McNair Scholars Journal

Volume 14 | Issue 1 Article 5

2010

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Abstract

To predict undiscovered archaeological sites in the Lower Grand River, we mapped known archaeological sites using color and infrared aerial photos, digital raster graphics, and digital elevation models. We interpreted the geomorphic settings of sites using this preliminary geographic information system. We found both spatial and temporal patterns in site location.

The Lower Grand River valley is cut into Quaternary glacial sediments that formed in front of the retreating Laurentide ice sheet roughly ~16,000 to 13,000 years before present (B.P.). The first inhabitants were the Paleo-Indian culture, which occupied the valley ~11,000 B.P. The following Archaic period spans from ~10,000 to 5,000 B.P. Between ~6,000 and 5,000 B.P., a transgression inundated much of the Lower Grand River Valley. By ~4,000 B.P., Lake Michigan had reached its current level, resulting in down cutting of the Grand River. The evidence for this is a stream terrace at elevations between 590 and 610 feet a.m.s. For the last 4,000 years, the base level of the river has stayed relatively the same, and lake levels have fluctuated by about two meters. The following Woodland (~3,000 to 400 B.P.) and Historic periods had a climate similar as present.

The frequency of sites in the valley decreases from higher elevations to lower elevations. The majority of the sites are from the Woodland and Historic periods, and they occupy all surfaces. Most sites are associated with resource gathering and camps, while larger, more permanent occupations are located on alluvial surfaces within the valley.

Introduction

The prehistoric and historic occupation of Ottawa County, Michigan is directly associated with the Grand River. The discovery of archaeological sites along this stretch of river has relied upon the intuition and diligence of many archaeologists in the twenty-first century (Brashler and Mead 1996). One frequently used method of discovering archaeological sites has been surveys (Brashler and Mead 1996). Traditional surveys are often used in which individuals scan the surface for artifacts. The preferred method is shovel testing, which involves shallow pit testing at a determined interval along a series of transects. The fruits of these labors have resulted in the discovery of a rich archaeological record with numerous sites found by amateurs, professionals, and cultural resource management firms. The development of Ottawa County in the last century has damaged this irreplaceable resource (Kingsley 1981). It is likely that a majority of the archaeological sites along this section of the Grand River have been destroyed (Kingsley 1981).

The goal of this study is to better understand the distribution of archaeological sites in the region with respect to their relationship to the geomorphic setting. By entering known site locations surrounding the Grand River in Ottawa County into a geographic system program, we produced a geographic map. From this map, we assigned these sites to different categories based on our interpretations of the geomorphic landscapes they occupy. Through the analysis of this map, we found both spatial and temporal relationships. It is the effort of this study to aid future work in the area by limiting the amount of time spent on locating undiscovered sites.

The Grand River is the most extensive river system in Michigan, and the watershed incorporates roughly 5,572 square miles. The Grand River's watershed covers almost a third of the southern portion of Michigan's Lower Peninsula and

extends from the western shores of Lake Michigan well into the center of the state. Although the Grand River flows westward towards Lake Michigan, its many tributaries offer access to other nearby rivers that flow toward eastern Great Lakes, such as Lake Huron and Lake Erie (Brashler and Mead 1996). Due to the size of the Grand River watershed, it has been influential in the exploration and later migration of cultures during prehistoric and historic times (Brashler and Mead 1996).

The stretch of the Grand River that is the focus of this study begins down river from an 18 foot drop in river elevation at the former rapids of Grand Rapids, Michigan, until it reaches its effluence with Lake Michigan in the city of Grand Haven. Between these two points, the Grand River Valley is eroded entirely in Quaternary glacial sediments. Bedrock in Ottawa County is buried by anywhere from 50 to 350 feet of glacial sediments (Colgan and Stark 2005; Colgan 2008). Bedrock units encountered directly below glacial sediments in Ottawa County are of the Coldwater Shale, the Marshall Sandstone, and the Michigan Formation (Milstein 1987).

Figure 1: The area of study is located in Western Michigan as the Grand River enters Ottawa County and reaches its mouth into Lake Michigan in the city of Grand Haven.

Geomorphic History

Michigan has been glaciated at least a dozen times during the Quaternary Period ~2.5 million years to ~11,000 years ago, but only deposits of the last glaciation have conclusively been dated in Michigan (Larson and Schaetzl 2001). In the western Great Lakes region, in states such as Wisconsin, there is evidence for at least six glaciations (Syverson and Colgan 2004).

The last glacial cycle of the current ice age (called the Wisconsinan Glaciation) began about 115,000 years ago and ended approximately 11,000 years ago. This glaciation had two cold phases in the early and late Wisconsinan with one warmer phase when the ice temporally retreated (the middle Wisconsinan). The early Wisconsinan Glaciation reached maximum ice extent between 80,000 to 65,000 years ago. Evidence for an early Wisconsinan glaciation in Michigan is equivocal (Eschman 1980; Winters, et al. 1986). The late Wisconsinan Glaciation began about 35,000 years ago, and most of the surface glacial sediments in Michigan are probably of this age. Ice reached its late Wisconsinan maximum approximately 23,000 years ago (Mickeslon, et al. 1983). At this time ice extended all the way to central Illinois and southern Indiana. The state of Michigan was probably covered with at least 1000 meters of glacier ice at this time (Clark 1992). By 16,500 the ice sheet was rapidly retreating, and the terminus of three ice lobes were retreating back into Michigan, the Lake Michigan, Saginaw, and Erie Lobes (Mickelson, et al. 1983).

During deglaciation the Grand River Valley was probably formed as a proglacial valley, carrying meltwater from the retreating Saginaw Lobe (Bretz 1953; Kehew 1993). As the ice sheet retreated out of the lowlands that would become the Great Lakes, large glacial lakes formed in front of the retreating ice. Three glacial lakes existed in Michigan from about 16,500 to 13,000 years ago. These were from west to east: Glacial Lakes Chicago, Saginaw, and Whittlesey (Mickelson, et al. 1983). During deglaciation the Grand River valley served as a spillway for lake overflows that carried water from Glacial Lake Saginaw to Glacial Lake Chicago (Bretz 1953; Kehew 1993). During this time the Grand River was an unpredictable environment, with flashy discharge, braided channels, and uplands covered by bare sediment and/or tundra. Broad high river terraces made up of sand and gravel along the lower Grand River provide evidence of this stage (Bretz 1953).

By 12,500 years ago, the climate warmed enough for the tundra to disappear, and spruce and pine took a foothold in the landscape (Clayton, et al. 2001; Howard 2010). Pollen records show that by 11,000 years ago, forests dominated by spruce and pine covered most of Michigan (Kapp 1999), and after 8,000 years ago mixed deciduous forests of pine, oak, hickory, and beech spread into the area (Kapp 1999). During the Holocene the river came to be more like its modern form. Seasonal discharge combined with low sediment load led to a slightly meandering stream with wide shallow channel, point bars, and cut off channels.

Human History

The Grand River extends through most of Lower Michigan, and this geographic position would have made it a locus of many different needs of prehistoric residents (Brashler and Mead 1996). It has been suggested that the Grand River was used extensively for transportation through a great portion of Michigan due to the extent of its length and its east-west bearing (Brashler and Mead 1996). Associated with the Grand River are many natural resources that would have attracted the attentions of local populations (Brashler and Mead 1996; Kingsley 1981). In the Lower Grand River, there are many different environments that produce resources, such as water fowl, and fish in wetlands (Brashler and Mead 1996). This includes local stands of nut bearing trees such as oak and hickory, and the sap of sugar maple (Brashler and Mead 1996). These stands of trees would have offered a bounty of resources during different seasons (Brashler and Mead 1996). These readily available resources imply that archaeological sites were most likely located throughout the drainage basin and were related to the exploitation of the landscape (Brashler and Mead 1996).

Archaeological investigations of the Grand River basin began in the later portion of the 19th century and have received sporadic attention since then (Brashler and Mead 1996). Kingsley's (1981) study of the spatial occurrence

of Middle Woodland sites in southern Michigan produced a model centered on resource gathering being the primary factor in site location. These environmental factors produce a predictable site model that places "village" sites on stream terraces and levees within the flood plain, while mounds and other earthworks are found in higher elevations (Kingsley 1981). Kingsley's (1981) model describes the geographic position of "villages" on well drained soils that are not frequently flooded, yet these are the same places that are commonly farmed, which most likely has disturbed or destroyed many of these sites (Brashler and Mead 1996). With further survey and the use of "deep-testing," it is possible, if not probable, that buried horizons that were once occupied by ancient peoples can be discovered (Brashler and Mead 1996).

Here we explore the relationship between the location of archaeological sites and their relationship to the geomorphic settings. As mentioned above, the use and occupation of the Lower Grand River is reflected in the geographic and geomorphic landscapes the sites occupy. We have explored the spatial and temporal relationships of all known archaeological sites in the study area and discovered trends that can be used in future land management and archaeological studies.

Methods

In order to better understand site location and frequency along the Grand River in Ottawa County, Michigan, townships were chosen by their relative geographic proximity to the river. All but two of the townships in the study area include the Grand River within the township borders. Two townships that were originally considered were disregarded because of the absence of archeological sites. The townships that are included are as follows: Allendale, Blendon, Crockery, Georgetown, Grand Haven, Polkton, Robinson, Spring Lake, Tallmadge, and Wright.

ESRI product ArcGIS 9.3.1 was used to digitally map all of the data collected. The digital raster graphic, digital elevation model, and orthorectified aerial photos used to produce the base map were accessed online from the Center for Geographic Information Department of Information Technology's Michigan Geographic Data Library. The projected coordinate system for the base map is the NAD 1983 Hotline Oblique Mercator Azimuth Natural. The individual site locations were input separately into the base map from notes and copied USGS topographic maps attained through the Michigan Office of the State Archaeologist, MSHDA. I was assisted by the Assistant State Archaeologist in accessing the state archaeological site file.

The archaeological site files contain an abundance of information, which is represented in Table 1. After the construction of the base map, the individual sites were compiled into a data base. The study data base contains only relevant data from the archaeological site that is pertinent to this study. Two categories were created for the study database. The first of these is if the site was considered to be insubstantial. An insubstantial site is determined by an extremely low artifact density. The interpreted geomorphic category is the second addition.

One hundred and eighty archaeological sites were input into the base map. Due to the absence of exact locations reported in the state archaeological files, some sites were placed in the designated area that were indicated on the topographic maps held at the Office of the State Archaeologist. Once the sites were entered into the base map, they were interpreted into six categories based on what geomorphic landscape they occupied. One of the categories is the *Modern Floodplain* for sites that are found close to the river and have low elevations. Another category is *Levees and Splays*. These geomorphic landforms are not included in the modern floodplain category because they have a notable rise in elevation above the modern floodplain. Sites found near and on a river terrace that occurs between 590 and 610 feet above the median sea level are designated as the *Pleistocene terrace 1* (Pt1). Most sites that are located well above the modern floodplain, often signified by an extreme increase in elevation, are categorized as *Uplands*. Sites found on an isolated landform that exhibit a drastic increase in elevation are noted as *Pleistocene terrace 2* (Pt2); this is a unique landform which is detached from the uplands. The final category is the *Artificial slope*. This is a designation for the few sites that are found on manmade landforms.

Results

The first inhabitants of Michigan are known as the Paleo-Indians, and their presence is only traceable by distinct cultural materials (Shott and Wright 1999). These early inhabitants probably arrived in Michigan around 12,000 and 10,000 B.P. as soon as the area became ice free, yet it is important to note that there are only five published sites that provide evidence for this early occupation (Shott and Wright 1999). The amount of evidence for Paleo-Indian occupation found in the archaeology site files of the study area is limited to a few sites. One site is a single find spot in which a fluted biface projectile point has been located and identified as a Hi-Lo point (Flanders 1983). Hi-Lo points are considered to be a material culture that lies on the ambiguous differentiation between the Paleo-Indian and Early Archaic periods; it is a fluted biface point. The site in which points take their name from is located in Macomb County, Michigan (Monaghan and Lovis 2005; Shott 1999). A fluted biface point is a projectile point that has one or more channels running the length of the point which are produced when "flakes" have been deliberately removed to secure the point to a shaft (Shott and Wright 1999). The Paleo-Indian period in Michigan is one of the shorter periods and only lasts roughly 2,000 years in Michigan (Shott 1999). As the environment changed with the further deglaciation of the region, the inhabitants changed their economy and subsistence patterns to the demands of this new environment (Shott 1999).

The Archaic period follows the Paleo-Indian period, which spanned from 10,000 to 5,000 B.P. (Monaghan and Lovis 2005). The Archaic period is divided into three subcategories designated Early, Middle, and Late, which are separated by changes in environment and subsistence patterns (Shott 1999; Lovis 1999; Robertson, et. al.1999). The division of the Archaic period and the Paleo-Indian period is barely distinguishable, and the demarcation of these two time periods is based on

the absence of biface fluting in their lithic industry (Shott 1999). The sub-sectioning of archaeological periods can be deceiving, in that it can at times blur the lines of interpretation in which some subsections are considered to stand alone, and inferences drawn across the periods may be neglected (Shott 1999). Although this approach to studying the past has its limitations, it does break up the volumes of information into easier, more approachable shorter periods of time (Shott 1999).

As the Archaic period unfolded in Michigan, many changes occurred in how these early inhabitants interacted with their environment. The most important of these is the change in subsistence patterns, the evolution of the lithic industries, the use of ground stone tools, and the trade in native copper, this diverse collection of artifacts reflecting a broader spectrum of subsistence (Shott 1999; Lovis 1999; Robertson, et. al.1999). At this time, the water levels of the Great Lakes were in a constant flux, and it is likely that many Archaic period sites have either been inundated or buried under alluvium (Shott 1999). This apparent absence of sites has resulted in interpretations of Michigan's Archaic population as sparse due to the climate (Shott 1999). This interpretation has been largely discredited by accommodating the Archaic Sites that are not currently accessible (Shott 1999).

The sophistication of subsistence patterns during the Archaic period focused on hunting and gathering, and it began to shift toward cultigens during Woodland period (Garland and Beld 1999). The Woodland period is also subdivided into Early, Middle, and Late (Monaghan and Lovis 2005; Garland and Beld 1999; Holman and Brasher 1999; Kingsley 1999; Stothers 1999). Traditionally, the introduction of pottery into the tool set of these early peoples demarkates the Woodland period from the Archaic (Garland and Beld 1999). In Michigan, pottery began to appear in the archaeological record around 2500 B.P. (Garland and Beld 1999). The subsistence patterns during this period began to utilize cultigens, such as squash and sunflower (Garland and Beld 1999). Another distinguishing feature of the Woodland period is the use of burial mounds in mortuary practices and the construction of earthwork enclosures (Halsey1999). This suggests that there was an increase in social interactions as time progressed into the Late Woodland (Garland and Beld 1999).The use of burial mounds in parts of the state reflects what is considered to be Hopewell tradition (Kingsley 1999; Halsey 1999). The extensive use of burial mounds and the adoption of the Hopewell tradition likely represent influences from southern cultures in Michigan's Lower Peninsula (Kingsley 1999; Halsey 1999). At the culmination of the Woodland period, the social structures which European traders and other explorers would find were developing and thriving in the region (Holman and Brashler 1999).

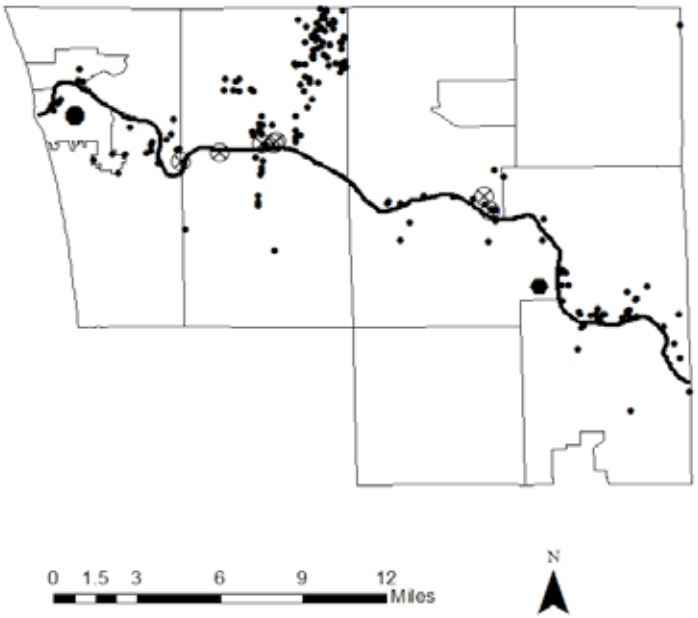

Figure 2. The resulting geographic map displayed here depicts the archaeological sites as small black dots. Village sites are circles with X in the center. The Grand River is the dark line winding east-west through the map. The GVSU campus is the large black hexagon in the eastern portion of the map and the other hexagon is the city of Grand Haven.

The final archaeological period in Michigan is the Historic period, which begins in the mid-seventeenth century and continues till modern times (Cleland 1999). The division of the Historic period is very different from the others because it is subdivided by known cultural affiliations. Some Historic archeologists focus on the discovery of the complex relationship between the Native Americans and the European military, explorers, traders, settlers, and missionaries during the settlement of Michigan (Cleland 1999). The Historic period is divided into subcategories by individual Western powers that become influential in the region, and they include the French, British, and American periods (Heldman, et. al. 1999; Pilling and Anderson 1999; Branster 1999). The Historic period contains the most complex archaeological record and is aided by historic writings.

One of the results of this study is a preliminary geographic map (Figure 2), which we used to interpret the geomorphic settings of each site. The map illuminates the relationship between archaeological site locations and their proximity to the river and its tributaries. A significant portion of the sites are found near the river itself. Sites that have been identified as villages are all located near the river. A majority of the sites are found near the many tributaries to the Grand River. The tributary known as Crockery Creek exhibits the highest frequency of sites. There is one notable exception to this trend, which lies in the north east portion of the study area. It occurs on the shore of a naturally occurring lake called Cranberry Lake. A series of sites across from Crockery Creek appear to form a linear feature. This resulted from the parameters of a survey in that area which was conducted by a cultural resource management firm, and it does not represent a tributary to the river.

All prehistoric and historic periods are found within the study area. Sites from more recent periods are more prevalent (Figure 3). The frequency of sites within the different geomorphic categories discloses that a majority of the sites lie on the uplands (Figure 4). The relationship is less drastic after insubstantial sites are not considered (Figure 5). Most of the remaining sites occupy lower elevations near or on the modern flood plain.

The sites exhibit different trends in geomorphic classification in each archaeological period (Figure 6). Paleo-Indian Period sites rarely occur and are not located below the Pleistocene Terrace 1. Woodland and Archaic Period sites follow a similar trend with the largest number of sites occupying the Uplands, with progressively fewer sites as the elevation decreases. The Historic period does not follow this trend. It is the only period that has a site on an artificial slope. Most of the Historic sites occupy both the uplands and the modern flood plain in high frequency while having a significant number of sites on the Pleistocene terrace 1.

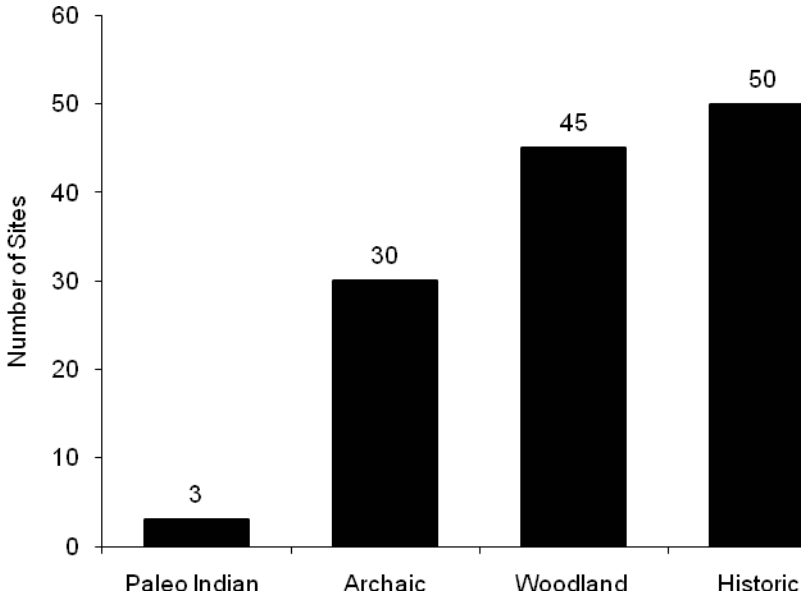

Figure 3. The histogram represents the number of sites within the study area and how they relate to the archaeological periods present in the area.

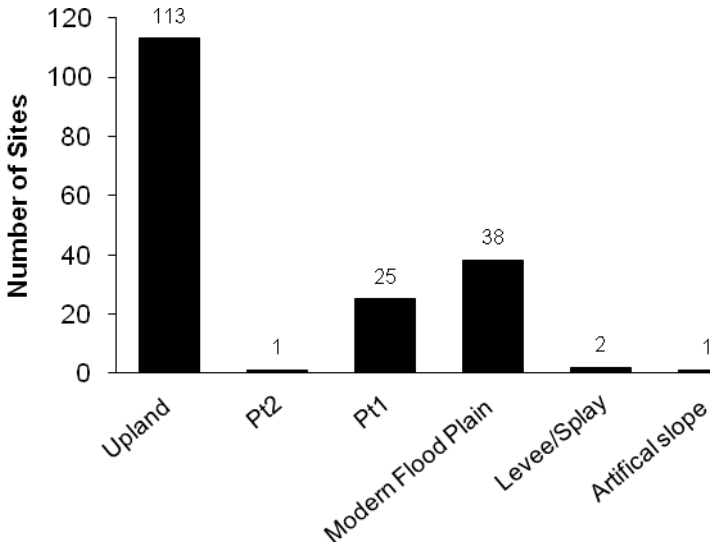

Figure 4. This represents all the archaeological sites categorized into their geomorphic and environmental settings.

Discussion

A significant finding of this study is that site location has a tendency to congregate along the various tributaries to the Grand River. The utilization of the riverine system in prehistoric times is most likely tied to the substance patterns of the individual groups. Brashler and Mead (1996) mention that, in the Woodland period, the riverine systems of the Lower Grand River likely produced ample waterfowl and fish as well as important trees, such as sugar maple. A majority of the sites associated with the small tributaries are light in artifact density and are commonly identified as camp sites or collection sites. This supports the argument that it was a source of subsistence.

All of the village sites that are in the study area are found near the Grand River and its tributaries. All but one of the village sites is prehistoric in age. These prehistoric villages are found on elevated terrains near the river. This supports Kingsley's (1981) argument that the villages are found on these well drained soils. These sites are the likely origins of the individuals who produced the smaller sites throughout the study area.

The increase in site frequency from early periods to more recent times could be interpreted as a gradual increase in population. This evidence may be misleading because of the changing environmental conditions during the Archaic period, which experienced a transgression of lake water into the lower Grand River that likely buried or destroyed sites in the lower elevations of the river (Shott 1999; Monaghan and Lovis 2005). There are fewer Archaic sites on the modern flood plain, which may support Shott's (1999) theory that some of the sites have been destroyed or buried. This destruction would skew the interpretation of population sizes during prehistoric times. Future exploration of the region for archaic sites should keep in mind that exploring for their sites in lower elevation may require more extensive excavation.

Like past archaeological work, future excavation in the lower Grand River will be driven by either the necessity of cultural resource management or research interests. Due to this, some of the data that is persevered within the Archaeological Site files of the Michigan Archaeologist may be skewed to favor one particular archaeological period. The diligence of decades of work has produced a comprehensive understanding of the region. Although it has been driven by various methods and research goals, the overall picture covers all the terrains that were scrutinized in this study. Future archaeological work in the area would benefit from diversifying the areas in their study to include terrains from the modern flood plain to the uplands. All of the archaeological periods are found in the uplands, and, although more artifact dense village sites are found in the low lands, not investigating the uplands could result in a misinterpretation of subsistence patterns.

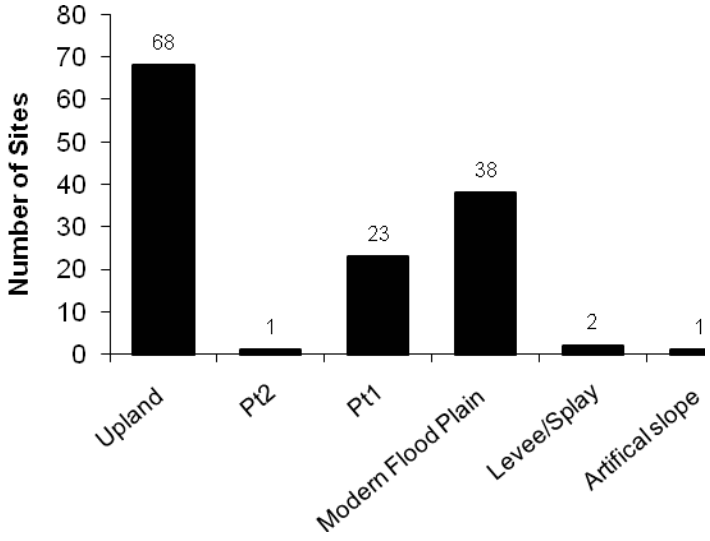

Figure 5. Archaeological sites that contain significant amount of material culture are categorized into the different geomorphic settings.

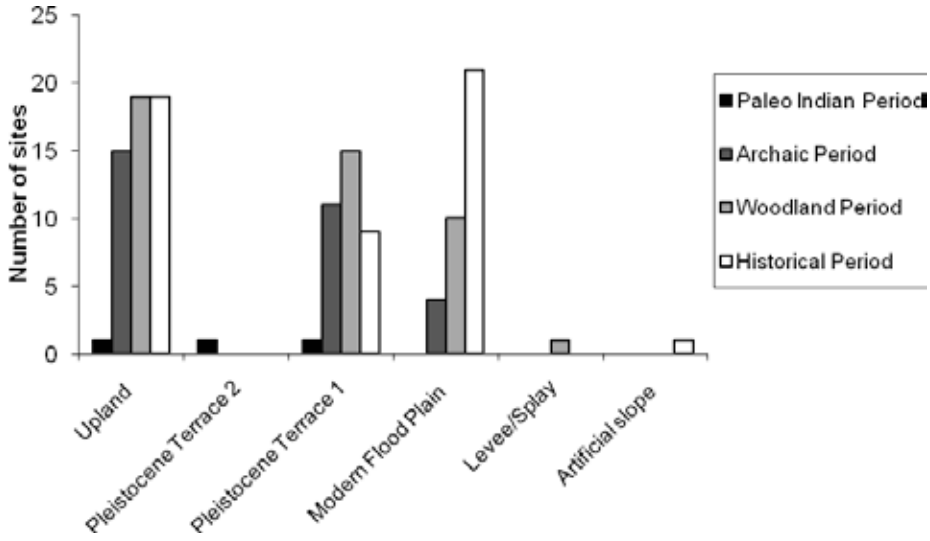

Figure 6. Archaeological sites that have been sufficiently identified and categorized into a known cultural period are placed into their geomorphic and environmental settings.

References

Branster, M.C., 1999, Euro-American archaeology in Michigan: The American Period, *In:* Halsey J.R., ed., Retrieving Michigan's Buried Past: The Archaeology of the Great Lakes State: Bloomfield Hills, Michigan, Cranbrook Institute of Science, p. 317-322.

Brashler, J.G., and Mead, B.E., 1996, Woodland archaeology in the Grand River Basin, *In* Holman H.B., Brashler J.G., and Parker K., eds., Investigating the Archaeological Record of the Great Lake State: Essays in Honor of Elizabeth Baldwin Garland: Kalamazoo, Michigan, New Issues Press, p. 181-249.

Bretz, J.H., 1953, Glacial Grand River, Michigan: Michigan Academy of Science, Arts, and Letters, Papers, v. 38, p. 359-382.

Clark, P.U., 1992, Surface form of the southern Laurentide Ice-Sheet and its Implications to ice sheet dynamics: Geological Society of America Bulletin, v.104, no. 5, p. 595-605.

Cleland, C.E., 1999, Cultural Transformation: The archaeology of Historic Indian sites in Michigan, *In:* Halsey J.R., ed., Retrieving Michigan's Buried Past: The Archaeology of the Great Lakes State: Bloomfield Hills, Michigan, Cranbrook Institute of Science, p. 279-290.

Clayton, L., Attig, J.W., and Mickelson, D.M., 2001, Effects of late Pleistocene permafrost on the Landscape of Wisconsin, USA: Boreas, v. 30, p. 173–188.

Colgan, P.M., 2008, Evidence of Subglacial and Glaciolacustrine Deposition on Grand Valley State University Campus: Michigan Academician, v. 38, no. 4, p. 57.

Colgan, P.M., and Stark, J.M., 2005, Quaternary Geology of the Muskegon East, Michigan 7.5 Minute Quadrangle: Michigan Department of Environmental Quality, map scale 1:24,000.

Eschman, D.F., 1980, Some Evidence of Mid-Wisconsinan Events in Michigan: Michigan Academician, v. 13, no. 4, p. 423-436.

Flanders, R.E., 1983, A Late Paleoindian Point from Jenison: The Coffinberry News Bulletin, v. 30, no. 9, p. 29.

Garland, E.B., and Beld, S.G., 1999, The Early Woodland: Ceramics, Domesticated Plants, and Burial Mounds Foretell the Shape of the Future, *In:* Halsey J.R., ed., Retrieving Michigan's Buried Past: The Archaeology of the Great Lakes State: Bloomfield Hills, Michigan, Cranbrook Institute of Science, p. 125-146.

Heldman, D.P., 1999, Euro-American Archaeology in Michigan: The French Period, *In:* Halsey J.R., ed., Retrieving Michigan's Buried Past: The Archaeology of the Great Lakes State: Bloomfield Hills, Michigan, Cranbrook Institute of Science, p. 292-311.

Halsey, J.R., 1999, Late Woodland Burial Practices, *In:* Halsey J.R., ed., Retrieving Michigan's Buried Past: The Archaeology of the Great Lakes State: Bloomfield Hills, Michigan, Cranbrook Institute of Science, p. 234-248.

Holman, M.B., and Brashler J.G., 1999, Economics, Material Culture, and Trade in the Late Woodland Lower Peninsula of Michigan, *In:* Halsey J.R., ed., Retrieving Michigan's Buried Past: The Archaeology of the Great Lakes State: Bloomfield Hills, Michigan, Cranbrook Institute of Science, p. 213-227.

Howard, J.L, 2010, Late Pleistocene Glaciolacustrine Sedimentation and Paleogeography of Southeastern Michigan, USA: Sedimentary Geology, v. 232, p. 126-142.

Kapp, R.O., 1999, Michigan Late Pleistocene, Holocene, and Presettlement Vegetation and Climate, *In:* Halsey J.R., ed., Retrieving Michigan's Buried Past: The Archaeology of the Great Lakes State: Bloomfield Hills, Michigan, Cranbrook Institute of Science, p. 31-58.

Kehew, A.E., 1993, Glacial-Lake Outburst Erosion of the Grand Valley, Michigan, and Impacts on Glacial Lakes in the Lake Michigan Basin: Quaternary Research, v. 39, p. 36-44.

Kingsley R.G., 1999, The Middle Woodland Period in Southern Michigan, *In:* Halsey J.R., ed., Retrieving Michigan's Buried Past: The Archaeology of the Great Lakes State: Bloomfield Hills, Michigan, Cranbrook Institute of Science, p. 148-172.

Kingsley, R.G., 1981, Hopewell Middle Woodland Settlement Systems and Cultural Dynamics in Southern Michigan: Mid-Continental Journal of Archaeology, v. 6, no. 2, p. 131-177.

Larson, G.J., and Schaetzl, R., 2001, Review: Origin and Evolution of the Great Lakes: International Association for Great Lakes Research, v. 27, no. 4, p. 518-546.

Lovis, W.A., 1999, The Middle Archaic: Learning to Live in the Woodlands, *In:* Halsey J.R., ed., Retrieving Michigan's Buried Past: The Archaeology of the Great Lakes State: Bloomfield Hills, Michigan, Cranbrook Institute of Science, p. 71-82.

Mickelson, D.M., Clayton, L., Fullerton, D.S., and Borns, H.W., Jr., 1983, The Late Wisconsin Glacial Record of the Laurentide Ice Sheet in the United States, *In:* Porter, S.C. ed., The Late Pleistocene, United States: Minneapolis, University of Minnesota Press, p. 3–37.

Milstein, R.L., 1987, Bedrock Geology of Southern Michigan: Michigan Department of Environmental Quality, map scale 1:500,000.

Monaghan, G.W., and Lovis W.A., 2005, Modeling Archaeological Site Burial in Southern Michigan: A Geoarchaeological Synthesis: East Lansing, Michigan, Michigan State University Press.

Pilling, A.R., and Anderson D.L., 1999, Euro-American Archaeology in Michigan: The British Period, *In:* Halsey J.R., ed., Retrieving Michigan's Buried Past: The Archaeology of the Great Lakes State: Bloomfield Hills, Michigan, Cranbrook Institute of Science, p. 312-316.

Robertson J.A., Lovis W.A., and Halsey J.R., 1999, The Late Archaic: Hunter-Gatherers in an Uncertain Environment, *In:* Halsey J.R., ed., Retrieving Michigan's Buried Past: The Archaeology of the Great Lakes State: Bloomfield Hills, Michigan, Cranbrook Institute of Science, p. 71-82.

Shott, M.J., 1999, The Early Archaic: Life after the Glaciers, In: Halsey J.R., ed., Retrieving Michigan's Buried Past: The Archaeology of the Great Lakes State: Bloomfield Hills, Michigan, Cranbrook Institute of Science, p. 71-82.

Shott, M.J., and Wright, H.T., 1999, The Paleo-Indians: Michigan's First People, *In:* Halsey J.R., ed., Retrieving Michigan's Buried Past: The Archaeology of the Great Lakes State: Bloomfield Hills, Michigan, Cranbrook Institute of Science, p. 59-70.

Stothers, D.M., 1999, Late Woodland Models for Cultural Development in Southern Michigan, *In:* Halsey J.R., ed., Retrieving Michigan's Buried Past: The Archaeology of the Great Lakes State: Bloomfield Hills, Michigan, Cranbrook Institute of Science, p. 194-220.

Syverson, K.M., and Colgan, P.M., 2004, The Quaternary of Wisconsin: A Review of Stratigraphy and Glaciation history, *In:* Ehlers, J. ed., The Glacial Stratigraphy of the Northern U.S.: Elsevier, p. 289-305.

Winters, H.A., Rieck, R.L., and Knapp, R.O., 1986, Significance and Ages of Mid Wisconsinan Organic Deposits in Southern Michigan: Physical Geography, v. 7, no. 4, p. 292-305.