AN EXPLORATORY ANALYSIS OF DIACHRONIC SETTLEMENT PATTERNS IN CENTRAL OHIO

Kevin C. Nolan

Abstract

The Ohio Archaeological Inventory (OAI) is the state database of officially recorded archaeological sites. There are tens of thousands of records. The database is far from complete, but this still represents the largest compilation of site-based records. The potential for region-level analysis is vast. I undertake a first-pass, exploratory analysis of all recorded prehistoric sites in eight central Ohio counties. There are definite temporal patterns in the data that complement the fine-scale narratives derived from the more detailed, larger-scale data of intensive survey and excavation. The clearest patterns are associated with the transition from a mobile hunting and gathering lifeway to a more sedentary horticultural pattern from the Archaic into the Woodland. The OAI is a valuable research tool that holds much potential to elucidate patterns in the prehistory of the state.

Introduction

The Ohio Archaeological Inventory (OAI) is the official state database of archaeological sites in Ohio. With over 40,000 records currently, this is the largest and most comprehensive collection of archaeological data in the state. Despite this, the OAI is not often utilized as a research tool. The compilation and maintenance of the database represents a substantial public investment in archaeology required by the National Historic Preservation Act (NHPA) 1966. The OAI holds most of the academically investigated sites in the state, though some records are missing and others woefully incomplete. The OAI is also a repository for information provided by the public about archaeological locales. More importantly, the database holds the record of all sites recorded in the gray cultural resource management (CRM) literature. Most of these sites are small, non-diagnostic lithic scatters. Few of these CRM-documented sites are incorporated into research or promulgated to the broader research community. There are notable exceptions (e.g., Purtill 2012). If the database is to serve the purpose and justify the expenditure of vast quantities of public funds to preserve the archaeological record from destruction in the wake of development, the OAI must be able to serve directly as a research tool.

Use of the OAI is becoming ever easier (see Wakeman 2003:26). The system is maintained in a queriable Microsoft Access database linked to a geographic information system (GIS) operated in ESRI software. Records are now available and searchable online through a GeoCortex portal (http://www.ohiohistory.org/ohio-historic-preservation-office/online-mapping-system). This system of organization of the records, and the availability online is one of the best in the region (though Indiana is also making great strides in this direction: https://gis.in.gov/apps/dnr/SHAARDGIS/). However, the system is still seeing little use by the research community (see Church [1987] and Wakeman [2003] for exceptions). The online and in-house versions serve primarily to facilitate background research for CRM surveys, which then feed into the gray literature and are amassed in the OAI records. While this function is important, we have yet to realize the full potential of the OAI database, and the massive expenditure of public funds has yet to bear the promised fruit of advancing our understanding of the past. Few academics have the time or willingness to sort through the massive volume of gray literature, and few CRM practitioners have time to pursue publica-

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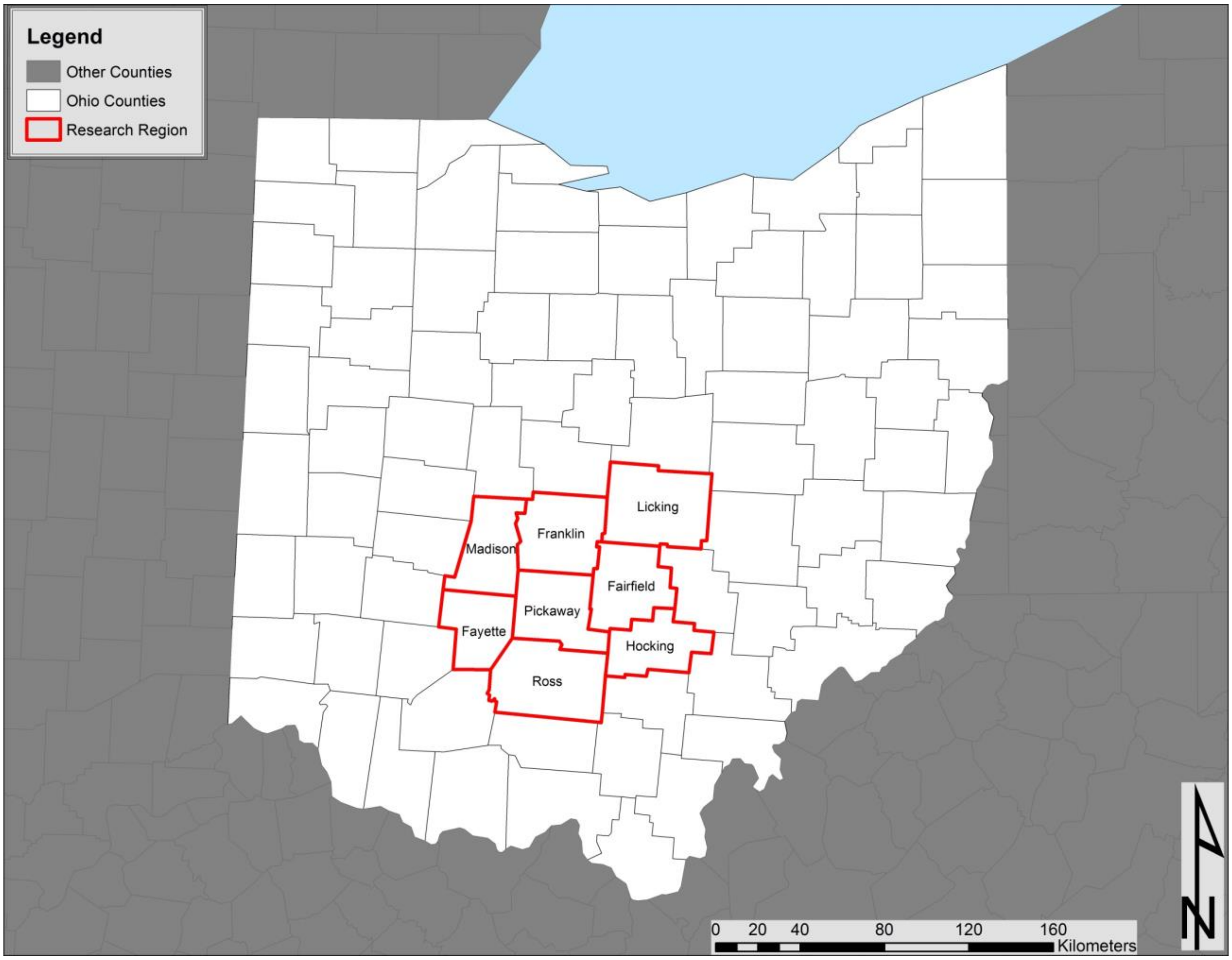

Figure 1. Location of research region within Ohio.

tion of their results. Very often, researchers choose not to consult the massive quantity of records generated by CRM. Further, the majority of the CRM surveys result in findings that are considered not worth promulgating. However, the mass of information accumulated in the OAI (not the full detail of all the reports that buttress the data) presents a unique opportunity for regional analyses that are well beyond the capabilities of any one researcher or research team to compile on their own. I propose that demonstrating the usefulness of the OAI GIS and database is the first step in bringing the immense quantity of data generated by CRM archaeology more regularly into the attention span of regional researchers. Such a demonstration is a prerequisite to realizing the promised return on the public investment in recovery and preservation of archaeological information.

There are many deficiencies in the database. Some sites are unreported. There are differing methods of recording and classification that obscure details. These problems should not be ignored. However, these problems are most significant at large scales (small areas), and become minor variation at small scales (large areas or regions). All state databases have their deficiencies, but many have proven useful in regional research (e.g., Thompson and Turck 2009; Wakeman 2003; Wells 2011). The large numbers available in state databases allow the researcher to treat these deficiencies and minor, non-systematic biases as noise. It is only with such large samples that the signal can be detected. Most analysis in archaeology focuses on the few handfuls of sites from each time period that have received academic excavation attention. This is a small and potentially very biased sample of the prehistoric record. Further, this is only a sample of a portion of the archaeological record. There is an overwhelming focus on long-term habitation sites to the exclusion of the rest of the archaeo-

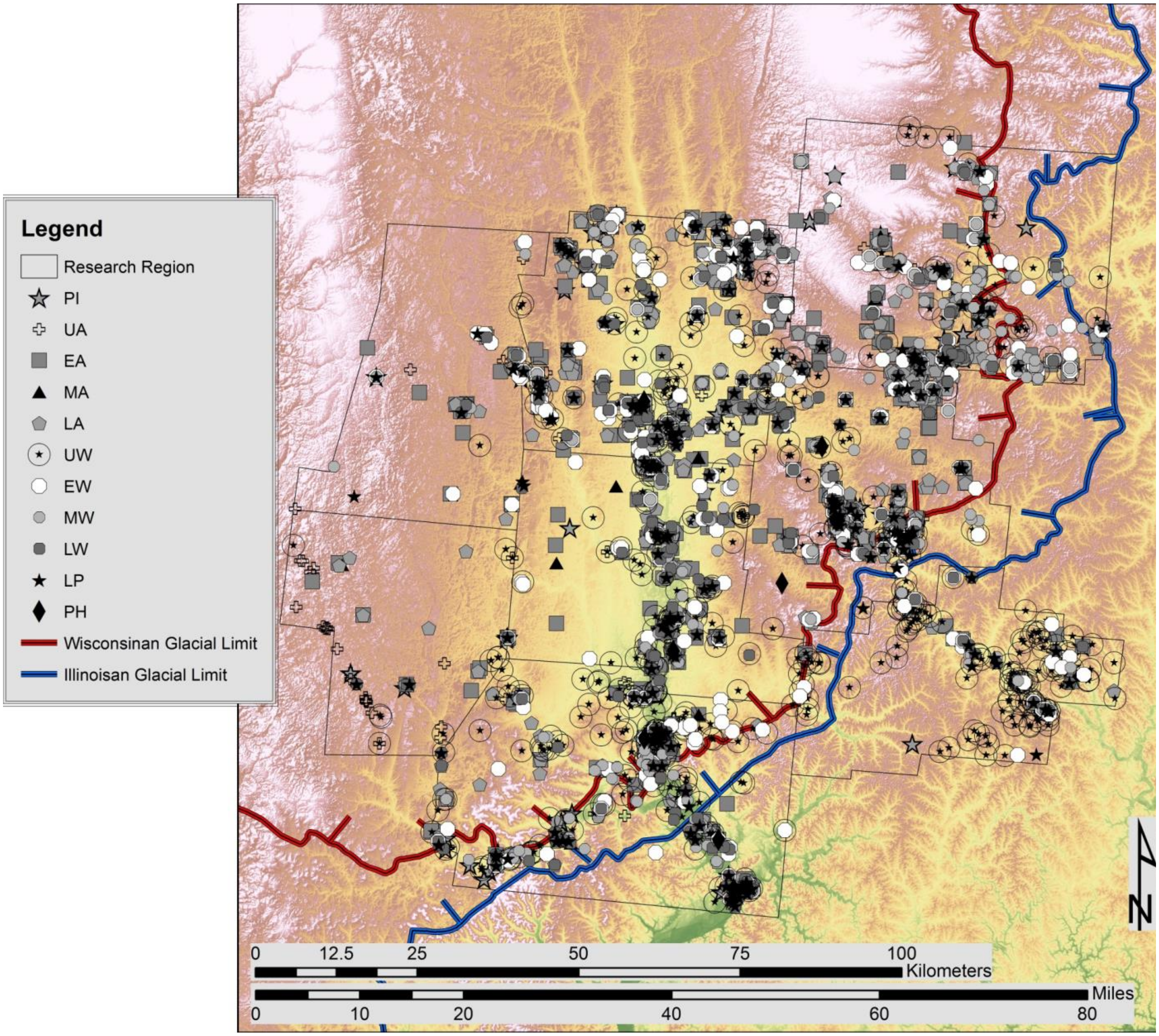

Figure 2. Location and temporal affiliation of sites used in the analysis. Red line represents the southern margin of the Wisconsin glacial advance and the yellow and black line represents the maximum advance of the Illinoian glaciation. UN = Unknown; PI = Paleoindian; EA = Early Archaic; MA = Middle Archaic; LA = Late Archaic; EW = Early Woodland; MW = Middle Woodland; LW = Late Woodland; LP = Late Prehistoric; PH = Protohistoric.

logical record. The state databases provide an opportunity to overcome this bias of focus. Incorporating lithic scatters, isolated finds, other and unknown site types allows analysis of the full distribution of activity, not just the location of sleeping quarters.

It has been suggested that a focus on only Phase II and Phase III compliance investigations would eliminate some of the bias in the state database. However, this would only perpetuate the biased focus on long-term habitation sites, and substantially limit the sample size and eliminate the possibility of performing a distributional analysis such as that performed here. Sites that are selected for Phase II are overwhelmingly long-term habitation sites, and there are unknown and unknowable biases in how different investigators make their judgments of significance. This would also eliminate amateur excavations, academic investigations, etc. If we are interested in the

Table 1. Distribution of components by temporal period.

Period	Components	Length	Per Century
Paleoindian (PI)	80	4000	2.00
Unknown Archaic	147	7000	2.10
Early Archaic (EA)	532	4000	13.30
Middle Archaic (MA)	70	3000	2.33
Late Archaic (LA)	721	2000	36.05
Unknown Woodland	549	2000	27.45
Early Woodland (EW)	304	1000	30.40
Middle Woodland (MW)	390	500	78.00
Late Woodland (LW)	363	500	72.60
Late Prehistoric (LP)	244	550	44.36
Protohistoric (PH)	9	245	3.67
Total	3409	14000	24.35

full distribution of human activity and changes in how humans interacted with their environment (e.g., Dunnell and Dancey 1983), then we need to examine the full suite of site types. In this investigation, my aims are similar, but on a broader temporal and spatial scale, to those of Wakeman (2003:10) who set out "to determine whether evidence of habitation and food subsistence for past human cultures will be found on certain landforms more commonly than other landforms." I go further by incorporating a wider variety of environmental variables more directly linked to human experience in interaction with environmental resources.

In order for biases in the reporting of sites to the OAI to negatively affect the use of data in a regional analysis, there would have to be systematic biases (by either professional or amateur) towards collecting particular types of points in particular locations. If this sort of collecting bias does not exist, then a sample of over 3,000 is sufficient to drown out the noise. There is no evidence of such a bias, and no other analyses using state databases has found such a bias precluding the use of the data in this way.

A reviewer noted that bias towards collecting on certain types of landforms for academic and amateur investigations (floodplains, flat terraces) might affect the patterns detected. This means that some types of locations are under sampled; however, within these uneven surveys, there are still differences in the frequency of encounter of certain age occupations. Further, there are sites that are documented, thanks largely to CRM survey and accidental discoveries, in non-traditional places (see the linear patterns across Pickaway, Licking, and Fairfield Counties in Figure 4). These surveys in non-typical areas also possess a temporal signal. There is also a rural vs. urban bias in the locations of CRM surveys. This is a real issue in the clustering of sites in space but does not create a pattern according to the variables used in this analysis. The reason for these surveys in urban areas are dictated by proximity to modern cultural landmarks and not correlated in a one-to-one fashion with the variables used here. There is some bias towards certain kinds of soils for some projects; however, just like with the sampling of academic surveys, there is still variability in the frequency of documentation of occupations of each period and their relationships to the variables examined. Even with a bias in where people collect artifacts (which is likely, especially for academic and amateur collections), to preclude detection of a temporal signal, there would also have to be a systematic bias against collecting diagnostics from certain periods in certain places. This type of bias is unlikely at best. There are few empty classes in the various sortings used here. All the types of places defined for this analysis were studied to some degree. Again, these factors do contribute noise to the analytical signal, but large samples (in this case N > 3,000) are the single best solution to detecting the target signal. In under-sampled kinds of places the statistical inference is less robust; however, these types of places, when surveyed, yield relatively few occupations with a known period of use (see Figure 2).

I explore the most basic research potential of the OAI for informing regional research through an analysis of all records of prehistoric sites in an eight county region of central Ohio (Madison, Franklin, Licking, Fayette, Pickaway, Hocking, Ross, and Fairfield) (Figure 1). This research region occupies the southern margin of the Wisconsin-aged till plains seeping onto the margins of the glaciated and unglaciated plateau in the east and just past the Illinoian glacial margin in the south (Figure 2).

The records analyzed here were acquired as part of a Certified Local Government grant funded research project in Pickaway County (Nolan 2009). At the time, there were a total of 7,900 prehistoric sites in the eight-county region (Figure 2). Within these records there are 3,409 occupations of approximately known age (Table 1). The entire prehistoric sequence is represented. There are just over 24 occupations per century recorded in the region. The Paleoindian, Early Archaic, Middle Archaic, and Protohistoric periods present below-average occupation rates. The Middle Woodland and Late Woodland periods are substantially above the average occupation rate. Whether these rates are representative of the actual occupation population is unknown, and I suspect that the Middle Woodland is systematically over-sampled. Further, occupation densities cannot be translated directly into population densities given the different size of typical habitation sites within each period.

Regional Prehistory

The general trend of prehistory in central Ohio is characterized relatively well by the general narrative for the Midwest. The prehistory of the Midwest is characterized by a series of subsistence and associated settlement shifts. In general, settlement patterns should be correlated with subsistence patterns; however, there is significant variability around this generalization. The first occupants of the region were Pleistocene hunter-gatherers characterized by a mobile settlement system with a generally light imprint on the landscape. With the start of the Holocene the environment and available resources began to change. Subsistence focus changed as well, but the mobile pattern generally prevailed. As the climate and environment approached the modern, subsistence became more intensive and gardening and farming based on local domesticated crops developed. There are significant settlement changes associated with this transition. As agriculture intensified, settlement systems continued to change, eventually resulting in large villages with hundreds of residents living in the same place (Lepper 2011).

The first major subsistence change in eastern North America was the increasing frequency of starchy and oily seeds in the Middle Archaic leading to eventual domestication of a several taxa by the Late Archaic period (Smith 2009). The general picture for the Middle and Late Archaic is one of seasonally mobile peopled gradually settling into a more modern and stable environment. Settlements became larger and more stable over time, and human impacts on ecological communities began to affect subsistence (e.g., Braun 1987; Smith 1987, 1989, 1995, 2009). Smith (2009:5) describes the typical Late Archaic pattern as:

> …a small-scale society consisting of perhaps a half-dozen related extended family units. Situated along and tethered to first- through third-order tributary river valley corridors …[and following] an annual cycle that linked semi-permanent to permanent river valley settlements in river valley locations like Riverton, with a range of other short-term multiple-family and single-family floodplain and upland occupations.

Central Ohio seems to have followed a similar pattern as that discussed by Smith (see Lepper 2011). The subsequent domination of Early and Middle Woodland assemblages by largely the same suite of starchy and oily seeds is as well documented in Ohio as it is in Illinois (e.g., Leone 2007; Wymer 1996, 1997). The pattern of human mobility and the effect this has on surrounding ecology plays a central role in models which account for both the change in subsistence and the eventual increase in residential stability. Central Ohio falls within Gremillion’s (2002: Figure 22.3) zone of developed pre-maize agriculture (see also Smith 1989:Figure 1).

The next major transition in settlement and subsistence draws on much Ohio data for its formulation. Early and Middle Woodland period domesticates and non-domesticated cultigens constitute a large portion of archaeobotanical assemblages. This is interpreted as an increasing emphasis on food production (sensu Smith 2001) and is thought by some to be associated with a high degree of residential stability (Abrams 2009; Dancey and Pacheco 1997; Pacheco 1997; Weaver et al. 2011; Wymer 1996, 1997). While most researchers agree that domesticated plants contributed to the diet of Early/Middle Woodland peoples, there is disagreement over the degree of dependence on cultigens. One extreme is represented by Wymer’s (1997) characterization of the Ohio Hopewell people as “farmers.” The other extreme is represented by Yerkes (e.g., 2002, 2009) who characterizes the Hopewell as hunter-gatherer populations. Both extremes are represented by distinct settlement models. Abrams (2009:178) presents a balanced assessment of extant arguments and evidence when he depicts “the Hopewell economy as one based on hunting (especially of white-tailed deer) and gathering (nuts as well as local seeds), supplemented to some degree with horticulture involving the intentional tending or planting of local seed-bearing plants.” As Abrams points out (2009:179), what remains to be determined is the variability with which communities pursued disparate strategies. Whether it is the mobile-hunting-gathering extreme, the sedentary-farmer extreme, or something in-between, we need the distributional data on various settlement and activity patterns for each period. One peculiarity of activity distribution has been documented in the eastern portion of the current study region. Spurlock et al. (2006) note that there is a conspicuous absence of Middle Woodland activity in the rockshelters of east-central Ohio. This is distinct from both preceding and subsequent time periods and may indicate different hunting strategies (Abrams 2009:178-179), different overall settlement system, and/or different subsistence strategies.

In the early Late Woodland people began exploiting new physiographic regions (Dancey 1992, 1996; McElrath et al. 2004:24; Seeman and Dancey 2000:594; Wakeman 2003:31). During the time between the "collapse" of Hopewell (ca. AD 400) and the emergence of Fort Ancient (ca. AD 950-1000) the economic and behavioral regimes diversified. After the end of the Middle Woodland period (ca. AD 400) large nucleated settlements begin to appear (Dancey 1992; Seeman and Dancey 2000). These nucleated, and occasionally fortified, settlements are generally characterized by an ethnobotanical assemblage similar to their predecessors, though Wymer argues that, in contrast to the Middle Woodland hamlets, early Late Woodland (ca. AD 400 – 800) nucleated settlements were places "where every available resource seems to have been *intensively* utilized, including less desirable plant foods" (Wymer 1996:42; emphasis added). However, the number of settlements intensively studied is small. Around the time that maize begins to show up with any ubiquity in botanical assemblages at the advent of the later Late Woodland (ca. AD 700 – 1000), dispersed hamlets seem to increase in frequency (Church 1987; Church and Nass 2002; Dancey 1992; Seeman and Dancey 2000). Seeman and Dancey (2000) note, however, that there is variability in settlement size, organization, and distribution throughout the Late Woodland period.

The final major subsistence shift is the advent of maize agriculture ca. AD 800 – 1000. Maize is known in the eastern Woodlands and Ohio as early as 200 BC, but does not become a major part of the diet for any populations until after AD 800 (Greenlee 2002; Hart 1999). Like the previous subsistence shifts, this transition is accompanied by changes in settlement patterns. As maize consumption steadily increases, the dispersed population of the later Late Woodland begin to aggregate. This aggregation generally results in more structured communities than the nucleated settlements of the earlier Late Woodland typified by circularly organized sites like SunWatch (Cook 2008). This shift is also often associated with a change in the location of settlements (Church 1987:169; Prufer and Shane 1970; Wakeman 2003:36). The contrast between Late Woodland and Late Prehistoric settlement led Prufer and Shane (1970) to propose a population intrusion; however, Church (1987) and Essenpreis (1982) directly challenged Prufer and Shane's invasion model. Specifically, Church (1987:168) found "no indication of a major population shift … with the transition from Late Woodland to Late Prehistoric." In some models, the increasing productivity of maize, especially relative to native cultigens, is related causally to these changes in settlement pattern and structure (Pollack and Henderson 1992).

This concomitant change in subsistence, settlement, and community patterns is often recognized as the origin of Fort Ancient (Griffin 1966; Pollack and Henderson 1992; Prufer and Shane 1970). The degree of commitment to maize has been shown to be widely variable at the community (Cook and Schurr 2009) and the regional levels (Greenlee 2002). If maize agriculture entails consequences for settlement location and community aggregation, then variable commitment to maize (coupled with retention of native domesticates [see Martin 2009; Nolan 2009: Appendix B]) should entail variable settlement and activity distributions and variable community organizations.

This brief review of regional prehistory serves to show that each of the major changes in subsistence strategy is generally associated with specific settlement patterning. A first step towards investigating the local nuance to these larger scale patterns, and towards more fully reconstructing the narrative of central Ohio's prehistory, is the examination of the massive compilation of distributional and coarse temporal data contained in the OAI.

Methods

In what follows I explore the distribution of temporally identified occupations in central Ohio from the OAI database (N = 3,409) in relation to a number of environmental attributes. This is the most modest use of the > 200 fields of information contained within the OAI database. Occupations will be examined for their relationship to water, soil texture, flooding frequency, ponding frequency, soil drainage class, slope, and ecoregions (Omernik 1987; Woods et al. 1998; Figure 3). It is expected that as populations increase and/or change the way in which they interact with their surroundings, there will be clear patterns in relationships between locations of occupation and these environmental attributes.

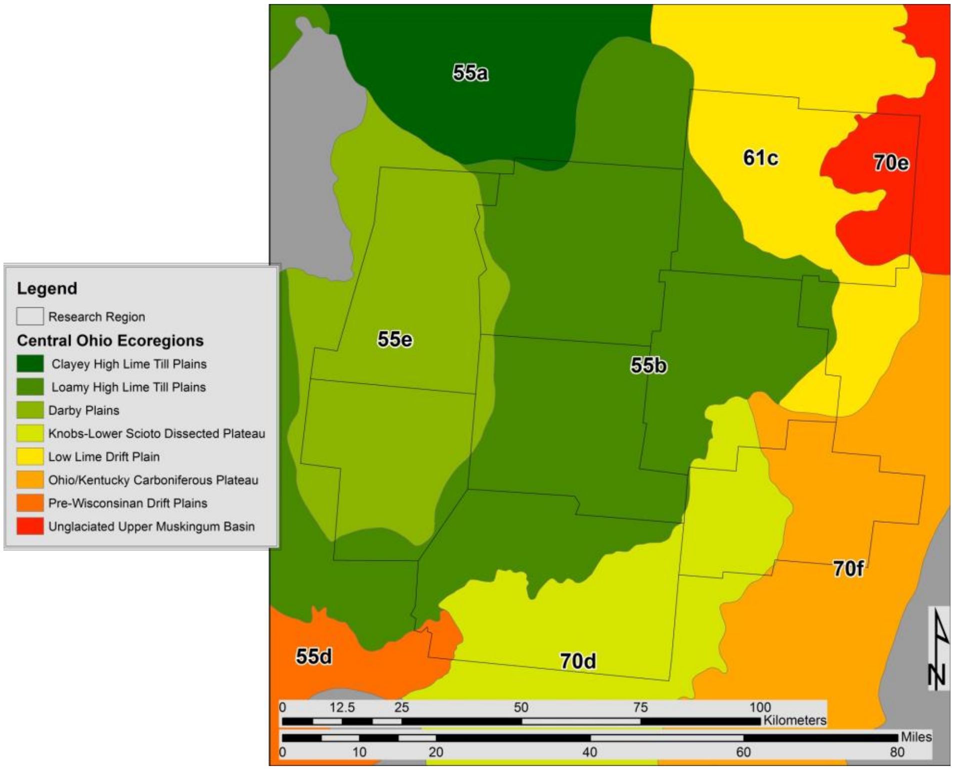

Figure 3. Level IV ecoregions in central Ohio.

Variables

The empirical unit of analysis in this investigation is the occupation. The use of the term "occupation" does not connote a habitation site. I use the term as defined and used by Dunnell (1971, 2008; Lipo and Dunnell 2008) and Rafferty (2008, 2012; Rafferty et al. 2011), among others. Dunnell (1971:150-151, 2008:50) defines occupations as the empirical (observable and observed) discrete entity (i.e., it has definite limits and component parts associated in reality) that occurs at the scale of the site or assemblage. Definition of occupation and delineation (empirical observation) of occupations are problem and analysis specific. Rafferty (2008:102) notes that the occupation is the empirical unit that allows meaningful treatment of change and difference and constitutes "the basic artifact scale used in settlement pattern analysis." "Occupations are composed of non-portable discrete artifacts that are associated in a primary depositional context that is spatially discrete and that represents continuous deposition through time" (Rafferty 2012:2). Both Dunnell and Rafferty note that occupations can be delineated at multiple scales and for multiple purposes. Recognizing the full potential of classes at this scale is beyond the use of the OAI data; however, we can recognize the presence of at least an occupation in this sense at each one of the locations in the OAI database. If there is a diagnostic artifact or other date from the site, we can place at least one of the occupations from the site in a relative temporal scale.

Any particular "site" will have one or more occupations. In this analysis, only occupations that can be assigned to a particular time period are used. All occupations without temporal information are excluded. This results in the exclusion of many sites, and leaving one or more occupations from some sites excluded. That is, there may be a site that contains multiple discrete (temporally) occupations where only one yielded an artifact assemblage that could be placed in a relative and coarse temporal scale. All occupations in this site are delineated by the identification in the OAI of known period of occupation at the site. This field is supplied directly from the OAI database. An occupation does not mean any particular site type, it simply means that there exists at that spot at least one assemblage of relatively known age. This includes isolated finds, lithic scatter, habitation sites, camps, mounds, and unknown site types. What is being analyzed is not the location of any one site type over space and time, but the changes in the distribution of activity of any kind. Certainly there are activities that are not represented or underrepresented; however, this is unavoidable with the current state archaeology and archaeological data.

The majority of the environmental variables examined are derived from the county soil surveys, and the SSURGO (Soil Survey Geographic Database) spatial data. For each county, the characteristics of the soil map units (phases) were compiled from the printed county surveys. The various counties in some cases had different abbreviations for the same series, so this task had to be done at the county level. The

Web Soil Survey (websoilsurvey.nrcs.usda.gov/app/) would now make this task obsolete. Variables extracted from the SSURGO and county soil survey data were slope class (A, B, C, D, etc.), soil texture class (e.g., clay loam, silt loam, sandy loam), drainage class (excessive, well, moderately well, somewhat poor, poor, very poor), flooding frequency class (none, rare, occasional, frequent), and ponding frequency class.

It is important to realize that county-level soil surveys, while being the most detailed surveys produced as a standard USDA product, are still generalizations (see Butler 1980). Any given spot within a soil map unit (SMU) may have properties not characteristic of the mapped soil series and phase. It is not possible to use SSURGO data to conduct an analysis of soil characteristics that occur at the location of a particular artifact or site. Most sites, and certainly all artifacts occur at scales larger than the SMU; however, the SMU that contains the artifact or site is a fairly good characterization of the context within which the site sits. If an agriculturalist is seeking a particular set of soil characteristics for their gardens and fields, they will settle in areas surrounded by those characteristics (if they want to be successful). In fact, the location of the habitation might even avoid those characteristics as to not remove productive land from use.

The only thing that can be analyzed using SSURGO is the predominant characteristics of the vicinity around the place where the artifacts were recovered. This is relevant and appropriate to this analysis as I am attempting to explore the variability in landscape use over time with changes in subsistence and resource procurement activities. Artifacts diagnostic of a particular period will gravitate around the factors (moisture, texture, slope, etc.) that were important for the people in getting their subsistence from their surroundings. The soil characteristics tracked by the USDA are characteristics that are relevant for understanding what kinds of plant and animal resources would be expected in a given area. As subsistence patterns change through time, different kinds of resources are exploited with variable frequency, and therefore different kinds of soils should exhibit patterned relationships with the temporally identifiable occupations.

Distance to water features was determined in the GIS using a base shapefile from the Ohio Department of Natural Resources (ODNR 2005). These are digitized from modern 1:24,000 scale USGS topographic maps, and, therefore, cannot be thought to represent natural water bodies, and certainly cannot reflect the prehistoric landscape. However, this is a standard and readily available dataset. The bias and error introduced here is suspected to be minimal. From all of the water bodies present in this layer, I selected all rivers, streams, ponds, lakes, and wetlands. This does not

Table 2. Ecoregion descriptions (after Woods et al. 1998).

Level III	Name	Level IV	Name	Description
55	Eastern Corn Belt Plains			
		a	Clayey High Lime Till Plains	Original beech and scattered Elm-Ash swamp forests
		b	Loamy High Lime Till Plains	Better drained, more fertile; beech, oak-maple, and elm-ash swamp forests
		d	Pre-Wisconsinan Drift Plains	Leached, acidic soils; greater stream biodiversity than ‘b’, though less fertile soils; beech & elm-ash swamp forests
		e	Darby Plains	Mixed oak and prairies, major stream high diversity
61	Erie/Ontario Drift and Lake Plain			
		c	Low Lime Drift Plain	Less fertile than 55, rolling landscape, relatively short growing season
70	Western Alleghany Plateau			
		d	Knobs-Lower Scioto Dissected Plateau	Rugged over shale and sandstone; mixed oak, mixed mesophytic, and bottomland hardwoods
		e	Unglaciated Upper Muskingum Basin	Dissected plateau; mixed oak and mixed mesophytic
		f	Ohio/Kentucky Carboniferous Plateau	Mixed oak hill slopes and mixed mesophytic valleys

Table 3. Average distance from streams and wetlands.

Average km from:	**PI**	**EA**	**MA**	**LA**	**EW**	**MW**	**LW**	**LP**	**PH**
Stream	3.04	2.99	3.37	2.91	2.69	2.36	2.58	2.41	2.88
Wetland	4.72	3.79	4.28	3.85	4.57	3.73	4.14	4.53	3.71

exclude artificial ponds, as this distinction is not maintained by the ODNR; however, it does eliminate many artificial features such as drainage ditches.

Finally, the relationship between EPA Level IV Ecoregions (Omernik 1987; Woods et al. 1998) and site locations were explored. A shapefile for these was downloaded from the EPA website (http://www.epa.gov/wed/pages/ecoregions/level_iii_iv.htm). The ecoregions vary in their typical geology, hydrography, climate, and ecology (Table 2). These units therefore represent coarse environmental variation. Ecoregions were included in this analysis to attempt to see if people favored areas with greater ecological diversity, over those with relatively uniform ecology.

To analyze distance from a particular feature, I created a series of 1 km buffers (0-1 km, 1-2 km, 2-3 km, etc.) up to 20 km from each ecoregion and up to 10 km for bodies of water. The sites were assigned a value for each ecoregion based on which buffer they fell into (e.g., 0-1 km assigned a value of 1). For quantitative analyses, the middle value for each class was assigned as the value for that site. Additionally, an ecotone score was computed for each site. The ecotone score was designed to rank highly those sites that are situated near the intersection of two or more ecoregions. A score was calculated by taking the buffer value for each ecoregion and subtracting it from 21. For example, a site in the 0-1 km buffer is given a value of 1 and a score of 20 for that ecoregion. The composite ecotone score is the sum of all scores for each site. A higher ecotone score means the site is positioned in proximity to one or more ecoregion boundaries. Most of the region is within 20 km of at least one boundary, and, therefore, most sites have a score greater than 0.

There will be little relevance to the earliest time periods for many of these variables, as they can change over time, especially with changes in climatic patterns. However, these will serve as a useful starting point. The requisite models of paleoecology and paleoenvironment are not available at present. These are the best available proxy data with sufficient spatial resolution, and suffice for this initial analysis.

Statistical Tests

The data used in this analysis are categorical, or continuous with unequal variances. All tests were conducted in SPSS 20. Comparisons among time periods for the continuous variables were conducted with a Welch test, followed by a Games-Howell post-hoc test. The Welch test (Welch 1951) is a method of comparing central tendency among groups where the assumption of equal variances required for a one-way ANOVA is not met. Likewise, if the samples exhibit unequal variances or unequal sample sizes, the Games-Howell post-hoc test is an appropriate tool for exploring which categories contribute to the multi-sample statistical differences (Tamhane 1979). For categorical attributes, a X^2 test was used to test for association between particular periods and categories of environmental variables. With large sample sizes, the probability of achieving a significant association with the X^2 test increases; to account for the sample-size effect, Cramer's V was calculated for each comparison to assess the strength of the documented association (Drennan 1996:193-194; see also Norušis 2010:436-437). A significant, but weak association is not likely to be meaningful. A value of 0.15, though not strong is suggested by Drennan to represent a meaningful difference; however, there is no standard for assessing how strong an association is meaningful. Additionally, adjusted residuals were calculated for all X^2 tests. Residuals ≥ 2 are considered significant at the 0.05 level (IBM 2012).

Results

Continuous Variables

Figure 4 shows the distribution of water features classified as streams, lakes, ponds, or wetlands (ODNR 2005). Average distance to water by time period is presented in Table 3. Average distance of known diagnostic artifacts from streams generally decreases from the Late Archaic through the Late Prehistoric, with an extra dip in the trend line in the Middle Woodland.

Distance from wetlands (lakes, ponds, and wetlands) shows no real patterning. Average distance to current wetlands fluctuates around 4 km. Early Archaic, Late Archaic, Middle Woodland, and Protohistoric components are more often closer to wetlands. Streams are more important than wetlands throughout.

Distance from Ecoregions shows no apparent patterning by period (Table 4). Likewise, ecotone scores do not seem to pattern by period.

Welch Test

The following variables show significant differences among periods without equal variances assumed (Welch test): distance from streams (p <0.000), distance from wetlands (p<0.000), and distance scores for Ecoregions 55b (p <0.000), 55e (p

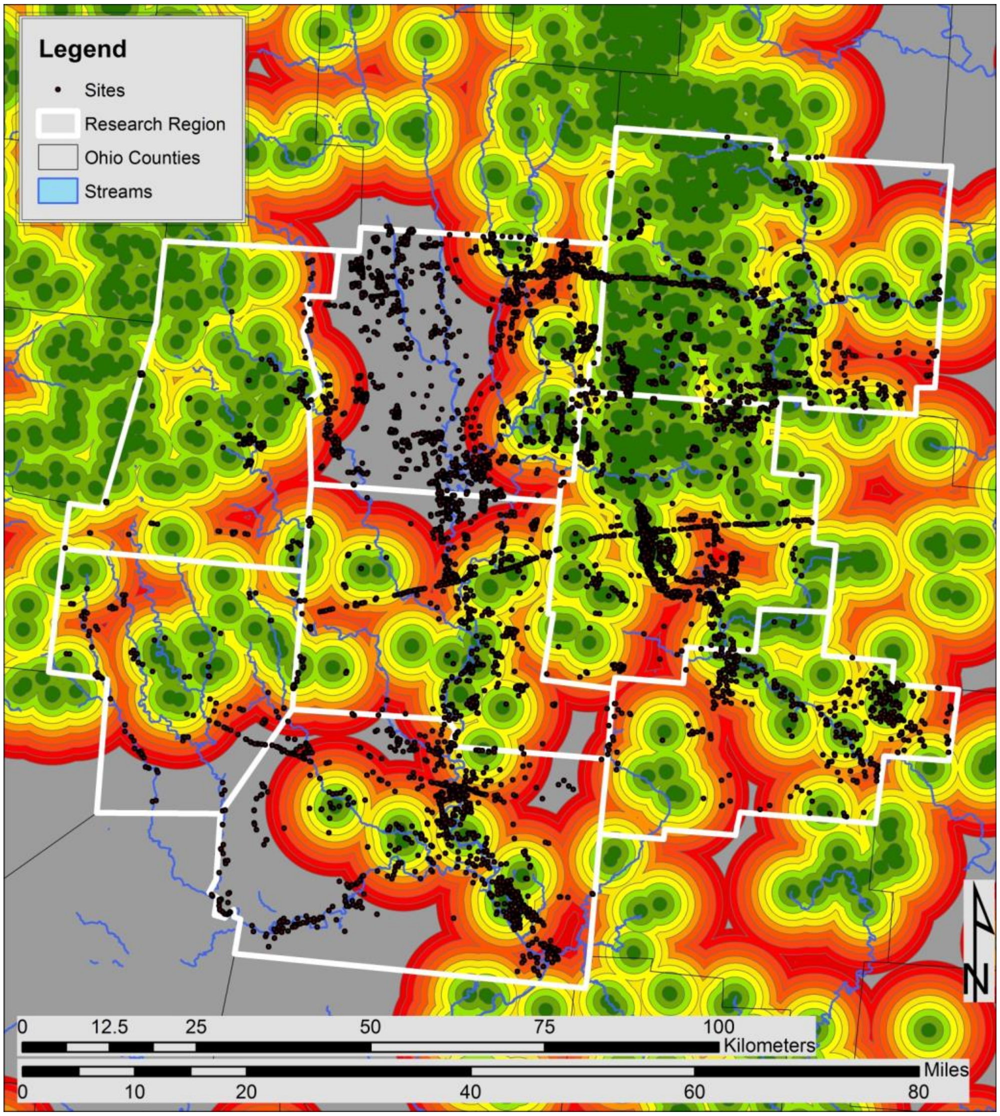

Figure 4. Streams and buffers around wetlands. Buffers are consecutive 1 km rings around wetlands (many too small to display at this scale) from 0-1 km up to 9-10 km.

Table 4. Average distance from ecoregion and average ecotone score by period.

Average km from:	**PI**	**EA**	**MA**	**LA**	**EW**	**MW**	**LW**	**LP**	**PH**
Frm55a	13	12.69	11.6	12.7	13.32	11.04	13.46	13.16	
Frm55b	7.69	7.44	7.61	7.32	7.4	8.35	8.22	7.57	16.5
Frm55d	8	11	9	9.54	9.88	11.23	9.83	8.29	
Frm55e	11.2	12.3	10.53	13.06	13.3	14.97	14.41	14.36	13
Frm61c	9.81	10.32	11.61	9.79	10.91	9.94	10.56	10.72	15
Frm70d	8.27	9.4	7.27	9.31	9.27	8.99	8.86	8.24	10.2
Frm70e	9.83	12.53	9.64	12.11	8.41	8.22	11.51	12.21	
Frm70f	7.67	10.8	10.06	10.89	12.54	13.07	10.82	9.98	15
Score55a	0.13	0.08	-0.26	0.08	0.06	-0.24	-0.13	-0.09	-1
Score55b	3.65	2.01	3.73	2.05	3.51	3.69	2	2.61	0.22
Score55d	-0.13	-0.81	-0.44	-0.59	-0.68	-0.39	-0.6	-0.61	-1
Score55e	1.44	1.33	1.46	0.93	1.12	0.26	0.82	0.38	0
Score61c	3.11	3.39	2.41	3.57	1.88	2.12	2.59	2.98	-0.2
Score70d	2.78	2.58	3.63	2.55	2.68	2.84	3.27	4.52	5.56
Score70e	0.83	1.08	0.94	1.08	1.19	2.22	0.42	-0.04	-1
Score70f	1.69	1.06	2.07	1.05	0.96	0.92	1.28	1.71	2.89
Ecotone score	13.5	10.73	13.54	10.75	10.72	11.42	9.65	11.45	5.44

<0.000), 61c (p <0.000), 70d (p<0.000), 70e (p<0.000), and 70f (p =0.010) (Table 5). Additionally, Ecoregion 55a exhibits near significant difference at p = 0.022. However, the Ecotone score is not significantly different among periods. A Games-Howell post hoc analysis (Table 6) reveals that differences in distance from streams is driven primarily by distinction between the Unknown Archaic (UA) and all other Archaic periods, especially the Early Archaic. The Middle Woodland and Late Prehistoric are nearly identical in this respect to the UA components. All three Archaic periods (excluding UA) are nearly identical with respect to distance from streams. With the exception of the Middle Woodland period, all post-Archaic periods have p values > 0.9.

Distance from wetlands (lakes, ponds, and wetlands) shows greater significant differences among periods (Table 6). The Unknown Archaic exhibits the greatest number of differences, and, where differences are non-significant, the p values are low with the exception of the Late Prehistoric period. The Early Archaic and Late Archaic are significantly different from the Unknown Woodland and Early Woodland; however, the Middle Woodland and Late Woodland are nearly identical (p > 0.74) to the Archaic periods (except UA). The Late Prehistoric period exhibits a different pattern in distance from wetlands than the Early Archaic, Late Archaic, and Middle Woodland (p = 0.017, 0.023, and 0.000, respectively).

The Paleoindian period shows no significant differences in either variable with any of the other periods. The similarities are split. With respect to distance from stream, we see near unity with all Archaic (except UA) and the Early Woodland period. With respect to distance from wetlands the Paleoindian period is indistinguishable from Unknown Woodland, Early Woodland, Late Prehistoric, and Middle Archaic.

Categorical Variables: Chi-square

Slope

There is an obvious and expected preference for low slopes throughout all time periods (Figure 5, Table 7). Late Woodland and Late Prehistoric components exhibit a slightly more marked preference for class A slopes (0-2%) slopes. However, nearly all sites are located on < 6 percent slopes (class A and B slopes). There is also a geographic pattern

Table 5. Welch test for difference in mean distance by archaeological period.

Robust Tests of Equality of Means

		Statistic[a]	**df1**	**df2**	**Sig.**
FrmStream	Welch	5.059	9	709.345	.000
FrmWtlnd	Welch	10.125	9	566.278	.000
Frm55a	Welch	.406	9	61.213	.927
Frm55b	Welch	1.871	9	215.358	.058
Frm55d	Welch	1.762	9	25.036	.127
Frm55e	Welch	3.965	9	149.807	.000
Frm61c	Welch	3.070	9	208.042	.002
Frm70d	Welch	1.920	9	221.630	.050
Frm70e	Welch	5.931	9	67.239	.000
Frm70f	Welch	3.936	9	120.323	.000
Score55a	Welch	2.168	9	709.966	.022
Score55b	Welch	5.608	9	707.709	.000
Score55d	Welch	1.808	9	706.388	.063
Score55e	Welch	3.579	9	706.406	.000
Score61c	Welch	6.598	9	716.513	.000
Score70d	Welch	7.170	9	712.939	.000
Score70e	Welch	11.794	9	725.775	.000
Score70f	Welch	2.443	9	709.624	.010
Ecotone score	Welch	1.131	9	714.145	.338

[a] Asymptotically F distributed.

that is quite obvious (Figure 5). Sites in areas with >6 percent slopes are concentrated in the unglaciated plateau to the southeast. I would also note that several of the components associated with steep slopes in the unglaciated area are cave and rockshelter sites and do not necessarily represent occupation or use of extreme slopes.

With 3332 valid cases, there are significant associations among the variables (p< 0.000) with low association (Cramer's V = 0.114). The significant associations between slope category and period of occupation appear to be primarily driven by the Unknown Woodland and the Late Archaic occupations (Table 8). There is a less than expected association between Unknown Woodland and slopes less than 6 percent (class A and B) and greater than expected association with all slopes greater than 6 percent (C through F). There is a greater than expected association between Unknown Archaic and 0-2 percent slopes. Early Archaic and Late Archaic exhibit a significant association with class B (2-6%) slopes. Early Archaic has a weaker than expected association with class E slopes, and Late Archaic components have a lower than expected association with all slope categories greater than 6 percent (i.e., class C – F). Late Woodland and Late Prehistoric occupations exhibit greater than expected associations with 0-2 percent (class A) slopes, with less than expected association with 6-12 percent (class C) slopes. Late Prehistoric occupations also show a strong association with class F slopes. This latter result is likely due to the association with rockshelters in the unglaciated plateau. Occupations from the Archaic period generally exhibit negative residuals for class C through F slopes, while the Woodland occupations generally exhibit positive residuals.

Table 6. Games-Howell post hoc tests for distance from streams and distance from wetlands.

		From Streams									
		PI	**UA**	**EA**	**MA**	**LA**	**UW**	**EW**	**MW**	**LW**	**LP**
From Wetland	**PI**		0.213	1.000	0.997	1.000	0.930	0.974	0.345	0.857	0.533
	UA	0.772		***0.003***	*0.023*	**0.010**	0.473	0.463	1.000	0.775	0.997
	EA	0.343	***0.000***		0.960	1.000	0.303	0.717	***0.001***	0.207	0.207
	MA	0.997	0.152	0.954		0.862	0.345	0.489	0.041	0.258	0.089
	LA	0.413	***0.000***	1.000	0.977		0.642	0.937	0.003	0.474	0.087
	UW	1.000	0.113	***0.000***	0.984	***0.000***		1.000	0.668	1.000	0.945
	EW	1.000	0.061	**0.007**	0.999	**0.009**	1.000		0.672	1.000	0.922
	MW	0.249	***0.000***	1.000	0.900	0.999	***0.000***	***0.002***		0.946	1.000
	LW	0.893	***0.000***	0.742	1.000	0.852	0.097	0.634	0.498		0.997
	LP	1.000	0.510	*0.017*	1.000	*0.023*	0.999	1.000	***0.000***	0.751	

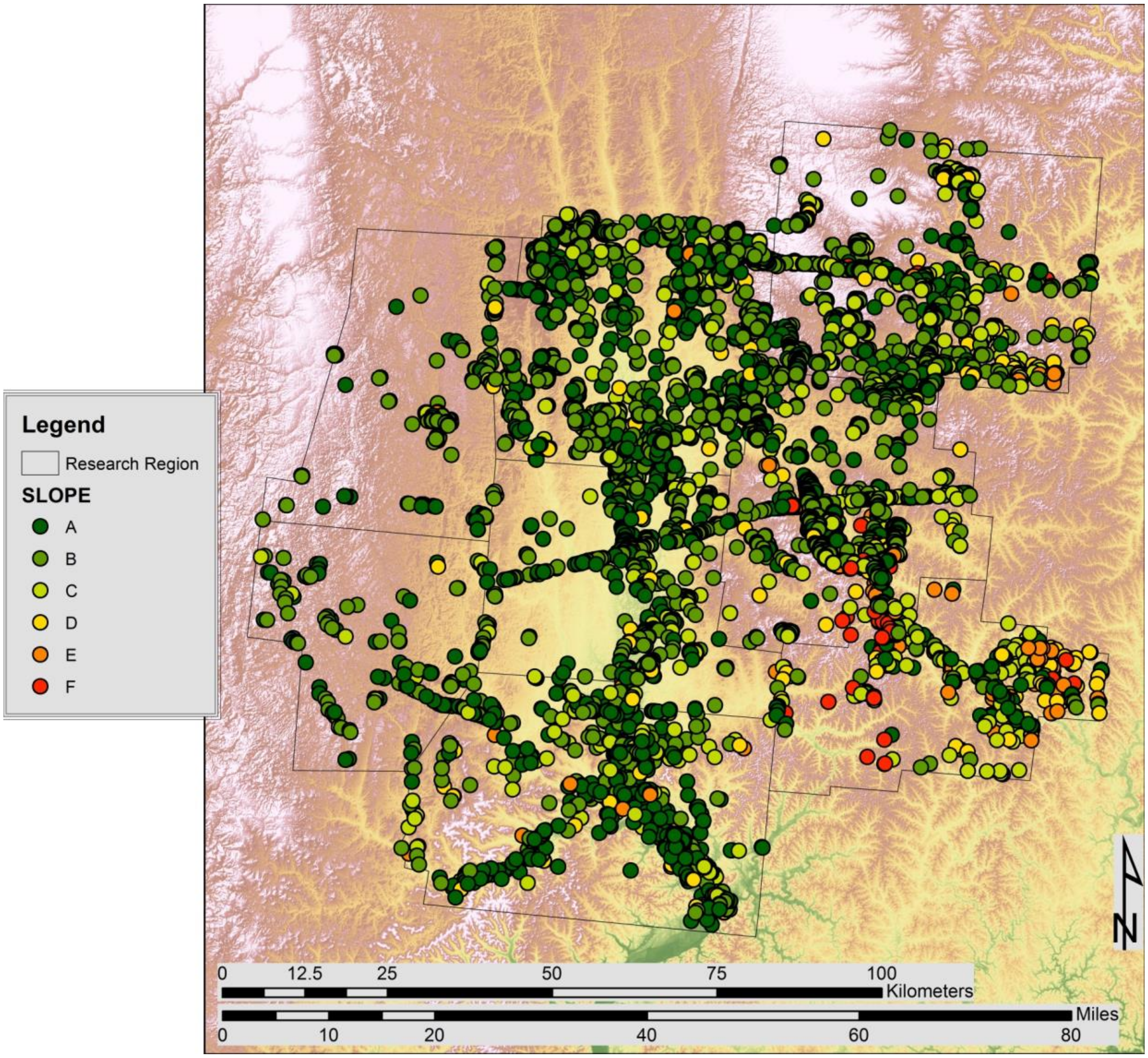

Figure 5. Distribution of soil slope categories by sites used in analysis.

Drainage

As expected, there is a strong preference for better drained soils; there is a strong geographic pattern (Figure 6). A plurality of components for all time periods is found on well drained soils. While less than 50 percent of Archaic components are located on well drained soils, a greater proportion (> 59%) of Woodland and Late Prehistoric occupations are located on well drained soils (Table 9). Archaic periods have a greater proportion of more poorly drained soils.

With 3337 valid cases there are significant associations among the variables ($p < 0.000$) with low association (Cramer's V = 0.118). The significant X^2 results are driven primarily by the very strong contrast between the Late Archaic and Unknown Woodland components (Table 10). Late Archaic components are significantly more frequent than expected on somewhat poor and very poorly drained soils, and to a lesser degree on moderately well drained soils. Whereas, Unknown Woodland are substantially underrepresented on those same drainage classes and in addition to poorly drained. The relationship switches with the well-drained class. Late Archaic components are underrepresented on well-drained soils and Unknown Woodland components are even more over-represented. Early Archaic has a greater than expected association with very poorly and somewhat poorly drained soils, and a lesser than expected association with well or excessively drained

Table 7. Proportional distribution of components by soil slope category.

Slope	PI	EA	MA	LA	EW	MW	LW	LP	PH
A	32.9%	35.9%	38.6%	38.94%	36.0%	39.2%	**44.8%**	**46.4%**	25.0%
B	**47.4%**	**49.6%**	**44.3%**	**48.5%**	**41.3%**	39.7%	38.9%	38.9%	**62.5%**
C	10.5%	9.8%	10.0%	8.1%	14.0%	11.9%	8.1%	4.6%	
D	6.6%	3.6%	5.7%	3.2%	5.3%	6.8%	4.8%	2.9%	12.5%
E		0.8%		0.7%	2.0%	1.6%	2.5%	2.1%	
F	2.6%	0.4%	1.4%	0.6%	1.3%	0.8%	1.9%	2.1%	

Table 8. Adjusted residuals for X^2 test of association between periods and SMU slope category.

	Slope					
	A	**B**	**C**	**D**	**E**	**F**
PI	-1.1	1	-0.1	0.7	-1.2	0.7
UA	**2**	-0.9	-0.5	-0.7	-1.1	-0.9
EA	-1.5	**3.9**	-0.9	-1.4	**-2**	-2.4
MA	0	0.4	-0.3	0.4	-1.2	-0.1
LA	0.1	**3.9**	**-3**	**-2**	**-3**	**-3**
UW	**-3**	**-6**	**6.9**	**2.7**	**6.3**	**4.1**
EW	-1	-0.2	1.8	0.5	0.1	-0.9
MW	0.2	-1	0.7	1.9	-0.6	-1.4
LW	**2.6**	-1.2	**-3**	0	0.9	0.2
LP	**2.5**	-1	**-3**	-1.4	0.2	**4.4**

Table 9. Proportional distribution of components by soil drainage class.

Drainage	PI	EA	MA	LA	EW	MW	LW	LP	PH
well/excessive	55.3%	45.9%	48.6%	46.7%	**60.1%**	**66.4%**	**59.4%**	**63.2%**	75.0%
moderately well	18.4%	**21.5%**	**24.3%**	**22.2%**	19.3%	**19.5%**	17.9%	18.4%	25.0%
somewhat poor	**18.4%**	**19.6%**	**18.6%**	**18.9%**	14.9%	8.9%	13.2%	9.6%	
poor	1.3%	0.9%	1.4%	0.8%		0.8%	0.8%	0.8%	
very poor	6.6%	**11.7%**	7.1%	**11.2%**	5.7%	3.9%	**8.4%**	**7.9%**	

soils. Middle Woodland has a lesser than expected association with somewhat poor drainage, and a greater than expected association with well or excessively drained soils. Late Prehistoric has a lesser than expected association with somewhat poorly drained soils.

Texture

There is a pronounced preference for silt loams (Figure 7), with most periods >70 percent (Table 11). Channery and coarse sandy loams are least preferred. Diversity of soil types exploited is fairly steady around 7 texture classes with only Paleoindian and Protohistoric having fewer types; in the latter case this is likely a sampling bias, and in the former this is likely a visibility and preservation bias. Gravelly loam, sandy loam, loam, and silty clay loam are nearly ubiquitously used. Gravelly loam is used in roughly equal proportions except for during the Middle Woodland period, where its proportion nearly triples, especially stark in contrast to the lower than average

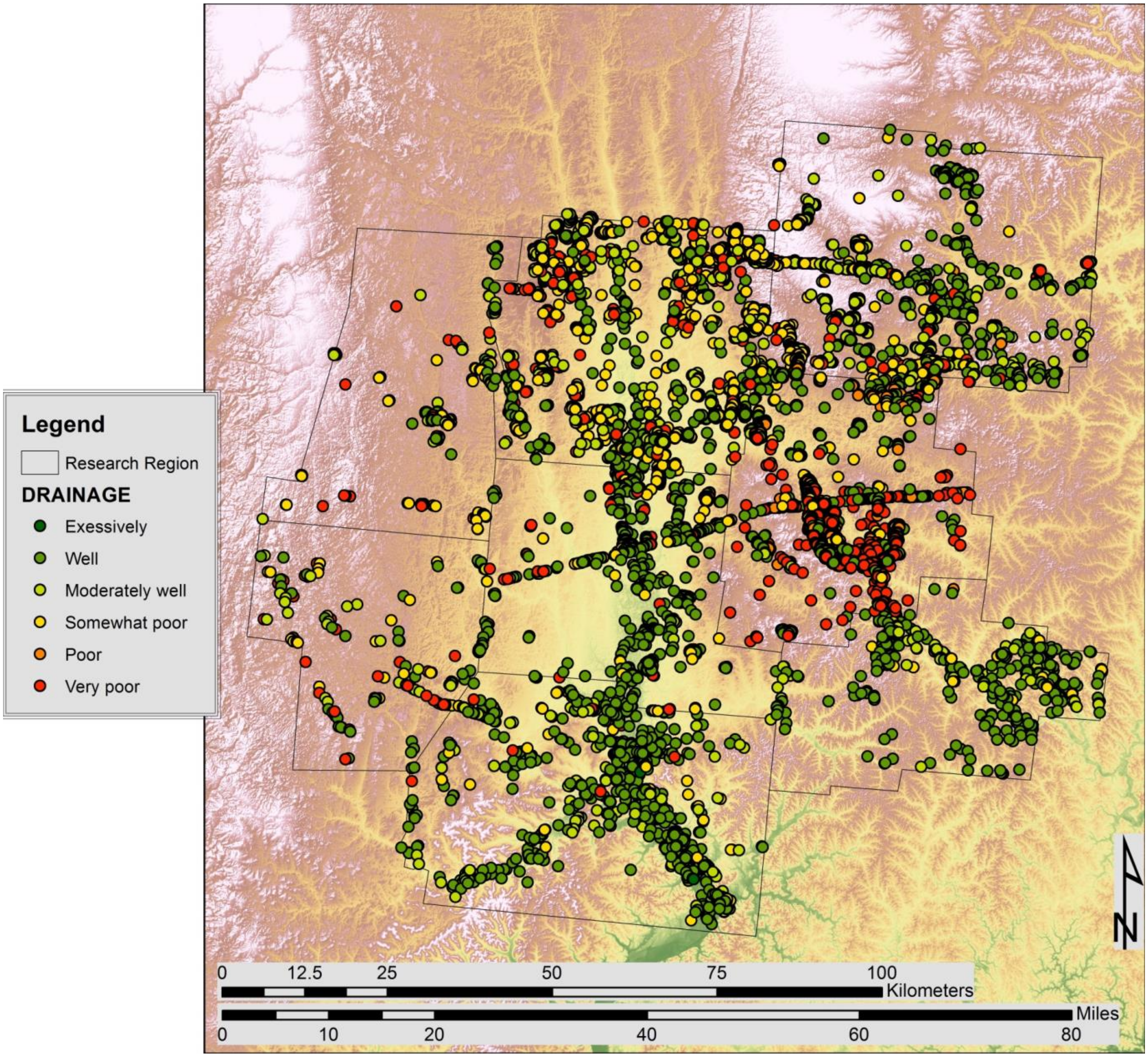

Figure 6. Distribution of soil drainage class at sites used in this analysis.

frequency of the two preceding periods. Sandy loam hovers around 1 percent from the Early Archaic through Late Woodland and then jumps above 5 percent for the Late Prehistoric. Loams hover around 8 percent until the Middle Woodland, and maintain approximately 12 percent for the remainder of the prehistoric period. This is likely associated with importance of food production. Silty clay loams are more important during the Paleoindian and Archaic periods than the Woodland and later periods. Clay loam hovers around 2 percent with the exception of the Early Woodland and Middle Woodland periods. Only the Middle Archaic and Early Woodland made use of mucky soils.

With 3341 valid cases there are significant associations among the variables ($p < 0.000$) with a low association (Cramer's V = 0.105). No single or combined set of periods drives the significant association in the X^2 test (Table 12). However, clay loam and sandy loam textures do contribute the most to the significant statistic; clay loam and sandy loam are largely the inverse. The relative decrease in percentage of components on clay loam soils (Table 11) is reflected as greater than expected frequency in the

Table 10. Adjusted residuals for X^2 test of association between periods and SMU drainage category.

			Drainage		
	Very Poor	**Poor**	**Somewhat Poor**	**Moderately Well**	**Well/Excessive**
PI	-0.4	0.7	1	-0.2	-0.4
UA	1.8	0.1	1	-0.8	-1
EA	**3.7**	0.9	**3.7**	1.3	**-5.8**
MA	-0.2	0.8	1	1	-1.6
LA	**3.8**	0.7	**3.8**	**2.2**	**-6.6**
UW	**-5.5**	**-2**	**-4.4**	**-2.8**	**8.7**
EW	-1.4	-1.5	0.3	0	0.9
MW	-3	0.3	**-3.3**	0.1	**3.9**
LW	0.5	0.5	-0.7	-0.7	0.8
LP	0.1	0.4	**-2.2**	-0.4	1.8

Table 11. Proportional distribution of components by soil texture category.

Texture	**PI**	**EA**	**MA**	**LA**	**EW**	**MW**	**LW**	**LP**	**PH**
gravelly loam	2.6%	2.5%		1.6%	1.3%	6.2%	3.1%	2.1%	
channery loam				0.1%	0.3%				
coarse sandy loam								0.42%	
sandy loam		0.6%	1.4%	0.7%	1.3%	0.5%	1.7%	5.4%	
fine sandy loam				0.1%	0.3%	0.3%			
loam	7.8%	8.5%	2.9%	9.2%	8.6%	12.2%	12.0%	11.3%	25.0%
loamy		0.2%		0.1%		0.5%			
silt loam	76.6%	73.6%	84.3%	74.9%	77.1%	73.1%	71.7%	71.1%	75.0%
silty clay loam	11.7%	12.2%	7.1%	10.5%	9.3%	6.7%	9.5%	7.1%	
clay loam		2.3%	1.4%	2.7%	0.3%	0.3%	1.7%	1.7%	
muck			1.4%		0.3%				

Archaic period and, to a lesser extent, lower than expected frequencies after that. Sandy loam frequencies are lower than expected in the Early and Late Archaic with substantially greater than expected frequency during the Late Prehistoric and Unknown Woodland periods. Middle Archaic exhibits a greater than expected association with Silt Loam. Middle Woodland exhibits a greater than expected association with Channery or Gravelly Loams and a less than expected association with Clay Loam. Overall there is a slight shift from avoidance of coarse texture to avoidance of fine texture (or at least less emphasis on fine texture) over time. However, this pattern is not pronounced.

Flooding

The vast majority of components are located in areas with no flooding (Figure 8). Emphasis on flooded areas increases over time, with a concomitant decrease in the emphasis on flood-free areas (Table 13).

With 3344 valid cases there are significant associations between frequency of flooding and periods of occupation ($p<0.000$); however, the strength of association is low (Cramer's V = 0.099). The significant X^2 result is driven almost entirely by the contrast between two Archaic (Early and Late) periods and the final two prehistoric periods (Late Woodland and Late Prehistoric) (Table 14). Early and Late Archaic periods have greater than expected frequencies of never flooded locations, and a less than expected frequency of occasionally flooded locations. Only the Early Archaic reaches a level of significance among the pair. The Late Woodland and Late Prehistoric ex-

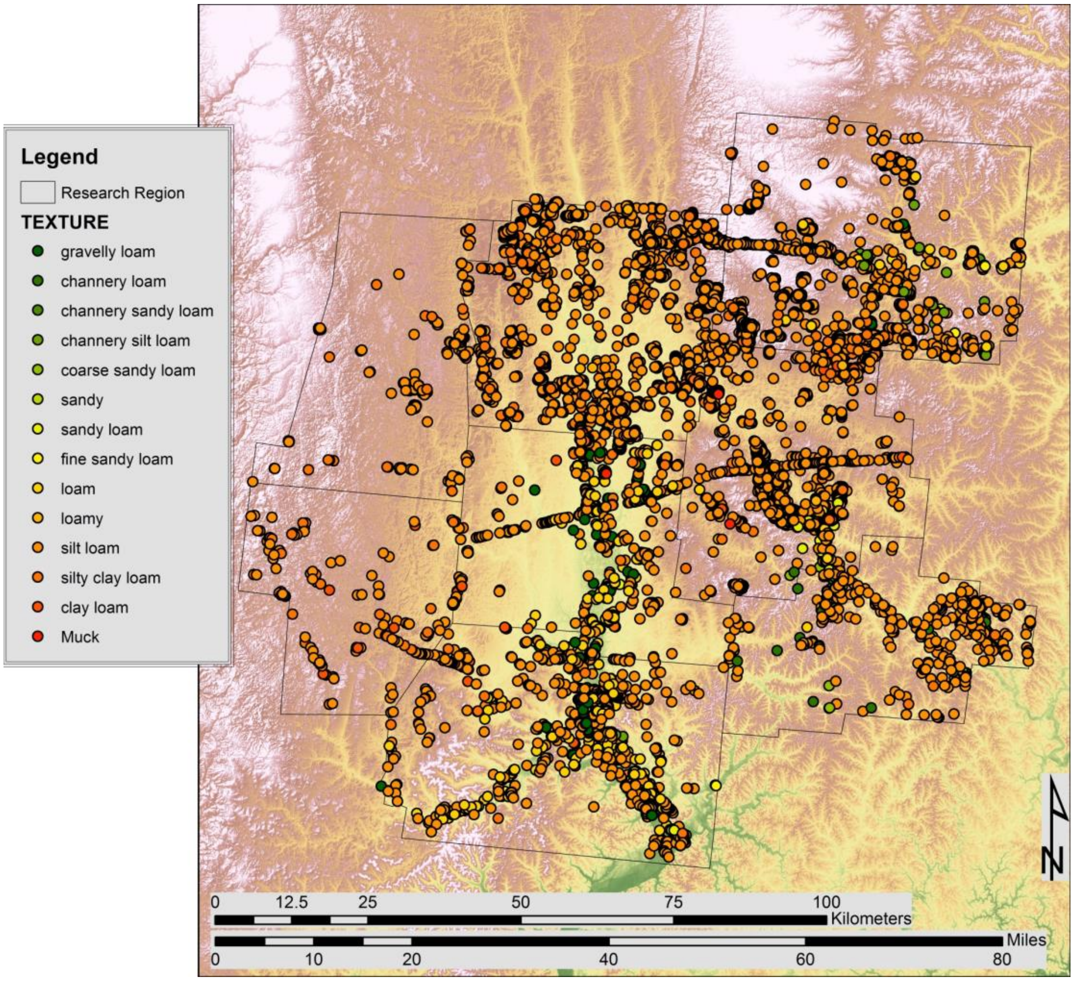

Figure 7. Distribution of soil texture at sites used in this analysis.

Table 12. Adjusted residuals for X^2 test of association between periods and soil texture.

	Texture				
	Channery/ Gravelly Loam	**Sandy Loam**	**Loam**	**Silt Loam**	**Clay Loam**
PI	-0.4	-1.2	-0.7	0.7	0.4
UA	-1.8	-0.3	-0.2	-0.9	**2.8**
EA	-1.1	**-2.3**	-1.4	-0.3	**3.4**
MA	-0.9	-0.2	-2	**2.2**	-0.4
LA	**-2.7**	**-2.1**	-1	0.5	**2.8**
UW	**3.4**	**4**	1.7	0.2	**-5.8**
EW	-0.4	-0.6	-1	1.3	-0.4
MW	**3.5**	-1.5	1.6	-0.5	**-2.3**
LW	-0.1	-0.5	1.1	-1	0.6
LP	-0.5	**5.1**	0.5	-1.1	-0.8

Table 13. Proportion of flooding frequency by time period.

Flooding	**PI**	**EA**	**MA**	**LA**	**EW**	**MW**	**LW**	**LP**	**PH**
none	93.5%	93.2%	87.1%	88.9%	86.1%	85.3%	78.4%	72.8%	87.5%
rare	1.3%	0.8%	2.9%	1.3%	1.0%	1.3%	1.7%	2.1%	
occasional	3.9%	4.9%	10.0%	6.0%	9.3%	10.1%	14.9%	15.5%	12.5%
frequent	1.3%	1.1%		2.7%	3.3%	3.4%	5.0%	8.8%	

Table 14. Adjusted residuals for X^2 test of association between periods and SMU flooding frequency.

	Flooding			
	None	**Rare**	**Occasional**	**Frequent**
PI	**2**	0	-1.7	-1.1
UA	-0.6	-1.4	0.7	0.8
EA	**5.4**	-1.1	**-3.9**	**-3.3**
MA	0.3	1.2	0.2	-1.6
LA	**2.8**	0	**-2.4**	-1.5
UW	-1.2	0.2	0.3	1.6
EW	0.1	-0.4	0.2	-0.2
MW	-0.3	0.1	0.5	-0.3
LW	**-4.2**	0.8	**3.8**	1.6
LP	**-6**	1.2	**3.8**	**4.5**

Table 15. Proportion of components by ponding frequency.

Ponding	**PI**	**EA**	**MA**	**LA**	**EW**	**MW**	**LW**	**LP**	**PH**
none	92.21%	87.57%	91.43%	88.28%	95.02%	95.35%	91.32%	92.47%	100.00%
occasional		1.13%		0.28%		0.26%	0.56%	0.42%	
frequent	7.79%	**12.24%**	8.57%	**11.44%**	4.98%	4.39%	8.12%	7.11%	

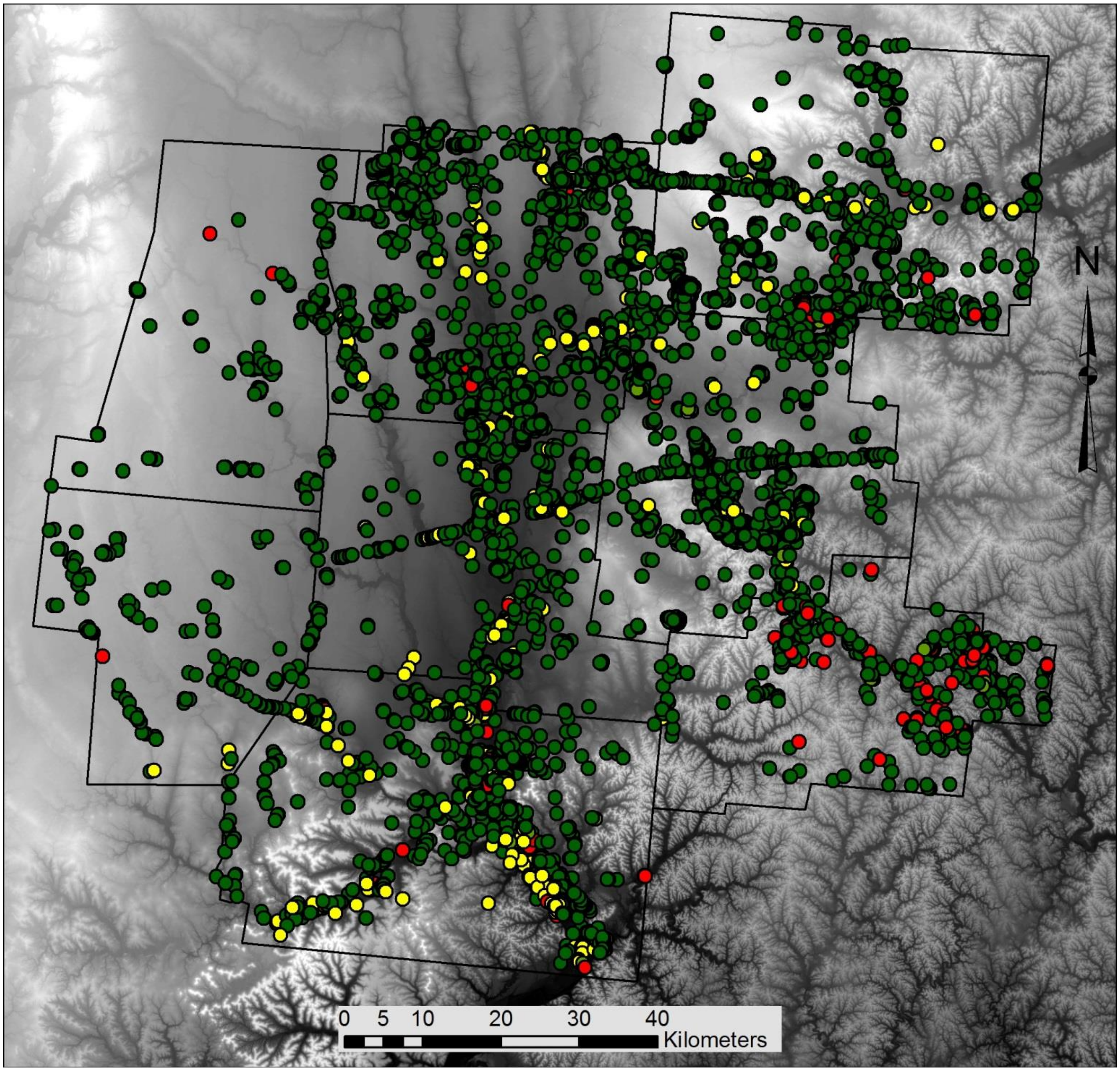

Figure 8. Distribution of flooding frequency. Key: dark green = none; green = rare; yellow = occasional; red = frequent.

hibit the inverse pattern of significance to the two Archaic periods just discussed.

There is a shift from an early preference for never or rarely flooded SMUs to a preference for flooded SMUs. The Woodland components occupy a transitional period from an Archaic distribution to the agricultural Late Woodland and, especially, Late Prehistoric. The pattern may reflect, at least partially, the tendency for older components to be more frequently buried by alluvial deposits. However, there may be a remnant behavioral signature.

Ponding

Again, the vast majority of components are in areas with no ponding (Figure 9). Avoidance of ponding areas fluctuates around 92 percent for most periods (Table 15). The Early and Late Archaic periods experienced an elevated emphasis on ponding areas, and the Early and Middle Woodland exhibit the greatest avoidance of ponded areas. The remainder of the periods hover around 8 percent of occupations on frequently ponded soils.

Table 16. Adjusted residuals for X^2 test of association between periods and SMU ponding.

	Ponding	
	No	**Yes**
PI	0.1	-0.1
UA	-1.4	1.4
EA	**-4**	**4**
MA	-0.2	0.2
LA	**-4**	**4**
UW	**5.6**	**-5.6**
EW	**2**	**-2**
MW	**2.6**	**-2.6**
LW	-0.5	0.5
LP	0.3	-0.3

Due to the low quantity of cases in the occasional ponding category, the frequent and occasional cases were collapsed into a single category. With 3344 valid cases there are significant associations between period of occupation and ponding SMUs; the association is relatively strong (Cramer's V = 0.140). The adjusted residuals (Table 16) reinforce the raw percentage pattern discussed above. Early and Late Archaic components show a marked and identical association with ponded soils. There is a shift with the transition to the Woodland period of significant (but not as strong) preference for never ponded soils. Interestingly, the Paleoindian, Middle Archaic, Late Woodland, and Late Prehistoric periods show no real preference with respect to ponding.

Discussion

There are several patterns and intriguing hints buried in the results discussed above. My discussion will focus primarily on the most consistent temporal trend at a coarse scale across most variables. Much work remains to be done to detangle the time and space patterns hinted at above.

Distance from streams decreases over time. This trend does not yield a statistically significant result. The post-hoc tests substantiate a general difference between Archaic periods and non-Archaic; however, significant differences are only found within the Archaic period. Components not assigned to a particular Archaic period (UA) are significantly different from components assigned to all three Archaic sub-periods.

Distance from wetlands shows no strong temporal patterning, though Archaic components exhibit a slightly greater preference for wetlands. This may be expected given that many of these features may be modern creations. Alternatively, it may express a consistent pattern of proximity to non-flowing water bodies throughout prehistory. Ecoregions show no temporal patterning either.

There is always a strong preference for low slopes, but the preference for near level (class A slopes) intensifies in the Late Woodland and Late Prehistoric (Table 7 and Table 8). This preference may have several causes. It is during these time periods that we begin to see larger aggregations of populations, and therefore, greater expanses of level ground were needed for habitations (villages). The areas with larger expanses of level ground are more likely to be classified by the soil survey as within a map unit that generally has 0-2 percent slopes. Smaller pockets of nearly level soils can exist within map units that have greater slope, and especially can be lumped in with the next highest slope category for the purposes of soil mapping if they are similar in other characteristics. So this could be a partial artifice of soil mapping generalization; however, it would still be a cultural signal. As noted above, I am not analyzing site locations with the SSURGO data, but site context. An alternative, and not mutually exclusive, explanation would be associated with a shift in subsistence strategy.

Late Woodland and especially Late Prehistoric populations are maize agriculturalists. An intensified (though still extensive) farming strategy may require a greater proportion of flat ground to be successful. It should also be noted that these "sites" or "components" do not refer exclusively to habitation sites (hamlets, villages, etc.) or base camps, or even hunting camps. There are many isolated finds and special purpose sites. Isolated finds could even be artificially inflated with the inclusion of amateur and collector sites in the database. Most non-professionals will not collect or report flake scatters; however, a complete diagnostic point will be collected and remembered. Such a bias would increase the proportion of non-habitation sites that have a known temporal component in the database. The size, or even the presence, of such a bias is not known.

Even in the absence of this sort of bias, points are likely to be lost from systemic context where they were used. Points lost during hunting or procurement trips reveal the patterns of environmental exploitation

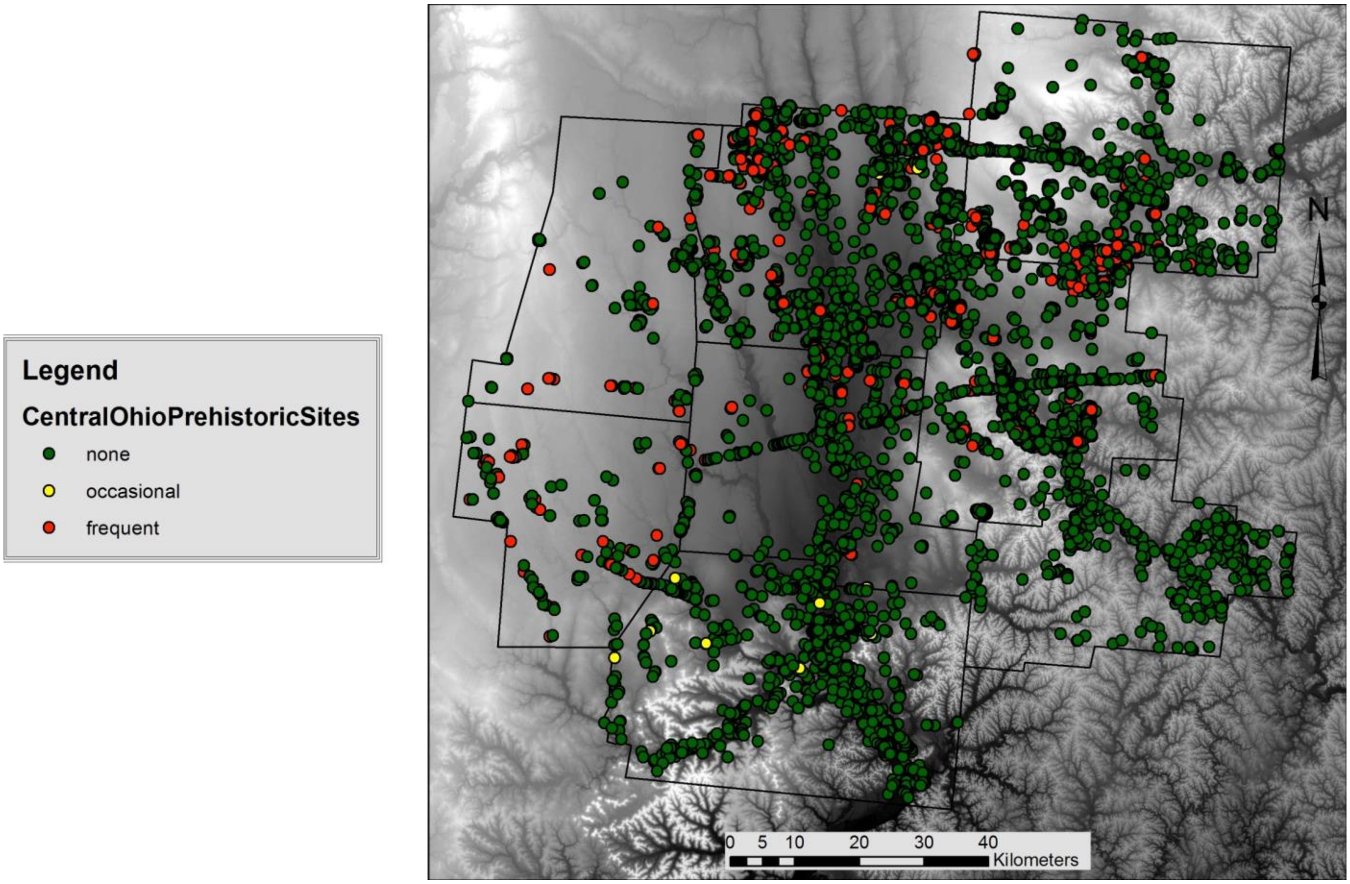

Figure 9. Distribution of ponding frequency.

of that particular time period. Therefore, many of the points found and reported are likely to be from non-habitation sites throughout the sequence of prehistory. In fact, most sites are likely to be a site type other than habitation. Therefore, the quantitative patterning is likely driven more by resource collection/extraction than by choices for the location of long-term habitation sites. Thus the significantly greater preference for class A slopes during the last two prehistoric periods (Table 8) likely represents a different strategy of environmental exploitation. The transition from preference for class B slopes to nearly level ground begins in the Middle Woodland period, and perhaps even in the Early Woodland period. As most habitation sites with Middle Woodland components are not large villages (e.g., Dancey and Pacheco 1996, 1997), this transition cannot be explained by size of habitation sites and as artifice in the soil map generalization. The location of diagnostic artifacts changed, and this pattern leads to the significantly greater preference for class A soils among agriculturalists.

While the plurality of components from all time periods are on well or excessively drained soils, there is a dramatic increase with the onset of the Early Woodland period (Table 9). The Archaic period components are never a majority located on well drained soils and this difference is significant (Table 10). After the onset of the Woodland period > 59 percent of components are on well drained soils. The potential explanations are the same as those for slope; however, the transition in subsistence patterns and environmental exploitation is most likely.

Soil texture shows a transition from a preference for fine particle sizes to an avoidance of these (Table 11and Table 12). The later occupations also exhibit a preference for coarser textures. This pattern largely mirrors that of soil drainage, and they may actually be one and the same.

There is a steady increase in preference for flood-

Table 17. Summary of Results.

	PI	EA	MA	LA	EW	MW	LW	LP	PH
Water		Wetlands (2)		Wetlands (3)	Streams (4)	Streams (1), Wetland (1)	Streams (3), Wetland (4)	Streams (2)	[Wetland 1]
Slope	B	B	B	B	B	B/A	A	A	B
Texture	siClLm	siClLm	siClLm	siClLm	siClLm	Lm	Lm	Lm	Lm
Flood	none	none	none	none; some frq	none; some frq	none; some frq	none; some frq	none; some frq	none
Pond	5	1	3	2	7	8	4	6	
Drain	mod/sm poor (4)	mod/sm poor (1)	mod/sm poor (3)	mod/sm poor (2)	well (3)	well (1)	well (4)	well (2)	
Region	55b	61c	55b	61c	55b	55b	70d	70d	70d
Ecotone	13.49	10.73	13.54	10.75	10.72	11.42	9.65	11.45	5.44

ed soils (Table 13) and decrease in preference for ponded soils (Table 15) through time. Both of these patterns are significant (Table 14 and Table 16) and significance once again seems to follow the transition in subsistence patterns and the shift from the Archaic to the Woodland period.

Table 17 provides a summary of all the results presented above. The table gives the strongest preference(s); some fields present the rank for each parenthetically. There is a very clear zone of transition (marked by the dotted lines) from an Archaic to a non-Archaic pattern. In all variables examined, except ecoregions, the Woodland and Late Prehistoric period occupations exhibit very similar patterns of settlement preference which are distinct from the Archaic pattern.

The most likely explanation for this pattern is a transition in environmental exploitation patterns. The ways that the people from the Middle Woodland were interacting with their environment is, overall, more similar to the agriculturalists of the Late Prehistoric than the Late Archaic. These transitions begin predominantly in the Early Woodland, though it is a gradual, continuous trend and not a difference of kind. The pattern of interacting with the environment associated with changes in subsistence results in diagnostic artifacts being deposited in different places through time. As agriculture becomes more important (perhaps as early as the Late Archaic), proximity to streams, level ground, and well drained loams become more important.

What is notable by its absences is a contrast between the Late Woodland and the Late Prehistoric occupations. Here, my findings mirror Church's (1987) and contrast with Prufer and Shane's (1970) and (to a lesser degree) Wakeman's (2003) findings. It would appear that Church's rejection of the "invasion" model of Fort Ancient has stood the test of time.

Conclusions

My exploratory analysis has demonstrated the usefulness of the OAI database for region-scale archaeological analysis. There are very clear patterns in the data, notwithstanding the imperfections in the data. There are inconsistencies in how data is recorded, the criteria used to assign an occupation to a category, the completeness of individual records, etc. The database is far from complete. The OAI does not always receive updates upon reinvestigation, and not all known sites are recorded. While some academically investigated sites do not make it into the OAI, a very small proportion of non-professionally reported sites make it into the OAI. This is a significant gap in our knowledge (LaBelle 2003; Shott 2008). These shortcomings notwithstanding, the OAI is a valuable research tool. My brief, exploratory analysis using a single field in the OAI has demonstrated the power and potential of this publicly funded resource. The OAI represents an investment with enormous potential for returns in knowledge about broad patterns in prehistory. It is also worth pointing out that those sites often judged as lacking "information potential" are an important part of the prehistoric signal we seek to understand. Failure to record and report these types of sites would significantly hamper our ability to ever fully understand the cultural systems we study (c.f. Baker 1998:54-55; ODOT 2012:7). The results of this analysis would have been drastically different if large-scale surveys and CRM investigations did not record all site types.

More work must be done to exploit the latent research potential of the OAI, and more work must be done to ensure the integrity and comparability of the data collected and entered.

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