1.3
20MK58	5	-	-	-	-	-	-
20MK61	338	-	-	-	99.7	-	-
20MK90	888	-	-	-	-	-	-
20ST1	453	-	-	-	-	-	-
20ST109/110	195	-	-	-	86.7	12.8	0.5
20ST14	35	-	-	-	74.3	14.3	11.4
20ST227	98	28.2	30.8	12.8	19.3	15.3	61.2

Table 45: (cont'd)

		Reduction Sequence (%)			Raw Material (%)		
State Number	**Count**	**First**	**Second**	**Third**	**Chert**	**Quartz**	**Quartzite**
20ST233	28	-	-	-	85.7	7.1	7.1
20ST262	148	11.3	33.1	16.2	77.7	14.9	8.8

State Number	Ground Stone Count	Mano	Hammer Stone	Anvil Stone	Net Sinker	Celts	Abrader	Unclassified	Drilled Slate	Adze	Pestle
20AR310	2		2								
20AR348	5		2		3						
20AR358/386	2		1	1							
20AR437	1	1									
20AR495	14		2	1	11						
20AR6	2				1			1			
20CH95	5			1	4						
20DE296	1		1								
20DE333	1		1								
20DE4 (O/LW)	6	2				2	2				
20DE4 (pHST)	4					2	1		1		
20DE43	2		2								
20MK1	31		20			1				1	3
20MK1 (Bois Blanc)	1		1								
20MK1 (Juntunen)	4		1								3
20MK1 (Mackinac)	2		1			1					
20MK19	2		2								
20MK22	25	6	9	9		1					
20MK261	3		1			2					
20MK90	1			1							
20ST1	1			1							
20ST109/110	2		1					1			
20ST227	1		1								
20ST262	1	1									

Table 46: Ground Stone Tools

Appendix E:

Ceramics

				Minimum Number of Vessels		
State Number	**Sherds #**	**MNV #**	**No. Types**	**ELW**	**LLW**	**Untyped**
20AR210	1	1	1			1
20AR245	8	1	1		1	
20AR310	4	1	1			1
20AR330	-	1	1			1
20AR348	671	4	4	1	2	
20AR350	7	1	1			1
20AR353	2	2	1			2
20AR358/386	269	1	1		1	
20AR359	163	3	2	1	2	2
20AR398	2	1	1		1	1
20AR400	126	2	1			2
20AR406	3	1	1			1
20AR435	91	1	1			1
20AR437	160	9	4	0	9	1
20AR495	6	1	1			1
20AR6	2	1	1			1
20CH171	2	1	1			1
20CH2	1089	58	4	51	7	
20CH238	408	3	3		3	
20CH27	-	1	1			1
20CH32	4	2	2	1	1	1
20CH41	6	1	1			1
20CH43	101	3	2		1	2
20CH433	1	1	1			1
20CH45	9	1	1		1	
20CH46	353	1	1		1	
20CH492	1	1	1		1	
20CH6	-	136	8	48	88	64
20CH77	51	3	3		3	
20CH86	1	1				
20CH95	577	13	4		13	6
20DE106	-	2				
20DE108	71	3	2		1	2
20DE17	-	1	1	1		
20DE188	97	1	1			1
20DE236	11	3	2		1	2
20DE294	2	1	1			1
20DE296	466	17	3		17	4
20DE326	5	3	2		1	2
20DE333	p	1	1		1	
20DE378	9	3	1	2	1	3

Table 47: Baseline Ceramic Data

Table 47: (cont'd)

State Number	Sherds #	MNV #	No. Types	Minimum Number of Vessels ELW	LLW	Untyped
20DE4 (O/LW)	538	16	4		16	
20DE4 (pHST)	66	13	5		13	
20DE43	9	2	1		2	2
20DE50	6	1	1			1
20DE7	14	2	2	1		1
20DE75	162	2	2		1	1
20MK1	101447	1656	11	*	*	463
20MK1 (Bois Bla	-	142			*	
20MK1 (Juntune	-	269			*	
20MK1 (Mackina	-	438		*		
20MK102	-	12	4	8	1	3
20MK159	14	2	1	2		
20MK169/457	224	27	13	9	16	2
20MK19	245	3	3	x		
20MK22	-	195	8			6
20MK239	-	3	1		3	
20MK24	117	19	3	2		12
20MK261	1773	8	2	8		
20MK3/11	1	1	1			1
20MK334	100	1	1			1
20MK375	-	1				
20MK53	41	5	2		1	4
20MK54	1557	19	6	3	6	8
20MK58	123	1	1		1	
20MK61	327	10	4	1	4	5
20MK90	246	2	1	2		
20ST1	609	8	2		7	1
20ST109/110	91	2	2		1	1
20ST14	88	3	2		2	1
20ST233	18	1	1			
20ST262	1	1	1			1

State Number	Juntunen	Bois Blanc	Mackinac	Sand Point	Heins Creek-like	Pt. Sauble	Madison	Lakes Phase	Miniature	Pine River	Traverse	Macomb-like	Spring Creek-like	Algoma-like	Wayne-like	Blackduck
20AR210																
20AR245						1										
20AR310																
20AR330																
20AR348				1			1		1							
20AR350																
20AR353																
20AR358/386				1												
20AR359				1												
20AR398																
20AR400																
20AR406																
20AR435																
20AR437	1															
20AR495																
20AR6																
20CH171																
20CH2	2	4	51													
20CH238				1										1		
20CH27																
20CH32			1													
20CH41																
20CH43		1														
20CH433																
20CH45	1															
20CH46	1															
20CH492	1															
20CH6	3		17						13	6				9		2
20CH77	1								1							
20CH86																
20CH95	1			5												
20DE106																
20DE108				1												
20DE17			1													
20DE188																
20DE236																
20DE294																
20DE296	0	0	0	12												
20DE326																
20DE333																
20DE378																

Table 48: Late Woodland Ceramic Types (MNV)

Table 48: (cont'd)

State Number	Juntunen	Bois Blanc	Mackinac	Sand Point	Heins Creek-like	Pt. Sauble	Madison	Lakes Phase	Miniature	Pine River	Traverse	Macomb-like	Spring Creek-like	Algoma-like	Wayne-like	Blackduck
20DE4 (O/LW)																
20DE4 (pHST)																
20DE43																
20DE50																
20DE7					1											
20DE75																
20MK1	309	138	631			15			21				2			55
20MK1 (Bois Blanc)																
20MK1 (Juntunen)																
20MK1 (Mackinac)																
20MK102	1		7												1	
20MK159			2													
20MK169/457	2	2	7	2					1	1	1					1
20MK19		x	x						x							
20MK22	48	22	42					2			7					
20MK239	3															
20MK24			3										4			
20MK261			4							4						
20MK3/11																
20MK334																
20MK375																
20MK53	1															
20MK54	2	1	3									1				
20MK58	1															
20MK61	3		1													
20MK90			2													
20ST1																
20ST109/110																
20ST14																
20ST233																
20ST262																

	Oneota Related										Other	
State Number	Grand River	Carcajou	Koshkonong	Pt. Detour	Lake Winnebago	Delta	Bay de Noc	Garden	Summer Island	Untyped Oneota	Ramey-like	Iroquoian
20AR210												
20AR245												
20AR310												
20AR330												
20AR348										1		
20AR350												
20AR353												
20AR358/386												
20AR359												
20AR398												
20AR400												
20AR406												
20AR435												
20AR437	6	1										
20AR495												
20AR6												
20CH171												
20CH2												1
20CH238										1		
20CH27												
20CH32												
20CH41												
20CH43												
20CH433												
20CH45												
20CH46												
20CH492												
20CH6												22
20CH77										1		
20CH86												
20CH95		1										
20DE106												
20DE108												
20DE17												
20DE188												
20DE236										1		

Table 49: Oneota-Related and Other Ceramic Types (MNV)

Table 49: (cont'd)

	Oneota Related										Other	
State Number	Grand River	Carcajou	Koshkonong	Pt. Detour	Lake Winnebago	Delta	Bay de Noc	Garden	Summer Island	Untyped Oneota	Ramey-like	Iroquoian
20DE294												
20DE296	0	0								1		
20DE326										1		
20DE333										1		
20DE378												
20DE4 (O/LW)		4	3	3		6						
20DE4 (pHST)					1		4	3	3			2
20DE43												
20DE50												
20DE7												
20DE75										1		
20MK1										42	15	2
20MK1 (Bois Blanc)												
20MK1 (Juntunen)												
20MK1 (Mackinac)												
20MK102												
20MK159												
20MK169/457	1	1								1		5
20MK19												
20MK22										67		1
20MK239												
20MK24												
20MK261												
20MK3/11												
20MK334												
20MK375												
20MK53												
20MK54										2		
20MK58												
20MK61										1		
20MK90												
20ST1										7		
20ST109/110										1		
20ST14										2		
20ST233										1		
20ST262												

Appendix F:

Other Artifacts

State Number	Ceramic Pipe	Stone Pipe	Bone Artifacts	Bone Awl	Bone Point	Bone Harpoon	Bone Netting Needle	Bone Chisel	Bone Needle	Bone Tubes	Copper Artifacts	Copper Awl	Copper Bead	Copper Scrap	Copper Pin	Copper Ring	Copper Point/Cone	Copper Effigy	Copper Knife
20AR400	1																		
20CH2	1																		
20CH6	1		1			1					6	5							1
20CH95	1										1	1							
20DE188		1																	
20DE4 (O/LW)			12	5	3		4				3			3					
20DE4 (pHST)											11	3	3				4	1	
20MK1	65		118	69	1	9		31	1	7	90	57	25						8
20MK1 (Bois Blanc)	7		5	5							4								
20MK1 (Juntunen)	9		21	18		3					22								
20MK1 (Mackinac)	10		22	20		2					1								
20MK169/457	2																		
20ST1	p	p									3				1	1			

p = present

Table 50: Other Artifact Types

Appendix G:

DUI Rank

State Number	DUI	DUIrev	DUI Rank
20AR173/174	1	1	Limited
20AR210	1	1	Limited
20AR245	9	1.2	Limited
20AR310	35	2.9	Limited
20AR330	4	4	Limited
20AR348	168	7	Extended
20AR350	1	1	Limited
20AR353	24	5.7	Intermediate
20AR358/386	25	2.2	Limited
20AR359	29	1.7	Limited
20AR398	1	1	Limited
20AR400	2	2	Limited
20AR406	1	1	Limited
20AR435	1	1	Limited
20AR437	52	8	Intermediate
20AR495	126	15.8	Intermediate
20AR6	40	20	Intermediate
20CH171	10	10	Intermediate
20CH2	207	1	Intermediate
20CH238	3	1.5	Limited
20CH27	1	1	Limited
20CH32	6	3.3	Limited
20CH41	5	5	Limited
20CH43	3	3	Limited
20CH433	1	1	Limited
20CH45	1	1	Limited
20CH46	1	1	Limited
20CH492	1	1	Limited
20CH6	770	7.5	Extended
20CH77	14	1	Limited
20CH86	4	2.7	Limited
20CH95	168	12.4	Extended
20DE106	2	2	Limited
20DE108	8	4	Limited
20DE167	2	1	Limited
20DE17	1	1	Limited
20DE188	36	5.9	Intermediate
20DE236	3	1	Limited
20DE294	1	1	Limited
20DE296	125	36.3	Intermediate
20DE326	8	2	Limited
20DE333	9	9	Intermediate

Table 51: Diversity Use Index (DUI) Rank

Table 51: (cont'd)

State Number	DUI	DUIrev	DUI Rank
20DE378	10	5.9	Intermediate
20DE4 (O/LW)	448	3.9	Intermediate
20DE4 (pHST)	702	6	Extended
20DE43	36	2.8	Limited
20DE459	1	1	Limited
20DE50	9	3.6	Limited
20DE7	15	15	Intermediate
20DE75	6	1	Limited
20DE85	6	2.4	Limited
20DE93	12	6	Intermediate
20MK1 (Bois Blanc	680	5.5	Extended
20MK1 (Juntunen)	1715	7.5	Extended
20MK1 (Mackinac)	3024	6.9	Extended
20MK102	30	2.5	Limited
20MK159	6	1.4	Limited
20MK169/457	170	1	Intermediate
20MK19	84	1.8	Limited
20MK22	1840	17.7	Extended
20MK239	3	1	Limited
20MK24	80	5.7	Intermediate
20MK261	294	24.5	Extended
20MK3/11	1	1	Limited
20MK334	1	1	Limited
20MK53	5	1	Limited
20MK54	258	3.5	Intermediate
20MK58	9	1	Limited
20MK61	40	1	Limited
20MK90	108	46.5	Intermediate
20ST1	84	8.4	Intermediate
20ST109/110	40	8.3	Intermediate
20ST14	3	1	Limited
20ST227	4	1	Limited
20ST233	4	2.9	Limited
20ST262	9	1	Limited

Appendix H:

Fauna

	11 sites	20AR359	20AR359	20DE75	20DE75	20MK90	20MK90	20CH95	20CH95	20AR348 (1990)	20AR348 (1990)	20AR348 (1994)	20AR348 (1994)	20MK261	2MK261	20DE188	20DE188	20MK24	20MK24	20ST109/ 110	20ST109/ 110	20DE296	20DE296	20AR437	20AR437
Taxon		NISP	MNI	NISP	MNI	NISP	MNI	NISP	MNI	NISP	MNI	NISP	MNI	NISP	MNI	NISP	MNI	NISP	MNI	NISP	MNI	NISP	MNI	NISP	MNI
MAMMALS																									
Beaver, *Castor canadensis*	x (7)					14	1			1	1	3	1	25	3	44	3			93	9	8	2	43	3
Black bear, *Ursus americanus*	x (2)									4	1	1	1									14	2		
Canis sp., wolf/dog	x (1)													3	1										
Chipmunk (eastern), *Tamias striatus*	x (1)																					2	1		
Porcupine, *Erethizon dorsatum*	x (2)																					2	1	1	1
Marten, *Martes americana*	x (2)											2	1									2	1		
Meadow jumping mouse, *Zapus hudsonicus*	x (3)																					3	1		
Mink, *Mustela vison*	x (1)																					1	1		
Moose, *Alces alces*	x (3)									6	1											12	1	13	1
Muskrat, *Ondatra zibethicus*	x (3)											1	1							7	2	2	1		
River otter, *Lutra canadensis*	x (2)													3	2									1	1
Short-tailed shrew, *Blarina brevicauda*	x (1)																					2	2		
White-tailed deer, *Odocoileus virginianus*	x (4)							1	1			1	1							1	1	3	1		
BIRDS																									
Bald eagle, *Haliaeetus leucocephalalus*	x (1)																					1	1		
Common goldeneye (duck), *Bucephala clangula*	x (1)																					1	1		
Common loon, *Gavia immer*	x (1)																					4	1		
Herring gull, *Larus argentatus*	x (1)									2	1														
Oldsquaw, *Clangula hyemalis*	x (1)											2	1												
Passenger Pigeon, *Ectopistes migratorius*	x (1)																	1	1						
Red-tailed hawk, *Buteo jamaicensis*	x (1)													3	2										
Ring-necked duck, *Aythya collaris*	x (1)									1	1														
Eggshell fragments	x (1)																					20	-		
REPTILES																									
Painted turtle, *Chrysemys picta*	x (3)	1	1																	4	3	6	1		
Snapping turtle, *Chelydra serpentina*	x (1)																			2	1				
AMPHIBIANS																									
Frog, *Rana sp.*	x (1)																					1	1		
FISH																									
Bass (smallmouth), *Micropterus dolomieui*	x (2)													1	1							41	8		
Burbot, *Lota lota*	x (1)																					2	1		
catfish/bullhead, *Ictalurus sp.*	x (1)																			1	1				
Freshwater drum, Aplodinotus grunniens	x (1)													1	1										
Lake Sturgeon, *Acipenser fulvescens*	x (8)	1	1	1	1	5	1	1	1			3	1	2	2	243	-					18	1		
Lake trout, *Salvelinus namaycush*	x (2)											p	-									2	2		
Northern pike, *Esox lucius*	x (4)													2	1					2	2	3	3	1	1
Sucker (longnose), *Catostomus catastomus*	x (3)	1	1											1	1							2	2		
Sucker (white), Catostomus commersoni	x (1)																					2	1		
Sucker, Catostomidae	x (5)	4	-											26	3	1	1					20	3	2	1
Sunfish, Centrarchidae	x (1)																			1	-				
Walleye, *Stizostedion vitrium*	x (2)									1	1	3	1									112	7		
Whitefish (lake whitefish), *Coregonus clupeaformis*	x (1)	1	1																						
Whitefish fam., Coregoninae sp.	x (3)	2	-									1	1	3	2										
Yellow perch, *Perca flavescens*	x (1)																					5	3		
BIVALVES																									
Fatmucket, *Lampsilis siliquoida*	x (1)																					1	1		
cf. White heelsplitter, *Lasmigona complanata*	x (1)																							1	1

Table 52: Fauna from sites within the HNF (Identified Species Only)

Taxon	9 sites (16 components)	20MK61	20MK457 (LW Mixed)	20MK457 (LW Mixed)	20MK457 (Bois Blanc)	20MK457 (Bois Blanc)	20MK457 (Early)	20MK457 (Early)	20CH6	20CH6	20ST1	20ST1	20DE4 (O/LW)	20DE4 (PHST)	20MK22 (Mackinac	20MK22 (Bois Blanc	20MK22 (Juntunen	20MK54	20MK1 (Mackinac	20MK1 (Bois Blanc	20MK1 (Juntunen)	20MK1	20CH238
		NISP	NISP	MNI	NISP	MNI	NISP	MNI	NISP	MNI	NISP	MNI	MNI	MNI	NISP	NISP	NISP	NISP	NISP	NISP	NISP	NISP	NISP
MAMMALS																							
Beaver, *Castor canadensis*	x (15)	5	68	4	4	1	5	2	468	4	18		x	x	8	15	42	2	32	5	25	62	
Black bear, *Ursus americanus*	x (6)	1	2	1					1	1				x			1			1		1	
Canis sp., wolf/dog	x (12)	4	81	7	14	2	32	2	259	1					5	2	2	1	40	6	20	66	
Caribou, *Rangifer species*	x (7)		12	2	2	1	2	1	1	1									3	1	2	6	
Chipmunk (eastern), *Tamias striatus*	x (5)	4														10		8		1	1	2	
Deermouse, *Peromscus maniculatus*	x (1)																		1			1	
Elk, *Cervis canadensis*	x (1)													x									
Fisher, *Martes pennanti*	x (1)																1						
Fox, *Vulpes species*	x (3)		3	2	2	1	2	2															
Marten, *Martes americana*	x (4)		3	1											1	1	2						
Moose, *Alces alces*	x (9)		18	2	2	1	3	1							1	1	2		2	3	1	6	
Muskrat, *Ondatra zibethicus*	x (4)		1	1					3	1	1					1							
Porcupine, *Erethizon dorsatum*	x (4)		5	2	1	1													2		1	3	
Rabbit?, Lepus	x (2)												x	x									
Red squirrel, *Tamiasciurus hudsonicus*	x (1)																		1			1	
River otter, *Lutra canadensis*	x (3)		1	1												6			1			1	
Skunk, *Mephitis mephitis*	x (1)																1						
Snowshoe hare, *Lepus americana*	x (6)		1	1													18		7	2	3	12	
Vole (red-backed), *Myodes species*	x (2)																		1		1	2	
White-tailed deer, *Odocoileus virginianus*	x (10)		1	1							5		x	x	1	1	3		2	1		3	x
Woodchuck, *Marmota Mona*	x (1)								1	1													
BIRDS																							
American bittern, *Botaurus lentiginosus*	x (1)															1							
Bald eagle, *Haliateetus leucocephalalus*	x (4)		3	1												6				2	1	3	
Blue jay, *Cyanocitta cristata*	x (1)																				2	2	
Canada goose, *Branta canadensis*	x (2)																		3		1	4	
Cuckoo, *Coccyzus sp.*	x (1)														1								
Common loon, *Gavia immer*	x (8)		4	2					4	2					7	13	13		4	2	10	16	
Crow, *Corvis brachyrhynchos*	x (1)																				2	2	
Goshawk, *Accipiter sp.*	x (1)																			1		1	
Herring gull, *Larus argentatus*	x (1)															1							
Passenger Pigeon, *Ectopistes migratorius*	x (6)		1	1											2			7	5	2	20	27	
Raven, *Coris corax*	x (3)																		4	1	1	6	
c.f. Red-shouldered hawk, *Buteo lineatus*	x (2)														1						1	1	
Ringbilled gull, *Larus delawarensis*	x (1)																		1			1	
Ruffed Grouse, *Bonasa umbellus*	x (3)														1		1		1			1	
Saw whet owl, *Aegolius acadicus*	x (1)																		1			1	
Wild turkey, *Meleagris gallopavo*	x (1)																			5		5	
REPTILES																							
Box turtle, *Terrapene carolina*	x (3)		2	1											1	1							
Painted turtle, *Chrysemys picta*	x (5)														5	11	5		7	2		9	
Snapping turtle, *Chelydra serpentina*	x (7)		1	1					469	4	23				13	13	3				1	1	
Blandings turtle, *Emydoidea blandingii*	x (5)		17	2	2	1	2	1			10									3		3	
Wood turtle, *Glyptemys insculpta*	x (1)																1						
AMPHIBIANS																							
Toad, *Bufo sp.*	x (1)								33	2													
FISH																							
Bass (smallmouth), *Micropterus dolomieui*	x (7)	1											x?	x?		4?			4	2	2	8	
Bass (largemouth), *Microterus salmoides*	x (4)														2	2			1	1		2	
Bullhead (brown), *Ameiurus nebulosus*	x (2)								10	3									2				
Burbot, *Lota lota*	x (2)		14	4			1	1															
Catfish/bullhead, *Ictalurus sp.*	x (1)								2	1													
Channel catfish, *Ictalurus punctatus*	x (3)	1	1	1															1			1	
Freshwater drum, *Aplodinotus grunniens*	x (3)								6	2									2	1		3	
Gar (longnose), *Lepistosteus osseus*	x (2)																		14	1		15	
Lake Sturgeon, *Acipenser fulvescens*	x (12)	2	1	1					1	1	28		x		29	39	9	7	221	17	26	264	
Lake trout, *Salvelinus namaycush*	x (11)	3	28	5	5	2	40	6			5				3	5	17		22	2	2	26	
Salmonidae	x (3)														87	193	65						
Northern pike, *Esox lucius*	x (7)		1	1					9	3				x	2?	5?	4?			2		2	
Sucker (longnose), *Catostomus catostomus*	x (4)								1	1									10	9	1	20	

Table 54: Fauna from Sites outside the HNF (Identified Species Only)

Table 54: (cont'd)	9 sites (16 components)	20MK61	20MK457 (LW Mixed)	20MK457 (LW Mixed)	20MK457 (Bois Blanc)	20MK457 (Bois Blanc)	20MK457 (Early)	20MK457 (Early)	20CH6	20CH6	20ST1	20ST1	20DE4 (O/LW)	20DE4 (PHST)	20MK22 (Mackinac	20MK22 (Bois Blanc	20MK22 (Juntunen	20MK54	20MK1 (Mackinac)	20MK1 (Bois Blanc	20MK1 (Juntunen)	20MK1	20CH238
Taxon		NISP	NISP	MNI	NISP	MNI	NISP	MNI	NISP	MNI	NISP	MNI	MNI	MNI	NISP	NISP	NISP	NISP	NISP	NISP	NISP	NISP	NISP
Sucker (redhorse), *Moxostoma carinatum*	x (3)																		6	1	4	11	
Sucker (white), *Catostomus commersoni*	x (5)														3	20	2		6	10		16	
Sucker, Catostomidae?	x (4)								36	3					5	1	4						
Walleye, *Stizostedion vitrium*	x (12)	1	4	1			1	1	26	3	4		x		1	1		2	24	5	19	48	
Whitefish (lake whitefish), *Coregonus clupeaformis*	x (9)		7	2	1	1	2	2								2	8	1	125	31	30	186	
Whitefish fam., *Coregoninae sp.*	x (6)		215	11	27	2	79	3	23	3													
Yellow perch, *Perca flavescens*	x (3)								3	1									10	4		14	
BIVALVES																							
Fatmucket, *Lampsilis siliquoida*	x (1)												7										
Fluted-shell, *Lasmigona costata*	x (2)	1	1																				
Plain Pocketbook, *Lampsilis cardium*	x (2)	2	2																				
Pink heelsplitter, *Potamilus alatus*	x (2)	4	2																				
Actinonaias carinata	x (1)															3							
Spike, *Elliptio dilatus*	x (3)	10	5													2							
Amblema costata	x (1)												17										

State Number	Setting	ELW	LLW	Diversity Mammals	Diversity Birds	Diversity Reptiles	Diversity Fish	Total Faunal	Diversity (total fauna x variety)
20AR348	C	E	L	6	3	0	4	13	39
20AR359	C	E	L	0	0	0	1	1	2
20AR437	I	-	L	4	0	0	2	6	12
20CH238	I	-	L	1	0	0	0	1	1
20CH6	C	E	L	6	1	1	9	17	68
20CH95	C	-	L	1	0	0	1	2	4
20DE188	I	-	-	1	0	0	3	3	6
20DE296	C	-	L	11	3	1	9	24	96
20DE4 (O/LW)	C	-	L	3	0	0	3	6	12
20DE4 (pHST)	C	-	L	5	0	0	2	7	14
20DE75	I	-	L	0	0	0	1	1	1
20MK1 (Bois Blanc)	C	-	L	8	6	2	13	29	116
20MK1 (Juntunen)	C	-	L	8	8	1	7	24	96
20MK1 (Mackinac)	C	E	-	11	7	1	15	34	136
20MK169/457 (Bois Blanc)	C	-	L	6	0	1	2	9	27
20MK169/457 (Early)	C	E	-	5	0	1	4	10	30
20MK169/457 (Mixed LW)	C	E	L	12	3	3	7	25	100
20MK22 (Bois Blanc)	C	-	L	8	4	3	9	24	96
20MK22 (Juntunen)	C	-	L	9	2	3	6	20	80
20MK22 (Mackinac)	C	E	-	5	5	3	7	20	80
20MK24	C	E	-	0	1	0	0	1	1
20MK261	C	E	-	3	1	0	6	10	30
20MK54	C	E	L	3	1	0	3	7	21
20MK61	C	E	L	4	0	0	5	9	18
20MK90	C	E	-	1	0	0	1	2	4
20ST1	C	E	L	3	0	2	3	8	24
20ST109/110	I	-	L	3	0	2	3	8	24

Table 54: Faunal Diversity Index

Appendix I:

Flora

	12 Sites (13 components)	20MK1	20CH6	20DE4 (O/LW)	20DE4 (Phst)	20DE75	20DE296	20DE326	20AR437	20AR348	20AR358	20AR359	20MK24	20ST109/110
Fruits														
Crategus sp. (Hawthorn)	1						2							
Arctostaphylus uva-ursi (bearberry)	1	x												
Frageria/Potentilla sp. (Strawberry)/(Cinquefoil)	1		15											
Prunus sp.(Cherry)	5	x			x				x	4	x			
Prunus virginiana (Choke Cherry)	1				2									
Prunus pennsylvanica (pin cherry)	2	x							3 (27)					
Prunus americana (Wild Plum)	1		3											
Prunus nigra (canada plum)	1	x												
Rubus sp. (Raspberry)	2	x	6				1		2					
Rhus sp. (Sumac)	1	x												
Sambucus sp. (Elderberry)	2	x	28						1 (4)					
Sorbus americana (mountain ash)	1								3 (2)					
Vaccinium sp. (blueberry)	1													
Vitis sp. (Grape)	2	x	1											
Other Seeds														
cf. Asteraceae (Aster Family)	1		1											
cf. *Cornus* sp. (Dogwood)	1						1							
Dentaria laciniata (pepper root)	1	x												
cf Fabicae (pea/legume family	1							1						
Galium sp. (Bedstraw)	3	x	17											6
Scirpus spp. (bullrush)	1													2
cf. Viola sp (Violet)	2		2											2
Nutshell														
Corylus sp. (Hazelnut)	5	x	5	7	8									2
Fagus grandifolia (beechnut)	1	x												
Juglandaceae (Walnut Family)	1		1											
Quercus sp. (Acorn)	6	x	115			2				6		31		1
Nutmeats														
Quercus sp. (Acorn)	2		2			2								
Domesticates														
Zea mays Kernel Count	3	x	15										7	
Cucurbita pepo	1				28									

Table 55: Botanical Remains (PEB Identified/Carbonized Only)

Table 55: (cont'd))	12 Sites (13 components)	20MK1	20CH6	20DE4 (O/LW)	20DE4 (Phst)	20DE75	20DE296	20DE326	20AR437	20AR348	20AR358	20AR359	20MK24	20ST109/110
Cultigens & Grains														
Chenopodium sp. (Chenopod)	2	x	3											
Polygonum spp. (Knotweed)	1		2											
Zizania aquatica (Wild Rice)	1		1											
Other Plant Remains														
cf., Aquatic Tuber	2	x									x			
Betula papyrifera (paper birch) bark	1	x												
Diversity Seed/Nut Remains		17	16	1	3	2	3	1	4	2	2	1	1	5

x = present

	No. of Sites	20MK54	20MK61	20DE296	20DE326	20AR437	20AR348	20AR359	20MK24
Acer spp. (maple)	4	x		13				6	x
Acer saccarum (sugar maple)	1								x
Betula spp. (birch)	5	x		6			2	2	x
Carya spp. (hickory)	2	x		4					
Conifer	3					12	1	28	
Conifer Type A (cf., Tsuga/ hemlock*)*	2			14					
Conifer Type B (cf., Larix/ tamarack*)*	1			2					
Conifer Type C (cf., Abies/fir)	1			3					
Fraxinus spp. (ash)	3			31	1				
Fraxinus americanus (white ash)	2	x							x
Pinus spp. (pine)	2			4		1			
Pinus resinosa (red pine)	1		1						
Pinus strobus (white pine)	1					13			
Quercus spp. (oak)	1						1		
Quercus bicolar (swamp white oak)	1	x?							
Ulmus spp. (elm)	1			1					

Table 56: Wood Charcoal Remains (PEB Identified/Carbonized Only)

Appendix J:

HNF Site Data

State No.	Setting	HNF Unit	Ownership	Survey
20AR013	Coastal	West Unit	PIRO	NPS CR Survey
20AR173/174	Interior	West Unit	HNF	HNF CR Survey
20AR245	Interior	West Unit	HNF	HNF CR Survey
20AR310	Interior	West Unit	HNF	HNF CR Survey
20AR338	Coastal	West Unit	HNF	HNF CR Survey
20AR348	Coastal	West Unit	HNF	HNF CR Survey
20AR350	Coastal	West Unit	HNF	HNF CR Survey
20AR353	Coastal	West Unit	HNF	HNF CR Survey
20AR358/386	Coastal	West Unit	HNF	HNF CR Survey
20AR359	Coastal	West Unit	HNF	HNF CR Survey
20AR398	Coastal	West Unit	HNF	HNF CR Survey
20AR400	Coastal	West Unit	HNF	HNF CR Survey
20AR406	Coastal	West Unit	HNF	HNF CR Survey
20AR435	Coastal	West Unit	HNF	HNF CR Survey
20AR437	Interior	West Unit	HNF	HNF CR Survey
20AR495	Coastal	West Unit	HNF	HNF CR Survey
20AR6	Coastal	West Unit	HNF	UMMA CR Survey
20DE106	Coastal	West Unit	Private	Informant, confirmed
20DE108	Coastal	West Unit	HNF	HNF CR Survey
20DE167	Interior	West Unit	HNF	HNF CR Survey
20DE188	Interior	West Unit	HNF	HNF CR Survey
20DE236	Coastal	West Unit	HNF	HNF CR Survey
20DE294	Interior	West Unit	HNF	HNF CR Survey
20DE296	Coastal	West Unit	HNF	HNF CR Survey
20DE326	Interior	West Unit	HNF	HNF CR Survey
20DE378	Interior	West Unit	HNF	HNF CR Survey
20DE43	Interior	West Unit	HNF	HNF CR Survey
20DE459	Interior	West Unit	HNF	HNF CR Survey
20DE50	Interior	West Unit	HNF	HNF CR Survey
20DE75	Interior	West Unit	HNF	MDOT CR Survey
20DE85	Coastal	West Unit	HNF	HNF CR Survey
20DE93	Interior	West Unit	HNF	HNF CR Survey
20ST109/110	Interior	West Unit	HNF	HNF CR Survey
20ST14	Interior	West Unit	HNF	HNF CR Survey
20ST227	Interior	West Unit	HNF	HNF CR Survey
20ST233	Interior	West Unit	HNF	HNF CR Survey
20ST262	Interior	West Unit	HNF	HNF CR Survey
20CH171/172	Interior	East Unit	Private	SHPO Site File
20CH2	Coastal	East Unit	HNF	UMMA CR Survey
20CH32	Coastal	East Unit	HNF	HNF CR Survey
20CH433	Coastal	East Unit	HNF	HNF CR Survey
20CH492	Coastal	East Unit	HNF	HNF CR Survey

Table 57: HNF Site Data

Table 57: (cont'd)

State No.	Setting	HNF Unit	Ownership	Survey
20CH86	Coastal	East Unit	HNF	HNF CR Survey
20CH95	Coastal	East Unit	HNF	HNF CR Survey
20MK159	Coastal	East Unit	HNF	HNF CR Survey
20MK24	Coastal	East Unit	HNF	SOM CR Survey
20MK261	Coastal	East Unit	HNF	HNF CR Survey
20MK3/11	Coastal	East Unit	HNF	MDOT CR Survey
20MK334	Interior	East Unit	HNF	HNF CR Survey
20MK375	Coastal	East Unit	Private	Informant, confirmed
20MK58	Coastal	East Unit	Private	Informant, confirmed
20MK6/7	Coastal	East Unit	Private	MDOT CR Survey
20MK90	Coastal	East Unit	HNF	MDOT CR Survey

Appendix K:

Archaeological Surveys on the HNF

Archaeological Survey on the Hiawatha National Forest

Archaeological surveys and excavations have been carried out in the eastern UP for well over 60 years, although the first concerted efforts were carried out by the University of Michigan in the 1960s. These projects were primarily geared towards Great Lakes coastal areas and provide the basic framework for our understanding of Woodland sequences in the region. These projects included excavations at such sites as Summer Island (Brose 1970), Juntunen (McPherron 1967), and Naomikong Point (Janzen 1968).

Direct archaeological information for LW sites in the interior of the eastern UP came about largely as a result of federal guidelines, primarily the National Historic Preservation Act, coming into effect in the late 1960s. This led to the US Forest Service establishing Heritage Programs to manage National Forest lands. Michigan State University developed sensitivity models and implemented surveys for the HNF in the late 1970s: Martin's (1977) resource management study; and Lovis' (1979) field test of that study.

Martin's (1977) study stratified a research universe according to natural environmental variables. These were then tested by Lovis' (1979) field survey to determine which variables correlated with prehistoric site loci. The results suggested that specific surface geological contexts, soil associations, and vegetation types are associated with prehistoric site locations, but only when they are spatially associated with major water features (see also Buckmaster 1979; Franzen 1983; Lovis 1976).

Lovis' (1979) test was a systematic survey of a randomly generated set of 186 quarter-section (160-acre) survey parcels (approx. 29,760 acres) of HNF. This entailed the implementation of survey transects at a maximum interval of 25 yards (ca. 22.5 m) across each of the subject quarter-sections. This unbiased, systematic survey identified 32 archaeological sites, all of which were historic.

A second systematic survey was conducted by Soil Systems, Inc. (Dorwin et al. 1980). This survey employed 60 foot (18.3 m) interval linear shovel test transects paralleling the long axis of each survey area (the survey areas were not randomly generated, rather representing locations of planned Forest Service activity). The 113 survey areas, spread throughout the HNF, included an aggregate of about 51,000 ac, of which 14,300 ac were directly surveyed. The survey recorded 34 archaeological sites, 6 of these were prehistoric. Each of the prehistoric sites was found in close proximity to water. The two systematic surveys directly examined about 44,060 ac, which represents an approximately 5 percent sample of the HNF.

The first quantified study of prehistoric site location on the HNF was carried out by Franzen (1983) who found that 52 of the 53 verified prehistoric sites on the West Unit of the HNF were located within 100 m of water and the remaining site within 150 m of water. On the East Unit, ten of the twenty verified prehistoric sites were situated within 200 m of a Great Lake shoreline and nine of the remaining sites were located on Holocene shoreline features between 90 m and 600 m from an extant Great Lake shoreline. The last East Unit site was located within 20 m of a major river as well as on a mid Holocene beach terrace within 300 m of Lake Michigan. Because the data included both random and non-random surveys (the latter including the early, shoreline-focused work of the University of Michigan and Michigan State University), there is a risk that much of the apparent high degree of correlation of prehistoric sites and water is the result of a circular argument.

Despite the relationship between water and prehistoric archaeological sites identified by the early archaeological studies, it was recognized that ethnographic and geomorphological evidence suggested the presence of archaeological site types not directly associated with extant sources of water (Franzen 1986; Martin 1977). The most sensitive locations potentially distant from extant water were determined to include post-Pleistocene (Holocene) shoreline features, bedrock outcrops where raw material for stone tool making might be found, and wetland edges.

The results of the two systematic surveys of the HNF and the other early studies, as well as the results of similar systematic surveys conducted on the Nicolet National Forest in Wisconsin and the Huron-Manistee National Forests in northern lower Michigan (Lovis et al. 1978; Ryden et al. 1983), led to the development of the archaeological survey methodologies used for locating prehistoric Native American sites by the HNF.

The methodology for archaeological survey used by the HNF since 1984 has relied on a stepwise, cultural landscape/landform-based survey and testing strategy that uses a combination of surface reconnaissance and shovel testing techniques (Anderton et al. 1991; Dunham and Branstner 1998; Dunham et al. 2010; Franzen 1986; Rutter and Weir 1985). Generalized areas of increased Native American archaeological site sensitivity are minimally defined as habitable, level, and well-drained surfaces lying within 300 m of riparian features and wetland edges, as well as identifiable post-Pleistocene terraces, beaches, and strand lines.

Between 1984 and 1990 a stratified survey methodology was used in areas defined as high sensitivity for prehistoric archaeological sites. In areas within 100 m of a major riparian feature or on a post-Pleistocene terrace, shovel testing was conducted on a 15 m interval grid. A 30 m interval grid was used in areas 100 m to 300 m of such features. Similarly, 15 m and 30 m transect zones were employed along wetland edges and bedrock outcrop areas. Shovel testing was not carried out if the area within the shovel test zone was exposed bedrock, thin soil horizon, wetland, or steeply sloped. Exposed unimproved road and trail surfaces were also routinely examined for prehistoric artifacts regardless of their relationship to a water source.

Prehistoric sites encountered by these surveys were typically within 100 m of a major riparian resource or associated with a post-Pleistocene beach ridge. A random examination of the results of the 1987 and 1990 surveys place 29 of the 43 prehistoric sites recorded (67 percent) within 100 m of an extant major riparian resource (Anderton et al. 1991; Rutter and Weir 1988). Two additional sites are within 150 m of an extant source of water. Twelve sites (27.9 percent) were recorded as 200 m or greater from an extant body of water with two of these sites each located 1600 m from a water source. Eleven of the sites over 200 m from water, including the two that were 1600 m from water, are situated on mid-Holocene shoreline features. The one that is not on a Holocene lakeshore is 200 m from a major river, but is also situated along a known, historic Native American trail (Anderton et al. 1991:203).

Beginning in the 1990s the methodology was modified and the emphasis was placed on shovel testing within 150 m of riparian features and Holocene beaches. This step-wise approach also placed more latitude in observing field conditions, allowing field identification of potential sensitivity areas inside and outside of the 150 m zone as well as in relation to bedrock outcrops, wetland edges, and a variety of Holocene shoreline features (Dunham and Branstner 1998; Dunham et al. 2010).

Using these methods, five hundred and seventy eight archaeological sites with prehistoric components have been found on the HNF as of 2009. Four hundred and seventy five of these have been identified on the West Unit and the remaining 103 on the East Unit. Forty eight of these include LW components with 36 in the West Unit and 12 in the East Unit. The HNF surveys have identified prehistoric sites in both coastal and interior contexts which provide a better balance of general site contexts than the coastal oriented University of Michigan surveys.

An inherent problem with stratified surveys, like those carried out on the HNF, is that they don't apply the same level of survey coverage uniformly across the landscape. This raises the question as to whether archaeological sites were found only in places that were intensively surveyed, and if sites were not found in areas that were not surveyed because they weren't surveyed. A case can be made for survey bias on the HNF, with an emphasis on intensive survey coverage (shovel testing) focused along major riparian resources. This approach may have led to a false correlation between water sources and the location of prehistoric archaeological sites. Although this is a valid concern, recall that the two systematic surveys, a five percent sample of HNF lands, only identified prehistoric sites in close proximity to water (Dorwin et al. 1980; Lovis 1979; see also Lovis et al. 1978; Ryden et al. 1983). Further, later stratified survey samples identified sites farther than 150 m from extant sources of water. The negative data resulting from these surveys, although not conclusive, along with data from other survey efforts in the northern Michigan and northern Wisconsin make a strong case for the relationship between prehistoric archaeological site locations and proximity to sources of water.

More recently, a systematic archaeological survey was conducted immediately outside the HNF study area in Menominee County which is also in the Upper Peninsula (Dunham et al. 2011). This survey directly investigated 693 acres of land through walkover reconnaissance and shovel testing. This survey was stratified, with areas within 500 m of the Menominee River shovel tested at 15 m interval (238 acres) and those areas greater than 500 m from the river shovel tested at 20 m intervals (455 acres). Fourteen prehistoric sites were identified as a result of this survey and five of these can be directly ascribed to the LW period. Thirteen of the prehistoric sites, including all the LW sites, were found within 150 m of a river or stream. One site was found about 2000 m from the Menominee River, but this site was situated on a well-defined terrace overlooking a wetland that appears to have once been a small lake or pond.

Although this survey was somewhat limited in the size of the survey area and used a stratified methodology, it supports the premise that prehistoric sites in the Upper Peninsula are typically found within 150 m of a riparian feature. Unfortunately, the results of this survey were undoubtedly also biased by the premise (reflected in the survey zones) that most sites would be near water. Furthermore, if there is a difference in site types and size for the near-water versus interior sites, many of the small, short-term sites of the interior may have been missed using a 20-m interval (i.e., many of the interior sites may be significantly smaller than 20 m in diameter).

In a related issue, determining where more intense archaeological survey has been carried out on the HNF may be a challenge. The HNF documents areas in their GIS files as either surveyed or not surveyed with no indication of the intensity of the survey coverage (this is also true in the HNF Survey Atlas). Some of the data concerning survey intensity is available in the appendices of archaeological surveys completed by contractors, but not all previously completed surveys are equally documented. Thus, it is not currently possible to definitively quantify which areas of the forest have been intensively surveyed (shovel tested), moderately surveyed (walkover reconnaissance), or not directly surveyed. The formal compilation of this data will be required for future explorations of site distribution on the forest.

Appendix L:

Variables and Summary Statistics

Summary Statistics	LW Sites	Random Points
Aspect (n=)	32	43
Mean	161.5	186.1
Median	172.7	180.0
St. Dev.	78.6	106.1
Minimum	0.1	0.0
Maximum	313.3	353.0
Elevation (n=)	36	50
Mean	657.5	747.7
Median	619	751.5
St. Dev.	82.2	82.8
Minimum	582	594
Maximum	856	921
Slope (n=)	36	50
Mean	14.0	5.6
Median	6	3
St. Dev.	20.9	8.1
Minimum	0	0
Maximum	82	84
D. to Water (n=)	36	50
Mean	66.3	459.4
Median	60	355
St. Dev.	66.4	360.8
Minimum	0	0
Maximum	335	1591
Grow Days (n=)	36	50
Mean	113.8	112.6
Median	110	110
St. Dev.	13.8	11.1
Minimum	99	99
Maximum	140	140

Table 58: Variables and Summary Statistics

Site No.	Slope	D. to Water	Elevation	Habitat	Pre 1800	Aspect	Growing Days	Wild Rice
20AR173/174	12	256	856	3	4	66.3	99	0
20AR245	23	30	805	2	4	219.4	100	1
20AR310	15	0	827	2	3	206.9	99	1
20AR338	6	30	608	2	4	165.5	100	0
20AR348	4	42	611	2	4	130.9	100	0
20AR350	18	67	622	2	4	131.8	100	0
20AR353	75	30	611	2	4	133.2	100	0
20AR358/386	18	67	625	5	4	233.3	110	0
20AR359	5	67	620	2	4	154.7	110	0
20AR398	8	30	607	2	4	184.6	100	0
20AR400	8	60	609	2	4	183.4	100	0
20AR406	12	335	621	1	4	95.2	100	0
20AR435	2	67	607	2	2	206.6	100	0
20AR437	23	42	790	2	3	214.9	100	1
20AR495	15	84	618	5	5	216.3	100	0
20AR6	2	0	602	5	7	0.1	100	0
20DE106	0	30	583	2	5	-1.0	130	0
20DE108	82	67	582	7	4	199.5	130	0
20DE167	1	30	591	5	1	116.6	130	0
20DE188	5	30	621	5	3	280.7	130	0
20DE236	0	189	585	2	3	-1.0	140	0
20DE294	0	0	585	4	1	-1.0	130	0
20DE296	0	67	584	7	5	90.0	130	0
20DE326	20	90	738	2	2	259.2	110	1
20DE378	2	90	583	5	3	180.0	130	0
20DE43	6	67	764	2	3	225.0	120	0
20DE459	26	42	714	2	3	116.3	120	0
20DE50	24	67	726	2	2	60.9	120	0
20DE75	0	30	600	2	2	-1.0	130	0
20DE85	74	67	585	2	1	313.3	140	0
20DE93	0	30	586	4	1	135.0	130	0
20ST109/110	7	42	674	2	5	67.6	120	1
20ST14	2	90	738	2	3	225.0	110	0
20ST227	1	30	770	2	2	63.4	110	0
20ST233	6	60	743	2	3	15.6	110	0
20ST262	1	60	678	2	5	278.1	110	1

Table 59: Variables and Summary Statistics LW Sites

WU Random	Slope	D. to Water	Elevation	Habitat	Pre 1800	Aspect	Growing Days	Wild Rice
WU1	1	726	837	5	4	116	99	0
WU2	0	182	758	4	3	-1	100	0
WU3	34	150	747	5	4	207	110	1
WU4	0	926	707	5	7	180	110	0
WU5	0	1376	673	5	7	71	120	0
WU6	25	308	785	2	2	235	110	0
WU7	0	108	740	2	3	341	110	0
WU8	0	270	682	2	2	0	110	0
WU9	35	94	688	6	2	230	110	0
WU10	2	210	647	5	5	144	120	0
WU11	13	785	838	4	4	315	120	0
WU12	12	891	832	4	4	76	120	0
WU13	4	1135	838	3	4	27	110	0
WU14	8	540	781	4	5	250	110	0
WU15	7	361	785	5	2	297	110	0
WU16	17	254	786	2	2	75	110	1
WU17	0	30	797	5	5	-1	110	0
WU18	0	666	780	2	2	-1	120	0
WU19	3	90	647	4	4	161	120	0
WU20	1	534	773	4	4	281	120	0
WU21	6	660	697	0	5	272	120	0
WU22	0	349	767	4	4	135	120	0
WU23	1	342	751	5	7	168	120	0
WU24	3	517	744	5	7	101	120	0
WU25	0	305	747	5	5	-1	120	0
WU26	3	210	753	5	7	145	120	0
WU27	1	646	735	5	7	251	130	0
WU28	1	894	738	3	2	270	130	0
WU29	0	30	620	7	5	-1	120	0
WU30	0	469	758	4	3	-1	130	0
WU31	0	436	629	5	5	-1	130	0
WU32	0	807	594	5	5	161	130	0
WU33	1	152	613	5	5	153	130	0
WU34	2	60	594	5	3	270	140	0
WU35	4	192	623	4	4	14	99	1
WU36	5	577	921	4	4	248	99	0
WU37	4	150	866	4	4	273	99	0
WU38	14	465	887	4	4	198	99	0
WU39	11	120	731	4	4	349	99	0
WU40	3	94	876	4	4	341	99	0
WU41	2	941	908	4	4	0	100	0

Table 60: Variables and Summary Statistics Random Points

Table 60: (cont'd)

WU Random	Slope	D. to Water	Elevation	Habitat	Pre 1800	Aspect	Growing Days	Wild Rice
WU42	10	270	802	4	4	17	110	0
WU43	3	67	726	4	4	51	110	0
WU44	12	502	719	4	4	353	99	0
WU45	4	379	664	4	3	220	100	0
WU46	3	1023	624	5	5	321	100	0
WU47	1	1591	829	5	7	90	100	0
WU48	10	342	820	4	4	325	110	0
WU49	13	152	752	4	4	179	100	0
WU50	0	590	778	4	4	90	100	0

Appendix M:

Pre-1800 Vegetation Coding

VEGCODE	COVERTYPE	Pre-1800
31	GRASSLAND	0
41	MIXED HARDWOOD SWAMP	6
42	MIXED CONIFER SWAMP	5
51	LAKE/RIVER	7
51	LAKE/RIVER	7
51	LAKE/RIVER	7
52	LAKE/RIVER	7
72	SAND DUNE	0
333	PINE BARRENS	1
334	OAK/PINE BARRENS	1
413	ASPEN-BIRCH FOREST	4
414	MIXED HARDWOOD SWAMP	6
423	MIXED CONIFER SWAMP	5
744	EXPOSED BEDROCK	0
744	SAND DUNE	0
4111	BEECH-SUGAR MAPLE-HEMLOCK FOREST	4
4141	BLACK ASH SWAMP	6
4143	MIXED HARDWOOD SWAMP	6
4146	MIXED HARDWOOD SWAMP	6
4147	MIXED HARDWOOD SWAMP	6
4148	MIXED HARDWOOD SWAMP	6
4211	WHITE PINE-RED PINE FOREST	2
4212	WHITE PINE-RED PINE FOREST	2
4213	JACK PINE-RED PINE FOREST	1
4215	JACK PINE-RED PINE FOREST	2
4216	WHITE PINE-RED PINE FOREST	2
4219	WHITE PINE-MIXED HARDWOOD FOREST	2
4221	SPRUCE-FIR-CEDAR FOREST	3
4223	SPRUCE-FIR-CEDAR FOREST	3
4226	HEMLOCK-WHITE PINE FOREST	3
4227	HEMLOCK-WHITE PINE FOREST	3
4228	SUGAR MAPLE-HEMLOCK FOREST	4
4229	HEMLOCK-YELLOW BIRCH FOREST	3
4231	CEDAR SWAMP	5
4232	MIXED CONIFER SWAMP	5
4233	MIXED CONIFER SWAMP	5
4235	MIXED CONIFER SWAMP	5
4236	MIXED CONIFER SWAMP	5
4237	MIXED CONIFER SWAMP	5
4238	MIXED CONIFER SWAMP	5
6121	MUSKEG/BOG	7
6122	SHRUB SWAMP/EMERGENT MARSH	7

Table 61: Pre-1800 Vegetation Coding

Table 61: (cont'd)

VEGCODE	COVERTYPE	Pre-1800
6124	MUSKEG/BOG	7
6125	MUSKEG/BOG	7
6221	SHRUB SWAMP/EMERGENT MARSH	7
6222	SHRUB SWAMP/EMERGENT MARSH	7
6223	SHRUB SWAMP/EMERGENT MARSH	7
6224	SHRUB SWAMP/EMERGENT MARSH	7
6227	WET PRAIRIE	7
6228	SHRUB SWAMP/EMERGENT MARSH	7
6231	CEDAR SWAMP	5

Appendix N:

Habitat Classification Coding

Numeric	Name	Habitat
10	Beaches	0
61	Pits, sand and gravel	0
62F	Udipsamments and Udorthents, nearly level to very steep	0
68	Pits, quarry	0
11C	Deer Park sand, 0 to 10 percent slopes	1
11E	Deer Park sand, 10 to 25 percent slopes	1
11F	Deer Park sand, 25 to 60 percent slopes	1
242B	Kalkaska sand, 0 to 6 percent slopes, severely burned	1
242D	Kalkaska sand, 6 to 15 percent slopes, severely burned	1
242F	Kalkaska sand, 35 to 70 percent slopes, severely burned	1
297B	Rubicon sand, 0 to 6 percent slopes, severely burned	1
297D	Rubicon sand, 6 to 15 percent slopes, severely burned	1
305B	Wurtsmith-Meehan sands, 0 to 8 percent	1
12B	Rubicon sand, 0 to 6 percent slopes	2
12D	Rubicon sand, 6 to 15 percent slopes	2
12E	Rubicon sand, 15 to 35 percent slopes	2
15A	Croswell sand, 0 to 3 percent slopes	2
109D	Rousseau-Dawson complex, 0 to 15 percent slopes	2
109F	Rousseau-Dawson complex, 0 to 60 percent slopes	2
176B	Croswell-Kinross complex, 0 to 6 percent slopes	2
307B	Rubicon sand, 0 to 6 percent slopes, very deep water table	2
307D	Rubicon sand, 6 to 15 percent slopes, very deep water table	2
308B	Rubicon-Sultz complex, 0 to 6 percent slopes	2
308D	Rubicon-Sultz complex, 6 to 15 percent slopes	2
309B	Rubicon sand, 0 to 6 percent slopes, deep water table	2
309D	Rubicon sand, 6 to 15 percent slopes, deep water table	2
255D	Wallace sand, 1 to 15 percent slopes	3
290A	Namur-Ruse complex, 0 to 2 percent slopes, very rocky, very stony	3
298B	Wurtsmith-Deford complex, 0 to 6 percent slopes	3
300F	Shelldrake-Duneland complex, 2 to 75 percent slopes	3
310B	Kalkaska sand, 0 to 6 percent slopes, burned	3
310D	Kalkaska sand, 6 to 15 percent slopes, burned	3
310E	Kalkaska sand, 15 to 50 percent slopes, burned	3
13B	Kalkaska sand, 0 to 6 percent slopes	4
13D	Kalkaska sand, 6 to 15 percent slopes	4
13E	Kalkaska sand, 15 to 35 percent slopes	4
16A	Paquin sand, 0 to 3 percent slopes	4
24B	Munising fine sandy loam, 1 to 6 percent slopes	4
25B	Munising-Yalmer complex, 1 to 6 percent slopes	4
25D	Munising-Yalmer complex, 6 to 18 percent slopes	4
31D	Trenary silt loam, 6 to 15 percent slopes	4

Table 62: Alger County

Table 62: (cont'd)

Numeric	Name	Habitat
35B	Munising-Yalmer-Frohling complex, calcareous substratum, 1 to 6 percent slopes	4
37B	Grand Sable loamy fine sand, 1 to 6 percent slopes	4
37E	Grand Sable loamy fine sand, 15 to 35 percent slopes	4
40B	Waiska cobbly loamy sand, 0 to 6 percent slopes, very stony	4
47C	Deerton-Au Train complex, 1 to 15 percent slopes	4
47E	Deerton-Au Train complex, 6 to 35 percent slopes	4
49B	Cookson fine sandy loam, 1 to 6 percent slopes	4
52B	Summerville fine sandy loam, 1 to 6 percent slopes	4
64B	Kiva fine sandy loam, 1 to 6 percent slopes	4
64D	Kiva fine sandy loam, 6 to 15 percent slopes	4
66D	Ruse-Ensign-Nykanen complex, bedrock terrace, 1 to 20 percent slopes	4
66F	Ruse-Ensign-Nykanen complex, bedrock terrace, 1 to 45 percent slopes	4
69B	Escanaba sand, 1 to 6 percent slopes	4
72E	Deerton-Tokiahok-Trout Bay complex, 8 to 35 percent slopes, dissected	4
72F	Deerton-Tokiahok-Trout Bay complex, 15 to 70 percent slopes, dissected	4
76C	Garlic-Blue Lake-Voelker complex, 1 to 12 percent slopes, dissected	4
76E	Garlic-Blue Lake-Voelker complex, 8 to 35 percent slopes, dissected	4
76F	Garlic-Blue Lake-Voelker complex, 15 to 60 percent slopes, dissected	4
77B	Garlic-Blue Lake-Voelker complex, 1 to 6 percent slopes	4
77D	Garlic-Blue Lake-Voelker complex, 6 to 15 percent slopes	4
77E	Garlic-Blue Lake-Voelker complex, 15 to 35 percent slopes	4
95B	Liminga fine sand, 0 to 6 percent slopes	4
104C	Fence very fine sandy loam, 1 to 12 percent slopes, dissected	4
125B	Stutts-Kalkaska complex, 0 to 6 percent slopes	4
125D	Stutts-Kalkaska complex, 6 to 15 percent slopes	4
125E	Stutts-Kalkaska complex, 15 to 35 percent slopes	4
135B	Munising, calcareous substratum-Ensley complex, 0 to 6 percent slopes	4
145C	Munising-Yalmer complex, 1 to 12 percent slopes, dissected, very stony	4
146B	Munising-Skanee complex, 0 to 6 percent slopes, stony	4
148B	Shoepac-Ensley complex, 0 to 6 percent slopes	4
155A	Zeba-Jacobsville complex, 0 to 3 percent slopes, very stony	4

Table 62: (cont'd)

Numeric	Name	Habitat
157B	Reade-Nahma complex, 0 to 6 percent slopes, stony	4
158C	Munising-Abbaye fine sandy loams, 1 to 12 percent slopes, dissected, stony	4
160B	Paquin-Finch sands, 0 to 6 percent slopes	4
161B	Yellowdog-Buckroe complex, 0 to 6 percent slopes, stony	4
165B	Chocolay-Waiska complex, 1 to 6 percent slopes, very stony	4
170B	Chocolay very stony fine sandy loam, 1 to 6 percent slopes, very stony	4
171B	Paavola very gravelly loamy sand, 0 to 6 percent slopes, very stony	4
172D	Buckroe-Rock outcrop complex, 6 to 25 percent slopes, very bouldery	4
172F	Buckroe-Rock outcrop complex, 25 to 70 percent slopes, very bouldery	4
181E	Frohling-Tokiahok complex, 8 to 35 percent slopes, dissected, stony	4
185B	McMaster cobbly sandy loam, 0 to 4 percent slopes	4
186B	Chatham fine sandy loam, 1 to 6 percent slopes, stony	4
186D	Chatham fine sandy loam, 6 to 15 percent slopes, stony	4
187B	Reade silt loam, 0 to 4 percent slopes	4
188B	Eben very cobbly sandy loam, 1 to 6 percent slopes, stony	4
188D	Eben very cobbly sandy loam, 6 to 15 percent slopes, stony	4
188E	Eben very cobbly sandy loam, 15 to 35 percent slopes, stony	4
197B	Shoepac-Trenary silt loams, 1 to 6 percent slopes	4
198B	Shoepac-Reade silt loams, 1 to 4 percent slopes	4
202B	Sauxhead sandy loam, 1 to 6 percent slopes, rocky, very stony	4
206B	Traunik cobbly fine sandy loam, 1 to 6 percent slopes	4
206D	Traunik cobbly fine sandy loam, 6 to 15 percent slopes	4
211B	Munising-Abbaye fine sandy loams, 1 to 6 percent slopes	4
214B	Kalkaska-Blue Lake complex, 1 to 6 percent slopes	4
214D	Kalkaska-Blue Lake complex, 6 to 15 percent slopes	4
214E	Kalkaska-Blue Lake complex, 15 to 35 percent slopes	4
225B	Cusino loamy sand, 1 to 6 percent slopes	4
225D	Cusino loamy sand, 6 to 15 percent slopes	4
226B	Kalkaska-Cusino complex, 1 to 6 percent slopes	4
226D	Kalkaska-Cusino complex, 6 to 15 percent slopes	4
226E	Kalkaska-Cusino complex, 15 to 35 percent slopes	4
226F	Kalkaska-Cusino complex, 35 to 70 percent slopes	4
227A	Halfaday sand, 0 to 3 percent slopes	4
232B	Shelldrake sand, 0 to 8 percent slopes	4
233B	Abbaye-Zeba complex, 0 to 6 percent slopes, very stony	4

Table 62: (cont'd)

Numeric	Name	Habitat
235B	Sauxhead-Burt complex, 0 to 4 percent slopes, rocky, very stony	4
236B	Waiska stony sandy loam, 1 to 6 percent slopes, extremely bouldery	4
236D	Waiska stony sandy loam, 6 to 15 percent slopes, extremely bouldery	4
237B	Chatham-Davies complex, 0 to 6 percent slopes	4
239B	Longrie-Shingleton complex, 1 to 6 percent slopes	4
240F	Trout Bay-Gongeau-Shingleton-Rock outcrop complex, 1 to 70 percent slopes	4
246B	Garlic sand, 0 to 6 percent slopes	4
246D	Garlic sand, 6 to 15 percent slopes	4
246E	Garlic sand, 15 to 35 percent slopes	4
248B	Escanaba-Greylock complex, 1 to 6 percent slopes	4
248D	Escanaba-Greylock complex, 6 to 15 percent slopes	4
248E	Escanaba-Greylock complex, 15 to 35 percent slopes	4
250B	Chocolay-Jacobsville complex, 0 to 6 percent slopes, extremely stony	4
251B	Greylock fine sandy loam, 1 to 6 percent slopes	4
251D	Greylock fine sandy loam, 6 to 15 percent slopes	4
254C	Kalkaska-Blue Lake complex, 1 to 12 percent slopes, dissected	4
254E	Kalkaska-Blue Lake complex, 8 to 35 percent slopes, dissected	4
254F	Kalkaska-Blue Lake complex, 15 to 70 percent slopes, dissected	4
256B	Whitewash sand, 0 to 4 percent slopes	4
268C	Munising, calcareous substratum-Frohling, 1 to 12	4
269E	Frohling, calcareous substratum-Garlic-Cookson complex, 8 to 35 percent slopes, dissected	4
272C	Munising-Yalmer-Frohling complex, calcareous substratum, 1 to 12 percent slopes, dissected	4
275B	Munising, calcareous substratum-Cookson fine sandy loams, 1 to 6 percent slopes	4
281E	Mongo silt loam, 8 to 45 percent slopes, dissected	4
282B	Furlong-Shingleton complex, 1 to 6 percent slopes	4
282D	Furlong-Shingleton complex, 6 to 15 percent slopes	4
284B	Steuben-Blue Lake-Kalkaska complex, 1 to 6 percent slopes	4
284D	Steuben-Blue Lake-Kalkaska complex, 6 to 15 percent slopes	4
284E	Steuben-Blue Lake-Kalkaska complex, 15 to 35 percent slopes	4

Table 62: (cont'd)

Numeric	Name	Habitat
285B	Halfaday-Kinross complex, 0 to 4 percent slopes	4
286B	Greylock-Cookson fine sandy loams, 1 to 6 percent slopes	4
287B	McMaster-Davies complex, 0 to 4 percent slopes	4
292B	Mashek fine sandy loam, sandy substratum, 0 to 4 percent slopes	4
296D	Island Lake-McMillan complex, 6 to 15 percent slopes	4
296E	Island Lake-McMillan complex, 15 to 35 percent slopes	4
299F	Shelldrake fine sand, 2 to 75 percent slopes	4
301F	Cookson-Nykanen complex, 15 to 50 percent slopes, dissected	4
302B	Dillingham-Kalkaska complex, 1 to 6 percent slopes	4
302D	Dillingham-Kalkaska complex, 6 to 15 percent slopes	4
302E	Dillingham-Kalkaska complex, 15 to 35 percent slopes	4
302F	Dillingham-Kalkaska complex, 35 to 70 percent slopes	4
303B	Kiva-Trenary fine sandy loams, 1 to 6 percent slopes	4
303D	Kiva-Trenary fine sandy loams, 6 to 15 percent slopes	4
303E	Kiva-Trenary fine sandy loams, 15 to 35 percent slopes	4
306C	Deerton-Tokiahok-Jeske complex, 1 to 12 percent slopes, dissected	4
311B	Kalkaska sand, 0 to 6 percent slopes, very deep water table, burned	4
311D	Kalkaska sand, 6 to 15 percent slopes, very deep water table, burned	4
312B	Island Lake sand, 0 to 6 percent slopes, burned	4
312D	Island Lake sand, 6 to 15 percent slopes, burned	4
313B	Kalkaska sand, 0 to 6 percent slopes, deep water table, burned	4
314B	Blue Lake loamy sand, 0 to 6 percent slopes, very deep water table, burned	4
315B	Blue Lake loamy sand, 0 to 6 percent slopes, deep water table, burned	4
316B	Blue Lake loamy sand, 0 to 6 percent slopes, burned	4
316D	Blue Lake loamy sand, 6 to 15 percent slopes, burned	4
317B	Kalkaska sand, 0 to 6 percent slopes, very deep water table	4
317D	Kalkaska sand, 6 to 15 percent slopes, very deep water table	4
318B	Island Lake sand, 0 to 6 percent slopes, very deep water table	4
318D	Island Lake sand, 6 to 15 percent slopes, very deep water table	4
319B	Island Lake sand, 0 to 6 percent slopes	4
319D	Island Lake sand, 6 to 15 percent slopes	4

Table 62: (cont'd)

Numeric	Name	Habitat
319E	Island Lake sand, 15 to 35 percent slopes	4
319F	Island Lake sand, 35 to 60 percent slopes	4
320B	Kalkaska sand, 0 to 6 percent slopes, deep water table	4
321B	Kalkaska-Deerton sands, 0 to 6 percent slopes	4
321D	Kalkaska-Deerton sands, 6 to 15 percent slopes	4
17A	Au Gres sand, 0 to 3 percent slopes	5
18	Kinross muck	5
19	Deford muck	5
21A	Ingalls sand, 0 to 3 percent slopes	5
38B	Rhody-Towes complex, 0 to 4 percent slopes	5
46	Jacobsville muck, very stony	5
48	Burt muck	5
51	Nahma-Ruse complex	5
57	Carbondale, Lupton, and Tawas soils	5
58	Dawson, Greenwood, and Loxley soils	5
59	Chippeny-Nahma mucks	5
65D	Jeske-Gongeau-Deerton complex, bedrock terrace, 1 to 20 percent slopes	5
65F	Jeske-Gongeau-Deerton complex, bedrock terrace, 1 to 45 percent slopes	5
88	Cathro-Ensley mucks	5
93	Tawas-Deford mucks	5
147A	Skanee-Gay complex, 0 to 3 percent slopes, very stony	5
166	Skandia mucky peat	5
167	Skandia-Jacobsville complex, stony	5
191B	Ruse-Ensign complex, 0 to 3 percent slopes	5
200A	Charlevoix-Ensley complex, 0 to 3 percent slopes	5
221B	Jeske-Au Train-Gongeau complex, 0 to 8 percent slopes	5
234A	Levasseur-Burt complex, 0 to 3 percent slopes, very stony	5
241	Cathro-Gay mucks	5
243	Markey mucky peat	5
245B	Trout Bay-Lupton-Gongeau complex, 0 to 6 percent slopes	5
249B	Sauxhead-Skandia complex, 0 to 4 percent slopes	5
252A	Finch-Kinross complex, 0 to 3 percent slopes	5
266A	Spot-Finch complex, 0 to 3 percent slopes	5
267A	Finch sand, 0 to 3 percent slopes	5
33	Ensley muck	6
42	Davies very cobbly muck	6
71A	Evart-Sturgeon silt loams, 0 to 2 percent slopes, frequently flooded	6
60	Histosols and Aquents, ponded	7
W	Water	7

Numeric	Name	Habitat
33	Pits, sand and gravel	0
50	Deford fine sand	5
116	Udorthents, nearly level	0
119	Gogomain very fine sandy loam	5
122	Pits, quarry	0
143	Burleigh loamy fine sand	5
144	Urban land-Udorthents complex, nearly level	0
153	Dumps, limestone	0
106A	Potagannissing-Rock outcrop complex, 0 to 3 percent slopes	0
108D	Shelter-Alpena complex, 0 to 15 percent slopes	5
117B	Manistee sand, 0 to 6 percent slopes	4
117D	Manistee sand, 6 to 15 percent slopes	4
117F	Manistee sand, 25 to 50 percent slopes	4
121B	Rockbottom stony silt loam, 2 to 6 percent slopes	4
123B	Ocqueoc fine sand, 0 to 6 percent slopes	4
124D	Alpena very cobbly sandy loam, 0 to 15 percent slopes	5
136A	Westbury-Gay complex, 0 to 3 percent slopes	5
147B	Shelter very stony loam, 0 to 6 percent slopes	5
147D	Shelter very stony loam, 6 to 15 percent slopes	5
156A	Rockcut-Pinconning complex, 0 to 3 percent slopes	5
29A	Solona fine sandy loam, 0 to 3 percent slopes	5
52A	Ingalls loamy sand, 0 to 3 percent slopes	6
53B	Menominee loamy sand, 0 to 6 percent slopes	4
56A	Ensign silt loam, 0 to 3 percent slopes, rocky	5
57B	Summerville-Longrie complex, 1 to 6 percent slopes, rocky	4
78B	Waiska sandy loam, 0 to 6 percent slopes	4
86A	Ingalls-Halfaday complex, 0 to 3 percent slopes	6
97A	Wega very fine sandy loam, 0 to 3 percent slopes	4
99A	Westbury stony fine sandy loam, 0 to 3 percent slopes	4
17D	Deer Park fine sand, 0 to 15 percent slopes	1
17F	Deer Park fine sand, 25 to 50 percent slopes	1
38F	Deer Park-Kinross complex, 0 to 50 percent slopes	1
18B	Rubicon sand, 0 to 6 percent slopes	2
18D	Rubicon sand, 6 to 15 percent slopes	2
18E	Rubicon sand, 15 to 35 percent slopes	2
98	Ermatinger silt loam	3
126	Pickford silt loam	3
103D	Velvet-Rockbottom complex, 6 to 15 percent slopes	3
103E	Velvet-Rockbottom complex, 15 to 35 percent slopes	3
10B	Ontonagon silt loam, 2 to 6 percent slopes	3

Table 63: Chippewa County

Table 63: (cont'd)

Numeric	Name	Habitat
10D	Ontonagon silt loam, 6 to 15 percent slopes	3
10F	Ontonagon silt loam, 25 to 50 percent slopes	3
114B	Velvet very stony loamy sand, 0 to 6 percent slopes	3
114D	Velvet very stony loamy sand 6 to 15 percent slopes	3
125B	Croswell-Markey complex, 0 to 6 percent slopes	3
139A	Rudyard-Urban land complex, 0 to 3 percent slopes	3
20A	Croswell sand, 0 to 3 percent slopes	3
41D	Summerville-Rock outcrop complex, 1 to 15 percent slopes	3
41F	Summerville-Rock outcrop complex, 15 to 45 percent slopes	3
67B	Duel-Rock outcrop complex, 1 to 6 percent slopes	3
87B	Rousseau fine sand, moderately wet, 0 to 6 percent slopes	3
88A	Croswell-Au Gres sands, 0 to 3 percent slopes	3
91B	Rousseau fine sand, 0 to 6 percent slopes	3
91D	Rousseau fine sand, 6 to 15 percent slopes	3
91E	Rousseau fine sand, 15 to 35 percent slopes	3
93F	Ontonagon-Pickford complex, 0 to 50 percent slopes	3
96B	Velvet-Westbury complex, 0 to 6 percent slopes	3
104B	Amasa very fine sandy loam, 0 to 6 percent slopes	4
104D	Amasa very fine sandy loam, 6 to 15 percent slopes	4
104F	Amasa very fine sandy loam, 25 to 50 percent slopes	4
107B	Oldman stony fine sandy loam, 2 to 6 percent slopes	4
132B	Sugar very fine sandy loam, 0 to 6 percent slopes	4
132F	Sugar very fine sandy loam, 25 to 50 percent slopes	4
135B	Longrie-Posen complex, 0 to 6 percent slopes	4
138B	Rousseau, dark subsoil-Urban land complex, 0 to 4 percent slopes	4
13B	Alcona loamy very fine sand, 0 to 6 percent slopes	4
13D	Alcona loamy very fine sand, 6 to 15 percent slopes	4
13F	Alcona loamy very fine sand, 25 to 50 percent slopes	4
148B	Longrie-Rock outcrop complex, 1 to 6 percent slopes	4
149B	Kalkaska sand, 0 to 6 percent slopes, stony	4
159B	Amasa-Sugar very fine sandy loams, 0 to 6 percent slopes	4
159F	Amasa-Sugar very fine sandy loam, 25 to 50 percent slopes	4
15B	Rousseau fine sand, dark subsoil, 0 to 6 percent slopes	4
15D	Rousseau fine sand, dark subsoil, 6 to 15 percent slopes	4

Table 63: (cont'd)

Numeric	Name	Habitat
15E	Rousseau fine sand, dark subsoil, 15 to 35 percent slopes	4
15F	Rousseau fine sand, dark subsoil, 35 to 60 percent slopes	4
19B	Kalkaska sand, 0 to 6 percent slopes	4
19D	Kalkaska sand, 6 to 15 percent slopes	4
19E	Kalkaska sand, 15 to 35 percent slopes	4
19F	Kalkaska sand, 35 to 60 percent slopes	4
25B	Guardlake loam, 0 to 6 percent slopes	4
25D	Guardlake loam, 6 to 15 percent slopes	4
27B	Emmet sandy loam, 1 to 6 percent slopes	4
28B	Longrie sandy loam, 1 to 6 percent slopes	4
42D	Emmet-Kalkaska complex, 1 to 15 percent slopes	4
44B	Posen stony fine sandy loam, 1 to 6 percent slopes	4
44D	Posen stony fine sandy loam, 6 to 15 percent slopes	4
44E	Poson stony fine sandy loam, 15 to 35 percent slopes	4
46B	Pence loamy sand, 0 to 6 percent slopes	4
46D	Pence loamy sand, 6 to 15 percent slopes	4
46E	Pence loamy sand, 15 to 35 percent slopes	4
61A	Halfaday sand, 0 to 3 percent slopes	4
79B	Kalkaska-Manistee sands, 0 to 6 percent slopes	4
79D	Kalkaska-Manistee sands, 6 to 15 percent slopes	4
80B	Superior fine sandy loam, 1 to 6 percent slopes	4
84B	Rousseau, dark subsoil-Alcona complex, 0 to 6 percent slopes	4
84D	Rousseau, dark subsoil-Alcona complex, 6 to 15 percent slopes	4
84F	Rousseau, dark subsoil-Alcona complex, 25 to 50 percent slopes	4
85B	Kalkaska-Ocqueoc complex, 0 to 6 percent slopes	4
12	Pickford silty clay loam	5
22	Kinross muck	5
23	Roscommon muck	5
36	Markey and Carbondale mucks	5
37	Dawson and Loxley peats	5
68	Pinconning mucky loamy sand	5
101	Chippeny muck	5
102	Kinross-Dawson complex	5
111	Gutport muck	5
112	Soo silty clay loam	5
113	Ruse mucky fine sandy loam	5

Table 63: (cont'd)

Numeric	Name	Habitat
127	Gay stony muck	5
133	Dora muck	5
150	Fibre muck	5
151	Beavertail muck	5
152	Grousehaven muck	5
11A	Rudyard silty clay loam, 0 to 3 percent slopes	5
128F	Alcona-Markey complex, 0 to 50 percent slopes	5
129A	Rudyard silt loam, 0 to 3 percent slopes	5
130A	Rudyard-Pickford silty clay loams, 0 to 3 percent slopes	5
137A	Kinross-Wainola complex, 0 to 3 percent slopes	5
145A	Gaastra-Gogomain-Ingalls complex, 0 to 3 percent slopes	5
146A	Allendale-Fibre complex, 0 to 3 percent slopes	5
14A	Gaastra silt loam, 0 to 3 percent slopes	5
154F	Dawson-Deer Park-Wainola complex, 0 to 50 percent slopes	5
155B	Allendale-Posen-Pickford complex, 0 to 6 percent slopes	5
21A	Au Gres sand, 0 to 3 percent slopes	5
32A	Allendale loamy fine sand, 0 to 3 percent slopes	5
39D	Au Gres-Dawson-Rubicon complex, 0 to 15 percent slopes	5
40A	Rudyard-Allendale complex, 0 to 3 percent slopes	5
48E	Wainola-Kinross-Rousseau complex, 0 to 35 percent slopes	5
49A	Wainola fine sand, 0 to 3 percent slopes	5
83A	Allendale-Croswell complex, 0 to 3 percent slopes	5
89A	Kinross-Au Gres complex, 0 to 3 percent slopes	5
92A	Biscuit very fine sandy loam, 0 to 3 percent slopes	5
94A	Markey-Kinross-Au Gres complex, 0 to 3 percent slopes	5
95A	Bowers silt loam, 0 to 3 percent slopes	5
34	Entisols, flooded	7
35	Histosols and Aquents, ponded	7
W	Water	7

Numeric	Name	Habitat
Bp	Borrow pits	0
BtA	Brimley fine sandy loam, 0 to 4 percent slopes	5
FaA	Fairport silt loam, 0 to 2 percent slopes	4
FaB	Fairport silt loam, 2 to 6 percent slopes	4
Gw	Greenwood peat	5
KlA	Kawkawlin silt loam, 0 to 2 percent slopes	4
KnB	Keweenaw loamy sand, 0 to 6 percent slopes	4
KnD	Keweenaw loamy sand, 6 to 18 percent slopes	4
Lm	Limestone rock land	0
Ma	Made land	0
MlB	Melita sand, 0 to 6 percent slopes	4
NsA	Nester silt loam, 0 to 2 percent slopes	4
NsB	Nester silt loam, 2 to 6 percent slopes	4
OtB	Otisco loamy sand, 0 to 6 percent slopes	5
PfA	Algonquin silt loam, 0 to 4 percent slopes	0
PkA	Algonquin-Pickford complex, 0 to 4 percent slopes	0
Pq	Pits, quarry	0
RkB	Roscommon-Kalkaska sands, 0 to 6 percent slopes	4
Sl	Sewage lagoons	0
YaB	Yalmer sand, 0 to 6 percent slopes	4
YaD	Yalmer sand, 6 to 18 percent slopes	4
GrB	Grayling sand, 0 to 6 percent slopes	1
GrD	Grayling sand, 6 to 18 percent slopes	1
EdB	Eastport sand, 0 to 6 percent slopes	2
EeB	Eastport-Roscommon sands, 0 to 6 percent slopes	2
RuB	Rubicon sand, 0 to 6 percent slopes	2
RuD	Rubicon sand, 6 to 18 percent slopes	2
RuE	Rubicon sand, 18 to 40 percent slopes	2
KdB	Karlin sandy loam, 0 to 6 percent slopes	3
KdD	Karlin sandy loam, 6 to 18 percent slopes	3
RoB	Rousseau fine sand, 0 to 6 percent slopes	3
RoD	Rousseau fine sand, 6 to 18 percent slopes	3
RsD	Rousseau fine sand, hilly	3
AlC	Alpena gravelly sandy loam, 0 to 12 percent slopes	4
BlB	Blue Lake sand, 0 to 6 percent slopes	4
BlD	Blue Lake sand, 6 to 18 percent slopes	4
BlE	Blue Lake sand, 18 to 40 percent slopes	4
BoB	Bohemian fine sandy loam, 0 to 6 percent slopes	4
BoD	Bohemian fine sandy loam, 6 to 18 percent slopes	4
BrA	Bowers silt loam, 0 to 4 percent slopes	4
CrA	Croswell sand, 0 to 4 percent slopes	4
DuB	Duel loamy sand, 0 to 6 percent slopes	4

Table 64: Delta County

Table 64: (cont'd)

Numeric	Name	Habitat
EaB	Springlake sand, 0 to 6 percent slopes	4
EmA	Emmet sandy loam, 0 to 2 percent slopes	4
EmB	Emmet sandy loam, 2 to 6 percent slopes	4
EmC	Emmet sandy loam, 6 to 12 percent slopes	4
EnA	Ensign fine sandy loam, 0 to 3 percent slopes	4
GcB	Gilchrist sand, 0 to 6 percent slopes	4
KaB	Kalkaska sand, 0 to 6 percent slopes	4
KaD	Kalkaska sand, 6 to 18 percent slopes	4
KaE	Kalkaska sand, 18 to 40 percent slopes	4
KsB	Kiva sandy loam, 0 to 6 percent slopes	4
KsD	Kiva sandy loam, 6 to 20 percent slopes	4
LoA	Longrie sandy loam, 0 to 2 percent slopes	4
LoB	Longrie sandy loam, 2 to 6 percent slopes	4
LsD	Longrie and Summerville sandy loams, 6 to 18 percent slopes	4
MnB	Menominee loamy sand, 0 to 6 percent slopes	4
MnD	Menominee loamy sand, 6 to 18 percent slopes	4
OnA	Onaway fine sandy loam, 0 to 2 percent slopes	4
OnB	Onaway fine sandy loam, 2 to 6 percent slopes	4
OnC	Onaway fine sandy loam, 6 to 12 percent slopes	4
OnD	Onaway fine sandy loam, 12 to 18 percent slopes	4
SuA	Summerville fine sandy loam, 0 to 4 percent slopes	4
TrA	Trenary fine sandy loam, 0 to 2 percent slopes	4
TrB	Trenary fine sandy loam, 2 to 6 percent slopes	4
TrC	Trenary fine sandy loam, 6 to 12 percent slopes	4
TrD	Trenary fine sandy loam, 12 to 18 percent slopes	4
WlB	Wallace sand, 0 to 6 percent slopes	4
WlD	Wallace sand, 6 to 18 percent slopes	4
AuB	Au Gres sand, 0 to 6 percent slopes	5
AvA	Battlefield loamy sand, 0 to 4 percent slopes	5
Bs	Brevort mucky loamy sand	5
Bu	Bruce mucky fine sandy loam, coarse variant	5
Cb	Carbondale, Lupton, and Rifle soils	5
Ch	Cathro muck	5
Ck	Cathro and Tacoosh mucks	5
ClA	Charlevoix sandy loam, 0 to 4 percent slopes	5
Cn	Chippeny muck	5
Da	Dawson peat	5
Dd	Dawson and Greenwood peats	5
IoB	Iosco sand, 0 to 6 percent slopes	5
Kr	Kinross mucky sand	5
McB	Mancelona loamy sand, 0 to 6 percent slopes	5
McD	Mancelona loamy sand, 6 to 18 percent slopes	5

Table 64: (cont'd)

Numeric	Name	Habitat
Nh	Nahma muck	5
Pc	Pickford silt loam	5
Rc	Roscommon mucky sand	5
Rv	Ruse silt loam	5
ScA	Finch sand, 0 to 3 percent slopes	5
SvA	Sundell fine sandy loam, 0 to 4 percent slopes	5
SwA	Sundell loamy fine sand, sandy variant, 0 to 4 percent slopes	5
Ta	Tawas muck	5
WaA	Wainola fine sand, 0 to 4 percent slopes	5
Wm	Wheatley mucky loamy sand	5
Dm	Deford loamy fine sand	6
Es	Ensley and Angelica soils	6
Ad	Alluvial land	7
Mh	Marsh	7
W	Water	7

Numeric	Name	Habitat
33	Pits, sand and gravel	0
116	Udipsamments and Udorthents, nearly level	0
122	Pits, quarry	0
300	Beaches	0
17C	Deer Park sand, 0 to 10 percent slopes	1
17E	Deer Park sand, 10 to 25 percent slopes	1
17F	Deer Park sand, 25 to 60 percent slopes	1
18B	Rubicon sand, 0 to 6 percent slopes	2
18D	Rubicon sand, 6 to 15 percent slopes	2
18E	Rubicon sand, 15 to 35 percent slopes	2
18F	Rubicon sand, 35 to 60 percent slopes	2
20B	Croswell sand, 0 to 6 percent slopes	2
45D	Rubicon-Spot complex, 0 to 15 percent slopes	2
45E	Rubicon-Spot complex, 0 to 35 percent slopes	2
65B	Rubicon sand, organic surface, 0 to 6 percent slopes	2
65D	Rubicon sand, organic surface, 6 to 15 percent slopes	2
65E	Rubicon sand, organic surface, 15 to 35 percent slopes	2
88B	Croswell-Au Gres sands, 0 to 6 percent slopes	2
90D	Rousseau-Spot complex, 0 to 15 percent slopes	2
90E	Rousseau-Spot complex, 0 to 35 percent slopes	2
90F	Rousseau-Spot complex, 0 to 60 percent slopes	2
91D	Rousseau fine sand, 6 to 15 percent slopes	2
91E	Rousseau fine sand, 15 to 35 percent slopes	2
91F	Rousseau fine sand, 35 to 60 percent slopes	2
109D	Rousseau-Dawson complex, 0 to 15 percent slopes	2
109F	Rousseau-Dawson complex, 0 to 60 percent slopes	2
174B	Croswell-Spot complex, 0 to 6 percent slopes	2
198B	Vilas loamy sand, 0 to 6 percent slopes	2
198D	Vilas loamy sand, 6 to 15 percent slopes	2
201B	Croswell, rarely flooded-Deford, frequently flooded complex, 0 to 6 percent slopes	2
214D	Rousseau-Markey complex, 0 to 15 percent slopes	2
214E	Rousseau-Markey complex, 0 to 35 percent slopes	2
129A	Rudyard silt loam, 0 to 3 percent slopes	3
130A	Rudyard-Pickford silt loams, 0 to 3 percent slopes	3
205B	Kalkaska sand, 0 to 6 percent slopes, burned	3
205D	Kalkaska sand, 6 to 15 percent slopes, burned	3
10D	Ontonagon silt loam, 6 to 15 percent slopes	4
15B	Liminga fine sand, 0 to 6 percent slopes	4
15D	Liminga fine sand, 6 to 15 percent slopes	4
15E	Liminga fine sand, 15 to 35 percent slopes	4
15F	Liminga fine sand, 35 to 60 percent slopes	4

Table 65: Luce County

Table 65: (cont'd)

Numeric	Name	Habitat
16B	Graveraet fine sandy loam, 1 to 4 percent slopes	4
19B	Kalkaska sand, 0 to 6 percent slopes	4
19D	Kalkaska sand, 6 to 15 percent slopes	4
19E	Kalkaska sand, 15 to 35 percent slopes	4
19F	Kalkaska sand, 35 to 60 percent slopes	4
24B	Springlake loamy coarse sand, 0 to 6 percent slopes	4
29A	Solona fine sandy loam, 0 to 3 percent slopes	4
31B	McMillan fine sandy loam, 0 to 6 percent slopes	4
31D	McMillan fine sandy loam, 6 to 15 percent slopes	4
31E	McMillan fine sandy loam, 15 to 35 percent slopes	4
31F	McMillan fine sandy loam, 35 to 60 percent slopes	4
46B	Kalkaska loamy sand, 0 to 6 percent slopes	4
46D	Kalkaska loamy sand, 6 to 15 percent slopes	4
46E	Kalkaska loamy sand, 15 to 35 percent slopes	4
46F	Kalkaska loamy sand, 35 to 60 percent slopes	4
47B	Trenary fine sandy loam, 2 to 6 percent slopes	4
47D	Trenary fine sandy loam, 6 to 15 percent slopes	4
53B	Menominee sand, sandy substratum, 2 to 6 percent slopes	4
57B	Amadon-Longrie sandy loams, 1 to 6 percent slopes, rocky	4
57D	Amadon-Longrie sandy loams, 6 to 15 percent slopes, rocky	4
57E	Amadon-Longrie sandy loams, 15 to 35 percent slopes, rocky	4
61B	Paquin sand, 0 to 6 percent slopes	4
66B	Kalkaska-Kaks complex, 0 to 6 percent slopes	4
66D	Kalkaska-Kaks complex, 6 to 15 percent slopes	4
66E	Kalkaska-Kaks complex, 15 to 35 percent slopes	4
66F	Kalkaska-Kaks complex, 35 to 60 percent slopes	4
74B	Menominee, sandy substratum-Graveraet complex, 1 to 6 percent slopes	4
75D	Dillingham-Kalkaska complex, 6 to 15 percent slopes	4
75E	Dillingham-Kalkaska complex, 15 to 35 percent slopes	4
75F	Dillingham-Kalkaska complex, 35 to 70 percent slopes	4
76D	Menominee, sandy substratum-Trenary complex, 6 to 15 percent slopes	4
76E	Menominee, sandy substratum-Trenary complex, 15 to 35 percent slopes	4
84B	Liminga-Alcona complex, 0 to 6 percent slopes	4
84D	Liminga-Alcona complex, 6 to 15 percent slopes	4
84E	Liminga-Alcona complex, 15 to 35 percent slopes	4
85B	Kalkaska-Okeefe sands, 0 to 6 percent slopes	4
85D	Kalkaska-Okeefe sands, 6 to 15 percent slopes	4
85E	Kalkaska-Okeefe sands, 15 to 35 percent slopes	4

Table 65: (cont'd)

Numeric	Name	Habitat
93F	Ontonagon-Pickford, occasionally flooded complex, 0 to 50 percent slopes	4
104B	Pence very fine sandy loam, 0 to 6 percent slopes	4
104D	Pence very fine sandy loam, 6 to 15 percent slopes	4
104E	Pence very fine sandy loam, 15 to 35 percent slopes	4
117D	Manistee sand, sandy substratum, 6 to 15 percent slopes	4
120B	McMillan-Trenary fine sandy loams, 6 to 15 percent slopes	4
120D	McMillan-Trenary fine sandy loams, 6 to 15 percent slopes	4
120E	McMillan-Trenary fine sandy loams, 15 to 35 percent slopes	4
132B	Sugar very fine sandy loam, 0 to 6 percent slopes	4
167D	Battydoe, stony-Wallace complex, 6 to 15 percent slopes	4
173B	Paquin-Finch sands, 0 to 6 percent slopes	4
175D	Wallace-Spot complex, 0 to 15 percent slopes	4
175E	Wallace-Spot complex, 0 to 35 percent slopes	4
176B	Paquin-Spot complex, 0 to 6 percent slopes	4
179B	Wallace sand, 0 to 6 percent slopes	4
179D	Wallace sand, 6 to 15 percent slopes	4
179E	Wallace sand, 15 to 35 percent slopes	4
179F	Wallace sand, 35 to 60 percent slopes	4
180B	Millecoquins silt loam, 0 to 6 percent slopes	4
186D	Sporley silt loam, 6 to 15 percent slopes	4
186E	Sporley silt loam, 15 to 35 percent slopes	4
186F	Sporley silt loam, 35 to 60 percent slopes	4
189A	Bodi-Chesbrough silt loams, 0 to 3 percent slopes	4
190B	Bodi silt loam, 0 to 6 percent slopes	4
191D	Widgeon-Kalkaska complex, 6 to 15 percent slopes	4
197D	Zandi silt loam, 6 to 15 percent slopes	4
197E	Zandi silt loam, 15 to 35 percent slopes	4
200B	Pence loamy sand, 0 to 6 percent slopes	4
200D	Pence loamy sand, 6 to 15 percent slopes	4
200E	Pence loamy sand, 15 to 35 percent slopes	4
202B	Whitewash sand, 0 to 4 percent slopes	4
203D	Frohling loamy sand, 8 to 15 percent slopes	4
203E	Frohling loamy sand, 15 to 35 percent slopes	4
206B	Deerton loamy sand, 0 to 6 percent slopes	4
211D	Frohling-Wallace complex, 6 to 15 percent slopes	4
211E	Frohling-Wallace complex, 15 to 35 percent slopes	4
215B	Wallace-Alcona complex, 0 to 6 percent slopes	4
215D	Wallace-Alcona complex, 6 to 15 percent slopes	4
246B	Garlic sand, 0 to 6 percent slopes	4
246D	Garlic sand, 6 to 15 percent slopes	4
286B	Fence silt loam, 0 to 6 percent slopes	4

Table 65: (cont'd)

Numeric	Name	Habitat
287B	Noseum fine sandy loam, 0 to 4 percent slopes	4
21A	Finch sand, 0 to 3 percent slopes	5
22	Spot peat	5
30	Kinross muck	5
32A	Allendale loamy fine sand, 0 to 3 percent slopes	5
36	Carbondale, Lupton, and Tawas soils	5
37	Dawson, Greenwood, and Loxley soils	5
60A	Kinross-Au Gres complex, 0 to 3 percent slopes	5
89A	Spot-Finch complex, 0 to 3 percent slopes	5
94A	Tawas-Spot-Finch complex, 0 to 3 percent slopes	5
102	Spot-Dawson peats	5
110D	Au Gres-Dawson-Rubicon complex, 0 to 15 percent slopes	5
110E	Au Gres-Dawson-Rubicon complex, 0 to 35 percent slopes	5
126	Pickford silt loam	5
133	Dorval muck	5
143	Caffey muck	5
146A	Allendale-Fibre complex, 0 to 3 percent slopes	5
187B	Auger silt loam, 0 to 6 percent slopes	5
193A	Annanias silt loam, 0 to 3 percent slopes	5
194A	Hendrie-Annanias complex, 0 to 3 percent slopes	5
195A	Chesbrough silt loam, 0 to 3 percent slopes	5
199B	Auger-Annanias silt loams, 0 to 6 percent slopes	5
188	Hendrie mucky peat	5
204	Gogomain muck	5
212	Markey mucky peat	5
23	Leafriver mucky peat	6
35	Histosols and Aquents, ponded	7
W	Water	7

Numeric	Name	Habitat
122	Pits, quarry	0
33	Pits, sand and gravel	0
70F	St. Ignace-Rock outcrop complex, 35 to 70 percent slopes	0
116	Udipsamments and Udorthents, nearly level	0
124D	Alpena gravelly loam, 0 to 15 percent slopes	0
20B	Croswell sand, 0 to 6 percent slopes	2
125B	Croswell-Markey complex, 0 to 6 percent slopes	2
88B	Croswell-Wainola complex, 0 to 6 percent slopes	2
17D	Eastport sand, 0 to 15 percent slopes	2
17E	Eastport sand, 15 to 35 percent slopes	2
38E	Eastport-Leafriver complex, 0 to 35 percent slopes	2
170B	Pullup fine sand, 0 to 6 percent slopes	2
170E	Pullup fine sand, 15 to 35 percent slopes	2
170D	Pullup fine sand, 6 to 15 percent slopes	2
18B	Rubicon sand, 0 to 6 percent slopes	2
18E	Rubicon sand, 15 to 35 percent slopes	2
18F	Rubicon sand, 35 to 60 percent slopes	2
18D	Rubicon sand, 6 to 15 percent slopes	2
57B	Amadon-Longrie sandy loams, 1 to 6 percent slopes, rocky	3
57D	Amadon-Longrie sandy loams, 6 to 15 percent slopes, rocky	3
41D	Amadon-Rock outcrop complex, 1 to 15 percent slopes	3
41F	Amadon-Rock outcrop complex, 15 to 45 percent slopes	3
95A	Bowers silt loam, 0 to 3 percent slopes	3
185	Ermatinger silt loam	3
10F	Ontonagon silt loam, 25 to 50 percent slopes	3
10D	Ontonagon silt loam, 6 to 15 percent slopes	3
93F	Ontonagon-Pickford, occasionally flooded complex, 0 to 50 percent slopes	3
46B	Adams sandy loam, 0 to 6 percent slopes	4
13B	Alcona fine sandy loam, 0 to 6 percent slopes	4
13D	Alcona fine sandy loam, 6 to 15 percent slopes	4
44B	Battydoe fine sandy loam, 1 to 6 percent slopes, stony	4
44E	Battydoe fine sandy loam, 15 to 35 percent slopes, stony	4
44D	Battydoe fine sandy loam, 6 to 15 percent slopes, stony	4
167B	Battydoe, stony-Wallace complex, 0 to 6 percent slopes	4
167E	Battydoe, stony-Wallace complex, 15 to 35 percent slopes	4
167D	Battydoe, stony-Wallace complex, 6 to 15 percent slopes	4
183B	Cozy cobbly fine sandy loam, 0 to 6 percent slopes	4
174B	Croswell-Spot complex, 0 to 6 percent slopes	4
67B	Furlong sand, 0 to 6 percent slopes, rocky	4
16B	Graveraet fine sandy loam, 1 to 6 percent slopes	4
16D	Graveraet fine sandy loam, 6 to 15 percent slopes	4

Table 66: Mackinac County

Table 66: (cont'd)

Numeric	Name	Habitat
27B	Greylock fine sandy loam, 1 to 6 percent slopes	4
27F	Greylock fine sandy loam, 35 to 60 percent slopes	4
27D	Greylock fine sandy loam, 6 to 15 percent slopes	4
100B	Greylock-Adams complex, 0 to 6 percent slopes	4
100D	Greylock-Adams complex, 6 to 15 percent slopes	4
25B	Guardlake fine sandy loam, 0 to 6 percent slopes	4
25E	Guardlake fine sandy loam, 15 to 35 percent slopes	4
25D	Guardlake fine sandy loam, 6 to 15 percent slopes	4
182B	Heinz sandy loam, 0 to 6 percent slopes	4
19B	Kalkaska sand, 0 to 6 percent slopes	4
19E	Kalkaska sand, 15 to 35 percent slopes	4
19F	Kalkaska sand, 35 to 60 percent slopes	4
19D	Kalkaska sand, 6 to 15 percent slopes	4
28B	Longrie sandy loam, 1 to 6 percent slopes, rocky	4
28D	Longrie sandy loam, 6 to 15 percent slopes, rocky	4
135B	Longrie-Battydoe, stony complex, 1 to 6 percent slopes	4
135D	Longrie-Battydoe, stony complex, 6 to 15 percent slopes	4
61B	Paquin sand, 0 to 6 percent slopes	4
173B	Paquin-Finch sands, 0 to 6 percent slopes	4
176B	Paquin-Spot complex, 0 to 6 percent slopes	4
69B	Satago silt loam, 1 to 6 percent slopes	4
24B	Springlake loamy coarse sand, 0 to 6 percent slopes	4
24E	Springlake loamy coarse sand, 15 to 35 percent slopes	4
24D	Springlake loamy coarse sand, 6 to 15 percent slopes	4
132F	Superior fine sandy loam, 25 to 50 percent slopes	4
132B	Superior fine sandy loam, till substratum, 1 to 6 percent slopes	4
132D	Superior fine sandy loam, till substratum, 6 to 15 percent slopes	4
179B	Wallace sand, 0 to 6 percent slopes	4
179E	Wallace sand, 15 to 35 percent slopes	4
179F	Wallace sand, 35 to 60 percent slopes	4
179D	Wallace sand, 6 to 15 percent slopes	4
84B	Wallace-Alcona complex, 0 to 6 percent slopes	4
84F	Wallace-Alcona complex, 35 to 60 percent slopes	4
84D	Wallace-Alcona complex, 6 to 15 percent slopes	4
175D	Wallace-Spot complex, 0 to 15 percent slopes	4
71B	Johnswood cobbly silt loam, 2 to 6 percent slopes	4
117B	Manistee sand, 0 to 6 percent slopes	4
53B	Menominee loamy sand, 0 to 6 percent slopes	4
53D	Menominee loamy sand, 6 to 15 percent slopes	4
180B	Millecoquins very fine sandy loam, 1 to 6 percent slopes	4

Table 66: (cont'd)

Numeric	Name	Habitat
177B	Millecoquins-Superior, till substratum complex, 1 to 6 percent slopes	4
177D	Millecoquins-Superior, till substratum complex, 6 to 15 percent slopes	4
169E	Ontonagon-Fluvaquents, frequently flooded complex, 0 to 35 percent slopes	4
70B	St. Ignace silt loam, 0 to 6 percent slopes	4
70D	St. Ignace silt loam, 6 to 15 percent slopes, rocky	4
32A	Allendale fine sand, 0 to 3 percent slopes	5
146A	Allendale-Wakeley complex, 0 to 3 percent slopes	5
43	Angelica muck	5
151	Beavertail muck	5
123B	Borgstrom sand, 0 to 6 percent slopes	5
143	Caffey muck	5
168B	Caffey-Ingalls-Iosco complex, 0 to 6 percent slopes	5
37	Dawson and Loxley peats	5
178B	Dinkey muck, 0 to 6 percent slopes	5
133	Dorval muck	5
21A	Finch sand, 0 to 3 percent slopes	5
39E	Finch-Dawson-Pullup complex, 0 to 35 percent slopes	5
62A	Iosco sand, 0 to 3 percent slopes	5
36	Markey and Carbondale mucks	5
94A	Markey-Spot-Finch complex, 0 to 3 percent slopes	5
181A	Mattix sandy loam, 0 to 3 percent slopes	5
164A	Moltke loam, 0 to 3 percent slopes	5
12	Pickford silty clay loam	5
11A	Rudyard silty clay loam, 0 to 3 percent slopes	5
113	Ruse mucky loam	5
112	Soo silty clay loam	5
22	Spot muck	5
89A	Spot-Finch complex, 0 to 3 percent slopes	5
49A	Wainola fine sand, 0 to 3 percent slopes	5
48E	Wainola-Leafriver-Pullup complex, 0 to 35 percent slopes	5
68	Wakeley muck	5
161	Zela muck	5
92A	Engadine fine sandy loam, 0 to 3 percent slopes	5
165A	Engadine-Rudyard complex, 0 to 3 percent slopes	5
56A	Ensign fine sandy loam, 0 to 3 percent slopes, rocky	5
160B	Esau extremely gravelly sandy loam, 0 to 3 percent slopes	5
163B	Esau-Zela complex, 0 to 3 percent slopes	5
98	Glawe silt loam	5
119	Gogomain very fine sandy loam	5

Table 66: (cont'd)

Numeric	Name	Habitat
166	Gogomain-Pickford complex	5
40A	Rudyard-Allendale complex, 0 to 3 percent slopes	5
64A	Search very fine sandy loam, 0 to 3 percent slopes	5
147B	Shelter very cobbly loam, 0 to 6 percent slopes, stony	5
147D	Shelter very cobbly loam, 6 to 15 percent slopes, stony	5
108D	Shelter-Alpena complex, 0 to 15 percent slopes, stony	5
29A	Solona loam, 0 to 3 percent slopes	5
23	Leafriver mucky peat	6
172B	Leafriver-Croswell-Wainola complex, 0 to 6 percent slopes	6
34	Entisols, frequently flooded	7
35	Histosols and Aquents, ponded	7
W	Water	7

Numeric	Name	Habitat
33	Pits, sand and gravel	0
76A	Shuberts-Manistique complex, 0 to 3 percent slopes	0
116F	Udipsamments and Udorthents, nearly level to very steep	0
119	Landfill	0
218	Pits, quarry	0
25B	Proper sand, 0 to 6 percent slopes	1
68F	Deer Park sand, 25 to 60 percent slopes	1
70F	Deer Park-Deford-Tawas complex, 0 to 60 percent slopes	1
12B	Rubicon sand, 0 to 6 percent slopes	2
12D	Rubicon sand, 6 to 15 percent slopes	2
12E	Rubicon sand, 15 to 35 percent slopes	2
12F	Rubicon sand, 35 to 60 percent slopes	2
80F	Deer Park-Dawson-Wainola complex, 0 to 60 percent slopes	2
86B	Wurtsmith-Tawas-Deford complex, 0 to 6 percent slopes	2
219B	Cublake sand, 0 to 6 percent slopes	2
491B	Neconish-Deford, rarely flooded-Wainola complex, 0 to 6 percent slopes	2
492D	Wurtsmith-Duck-Rubicon complex, 0 to 15 percent slopes	2
515B	Vilas loamy sand, 0 to 6 percent slopes	2
520B	Rubicon-Sultz complex, 0 to 6 percent slopes	2
520D	Rubicon-Sultz complex, 6 to 15 percent slopes	2
525B	Neconish-Kinross-Wainola complex, 0 to 6 percent slopes	2
547B	Rubicon sand, 0 to 6 percent slopes, very deep water table	2
547D	Rubicon sand, 6 to 15 percent slopes, very deep water table	2
565B	Rubicon sand, 0 to 6 percent slopes, deep water table	2
565D	Rubicon sand, 6 to 15 percent slopes, deep water table	2
17A	Au Gres sand, 0 to 3 percent slopes	3
155B	Karlin loamy fine sand, 0 to 6 percent slopes	3
514B	Kalkaska sand, 0 to 6 percent slopes, burned	3
514D	Kalkaska sand, 6 to 15 percent slopes, burned	3
514E	Kalkaska sand, 15 to 50 percent slopes, burned	3
534	Pickford silty clay loam	3
10B	Amadon-Rock outcrop complex, 1 to 6 percent slopes	4
11B	Kalkaska loamy sand, 0 to 6 percent slopes	4
13B	Kalkaska sand, 0 to 6 percent slopes	4
13D	Kalkaska sand, 6 to 15 percent slopes	4
13E	Kalkaska sand, 15 to 35 percent slopes	4
13F	Kalkaska sand, 35 to 60 percent slopes	4
16A	Paquin sand, 0 to 3 percent slope	4
20E	Rousseau-Neconish-Finch complex, 0 to 25 percent slopes	4
21B	Garlic sand, 0 to 6 percent slopes	4
21D	Garlic sand, 6 to 15 percent slopes	4

Table 67: Schoolcraft County

Table 67: (cont'd)

Numeric	Name	Habitat
21E	Garlic sand, 15 to 35 percent slopes	4
22E	Rousseau-Neconish-Deford complex, 0 to 25 percent slopes	4
24B	Rousseau fine sand, 0 to 6 percent slopes	4
24D	Rousseau fine sand, 6 to 15 percent slopes	4
24E	Rousseau fine sand, 15 to 35 percent slopes	4
34B	Liminga fine sand, 0 to 6 percent slopes	4
34E	Liminga fine sand, 15 to 35 percent slopes	4
56B	Shuberts-Wurtsmith-Meehan complex, 0 to 6 percent slopes	4
62B	McMillan-Greylock fine sandy loams, 1 to 6 percent slopes	4
62D	McMillan-Greylock fine sandy loams, 6 to 15 percent slopes	4
62E	Greylock-McMillan fine sandy loams, 15 to 35 percent slopes	4
67B	Pelkie, occasionally flooded-Deford,frequently flooded, complex, 0 to 4 percent slopes	4
73B	Graveraet-Gulliver complex, 1 to 6 percent slopes	4
78B	Heinz sandy loam, 0 to 6 percent slopes	4
87B	Longrie-Amadon silt loams, 0 to 6 percent slopes, rocky	4
87D	Amadon-Longrie silt loams, 6 to 15 percent slopes, rocky	4
87E	Amadon-Longrie-Rock outcrop complex, 15 to 35 percent slopes	4
88B	Cookson-Amadon silt loams, 1 to 6 percent slopes	4
89B	Cookson-Trenary silt loams, 1 to 6 percent slopes	4
98B	Guardlake fine sandy loam, 0 to 6 percent slopes	4
98D	Guardlake fine sandy loam, 6 to 15 percent slopes	4
98E	Guardlake fine sandy loam, 15 to 35 percent slopes	4
125B	Stutts-Kalkaska complex, 0 to 6 percent slopes	4
125D	Stutts-Kalkaska complex, 6 to 15 percent slopes	4
125E	Stutts-Kalkaska complex, 15 to 35 percent slopes	4
131B	Furlong-Shingleton complex, 1 to 6 percent slopes	4
141A	Halfaday sand, 0 to 3 percent slopes	4
145B	Noseum fine sandy loam, 0 to 4 percent slopes	4
160B	Paquin-Finch sands, 0 to 6 percent slopes	4
225B	Cusino loamy sand, 1 to 6 percent slopes	4
248B	Escanaba-Greylock complex, 1 to 6 percent slopes	4
287B	Hiawatha fine sandy loam, 0 to 6 percent slopes	4
289B	Wallace sand, 0 to 6 percent slopes	4
289D	Wallace sand, 6 to 15 percent slopes	4
289E	Wallace sand, 15 to 35 percent slopes	4
294B	Munising-Yalmer-Frohling complex, calcareous substratum, 1 to 6 percent slopes	4
295E	Dillingham-Kalkaska complex, 15 to 35 percent slopes	4
355B	Springlake loamy sand, 0 to 6 percent slopes	4
366B	Gilchrist sand, 0 to 6 percent slopes	4
367B	Cozy fine sandy loam, 0 to 6 percent slopes	4

Table 67: (cont'd)

Numeric	Name	Habitat
400B	Amadon-Rock outcrop complex, 1 to 6 percent slopes	4
490B	Pelkie, occasionally flooded-Arnheim, frequently flooded complex, 0 to 4 percent slopes	4
505B	Graveraet fine sandy loam, 1 to 4 percent slopes	4
505D	Graveraet fine sandy loam, 6 to 15 percent slopes	4
512A	Growton fine sandy loam, 0 to 3 percent slopes	4
518A	Deford-Seney complex, frequently flooded, 0 to 3 percent slopes	4
519B	Trenary silt loam, 2 to 6 percent slopes	4
526B	Graveraet-Angelica complex, 0 to 4 percent slopes	4
527B	Islandlake-McMillan complex, 0 to 6 percent slopes	4
527D	Islandlake-McMillan complex, 6 to 15 percent slopes	4
527E	Islandlake-McMillan complex, 15 to 35 percent slopes	4
531B	Greylock fine sandy loam, 1 to 6 percent slopes	4
531D	Greylock fine sandy loam, 6 to 15 percent slopes	4
535B	Trenary fine sandy loam, 2 to 6 percent slopes	4
535D	Trenary fine sandy loam, 6 to 15 percent slopes	4
536B	Menominee sand, sandy substratum, 2 to 6 percent slopes	4
537B	McMillan fine sandy loam, 0 to 6 percent slopes	4
537D	McMillan fine sandy loam, 6 to 15 percent slopes	4
538B	Menominee, sandy substratum-McMillan complex, 0 to 6 percent slopes	4
546B	Kalkaska sand, 0 to 6 percent slopes, deep water table	4
546D	Kalkaska sand, 6 to 15 percent slopes, deep water table	4
548B	McMillan-Trenary fine sandy loams, 1 to 6 percent slopes	4
549B	Islandlake sand, 0 to 6 percent slopes	4
549D	Islandlake sand, 6 to 15 percent slopes	4
549E	Islandlake sand, 15 to 35 percent slopes	4
551B	Kalkaska sand, 0 to 6 percent slopes, very deep water table	4
551D	Kalkaska sand, 6 to 15 percent slopes, very deep water table	4
554B	Duck-Halfaday complex, 0 to 6 percent slopes	4
555D	Hiawatha-Deer Park-Rubicon complex, 0 to 15 percent slopes	4
557B	Kalkaska sand, 0 to 6 percent slopes, very deep water table, burned	4
557D	Kalkaska sand, 6 to 15 percent slopes, very deep water table, burned	4
558B	Islandlake sand, 0 to 6 percent slopes, burned	4
558D	Islandlake sand, 6 to 15 percent slopes, burned	4
559B	Kalkaska sand, 0 to 6 percent slopes, deep water table, burned	4
560B	Islandlake sand, 0 to 6 percent slopes, very deep water table	4
561A	Croswell sand, 0 to 3 percent slopes	4
562B	Croswell-Kinross complex, 0 to 6 percent slopes	4
563B	Halfaday-Kinross complex, 0 to 4 percent slopes	4

Table 67: (cont'd)

Numeric	Name	Habitat
18	Kinross muck	5
19A	Au Gres-Deford complex, 0 to 3 percent slopes	5
26A	Spot-Finch complex, 0 to 3 percent slopes	5
27A	Hendrie-Annanias complex, 0 to 3 percent slopes	5
30	Hendrie mucky peat	5
36	Carbondale, Lupton, and Tawas soils	5
37	Dawson, Greenwood, and Loxley soils	5
61A	Ingalls-Caffey complex, 0 to 3 percent slopes	5
69	Ruse mucky loam, rocky	5
72	Spot peat	5
84	Dawson-Kinross complex	5
90	Chippeny muck	5
91	Cathro and Lupton soils	5
93A	Ruse-Ensign complex, 0 to 3 percent slopes	5
120A	Charlevoix-Ensley complex, 0 to 3 percent slopes	5
122A	Wormet fine sandy loam, 0 to 3 percent slopes	5
249A	Iosco sand, 0 to 3 percent slopes	5
267A	Finch sand, 0 to 3 percent slopes	5
401A	Ingalls sand, 0 to 3 percent slopes	5
517B	Mancelona sand, 0 to 6 percent slopes	5
517D	Mancelona sand, 6 to 15 percent slopes	5
532	Angelica muck	5
541D	Kinross-Au Gres-Rubicon complex, 0 to 15 percent slopes	5
543B	Auger very fine sandy loam, sandy substratum, 0 to 6 percent slopes	5
553	Carbondale-Loxley complex	5
564A	Ingalls loamy sand, 0 to 3 percent slopes	5
43	Ensley muck	6
63	Deford muck	6
65	Ausable, Deford, and Tawas mucks, frequently flooded	6
123	Minocqua muck	6
493A	Deford-Meehan-Seney complex, 0 to 3 percent slopes	6
516A	Deford-Meehan complex, 0 to 3 percent slopes, drained	6
540D	Deford-Rubicon-Au Gres complex, 0 to 15 percent slopes	6
222	Histosols and Aquents, ponded	7
W	Water	7
66	Markey mucky peat	5
498B	Bursaw-Beavertail complex, 0 to 6 percent slopes	5

Appendix O:

Regression Analysis Output

Regression Analysis Output

Session Start: Friday, March 29th, 2013, 11:31:32 AM.

▼Binary Logistic Regression

The categorical values encountered during processing are

Variables	Levels				
Random/Site (2 levels)	Random	Site			
Habitat (8 levels)	Unclassified	Jack Pine	Mixed Pine	Mixed Upland	Northern Hardwood
	Lowland Conifer	Lowland Hardwood	Wetland/Marsh		

Table 68: Categorical Variables

Categorical variables are dummy coded with the highest value as reference.

Dependent Variable	:	Random/Site
Input Records	:	87
Records for Analysis	:	86
Records Deleted for Missing Data	:	1

Table 69: Calculation Parameters

Dependent Variable Levels	Category Choices	Count
Random	RESPONSE	50
Site	REFERENCE	36

Table 70: Sample Split

Failure to improve the likelihood function at Iteration 37

Old Log-Likelihood = -13.911 New Log-Likelihood = -13.911

Log-Likelihood at Iteration1	-59.611
Log-Likelihood at Iteration2	-30.856
Log-Likelihood at Iteration3	-23.480
Log-Likelihood at Iteration4	-18.532
Log-Likelihood at Iteration5	-15.228
Log-Likelihood at Iteration6	-14.086
Log-Likelihood at Iteration7	-13.919
Log-Likelihood at Iteration8	-13.912
Log-Likelihood at Iteration9	-13.911
Log-Likelihood at Iteration10	-13.911
Log-Likelihood at Iteration11	-13.911
Log-Likelihood at Iteration12	-13.911
Log-Likelihood at Iteration13	-13.911
Log-Likelihood at Iteration14	-13.911
Log-Likelihood at Iteration15	-13.911
Log-Likelihood at Iteration16	-13.911
Log-Likelihood at Iteration17	-13.911
Log-Likelihood at Iteration18	-13.911
Log-Likelihood at Iteration19	-13.911
Log-Likelihood at Iteration20	-13.911
Log-Likelihood at Iteration21	-13.911
Log-Likelihood at Iteration22	-13.911
Log-Likelihood at Iteration23	-13.911
Log-Likelihood at Iteration24	-13.911
Log-Likelihood at Iteration25	-13.911
Log-Likelihood at Iteration26	-13.911
Log-Likelihood at Iteration27	-13.911
Log-Likelihood at Iteration28	-13.911
Log-Likelihood at Iteration29	-13.911
Log-Likelihood at Iteration30	-13.911
Log-Likelihood at Iteration31	-13.911
Log-Likelihood at Iteration32	-13.911
Log-Likelihood at Iteration33	-13.911
Log-Likelihood at Iteration34	-13.911
Log-Likelihood at Iteration35	-13.911
Log-Likelihood at Iteration36	-13.911
Log-Likelihood at Iteration37	-13.911
Log-Likelihood	-13.911

Table 71: Log-Likelihood Iteration History

AIC	45.821
Schwarz's BIC	67.911

Table 72: Information Criteria

Parameter	Estimate	Standard Error	Z	p-Value	95% Confidence Interval	
					Lower	Upper
CONSTANT	-2.480	1.375	-1.803	0.071	-5.176	0.216
Distance to Water	0.032	0.009	3.343	0.001	0.013	0.050
Habitat_Unclassified	19.798	1.198E+008	0.000	1.000	-2.348E+008	2.348E+008
Habitat_Jack Pine	-46.324	1.198E+008	0.000	1.000	-2.348E+008	2.348E+008
Habitat_Mixed Pine	-3.169	1.770	-1.791	0.073	-6.637	0.299
Habitat_Mixed Upland	-15.715	110.119	-0.143	0.887	-231.544	200.113
Habitat_Northern Hardwood	1.343	1.607	0.836	0.403	-1.805	4.492
Habitat_Lowland Conifer	-0.183	1.491	-0.123	0.902	-3.106	2.739
Habitat_Lowland Hardwood	37.708	1.198E+008	0.000	1.000	-2.348E+008	2.348E+008

Table 73: Parameter Estimates

Parameter	Odds Ratio	Standard Error	95% Confidence Interval	
			Lower	Upper
Distance to Water	1.032	0.010	1.013	1.051
Habitat_Unclassified	3.964E+008	4.749E+016	0.000	.
Habitat_Jack Pine	0.000	0.000	0.000	.
Habitat_Mixed Pine	0.042	0.074	0.001	1.349
Habitat_Mixed Upland	0.000	0.000	0.000	.
Habitat_Northern Hardwood	3.832	6.156	0.164	89.312
Habitat_Lowland Conifer	0.833	1.242	0.045	15.477
Habitat_Lowland Hardwood	2.379E+016	2.851E+024	0.000	.

Table 74: Odds Ratio Estimates

Log-Likelihood of Constant Only Model	-58.466
Log-Likelihood of Full Model	-13.911
Chi-Square	89.111
df	8
p-Value	0.000

Table 75: Overall Model Fit

McFadden's Rho-Squared	0.762
Cox and Snell R-Square	0.645
Naglekerke's R-Square	0.868

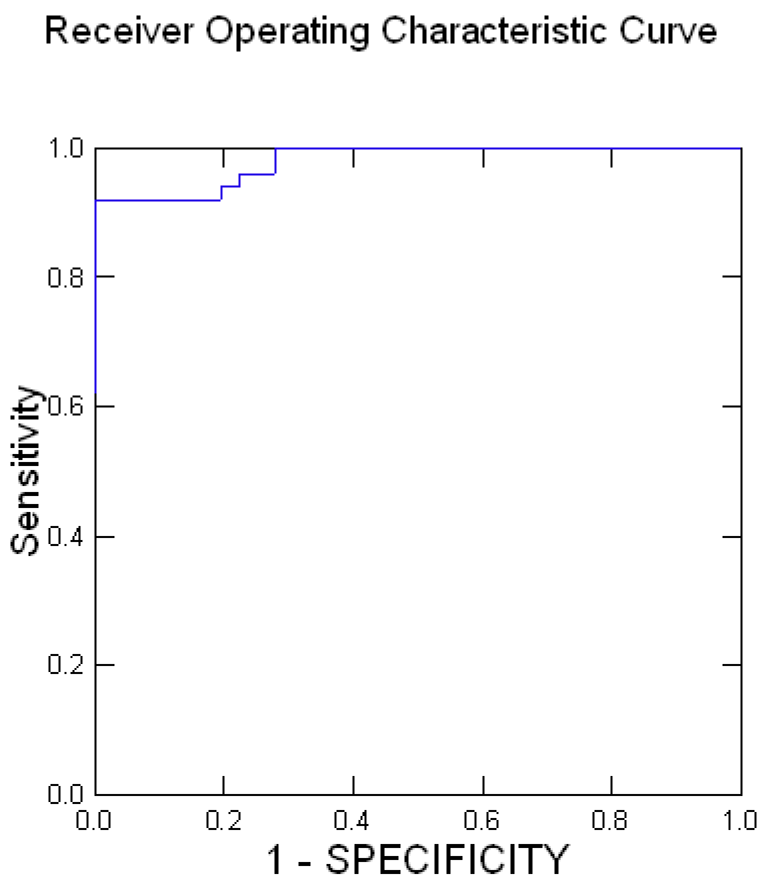
Table 76: R-Square Measures

Actual Choice	Predicted Choice		Actual Total
	Response	Reference	
Response	45.643	4.357	50.000
Reference	4.357	31.643	36.000
Predicted Total	50.000	36.000	86.000
Correct	0.913	0.879	
Success Index	0.331	0.460	
Total Correct	0.899		

Table 77: Model Prediction Success Table

Sensitivity	0.913
Specificity	0.879
False Reference	0.087
False Response	0.121

Table 78: Summary of Prediction Success Table



Area under ROC Curve	0.981

Figure 71: Receiver Operating Characteristic Curve

▼Logistic Regression: Simulation

Fixed Parameter	Value		
CONSTANT	1.000		
Distance to Water	0.000		
Habitat_Unclassified	0.000		
Habitat_Jack Pine	0.000		
Habitat_Mixed Pine	0.000		
Habitat_Mixed Upland	0.000		
Habitat_Northern Hardwood	0.000		
Habitat_Lowland Conifer	0.000		
Habitat_Lowland Hardwood	0.000		

Table 79: Simulation Vector

Odds Ratio, 95.000 % Bounds = 0.084 [0.006, 1.241]

Appendix P:

Site Predictive Scores

State No.	Predictive Score	Rank
20AR173/174	92	Medium
20AR245	155	High
20AR310	155	High
20AR338	140	High
20AR348	140	High
20AR350	140	High
20AR353	140	High
20AR358/386	108	Medium
20AR359	140	High
20AR398	140	High
20AR400	140	High
20AR406	9	Low
20AR435	140	High
20AR437	155	High
20AR495	108	Medium
20AR6	108	Medium
20CH2	108	Medium
20CH32	140	High
20CH433	140	High
20CH492	105	Medium
20CH86	98	Medium
20CH95	92	Medium
20DE106	155	High
20DE108	93	Medium
20DE167	108	Medium
20DE188	108	Medium
20DE236	59	Medium
20DE294	105	Medium
20DE296	93	Medium
20DE326	155	High
20DE378	108	Medium
20DE43	140	High
20DE459	140	High
20DE50	140	High
20DE75	140	High
20DE85	140	High
20DE93	105	Medium
20MK159	105	Medium
20MK24	59	Medium
20MK261	108	Medium
20MK3/11	108	Medium

Table 80: Predictive Scores HNF Sites

Table 80: (cont'd)

State No.	Predictive Score	Rank
20MK334	120	Medium
20MK90	155	High
20ST109/110	155	High
20ST14	140	High
20ST227	140	High
20ST233	140	High
20ST262	155	High
20AR013	98	Medium

State No.	Predictive Score	Rank
20AR210	98	Medium
20AR330	98	Medium
20CH171/172	123	Medium
20CH238	105	Medium
20CH27	98	Medium
20CH41	108	Medium
20CH43	98	Medium
20CH45	24	Low
20CH46	98	Medium
20CH6	42	Low
20CH77	94	Medium
20DE1	24	Low
20DE17	108	Medium
20DE19	94	Medium
20DE333	140	High
20DE4	105	Medium
20DE7	140	High
20MK1	108	Medium
20MK102	105	Medium
20MK169	105	Medium
20MK19	94	Medium
20MK22	140	High
20MK239	105	Medium
20MK375	105	Medium
20MK51/82/99	94	Medium
20MK53	105	Medium
20MK54	94	Medium
20MK58	9	Low
20MK6/7	108	Medium
20MK61	105	Medium
20ST1	105	Medium
20ST2	140	High

Table 81: Predictive Scores Other Sites

Appendix Q:

Site Data (LWPM and DUI Ranks)

State No.	Setting	LWPM Rank	DUI Rank	Great Lake	Lake/River	Early LW	Late LW
20AR173/174	Interior	Medium	Limited	Michigan	River		
20AR210	Interior	Medium	Limited	Michigan	Lake		
20AR245	Interior	High	Limited	Michigan	River		x
20AR310	Interior	High	Limited	Michigan	Lake		x
20AR330	Coastal	Medium	Limited	Superior			
20AR348	Coastal	High	Extended	Superior		x	x
20AR350	Coastal	High	Limited	Superior			
20AR353	Coastal	High	Intermediate	Superior			
20AR358/386	Coastal	Medium	Limited	Superior			x
20AR359	Coastal	High	Limited	Superior		x	x
20AR398	Coastal	High	Limited	Superior			x
20AR400	Coastal	High	Limited	Superior			
20AR406	Coastal	Low	Limited	Superior			
20AR435	Coastal	High	Limited	Superior			
20AR437	Interior	High	Intermediate	Michigan	Lake		x
20AR495	Coastal	Medium	Intermediate	Superior			
20AR6	Coastal	Medium	Intermediate	Superior			
20CH171/172	Interior	Medium	Intermediate	Huron	Lake		
20CH2	Coastal	Medium	Intermediate	Superior		x	x
20CH238	Interior	Medium	Limited	Huron	River		x
20CH27	Coastal	Medium	Limited	Superior			
20CH32	Coastal	High	Limited	Superior		x	x
20CH41	Interior	Medium	Limited	Superior	River		
20CH43	Coastal	Medium	Limited	Huron			x
20CH433	Coastal	High	Limited	Superior			
20CH45	Coastal	Low	Limited	Huron			x
20CH46	Coastal	Medium	Limited	Huron			x
20CH492	Coastal	Medium	Limited	Superior			x
20CH6	Coastal	Low	Extended	Huron		x	x
20CH77	Coastal	Medium	Limited	Superior			x
20CH86	Coastal	Medium	Limited	Superior			
20CH95	Coastal	Medium	Extended	Superior			x
20DE106	Coastal	High	Limited	Michigan			
20DE108	Coastal	Medium	Limited	Michigan			x
20DE167	Coastal	Medium	Limited	Michigan		x	x
20DE17	Coastal	Medium	Limited	Michigan		x	
20DE188	Interior	Medium	Intermediate	Michigan	River		
20DE236	Coastal	Medium	Limited	Michigan			x
20DE294	Interior	Medium	Limited	Michigan	River		
20DE296	Coastal	Medium	Intermediate	Michigan			x
20DE326	Interior	High	Limited	Michigan	Lake		x
20DE333	Coastal	High	Intermediate	Michigan			x
20DE378	Interior	Medium	Intermediate	Michigan	River	x	x
20DE4 (O/LW)	Coastal	Medium	Intermediate	Michigan			x
20DE4 (pHST)	Coastal	Medium	Extended	Michigan			x
20DE43	Interior	High	Limited	Michigan	Lake		x
20DE459	Interior	High	Limited	Michigan	Lake		
20DE50	Interior	High	Limited	Michigan	River		

Table 82: Site Data (LWPM and DUI Ranks)

Table 82: (cont'd)

State No.	Setting	LWPM Rank	DUI Rank	Great Lake	Lake/River	Early LW	Late LW
20DE7	Coastal	High	Intermediate	Michigan			
20DE75	Interior	High	Limited	Michigan	River		x
20DE85	Coastal	High	Limited	Michigan			x
20DE93	Interior	Medium	Intermediate	Michigan	River		
20MK1 (Bois Blanc)	Coastal	Medium	Extended	Huron			x
20MK1 (Juntunen)	Coastal	Medium	Extended	Huron			x
20MK1 (Mackinac)	Coastal	Medium	Extended	Huron		x	
20MK102	Coastal	Medium	Limited	Huron		x	x
20MK159	Coastal	Medium	Limited	Huron		x	
20MK169	Coastal	Medium	Intermediate	Huron		x	x
20MK19	Coastal	Medium	Limited	Huron		x	
20MK22	Coastal	High	Extended	Michigan		x	x
20MK239	Coastal	Medium	Limited	Huron			x
20MK24	Coastal	Medium	Intermediate	Michigan		x	x
20MK261	Coastal	Medium	Extended	Huron		x	
20MK3/11	Coastal	Medium	Limited	Huron			
20MK334	Interior	Medium	Limited	Michigan	Lake		
20MK53	Coastal	Medium	Limited	Huron			x
20MK54	Coastal	Medium	Intermediate	Huron		x	x
20MK58	Coastal	Low	Limited	Huron			x
20MK61	Coastal	Medium	Limited	Huron		x	x
20MK90	Coastal	High	Intermediate	Michigan		x	
20ST1	Coastal	Medium	Intermediate	Michigan		x	x
20ST109/110	Interior	High	Intermediate	Michigan	Lake		x
20ST14	Interior	High	Limited	Michigan	Lake		x
20ST227	Interior	High	Limited	Michigan	River		
20ST233	Interior	High	Limited	Michigan	Lake		
20ST262	Interior	High	Limited	Michigan	Lake		

Appendix R:

150 m Radius Catchment Data (SS&HD and DUI Ranks)

State No.	Setting	Great Lake	Lake/River	SS&HD Rank	DUI Rank	Early LW	Late LW
20AR173/174	Interior	Interior	River	Moderate	Limited		
20AR245	Interior	Interior	River	Increased	Limited		x
20AR310	Interior	Interior	Lake	Increased	Limited		x
20AR338	Coastal	Superior		Moderate	Limited		x
20AR348	Coastal	Superior		Moderate	Extended	x	x
20AR358/386	Coastal	Superior		Mimimal	Limited	x	x
20AR406	Coastal	Superior		Mimimal	Limited		
20AR435	Coastal	Superior		Moderate	Limited		
20AR437	Interior	Interior	Lake	Increased	Intermediate		x
20AR495	Coastal	Superior		Mimimal	Intermediate		
20AR6	Coastal	Superior		Mimimal	Intermediate		
20CH171/172	Interior	Interior	Lake	Increased	Intermediate		
20CH2	Coastal	Superior		Mimimal	Intermediate	x	x
20CH32/433	Coastal	Superior		Increased	Limited	x	x
20CH492	Coastal	Superior		Mimimal	Limited		x
20CH86	Coastal	Superior		Mimimal	Limited		
20CH95	Coastal	Superior		Mimimal	Extended		x
20DE106	Coastal	Michigan		Increased	Limited		
20DE108	Coastal	Michigan		Mimimal	Limited		x
20DE167	Coastal	Michigan		Moderate	Limited		x
20DE188	Interior	Interior	River	Mimimal	Intermediate		
20DE236	Coastal	Michigan		Moderate	Limited		x
20DE294	Interior	Interior	River	Moderate	Limited		
20DE296	Coastal	Michigan		Moderate	Intermediate		x
20DE326	Interior	Interior	Lake	Increased	Limited		x
20DE378	Interior	Interior	River	Mimimal	Intermediate	x	x
20DE43	Interior	Interior	Lake	Moderate	Limited		x
20DE459	Interior	Interior	Lake	Moderate	Limited		
20DE50	Interior	Interior	River	Increased	Limited		
20DE75	Interior	Interior	River	Moderate	Limited		x
20DE85	Coastal	Michigan		Moderate	Limited		x
20DE93	Interior	Interior	River	Moderate	Intermediate		
20MK159	Coastal	Huron		Moderate	Limited	x	
20MK24	Coastal	Michigan		Mimimal	Intermediate	x	x
20MK261	Coastal	Huron		Mimimal	Extended	x	
20MK3/11	Coastal	Huron		Mimimal	Limited		
20MK334	Interior	Interior	Lake	Increased	Limited		
20MK58	Coastal	Huron		Mimimal	Limited		x
20MK90	Coastal	Michigan		Increased	Intermediate	x	
20ST109/110	Interior	Interior	Lake	Increased	Intermediate		x
20ST14	Interior	Interior	Lake	Moderate	Limited		x
20ST227	Interior	Interior	River	Moderate	Limited		
20ST233	Interior	Interior	Lake	Moderate	Limited		
20ST262	Interior	Interior	Lake	Increased	Limited		

Table 83: 150 m Radius Catchment Data (SS&HD and DUI Ranks)

Appendix S:

1500 m Radius Catchment Data (SS&HD and DUI Ranks)

State No.	Setting	Setting 2	SS&HD Rank	DUI Rank	Early LW	Late LW
20AR173/174	Interior	River	Moderate	Limited		
20AR245&AR437	Interior	Lake	Increased	Intermediate		x
20AR310	Interior	Lake	Increased	Limited		x
20AR338 Cluster of 4	Coastal	Superior	Minimal	Limited		x
20AR348 Cluster of 4	Coastal	Superior	Minimal	Extended	x	x
20AR358&AR359	Coastal	Superior	Minimal	Limited	x	x
20AR435	Coastal	Superior	Moderate	Limited		
20AR495	Coastal	Superior	Minimal	Intermediate		
20CH171/172	Interior	Lake	Increased	Intermediate		
20CH2	Coastal	Superior	Minimal	Intermediate	x	x
20CH32/433	Coastal	Superior	Moderate	Limited	x	x
20CH492	Coastal	Superior	Minimal	Limited		x
20CH86	Coastal	Superior	Minimal	Limited		
20CH95	Coastal	Superior	Moderate	Extended		x
20DE106	Coastal	Michigan	Increased	Limited		
20DE108	Coastal	Michigan	Minimal	Limited		x
20DE167 Cluster of 3	Interior	River	Increased	Intermediate		x
20DE188	Interior	River	Moderate	Intermediate		
20DE236	Coastal	Michigan	Moderate	Limited		x
20DE296	Coastal	Michigan	Minimal	Intermediate		x
20DE326	Interior	Lake	Minimal	Limited		x
20DE378	Interior	River	Minimal	Intermediate	x	x
20DE43	Interior	Lake	Moderate	Limited		x
20DE459	Interior	Lake	Moderate	Limited		
20DE50	Interior	River	Moderate	Limited		
20DE75	Interior	River	Moderate	Limited		x
20DE85	Coastal	Michigan	Minimal	Limited		x
20MK159/261	Coastal	Huron	Minimal	Extended	x	
20MK24	Coastal	Michigan	Increased	Intermediate	x	x
20MK3/11	Coastal	Huron	Moderate	Limited		
20MK334	Interior	Lake	Minimal	Limited		
20MK58/375	Coastal	Huron	Increased	Limited		x
20MK90	Coastal	Michigan	Increased	Intermediate	x	
20ST109/110&ST262	Interior	Lake	Increased	Intermediate		x
20ST14&ST233	Interior	Lake	Increased	Limited		x
20ST227	Interior	River	Increased	Limited		

Table 84: 1500 m Radius Catchment Data (SS&HD and DUI Ranks)

Appendix T:

Fall and Spring Spawning Fish at Extended and Intermediate Diversity Sites

Site (Phase)	Basin/Region	Fall Spawning	Spring Spawning	Early/Late	Sensitivity	Big Game
20MK1 (Mackinac)	Straits	x	x	E	M	x
20MK22 (Mackinac)	Michigan	x	x	E	H	x
20MK261[1]	Straits	-	x	E	M	-
20AR348	Superior	x	x	E/L	H	x
20CH6	Huron	-	x	E/L	L	x
20CH95[2]	Superior	-	x	L	M	x
20DE4 (proto-HST)	Michigan	-	-	L	M	x
20MK1 (Bois Blanc)	Straits	x	x	L	M	x
20MK1 (Juntunen)	Straits	x	x	L	M	x
20MK22 (Bois Blanc)	Michigan	x	x	L	H	x
20MK22 (Juntunen)	Michigan	x	x	L	H	x

[1]=Whitefish family (Coregoninae) present, but not identified to species

[2]= Gill net sinkers recovered

Table 85: Extended Diversity Sites

Site (Phase)	Basin/Region	Fall Spawning	Spring Spawning	Early/Late	Sensitivity	Big Game
20MK169/457 (Early)	Straits	x	x	E	M	x
20MK90	Straits	-	x	E	M	-
20DE4 (Oneota)	Bay de Noc	-	x	L	M	x
20DE296	Bay de Noc	x	x	L	M	x
20MK169/457 (Bois Blanc)	Straits	x	-	L	M	x
20AR359[1]	Superior	x	x	L	H	-
20AR437	Interior	-	x	L	H	x
20DE75[2]	Interior	-	x	L	H	-
20DE188	Interior	-	x	L	M	-
20ST1	Michigan	x	x	E/L	M	x
20MK169/457 (Mixed)	Straits	x	x	E/L	M	x
20MK54	Straits	x	x	E/L	M	-
20MK61	-	x	x	E/L	M	-

[1]=20AR359 is coded as limited diversity, but is part of a 150 m radius cluster with 20AR358 which is intermediate diversity

[2]=20DE75 is coded as limited diversity

Table 86: Intermediate Diversity Sites

Appendix U:

Sites Associated with Wild Rice Locales

State No.	LWSM Rank	DUI Rank	Setting	Early LW	Late LW	150 m Rank	1500 m Rank
20AR245	High	Limited	River	-	x	Increased	Increased
20AR310	High	Limited	Lake	-	x	Increased	Increased
20AR437	High	Intermediate	Lake	-	x	Increased	Increased
20CH171/172	Medium	Intermediate	Lake	-	-	Increased	Increased
20CH6	Low	Extended	Great Lake	x	x	-	-
20DE106	High	Limited	Great Lake	-	-	Increased	Increased
20DE326	High	Limited	Lake	-	x	Increased	Minimal
20DE50	High	Limited	River	-	-	Increased	Moderate
20MK334	Medium	Limited	Lake	-	-	Increased	Minimal
20MK90	High	Intermediate	Great Lake	x	-	Increased	Increased
20ST109/110	High	Intermediate	Lake	-	x	Increased	Increased
20ST262	High	Limited	Lake	-	-	Increased	Increased

Table 87: Sites Associated with Wild Rice Locales

Appendix V:

Sites in Mixed Pine Habitats

State No.	Setting	LWPM Rank	DUI Rank	Lake	Early LW	Late LW
20AR245	Interior	High	Limited	Michigan		x
20AR310	Interior	High	Limited	Michigan		x
20AR348	Coastal	High	Extended	Superior	x	x
20AR350	Coastal	High	Limited	Superior		
20AR353	Coastal	High	Intermediate	Superior		
20AR359	Coastal	High	Limited	Superior	x	x
20AR398	Coastal	High	Limited	Superior		x
20AR400	Coastal	High	Limited	Superior		
20AR435	Coastal	High	Limited	Superior		
20AR437	Interior	High	Intermediate	Michigan		x
20CH32	Coastal	High	Limited	Superior	x	x
20CH433	Coastal	High	Limited	Superior		
20DE106	Coastal	High	Limited	Michigan		
20DE236	Coastal	Medium	Limited	Michigan		x
20DE326	Interior	High	Limited	Michigan		x
20DE333	Coastal	High	Intermediate	Michigan		x
20DE43	Interior	High	Limited	Michigan		x
20DE459	Interior	High	Limited	Michigan		
20DE50	Interior	High	Limited	Michigan		
20DE7	Coastal	High	Intermediate	Michigan		
20DE75	Interior	High	Limited	Michigan		x
20DE85	Coastal	High	Limited	Michigan		x
20MK22	Coastal	High	Extended	Michigan	x	x
20MK24	Coastal	Medium	Intermediate	Michigan	x	x
20MK90	Coastal	High	Intermediate	Michigan	x	
20ST109/110	Interior	High	Intermediate	Michigan		x
20ST14	Interior	High	Limited	Michigan		x
20ST227	Interior	High	Limited	Michigan		
20ST233	Interior	High	Limited	Michigan		
20ST262	Interior	High	Limited	Michigan		

Table 88: Sites in Mixed Pine Habitats

Appendix W:

Extended Diversity Sites

State No.	Great Lake	LWPM Rank	DUI Rank	Early LW	Late LW	Occupations
20AR348	Superior	High	Extended	x	x	Late Archaic - Contact
20CH6	Huron	Low	Extended	x	x	Middle Woodland - Contact
20CH95	Superior	Medium	Extended		x	Middle Woodland - Late Woodland
20DE4 (Protohistoric)	Michigan	Medium	Extended		x	Middle Woodland - Contact
20MK1 (Bois Blanc)	Huron	Medium	Extended		x	Middle Woodland - Contact
20MK1 (Juntunen)	Huron	Medium	Extended		x	Middle Woodland - Contact
20MK1 (Mackinac)	Huron	Medium	Extended	x		Middle Woodland - Contact
20MK22	Michigan	High	Extended	x	x	Multiple Late Woodland Components
20MK261	Huron	Medium	Extended	x		Middle Woodland - Early Late Woodland

Table 89: Extended Diversity Sites

Appendix X:

Ceramics Data

State Number	Early Type	Late Type	Setting	LWPM Rank	FDUI Rank	Great Lake	Locality
20AR245		Point Sauble	Interior	High	Limited	Michigan	Indian River
20AR348	Madison	Sand Point	Coastal	High	Extended	Superior	Grand Island
20AR358/386		Sand Point	Coastal	Medium	Limited	Superior	Grand Island
20AR359		Sand Point	Coastal	High	Limited	Superior	Grand Island
20AR437		Oneota	Interior	High	Intermediate	Michigan	Indian River
20CH2	Mackinac	Bois Blanc	Coastal	Medium	Intermediate	Superior	Whitefish Bay
20CH32	Mackinac		Coastal	High	Limited	Superior	Whitefish Bay
20CH43		Bois Blanc	Coastal	Medium	Limited	Huron	N. Lake Huron
20CH45		Juntunen	Coastal	Low	Limited	Huron	N. Lake Huron
20CH492		Juntunen	Coastal	Medium	Limited	Superior	Whitefish Bay
20CH6	Mackinac	Iroquoian	Coastal	Low	Extended	Huron	N. Lake Huron
20CH95		Sand Point	Coastal	Medium	Extended	Superior	Whitefish Bay
20DE108		Sand Point	Coastal	Medium	Limited	Michigan	Bay de Noc
20DE17	Mackinac		Coastal	Medium	Limited	Michigan	Bay de Noc
20DE236		Oneota	Coastal	Medium	Limited	Michigan	Bay de Noc
20DE296		Sand Point	Coastal	Medium	Intermediate	Michigan	Bay de Noc
20DE326		Oneota	Interior	High	Limited	Michigan	Indian River
20DE333		Oneota	Coastal	High	Intermediate	Michigan	Bay de Noc
20DE4 (O/LW)		Oneota	Coastal	Medium	Extended	Michigan	Bay de Noc
20DE7	Heins Creek		Coastal	High	Intermediate	Michigan	Bay de Noc
20DE75		Oneota	Interior	High	Limited	Michigan	Sturgeon River
20MK1	Mackinac	Juntunen	Coastal	Medium	Extended	Huron	Mackinac Straits
20MK102	Mackinac	Juntunen	Coastal	Medium	Limited	Huron	Mackinac Straits
20MK159	Mackinac		Coastal	Medium	Limited	Huron	Mackinac Straits
20MK169/457	Mackinac	Iroquoian	Coastal	Medium	Intermediate	Huron	Mackinac Straits
20MK19	Mackinac		Coastal	Medium	Limited	Huron	Mackinac Straits
20MK22	Mackinac	Oneota	Coastal	High	Extended	Michigan	N. Lake Michigan
20MK239		Juntunen	Coastal	Medium	Limited	Huron	Mackinac Straits
20MK24	Spring Creek		Coastal	Medium	Intermediate	Michigan	Mackinac Straits
20MK261	Mackinac		Coastal	Medium	Extended	Huron	Mackinac Straits
20MK53		Juntunen	Coastal	Medium	Limited	Huron	Mackinac Straits
20MK54	Mackinac	Juntunen	Coastal	Medium	Intermediate	Huron	Mackinac Straits
20MK61	Mackinac	Juntunen	Coastal	Medium	Limited	Huron	Mackinac Straits
20MK90	Mackinac		Coastal	High	Intermediate	Michigan	Mackinac Straits
20ST1		Oneota	Coastal	Medium	Intermediate	Michigan	N. Lake Michigan
20ST109/110		Oneota	Interior	High	Intermediate	Michigan	Indian River
20ST14		Oneota	Interior	High	Limited	Michigan	Indian River

Table 90: Ceramics Data

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