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Investigating “lithic scatter” variability: space, time, and form

By

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Investigating “lithic scatter” variability: space, time, and form

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Using flake dimensions and attributes commonly agreed are associated with site use, occupation age, and occupation duration, it was argued that relative estimations of site function and occupation age could be determined using debitage. This is particularly beneficial for assemblages that have little to no diagnostics that could provide a general cultural period for one or more occupations at a site.

The results of this study suggest that, although certain attributes are generally associated with lithic production stage, relative age, and duration indicators, they were not all applicable within this study. The methods employed were relatively successful; however, reducing the number of classes, removing of a dimension, and more sites that meet the definition of lithic scatter is needed. Furthermore, testing occupation duration using the number of breaks on a flake is not possible unless it is proven a single occupation site.

ACKNOWLEDGEMENTS

Many thanks to my committee members, Drs. Evan Peacock, Janet Rafferty, and Nicholas Herrmann, for their guidance and patience. To Evan and Janet, you two ignited the spark of interest that guided me to this point and such a feat deserves more than a thank you. Without a solid beginning, the interest would not have fostered a love for CRM that I hope will never fade. To Nick, thank you for the patience you showed a student who seemed always distracted. Even though it did not appear to be so, I was paying attention.

To those at the Tombigbee National Forest, thank you for giving a student worker such as I the experiences that changed my career.

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And last, but not least, many thanks to my family. Your love and support never wavered, even when you realized the little girl who was once afraid of dirt wanted to dig in it for a living.

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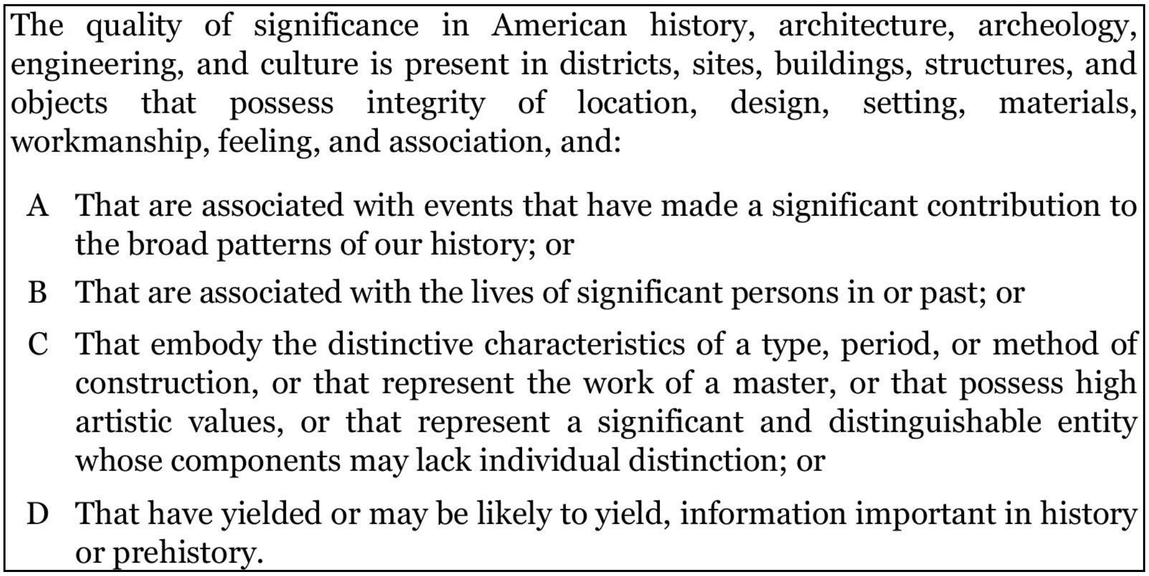
CHAPTER I

PROBLEM STATEMENT

American archaeological research once focused primarily on large base camps, villages, monumental works, and unique artifacts (Dunnell 1984). Similarly, much lithic research has focused on formal tools: tools that require a greater amount of time and energy to produce, including but not limited to bifaces and prepared cores (e.g., Grills 2008; Rinehart 2008) with much of the focus on typology (e.g., Dick and Mountain 1960; Flenniken and Raymond 1986; see also Mesoudi and O'Brien 2008). Small lithic debitage sites, or "lithic scatters," have few formal tools and are the predominant (Andrefsky 2001), yet arguably, the least understood site "type" in the world (Andrefsky 2001; Rieth 2008a). Although most archaeological investigations have not touched upon small, lithic debitage sites, the last few decades have witnessed a new interest in small, short-duration occupations (Andrefsky 2001a; Means 1999; Peacock et al. 2010; Rieth 2008a; Sullivan 1992). This shift in interest is providing a broader view of human lifeways (Rieth 2008a) with research on paleoenvironments (Grills 2008; Sullivan 1992; Zvelebil et al. 1991), lithic technologies (Fish 1981; Odell 1980), lithic sourcing (Luedtke 1979; Newman 1994), subsistence organization (Sullivan 1995), site formation (Bradbury and Creasman 2008; Bradley et al. 1987; Clarke 1989), site use (Carter 1996; Logan and Hill 2000), and predictive modeling for site locations (Grills 2008; Rush et al. 2008), to list only a few areas of research.

Despite the vast amount of knowledge obtainable from such sites, “lithic scatters” are often deemed unimportant and the term remains a catch-all phrase in cultural resource management (CRM) that means not significant (Butler 1987). The National Register of Historic Places (NRHP) provides four criteria (Table 1.1), of which one must be met for eligibility, or significance, to be determined. In addition to meeting one of these criteria, a site must also retain “integrity.” It is often assumed that “lithic scatters” lack integrity due to the shallow nature of deposits and their lack of culturally diagnostic artifacts identified during survey (Rieth 2008b).

Table 1.1 National Register Criteria for Evaluation (36 CFR 60.4)



The quality of significance in American history, architecture, archeology, engineering, and culture is present in districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling, and association, and:

A That are associated with events that have made a significant contribution to the broad patterns of our history; or

B That are associated with the lives of significant persons in or past; or

C That embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or

D That have yielded or may be likely to yield, information important in history or prehistory.

A growing movement in archaeological research opposes determining significance after doing nothing more than shovel tests or shovel test pits. This is particularly true of lithic scatters, as they often produce small assemblages (Binzen 2008; Blakemore et al. 2008; Carr 2008; Miller 2008; Peacock et al. 2008; Perazio 2008; Rush et al. 2008; Versaggi and Hohman 2008). Creasman et al. (2000) have suggested that the reasons small lithic sites are often written off (i.e., low artifact count, low diversity of artifact classes, and lack of features) are the characteristics that should be investigated further, rather than using them to make negative significance decisions.

Studying variability within the archaeological record enables researchers to observe change selected for through time and space. Variability is not just noting similarities and differences, it is about quantifying related discrete changes throughout the record. Variability is what is central in archaeological investigation, whatever that variability may be due to. Where genetics answers how variability came to be in biology, variability in the archaeological record must be approached with a theory strong in systematic research methods in order to gain understanding of its import (Dunnell 1980). The range of variability within the dimensions of space, time, and form is largely unknown at small lithic sites (Carter 1996; Creasman et al. 2000; Curtin et al. 2008; Peacock et al. 2008; Perazio 2008; Sullivan 1995).

This thesis research addresses the misconceptions that “lithic scatters” have little to offer and helps provide a valid argument for the significance of such sites. I investigated debitage from plowzone sites that traditionally would be characterized as “lithic scatters” (i.e., presumably single component occupations from which only or mostly debitage has been recovered), where the debitage was collected from the surface rather than via subsurface investigations. In order to identify variability along the dimensions of space, time, and form, attributes related to site use, occupation age, and occupation duration were employed. Tests were conducted on five “lithic scatters” to identify variation in the assemblages and to identify their use, age, and duration. The assemblages from an additional 17 sites that do not meet the definition of "lithic scatter," as defined in the next chapter, were included in the analysis. These assemblages were pulled from hundreds identified within the study area. The additional assemblages were incorporated into this research in order to compare the variation of lithic scatters to a random selection of site assemblages in the region. The goal of this research is to analyze the lithic debitage at sites with a low number of artifacts, and few to no diagnostics, and to provide evidence of research potential at these sites that would not typically have been recommended for future research beyond their initial identification.

I expect that, rather than being a unitary phenomenon, the "lithic scatters" investigated in this study will display considerable variability along the dimensions of space, time, and form. If so, then strong considerations of how best to sample that variability in order to meet the Principle of Representativeness (Dunnell 1984) must be undertaken. This will better inform considerations of potential significance under Criterion D of 36 CFR 60.4 (King 2004; Little et al. 2000; Peacock et al. 2008).

CHAPTER II

BACKGROUND

Lithic Scatters

Debitage is present worldwide, having been produced by all populations that employ lithic tool technology (Andrefsky 2001a; Curtin et al. 2008; Rieth 2008b), yet few archaeologists explicitly define what they mean by "lithic scatter." Most definitions are subjective (Curtin et al. 2008). It is important from both a research and management perspective to gain an appropriate understanding of "lithic scatters" (Chartkoff 1995), particularly when the term is often treated as synonymous with unimportant (Andrefsky 2001a; Cain 2012; Peacock et al. 2010).

The Dictionary of Artifacts defines a "lithic scatter" as "a common class of sites where tools were made or repaired, resulting in a large number of flakes (and typically few other artifacts) at a site" (Kipfer 2007:180). These sites contain concentrations of cultural debris that are predominantly flakes and broken tools (Andrefsky 2001a; Keyser et al. 1988), but seem to have no other features, such as occupation middens, food deposits, or hearths and house features (Chartkoff 1995). Carr (2008) states that classifying small lithic debitage sites as "scatters" is a practice that should be abandoned, while others believe that more work is needed to address the terminological inconsistencies and ambiguities, rather than abandoning years of research that they consider reliable (Johnson 2001; Magne 2001). Recently, Cain (2012) described lithic scatters as “an assortment of waste flakes, occasionally accompanied by temporally diagnostic tools, [and] often in areas topographically unsuited to intensive habitation” (Cain 2012:207). Sites are often lumped into such a category based on assumed similarities, and often using very small samples.

Not all lithic scatters contain small amounts of debitage, nor are they all small in size (Gates 2009; Sullivan 1992; Whittaker and Kaldahl 2001). If Kipfer’s (2007) definition is to be taken as a universal definition, then all lithic scatters are of the same class and therefore their functions are known. As many have shown (e.g., Andrefsky 2001a; Larson 2004; Rieth 2008a), this is not true. For the purpose of this thesis, lithic scatters will refer to assemblages that consist mostly, or entirely, of lithic debitage (i.e., >70% of the total artifacts recovered), based on the artifact descriptions initially described on the original site cards. This is in keeping with the most common use of the term, and is appropriate because of the implications of this research for common archaeological practice. An arbitrary percentage was chosen rather than a specific count of debitage in order to account for large lithic scatters. The choice of >70% was chosen but this percentage is an understandably low number to account for the majority of the debitage. Instead, this percentage was chosen to possibly account for sites that may have been classified as “lithic scatter” based on the artifacts rather than their counts.

Significance Issues

As noted above, lithic scatters are the most abundant prehistoric site “type” in the world (Andrefsky 2001a; Curtin et al. 2008; Rieth 2008b). The relative lack of research on this phenomenon (Andrefsky 2001a), coupled with the abundance of dimensions suitable for exploring variability (Chartkoff 1995), is a basis for arguing for the significance of such sites. These dimensions can include, but are not limited to, site distribution patterns, lithic reduction and production stages, distance from raw material sources, and occupation duration (Chartkoff 1995). With few exceptions (e.g., Andrefsky 2001b; Rieth 2008a), the potential for lithic scatters to express past cultural activity has not been fully explored (Chartkoff 1995).

Cultural resource management (CRM) archaeologists often encounter lithic scatters during Phase I surveys, but this is due in part to testing techniques. When found, archaeologists often classify these sites as not significant or unimportant in the field (Cain 2012; Hasenstab 2008). Lithic scatters are only eligible for the National Register of Historic Places under Criterion D, which states that “a place is eligible if it contains-or may contain- information significant in history or prehistory” (NRHP 1991).

The National Register Bulletin, Guidelines for Evaluating and Registering Archaeological Properties, includes a section specifically discussing the importance of small and typically overlooked sites. This section states that small sites can provide important information and that overlooking their significance skews our understanding of past lifeways. The bulletin states that “it is also important to consider significance before considering integrity” (Little et al. 2000: 22), however, too many archaeologists automatically consider these sites not significant because they often lack “integrity”; e.g., they have been plowed through or otherwise disturbed to subsoil (Carr 2008). The different federal and state agencies have their own standards for the management and treatment of lithic scatters. For example, the U.S. Forest Service ostensibly leaves it to the discretion of the Forest Archaeologist which level of preservation to employ (Keyser et al. 1988). Of course, the State Historic Preservation Officer (SHPO) might disagree, but federal agencies are not ultimately bound by SHPO opinion (King 2004).

Research on surface collections, particularly from plowzones, has been a growing topic of interest in the past few decades. These investigations have shown that years of plowing do not destroy cultural patterns (Butler 1987; Carr 2008; Lewarch and O'Brien 1981; Shott 1995) and that one can determine where to excavate within a site using data from the surface, regardless of the limitations surrounding surface artifacts (Dunnell and Dancey 1983). In fact, Dunnell and Dancey (1983) have observed that surface assemblages are “comparable” to subsurface assemblages with regard to context, and the information that can be drawn from surface collections can provide significant information prior to excavation or in its own right (Dunnell and Dancey 1983).

In CRM, where there are practical limits to the amount of time and funding available, intensive surface collection at the Phase I level has provided a cost-efficient way to obtain materials for archaeological analysis (Lewarch and O'Brien 1981). Surface collection methods are often left to the agency to decide, although there are state requirements to be considered. For example, Mississippi Department of Archives and History (MDAH) guidelines state that “a systematic pedestrian visual surface examination must be conducted in those portions of the project area, such as cultivated cropland, possessing good surface visibility” (Sims 2001:12). MDAH also requires “some subsurface investigations” to assess the nature of a site, such as depth, integrity, etc. (Sims 2001).

To obtain useful information from surface collections, the material collected must be assessed using appropriate analytic methods (Lewarch and O'Brien 1981). Research that has come out since Lewarch and O'Brien's (1981) statement has shown that surface collections from sites in plowzones can hold significant amounts of information that can be obtained prior to excavation (e.g., Butler 1987; Carr 2008; Shott 1995).

Where they have been conducted, more in-depth investigations of lithic scatters have sometimes belied traditional conceptions of limited activity or short occupational duration. Blakemore et al. (2008) have shown that, if subsurface investigations are conducted on sites deemed lithic scatters, evidence of features, pits, and even large residential areas may be revealed. However, not all subsurface investigations lead to such findings, and in fact the majority have not (Zvelebil et al. 1991). While the Blakemore et al. (2008) example may not be representative of what lithic scatter research can provide, it does show that investigations beyond Phase I surveys may be needed to make accurate significance determinations before allowing such sites to be destroyed based on incorrect assumptions. It is not feasible to subject every site to Phase II investigations; hence, it is important for the surveyor to learn to identify and adequately sample variability in space, time, and form at the Phase I level (Dunnell 1984; Peacock et al. 2008).

Chronology and assignments of cultural affiliation are often a determining factor in significance and preservation decisions (Keyser et al. 1988), but diagnostics are not always recovered, preventing such estimates (Peacock et al. 2010). It has been argued that a lack of diagnostics is not a legitimate reason for writing off a site: if an occupational age is unknown, there clearly is something important to learn about that site (Peacock et al. 2008; Rieth 2008a).

Sutton (1995) fears that, if methods for determining significance are not scientific, they can lead to an inappropriate, if not incorrect, classification schemes in which some sites are automatically classified as non-significant. The purpose of this thesis is not to provide a rote classification scheme, but rather to provide another method for making significance determinations within the CRM context. When you automatically exclude part of the archaeological record because it is deemed by definition to contain no significance, you are excluding some facts, and providing a means for a self-fulfilling prophecy to thrive while preventing new questions from being asked (Sutton 1995).

Unless demonstrated otherwise, it must be assumed that lithic scatters can provide useful data for a variety of archaeological questions (Chartkoff 1995; Sutton 1995), but fiscal considerations by many government management and CRM firms limit such research potential by leaning toward “write-off” decisions (Perazio 2008). This is, in fact, a false economy. As researchers have shown, further investigation into lithic scatters is not a financial burden (Peacock et al. 2008; Peacock et al. 2010). In fact, the research conducted by Peacock et al. (2010) provides an appropriate example of the ability to investigate many small, light artifact density sites at far less cost than a single large, artifact-rich site, as well as showing that SHPO offices may be open to arguments regarding the preservation of small sites such as lithic scatters (Peacock et al. 2010). Though it is rare, lithic scatters have been found to be significant in a legal compliance context in North America (e.g., Blakemore et al. 2008).

Moral dilemmas attend research within the scientific disciplines, and archaeology is not an exception. Archaeological significance decisions are a dominant source of moral dilemmas within the field, as not all sites and resources can feasibly be saved. Dunnell (1984) confronts such dilemmas and calls for significance decisions that minimize systematic sampling errors (Dunnell 1984). As theoretical views, methods, and techniques change with time and technology, so will the standards by which archaeologists determine site significance. Therefore, the changes in perceptions of research potential will also affect such standards (Dunnell 1984; Lewarch and O'Brien 1981; Little et al. 2000). The idea of the Principle of Representativeness enables public archaeologists to save a representative sample of everything in hopes that future research can bring new knowledge to the subject matter (Dunnell 1984; Glassow 1977).

To obtain a better understanding of significance potential under criterion D of 36 CFR 60.4, this research investigated lithic debitage from sites identified through surface collections. It was expected that, rather than representing a unitary phenomenon, considerable variability will be present at these sites along the dimensions of space, time, and form. Those attributes that display notable variation at lithic scatters can provide further understanding of this site “type”, which in turn could provide archaeologists a means for determining which lithic scatters to sample via the Principle of Representativeness. Understanding what the variability means in terms of occupation age, function, or duration may be aided by comparing debitage from lithic scatters to that from other sites.

Sites

The lithic assemblages chosen were obtained from the 1984 and 1985 Mississippi State University archaeological field school collections from Union and Pontotoc counties in northern Mississippi. These sites were collected under the direction of Dr. Janet Rafferty via general surface collection (GSC) in cultivated fields. Field conditions were generally comparable and collection methods and intensity were comparable for each site. Assuming previous research is pertinent to the Southeast, the artifacts from plowzone surfaces would represent between 4-7% of the artifacts within the plowzone, thus providing an adequate sample for the purposes of this research (Ammerman 1985; Lewarch and O'Brien 1981).

All sites considered are from within a 10 kilometer (6.2 mi.) radius circle surrounding Ingomar Mound (22UN500) in Union County, Mississippi. Hundreds of sites of various components were collected (e.g. Rafferty 1994). In order to construct a stratified random sample for archaeological survey, Dr. Rafferty divided the land area into four sample strata based on major soil associations (Table 2.1; Figure 2.1) (USDA 1971, 1977). Each stratum was divided into quarter section (160 acre) segments and a 5% random sample of each segment was chosen for survey. This assured that the sites found represent a random sample of sites within the 10 km catchment surrounding Ingomar Mounds (22UN500). The strata and quarter sections were established by Dr. Janet Rafferty during the initial 1984 and 1985 field school investigations. For the sake of manageability, a sample of sites was chosen for use in this thesis. All of the assemblages chosen for analysis presented evidence of continuous occupation (overlapping diagnostics) or unknown components (a lack of diagnostics) based on catalog data; several fit the definition of lithic scatter. Non-“lithic scatter” sites were included for comparison.

The components for each site were determined based upon the artifacts present, such as, but not limited to, projectile point types (Cambron and Hulse 1975; Justice 2012; McGahey 2000; Rafferty 1994) and pottery identified by temper and decoration (Futato 1983; Jenkins 1981; Phillips 1970) (Tables 2.2-2.4).

As stated earlier, “lithic scatters” are here considered to consist mostly, or entirely, of lithic debitage (i.e., greater than 70% debitage in the total assemblage recovered). The sites chosen were limited to those containing a minimum of three flakes in the assemblage. Although interpretations have been made using individual flakes (Andrefsky 1998; Magne 1985), the arbitrary limitation on the number of flakes is to allow for at least some variation in the debitage to be expressed (Carr and Bradbury 2001).

Table 2.1 Soil Association Code (USDA 1971, 1979)

Union County Soil Association	Code	Pontotoc County Soil Association
Arkabutla-Mantachie-Jena nearly level, somewhat poorly drained, silty and loamy soils and well drained, loamy soils; on *floodplain*	1	**Arkabutla-Cascilla-Urbo** nearly level somewhat poorly drained and well-drained soils that have a loamy and clayey subsoil; on *floodplain*
Jena-Mantachie nearly level, well drained and somewhat poorly drained, loamy soils; on *floodplain*	2	**Robinsonville-Commerce-Mantachie** nearly level, well-drained and somewhat poorly drained soils that are loamy throughout; on *floodplain*
Tippah-Falkner-Wilcox undulating moderately well drained and somewhat poorly drained, silty soils in which the lower part of the subsoil is clayey and somewhat poorly drained soils that have a clayey subsoil; on *uplands*	3	**Falkner-Providence-Mayhew** nearly level to rolling, moderately well drained to poorly drained soils that have a loamy and clayey subsoil; on *uplands*
Atwood-Smithdale undulating, well drained, silty soils and hilly, well drained, loamy soils; on *uplands*	4	**Oktibbeha-Ruston-Atwood** nearly level to very steep, moderately well drained and well drained soils that have a loamy and clayey subsoil; on *uplands*

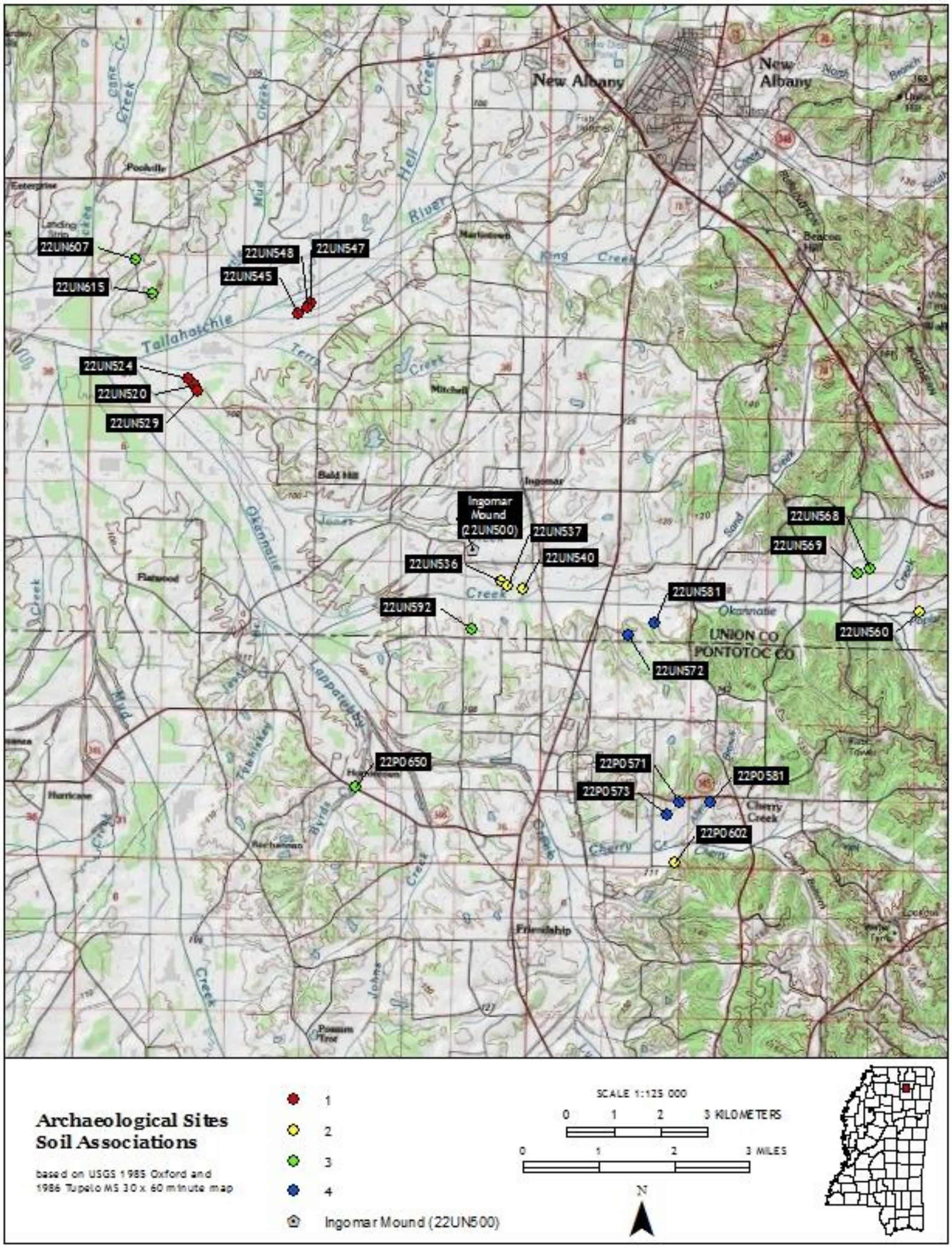


Figure 2.1 Soil association map of selected sites within a 10-km radius surrounding Ingomar Mound (22UN500)

Table 2.2 Projectile Point Attribute Types.

Site	Haft Size [1]	Haft-Element [2]	Haft Angle [3]	Base Treatment [4]	Basal Grinding
22PO581	small	defined	expanding (sl)	thinned	absent
	small	defined	expanding (sl)	thinned	absent
22UN524*	large	defined	expanding (ext)	thinned	present
	small	defined	expanding (sl)	thinned	absent
	medium	defined	expanding (sl)	thinned	absent
	medium	defined	expanding (sl)	beveled	absent
22UN529	small	undefined	contracting	thinned	absent
22UN536	medium	defined	contracting	thinned	absent
	small	undefined	expanding (sl)	beveled	present
22UN537	small	undefined	expanding (sl)	thinned	absent
22UN540	small	defined	contracting	thinned	absent
22UN545	medium	defined	expanding (sl)	beveled	absent
	small	defined	contracting	unmodified	absent
	small	defined	contracting	unmodified	absent
	large	defined	expanding (ext)	beveled	present
	large	undefined	expanding (sl)	beveled	absent
	small	undefined	contracting	thinned	absent
	medium	defined	expanding (sl)	thinned	absent
	small	defined	contracting	unmodified	absent
	small	defined	contracting	unmodified	absent
	small	defined	contracting	unmodified	absent
	small	defined	expanding (sl)	thinned	absent
	large	defined	expanding (sl)	beveled	absent
22UN547	small	undefined	expanding (sl)	thinned	absent
	large	defined	expanding (ext)	thinned	present
	medium	defined	expanding (sl)	unmodified	absent
	small	defined	contracting	unmodified	absent
	medium	defined	contracting	thinned	absent
22UN548	medium	defined	expanding (ext)	thinned	present
	small	defined	expanding (sl)	unmodified	absent
	large	defined	contracting	thinned	present

Table 2.2 (continued)

Site	Haft Size [1]	Haft-Element [2]	Haft Angle [3]	Base Treatment [4]	Basal Grinding
22UN569	large	defined	expanding (sl)	thinned	present
	large	defined	contracting	thinned	absent
	small	defined	contracting	thinned	absent
22UN572	small	defined	contracting	thinned	absent
	medium	defined	expanding (sl)	thinned	absent
	large	defined	expanding (ext)	thinned	present
	medium	defined	contracting	thinned	absent
22UN581	small	undefined	expanding (sl)	thinned	absent
22UN592	medium	defined	contracting	thinned	absent
22UN615*	small	defined	contracting	thinned	absent
	large	undefined	expanding (ext)	thinned	absent
	large	defined	expanding (ext)	thinned	present
	small	defined	contracting	thinned	absent

* Sites meeting the definition of lithic scatter.

[1] small = <1.75 cm; medium = 1.76 – 2.25 cm; large = >2.25 cm.

[2] defined = haft element demarcated by stemming or notching; undefined = haft element continuous with blade.

[3] contracting = angle > 90°; expanding (slight [sl]) = angle 75 -90°; expanding (extreme [ext]) = angle <75°.

[4] thinned = flakes irregular in size and shape removed from base; unmodified = cortex or striking platform retained on base; beveled = small regular flakes removed from one or both sides of base.

Table 2.3 Ceramic Typology

Site	**Ceramic Typology**
22PO571*	Sand Tempered Sherdlets
22PO581	Sand Tempered Fabric Impressed (Saltillo Fabric Marked)
22UN529	Grog Tempered Sherdlets
22UN536	Sand Tempered Plain (Baldwin Plain), Sand Tempered Incised (Alexander Incised), Grog Tempered Plain (Baytown Plain), Grog Tempered Cordmarked (Mulberry Creek Cordmarked)
22UN537	Sand Tempered Plain (Baldwin Plain), Sand Tempered Cordmarked (Furrs Cordmarked), Grog Tempered Plain (Baytown Plain), Grog Tempered Cordmarked (Mulberry Creek Cordmarked), Bone Tempered Plain and Cordmarked (Turkey Paw), Bone/Grog Tempered Plain and Incised
22UN540	Sand Tempered Fabric Impressed (Saltillo Fabric Marked), Grog Tempered Plain (Baytown Plain), Grog Tempered Cordmarked (Mulberry Creek Cordmarked), Shell Tempered Plain (Mississippi Plain), Bone Tempered Plain (Turkey Paw), Bone/Grog Tempered Plain and Cordmarked
22UN545	Sand Tempered Plain (Baldwin Plain), Sand Tempered Cordmarked (Furrs Cordmarked), Grog Tempered Plain (Baytown Plain), Grog Tempered Cordmarked (Mulberry Creek Cordmarked), Grog Tempered Ext. Red Slipped (Chicot Red), Fiber Tempered Unidentifiable (Wheeler)
22UN547	Sand Tempered Plain (Baldwin Plain), Sand Tempered Cordmarked (Furrs Cordmarked), Grog Tempered Plain (Baytown Plain), Grog Tempered Cordmarked (Mulberry Creek Cordmarked), Grog Tempered Punctate
22UN560	Sand Tempered Plain (Baldwin Plain), Sand Tempered Cordmarked (Furrs Cordmarked), Grog Tempered Plain (Baytown Plain), Grog Tempered Cordmarked (Mulberry Creek Cordmarked), Bone Tempered Plain (Turkey Paw)
22UN568	Grog Tempered Plain (Baytown Plain)
22UN569	Sand Tempered Plain (Baldwin Plain), Sand Tempered Cordmarked (Furrs Cordmarked), Sand Tempered Fabric Impressed (Saltillo Fabric Marked), Limestone Tempered Plain (Mulberry Creek Plain), Grog Tempered Plain (Baytown Plain)
22UN572	Sand Tempered Plain (Baldwin Plain), Coarse Sand Tempered Cordmarked (Furrs Cordmarked), Limestone Tempered Plain (Mulberry Creek Plain)
22UN581	Sand Tempered Plain (Baldwin Plain), Grog Fabric Impressed
22UN592	Sand Tempered Plain (Baldwin Plain), Sand Tempered Cordmarked (Furrs Cordmarked), Sand Tempered Fabric Impressed (Saltillo Fabric Marked),Grog Tempered Plain (Baytown Plain), Grog Tempered Cordmarked (Mulberry Creek Cordmarked)

* Sites meeting the definition of lithic scatter.

Table 2.4 Site Information

Site	Soil Group	Component	Total Flakes	Whole Flakes	Percentage of Flakes
22PO571*	4	Woodland	27	17	77.14%
22PO573*	4	Unknown	3	2	75.00%
22PO581	4	Middle Woodland	53	36	68.83%
22PO602*	2	Unknown	10	5	71.43%
22PO650	3	Unknown	7	4	50.00%
22UN520	1	Unknown	27	12	65.85%
22UN524*	1	Early, Middle Archaic	69	41	75.00%
22UN529	1	Late Woodland-Mississippian	6	4	42.86%
22UN536	2	Middle Woodland; Late Woodland-Mississippian	14	6	38.89%
22UN537	2	Middle Woodland; Late Woodland-Mississippian	100	72	27.32%
22UN540	2	Middle, Late Woodland	40	32	39.22%
22UN545	1	Early, Middle Archaic; Gulf Formational; Middle Woodland; Late Woodland-Mississippian	45	33	29.80%
22UN547	1	Early, Middle Archaic; Gulf Formational; Middle, Late Woodland	63	38	59.43%
22UN548	1	Gulf Formational; Middle Woodland	3	3	27.27%
22UN560	2	Middle, Late Woodland	7	6	25.93%
22UN568	3	Middle, Late Woodland	17	10	60.71%
22UN569	3	Middle Archaic; Gulf Formational; Middle, Late Woodland	171	109	50.74%
22UN572	4	Early Archaic; Gulf Formational; Middle Woodland	36	22	28.57%
22UN581	4	Middle Woodland; Late Woodland-Mississippian	13	11	61.90%
22UN592	3	Archaic; Middle, Late Woodland	10	8	25.00%
22UN607	3	Unknown	5	2	62.50%
22UN615*	3	Early, Middle, Late Archaic	79	46	82.29%

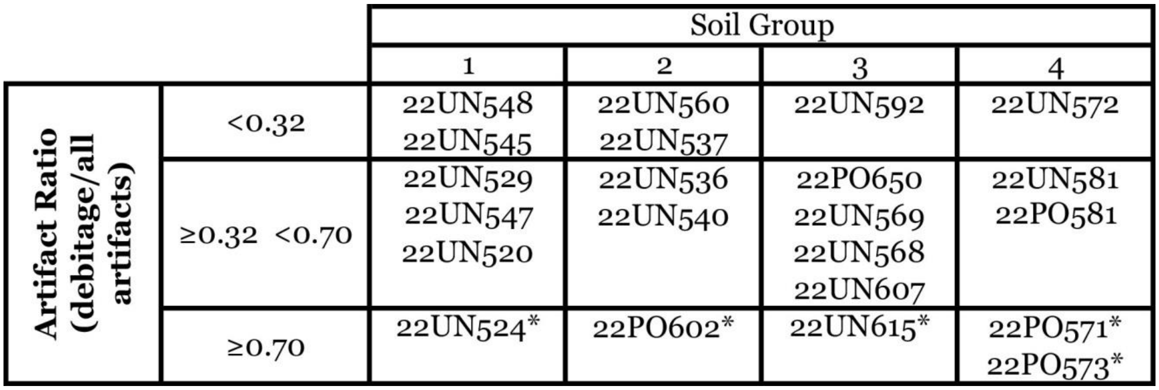
* Sites meeting the definition of lithic scatter.

A total of 104 assemblages met the limitations set above; these included sites that did not meet the definition of lithic scatter in order to determine, based on their age, function, or duration, whether the debitage assemblages of “lithic scatters” do or do not represent “types” than the other assemblages.

To obtain samples, the ratio of debitage to all artifacts was calculated based on the actual number of flakes analyzed and the total artifact count. The artifact count was amended from the catalog list from the respective field schools. All historic artifacts and any chunky or blocky unmodified sandstone or siltstone were removed prior to calculating the debitage ratio. This ratio value was run through the open source statistical program R (R Core Team 2013) and Jenks natural breaks optimization run using the ”classInt” R package, dividing the ratio count into three arbitrary groups. A paradigm was created using artifact ratio and major soil associations, then a random number generator was used to select at least two sites from each class. If there were two sites or fewer within a class, those sites were used and the random generator was not needed.

Due to an oversight, the classes were adjusted so the lithic scatters fell into their own ratio group and a natural breaks was calculated for the remainder of the sites (<0.32, ≥0.32-<0.70, and ≥0.70), resulting in two classes with extra sites. The results yielded 22 sites from 12 classes, 5 of which met the definition of lithic scatter (Table 2.5). Basic information on components represented and debitage assemblages at the chosen sites is given in Table 2.3.

Table 2.5 Artifact Ratio and Soil Group Paradigm



		Soil Group			
		1	2	3	4
Artifact Ratio (debitage/all artifacts)	<0.32	22UN548 22UN545	22UN560 22UN537	22UN592	22UN572
	≥0.32 <0.70	22UN529 22UN547 22UN520	22UN536 22UN540	22PO650 22UN569 22UN568 22UN607	22UN581 22PO581
	≥0.70	22UN524*	22PO602*	22UN615*	22PO571* 22PO573*

* Sites meeting the definition of lithic scatter.

CHAPTER III

ANALYTICAL METHODS

Debitage from the selected sites was analyzed for variability in form through space and time. The best way to test for the effects of space is to analyze how the sites were used, which can be expected to vary across different environments, whereas the considerations of time include both occupation age and duration. Paradigmatic classifications for debitage were constructed to explore all of these areas. All analysis was done by the author to insure consistency.

Site Use

Habitation sites, which tend to be the center of various activities, are expected to show greater variability in debitage, reflecting the production, use, and maintenance of multiple tool forms, than do single use or “special use” sites, with assemblages that reflect limited or single activities. The dimensions for tool production stage indicators (flake size, number of platform facets, number of dorsal scars, and percentage of cortex present) were used to test for site use, which is presumed to be highly influenced by the environment (i.e., variability through space). Although information was collected for all flakes, only whole flake attributes were included when testing site use because flake size, number of dorsal scars, and percent of cortex can be measured accurately only on whole flakes.

Flake size can provide information regarding tool production and reduction stages (Kalin 1981; Patterson 1990; Raab et al. 1979; Stahle and Dunn 1982), as well as reflecting differences between multidirectional and unidirectional cores (Andrefsky 1998). Relatively smaller flakes are considered late stage flakes whereas relatively larger flakes are considered early stage flakes, which often contain more cortex on the dorsal surface and are often found in and around quarry sites (Bradbury and Carr 2004; Stahle and Dunn 1982). Although flake size has been a useful measurement when analyzing flakes, alone, it is the least important variable for discerning general stages. Often, larger flakes were worked into other tools (Magne 1989). Mauldin and Amick (1989) state that flake size is not a good indicator for determining flake stage and that the majority of flakes produced can be relatively small, regardless of stage.

Flake length was measured perpendicular to the striking platform, and both the flake length and weight attribute divisions were determined using Jenks natural breaks optimization. Each dimension was divided into three attribute classes [flake length: “Short” (<13.8 mm), “Medium” (≥13.8 - <28.1 mm), and “Long” (≥28.1 mm), and flake weight: “Light” (<1.13 g), “Medium” (≥1.13 - <12.59 g), and “Heavy” (≥12.59 g)].

Platform morphology is one of the most important characteristics linking debitage with tool production, core reduction (Bradbury and Carr 1995, 2004; Morrow 1984; Odell 1989; Parry and Kelly 1987; Shott 1994), and hammer type (Cotterell and Kamminga 1987; Frison 1968; Hayden and Hutchings 1989). For this analysis, platform morphology was characterized using the number of facets found on the striking platform (1, 2, or 3 or more).

For those flakes that contain a platform but where the platform facets could not be distinguished due to the level of damage, the platform was classified as “crushed” since a platform was present. Those flakes that present “3 or more” and “crushed” platform facets are considered late stage flakes. Similarly, flakes that present single platform facets are early stage flake indicators (Bradbury and Carr 2004). Flakes with cortex covering the striking platform, facet counts were classified as having a single platform. A single platform, rather than zero platform facets, was decided as it contains an identifiable striking instance.

During the knapping process, cortex is progressively removed from an unprepared core (Ahler 1989; Andrefsky 1998; Magne 1989; Mauldin and Amick 1989). The percentage of cortex can provide relative assessments of the type of core reduction or tool production at a site (Andrefsky 1998; Magne 1989; Mauldin and Amick 1989; Morrow 1984), but alone it may not be a reliable stage identifier (Root 2004), and cortex variability can be more or less obvious depending on the raw material and nodule size (Carr and Bradbury 2004). Using cortex percentage as a dimension to measure site use, the attributes 0%, >0% - ≤50%, >50% - <100%, and 100% were used for each whole flake. A greater percentage of cortex present is generally indicative of primary flakes, where the least percentage of cortex present is indicative of tertiary flakes (Dibble et al. 2005).

Whereas platform facet count is a good indicator for core reduction, dorsal scar count is a better indicator for tool production (Bradbury and Carr 2004), with the number of dorsal scars increasing as reduction progresses (Magne 1989). Experimental research has suggested a correlation between flake size and the number of dorsal scars, but it has been debated whether large flakes, or smaller ones, contain more scars (Ingbar et al. 1989; Mauldin and Amick 1989; Tomka 1989). Using dorsal scar count as the final dimension in analyzing site use, four attributes were defined (0, 1, 2, and 3 or more). Classifying a dorsal scar count of “0” corresponds with a cortex percentage classification of “100%”; therefore, all flakes classified as 100% cortex have no available dorsal scar count.

The intersection of these attributes created 468 classes hypothetically related to site use (Tables 3.1 – 3.22).

Table 3.1 Site 22PO571 Use Paradigm

Platform Facets	Cortex Percentage	Dorsal Scars	<13.8			≥13.8 - <28.1			≥28.1			Length (mm)
			<1.13	≥1.13 - <12.59	≥12.59	<1.13	≥1.13 - <12.59	≥12.59	<1.13	≥1.13 - <12.59	≥12.59	Weight (g)
1	0%	0										
		1					2					
		2				2						
		3+	1			2				2		
	>0 - <50%	0										
		1										
		2				1						
		3+					2					
	≥50 - <100%	0										
		1										
		2										
		3+										
	100%	NA	1				1					
2	0%	0										
		1										
		2										
		3+										
	>0 - <50%	0										
		1	1									
		2										
		3+										
	≥50 - <100%	0										
		1										
		2										
		3+										
	100%	NA										
3+	0%	0										
		1										
		2										
		3+										
	>0 - <50%	0										
		1										
		2										
		3+										
	≥50 - <100%	0										
		1										
		2										
		3+										
	100%	NA										
Crushed	0%	0										
		1										
		2										
		3+							1			
	>0 - <50%	0										
		1										
		2										
		3+		1								
	≥50 - <100%	0										
		1										
		2										
		3+										
	100%	NA										

Table 3.2 Site 22PO573 Use Paradigm

Platform Facets	Cortex Percentage	Dorsal Scars \ Length (mm)	<13.8			≥13.8 - <28.1			≥28.1		
		Weight (g)	<1.13	≥1.13 - <12.59	≥12.59	<1.13	≥1.13 - <12.59	≥12.59	<1.13	≥1.13 - <12.59	≥12.59
1	0%	0									
		1									
		2									
		3+				1				1	
	>0 - <50%	0									
		1									
		2									
		3+									
	≥50 - <100%	0									
		1									
		2									
		3+									
	100%	NA									
2	0%	0									
		1									
		2									
		3+									
	>0 - <50%	0									
		1									
		2									
		3+									
	≥50 - <100%	0									
		1									
		2									
		3+									
	100%	NA									
3+	0%	0									
		1									
		2									
		3+									
	>0 - <50%	0									
		1									
		2									
		3+									
	≥50 - <100%	0									
		1									
		2									
		3+									
	100%	NA									
Crushed	0%	0									
		1									
		2									
		3+									
	>0 - <50%	0									
		1									
		2									
		3+									
	≥50 - <100%	0									
		1									
		2									
		3+									
	100%	NA									

Table 3.3 Site 22PO581 Use Paradigm

		Length (mm)	<13.8			≥13.8 - <28.1			≥28.1		
		Weight (g)	<1.13	≥1.13 - <12.59	≥12.59	<1.13	≥1.13 - <12.59	≥12.59	<1.13	≥1.13 - <12.59	≥12.59
Platform Facets	Cortex Percentage	Dorsal Scars									
1	0%	0									
		1									
		2	1			2					
		3+	6			2	2				
	>0 - <50%	0									
		1									
		2	1				1				
		3+	1			1					
	≥50 - <100%	0									
		1	1			1	1				
		2									
		3+									
	100%	NA									
2	0%	0	1								
		1									
		2									
		3+	2			3					
	>0 - <50%	0									
		1									
		2				2					
		3+	1								
	≥50 - <100%	0									
		1									
		2									
		3+									
	100%	NA									
3+	0%	0									
		1									
		2									
		3+									
	>0 - <50%	0									
		1									
		2									
		3+									
	≥50 - <100%	0									
		1									
		2									
		3+									
	100%	NA									
Crushed	0%	0									
		1									
		2				1					
		3+	1			1					
	>0 - <50%	0									
		1									
		2					1				
		3+					1				
	≥50 - <100%	0	1								
		1									
		2				1					
		3+									
	100%	NA									

Table 3.4 Site 22PO602 Use Paradigm

Platform Facets	Cortex Percentage	Dorsal Scars \ Length (mm)	<13.8			≥13.8 - <28.1			≥28.1		
		Weight (g)	<1.13	≥1.13 - <12.59	≥12.59	<1.13	≥1.13 - <12.59	≥12.59	<1.13	≥1.13 - <12.59	≥12.59
1	0%	0									
		1									
		2									
		3+	1							1	
	>0 - <50%	0									
		1									
		2									
		3+									
	≥50 - <100%	0									
		1					1				
		2									
		3+									
	100%	NA	1								
2	0%	0									
		1									
		2									
		3+									
	>0 - <50%	0									
		1									
		2									
		3+									
	≥50 - <100%	0									
		1									
		2									
		3+									
	100%	NA									
3+	0%	0									
		1									
		2									
		3+									
	>0 - <50%	0									
		1									
		2									
		3+									
	≥50 - <100%	0									
		1									
		2									
		3+									
	100%	NA									
Crushed	0%	0									
		1									
		2									
		3+	1								
	>0 - <50%	0									
		1									
		2									
		3+									
	≥50 - <100%	0									
		1									
		2									
		3+									
	100%	NA									

Table 3.5 Site 22PO650 Use Paradigm

Platform Facets	Cortex Percentage	Dorsal Scars \ Length (mm)	<13.8			≥13.8 - <28.1			≥28.1		
		Weight (g)	<1.13	≥1.13 - <12.59	≥12.59	<1.13	≥1.13 - <12.59	≥12.59	<1.13	≥1.13 - <12.59	≥12.59
1	0%	0									
		1									
		2									
		3+				1	1				
	>0 - <50%	0									
		1									
		2									
		3+									
	≥50 - <100%	0									
		1									
		2									
		3+									
	100%	NA									
2	0%	0									
		1									
		2									
		3+					1				
	>0 - <50%	0									
		1									
		2									
		3+									
	≥50 - <100%	0									
		1									
		2									
		3+									
	100%	NA									
3+	0%	0									
		1									
		2									
		3+									
	>0 - <50%	0									
		1									
		2									
		3+									
	≥50 - <100%	0									
		1									
		2									
		3+									
	100%	NA									
Crushed	0%	0									
		1									
		2									
		3+					1				
	>0 - <50%	0									
		1									
		2									
		3+									
	≥50 - <100%	0									
		1									
		2									
		3+									
	100%	NA									

Table 3.6 Site 22UN520 Use Paradigm

Platform Facets	Cortex Percentage	Dorsal Scars	<13.8			≥13.8 - <28.1			≥28.1			Length (mm)
			<1.13	≥1.13 - <12.59	≥12.59	<1.13	≥1.13 - <12.59	≥12.59	<1.13	≥1.13 - <12.59	≥12.59	Weight (g)
1	0%	0										
		1	1									
		2					1					
		3+				1	3			1		
	>0 - <50%	0										
		1										
		2										
		3+										
	≥50 - <100%	0										
		1										
		2					1					
		3+										
	100%	NA										
2	0%	0										
		1										
		2										
		3+	1			2				1		
	>0 - <50%	0										
		1										
		2										
		3+										
	≥50 - <100%	0										
		1										
		2										
		3+										
	100%	NA										
3+	0%	0										
		1										
		2										
		3+										
	>0 - <50%	0										
		1										
		2										
		3+										
	≥50 - <100%	0										
		1										
		2										
		3+										
	100%	NA										
Crushed	0%	0										
		1										
		2										
		3+										
	>0 - <50%	0										
		1										
		2										
		3+										
	≥50 - <100%	0										
		1										
		2										
		3+										
	100%	NA										

Table 3.7 Site 22UN524 Use Paradigm

Platform Facets	Cortex Percentage	Dorsal Scars	<13.8			≥13.8 - <28.1			≥28.1		
		Length (mm) / Weight (g)	<1.13	≥1.13 - <12.59	≥12.59	<1.13	≥1.13 - <12.59	≥12.59	<1.13	≥1.13 - <12.59	≥12.59
1	0%	0									
		1		1							
		2	4			3	2				
		3+	10	1		8	1				
	>0 - <50%	0									
		1									
		2				1				1	
		3+									
	≥50 - <100%	0									
		1									
		2					1				
		3+									
	100%	NA				1					
2	0%	0									
		1									
		2									
		3+	2			2					
	>0 - <50%	0									
		1									
		2									
		3+									
	≥50 - <100%	0									
		1									
		2									
		3+									
	100%	NA									
3+	0%	0									
		1									
		2					1				
		3+									
	>0 - <50%	0									
		1									
		2									
		3+									
	≥50 - <100%	0									
		1									
		2									
		3+									
	100%	NA									
Crushed	0%	0									
		1									
		2									
		3+				1	1				
	>0 - <50%	0									
		1									
		2									
		3+									
	≥50 - <100%	0									
		1									
		2									
		3+									
	100%	NA									

Table 3.8 Site 22UN529 Use Paradigm

		Length (mm)	<13.8			≥13.8 - <28.1			≥28.1		
Platform Facets	Cortex Percentage	Dorsal Scars Weight (g)	<1.13	≥1.13 - <12.59	≥12.59	<1.13	≥1.13 - <12.59	≥12.59	<1.13	≥1.13 - <12.59	≥12.59
1	0%	0									
		1									
		2									
		3+	1			1				1	
	>0 - <50%	0									
		1									
		2									
		3+									
	≥50 - <100%	0									
		1								1	
		2									
		3+									
	100%	NA									
2	0%	0									
		1									
		2									
		3+									
	>0 - <50%	0									
		1									
		2									
		3+									
	≥50 - <100%	0									
		1									
		2									
		3+									
	100%	NA									
3+	0%	0									
		1									
		2									
		3+									
	>0 - <50%	0									
		1									
		2									
		3+									
	≥50 - <100%	0									
		1									
		2									
		3+									
	100%	NA									
Crushed	0%	0									
		1									
		2									
		3+									
	>0 - <50%	0									
		1									
		2									
		3+									
	≥50 - <100%	0									
		1									
		2									
		3+									
	100%	NA									

Table 3.9 Site 22UN536 Use Paradigm

Length (mm)			<13.8			≥13.8 - <28.1			≥28.1		
Weight (g)			<1.13	≥1.13 - <12.59	≥12.59	<1.13	≥1.13 - <12.59	≥12.59	<1.13	≥1.13 - <12.59	≥12.59
Platform Facets	Cortex Percentage	Dorsal Scars									
1	0%	0									
		1									
		2					1				
		3+	1			1	2				
	>0 - <50%	0									
		1									
		2									
		3+									
	≥50 - <100%	0									
		1									
		2									
		3+									
	100%	NA									
2	0%	0									
		1									
		2									
		3+									
	>0 - <50%	0									
		1									
		2									
		3+									
	≥50 - <100%	0									
		1									
		2									
		3+									
	100%	NA									
3+	0%	0									
		1									
		2									
		3+									
	>0 - <50%	0									
		1									
		2									
		3+									
	≥50 - <100%	0									
		1									
		2									
		3+									
	100%	NA									
Crushed	0%	0									
		1									
		2									
		3+									
	>0 - <50%	0									
		1									
		2									
		3+									
	≥50 - <100%	0									
		1									
		2									
		3+									
	100%	NA					1				

Table 3.10 Site 22UN537 Use Paradigm

		Length (mm)	<13.8			≥13.8 - <28.1			≥28.1		
		Weight (g)	<1.13	≥1.13 - <12.59	≥12.59	<1.13	≥1.13 - <12.59	≥12.59	<1.13	≥1.13 - <12.59	≥12.59
Platform Facets	Cortex Percentage	Dorsal Scars									
1	0%	0									
		1									
		2	8			2	1				
		3+	18			9	3				1
	>0 - <50%	0									
		1	2								
		2									
		3+	1			1	1				
	≥50 - <100%	0									
		1								1	
		2					2				
		3+					2				
	100%	NA		1		2	1				
2	0%	0									
		1				1					
		2	2								
		3+	5			1					
	>0 - <50%	0									
		1									
		2									
		3+									
	≥50 - <100%	0									
		1									
		2									
		3+									
	100%	NA									
3+	0%	0									
		1									
		2									
		3+	1				1				
	>0 - <50%	0									
		1									
		2									
		3+				1					
	≥50 - <100%	0									
		1									
		2									
		3+									
	100%	NA	1								
Crushed	0%	0									
		1									
		2									
		3+	2			1					
	>0 - <50%	0									
		1									
		2									
		3+									
	≥50 - <100%	0									
		1									
		2									
		3+									
	100%	NA									

Table 3.11 Site 22UN540 Use Paradigm

Length (mm)			<13.8			≥13.8 - <28.1			≥28.1		
Platform Facets	Cortex Percentage	Dorsal Scars / Weight (g)	<1.13	≥1.13 - <12.59	≥12.59	<1.13	≥1.13 - <12.59	≥12.59	<1.13	≥1.13 - <12.59	≥12.59
1	0%	0									
		1									
		2	2			1					
		3+				3	4				
	>0 - <50%	0									
		1									
		2				1					
		3+				1					
	≥50 - <100%	0									
		1		1							
		2					1			1	
		3+					2				
	100%	NA	2								
2	0%	0									
		1									
		2	2								
		3+	4			1					
	>0 - <50%	0									
		1									
		2	1								
		3+	1								
	≥50 - <100%	0									
		1									
		2									
		3+									
	100%	NA									
3+	0%	0									
		1									
		2									
		3+									
	>0 - <50%	0									
		1									
		2									
		3+									
	≥50 - <100%	0									
		1									
		2									1
		3+									
	100%	NA									
Crushed	0%	0									
		1									
		2									
		3+	1								
	>0 - <50%	0									
		1									
		2									
		3+									
	≥50 - <100%	0									
		1									
		2	1								
		3+									
	100%	NA	1								

Table 3.12 Site 22UN545 Use Paradigm

Platform Facets	Cortex Percentage	Dorsal Scars	<13.8			≥13.8 - <28.1			≥28.1			Length (mm)
			<1.13	≥1.13 - <12.59	≥12.59	<1.13	≥1.13 - <12.59	≥12.59	<1.13	≥1.13 - <12.59	≥12.59	Weight (g)
1	0%	0										
		1										
		2	3			4						
		3+	5			4	3			1		
	>0 - <50%	0										
		1				1						
		2										
		3+										
	≥50 - <100%	0										
		1										
		2					2					
		3+										
	100%	NA										
2	0%	0										
		1										
		2				1						
		3+				2	1					
	>0 - <50%	0										
		1										
		2										
		3+										
	≥50 - <100%	0										
		1										
		2										
		3+										
	100%	NA										
3+	0%	0										
		1										
		2										
		3+					1					
	>0 - <50%	0										
		1										
		2										
		3+										
	≥50 - <100%	0										
		1										
		2										
		3+										
	100%	NA										
Crushed	0%	0										
		1										
		2				1						
		3+				2						
	>0 - <50%	0										
		1										
		2				1						
		3+										
	≥50 - <100%	0										
		1										
		2										
		3+					1					
	100%	NA										

Table 3.13 Site 22UN547 Use Paradigm

Length (mm)			<13.8			≥13.8 - <28.1			≥28.1		
Platform Facets	**Cortex Percentage**	**Dorsal Scars** \ Weight (g)	<1.13	≥1.13 - <12.59	≥12.59	<1.13	≥1.13 - <12.59	≥12.59	<1.13	≥1.13 - <12.59	≥12.59
1	0%	0									
		1					1				
		2	1			2					
		3+	6			6	3			3	1
	>0 - <50%	0									
		1									
		2				1	1				
		3+				3					
	≥50 - <100%	0									
		1									
		2									
		3+				1					
	100%	NA									
2	0%	0									
		1									
		2									
		3+	2			1					
	>0 - <50%	0									
		1									
		2									
		3+									
	≥50 - <100%	0									
		1									
		2									
		3+									
	100%	NA					1				
3+	0%	0									
		1									
		2									
		3+	1				1				
	>0 - <50%	0									
		1									
		2									
		3+									
	≥50 - <100%	0									
		1									
		2									
		3+									
	100%	NA									
Crushed	0%	0									
		1									
		2	1								
		3+	1							1	
	>0 - <50%	0									
		1									
		2									
		3+									
	≥50 - <100%	0									
		1									
		2									
		3+									
	100%	NA									

Table 3.14 Site 22UN548 Use Paradigm

Platform Facets	Cortex Percentage	Dorsal Scars	<13.8			≥13.8 - <28.1			≥28.1			Length (mm)
			<1.13	≥1.13 - <12.59	≥12.59	<1.13	≥1.13 - <12.59	≥12.59	<1.13	≥1.13 - <12.59	≥12.59	Weight (g)
1	0%	0										
		1										
		2										
		3+	1			2						
	>0 - <50%	0										
		1										
		2										
		3+										
	≥50 - <100%	0										
		1										
		2										
		3+										
	100%	NA										
2	0%	0										
		1										
		2										
		3+										
	>0 - <50%	0										
		1										
		2										
		3+										
	≥50 - <100%	0										
		1										
		2										
		3+										
	100%	NA										
3+	0%	0										
		1										
		2										
		3+										
	>0 - <50%	0										
		1										
		2										
		3+										
	≥50 - <100%	0										
		1										
		2										
		3+										
	100%	NA										
Crushed	0%	0										
		1										
		2										
		3+										
	>0 - <50%	0										
		1										
		2										
		3+										
	≥50 - <100%	0										
		1										
		2										
		3+										
	100%	NA										

Table 3.15 Site 22UN560 Use Paradigm

		Length (mm)	<13.8			≥13.8 - <28.1			≥28.1		
		Weight (g)	<1.13	≥1.13 - <12.59	≥12.59	<1.13	≥1.13 - <12.59	≥12.59	<1.13	≥1.13 - <12.59	≥12.59
Platform Facets	Cortex Percentage	Dorsal Scars									
1	0%	0									
		1	1								
		2									
		3+	2								
	>0 - <50%	0									
		1									
		2									
		3+				1					
	≥50 - <100%	0									
		1									
		2									
		3+									
	100%	NA									
2	0%	0									
		1									
		2									
		3+	1								
	>0 - <50%	0									
		1									
		2									
		3+									
	≥50 - <100%	0									
		1									
		2									
		3+									
	100%	NA									
3+	0%	0									
		1									
		2									
		3+									
	>0 - <50%	0									
		1									
		2									
		3+									
	≥50 - <100%	0									
		1									
		2									
		3+									
	100%	NA									
Crushed	0%	0									
		1									
		2									
		3+									
	>0 - <50%	0									
		1									
		2									
		3+	1								
	≥50 - <100%	0									
		1									
		2									
		3+									
	100%	NA									

Table 3.16 Site 22UN568 Use Paradigm

Length (mm)			<13.8			≥13.8 - <28.1			≥28.1		
Weight (g)			<1.13	≥1.13 - <12.59	≥12.59	<1.13	≥1.13 - <12.59	≥12.59	<1.13	≥1.13 - <12.59	≥12.59
1	0%	0									
		1									
		2	1				1				
		3+	1			1	4				
	>0 - <50%	0									
		1									
		2									
		3+									
	≥50 - <100%	0									
		1									
		2									
		3+									
	100%	NA									
2	0%	0									
		1									
		2									
		3+									
	>0 - <50%	0									
		1									
		2									
		3+									
	≥50 - <100%	0									
		1									
		2									
		3+					1				
	100%	NA									
3+	0%	0									
		1									
		2									
		3+									
	>0 - <50%	0									
		1									
		2									
		3+									
	≥50 - <100%	0									
		1									
		2									
		3+									
	100%	NA									
Crushed	0%	0									
		1									
		2									
		3+				1					
	>0 - <50%	0									
		1									
		2									
		3+									
	≥50 - <100%	0									
		1									
		2									
		3+									
	100%	NA									
Platform Facets	Cortex Percentage	Dorsal Scars									

Table 3.17 Site 2UN569 Use Paradigm

Platform Facets	Cortex Percentage	Dorsal Scars	<13.8			≥13.8 - <28.1			≥28.1			Length (mm)
			<1.13	≥1.13 - <12.59	≥12.59	<1.13	≥1.13 - <12.59	≥12.59	<1.13	≥1.13 - <12.59	≥12.59	Weight (g)
1	0%	0										
		1										
		2	14				1					
		3+	19			13	11			1	1	
	>0 - <50%	0										
		1	2							1		
		2				1						
		3+					2			2	1	
	≥50 - <100%	0										
		1					1					
		2					1					
		3+					2					
	100%	NA				2						
2	0%	0										
		1					1					
		2	2									
		3+	2			5	3			1		
	>0 - <50%	0										
		1										
		2										
		3+										
	≥50 - <100%	0										
		1					1					
		2										
		3+										
	100%	NA										
3+	0%	0										
		1										
		2										
		3+										
	>0 - <50%	0										
		1										
		2										
		3+										
	≥50 - <100%	0										
		1										
		2										
		3+										
	100%	NA										
Crushed	0%	0										
		1										
		2					1					
		3+	5	1		3	4			2		
	>0 - <50%	0										
		1										
		2										
		3+				1	1					
	≥50 - <100%	0										
		1										
		2				1						
		3+										
	100%	NA										

Table 3.18 Site 22UN572 Use Paradigm

Length (mm)			<13.8			≥13.8 - <28.1			≥28.1		
Weight (g)			<1.13	≥1.13 - <12.59	≥12.59	<1.13	≥1.13 - <12.59	≥12.59	<1.13	≥1.13 - <12.59	≥12.59
Platform Facets	Cortex Percentage	Dorsal Scars									
1	0%	0									
		1									
		2				1	1				
		3+	3			3					1
	>0 - <50%	0									
		1									
		2									
		3+					1				
	≥50 - <100%	0									
		1				1				1	
		2				1					
		3+									
	100%	NA									
2	0%	0									
		1									
		2									
		3+	1	1		1					
	>0 - <50%	0									
		1									
		2				1					
		3+	1								
	≥50 - <100%	0									
		1									
		2								1	
		3+									
	100%	NA									
3+	0%	0									
		1									
		2									
		3+									
	>0 - <50%	0									
		1									
		2									
		3+									
	≥50 - <100%	0									
		1				1					
		2									
		3+									
	100%	NA									
Crushed	0%	0									
		1									
		2									
		3+	1								
	>0 - <50%	0									
		1									
		2									
		3+									
	≥50 - <100%	0									
		1									
		2									
		3+				1					
	100%	NA									

Table 3.19 Site 22UN581 Use Paradigm

Platform Facets	Cortex Percentage	Dorsal Scars	<13.8			≥13.8 - <28.1			≥28.1			Length (mm)
			<1.13	≥1.13 - <12.59	≥12.59	<1.13	≥1.13 - <12.59	≥12.59	<1.13	≥1.13 - <12.59	≥12.59	Weight (g)
1	0%	0										
		1	1									
		2	1									
		3+	1				1					
	>0 - <50%	0										
		1										
		2					1					
		3+										
	≥50 - <100%	0										
		1										
		2										
		3+										
	100%	NA	1									
2	0%	0										
		1	1									
		2	1									
		3+										
	>0 - <50%	0										
		1										
		2										
		3+										
	≥50 - <100%	0										
		1										
		2				1						
		3+										
	100%	NA										
3+	0%	0										
		1										
		2										
		3+	1									
	>0 - <50%	0										
		1										
		2										
		3+										
	≥50 - <100%	0										
		1										
		2										
		3+										
	100%	NA										
Crushed	0%	0										
		1										
		2										
		3+				1						
	>0 - <50%	0										
		1										
		2										
		3+										
	≥50 - <100%	0										
		1										
		2										
		3+										
	100%	NA										

Table 3.20 Site 22UN592 Use Paradigm

		Length (mm)	<13.8			≥13.8 - <28.1			≥28.1		
		Weight (g)	<1.13	≥1.13 - <12.59	≥12.59	<1.13	≥1.13 - <12.59	≥12.59	<1.13	≥1.13 - <12.59	≥12.59
Platform Facets	Cortex Percentage	Dorsal Scars									
1	0%	0									
		1									
		2					1				
		3+	1			2				1	
	>0 - <50%	0									
		1									
		2									
		3+									
	≥50 - <100%	0									
		1									
		2									
		3+									
	100%	NA									
2	0%	0									
		1									
		2									
		3+					1				
	>0 - <50%	0									
		1									
		2									
		3+									
	≥50 - <100%	0									
		1									
		2									
		3+									
	100%	NA									
3+	0%	0									
		1									
		2									
		3+									
	>0 - <50%	0									
		1									
		2									
		3+									
	≥50 - <100%	0									
		1									
		2									
		3+									
	100%	NA									
Crushed	0%	0									
		1									
		2									
		3+				1				1	
	>0 - <50%	0									
		1									
		2									
		3+									
	≥50 - <100%	0									
		1									
		2									
		3+									
	100%	NA									

Table 3.21 Site 22UN607 Use Paradigm

		Length (mm)	<13.8			≥13.8 - <28.1			≥28.1		
		Weight (g)	<1.13	≥1.13 - <12.59	≥12.59	<1.13	≥1.13 - <12.59	≥12.59	<1.13	≥1.13 - <12.59	≥12.59
Platform Facets	Cortex Percentage	Dorsal Scars									
1	0%	0									
		1									
		2									
		3+				1					
	>0 - <50%	0									
		1									
		2	1								
		3+									
	≥50 - <100%	0									
		1									
		2									
		3+									
	100%	NA									
2	0%	0									
		1									
		2									
		3+									
	>0 - <50%	0									
		1									
		2									
		3+									
	≥50 - <100%	0									
		1									
		2									
		3+									
	100%	NA									
3+	0%	0									
		1									
		2									
		3+									
	>0 - <50%	0									
		1									
		2									
		3+									
	≥50 - <100%	0									
		1									
		2									
		3+									
	100%	NA									
Crushed	0%	0									
		1									
		2									
		3+									
	>0 - <50%	0									
		1									
		2									
		3+									
	≥50 - <100%	0									
		1									
		2									
		3+									
	100%	NA									

Table 3.22 Site 22UN615 Use Paradigm

Platform Facets	Cortex Percentage	Dorsal Scars	<13.8			≥13.8 - <28.1			≥28.1			Length (mm)
			<1.13	≥1.13 - <12.59	≥12.59	<1.13	≥1.13 - <12.59	≥12.59	<1.13	≥1.13 - <12.59	≥12.59	Weight (g)
1	0%	0										
		1	4			2						
		2	1			1	2			2		
		3+	3	1		2	6			6	1	
	>0 - <50%	0										
		1										
		2										
		3+										
	≥50 - <100%	0										
		1										
		2										
		3+										
	100%	NA										
2	0%	0										
		1										
		2					1					
		3+				1	1			1		
	>0 - <50%	0										
		1										
		2										
		3+										
	≥50 - <100%	0										
		1										
		2										
		3+										
	100%	NA										
3+	0%	0										
		1										
		2					1					
		3+										
	>0 - <50%	0										
		1										
		2										
		3+										
	≥50 - <100%	0										
		1										
		2										
		3+										
	100%	NA										
Crushed	0%	0										
		1										
		2	2									
		3+	1			2	4			1		
	>0 - <50%	0										
		1										
		2										
		3+										
	≥50 - <100%	0										
		1										
		2										
		3+										
	100%	NA										

Occupation Age

To investigate whether variability in debitage assemblages could be due to differences in age, flakes were analyzed for the dimensions of raw material, flake size, and the presence/absence of heat-treating. Although information was collected for all flakes, only whole flake attributes were included when testing occupation age. The information gathered was assessed against the cultural period assigned during the initial analysis of these assemblages, which used the artifacts present [e.g., a projectile point with a large haft size, defined haft-element, and basal grinding, such as that identified at 22UN569 is an indicator for a Middle Archaic occupation (McGahey 2000; Rafferty 1994) and sand tempered fabric impressed (Saltillo Fabric Impressed) pottery found at 22UN540 is an indicator for an early Middle Woodland occupation (Jenkins 1981)]. For sites with no diagnostics, the cultural period is “unknown” (see Tables 2.02 and 2.03).

A total of five different attributes were used for raw material: (1) Fort Payne/Pickwick Chert; (2) Gravel Chert, which included Camden, Tuscaloosa, and Citronelle gravel cherts; (3) Tallahatta Quartzite; (4) Kosciusko Quartzite; and (5) Other, which accounted for unidentifiable raw material. The decision to combine certain groups was to reduce noise within the data by reducing the number of attributes. Pickwick Chert was grouped with Fort Payne based on the coarse grain size, which is associated with Fort Payne formations (Futato 1983; Meeks 2000). All fossiliferous material was grouped with its parent material (e.g., fossiliferous Fort Payne was grouped as Fort Payne/Pickwick Chert). Raw materials other than those listed above or which could not be identified with certainty were incorporated into the ‘other’ category (Table 3.23).

Table 3.23 Raw Material Counts for All Flakes

	Fort Payne/ Pickwick	Gravel Chert	Tallahatta Quartzite	Kosciusko Quartzite	Other
22PO571*	6	18	-	-	3
22PO573*	2	1	-	-	-
22PO581	1	47	-	-	5
22PO602*	-	6	1	-	3
22PO650	3	2	-	-	2
22UN520	5	19	-	-	3
22UN524*	12	46	-	11	-
22UN529	-	6	-	-	-
22UN536	2	11	1	-	-
22UN537	7	89	-	4	-
22UN540	10	29	-	-	1
22UN545	14	25	1	5	-
22UN547	9	51	-	2	1
22UN548	-	3	-	-	-
22UN560	2	5	-	-	-
22UN568	5	11	-	-	1
22UN569	64	102	-	1	4
22UN572	9	23	1	-	3
22UN581	3	8	1	-	1
22UN592	4	6	-	-	-
22UN602	-	5	-	-	-
22UN615*	5	12	3	54	5

*Sites meeting the definition of lithic scatter.

The favoring of certain raw materials may also correspond to the tool type being produced, allowing for flake size to be incorporated into testing for age: the larger the tool being manufactured, the larger the flakes being produced (Andrefsky 1998, 2001a; McGahey 2000; Parry and Kelly 1987; Stahle and Dunn 1982). Therefore flake size, measured in flake length and weight (with divisions determined using natural breaks, as discussed earlier), is included in the occupation age paradigms.

Heat-treatment usually is assumed to be intentional, although at times this distinction can be difficult or even impossible to determine with accuracy. Experimental tests have shown that stone can be positively affected by heat-treatment (Bleed and Meier 1980), which makes knapping easier (Bleed and Meier 1980; Schindler et al. 1982). Evidence of heating, even burned debitage, can indicate the presence of hearths even without the presence of hearth features, charcoal, or burned sediments (Baales 2001). An increase in the presence of heat-treated lithics during the Woodland period has been seen along the Tennessee-Tombigbee waterway (Ensor 1981). If this same pattern holds in the study area, heat-treated flakes are expected to increase in the Woodland period.

The intersection of attributes from these four dimensions created 90 classes hypothetically related to occupation age (Tables 3.24 – 3.45). These tables contain flake counts for flakes that contain all attributes listed.

Table 3.24 Site 22PO571 Age Paradigm

		<13.8			≥13.8 - <28.1			≥28.1			Length (mm)
		<1.13	≥1.13 - <12.59	≥12.59	<1.13	≥1.13 - <12.59	≥12.59	<1.13	≥1.13 - <12.59	≥12.59	Weight (g)
Fort Payne/ Pickwick	Absent				1				1		
	Present		1								
Gravel Chert	Absent										
	Present	3			3	5			1		
Tallahatta Quartzite	Absent										
	Present										
Kosciusko Quartzite	Absent										
	Present										
Other	Absent				1				1		
	Present										
Raw Material	Heat-Treatment										

Table 3.25 Site 22PO573 Age Paradigm

		<13.8			≥13.8 - <28.1			≥28.1			Length (mm)
		<1.13	≥1.13 - <12.59	≥12.59	<1.13	≥1.13 - <12.59	≥12.59	<1.13	≥1.13 - <12.59	≥12.59	Weight (g)
Fort Payne/ Pickwick	Absent								1		
	Present										
Gravel Chert	Absent										
	Present				1						
Tallahatta Quartzite	Absent										
	Present										
Kosciusko Quartzite	Absent										
	Present										
Other	Absent										
	Present										
Raw Material	Heat-Treatment										

Table 3.26 Site 22PO581 Age Paradigm

		<13.8			≥13.8 - <28.1			≥28.1			Length (mm)
		<1.13	≥1.13 - <12.59	≥12.59	<1.13	≥1.13 - <12.59	≥12.59	<1.13	≥1.13 - <12.59	≥12.59	Weight (g)
Fort Payne/ Pickwick	Absent										
	Present	1									
Gravel Chert	Absent										
	Present	12			12	8					
Tallahatta Quartzite	Absent										
	Present										
Kosciusko Quartzite	Absent										
	Present										
Other	Absent	3									
	Present										
Raw Material	Heat-Treatment										

Table 3.27 Site 22PO602 Age Paradigm

		<13.8			≥13.8 - <28.1			≥28.1			Length (mm)
		<1.13	≥1.13 - <12.59	≥12.59	<1.13	≥1.13 - <12.59	≥12.59	<1.13	≥1.13 - <12.59	≥12.59	Weight (g)
Fort Payne/ Pickwick	Absent										
	Present										
Gravel Chert	Absent	1			1						
	Present	1							1		
Tallahatta Quartzite	Absent										
	Present										
Kosciusko Quartzite	Absent										
	Present										
Other	Absent	1									
	Present										
Raw Material	Heat-Treatment										

Table 3.28 Site 22PO650 Age Paradigm

		<13.8			≥13.8 - <28.1			≥28.1			Length (mm)
		<1.13	≥1.13 - <12.59	≥12.59	<1.13	≥1.13 - <12.59	≥12.59	<1.13	≥1.13 - <12.59	≥12.59	Weight (g)
Fort Payne/ Pickwick	Absent				1	1					
	Present										
Gravel Chert	Absent										
	Present										
Tallahatta Quartzite	Absent										
	Present										
Kosciusko Quartzite	Absent										
	Present										
Other	Absent				1	1					
	Present										
Raw Material	Heat-Treatment										

Table 3.29 Site 22UN520 Age Paradigm

		<13.8			≥13.8 - <28.1			≥28.1			Length (mm)
		<1.13	≥1.13 - <12.59	≥12.59	<1.13	≥1.13 - <12.59	≥12.59	<1.13	≥1.13 - <12.59	≥12.59	Weight (g)
Fort Payne/ Pickwick	Absent								1		
	Present										
Gravel Chert	Absent					2					
	Present	2			2	2			2		
Tallahatta Quartzite	Absent										
	Present										
Kosciusko Quartzite	Absent										
	Present										
Other	Absent										
	Present					1					
Raw Material	Heat-Treatment										

Table 3.30 Site 22UN524 Age Paradigm

		<13.8			≥13.8 - <28.1			≥28.1			Length (mm)
Raw Material	Heat-Treatment	<1.13	≥1.13 - <12.59	≥12.59	<1.13	≥1.13 - <12.59	≥12.59	<1.13	≥1.13 - <12.59	≥12.59	Weight (g)
Fort Payne/ Pickwick	Absent	3			2						
	Present					1					
Gravel Chert	Absent	3			6	2					
	Present	11	1		5	4					
Tallahatta Quartzite	Absent										
	Present										
Kosciusko Quartzite	Absent				1				1		
	Present		1								
Other	Absent										
	Present										

Table 3.31 Site 22UN529 Age Paradigm

		<13.8			≥13.8 - <28.1			≥28.1			Length (mm)
Raw Material	Heat-Treatment	<1.13	≥1.13 - <12.59	≥12.59	<1.13	≥1.13 - <12.59	≥12.59	<1.13	≥1.13 - <12.59	≥12.59	Weight (g)
Fort Payne/ Pickwick	Absent										
	Present										
Gravel Chert	Absent										
	Present	1			1				2		
Tallahatta Quartzite	Absent										
	Present										
Kosciusko Quartzite	Absent										
	Present										
Other	Absent										
	Present										

Table 3.32 Site 22UN536 Age Paradigm

Raw Material	Heat-Treatment	<13.8			≥13.8 - <28.1			≥28.1			Length (mm)
		<1.13	≥1.13 - <12.59	≥12.59	<1.13	≥1.13 - <12.59	≥12.59	<1.13	≥1.13 - <12.59	≥12.59	Weight (g)
Fort Payne/ Pickwick	Absent										
	Present										
Gravel Chert	Absent					1					
	Present	1				3					
Tallahatta Quartzite	Absent					1					
	Present										
Kosciusko Quartzite	Absent										
	Present										
Other	Absent										
	Present										

Table 3.33 Site 22UN537 Age Paradigm

Raw Material	Heat-Treatment	<13.8			≥13.8 - <28.1			≥28.1			Length (mm)
		<1.13	≥1.13 - <12.59	≥12.59	<1.13	≥1.13 - <12.59	≥12.59	<1.13	≥1.13 - <12.59	≥12.59	Weight (g)
Fort Payne/ Pickwick	Absent	1			2						
	Present				2						
Gravel Chert	Absent	5			1	2				1	
	Present	32	1		9	11			1		
Tallahatta Quartzite	Absent										
	Present										
Kosciusko Quartzite	Absent	1				2					
	Present	1									
Other	Absent										
	Present										

Table 3.34 Site 22UN540 Age Paradigm

		<13.8			≥13.8 - <28.1			≥28.1			Length (mm)
		<1.13	≥1.13 - <12.59	≥12.59	<1.13	≥1.13 - <12.59	≥12.59	<1.13	≥1.13 - <12.59	≥12.59	Weight (g)
Fort Payne/ Pickwick	Absent	2				2					
	Present				2	1					
Gravel Chert	Absent	2			3	2				1	
	Present	10	1		1	3			1		
Tallahatta Quartzite	Absent										
	Present										
Kosciusko Quartzite	Absent										
	Present										
Other	Absent	1									
	Present										
Raw Material	Heat-Treatment										

Table 3.35 Site 22UN545 Age Paradigm

		<13.8			≥13.8 - <28.1			≥28.1			Length (mm)
		<1.13	≥1.13 - <12.59	≥12.59	<1.13	≥1.13 - <12.59	≥12.59	<1.13	≥1.13 - <12.59	≥12.59	Weight (g)
Fort Payne/ Pickwick	Absent	2			6	1					
	Present										
Gravel Chert	Absent	2			2	2					
	Present	4			5	3			1		
Tallahatta Quartzite	Absent					1					
	Present										
Kosciusko Quartzite	Absent				2	1					
	Present					1					
Other	Absent										
	Present										
Raw Material	Heat-Treatment										

Table 3.36 Site 22UN547 Age Paradigm

	Length (mm)	<13.8			≥13.8 - <28.1			≥28.1		
	Weight (g)	<1.13	≥1.13 - <12.59	≥12.59	<1.13	≥1.13 - <12.59	≥12.59	<1.13	≥1.13 - <12.59	≥12.59
Fort Payne/ Pickwick	Absent	3			2					
	Present									
Gravel Chert	Absent	1			4	2			2	1
	Present	8			8	4			2	
Tallahatta Quartzite	Absent									
	Present									
Kosciusko Quartzite	Absent					1				
	Present									
Other	Absent									
	Present									
Raw Material	Heat-Treatment									

Table 3.37 Site 22UN548 Age Paradigm

	Length (mm)	<13.8			≥13.8 - <28.1			≥28.1		
	Weight (g)	<1.13	≥1.13 - <12.59	≥12.59	<1.13	≥1.13 - <12.59	≥12.59	<1.13	≥1.13 - <12.59	≥12.59
Fort Payne/ Pickwick	Absent									
	Present									
Gravel Chert	Absent	1								
	Present				2					
Tallahatta Quartzite	Absent									
	Present									
Kosciusko Quartzite	Absent									
	Present									
Other	Absent									
	Present									
Raw Material	Heat-Treatment									

Table 3.38 Site 22UN560 Age Paradigm

Raw Material	Heat-Treatment	<13.8			≥13.8 - <28.1			≥28.1			Length (mm)
		<1.13	≥1.13 - <12.59	≥12.59	<1.13	≥1.13 - <12.59	≥12.59	<1.13	≥1.13 - <12.59	≥12.59	Weight (g)
Fort Payne/ Pickwick	Absent										
	Present	2									
Gravel Chert	Absent	1									
	Present	2			1						
Tallahatta Quartzite	Absent										
	Present										
Kosciusko Quartzite	Absent										
	Present										
Other	Absent										
	Present										

Table 3.39 Site 22UN568 Age Paradigm

Raw Material	Heat-Treatment	<13.8			≥13.8 - <28.1			≥28.1			Length (mm)
		<1.13	≥1.13 - <12.59	≥12.59	<1.13	≥1.13 - <12.59	≥12.59	<1.13	≥1.13 - <12.59	≥12.59	Weight (g)
Fort Payne/ Pickwick	Absent					2					
	Present										
Gravel Chert	Absent	2			1	1					
	Present				1	3					
Tallahatta Quartzite	Absent										
	Present										
Kosciusko Quartzite	Absent										
	Present										
Other	Absent										
	Present										

Table 3.40 Site 22UN569 Age Paradigm

Raw Material	Heat-Treatment	<13.8			≥13.8 - <28.1			≥28.1		
		<1.13	≥1.13 - <12.59	≥12.59	<1.13	≥1.13 - <12.59	≥12.59	<1.13	≥1.13 - <12.59	≥12.59
Fort Payne/ Pickwick	Absent	16			5	8			2	2
	Present	5			4	5				
Gravel Chert	Absent	3			5	5			2	
	Present	17	1		10	13			2	1
Tallahatta Quartzite	Absent									
	Present									
Kosciusko Quartzite	Absent	2								
	Present									
Other	Absent	1								
	Present									

Length (mm)
Weight (g)

Table 3.41 Site 22UN572 Age Paradigm

Raw Material	Heat-Treatment	<13.8			≥13.8 - <28.1			≥28.1		
		<1.13	≥1.13 - <12.59	≥12.59	<1.13	≥1.13 - <12.59	≥12.59	<1.13	≥1.13 - <12.59	≥12.59
Fort Payne/ Pickwick	Absent	2			2	1				
	Present									
Gravel Chert	Absent	2			1	1			1	
	Present	2	1		6	1			1	
Tallahatta Quartzite	Absent									
	Present									
Kosciusko Quartzite	Absent									
	Present									
Other	Absent									1
	Present									

Length (mm)
Weight (g)

Table 3.42 Site 22UN581 Age Paradigm

Raw Material	Heat-Treatment	<13.8			≥13.8 - <28.1			≥28.1			Length (mm)
		<1.13	≥1.13 - <12.59	≥12.59	<1.13	≥1.13 - <12.59	≥12.59	<1.13	≥1.13 - <12.59	≥12.59	Weight (g)
Fort Payne/ Pickwick	Absent	1				1					
	Present	1									
Gravel Chert	Absent	1									
	Present	3			1	1					
Tallahatta Quartzite	Absent	1									
	Present										
Kosciusko Quartzite	Absent										
	Present										
Other	Absent				1						
	Present										

Table 3.43 Site 22UN592 Age Paradigm

Raw Material	Heat-Treatment	<13.8			≥13.8 - <28.1			≥28.1			Length (mm)
		<1.13	≥1.13 - <12.59	≥12.59	<1.13	≥1.13 - <12.59	≥12.59	<1.13	≥1.13 - <12.59	≥12.59	Weight (g)
Fort Payne/ Pickwick	Absent					1					
	Present					1			1		
Gravel Chert	Absent				1	1					
	Present	1			1				1		
Tallahatta Quartzite	Absent										
	Present										
Kosciusko Quartzite	Absent										
	Present										
Other	Absent										
	Present										

Table 3.44 Site 22UN607 Age Paradigm

	Length (mm)	<13.8			≥13.8 - <28.1			≥28.1		
	Weight (g)	<1.13	≥1.13 - <12.59	≥12.59	<1.13	≥1.13 - <12.59	≥12.59	<1.13	≥1.13 - <12.59	≥12.59
Fort Payne/ Pickwick	Absent									
	Present									
Gravel Chert	Absent									
	Present	1			1					
Tallahatta Quartzite	Absent									
	Present									
Kosciusko Quartzite	Absent									
	Present									
Other	Absent									
	Present									
Raw Material	Heat-Treatment									

Table 3.45 Site 22UN615 Age Paradigm

	Length (mm)	<13.8			≥13.8 - <28.1			≥28.1		
	Weight (g)	<1.13	≥1.13 - <12.59	≥12.59	<1.13	≥1.13 - <12.59	≥12.59	<1.13	≥1.13 - <12.59	≥12.59
Fort Payne/ Pickwick	Absent									1
	Present	1								
Gravel Chert	Absent									
	Present	1			3	2				
Tallahatta Quartzite	Absent					1				1
	Present								1	
Kosciusko Quartzite	Absent	6			1	6			2	1
	Present	3			2	6			3	
Other	Absent				1	1			1	1
	Present									
Raw Material	Heat-Treatment									

Duration

The final measurement of age is that of duration; how long the site was occupied. A means of measuring duration is through trampling. Trampling is the most common cause of flake fragmentation and can seriously affect debitage assemblages (Magne 1985; Rasic 2004; Sullivan and Rozen 1985). All flakes were analyzed and, rather than using the traditional analysis of flake portion (whole, proximal, medial, distal, or shattered) (e.g., Magne 1985; Rasic 2004; Sullivan and Rozen 1985), the number of breaks present on each flake was noted (0, 1, 2, and 3 or more), creating four classes (Table 3.46). It is expected that, for sites that contain a higher proportion of fragmented flakes, the occupation was relatively longer than at those sites with low proportions.

Table 3.46 Flake Break Counts for All Flakes

	0 Breaks	1 Break	2 Breaks	3+ Breaks
22PO571*	7	8	6	6
22PO573*	1	1	1	-
22PO581	22	19	10	2
22PO602*	2	6	-	2
22PO650	3	3	-	1
22UN520	4	12	6	5
22UN524*	13	29	13	14
22UN529	2	3	1	-
22UN536	1	7	5	1
22UN537	36	35	21	8
22UN540	14	14	7	5
22UN545	11	15	14	5
22UN547	21	21	14	7
22UN548	-	3	-	-
22UN560	6	-	1	-
22UN568	7	8	1	1
22UN569	54	57	39	21
22UN572	12	10	7	7
22UN581	4	4	3	2
22UN592	4	4	2	-
22UN607	-	3	2	-
22UN615*	19	35	17	8

* Sites meeting the definition of lithic scatter.

Statistical Methods

The attributes under platform morphology and dorsal scar count are prone to analyst bias (Bradbury and Carr 1995). To preclude any inter-observer error, all analysis was conducted by the author. Classes were coded to fit the labeling requirements for PC-ORD (McCune and Mefford 2011), with the letters reflecting attributes within classificatory dimensions. Since PC-ORD rejects null columns, classes that present a null throughout all sites were omitted from this analysis. The data tables generated after analysis resulted in many null classes, as not every class in the paradigms was occupied. Although PC-ORD predominately has been employed in ecological research, it also can be applied in archaeological research (e.g. Peacock 2002; Peacock and Gerber 2008).

With the incorporation of multiple dimensions in the paradigmatic classes, the best statistical approach to address variation is multivariate analysis. Multivariate analysis falls into two main methods: classification and ordination. Classification divides datasets into groups, whereas ordination places sampling sites, or shows class distributions, along gradients (Palmer 2015). This research aims to address variability among predetermined groups (sites and classes) rather than create a new classification scheme. As a result, multivariate analysis using an ordination method was determined appropriate to best address variability across space, time, and form.

Incorporating ordination methods into any research enables an easier visualization of multiple dimensions simultaneously (Palmer 2015). Ordinations are typically visualized in two-dimensions, as higher-dimensional ordinations are harder to display. The representation of the data along a gradient in a low-dimensional space not only saves time by displaying the data simultaneously, as affected by all variables ("dimensions" in ordination); it diminishes problems of multiple univariate comparisons while focusing on those dimensions with the highest variance along any gradient, or axis. Univariate approaches cannot detect gradients except via simple regression (Palmer 2015). The main types of ordination methods considered for this research were: Principal Components Analysis (PCA), Principal Coordinates Analysis (PCoA), Correspondence Analysis (CA), Detrended Correspondence Analysis (DCA), and Bray-Curtis ordination (or polar ordination). These are all indirect (unconstrained) ordination methods. Direct gradient analysis, such as Canonical Correspondence Analysis, is an option when underlying environmental gradients of known importance are measured, with those data being used to constrain the results of an ordination. Indirect gradient analysis simply presents the data in unconstrained form, the interpretation of which is left to the analyst. There are fewer mathematical assumptions involved with indirect gradient analysis, which is used here.

Linear ordination methods assume a linear relationship between variables and underlying environmental characteristics. Such methods, which include PCA and PCoA, are more appropriate with abundant datasets (few classes with a null count) and with little variation between sites (Kindt and Coe 2005; Legendre and Birks 2012; Rossi 2010). With the number of null classes present in the datasets, and with no reason to expect linear relationships in the data, linear ordination methods are not appropriate for this research (Rossi 2010).

An underlying unimodal distribution curve is assumed in CA and DCA (Rossi 2010; ter Braak 1988), imparting "normality" (i.e., data are artificially fitted to a Gaussian curve) regardless of whether or not normal distributions are in fact present in the data (Rossi 2010). Where biological species are concerned, unimodal curves are expected along certain environmental gradients. Certain site types would have optimal environmental conditions. Therefore, the proportions of zeroes would be greater in areas where the sampling has crossed different environmental gradients (Legendre and Birks 2012; ter Braak and Prentice 1988). This reasoning could be applied to archaeological data; e.g., if habitation sites were reasoned to be closer to water, with habitation falling off with distance from water. However, the sites tested in this research are typically of unknown use, age, and duration, water sources may have moved or changed flow over time, and survey was conducted in blocks rather than continuous transects. As a result, it cannot be assumed a specific curve type will be present in the archaeological data. Bray-Curtis ordination is best for situations in which the distribution curves are unknown (Beals 1984; Rossi 2010).

Statistical analyses require a distance relationship among observations (Legendre and Birks 2012). These distance measures quantify distances between data occupying cells in a matrix (Beals 1984; Legendre and Birks 2012). That is, they measure the similarity (or dissimilarity) between samples across a matrix. The distance measures most often used with Bray-Curtis ordinations are typically Chi-square, Euclidean, and Bray-Curtis (Sorenson) (Beals 1984).

The Chi-square distance measure is typically employed in cluster analysis, CA, and DCA. This distance measure down-weights ‘rare’ species (classes with null or small values, and/or of infrequent occurrence). The goal of this research is to address variation at small lithic scatters, in which the variation may be slight (Jackson 1993). With a Chi-square distance measure down-weighting the smaller classes, this distance measure is not appropriate given the aims of this research (Jackson 1993; Kindt and Coe 2005).

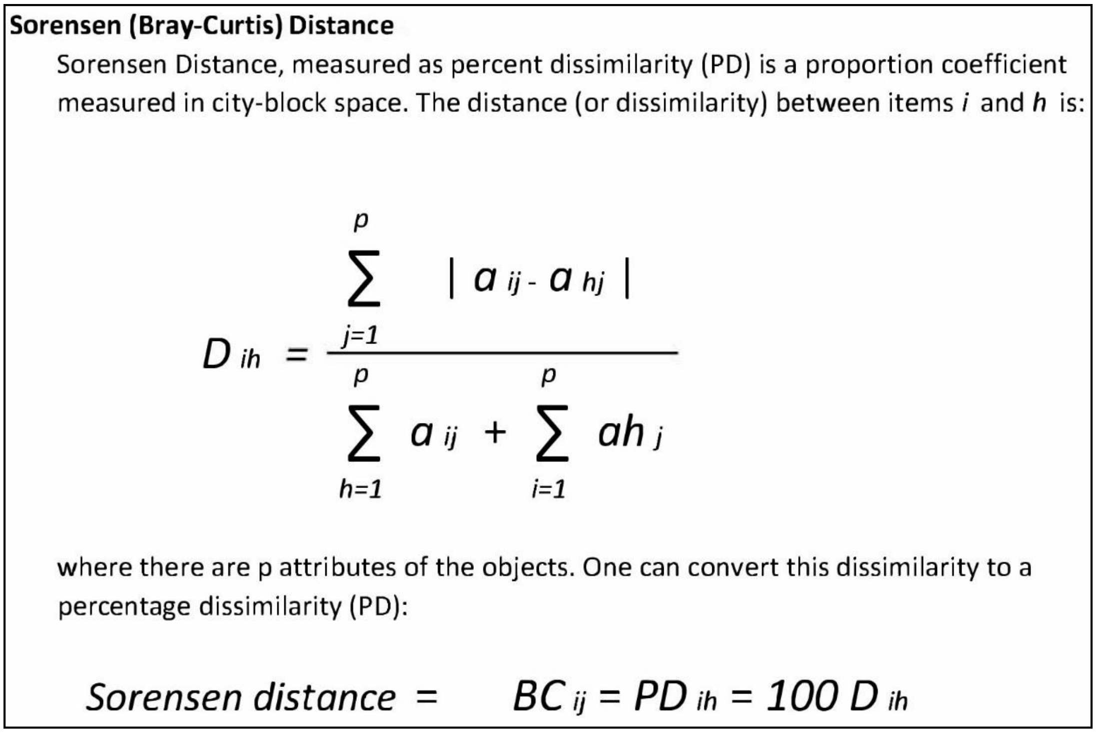
Ordination methods often assume that a Euclidean distance measure is the best measure (Legendre and Birks 2012). For example, in PCA, all distance measures are Euclidean. Euclidean distance is the straight-line distance between two points in a Cartesian coordinate system. The Euclidean distance measure does not need standardization, using absolute rather than relative abundance (Jackson 1993) and is based on squared differences dominated by single, large differences (Oksanen 2015).

Although the Euclidean distance measure is not constrained by a maximum value (e.g., being transformed to a zero to one score), allowing for larger distances to be displayed (Kindt and Coe 2005), it shows a relatively high degree of inconsistency across different ordination methods (Jackson 1993). It also is negatively affected by matrices with lots of null values, because resulting distance measures will necessarily be small, resulting in compression of samples near the center of an ordination plot.

The Bray-Curtis (Sorensen) distance measure is a city-block method that down-weights the most abundant classes, allowing for the smaller classes with higher variance to present themselves in the data results (Jackson 1993). The Bray-Curtis distance measure is powerful at detecting gradients (Oksanen 2015) and is not affected by data standardization (Jackson 1993) given that data aren't transformed in city-block methods. The Bray-Curtis (Sorensen) distance measure includes no assumptions about distributions of the data, and thus provides more interpretable results in multivariate analysis (Beals 1984). In sum, a Bray-Curtis ordination method with a Bray-Curtis (Sorensen) distance measure was deemed most appropriate for this portion of the analysis.

Finally, cluster analysis was performed to address the similarity/ dissimilarity of the data between assemblages, where the sites are grouped, or clustered, in a dendrogram. A Bray-Curtis (Sorensen) distance measure with a nearest neighbor group linkage was chosen for this cluster analysis. The Bray-Curtis (Sorensen) distance measure is a non-Euclidean distance measure, retaining its sensitivity within heterogeneous datasets while giving less weight to outliers (Table 3.47) (McCune and Mefford 2011). The inclusion of cluster analysis into this research is not to provide a classification scheme for assemblages, but rather to address the relationships between them.

Table 3.47 Cluster Analysis, Bray-Curtis (Sorensen) Distance Measure (McCune and Mefford 2011)



Sorensen (Bray-Curtis) Distance

Sorensen Distance, measured as percent dissimilarity (PD) is a proportion coefficient measured in city-block space. The distance (or dissimilarity) between items *i* and *h* is:

$$D_{ih} = \frac{\sum_{j=1}^{p} | a_{ij} - a_{hj} |}{\sum_{h=1}^{p} a_{ij} + \sum_{i=1}^{p} ah_{j}}$$

where there are p attributes of the objects. One can convert this dissimilarity to a percentage dissimilarity (PD):

$$\text{Sorensen distance} = BC_{ij} = PD_{ih} = 100\, D_{ih}$$

CHAPTER IV

RESULTS

Site Use

Bray-Curtis (polar) ordination and cluster analysis, both with a Bray-Curtis distance measure, were first performed using classes hypothetically related to site use (dimensions for platform facet count, cortex percentage, dorsal scar count, flake length, and flake width) on all whole flakes (n=111) for those sites meeting the definition of lithic scatter and all whole flakes (n=519) for all sites tested, which include an additional 17 sites that did not meet the definition of lithic scatter. A total of 36 classes were occupied for lithic scatters and 82 classes were occupied for all sites (Table 4.1). Class IQRDG would represent the earliest stage; however, IQRDG is not present in any collection. As a result, IQRCF represents the earliest stage within the data present, whereas, KMUBE and LMUBE represent the latest stage (see Table 4.2 for code conversion). The statistical program, PC-ORD, rejects null data; therefore, classes that did not contain data were removed.

Table 4.1 Site Use Coded Classes with Whole Flake Counts for All Sites

	22PO571*	22PO573*	22PO581	22PO602*	22PO650	22UN520	22UN524*	22UN529	22UN536	22UN537	22UN540	22UN545	22UN547	22UN548	22UN560	22UN568	22UN569	22UN572	22UN581	22UN592	22UN607	22UN615*
IMSBE						1													1			4
IMSBF							1															
IMSCE																						2
IMSCF	2												1									
IMTBE			1				4			8	2	3	1		1	1	14		1			1
IMTCE	2		2				3			1		3	2					1				1
IMTCF							2		1	2	1	1				1	1	1		1		2
IMTCG						1																
IMTDF																						2
IMUBE	1		6	1			10	1	1	18		5	6	1	2	1	19	3	1	1		3
IMUBF							1															1
IMUCE	2	1	2		1	1	8	1		9	3	4	6	2		1	12	3		2	1	1
IMUCF	1		2		1	3	1		3	3	4	3	3			4	12		1			7
IMUDF	1	1		1		1		1				1	3				1			1		4
IMUDG										1			1				1	1				3
INSBE			1							2							2					
INSCE												1										
INSDF																	1					
INTBE			1																		1	
INTCE	1						1				1		1				1					
INTCF			1				1			1		1	1				1	1	1			
INTDF							1				1											
INUBE			1							1												
INUCE			1							1	1		4		1							
INUCF	2									3	2						4	1				
INUDF																	1					
INUDG																	2					
IPSBF											1											
IPSCE																		1				
IPSCF			2	1													1					
IPSDF								1		1								1				
IPTCF						1				1	1	1										
IQRBE				1							2								1			
IQRBF										1												
IQRCE	1																2					
IQRCF	1						1			3												
JMRBE			1																			
JMSBE																			1			
JMSCE										1												
JMSCF																	1					
JMTBE										2	2						2		1			

.

Table 4.1 (Continued)

	22PO571*	22PO573*	22PO581	22PO602*	22PO650	22UN520	22UN524*	22UN529	22UN536	22UN537	22UN540	22UN545	22UN547	22UN548	22UN560	22UN568	22UN569	22UN572	22UN581	22UN592	22UN607	22UN615*
JMTCE												1										1
JMTCF																						
JMUBE			2			1	2			5	4		2		1		2	1				
JMUBF																		1				
JMUCE			2			1	2			1	1	2	1				5	1				1
JMUCF			1		1	1						1					3			1		1
JMUDF						1											1					1
JNSBE	1																					
JNSCF																	1					
JNTBE											1											
JNTCE			2															1	1			
JNUBE			1								1							1				
JNUCF																1						
JPTDF																		1				
JQRCF													1									
KMTCF							1															1
KMUBE										1			1						1			
KMUCF										1		1	1									
KNSCE																		1				
KNTDG											1											
KNUCE										1												
KQRBE										1												
LMTBE													1									2
LMTCE			1									1										
LMTCF																	1					
LMUBE			1	1						2	1		1				5	1				1
LMUBF																	1					
LMUCE			1				1			1		2				1	3		1			2
LMUCF					1		1										4			1		4
LMUDF	1												1				2			1		
LMUDG																						1
LNTBE											1											
LNTCE												1					1					
LNTCF			1																			
LNUBE															1							
LNUBF	1																					
LNUCE																		1				
LNUCF			1									1					2					
LPTCE			1																			
LQRBE			1								1											
LQRCF									1													

* Sites meeting the definition of lithic scatter.

Table 4.2 Site Use Ordination Class Code

Code	Attribute	
I	Platform Facets	1
J	Platform Facets	2
K	Platform Facets	3 or more
L	Platform Facets	Crushed
M	Cortex Percentage	0%
N	Cortex Percentage	>0 - <50%
P	Cortex Percentage	≥50 - <100%
Q	Cortex Percentage	100%
R	Dorsal Scars	0
S	Dorsal Scars	1
T	Dorsal Scars	2
U	Dorsal Scars	3 or more
B	Flake Length	<13.8
C	Flake Length	≥13.8 - <28.1
D	Flake Length	≥28.1
E	Flake Weight	<1.13
F	Flake Weight	≥1.13 - <12.59
G	Flake Weight	≥12.59

Bray-Curtis (Polar) Ordination

Five lithic scatters were tested for significant variability resulting in the first two axes accounting for 94.38% of the variance (Table 4.3) (See Appendix A for the raw PC-ORD results).

Table 4.3 Bray-Curtis Ordination Variance Extracted for Lithic Scatters Testing for Site Use

Axis	Percentage of Variance	Cumulative Percentage of Variance
1	70.55	70.55
2	23.83	94.38
3	5.61	99.99
4	0.01	100.00

In Bray-Curtis ordination, the axes boundaries are determined based on the differences between sites with the most dissimilar sites being placed at opposite ends of the axis. Sites 22PO573 and 22UN524 show the most difference along Axis 1 while sites 22PO571 and 22UN615 show the most difference along Axis 2. A total of 19 classes contribute to the pulling of these sites. The final lithic scatter, 22PO602, falls along the negative of both Axes 1 and 2, near their intersection (Figures 4.1-4.3).

It is expected that the pull of 22PO573 is a result of sample size rather than the information available within the classes. Site 22PO573 contained two classes, IMUCE (n=1) and IMUDF (n=1). Class IMUCE was also identified within sites 22PO571, 22UN524, and 22UN615’s datasets. Class IMUDF was also identified within 22PO571, 22PO602, and 22UN615’s datasets (see Table 4.1).

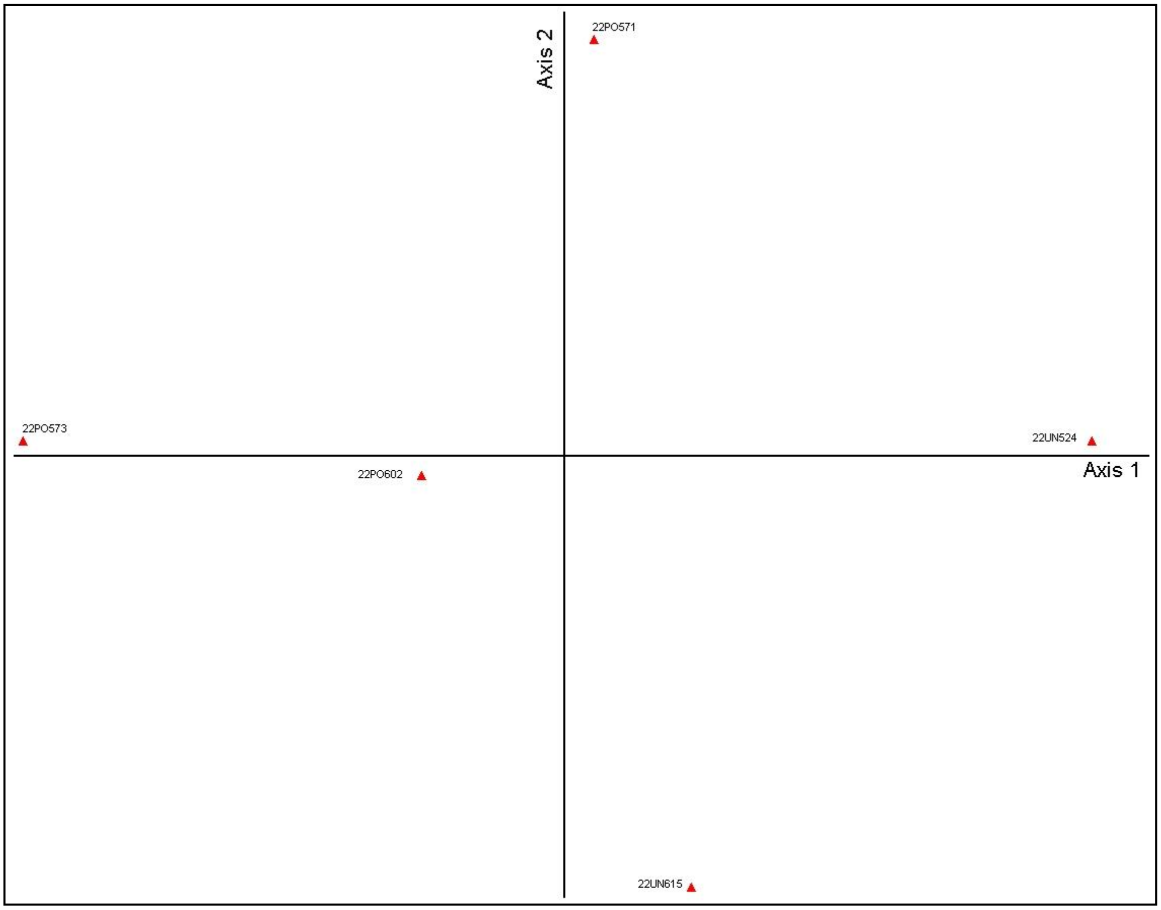


Figure 4.1 Bray-Curtis ordination showing the distribution of lithic scatters along Axes 1 and 2, testing for site use

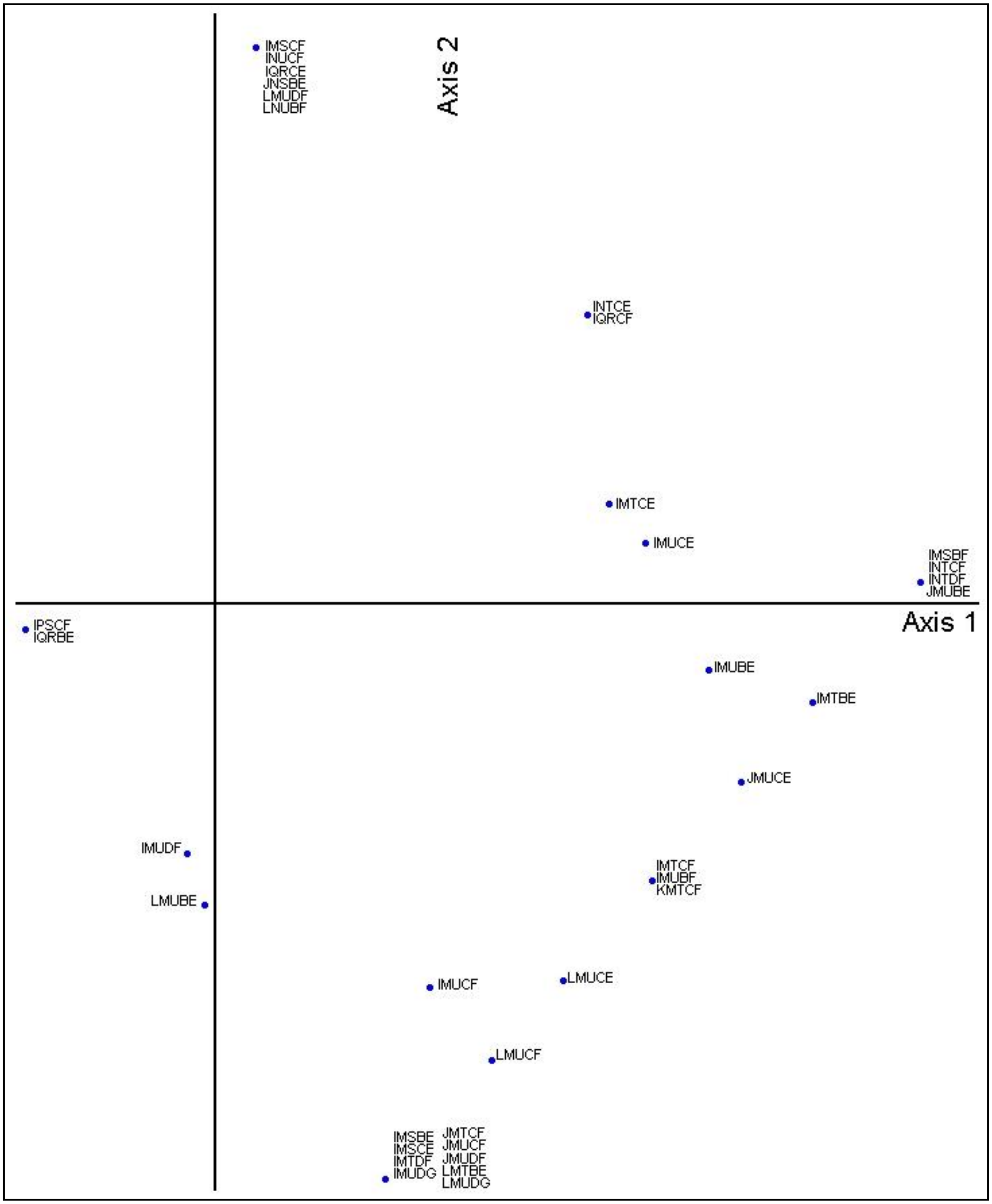


Figure 4.2 Bray-Curtis ordination showing the distribution of lithic scatter classes along Axes 1 and 2, testing for site use

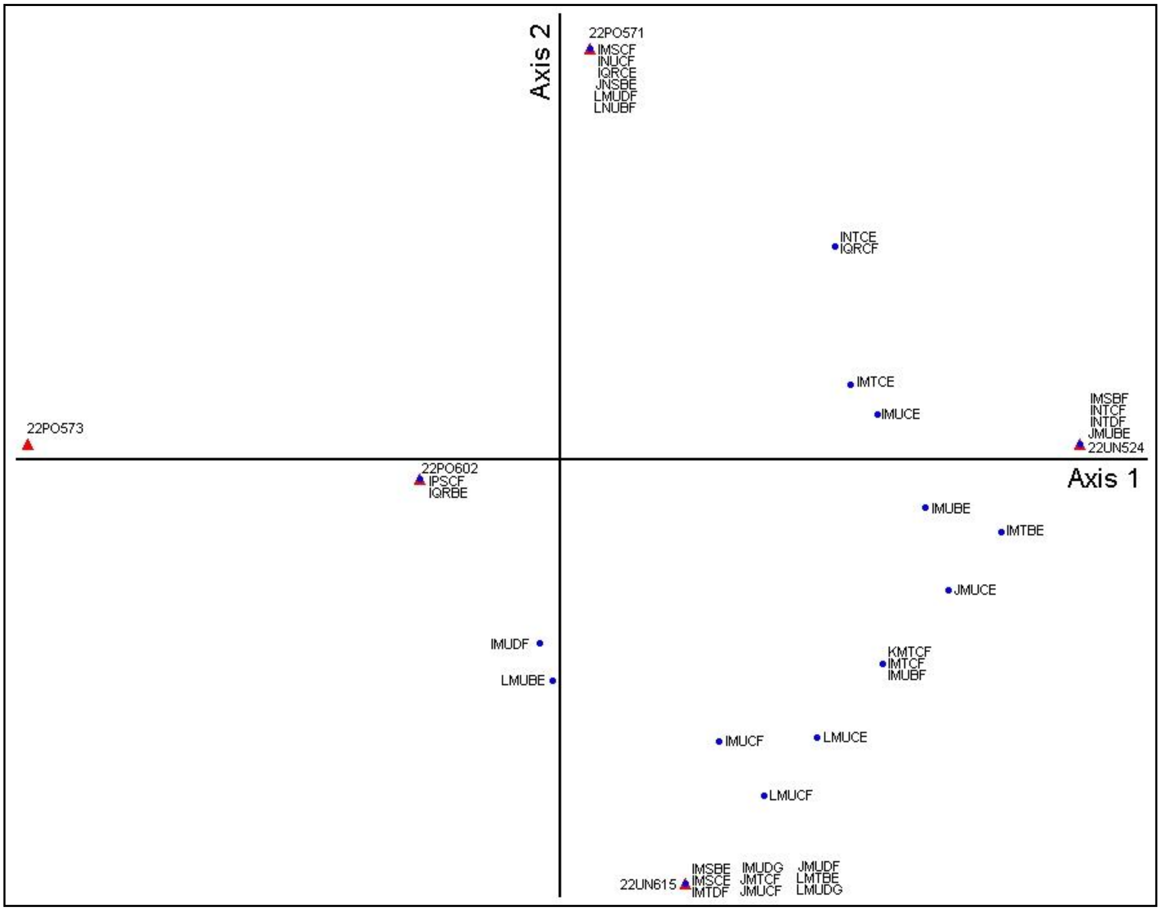


Figure 4.3 Bray-Curtis ordination biplot showing the distribution of lithic scatters in relation to the distribution of their classes along Axes 1 and 2, testing for site use

Considered in their entirety, all five lithic scatters' classes indicate predominantly late stage lithic reduction. However, the classes associated with specific assemblages within the ordination indicate late-stage lithic reduction with the exception of 22PO602, which indicated early stage. Those sites that fell along the positive end of the axes display classes containing a mix of mid- to late-stage lithic reduction, whereas those along the negative end of the axes were well within the late-stage (Table 4.4).

All classes associated with each site’s pull along the axes are only present at those sites. This is not an accurate distinction for determining each sites’ placement within the ordination due to a low sample size from sites 22PO573 (n=2) and 22PO602 (n=5).

Table 4.4 Bray-Curtis Ordination Results for Classes Pulled for Lithic Scatters

Site	Axes Placement	Classes	Stage
22UN524	Positive end of Axis 1	IMSBF	late-stage
		INTCF	mid-stage
		INTDF	mid-stage
		JMUBE	late-stage
22PO573	Negative end of Axis 1	IMUCE	late-stage
		IMUDF	late-stage
22PO571	Positive end of Axis 2	IMSCF	mid-stage
		INUCF	late-stage
		IQRCE	late-stage
		JNSBE	mid-stage
		LMUDF	late-stage
		LNUBF	mid-stage
22UN615	Negative end of Axis 2	IMSBE	late-stage
		IMSCE	late-stage
		IMTDF	late-stage
		IMUDG	late-stage
		JMTCF	late-stage
		JMUCF	late-stage
		JMUDF	late-stage
		LMTBE	late-stage
		LMUDG	late-stage
22PO602	Negative end of Axis 1	IPSCF	early-stage
		IQRBE	early-stage

To compare the five lithic scatters to non-lithic scatter sites, a sample of 17 sites that did not meet the definition of lithic scatter within the 10 km radius surrounding Ingomar Mound (22UN500) were included in the Bray-Curtis ordinations. The first two axes accounted for 61.96% of the variance (Table 4.5), with the majority of the site and class data clustered at the intersection of the axes (see Appendix A for the raw PC-ORD results).

Table 4.5 Bray-Curtis Ordination Variance Extracted for All Sites, Testing for Site Use

Axis	Percentage of Variance	Cumulative Percentage of Variance
1	37.32	37.32
2	24.64	61.96
3	16.93	78.88
4	9.37	88.26
5	5.62	93.88
6	3.45	97.32
7	1.55	98.88
8	0.51	99.39
9	0.33	99.72

Sites 22UN581 and 22UN607 show the most difference along Axis 1 while sites 22UN569 and 22UN560 show the most difference along Axis 2 (Figures 4.4-4.6). A total of 10 classes contribute to the pulling of these sites (Table 4.6). With the exception of class INTBE associated with sites 22UN607 and 22PO581, all the classes contributing to the pulling of these four sites along the two axes were only present at those sites.

Site 22UN581 is pulled along the positive end of Axis 1 as a result of one class, JMSBE (n=1). This class represents a small flake associated with late stage reduction. Class INTBE, representing a small mid-stage flake, is the cause for 22UN607's pull along the axis (Figure 4.6).

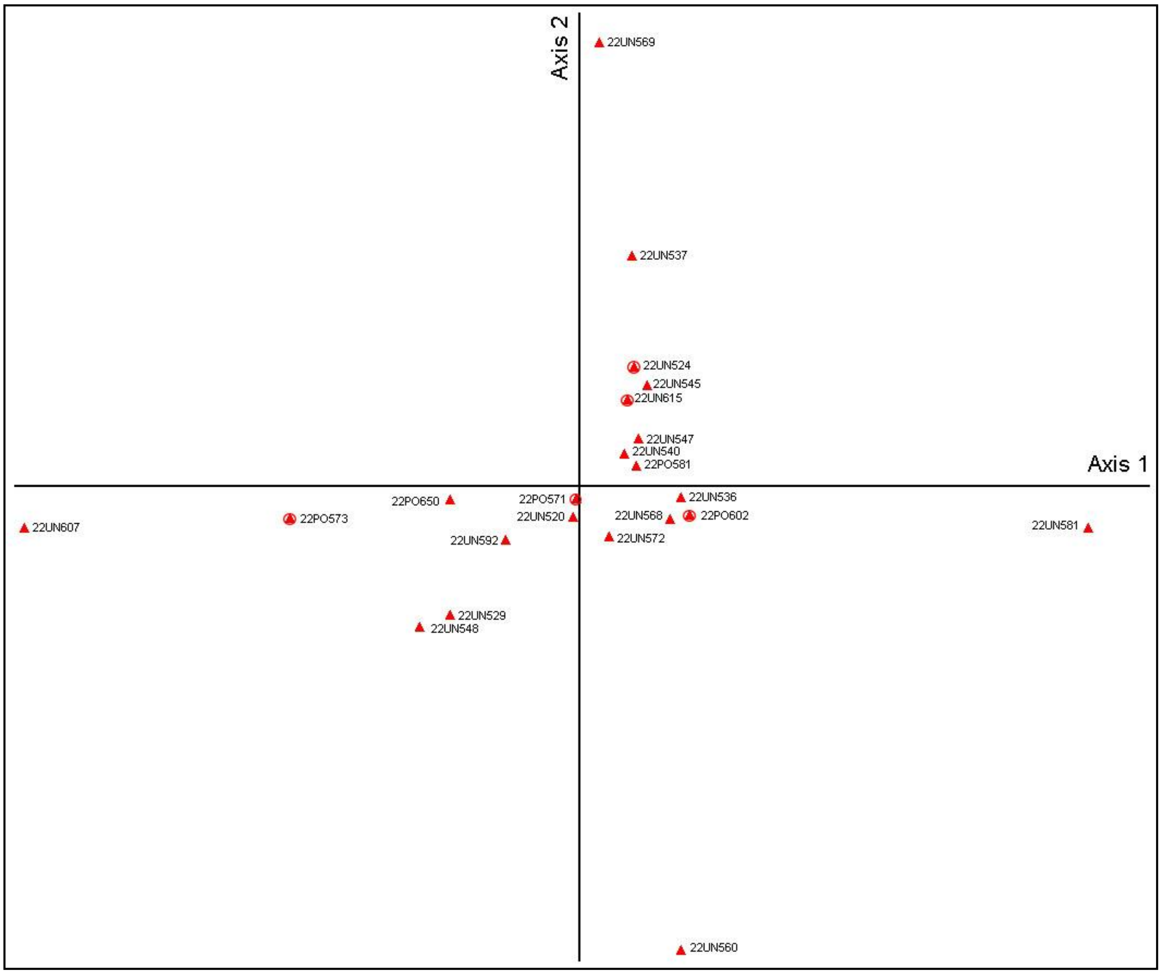


Figure 4.4 Bray-Curtis ordination showing the distribution of all sites along Axes 1 and 2, testing for site use

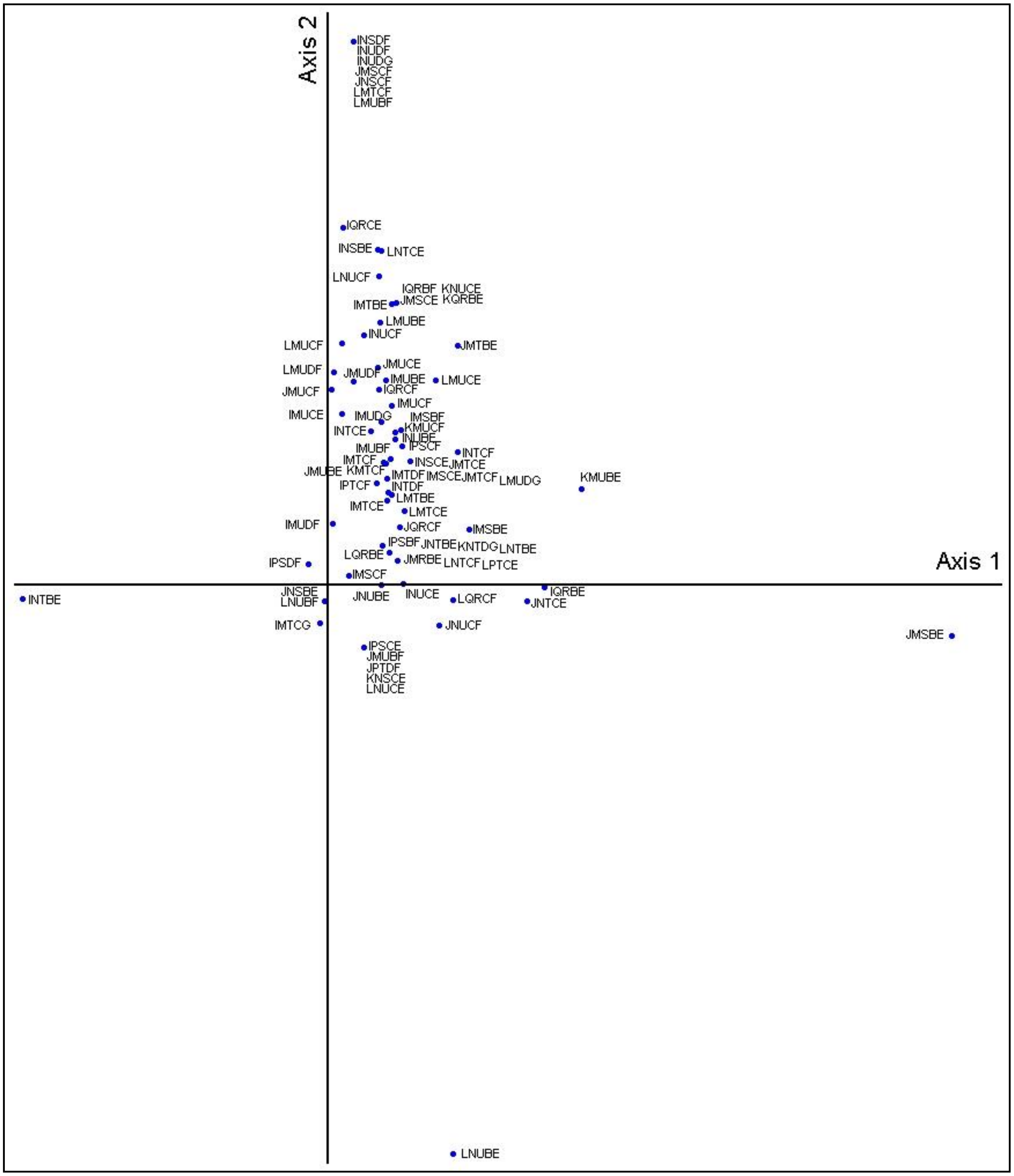


Figure 4.5 Bray-Curtis ordination showing the distribution of all site classes along Axes 1 and 2, testing for site use

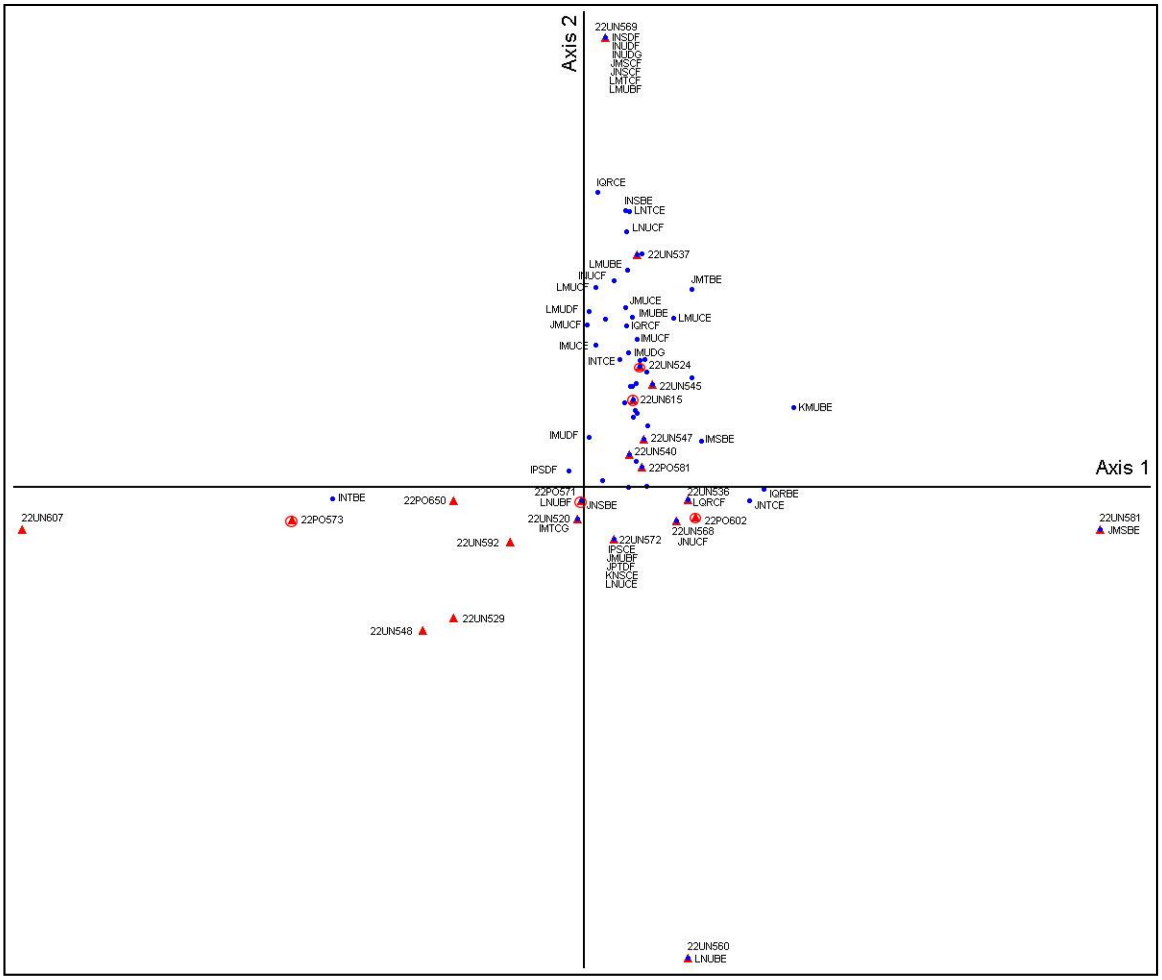


Figure 4.6 Bray-Curtis ordination biplot showing the distribution of all sites in relation to the distribution of their classes along Axes 1 and 2, testing for site use

Site 22UN569 is pulled along the positive end of Axis 2 as a result of seven classes: INSDF (n=1), INUDF (N=1), INUDG (n=2), JMSCF (n=1), JNSCF (n=1), LMTCF (n=1), and LMUBF (n=1). These classes represent larger flakes associated with mid- to late stage lithic reduction. Site 22UN560 is pulled along the negative end of Axis 2 as a result of one class: LNUBE (n=1). This class represents a small flake associated with late stage reduction.

Table 4.6 Bray-Curtis Ordination Results for Classes Pulled for All Sites

Site	Axes Placement	Classes	Stage
22UN581	Positive end of Axis 1	JMSBE	late-stage
22UN607	Negative end of Axis 1	INTBE	mid-stage
22UN569	Positive end of Axis 2	INSDF	mid-stage
		INUDF	mid-stage
		INUDG	mid-stage
		JMSCF	late stage
		JNSCF	mid-stage
		LMTCF	late-stage
		LMUBF	late-stage
22UN560	Negative end of Axis 2	LNUBE	late-stage

Whereas the axes were more defined with the lithic scatters (mid- to late-stage along the positive end of the axes, late-stage along the negative ends, and early-stage along the intersection), the ordinations with all the sites are not as defined. With all sites, the positive end of Axis 1 and the negative end of Axis 2 identify late-stage lithic reduction classes as the primary cause while the negative end of Axis 1 and the positive end of Axis 2 identify mid- to late-stage lithic reduction classes. The majority of the other classes are grouped around the intersection of the two axes with a lean towards the positive ends. Although this also includes early-stage lithic reduction centered around the intersection, there is too much ‘noise’ to assume that all sites near the intersection are a result of early-stage lithic reduction.

Cluster Analysis

A total of 36 classes were analyzed from the five lithic scatters using a Sorensen (Bray-Curtis) hierarchical cluster analysis with a nearest neighbor group linkage with a distance measure resulting in 0.00% chaining. Chaining indicates clustering at a lower level, thus lacking discrete clusters within the data (Holland 2006), therefore, the higher the percentage of chaining, the less discrete the cluster becomes. As marked in Figure 4.7, two lithic scatters (22UN524 and 22UN615) are clustered within one link (in the first 1% of the information with a distance of 0.23) (see Appendix A for the raw PC-ORD results).

Although sites 22UN524 and 22UN615 are spatially close, both lack post-Archaic identifiers and contain flake attributes indicating late-stage lithic reduction. The clustering of these sites could be the result of sample size. These sites contain larger sample sizes and therefore more classes are expressed within the data (Table 4.7).

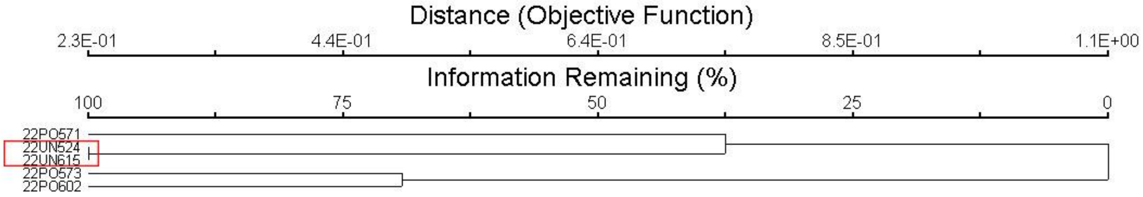


Figure 4.7 Cluster analysis dendrogram for lithic scatters, testing for site use

Table 4.7 Site Use Cluster Analysis Review for Lithic Scatters

Site	Reduction Stage for Entire Assemblage	Soil	Whole Flake Count	Components
22PO571	Late	4	17	Woodland
22UN524	Late	1	41	Early and Middle Archaic
22UN615	Late	3	46	Early, Middle, Late Archaic
22PO573	Late	4	2	Unknown
22PO602	Late	2	5	Unknown

A total of 82 classes were analyzed for all sites using a Sorensen (Bray-Curtis) hierarchical cluster analysis with a nearest neighbor group linkage with a distance measure resulting in 30.92% chaining. As marked in Figure 4.8, three clusters are present in the first 15% of information (see Appendix A for the raw PC-ORD results).

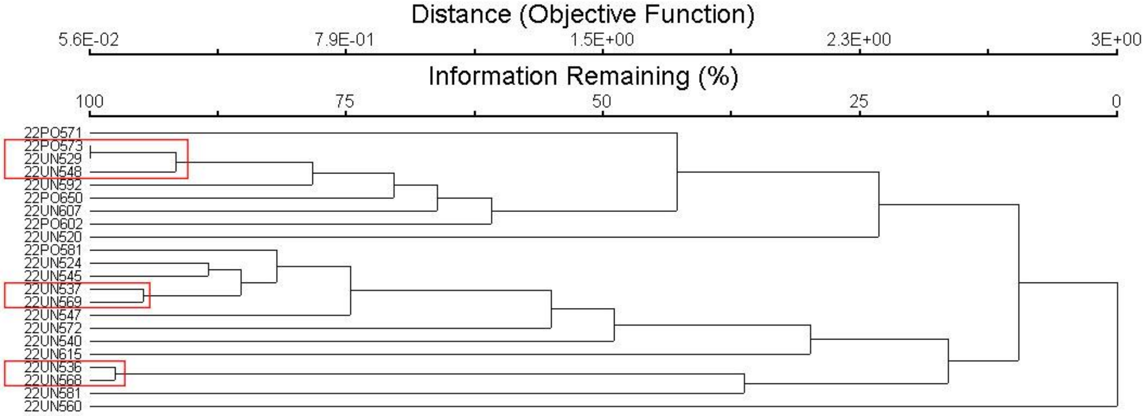


Figure 4.8 Cluster analysis dendrogram for all sites, testing for site use

The first cluster, sites 22PO573 (n=2) and 22UN529 (n=4), are clustered within one link (in the first 1% of information). This group is within one link (approximately in the first 15% of information) of 22UN548 (n=3). This is the only cluster that contains a lithic scatter (22PO573). The second cluster, sites 22UN537 (n=72) and 22UN569 (n=109), are clustered within one link (in the first 10% of information). The third cluster, sites 22UN536 (n=6) and 22UN568 (n=10), are clustered within one link (in the first 5% of information).

The clustering of these sites appears to be dependent on flake counts. Four out of five lithic scatters failed to cluster within the first 15%. The last link connecting all of these sites could be an identifying feature relating to lithic scatters that have the potential to contribute to research, or possibly simply a result of sample size (Table 4.8). Based on the locations of these clusters within the ordination (Figure 4.9), these clusters are based on something more than just sample size.

Looking at these sites within the ordination one can see a similarity within the clusters based on the classes. The first group has similar issues as a few sites from the Bray-Curtis ordinations; that is no classes fall around the sites within the biplot (see Figure 4.6), indicating multiple “pull” factors. However, a total of eight classes are present at each of these sites: 22PO573 (IMUCE and IMUDF), 22UN548 (IMUBE and IMUCE), and 22UN529 (IMUBE, IMUCE, IMUDF, and IPSDF). In total, four classes are spread across all three assemblages, and all except one class (IPSDF) is late-stage lithic reduction. Site 22UN529 is located closest to the intersection, corresponding with the mixed reduction stage near the intersection seen above.

Table 4.8 Site Use Cluster Analysis Review for All Sites Clustered Within the First 15% of Information

Site	**Reduction Stage for Entire Assemblage**	**Soil Group**	**Whole Flake Count**	**Components**
22PO573*	Late	4	2	Unknown
22UN529	Early	1	4	Late Woodland-Mississippian
22UN548	Early	1	3	Gulf Formational; Middle Woodland
22UN537	All Stages	2	72	Middle Woodland; Late Woodland-Mississippian
22UN569	Late	3	109	Middle Archaic; Gulf Formational; Middle, Late Woodland
22UN536	Mid to Late	2	6	Middle Woodland; Late Woodland-Mississippian
22UN568	Late	3	10	Middle, Late Woodland

* Sites meeting the definition of lithic scatter.

The second cluster contains eight classes between the two sites: 22UN537 (IMTBE) and 22UN569 (INSDF, INUDF, INUDG, JMSCF, JNSCF, LMTCF, and LNUDF). This group is mid- to late-stage lithic reduction, corresponding with the Bray-Curtis results along the negative end of Axis 1. The third cluster contains two classes between two sites: 22UN536 (LQRCF) and 22UN568 (JNUCF). These classes are early-stage and mid-stage, respectively. These results correspond with the lithic scatter ordination results, identifying early-stage reduction classes closest to the intersection with late-stage reduction classes along the farthest ends of the axes. It appears the clusters are falling along the ordination with classes containing a mixture of tool production and maintenance stages, possibly the result of multi-use sites.

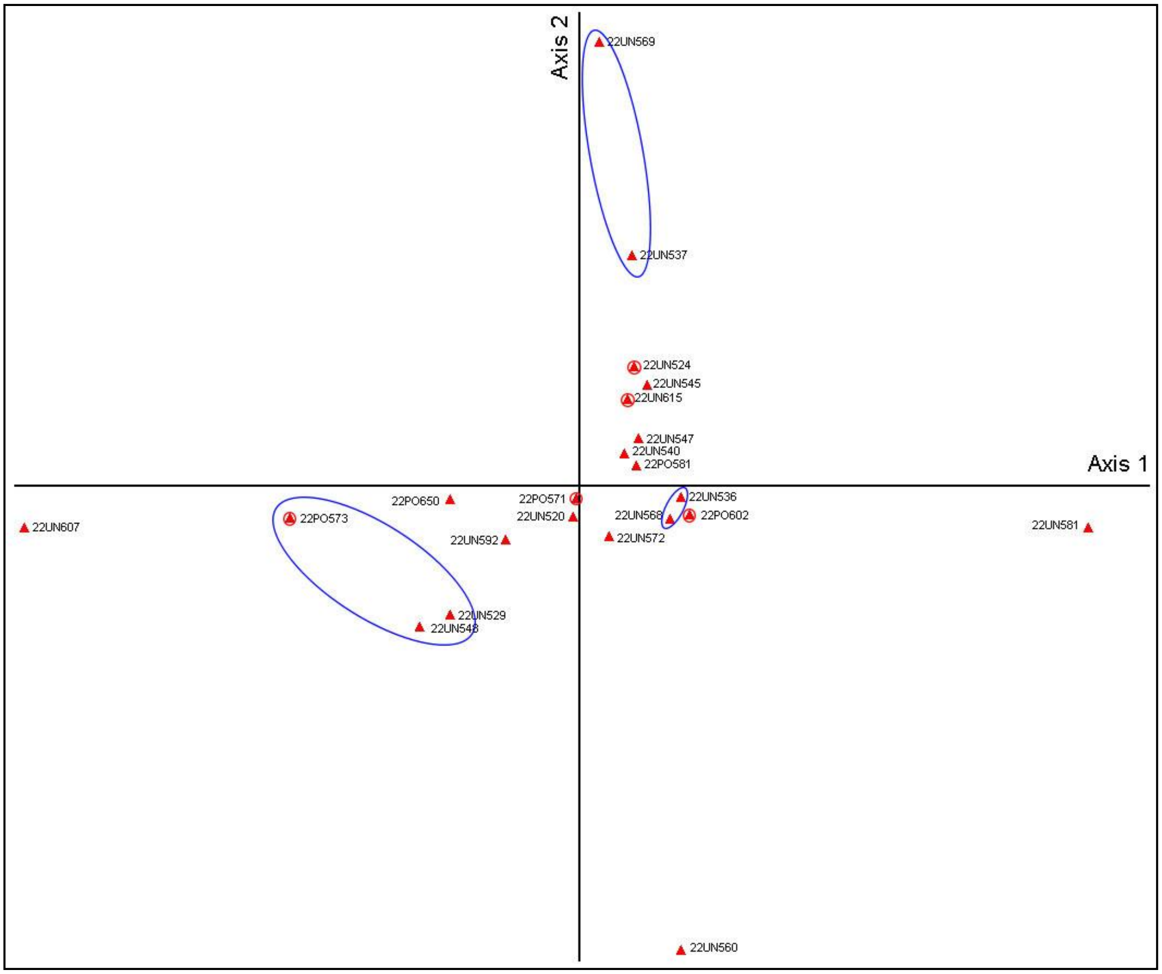


Figure 4.9 Bray-Curtis ordination showing the cluster analysis groupings of all sites along Axes 1 and 2 within the first 15% of information, testing for site use

Occupation Age

Bray-Curtis (polar) ordination and cluster analysis, both with a Bray-Curtis distance measure, were first performed using classes hypothetically related to site age (dimensions are raw material type, absence/presence of heat-treatment counts, flake length, and flake width) on all whole flakes (n=111) for those sites meeting the definition of lithic scatter and all whole flakes (n=519) for all sites tested. As stated earlier, an additional 17 sites were tested that did not meet the definition of lithic scatter in order to compare the variation of the lithic scatters to other sites in the test area. A total of 36 classes were occupied for lithic scatters and 47 classes were occupied for all sites (Table 4.9; see Table 4.10 for code conversion). The statistical program, PC-ORD, rejects null data, therefore classes that did not contain data were removed.

Table 4.9 Occupation Age Coded Classes with Whole Flake Counts

	22PO571*	22PO573*	22PO581	22PO602*	22PO650	22UN520	22UN524*	22UN529	22UN536	22UN537	22UN540	22UN545	22UN547	22UN548	22UN560	22UN568	22UN569	22UN572	22UN581	22UN592	22UN607	22UN615*
HNBE							3			1	2	2	3				16	2	1			
HNCE	1				1		2			2		6	2				5	2				
HNCF					1						2	1				2	8	1	1	1		
HNDF	1	1				1											2					
HNDG																	2					1
HOBE			1												2		5		1			1
HOBF	1																					
HOCE										2	2						4					
HOCF							1				1						5			1		
HODF																				1		
INBE				1			3			5	2	2	1	1	1	2	3	2	1			
INCE				1			6			1	3	2	4			1	5	1		1		
INCF						2	2		1	2	2	2	2			1	5	1		1		
INDF													2				2	1				
INDG										1	1		1									
IOBE	3		12	1		2	11	1	1	32	10	4	8		2		17	2	3	1	1	1
IOBF							1			1	1						1	1				
IOCE	3	1	12			2	5	1		9	1	5	8	2	1	1	10	6	1	1	1	3
IOCF	5		8			2	4		3	11	3	3	4			3	13	1	1			2
IODF	1			1		2		2		1	1	1	2				2	1		1		
IODG																	1					
JNBE																			1			
JNCF									1			1										1
JNDG																						1
JODF																						1
KNBE										1							2					6
KNCE							1					2										1
KNCF										2		1	1									6
KNDF							1															2
KNDG																						1
KOBE										1												3
KOBF							1															
KOCE																						2
KOCF												1										6
KODF																						3
LNBE			3	1							1						1					
LNBF																						1
LNCE	1				1														1			1
LNCF					1																	1
LNDF	1																					1
LNDG																		1				1
LOCF						1																

* Sites meeting the definition of lithic scatter.

Table 4.10 Occupation Age Ordination Class Codes

Code	Attribute	
H	Raw Material	Fort Payne/Pickwick
I	Raw Material	Gravel Chert
J	Raw Material	Tallahatta Quartzite
K	Raw Material	Kosciusko Quartzite
L	Raw Material	Other
N	Heated	Absent
O	Heated	Present
B	Flake Length	<13.8
C	Flake Length	≥13.8 - <28.1
D	Flake Length	≥28.1
E	Flake Weight	<1.13
F	Flake Weight	≥1.13 - <12.59
G	Flake Weight	≥12.59

Bray-Curtis (Polar) Ordination

Five lithic scatters were tested for variability resulting in the first two axes accounting for 96.41% of the variance (Table 4.11; Figures 4.10-4.12) (see Appendix B for the raw PC-ORD results).

Table 4.11 Bray-Curtis Ordination Variance Extracted for Lithic Scatters, Testing for Occupation Age

Axis	Percentage of Variance	Cumulative Percentage of Variance
1	67.62	67.62
2	28.8	96.41
3	3.57	99.98
4	0.02	100

In Bray-Curtis ordination, the axes boundaries are determined based on the differences between sites with the sites most different at opposite ends of the axis. Sites 22PO602 and 22PO573 show the most difference along Axis 1 while sites 22UN524 and

22UN615 show the most difference along Axis 2. A total of 23 classes contribute to the pulling of these lithic scatters. The final lithic scatter, 22PO571, falls along the negative of Axis 1 and positive of Axis 2, near their intersection (Figures 4.10-4.12).

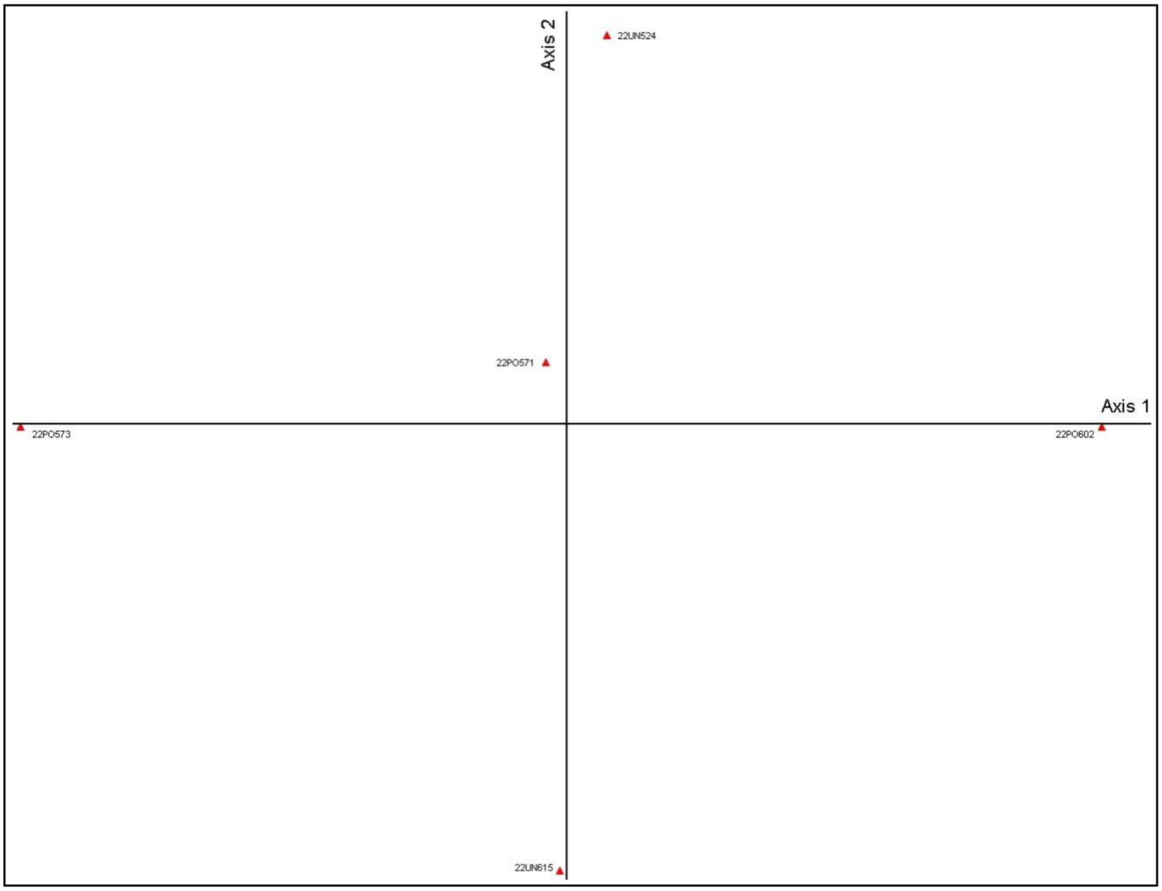


Figure 4.10 Bray-Curtis ordination showing the distribution of lithic scatters along Axes 1 and 2, testing for occupation age

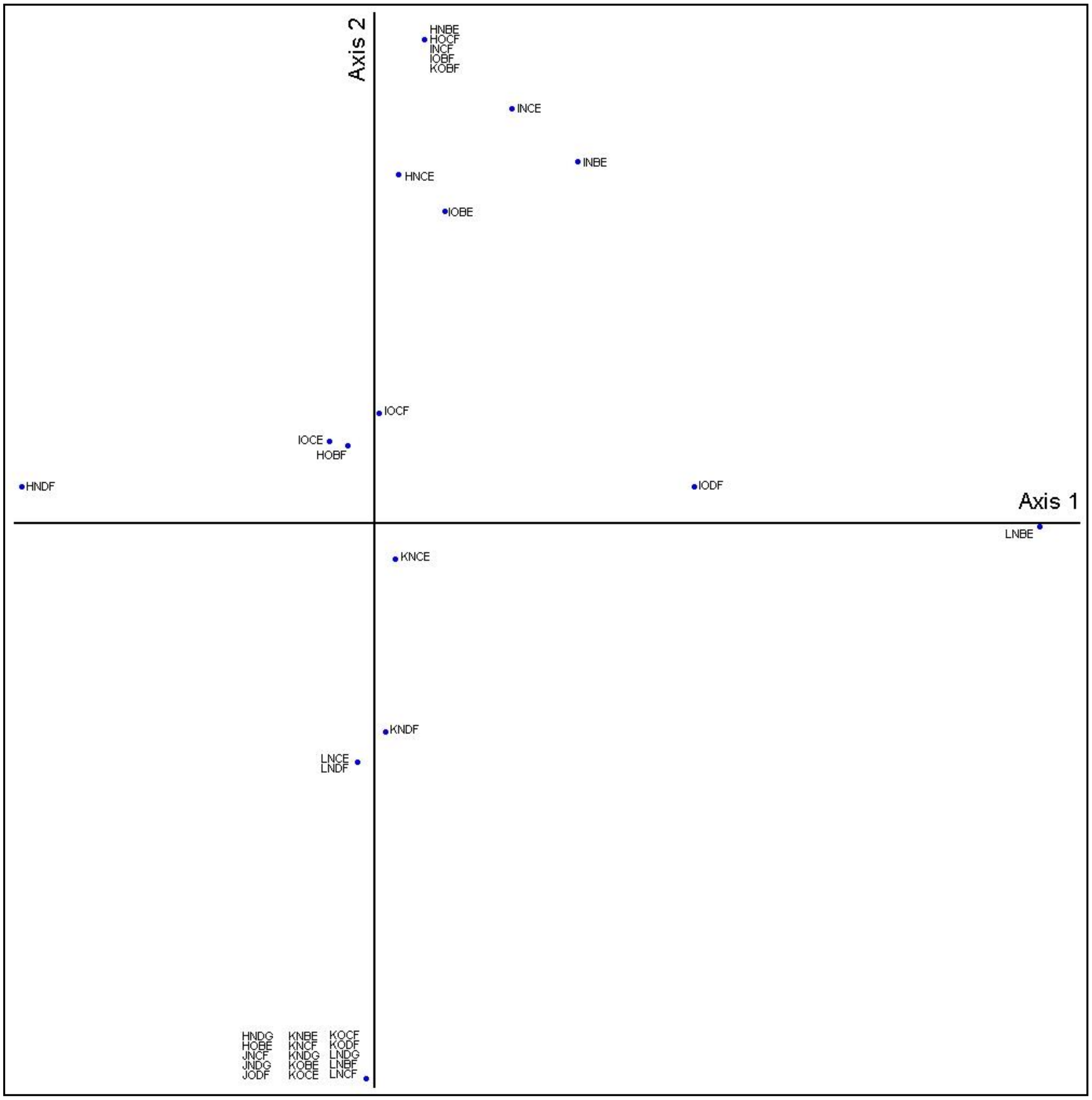


Figure 4.11 Bray-Curtis ordination showing the distribution of lithic scatter classes along Axes 1 and 2, testing for occupation age

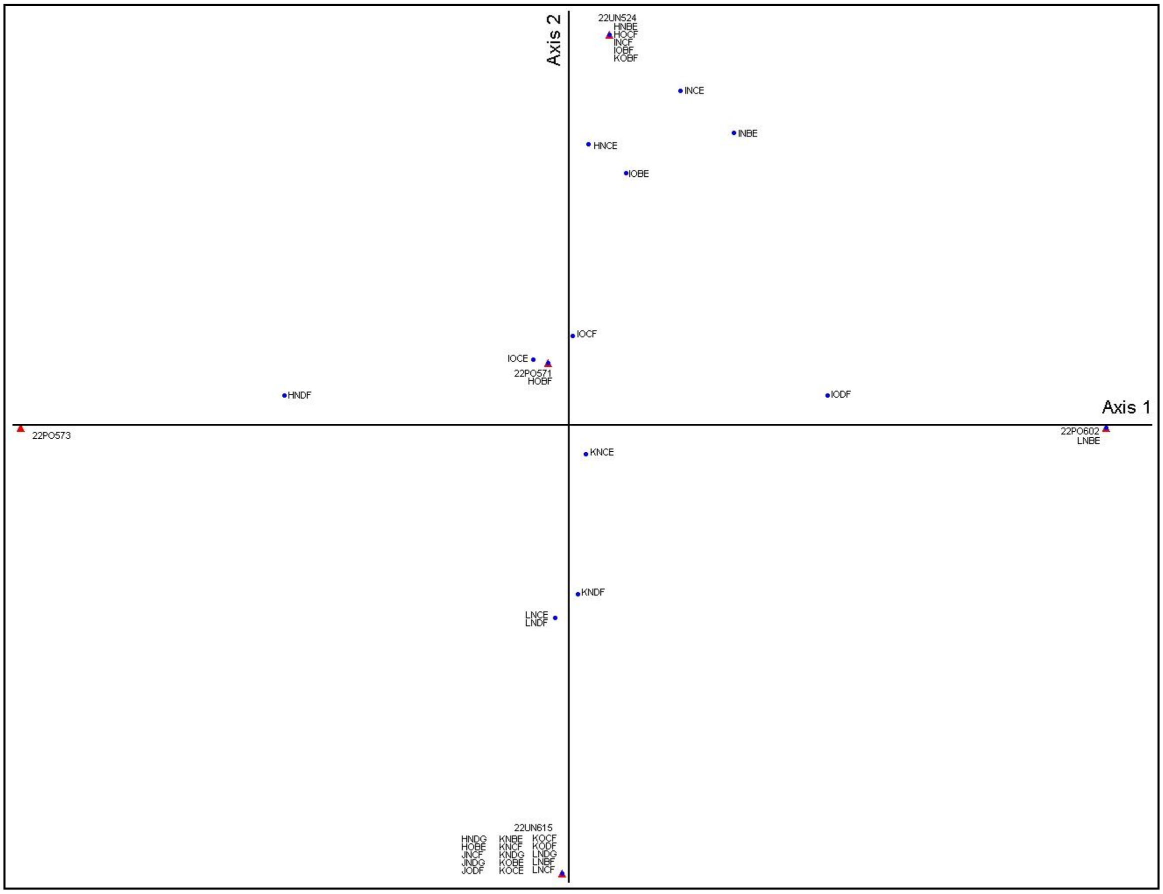


Figure 4.12 Bray-Curtis ordination biplot showing the distribution of lithic scatters in relation to the distribution of their classes along Axes 1 and 2, testing for occupation age

Site 22PO602 pulled along the positive end of Axis 1 as a result of one class: LNBE (n=1). No other lithic scatter contained this class, which could represent a late-stage flake that is older than Woodland (no heat-treatment) or an unheated flake from a more recent occupation. Reviewing the assemblage (n=5) further affirms the ‘unknown’ occupation classification of the site; the majority of the flakes present at the site were local gravel chert. No diagnostics were present at this site to provide an occupation age to compare this site’s relative age (see Tables 2.2 and 2.3).

Site 22PO573 pulled along the negative end of Axis 1 as a result of two classes: HNDF (n=1) and IOCE (1). These two flakes were the only whole flakes present in the assemblage. The presence of Fort Payne chert indicates a possible Archaic component. Although some bifaces throughout the Archaic and Woodland periods were made of this material (McGahey 2000), Fort Payne chert made up approximately 50-80% of all stone tools during the Middle Archaic Benton phase (Connaway 1977; Johnson and Brookes 1988; Rafferty et al. 1980; Smith 1982). Johnson and Brookes (1988) state that this material type declined in use after the Middle Archaic. No diagnostics were present at this site (Tables 2.2 and 2.3) and the rough, possible Archaic occupation can only be confirmed by the lack of pottery at the site.

Site 22UN524 pulled along the positive end of Axis 2 as a result of five classes: HNBE (n=3), HOCF (n=1), INCF (n=2), IOBF (n=1), and KOBF (n=1). The presence of Fort Payne chert indicates a possible Archaic occupation (Connaway 1977; Johnson and Brookes 1988; Rafferty et al. 1980; Smith 1982; McGahey 2000); however, other material is seen in the bifaces at this site. The majority of flakes lack heat-treatment, suggesting a pre-Woodland occupation. The lack of ceramics (Table 2.2) affirms the possible Archaic occupation. The presence of beveled base treatment, expanded (angle <75°) haft angle, and basal grinding indicates an Early and Middle Archaic component (Table 2.3) (McGahey 2000; Rafferty 1994).

Site 22UN615 pulled along the negative end of Axis 2 as a result of 15 classes: HNDG (n=1), HOBE (n=1), JNCF (n=1), JNDG (n=1), JODF (n=1), KNBE (n=6), KNCF (n=6), KNDG (n=1), KOBE (n=3), KOCE (n=2), KOCF (n=6), KODF (n=3), LNDG (n=1), LNBF (n=1), and LNCF (n=1). Kosciusko Quartzite was used throughout the Paleo-Indian period and heavily exploited for the production of Pine Tree bifaces in the Early Archaic; however, it was rarely used between the Early Archaic and Late Woodland (Brookes 1999; McGahey 1999, 2000). Kosciusko Quartzite was predominately used again during the Late Woodland/Mississippian transition (Lehmann 1982), when it is prevalent at sites near the Kosciusko formation (Johnson 1984; McGahey 1999). The majority of flakes responsible for variation at 22UN615 represent classes relating to a relative age indicating an Early Archaic component. The location of this site near the Kosciusko formation would explain the material's abundance if not for the lack of this material type at the other sites tested in this research.

The diagnostics present identified projectile point components ranging from Early Archaic to Late Archaic (see Table 2.2). Site 22UN615 was included in Rafferty's (1994) study, where she seriated short- and long-duration assemblages using biface and pottery types. Site 22UN615 contained no pottery in the artifact assemblage and therefore was included only in the biface seriation in which Rafferty reported four bifaces. Rafferty identified this site as a short-duration assemblage falling along the bottom of the seriation, indicating a relatively early occupation (Rafferty 1994).

The fifth site, 22PO571, was located near the intersection of both axes. This placement within the ordination is based on a single class: HODF (n=1). This single class represents a large, heated, Fort Payne flake. Coupled with the presence of sand-tempered sherdlets, this site has a relative age of Gulf Formational or later.

To compare the results for the five lithic scatters tested against non-lithic scatter sites, the 17 sites that did not meet the definition of lithic scatter within the 10 km radius surrounding Ingomar Mounds (22UN500) were included in the analysis. The first two axes accounted for 61.85% of the variance (Table 4.12), with the majority of the site and classes clustered near the intersection of both axes (Figures 4.13 - 4.15) (see Appendix B for the raw PC-ORD results).

Sites 22UN607 and 22PO650 show the most difference along Axis 1 while sites 22UN568 and 22UN615 show the most difference along Axis 2.

Table 4.12 Bray-Curtis Ordination Variance Extracted for All Sites, Testing for Occupation Age

Axis	**Percentage of Variance**	**Cumulative Percentage of Variance**
1	40.31	40.31
2	21.55	61.85
3	15.53	77.38
4	13.96	91.35
5	5.04	96.39

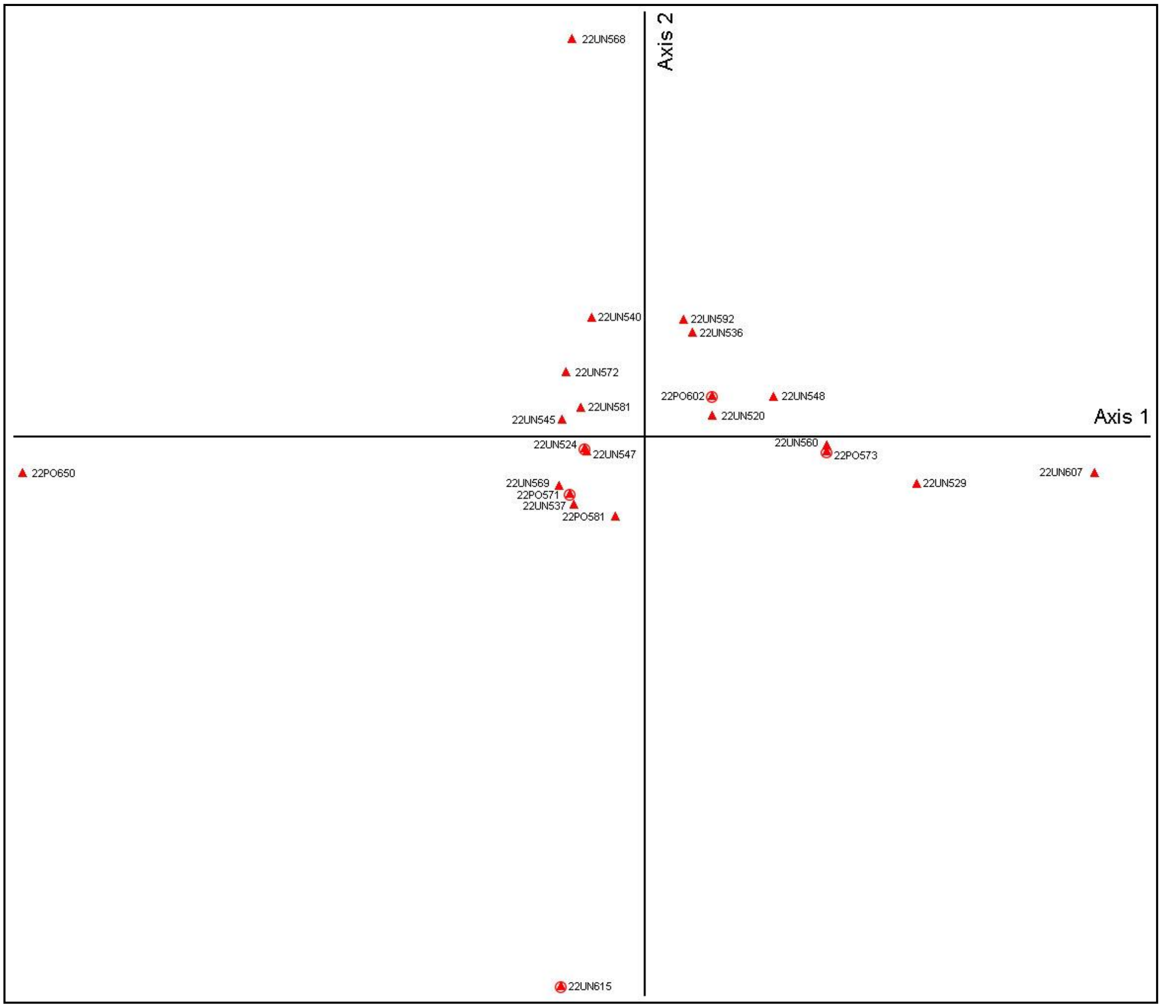


Figure 4.13 Bray-Curtis ordination showing the distribution of all sites along Axes 1 and 2, testing for occupation age

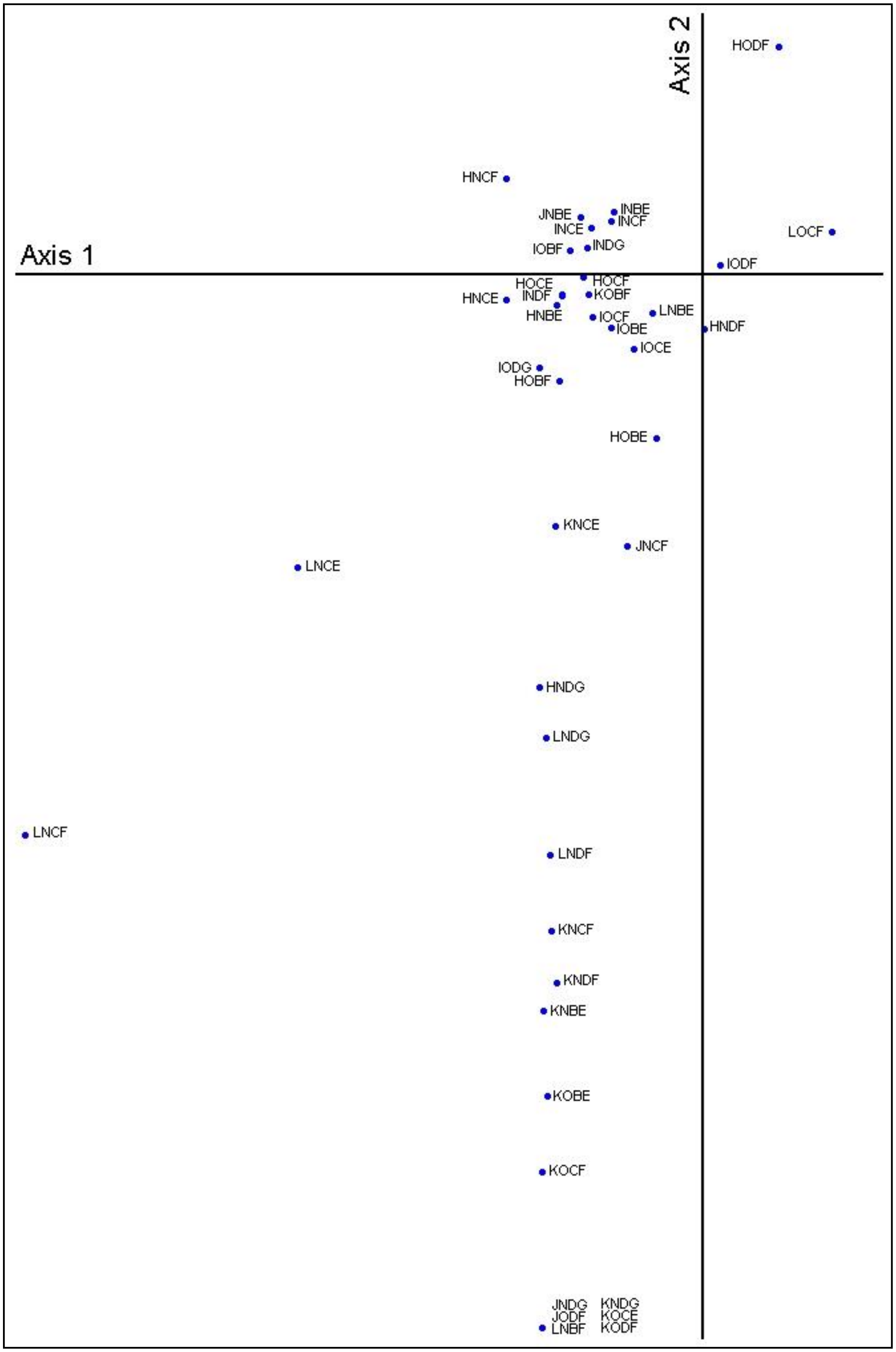


Figure 4.14 Bray-Curtis ordination showing the distribution of all site classes along Axes 1 and 2, testing for occupation age

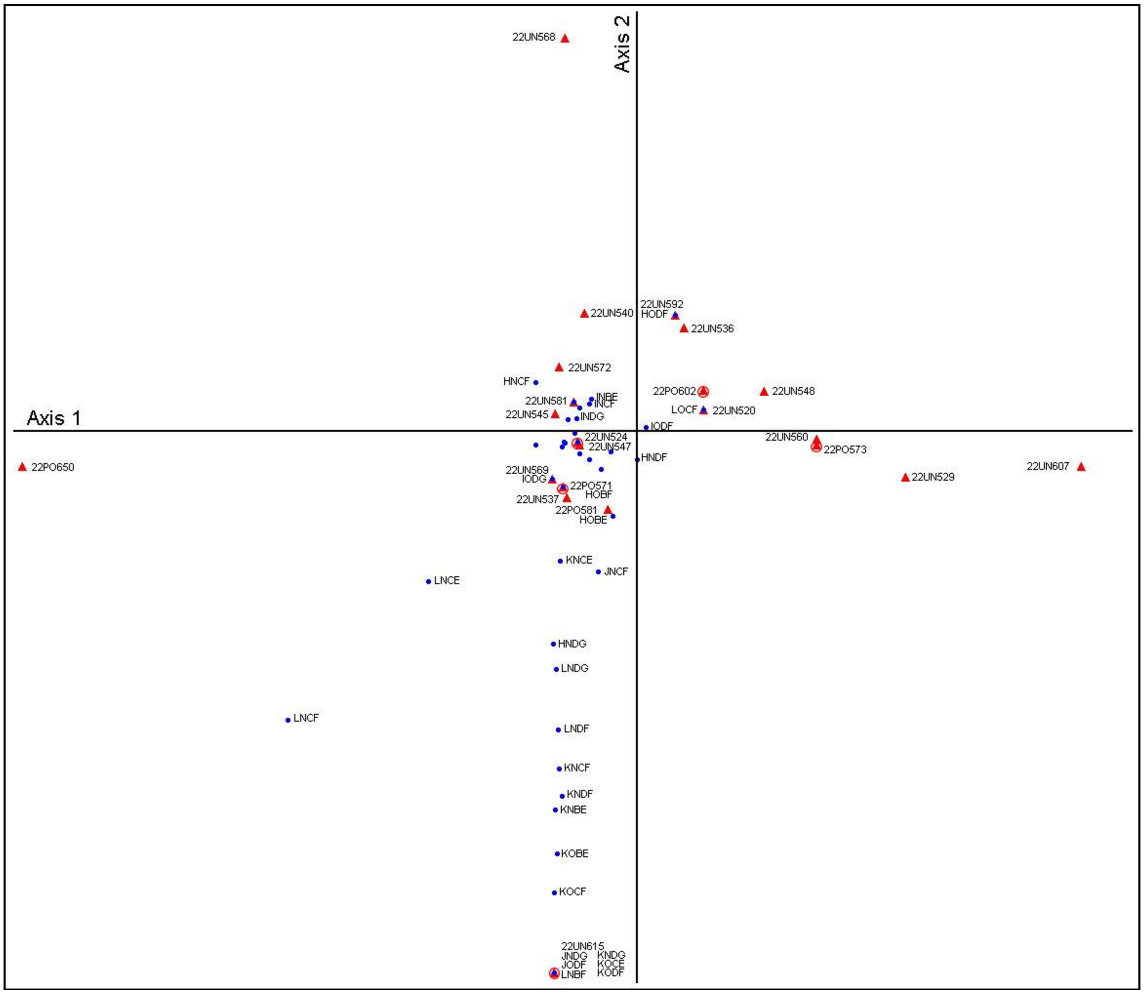


Figure 4.15 Bray-Curtis ordination biplot showing the distribution of all sites in relation to the distribution of their classes along Axes 1 and 2, testing for occupation age

Site 22UN607 pulled along the positive end of Axis 1 as a result of the only two classes present within the data: IOBE (n=1) and IOCE (n=1). These classes represent small, heated gravel chert flakes. The presence of heat-treatment identifies a potential Woodland, or later, occupation. No diagnostics were recovered from this site, and without more information the relative age cannot tested for accuracy.

Site 22PO650 pulled along the negative end of Axis 1. After reviewing the biplot and the coded class data, site placement is seen to be a result of the only four classes present within the assemblage: HNCE (n=1), HNCF (n=1), LNCE (n=1), and LNCF (n=1). These classes represent relatively small, unheated, Fort Payne chert flakes. The absence of heat-treatment identifies a potential pre-Woodland occupation and the presence of Fort Payne indicates a possible Middle Archaic component. No diagnostics were recovered from this site and only the lack of pottery can confirm the relative age assessment.

Site 22UN568 pulled along the positive end of Axis 2. After reviewing the biplot and the coded class data, ordination position is seen to be a result of the only six classes present within the assemblage: HNCF (n=2), INBE (n=2), INCE (n=1), INCF (n=1), IOCE (n=1), and IOCF (n=3). These classes represent primarily average-sized gravel chert flakes with a mix of presence/absence of heat-treatment. This relatively even distribution of heated and unheated debitage could indicate a transition to heat-treatment technology as seen during the Woodland period. The presence of grog-tempered plain sherds indicate a possible Middle to Late Woodland occupation (Futato 1983; Jenkins 1981; Phillips 1970), potentially confirming the relative age of Woodland.

Site 22UN615 pulled along the negative end of Axis 2 as a result of six classes: JNDG (n=1), JODF (n=1), LNBF (n=1), KNDG (n=1), KOCE (n=2), and KODF (n=3). Similar to the lithic scatter analysis, Kosciusko Quartzite is the primary cause for this site being pulled and suggests an Early Archaic component. As discussed above, this site was also included in Rafferty's (1994) study, where it was among the earliest of her assemblages (Rafferty 1994:

Figure 2).

As opposed to testing for site use, testing for occupation age did not result in distinct reasoning as to why sites were pulled along the axes. The only notable distinction was the pull of Kosciusko Quartzite along Axis 2. This could be the result of the abundance of gravel chert throughout sites in the region and across multiple cultural periods.

Cluster Analysis

A total of 36 classes were analyzed from the five lithic scatters using a Sorensen (Bray-Curtis) hierarchical cluster analysis with a nearest neighbor group linkage resulting in a distance measure resulting in 100% chaining. Chaining indicates clustering at a wider variety of levels, thus lacking discrete clusters within the data (Holland 2006), therefore, the higher the percentage of chaining, the less discrete the cluster becomes. Due to the percentage of chaining, these clusters are not discrete. As marked in Figure 4.16, two lithic scatters, 22PO571 (n=17) and 22UN524 (n=41) are clustered within one link (in the first 1% of the information with a distance of 0.193) (see Appendix B for the raw PC-ORD results).

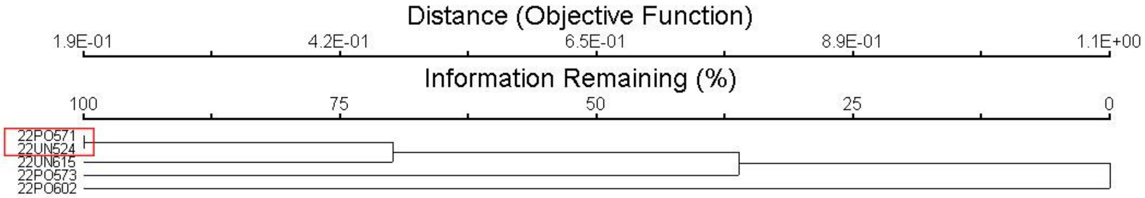


Figure 4.16 Cluster analysis dendrogram for the lithic scatters, testing for occupation age

Within the Bray-Curtis ordination, sites 22PO571 and 22UN524 were located along the positive ends of Axis 1 and 2 respectively. However, the remainder of the cluster analysis does not correspond with the Bray-Curtis ordination. Although sites 22UN615 and 22UN524 were grouped within the lithic scatter cluster analysis and the Bray-Curtis ordination, it was expected they would be grouped closer during the occupation age clustering. Both sites contain relatively high whole flake counts and, based on the diagnostics present, were identified as having Early and Middle Archaic components.

A total of 47 classes were analyzed for all sites using a Sorensen (Bray-Curtis) hierarchical cluster analysis with a nearest neighbor group linkage resulting in a distance measure resulting in 40.79% chaining. As marked in Figure 4.17, two clusters are present in the first 20% of information (see Appendix B for the raw PC-ORD results).

The first cluster, sites 22UN529 (n=4) and 22UN607 (n=2), are clustered within one link (in the first 1% of information). These sites only contain unheated, gravel chert.

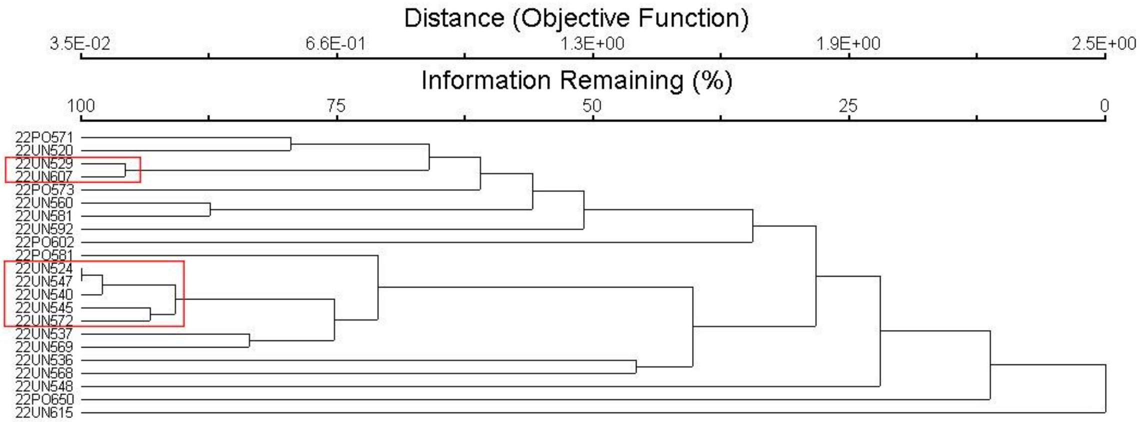


Figure 4.17 Cluster analysis dendrogram for all sites, testing for occupation age

The second cluster, sites 22UN524 (n=41) and 22UN547 (n=38), are clustered within one link (in the first 1% of information). This cluster is grouped within one link to 22UN540 (n=32) (approximately in the first 8% of information). This larger cluster is grouped with another cluster of two sites, 22UN545 (n=33) and 22UN572 (n=22) (clustered within one link at approximately 15% of information), by a third link (approximately in the first 20% of information). The second cluster marks the majority of unheated, Fort Payne chert from the entire dataset. If this cluster was extended to include the next link (within approximately the first 25% of information), another cluster of two sites, 22UN537 (n=72) and 22UN569 (n=109), the new larger cluster would contain 85% of the unheated Fort Payne/Pickwick present across the entire dataset.

Four out of five lithic scatters failed to cluster within the first 20% of information. Based on the locations of these two clusters within the Bray-Curtis ordination (Figure 4.18), the clustering could be seen within the ordination. The first cluster is located along the positive end of the Axis 1 during the Bray-Curtis ordination. The second cluster is group near the intersection of the ordination, focused along the negative side of Axis 1 and the positive side of Axis 2. With the second group, site 22UN581 is in the center of the cluster, which does not align with the cluster dendrogram.

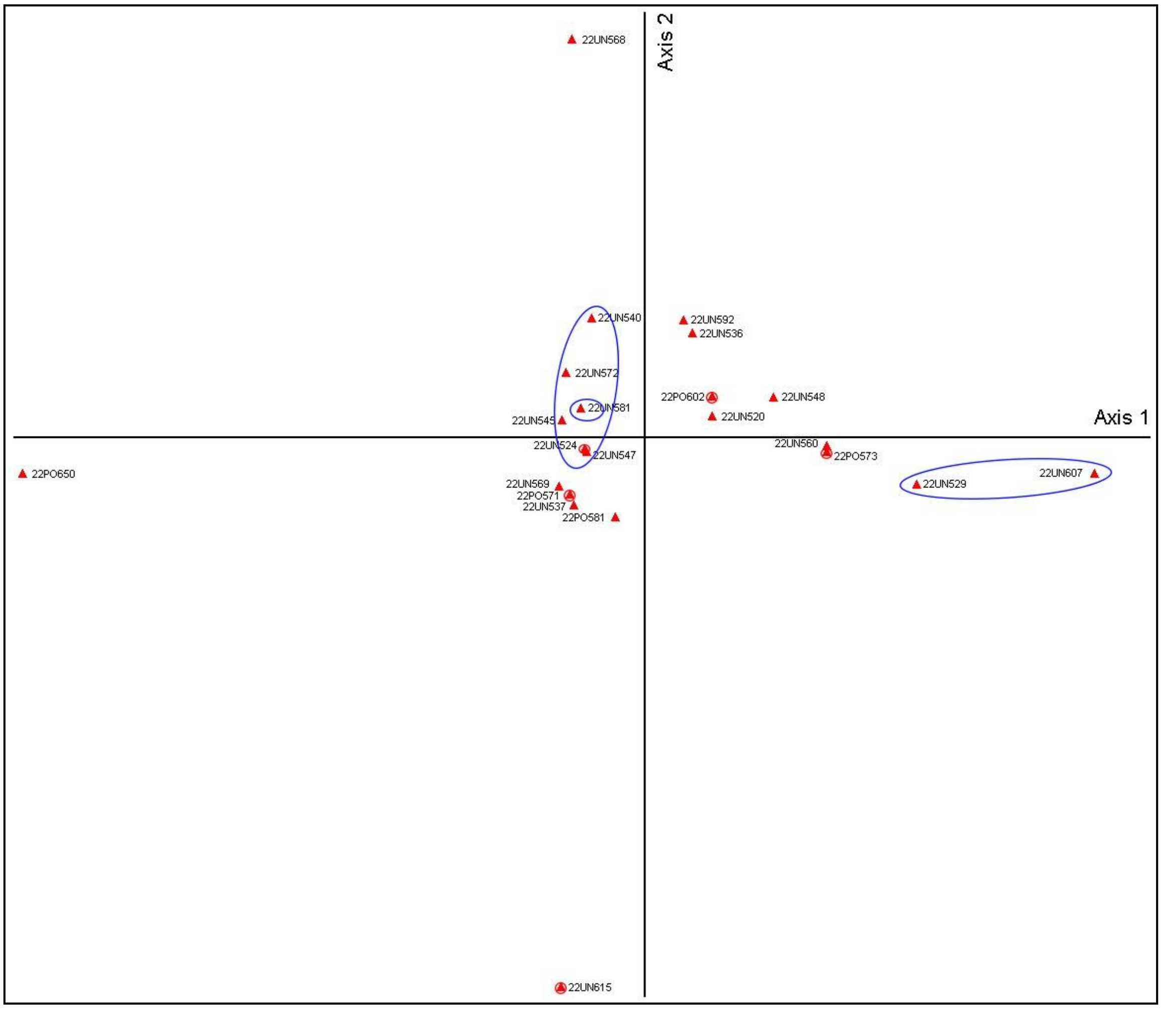


Figure 4.18 Bray-Curtis ordination showing the cluster analysis grouping of all sites related to occupation age along Axes 1 and 2 within the first 20% of information

Duration

Using classes hypothetically related to site duration (a single dimension counting flake breaks on all flakes), an analysis was done of all flakes (n=805) for all sites tested. The number of breaks present on each flake was counted and a percentage was determined for each attribute. Flakes that were classified as whole may have contained a break but were classified as such due to the

presence of a platform facet and the ability to measure length. Due to this test containing a single dimension, Bray-Curtis ordination and cluster analysis could not be conducted.

Flake count percentages were calculated on all flakes (Figure 4.19). Due to the small size of assemblages from lithic scatters 22PO602 and 22PO602, and sites 22UN529, 22UN548, 22UN560, and 22UN607, these sites' percentage could be misleading. Due to their assemblages containing diagnostics spanning multiple components, it was expected that four sites (22UN537, 22UN540, 22UN545, and 22UN547) would contain a higher percentage of flakes with

3 or more flake breaks; however, this was not the case. This could be evidence that, even though these sites display multiple components, they were not continuous occupations.

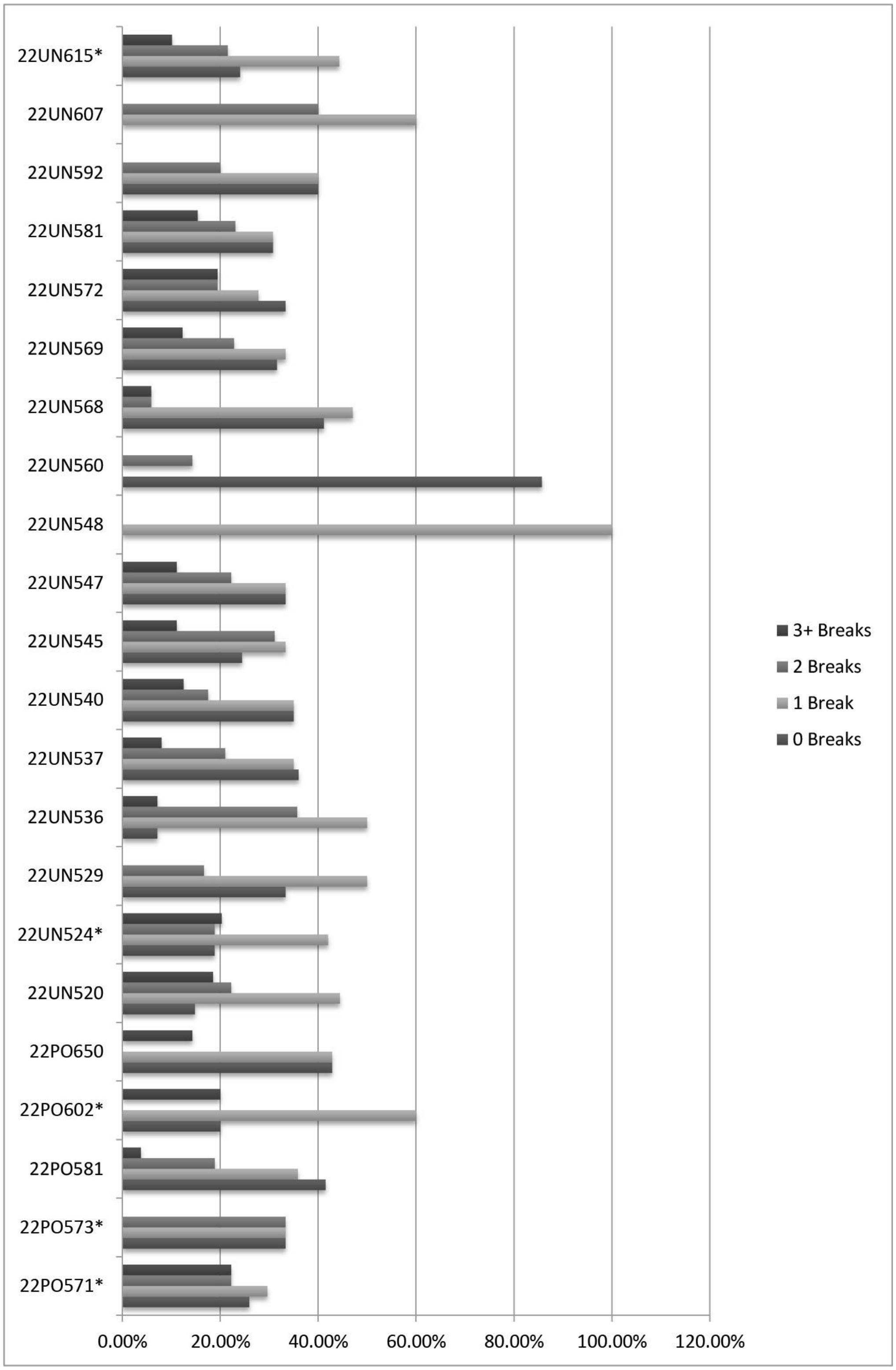


Figure 4.20 Flake break percentages for all flakes from all sites

* Sites meeting the definition of lithic scatter.

Seriations conducted by Rafferty (1994) using projectile points and ceramics at sites within the study area, identified sites 22UN536, 22UN537, 22UN540, 22UN569, and 22UN615 as short duration sites. The evidence presented here corresponds with her assessment. Rafferty (1994) also identified sites 22UN545 and 22UN569 as long duration sites. The evidence presented here does not correspond with these assessments. However, the presence of 22UN569 in both the short duration and long duration seriations could point to a need for more information (Rafferty 1994). It is highly probably that this identifies multiple occupations, one potentially long and one potentially short.

In any case, testing for duration using this method does not appear to be successful for identifying relative duration spans at sites collected from plowzones in regularly cultivated fields.

CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

The purpose of this research was to test lithic debitage for variation along the dimensions of space, time, and form using attributes related to use, age and duration at sites with few artifacts and few to no diagnostics. If successful, this thesis could provide evidence of research potential at sites that would not typically have been recommended for future research beyond their initial identification. It was given that variation would be present, as variation exists between any two things that are not exact copies of one another, but it was expected that notable, or significant, variation could be identified.

Three hypotheses were tested for this thesis. The first was that, using paradigmatic classes, debitage could provide information regarding site use at sites where only debitage was identified. The second was that debitage could provide constructive information regarding occupational age, even if diagnostics were are not present. The third was that debitage could indicate relative duration of occupation.

In order to identify variability along the dimensions of space, time, and form, classes related to use, age, and duration were created. Flakes were then analyzed and the data were then treated to Bray-Curtis ordinations using the statistical program PC-ORD. Each hypothesis was tested with lithic scatters, as well as with a combination of lithic scatters and other sites from the study area that did not meet the definition of lithic scatter to see if site use, occupation age, and the duration the site was occupied were similar across different "classes" of sites.

The results suggest that the methods used to test site use and occupation age were relatively successful, but would have been better with larger sample sizes, the inclusion of more lithic scatters, and fewer classes. Combined, these results provide a broader picture for sites that were identified as a result of only a few artifacts.

This research did suggest that platform morphology may not directly reflect site use. In fact, many of the classes that identified a certain stage of reduction rarely contained the corresponding platform morphology. Due to difficulties with analytical consistency, platform morphology can be difficult to regularly incorporate into CRM investigations. This research suggests that previous use of platform morphology within stage reduction assessments could be incorrect or not applicable to debitage analysis outside of experimental results.

This research agrees with Mauldin and Amick's (1989) research showing that flake size is not an accurate reflection of lithic reduction stages. Flake size could be more useful if coupled with a known occupation age, as flakes of all sizes can be found across all occupation ages. Smaller flakes can be found during any reduction stage but are more common in late production stages (Andrefsky 1998; Kalin 1981; Patterson 1990; Raab et al. 1979; Stahle and Dunn 1982). Similarly, larger flakes are often worked into other tools (Magne 1989), resulting in a lack of early-stage flakes. Few definite early-stage flakes were represented within the data collected for this research.

The expectation that the number of flake breaks would represent the duration of a site was not met. It is possible the occupation designations for the sites are incorrect or must be expanded, as more information could be present below the surface. It is also possible that the issues lie with collection methods or that numerous years of plowing does damage the flakes, regardless of previous investigations showing that years of plowing do not destroy cultural patterns (Butler 1987; Carr 2008; Lewarch and O'Brien 1981; Shott 1995). Regardless, the methods used for testing occupation duration were inconclusive and could provide no information to support that debitage breakage patterns could provide information on the duration of an occupation.

Testing for site use and occupation age at lithic scatters produced equivocal results. Using Bray-Curtis ordination with only five lithic scatters resulted in a requirement of two sites to provide the boundaries for each axis. Using five lithic scatters left only one site to ‘bounce’ between the four ends. This led to ambiguous information; however, incorporating assemblages from additional sites could have provided more data that would either further confirm or deny the accuracy of this method for investigating variability among “lithic scatters” or other traditional site “types.”

With the results presented with only five lithic scatters, sites 22UN524 and 22UN615 were pulled within the site use and occupation age ordinations as a result of multiple classes. Also, site 22PO573 was pulled as a result of two classes (n=2). As a result, lithic scatters 22PO573, 22UN524, and 22UN615 would be recommended for further research for their potential to yield important information regarding the region’s prehistory (Criterion D).

Blakemore et al. (2008) showed that sites previously thought to be nothing more than an artifact scatter within a plowzone, when excavated further, resulted in multiple subsurface features and thus no longer fit the lithic scatter label. My research was not meant to identify sites that may contain more information than what could be on the surface, but I expect that if lithic scatters 22PO573, 22UN524, and 22UN615 were investigated further, more would reveal itself below or within the plowzone. If diagnostics or features were discovered at 22PO573, inferences regarding the site's use and occupation age could be made, which could confirm or reject the research within this thesis. If pottery is discovered at 22UN615, a resulting shift from an Early Archaic component to a Late Woodland to Mississippian occupation would occur based on the predominance of Kosciusko Quartzite. Given that no pottery was found on the surface, however, and given placement of the assemblage early in Rafferty's (2004) seriation of projectile points, the association of Kosciusko Quartzite with an Early Archaic occupation seems correct.

As all sites included in this research were identified, collected, and recorded by MSU's field school, rather than with a compliance project, site significance recommendations were not made. At least some of the sites that cluster together during this research should be considered potentially eligible for inclusion in the National Register of Historic Places as they arguably do represent a site "type" that bears investigation.

Based on artifact density CRM offices and firms sometimes recommend debitage scatters for further testing (Meeks et al. 2015; Peacock et al. 2008; Rafferty et al. 2011). Unfortunately, it is difficult to argue the potential of smaller lithic scatters with the SHPO. While it is not feasible to subject each site to further testing, it is important to take a regional assessment of similar site types in order to account for the possibility of special-use sites associated with larger sites in settlement pattern analysis.

In summation, although these methods provide useful information, the influence of sample size within PC-ORD resulted in unclear data with lithic scatters. Overall, these methods potentially can provide more information than typical debitage analysis; however, within a Phase I CRM context, I do not feel the methods used in this research can provide more information than methods currently used in CRM analysis (Ahler 1989; Bradbury and Carr 2004; Mauldin and Amick 1989; Sutton 1995) without changes.

Future Research

All sites tested within this research were identified in plowzones and collected via GSC. As a result, information about these sites was limited to the 4-7% of artifacts on the surface of the plowzone (Ammerman 1985; Lewarch and O'Brien 1981). Lithic scatters 22PO573, 22UN524, and 22UN615 are recommended for further research. Controlled surface collection (CSC) at these sites could provide spatial distribution of occupations to ascertain which, if any, portions of the sites present with concentrations of material that could identify different occupations (e.g., Early, Middle, and Late Archaic occupations at 22UN615). For example, if CSC identified a concentration of Kosciusko Quartzite within a limited area of the site, it would confirm an Early Archaic occupation within that portion of the site. Coupling CSC with systematic shovel testing would provide a sample of potential information below the plowzone.

If excavation is warranted beyond CSC, non-destructive techniques (e.g., magnetometry, ground penetrating radar, LIDAR, etc.) are recommended prior to in-depth subsurface testing. CSC, shovel testing, and geophysical techniques could provide information about potential subsurface features and a potential placement for excavation units.

Once as much information as possible has been retrieved from the site via CSC, shovel testing, geophysical techniques, and excavation units, and the information points towards more potential information, systematic stripping of the plowzone is recommended. The stripping of the plowzone to unearth subsurface features is not unheard of in CRM and has been successful in identifying important features in regional prehistory (Little et al. 2015), but the process will destroy information contained within the plowzone unless its use is delayed until after less destructive methods have been employed.

I am reluctant to perpetuate the misconception that lithic scatters hold little to no research potential beyond their identification. This research only determined that amount of late stage debitage was possibly one cause of variation within the study area and that occupation age could, in some cases, be partly determined based on debitage alone. I can say with some certainty that debitage alone can provide information about a site that may previously have been overlooked. This research does not establish a "cut-off" count for what is or is not a lithic scatter, based on archaeologists' misconceived write-off of such sites, but rather is a push for further research into such site "types".

As this research progressed, it became clear that fewer paradigmatic classes were needed and that, for the ideas discussed above to be fully tested, a more in-depth regional study for portions of the Southeast is needed to provide a better understanding of these site "types". These methods could be bettered by condensing the dimensions of flake length and flake weight. Since flake weight is a more appropriate measure, as "light" flakes could be "long" and "heavy" flakes could be "short", it is recommended that flake length be removed from future paradigms. The dimension pertaining to platform morphology is highly variable and dependant on the observer. During the course of this investigation, this dimension was not applicable and, as a result, is not recommended for incorporation in future research.

Regional studies have begun in the Northeast, United States (e.g., Rieth 2008a), and since lithic tools were used worldwide, similar research could set a standard for archaeological investigations into human lifeways globally. Since the only information we are able to obtain regarding prehistoric peoples comes from the artifacts they left behind, more in depth research into such everyday detritus could potentially change the field.

For the best results, lithic scatters must be identified in fairly undisturbed locations and systematically excavated to obtain the greatest amount of information from the sites as well as to determine site stratigraphy. The amount of information that could be gained from in-depth studies of lithic scatters has yet to be realized.

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APPENDIX A

RAW PC-ORD RESULTS FOR SITE USE

```
********************** Bray-Curtis Ordination: Site Use, Lithic Scatter************************
PC-ORD, 6.08

Use_Bray-Curtis_Lithic Scatter

Ordination of Sites in Classes  space.          5 Sites          36 Classes

The following options were selected:

Distance measure = Sorensen (Bray & Curtis)
Endpoint selection = Original
Projection geometry = City-block
Calculation of residuals = City-block

Output options selected:
  *  Write distance matrix
  *  Write axes 1 through 9
     Write no residual distance matrix

               DISTANCE MATRIX

22PO571
          .000000E+00
22PO573
          .789474E+00   .000000E+00
22PO602
          .818182E+00   .714286E+00   .000000E+00
22UN524
          .724138E+00   .953488E+00   .956522E+00   .000000E+00
22UN615
          .841270E+00   .916667E+00   .882353E+00   .678161E+00    .000000E+00
```

Use_Bray-Curtis_Lithic Scatters

```
Endpoints for axis 1: 22PO573   22UN524
Distances (ordination scores) are from 22PO573
Sum of squares of non-redundant distances in original matrix = .693781E+01
Axis 1 extracted  70.55% of the original distance matrix
Cumulative:  70.55%
Sum of squares of residual distances remaining = .204291E+01

Ordination scores on axis 1
Seq.  Name      Score      Seq.  Name      Score      Seq.  Name      Score
--------------------------------------------------------------------------------
1     22PO571   0.509      2     22PO573   0.000      3     22PO602   0.356
4     22UN524   0.953      5     22UN615   0.596


Endpoints for axis 2: 22UN615   22PO571
Distances (ordination scores) are from 22UN615
Axis 2 extracted  23.83% of the original distance matrix
Cumulative:  94.38%
Sum of squares of residual distances remaining = .389937E+00

Ordination scores on axis 2
Seq.  Name      Score      Seq.  Name      Score      Seq.  Name      Score
--------------------------------------------------------------------------------
1     22PO571   0.755      2     22PO573   0.398      3     22PO602   0.366
4     22UN524   0.398      5     22UN615   0.000


Endpoints for axis 3: 22PO602   22PO573
Distances (ordination scores) are from 22PO602
Axis 3 extracted   5.61% of the original distance matrix
Cumulative:  99.99%
Sum of squares of residual distances remaining = .988784E-03

Ordination scores on axis 3
Seq.  Name      Score      Seq.  Name      Score      Seq.  Name      Score
--------------------------------------------------------------------------------
1     22PO571   0.263      2     22PO573   0.327      3     22PO602   0.000
4     22UN524   0.327      5     22UN615   0.263
```

```
Use_Bray-Curtis_Lithic Scatter

Endpoints for axis 4: 22UN615   22UN524
Distances (ordination scores) are from 22UN615
Axis 4 extracted   0.01% of the original distance matrix
Cumulative: 100.00%
Sum of squares of residual distances remaining = .355271E-14

Ordination scores on axis 4
Seq.  Name       Score      Seq.  Name       Score      Seq.  Name       Score
______________________________________________________________________________
1     22PO571    0.000      2     22PO573    0.013      3     22PO602    0.013
4     22UN524    0.013      5     22UN615    0.000


Endpoints for axis 5: 22PO571   22UN615
Distances (ordination scores) are from 22PO571
Axis 5 extracted   0.00% of the original distance matrix
Cumulative: 100.00%
Sum of squares of residual distances remaining = .000000E+00

Ordination scores on axis 5
Seq.  Name   Score  Seq.  Name   Score  Seq.  Name   Score
______________________________________________________________________________
1     22PO571    0.000      2     22PO573    0.000      3     22PO602    0.000
4     22UN524    0.000      5     22UN615    0.000

All of the possible information has been extracted.
Writing weighted average scores on 9 axes for   36 Classes into file for graphing.


****** Calculations completed. There were 5 Bray-Curtis axes calculated ******
```

```
*********************** Bray-Curtis Ordination: Site Use, All Sites ***************************
PC-ORD, 6.08

Use_Bray-Curtis_All Sites

Ordination of Sites    in Classes  space.        22 Sites     82 Classes

The following options were selected:
          Distance measure = Sorensen (Bray & Curtis)
          Endpoint selection = Original
          Projection geometry = City-block
          Calculation of residuals = City-block

Output options selected:
          Write distance matrix*
          Write axes 1 through 9*
          Write no residual distance matrix

Use_Bray-Curtis_All Sites

DISTANCE MATRIX

22PO571
          .000000E+00
22PO573
          .789474E+00  .000000E+00
22PO581
          .773585E+00  .947368E+00  .000000E+00
22PO602
          .818182E+00  714286E+00   .853659E+00  .000000E+00
22PO650
          .809524E+00  .666667E+00  .850000E+00  .100000E+01  .000000E+00
22UN520
          .793103E+00  .714286E+00  .750000E+00  .882353E+00  .625000E+00  .000000E+00
22UN524
          .724138E+00  .953488E+00  .532468E+00  .956522E+00  .866667E+00  .849057E+00
          .000000E+00
22UN529
          .714286E+00  .333333E+00  .900000E+00  .555556E+00  .750000E+00  .750000E+00
          .911111E+00   .000000E+00
```

```
22UN536
          .826087E+00  .100000E+01  .857143E+00  .818182E+00  .800000E+00  .666667E+00
          .872340E+00  .800000E+00  .000000E+00
22UN537
          .820225E+00  .972973E+00  .611111E+00  .948052E+00  .947368E+00  .833333E+00
          .433628E+00  .921053E+00  .871795E+00  .000000E+00
22UN540
          .755102E+00  .941176E+00  .647059E+00  .891892E+00  .888889E+00  .681818E+00
          .671233E+00  .944444E+00  .789474E+00  .596154E+00  .000000E+00
22UN545
          .720000E+00  .885714E+00  .449275E+00  .894737E+00  .837838E+00  .644444E+00
          .432432E+00  .837838E+00  .743590E+00  .580952E+00  .661538E+00  .000000E+00
22UN547
          .636364E+00  .900000E+00  .486486E+00  .860465E+00  .904762E+00  .720000E+00
          .468354E+00  .857143E+00  .818182E+00  .527273E+00  .628571E+00  .464789E+00
          .000000E+00
22UN548
          .700000E+00  .600000E+00  .846154E+00  .750000E+00  .714286E+00  .866667E+00
          .863636E+00  .428571E+00  .777778E+00  .920000E+00  .885714E+00  .833333E+00
          .853659E+00  .000000E+00
22UN560
          .913043E+00  .100000E+01  .761905E+00  .818182E+00  .100000E+01  .888889E+00
          .829787E+00  .800000E+00  .833333E+00  .871795E+00  .842105E+00  .846154E+00
          .772727E+00  .777778E+00  .000000E+00
22UN568
          .777778E+00  .833333E+00  .739130E+00  .866667E+00  .714286E+00  .636364E+00
          .764706E+00  .714286E+00  .375000E+00  .804878E+00  .666667E+00  .627907E+00
          .750000E+00  .692308E+00  .750000E+00  .000000E+00
22UN569
          .841270E+00  .963964E+00  .696552E+00  .929825E+00  .929204E+00  .851240E+00
          .573333E+00  .946903E+00  .913043E+00  .403315E+00  .730496E+00  .647887E+00
          .659864E+00  .946429E+00  .930435E+00  .848740E+00  .000000E+00
22UN572
          .743590E+00  .916667E+00  .586207E+00  .851852E+00  .923077E+00  .823529E+00
          .650794E+00  .769231E+00  .857143E+00  .680851E+00  .666667E+00  .636364E+00
          .600000E+00  .760000E+00  .785714E+00  .812500E+00  .801527E+00  .000000E+00
22UN581
          .857143E+00  .100000E+01  .744681E+00  .750000E+00  .866667E+00  .826087E+00
          .807692E+00  .866667E+00  .764706E+00  .831325E+00  .813953E+00  .772727E+00
          .795918E+00  .857143E+00  .764706E+00  .619048E+00  .900000E+00  .818182E+00
          .000000E+00
```

```
22UN592
          .600000E+00 .600000E+00 .818182E+00  .692308E+00  .500000E+00 .700000E+00
          .795918E+00  .500000E+00 .714286E+00  .900000E+00 .850000E+00 .707317E+00
          .782609E+00  .454545E+00  .857143E+00  .666667E+00  .863248E+00  .733333E+00
          .894737E+00  .000000E+00
22UN607
          .894737E+00  .500000E+00 .894737E+00  .100000E+01  .666667E+00  .857143E+00
          .953488E+00  .666667E+00  .100000E+01  .972973E+00  .941176E+00  .942857E+00
          .950000E+00  .600000E+00  .100000E+01  .833333E+00  .981982E+00  .916667E+00
          .100000E+01  .800000E+00 .000000E+00
22UN615
          .841270E+00  .916667E+00  .707317E+00  .882353E+00  .840000E+00 .689655E+00
          .678161E+00  .880000E+00 .807692E+00  .745763E+00  .769231E+00  .620253E+00
          .619048E+00  .918367E+00  .884615E+00  .678571E+00  .677419E+00  .735294E+00
          .824561E+00  .777778E+00  .958333E+00  .000000E+00
```

```
Use_Bray-Curtis_All Sites

Endpoints for axis 1: 22UN607 and 22UN581
Distances (ordination scores) are from 22UN607
Sum of squares of non-redundant distances in original matrix = .144743E+03
Axis 1 extracted  37.32% of the original distance matrix
Cumulative:  37.32%
Sum of squares of residual distances remaining = .907274E+02

Ordination scores on axis 1
Seq.  Name      Score       Seq.  Name      Score       Seq.  Name      Score
_____________________________________________________________________________

1     22PO571   0.519       2     22PO573   0.250       3     22PO581   0.575
4     22PO602   0.625       5     22PO650   0.400       6     22UN520   0.516
7     22UN524   0.573       8     22UN529   0.400       9     22UN536   0.618
10    22UN537   0.571       11    22UN540   0.564       12    22UN545   0.585
13    22UN547   0.577       4     22UN548   0.371       15    22UN560   0.618
16    22UN568   0.607       17    22UN569   0.541       18    22UN572   0.549
19    22UN581   1.000       20    22UN592   0.453       21    22UN607   0.000
22    22UN615   0.567
```

Use_Bray-Curtis_All Sites

Endpoints for axis 2: 22UN560 22UN569
Distances (ordination scores) are from 22UN560
Axis 2 extracted 24.64% of the original distance matrix
Cumulative: 61.96%
Sum of squares of residual distances remaining = .550670E+02

Ordination scores on axis 2

Seq.	Name	Score	Seq.	Name	Score	Seq.	Name	Score
1	22PO571	0.424	2	22PO573	0.407	3	22PO581	0.455
4	22PO602	0.409	5	22PO650	0.424	6	22UN520	0.407
7	22UN524	0.549	8	22UN529	0.315	9	22UN536	0.425
10	22UN537	0.653	11	22UN540	0.467	12	22UN545	0.532
13	22UN547	0.481	14	22UN548	0.304	15	22UN560	0.000
16	22UN568	0.405	17	22UN569	0.854	18	22UN572	0.389
19	22UN581	0.398	20	22UN592	0.386	21	22UN607	0.398
22	22UN615	0.518						

Endpoints for axis 3: 22PO602 22UN568
Distances (ordination scores) are from 22PO602
Axis 3 extracted 16.93% of the original distance matrix
Cumulative: 78.88%
Sum of squares of residual distances remaining = .305635E+02

Ordination scores on axis 3

Seq.	Name	Score	Seq.	Name	Score	Seq.	Name	Score
1	22PO571	0.436	2	22PO573	0.353	3	22PO581	0.473
4	22PO602	0.000	5	22PO650	0.558	6	22UN520	0.536
7	22UN524	0.511	8	22UN529	0.332	9	22UN536	0.648
10	22UN537	0.487	11	22UN540	0.528	12	22UN545	0.549
13	22UN547	0.471	14	22UN548	0.440	15	22UN560	0.456
16	22UN568	0.845	17	22UN569	0.456	18	22UN572	0.431
19	22UN581	0.495	20	22UN592	0.424	21	22UN607	0.495
22	22UN615	0.517						

Use_Bray-Curtis_All Sites

Endpoints for axis 4: 22PO571   22UN572
Distances (ordination scores) are from 22PO571
Axis 4 extracted   9.37% of the original distance matrix
Cumulative: 88.26%
Sum of squares of residual distances remaining = .169986E+02

Ordination scores on axis 4

Seq.	Name	Score	Seq.	Name	Score	Seq.	Name	Score
1	22PO571	0.000	2	22PO573	0.286	3	22PO581	0.435
4	22PO602	0.305	5	22PO650	0.315	6	22UN520	0.340
7	22UN524	0.378	8	22UN529	0.304	9	22UN536	0.326
10	22UN537	0.411	11	22UN540	0.386	12	22UN545	0.383
13	22UN547	0.360	14	22UN548	0.306	15	22UN560	0.369
16	22UN568	0.305	17	22UN569	0.369	18	22UN572	0.673
19	22UN581	0.334	20	22UN592	0.265	21	22UN607	0.334
22	22UN615	0.394						

Endpoints for axis 5: 22UN540   22UN615
Distances (ordination scores) are from 22UN540
Axis 5 extracted   5.62% of the original distance matrix
Cumulative: 93.88%
Sum of squares of residual distances remaining = .886452E+01

Ordination scores on axis 5

Seq.	Name	Score	Seq.	Name	Score	Seq.	Name	Score
1	22PO571	0.331	2	22PO573	0.386	3	22PO581	0.332
4	22PO602	0.375	5	22PO650	0.409	6	22UN520	0.381
7	22UN524	0.316	8	22UN529	0.406	9	22UN536	0.372
10	22UN537	0.236	11	22UN540	0.000	12	22UN545	0.351
13	22UN547	0.361	14	22UN548	0.358	15	22UN560	0.349
16	22UN568	0.375	17	22UN569	0.349	18	22UN572	0.331
19	22UN581	0.365	20	22UN592	0.410	21	22UN607	0.365
22	22UN615	0.695						

```
Use_Bray-Curtis_All Sites

Endpoints for axis 6: 22UN520   22UN524
Distances (ordination scores) are from 22UN520
Axis 6 extracted   3.45% of the original distance matrix
Cumulative:  97.32%
Sum of squares of residual distances remaining = .387635E+01

Ordination scores on axis 6
Seq.  Name      Score      Seq.  Name      Score      Seq.  Name      Score
___________________________________________________________________________
1     22PO571   0.364      2     22PO573   0.280      3     22PO581   0.315
4     22PO602   0.298      5     22PO650   0.287      6     22UN520   0.000
7     22UN524   0.522      8     22UN529   0.319      9     22UN536   0.238
10    22UN537   0.300      11    22UN540   0.211      12    22UN545   0.280
13    22UN547   0.355      14    22UN548   0.378      15    22UN560   0.310
16    22UN568   0.298      17    22UN569   0.310      18    22UN572   0.364
19    22UN581   0.336      20    22UN592   0.351      21    22UN607   0.336
22    22UN615   0.211


Endpoints for axis 7: 22UN547   22PO650
Distances (ordination scores) are from 22UN547
Axis 7 extracted   1.55% of the original distance matrix
Cumulative:  98.88%
Sum of squares of residual distances remaining = .162709E+01

Ordination scores on axis 7
Seq.  Name      Score      Seq.  Name      Score      Seq.  Name      Score
___________________________________________________________________________
1     22PO571   0.206      2     22PO573   0.197      3     22PO581   0.201
4     22PO602   0.209      5     22PO650   0.423      6     22UN520   0.208
7     22UN524   0.208      8     22UN529   0.146      9     22UN536   0.206
10    22UN537   0.164      11    22UN540   0.170      12    22UN545   0.120
13    22UN547   0.000      14    22UN548   0.243      15    22UN560   0.237
16    22UN568   0.209      17    22UN569   0.237      18    22UN572   0.206
19    22UN581   0.287      20    22UN592   0.316      21    22UN607   0.287
22    22UN615   0.170
```

```
Use_Bray-Curtis_All Sites

Endpoints for axis 8: 22PO581   22UN536
Distances (ordination scores) are from 22PO581
Axis 8 extracted   0.51% of the original distance matrix
Cumulative:  99.39%
Sum of squares of residual distances remaining = .882339E+00

Ordination scores on axis 8
Seq.  Name      Score       Seq.  Name      Score      Seq.  Name      Score
_________________________________________________________________________________

1     22PO571   0.259       2     22PO573   0.187      3     22PO581   0.000
4     22PO602   0.202       5     22PO650   0.156      6     22UN520   0.159
7     22UN524   0.159       8     22UN529   0.259      9     22UN536   0.378
10    22UN537   0.244       11    22UN540   0.175      12    22UN545   0.089
13    22UN547   0.156       14    22UN548   0.285      15    22UN560   0.228
16    22UN568   0.202       17    22UN569   0.228      18    22UN572   0.259
19    22UN581   0.186       20    22UN592   0.260      21    22UN607   0.186
22    22UN6150.175


Endpoints for axis 9: 22PO581   22UN607
Distances (ordination scores) are from 22PO581
Axis 9 extracted   0.33% of the original distance matrix
Cumulative:  99.72%
Sum of squares of residual distances remaining = .404581E+00

Ordination scores on axis 9
Seq.  Name      Score       Seq   Name      Score      Seq.  Name      Score
____________________________________________________________________________________

1       22PO571  0.137     2     22PO573  0.073     3      22PO581    0.000
4       22PO602  0.147     5     22PO650  0.095     6      22UN520    0.108
7       22UN524  0.108     8     22UN529  0.106     9      22UN536    0.000
10      22UN537  0.086     11    22UN540  0.110     12     22UN545    0.087
13      22UN547  0.095     14    22UN548  0.106     15     22UN560    0.138
16      22UN568  0.147     17    22UN569  0.138     18     22UN572    0.137
19      22UN581  0.185     20    22UN592  0.117     21     22UN607    0.185
22      22UN615  0.110

Writing weighted average scores on 9 axes for    82 Classes    into file for graphing.
****** Calculations completed. There were 9 Bray-Curtis axes calculated ******
```

```
****************** Hierarchical Cluster Analysis: Site Use, Lithic Scatter**********************
PC-ORD, 6.08


Linkage method:   NEAREST NEIGHBOR
Distance measure:  Sorensen (Bray-Curtis)
Total sum of squares:    248.8000
Distance Squard


22PO571
        0.000E+00    6.233E-01    6.694E-01    5.244E-01    7.077E-01
22PO573
        6.233E-01    0.000E+00    5.102E-01    9.091E-01    8.403E-01
22PO602
        6.694E-01    5.102E-01    0.000E+00    9.149E-01    7.785E-01
22UN524
        5.244E-01    9.091E-01    9.149E-01    0.000E+00    4.599E-01
22UN615
        7.077E-01    8.403E-01    7.785E-01    4.599E-01    0.000E+00

Cluster cycle
      1 Combined group       5 into group       4 at level 2.2995E-01
      2 Combined group       3 into group       2 at level 4.8505E-01
      3 Combined group       4 into group       1 at level 7.4724E-01
      4 Combined group       2 into group       1 at level 1.0589E+00

Percent chaining =   0.00

************************ Cluster analysis completed ************************
```

```
****************** Hierarchical Cluster Analysis: Site Use, All Sites ***********************
PC-ORD, 6.08


Use_Cluster_All Sites

Linkage method:    NEAREST NEIGHBOR
Distance measure:  Sorensen (Bray-Curtis)
Total sum of squares:     1683.136
Distance Squared

22PO571
        0.000E+00    6.233E-01    5.984E-01    6.694E-01    6.553E-01    6.290E-01
        5.244E-01    5.102E-01    6.824E-01    6.728E-01    5.702E-01    5.184E-01
        4.050E-01    4.900E-01    8.336E-01    6.049E-01    7.077E-01    5.529E-01
        7.347E-01    3.600E-01    8.006E-01    7.077E-01
22PO573
        6.233E-01    0.000E+00    8.975E-01    5.102E-01    4.444E-01    5.102E-01
        9.091E-01    1.111E-01    1.000E+00    9.467E-01    8.858E-01    7.845E-01
        8.100E-01    3.600E-01    1.000E+00    6.944E-01    9.292E-01    8.403E-01
        1.000E+00    3.600E-01    2.500E-01    8.403E-01
22PO581
        5.984E-01    8.975E-01    0.000E+00    7.287E-01    7.225E-01    5.625E-01
        2.835E-01    8.100E-01    7.347E-01    3.735E-01    4.187E-01    2.018E-01
        2.367E-01    7.160E-01    5.805E-01    5.463E-01    4.852E-01    3.436E-01
        5.545E-01    6.694E-01    8.006E-01    5.003E-01
22PO602
        6.694E-01    5.102E-01    7.287E-01    0.000E+00    1.000E+00    7.785E-01
        9.149E-01    3.086E-01    6.694E-01    8.988E-01    7.955E-01    8.006E-01
        7.404E-01    5.625E-01    6.694E-01    7.511E-01    8.646E-01    7.257E-01
        5.625E-01    4.793E-01    1.000E+00    7.785E-01
22PO650
        6.553E-01    4.444E-01    7.225E-01    1.000E+00    0.000E+00    3.906E-01
        7.511E-01    5.625E-01    6.400E-01    8.975E-01    7.901E-01    7.020E-01
        8.186E-01    5.102E-01    1.000E+00    5.102E-01    8.634E-01    8.521E-01
        7.511E-01    2.500E-01    4.444E-01    7.056E-01
22UN520
        6.290E-01    5.102E-01    5.625E-01    7.785E-01    3.906E-01    0.000E+00
        7.209E-01    5.625E-01    4.444E-01    6.944E-01    4.649E-01    4.153E-01
        5.184E-01    7.511E-01    7.901E-01    4.050E-01    7.246E-01    6.782E-01
        6.824E-01    4.900E-01    7.347E-01    4.756E-01
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22UN524
          5.244E-01    9.091E-01    2.835E-01    9.149E-01    7.511E-01    7.209E-01
          0.000E+00    8.301E-01    7.610E-01    1.880E-01    4.506E-01    1.870E-01
          2.194E-01    7.459E-01    6.885E-01    5.848E-01    3.287E-01    4.235E-01
          6.524E-01    6.335E-01    9.091E-01    4.599E-01
22UN529
          5.102E-01    1.111E-01    8.100E-01    3.086E-01    5.625E-01    5.625E-01
          8.301E-01    0.000E+00    6.400E-01    8.483E-01    8.920E-01    7.020E-01
          7.347E-01    1.837E-01    6.400E-01    5.102E-01    8.966E-01    5.917E-01
          7.511E-01    2.500E-01    4.444E-01    7.744E-01
22UN536
          6.824E-01    1.000E+00    7.347E-01    6.694E-01    6.400E-01    4.444E-01
          7.610E-01    6.400E-01    0.000E+00    7.600E-01    6.233E-01    5.529E-01
          6.694E-01    6.049E-01    6.944E-01    1.406E-01    8.336E-01    7.347E-01
          5.848E-01    5.102E-01    1.000E+00    6.524E-01
22UN537
          6.728E-01    9.467E-01    3.735E-01    8.988E-01    8.975E-01    6.944E-01
          1.880E-01    8.483E-01    7.600E-01    0.000E+00    3.554E-01    3.375E-01
          2.780E-01    8.464E-01    7.600E-01    6.478E-01    1.627E-01    4.636E-01
          6.911E-01    8.100E-01    9.467E-01    5.562E-01
22UN540
          5.702E-01    8.858E-01    4.187E-01    7.955E-01    7.901E-01    4.649E-01
          4.506E-01    8.920E-01    6.233E-01    3.554E-01    0.000E+00    4.376E-01
          3.951E-01    7.845E-01    7.091E-01    4.444E-01    5.336E-01    4.444E-01
          6.625E-01    7.225E-01    8.858E-01    5.917E-01
22UN545
          5.184E-01    7.845E-01    2.018E-01    8.006E-01    7.020E-01    4.153E-01
          1.870E-01    7.020E-01    5.529E-01    3.375E-01    4.376E-01    0.000E+00
          2.160E-01    6.944E-01    7.160E-01    3.943E-01    4.198E-01    4.050E-01
          5.971E-01    5.003E-01    8.890E-01    3.847E-01
22UN547
          4.050E-01    8.100E-01    2.367E-01    7.404E-01    8.186E-01    5.184E-01
          2.194E-01    7.347E-01    6.694E-01    2.780E-01    3.951E-01    2.160E-01
          0.000E+00    7.287E-01    5.971E-01    5.625E-01    4.354E-01    3.600E-01
          6.335E-01    6.125E-01    9.025E-01    3.832E-01
22UN548
          4.900E-01    3.600E-01    7.160E-01    5.625E-01    5.102E-01    7.511E-01
          7.459E-01    1.837E-01    6.049E-01    8.464E-01    7.845E-01    6.944E-01
          7.287E-01    0.000E+00    6.049E-01    4.793E-01    8.957E-01    5.776E-01
          7.347E-01    2.066E-01    3.600E-01    8.434E-01
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22UN560
          8.336E-01   1.000E+00   5.805E-01   6.694E-01   1.000E+00   7.901E-01
          6.885E-01   6.400E-01   6.944E-01   7.600E-01   7.091E-01   7.160E-01
          5.971E-01   6.049E-01   0.000E+00   5.625E-01   8.657E-01   6.173E-01
          5.848E-01   7.347E-01   1.000E+00   7.825E-01
22UN568
          6.049E-01   6.944E-01   5.463E-01   7.511E-01   5.102E-01   4.050E-01
          5.848E-01   5.102E-01   1.406E-01   6.478E-01   4.444E-01   3.943E-01
          5.625E-01   4.793E-01   5.625E-01   0.000E+00   7.204E-01   6.602E-01
          3.832E-01   4.444E-01   6.944E-01   4.605E-01
22UN569
          7.077E-01   9.292E-01   4.852E-01   8.646E-01   8.634E-01   7.246E-01
          3.287E-01   8.966E-01   8.336E-01   1.627E-01   5.336E-01   4.198E-01
          4.354E-01   8.957E-01   8.657E-01   7.204E-01   0.000E+00   6.424E-01
          8.100E-01   7.452E-01   9.643E-01   4.589E-01
22UN572
          5.529E-01   8.403E-01   3.436E-01   7.257E-01   8.521E-01   6.782E-01
          4.235E-01   5.917E-01   7.347E-01   4.636E-01   4.444E-01   4.050E-01
          3.600E-01   5.776E-01   6.173E-01   6.602E-01   6.424E-01   0.000E+00
          6.694E-01   5.378E-01   8.403E-01   5.407E-01
22UN581
          7.347E-01   1.000E+00   5.545E-01   5.625E-01   7.511E-01   6.824E-01
          6.524E-01   7.511E-01   5.848E-01   6.911E-01   6.625E-01   5.971E-01
          6.335E-01   7.347E-01   5.848E-01   3.832E-01   8.100E-01   6.694E-01
          0.000E+00   8.006E-01   1.000E+00   6.799E-01
22UN592
          3.600E-01   3.600E-01   6.694E-01   4.793E-01   2.500E-01   4.900E-01
          6.335E-01   2.500E-01   5.102E-01   8.100E-01   7.225E-01   5.003E-01
          6.125E-01   2.066E-01   7.347E-01   4.444E-01   7.452E-01   5.378E-01
          8.006E-01   0.000E+00   6.400E-01   6.049E-01
22UN607
          8.006E-01   2.500E-01   8.006E-01   1.000E+00   4.444E-01   7.347E-01
          9.091E-01   4.444E-01   1.000E+00   9.467E-01   8.858E-01   8.890E-01
          9.025E-01   3.600E-01   1.000E+00   6.944E-01   9.643E-01   8.403E-01
          1.000E+00   6.400E-01   0.000E+00   9.184E-01
22UN615
          7.077E-01   8.403E-01   5.003E-01   7.785E-01   7.056E-01   4.756E-01
          4.599E-01   7.744E-01   6.524E-01   5.562E-01   5.917E-01   3.847E-01
          3.832E-01   8.434E-01   7.825E-01   4.605E-01   4.589E-01   5.407E-01
          6.799E-01   6.049E-01   9.184E-01   0.000E+00
```

```
Cluster cycle
          1 Combined group     8 into group    2 at level 5.5556E-02
          2 Combined group     16 into group   9 at level 1.2587E-01
          3 Combined group     17 into group   10 at level 2.0720E-01
          4 Combined group     14 into group   2 at level 2.9904E-01
          5 Combined group     12 into group   7 at level 3.9254E-01
          6 Combined group     10 into group   7 at level 4.8655E-01
          7 Combined group     7 into group    3 at level 5.8748E-01
          8 Combined group     20 into group   2 at level 6.9078E-01
          9 Combined group     13 into group   3 at level 7.9880E-01
          10 Combined group    5 into group    2 at level 9.2380E-01
          11 Combined group    21 into group   2 at level 1.0488E+00
          12 Combined group    4 into group    2 at level 1.2031E+00
          13 Combined group    18 into group   3 at level 1.3749E+00
          14 Combined group    11 into group   3 at level 1.5526E+00
          15 Combined group    2 into group    1 at level 1.7326E+00
          16 Combined group    19 into group   9 at level 1.9242E+00
          17 Combined group    22 into group   3 at level 2.1159E+00
          18 Combined group    6 into group    1 at level 2.3112E+00
          19 Combined group    9 into group    3 at level 2.5083E+00
          20 Combined group    3 into group    1 at level 2.7108E+00
          21 Combined group    15 into group   1 at level 2.9920E+00


Percent chaining =  30.92


************************* Cluster analysis completed *************************
```

APPENDIX B

RAW PC-ORD RESULTS FOR OCCUPATION AGE

```
***************** Bray-Curtis Ordination: Occupation Age, Lithic Scatter **********************
PC-ORD, 6.08

Ordination of Sites in Classes  space.       5 Sites       34 Classes

The following options were selected:
Distance measure = Sorensen (Bray & Curtis)
Endpoint selection = Original
Projection geometry = City-block
Calculation of residuals = City-block

Output options selected:
 *  Write distance matrix
 *  Write axes 1 through 9
    Write no residual distance matrix

                DISTANCE MATRIX

22PO571
           .000000E+00
22PO573
           .789474E+00  .000000E+00
22PO602
           .818182E+00  .100000E+01  .000000E+00
22UN524
           .620690E+00  .953488E+00  .869565E+00  .000000E+00
22UN615
           .746032E+00  .958333E+00  .960784E+00  .816092E+00  .000000E+00
```

```
Endpoints for axis 1: 22PO573   22PO602
Distances (ordination scores) are from 22PO573
Sum of squares of non-redundant distances in original matrix = .740731E+01
Axis 1 extracted  67.62% of the original distance matrix
Cumulative:  67.62%
Sum of squares of residual distances remaining = .239877E+01

Ordination scores on axis 1
Seq.  Name      Score     Seq.  Name      Score     Seq.  Name      Score
_________________________________________________________________________

1     22PO571   0.486     2     22PO573   0.000     3     22PO602   1.000
4     22UN524   0.542     5     22UN615   0.499


Endpoints for axis 2: 22UN615   22UN524
Distances (ordination scores) are from 22UN615
Axis 2 extracted  28.80% of the original distance matrix
Cumulative:  96.41%
Sum of squares of residual distances remaining = .265784E+00

Ordination scores on axis 2
Seq.  Name      Score     Seq.  Name      Score     Seq.  Name      Score
_________________________________________________________________________

1     22PO571   0.471     2     22PO573   0.410     3     22PO602   0.410
4     22UN524   0.773     5     22UN615   0.000


Endpoints for axis 3: 22PO571   22UN615
Distances (ordination scores) are from 22PO571
Axis 3 extracted   3.57% of the original distance matrix
Cumulative:  99.98%
Sum of squares of residual distances remaining = .139385E-02

Ordination scores on axis 3
Seq.  Name      Score     Seq.  Name      Score     Seq.  Name      Score
_________________________________________________________________________

1     22PO571   0.000     2     22PO573   0.228     3     22PO602   0.228
4     22UN524   0.262     5     22UN615   0.262
```

```
Endpoints for axis 4: 22PO573   22UN615
Distances (ordination scores) are from 22PO573
Axis 4 extracted   0.02% of the original distance matrix
Cumulative: 100.00%
Sum of squares of residual distances remaining = .621725E-14

Ordination scores on axis 4
Seq.  Name      Score     Seq.  Name      Score     Seq.  Name      Score
__________________________________________________________________________
1     22PO571   0.015     2     22PO573   0.000     3     22PO602   0.000
4     22UN524   0.015     5     22UN615   0.015


Endpoints for axis 5: 22PO602   22UN524
Distances (ordination scores) are from 22PO602
Axis 5 extracted   0.00% of the original distance matrix
Cumulative: 100.00%
Sum of squares of residual distances remaining = .355271E-14

Ordination scores on axis 5
Seq.  Name      Score     Seq.  Name      Score     Seq.  Name      Score
__________________________________________________________________________
1     22PO571   0.000     2     22PO573   0.000     3     22PO602   0.000
4     22UN524   0.000     5     22UN615   0.000


Endpoints for axis 6: 22PO573   22UN524
Distances (ordination scores) are from 22PO573
Axis 6 extracted   0.00% of the original distance matrix
Cumulative: 100.00%
Sum of squares of residual distances remaining = .888178E-15

Ordination scores on axis 6
Seq.  Name      Score     Seq.  Name      Score     Seq.  Name      Score
__________________________________________________________________________
1     22PO571   0.000     2     22PO573   0.000     3     22PO602   0.000
4     22UN524   0.000     5     22UN615   0.000
```

```
Endpoints for axis 7: 22PO571   22UN615
Distances (ordination scores) are from 22PO571
Axis 7 extracted   0.00% of the original distance matrix
Cumulative: 100.00%
Sum of squares of residual distances remaining = .000000E+00

Ordination scores on axis 7
Seq.  Name      Score     Seq.  Name      Score     Seq.  Name      Score
__________________________________________________________________________
1     22PO571   0.000     2     22PO573   0.000     3     22PO602   0.000
4     22UN524   0.000     5     22UN615   0.000

All of the possible information has been extracted.
Writing weighted average scores on 9 axes for   34 Classes into file for graphing.


****** Calculations completed. There were 7 Bray-Curtis axes calculated ******
```

```
***************** Bray-Curtis Ordination: Occupation Age, All Sites ****************************
PC-ORD, 6.08


Ordination of Sites in Classes  space.       22 Sites       42 Classes

The following options were selected:
Distance measure = Sorensen (Bray & Curtis)
Endpoint selection = Original
Projection geometry = City-block
Calculation of residuals = City-block

Output options selected:
 *  Write distance matrix
 *  Write axes 1 through 9
    Write no residual distance matrix

             DISTANCE MATRIX

22PO571
         .000000E+00
22PO573
         .789474E+00  .000000E+00
22PO581
         .584906E+00  .947368E+00  .000000E+00
22PO602
         .818182E+00  .100000E+01  .902439E+00  .000000E+00
22PO650
         .809524E+00  .100000E+01  .100000E+01  .100000E+01  .000000E+00
22UN520
         .448276E+00  .714286E+00  .750000E+00  .764706E+00  .100000E+01  .000000E+00
22UN524
         .620690E+00  .953488E+00  .480519E+00  .869565E+00  .955556E+00  .698113E+00
         .000000E+00
22UN529
         .714286E+00  .666667E+00  .900000E+00  .555556E+00  .100000E+01  .500000E+00
         .911111E+00  .000000E+00
22UN536
         .652174E+00  .100000E+01  .809524E+00  .818182E+00  .100000E+01  .555556E+00
         .787234E+00  .800000E+00  .000000E+00
```

```
22UN537
        .707865E+00  .972973E+00  .462963E+00  .896104E+00  .973684E+00  .785714E+00
        .469027E+00  .921053E+00  .871795E+00  .000000E+00
22UN540
        .673469E+00  .941176E+00  .558824E+00  .729730E+00  .944444E+00  .636364E+00
        .315068E+00  .833333E+00  .736842E+00  .519231E+00  .000000E+00
22UN545
        .560000E+00  .942857E+00  .652174E+00  .789474E+00  .891892E+00  .600000E+00
        .378378E+00  .837838E+00  .692308E+00  .580952E+00  .446154E+00  .000000E+00
22UN547
        .563636E+00  .950000E+00  .459459E+00  .813953E+00  .952381E+00  .600000E+00
        .265823E+00  .809524E+00  .772727E+00  .454545E+00  .371429E+00  .352113E+00
        .000000E+00
22UN548
        .800000E+00  .600000E+00  .897436E+00  .750000E+00  .100000E+01  .733333E+00
        .863636E+00  .714286E+00  .100000E+01  .920000E+00  .885714E+00  .833333E+00
        .853659E+00  .000000E+00
22UN560
        .739130E+00  .750000E+00  .809524E+00  .636364E+00  .100000E+01  .666667E+00
        .829787E+00  .600000E+00  .833333E+00  .897436E+00  .789474E+00  .794872E+00
        .818182E+00  .555556E+00  .000000E+00
22UN568
        .703704E+00  .833333E+00  .826087E+00  .733333E+00  .857143E+00  .636364E+00
        .686275E+00  .857143E+00  .500000E+00  .804878E+00  .523810E+00  .581395E+00
        .708333E+00  .692308E+00  .750000E+00  .000000E+00
22UN569
        .777778E+00  .963964E+00  .558621E+00  .912281E+00  .964602E+00  .818182E+00
        .506667E+00  .929204E+00  .913043E+00  .436464E+00  .560284E+00  .619718E+00
        .510204E+00  .946429E+00  .895652E+00  .831933E+00  .000000E+00
22UN572
        .589744E+00  .916667E+00  .689655E+00  .703704E+00  .846154E+00  .588235E+00
        .460317E+00  .769231E+00  .785714E+00  .617021E+00  .518519E+00  .345455E+00
        .400000E+00  .760000E+00  .714286E+00  .562500E+00  .679389E+00  .000000E+00
22UN581
        .571429E+00  .846154E+00  .744681E+00  .750000E+00  .733333E+00  .652174E+00
        .730769E+00  .733333E+00  .764706E+00  .831325E+00  .627907E+00  .636364E+00
        .714286E+00  .714286E+00  .411765E+00  .619048E+00  .850000E+00  .575758E+00
        .000000E+00
```

```
22UN592
        .760000E+00  .800000E+00 .909091E+00  .538462E+00  .833333E+00  .600000E+00
        .795918E+00  .500000E+00 .714286E+00  .875000E+00  .650000E+00  .707317E+00
        .782609E+00  .818182E+00  .714286E+00  .555556E+00  .880342E+00  .600000E+00
        .684211E+00  .000000E+00
22UN607
        .789474E+00  .500000E+00  .894737E+00  .714286E+00 .100000E+01   .714286E+00
        .906977E+00  .333333E+00  .750000E+00  .945946E+00  .882353E+00  .885714E+00
        .900000E+00  .600000E+00  .500000E+00  .833333E+00  .963964E+00  .833333E+00
        .692308E+00  .600000E+00  .000000E+00
22UN615
        .746032E+00  .958333E+00  .829268E+00  .960784E+00  .920000E+00  .827586E+00
        .816092E+00  .920000E+00  .846154E+00  .830508E+00  .897436E+00  .746835E+00
        .833333E+00  .918367E+00  .884615E+00  .892857E+00  .870968E+00  .823529E+00
        .824561E+00  .925926E+00  .916667E+00  .000000E+00


Endpoints for axis 1: 22PO650   22UN607
Distances (ordination scores) are from 22PO650
Sum of squares of non-redundant distances in original matrix = .135135E+03
Axis 1 extracted  40.31% of the original distance matrix
Cumulative:  40.31%
Sum of squares of residual distances remaining = .806660E+02

Ordination scores on axis 1
Seq.  Name      Score     Seq.  Name      Score     Seq.  Name      Score
____________________________________________________________________________

1     22PO571   0.510     2     22PO573   0.750     3     22PO581   0.553
4     22PO602   0.643     5     22PO650   0.000     6     22UN520   0.643
7     22UN524   0.524     8     22UN529   0.833     9     22UN536   0.625
10    22UN537   0.514     11    22UN540   0.531     12    22UN545   0.503
13    22UN547   0.526     14    22UN548   0.700     15    22UN560   0.750
16    22UN568   0.512     17    22UN569   0.500     18    22UN572   0.506
19    22UN581   0.521     20    22UN592   0.617     21    22UN607   1.000
22    22UN615   0.502
```

Endpoints for axis 2: 22UN615 22UN568
Distances (ordination scores) are from 22UN615
Axis 2 extracted 21.55% of the original distance matrix
Cumulative: 61.85%
Sum of squares of residual distances remaining = .515493E+02

Ordination scores on axis 2

Seq.	Name	Score	Seq.	Name	Score	Seq.	Name	Score
1	22PO571	0.459	2	22PO573	0.499	3	22PO581	0.438
4	22PO602	0.550	5	22PO650	0.478	6	22UN520	0.532
7	22UN524	0.501	8	22UN529	0.468	9	22UN536	0.609
10	22UN537	0.449	11	22UN540	0.623	12	22UN545	0.528
13	22UN547	0.499	14	22UN548	0.549	15	22UN560	0.503
16	22UN568	0.883	17	22UN569	0.466	18	22UN572	0.572
19	22UN581	0.539	20	22UN592	0.621	21	22UN607	0.478
22	22UN615	0.000						

Endpoints for axis 3: 22PO573 22PO602
Distances (ordination scores) are from 22PO573
Axis 3 extracted 15.53% of the original distance matrix
Cumulative: 77.38%
Sum of squares of residual distances remaining = .305631E+02

Ordination scores on axis 3

Seq.	Name	Score	Seq.	Name	Score	Seq.	Name	Score
1	22PO571	0.379	2	22PO573	0.000	3	22PO581	0.415
4	22PO602	0.842	5	22PO650	0.393	6	22UN520	0.335
7	22UN524	0.432	8	22UN529	0.556	9	22UN536	0.433
10	22UN537	0.431	11	22UN540	0.447	12	22UN545	0.441
13	22UN547	0.461	14	22UN548	0.324	15	22UN560	0.552
16	22UN568	0.392	17	22UN569	0.419	18	22UN572	0.448
19	22UN581	0.401	20	22UN592	0.472	21	22UN607	0.393
22	22UN615	0.392						

Endpoints for axis 4: 22UN569 22UN581
Distances (ordination scores) are from 22UN569
Axis 4 extracted 13.96% of the original distance matrix
Cumulative: 91.35%
Sum of squares of residual distances remaining = .116922E+02

Ordination scores on axis 4

Seq.	Name	Score	Seq.	Name	Score	Seq.	Name	Score
1	22PO571	0.500	2	22PO573	0.413	3	22PO581	0.308
4	22PO602	0.413	5	22PO650	0.511	6	22UN520	0.404
7	22UN524	0.258	8	22UN529	0.501	9	22UN536	0.406
10	22UN537	0.214	11	22UN540	0.298	12	22UN545	0.352
13	22UN547	0.270	14	22UN548	0.430	15	22UN560	0.605
16	22UN568	0.429	17	22UN569	0.000	18	22UN572	0.398
19	22UN581	0.739	20	22UN592	0.430	21	22UN607	0.511
22	22UN615	0.429						

Endpoints for axis 5: 22UN536 22UN548
Distances (ordination scores) are from 22UN536
Axis 5 extracted 5.04% of the original distance matrix
Cumulative: 96.39%
Sum of squares of residual distances remaining = .488198E+01

Ordination scores on axis 5

Seq.	Name	Score	Seq.	Name	Score	Seq.	Name	Score
1	22PO571	0.288	2	22PO573	0.450	3	22PO581	0.379
4	22PO602	0.450	5	22PO650	0.376	6	22UN520	0.235
7	22UN524	0.402	8	22UN529	0.384	9	22UN536	0.000
10	22UN537	0.415	11	22UN540	0.426	12	22UN545	0.369
13	22UN547	0.399	14	22UN548	0.733	15	22UN560	0.480
16	22UN568	0.340	17	22UN569	0.409	18	22UN572	0.476
19	22UN581	0.409	20	22UN592	0.424	21	22UN607	0.376
22	22UN615	0.340						

Endpoints for axis 6: 22PO581 22UN592

Distances (ordination scores) are from 22PO581

Axis 6 extracted 2.14% of the original distance matrix

Cumulative: 98.53%

Sum of squares of residual distances remaining = .198591E+01

Ordination scores on axis 6

Seq.	Name	Score	Seq.	Name	Score	Seq.	Name	Score
1	22PO571	0.224	2	22PO573	0.253	3	22PO581	0.000
4	22PO602	0.253	5	22PO650	0.296	6	22UN520	0.276
7	22UN524	0.194	8	22UN529	0.337	9	22UN536	0.152
10	22UN537	0.186	11	22UN540	0.148	12	22UN545	0.268
13	22UN547	0.166	14	22UN548	0.152	15	22UN560	0.148
16	22UN568	0.286	17	22UN569	0.232	18	22UN572	0.197
19	22UN581	0.232	20	22UN592	0.438	21	22UN607	0.296
22	22UN615	0.286						

Endpoints for axis 7: 22UN537 22UN524

Distances (ordination scores) are from 22UN537

Axis 7 extracted 0.49% of the original distance matrix

Cumulative: 99.02%

Sum of squares of residual distances remaining = .132568E+01

Ordination scores on axis 7

Seq.	Name	Score	Seq.	Name	Score	Seq.	Name	Score
1	22PO571	0.203	2	22PO573	0.179	3	22PO581	0.159
4	22PO602	0.179	5	22PO650	0.191	6	22UN520	0.151
7	22UN524	0.341	8	22UN529	0.155	9	22UN536	0.177
10	22UN537	0.000	11	22UN540	0.229	12	22UN545	0.218
13	22UN547	0.211	14	22UN548	0.177	15	22UN560	0.168
16	22UN568	0.164	17	22UN569	0.169	18	22UN572	0.208
19	22UN581	0.169	20	22UN592	0.159	21	22UN607	0.191
22	22UN615	0.164						

```
Endpoints for axis 8: 22UN524   22UN560
Distances (ordination scores) are from 22UN524
Axis 8 extracted   0.58% of the original distance matrix
Cumulative:  99.60%
Sum of squares of residual distances remaining = .536851E+00

Ordination scores on axis 8
Seq.  Name      Score      Seq.  Name      Score     Seq.  Name      Score
________________________________________________________________________________

1     22PO571   0.075      2     22PO573   0.114     3     22PO581   0.056
4     22PO602   0.114      5     22PO650   0.125     6     22UN520   0.141
7     22UN524   0.000      8     22UN529   0.115     9     22UN536   0.064
10    22UN537   0.000      11    22UN540   0.082     12    22UN545   0.071
13    22UN547   0.100      14    22UN548   0.064     15    22UN560   0.161
16    22UN568   0.070      17    22UN569   0.090     18    22UN572   0.082
19    22UN581   0.090      20    22UN592   0.056     21    22UN607   0.125
22    22UN615   0.070


Endpoints for axis 9: 22UN548   22UN568
Distances (ordination scores) are from 22UN548
Axis 9 extracted   0.22% of the original distance matrix
Cumulative:  99.82%
Sum of squares of residual distances remaining = .236743E+00

Ordination scores on axis 9
Seq.  Name      Score      Seq.  Name      Score     Seq.  Name      Score
______________________________________________________________________________

1     22PO571   0.054      2     22PO573   0.064     3     22PO581   0.041
4     22PO602   0.064      5     22PO650   0.083     6     22UN520   0.064
7     22UN524   0.095      8     22UN529   0.080     9     22UN536   0.000
10    22UN537   0.095      11    22UN540   0.055     12    22UN545   0.070
13    22UN547   0.066      14    22UN548   0.000     15    22UN560   0.095
16    22UN568   0.137      17    22UN569   0.098     18    22UN572   0.082
19    22UN581   0.098      20    22UN592   0.041     21    22UN607   0.083
22    22UN615   0.137

Writing weighted average scores on 9 axes for    42 Classes into file for graphing.


****** Calculations completed. There were 9 Bray-Curtis axes calculated ******
```

```
************** Hierarchical Cluster Analysis: Occupation Age, Lithic Scatter **********************
PC-ORD, 6.08


Linkage method:    NEAREST NEIGHBOR
Distance measure:  Sorensen (Bray-Curtis)
Total sum of squares:     288.8000

D I S T A N C E   S Q U A R E D


22PO571
         0.000E+00     6.233E-01     6.694E-01     3.853E-01     5.566E-01
22PO573
         6.233E-01     0.000E+00     1.000E+00     9.091E-01     9.184E-01
22PO602
         6.694E-01     1.000E+00     0.000E+00     7.561E-01     9.231E-01
22UN524
         3.853E-01     9.091E-01     7.561E-01     0.000E+00     6.660E-01
22UN615
         5.566E-01     9.184E-01     9.231E-01     6.660E-01     0.000E+00

Cluster  cycle
         1 Combined group     4 into group    1 at level 1.9263E-01
         2 Combined group     5 into group    1 at level 4.7091E-01
         3 Combined group     2 into group    1 at level 7.8254E-01
         4 Combined group     3 into group    1 at level 1.1173E+00

Percent chaining = 100.00

************************ Cluster analysis completed ************************
```

```
********************** Hierarchical Cluster Analysis **********************
PC-ORD, 6.08


Linkage method:   NEAREST NEIGHBOR
Distance measure:  Sorensen (Bray-Curtis)
Total sum of squares:    2557.955

DISTANCE SQUARED

22PO571
        0.000E+00    6.233E-01    3.421E-01    6.694E-01    6.553E-01    2.010E-01
        3.853E-01    5.102E-01    4.253E-01    5.011E-01    4.536E-01    3.136E-01
        3.177E-01    6.400E-01    5.463E-01    4.952E-01    6.049E-01    3.478E-01
        3.265E-01    5.776E-01    6.233E-01    5.566E-01
22PO573
        6.233E-01    0.000E+00    8.975E-01    1.000E+00    1.000E+00    5.102E-01
        9.091E-01    4.444E-01    1.000E+00    9.467E-01    8.858E-01    8.890E-01
        9.025E-01    3.600E-01    5.625E-01    6.944E-01    9.292E-01    8.403E-01
        7.160E-01    6.400E-01    2.500E-01    9.184E-01
22PO581
        3.421E-01    8.975E-01    0.000E+00    8.144E-01    1.000E+00    5.625E-01
        2.309E-01    8.100E-01    6.553E-01    2.143E-01    3.123E-01    4.253E-01
        2.111E-01    8.054E-01    6.553E-01    6.824E-01    3.121E-01    4.756E-01
        5.545E-01    8.264E-01    8.006E-01    6.877E-01
22PO602
        6.694E-01    1.000E+00    8.144E-01    0.000E+00    1.000E+00    5.848E-01
        7.561E-01    3.086E-01    6.694E-01    8.030E-01    5.325E-01    6.233E-01
        6.625E-01    5.625E-01    4.050E-01    5.378E-01    8.323E-01    4.952E-01
        5.625E-01    2.899E-01    5.102E-01    9.231E-01
22PO650
        6.553E-01    1.000E+00    1.000E+00    1.000E+00    0.000E+00    1.000E+00
        9.131E-01    1.000E+00    1.000E+00    9.481E-01    8.920E-01    7.955E-01
        9.070E-01    1.000E+00    1.000E+00    7.347E-01    9.305E-01    7.160E-01
        5.378E-01    6.944E-01    1.000E+00    8.464E-01
22UN520
        2.010E-01    5.102E-01    5.625E-01    5.848E-01    1.000E+00    0.000E+00
        4.874E-01    2.500E-01    3.086E-01    6.173E-01    4.050E-01    3.600E-01
        3.600E-01    5.378E-01    4.444E-01    4.050E-01    6.694E-01    3.460E-01
        4.253E-01    3.600E-01    5.102E-01    6.849E-01
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22UN524
          3.853E-01   9.091E-01   2.309E-01   7.561E-01   9.131E-01   4.874E-01
          0.000E+00   8.301E-01   6.197E-01   2.200E-01   9.927E-02   1.432E-01
          7.066E-02   7.459E-01   6.885E-01   4.710E-01   2.567E-01   2.119E-01
          5.340E-01   6.335E-01   8.226E-01   6.660E-01
22UN529
          5.102E-01   4.444E-01   8.100E-01   3.086E-01   1.000E+00   2.500E-01
          8.301E-01   0.000E+00   6.400E-01   8.483E-01   6.944E-01   7.020E-01
          6.553E-01   5.102E-01   3.600E-01   7.347E-01   8.634E-01   5.917E-01
          5.378E-01   2.500E-01   1.111E-01   8.464E-01
22UN536
          4.253E-01   1.000E+00   6.553E-01   6.694E-01   1.000E+00   3.086E-01
          6.197E-01   6.400E-01   0.000E+00   7.600E-01   5.429E-01   4.793E-01
          5.971E-01   1.000E+00   6.944E-01   2.500E-01   8.336E-01   6.173E-01
          5.848E-01   5.102E-01   5.625E-01   7.160E-01
22UN537
          5.011E-01   9.467E-01   2.143E-01   8.030E-01   9.481E-01   6.173E-01
          2.200E-01   8.483E-01   7.600E-01   0.000E+00   2.696E-01   3.375E-01
          2.066E-01   8.464E-01   8.054E-01   6.478E-01   1.905E-01   3.807E-01
          6.911E-01   7.656E-01   8.948E-01   6.897E-01
22UN540
          4.536E-01   8.858E-01   3.123E-01   5.325E-01   8.920E-01   4.050E-01
          9.927E-02   6.944E-01   5.429E-01   2.696E-01   0.000E+00   1.991E-01
          1.380E-01   7.845E-01   6.233E-01   2.744E-01   3.139E-01   2.689E-01
          3.943E-01   4.225E-01   7.785E-01   8.054E-01
22UN545
          3.136E-01   8.890E-01   4.253E-01   6.233E-01   7.955E-01   3.600E-01
          1.432E-01   7.020E-01   4.793E-01   3.375E-01   1.991E-01   0.000E+00
          1.240E-01   6.944E-01   6.318E-01   3.380E-01   3.841E-01   1.193E-01
          4.050E-01   5.003E-01   7.845E-01   5.578E-01
22UN547
          3.177E-01   9.025E-01   2.111E-01   6.625E-01   9.070E-01   3.600E-01
          7.066E-02   6.553E-01   5.971E-01   2.066E-01   1.380E-01   1.240E-01
          0.000E+00   7.287E-01   6.694E-01   5.017E-01   2.603E-01   1.600E-01
          5.102E-01   6.125E-01   8.100E-01   6.944E-01
22UN548
          6.400E-01   3.600E-01   8.054E-01   5.625E-01   1.000E+00   5.378E-01
          7.459E-01   5.102E-01   1.000E+00   8.464E-01   7.845E-01   6.944E-01
          7.287E-01   0.000E+00   3.086E-01   4.793E-01   8.957E-01   5.776E-01
          5.102E-01   6.694E-01   3.600E-01    8.434E-01
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22UN560
          5.463E-01    5.625E-01    6.553E-01    4.050E-01    1.000E+00    4.444E-01
          6.885E-01    3.600E-01    6.944E-01    8.054E-01    6.233E-01    6.318E-01
          6.694E-01    3.086E-01    0.000E+00    5.625E-01    8.022E-01    5.102E-01
          1.696E-01    5.102E-01    2.500E-01    7.825E-01
22UN568
          4.952E-01    6.944E-01    6.824E-01    5.378E-01    7.347E-01    4.050E-01
          4.710E-01    7.347E-01    2.500E-01    6.478E-01    2.744E-01    3.380E-01
          5.017E-01    4.793E-01    5.625E-01    0.000E+00    6.921E-01    3.164E-01
          3.832E-01    3.086E-01    6.944E-01    7.972E-01
22UN569
          6.049E-01    9.292E-01    3.121E-01    8.323E-01    9.305E-01    6.694E-01
          2.567E-01    8.634E-01    8.336E-01    1.905E-01    3.139E-01    3.841E-01
          2.603E-01    8.957E-01    8.022E-01    6.921E-01    0.000E+00    4.616E-01
          7.225E-01    7.750E-01    9.292E-01    7.586E-01
22UN572
          3.478E-01    8.403E-01    4.756E-01    4.952E-01    7.160E-01    3.460E-01
          2.119E-01    5.917E-01    6.173E-01    3.807E-01    2.689E-01    1.193E-01
          1.600E-01    5.776E-01    5.102E-01    3.164E-01    4.616E-01    0.000E+00
          3.315E-01    3.600E-01    6.944E-01    6.782E-01
22UN581
          3.265E-01    7.160E-01    5.545E-01    5.625E-01    5.378E-01    4.253E-01
          5.340E-01    5.378E-01    5.848E-01    6.911E-01    3.943E-01    4.050E-01
          5.102E-01    5.102E-01    1.696E-01    3.832E-01    7.225E-01    3.315E-01
          0.000E+00    4.681E-01    4.793E-01    6.799E-01
22UN592
          5.776E-01    6.400E-01    8.264E-01    2.899E-01    6.944E-01    3.600E-01
          6.335E-01    2.500E-01    5.102E-01    7.656E-01    4.225E-01    5.003E-01
          6.125E-01    6.694E-01    5.102E-01    3.086E-01    7.750E-01    3.600E-01
          4.681E-01    0.000E+00    3.600E-01    8.573E-01
22UN607
          6.233E-01    2.500E-01    8.006E-01    5.102E-01    1.000E+00    5.102E-01
          8.226E-01    1.111E-01    5.625E-01    8.948E-01    7.785E-01    7.845E-01
          8.100E-01    3.600E-01    2.500E-01    6.944E-01    9.292E-01    6.944E-01
          4.793E-01    3.600E-01    0.000E+00    8.403E-01
22UN615
          5.566E-01    9.184E-01    6.877E-01    9.231E-01    8.464E-01    6.849E-01
          6.660E-01    8.464E-01    7.160E-01    6.897E-01    8.054E-01    5.578E-01
          6.944E-01    8.434E-01    7.825E-01    7.972E-01    7.586E-01    6.782E-01
          6.799E-01    8.573E-01    8.403E-01    0.000E+00
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Cluster cycle
          1 Combined group    13 into group   7 at level 3.5331E-02
          2 Combined group    11 into group   7 at level 8.4965E-02
          3 Combined group    21 into group   8 at level 1.4052E-01
          4 Combined group    18 into group   12 at level 2.0019E-01
          5 Combined group    12 into group   7 at level 2.6218E-01
          6 Combined group    19 into group   15 at level 3.4696E-01
          7 Combined group    17 into group   10 at level 4.4221E-01
          8 Combined group    6 into group    1 at level 5.4268E-01
          9 Combined group    10 into group   7 at level 6.4599E-01
          10 Combined group   7 into group    3 at level 7.5154E-01
          11 Combined group   8 into group    1 at level 8.7654E-01
          12 Combined group   2 into group    1 at level 1.0015E+00
          13 Combined group   15 into group   1 at level 1.1265E+00
          14 Combined group   20 into group   1 at level 1.2515E+00
          15 Combined group   16 into group   9 at level 1.3765E+00
          16 Combined group   9 into group    3 at level 1.5137E+00
          17 Combined group   4 into group    1 at level 1.6587E+00
          18 Combined group   3 into group    1 at level 1.8130E+00
          19 Combined group   14 into group   1 at level 1.9673E+00
          20 Combined group   5 into group    1 at level 2.2362E+00
          21 Combined group   22 into group   1 at level 2.5145E+00


Percent chaining =  40.79

************************* Cluster analysis completed *************************
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