THE DETERMINATION OF PALEO-INDIAN TERRITORIALITY THROUGH THE EXPLORATORY SPATIAL DATA ANALYSIS OF PALEO-INDIAN FLUTED POINTS AND THEIR LITHIC SOURCES

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Abstract

Territories have long been proposed for highly mobile Early Paleo-Indians based on the presence of their distinctive fluted point. However, there has not yet been a systematic spatial and statistical analysis of fluted points and their lithic sources to determine if the territories did exist or if Fluted Point peoples remained "free wandering". By first determining if cultural groups could be inferred from point morphology and then examining the transportation of fluted points away from their lithic source, this study takes an objective view of the large number of fluted points to understand their distribution patterning using Exploratory Spatial Data Analysis (ESDA) to test this hypothesis. The final result derives possible territories that were traversed by these early pioneers.

Keywords: Fluted point; Paleo-Indian; Territories; Exploratory Spatial Data Analysis; ESDA;

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Chapter 1:
Introduction

Interest in the earliest pioneers into the Americas was focused in 1927 with the discovery of a fluted projectile point directly associated with extinct Pleistocene fauna (Witthoft 1952), signifying the movement of modern humans into a new and rich landscape. Since this discovery, fluted projectile points have been identified in many other areas of North America and limited finds in South America (Faught and Anderson 2000; Fowler 1954). Such finds now number over 13,000 (PIDBA 2008).

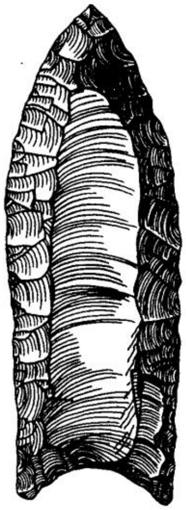


Figure 1: A "Gainey" fluted point. From Ellis 1984b

The fluted point (Figure 1) is characteristic of assemblages in Terminal Pleistocene occupations of North America, between 11,500 – 10,100 B.P. (V. Haynes 1984). They are based on a lanceolate form and exhibit concave bases with a distinctive channel flake, or flute, removed from one or both faces extending from the base upwards

(Roosa and Ellis 2000; Gramly 1990). As observed by Richie (1957), and reiterated in many studies (Gardner 1974; Goodyear 1979; V. Haynes 1982; Meltzer 1988; MacAvoy 1992; Dent 1995; Tankersley 1998; Curran 1999; Ellis and Deller 2000), Eastern fluted point lithic assemblages are generally manufactured from high grade cryptocrystalline siliceous raw materials (Curran and Grimes 1989;47). Examples include crystal quartz, quartzite, chalcedony, jasper, flint, and chert, with *chert* often being used as the general term (Boudreau 1981). Other lower, quality materials such as quartz, quartzite, felsic and petrified wood have also been used. These materials are considered to be superior due to their conchordial fracturing during tool manufacture (Crabtree 1967; Spiess and Wilson 1989:47). Cherts come from bedded outcrops and occasionally cobbles. Due to the high quality and unique geochemical characteristics, it is often possible to identify the raw material source for many fluted points (Roberts 1985, 1988; Tankersley 1990; Leudtke 1992; Seemen 1994; Pollock et al. 1999).

Improved understanding of spatial contexts for both fluted point distributions and their lithic sources began with Witthoft (1952) at the Shoop site and was bolstered by the discovery of large (and now well known) sites like Williamson (McCary 1951), Reagan (Ritchie 1953), Bullbrook (Byers 1954) and Debert (MacDonald 1968). Along with locally manufactured stone tools, many Early Paleo-Indian (also known as Fluted Point peoples) sites contain exotic lithic materials. The movement of Paleo-Indian groups was initially inferred by Witthoft (1952) through identifying the specific lithic sources within assemblages. Since Witthoft, most researchers (Ellis 1984; Laub 2003; McNett 1985; Storck 1997) include the range of raw materials represented at a given site, their sources if possible, and their distances to source, to further improve our understanding of Paleo-Indian movements. The procurement of the “exotic” lithic material may not be the result of long-distance exchange or specific quarrying trips, but as part of their seasonal rounds. Roberts (in *Historical Atlas of Canada* 1987:plate 3), provides an example of this type of band movement in relation to lithic types.

Fluted Point Paleo-Indian populations are thought to be highly mobile, covering large distances (Tankersley 1989) and possibly had established resource procurement sites within an established range. The high numbers of artefacts from distant sources has been used as a measure of distance that hunter-gatherer bands travelled on their annual cycle. (Roosa 1977, Storck and VonBitter 1987) Based on this information, some authors (Gardner 1977; Custer 1984; Lantz 1984; Meltzer 1985; Roberts 1985; Gramly 1988; Tankersley 1991, 1998; Dincauze 1993; Seeman 1994; Storck 2004) have suggested or denoted possible ranges and movement patterns for Fluted Point peoples, involving both colonization and established settlement patterns. Others suggest that Early Fluted Point people remained Free-Wandering (Mason 1981; Spiess and Wilson 1987) until changes in subsistence and increasing population during the Late Paleo-Indian/Early Archaic phase (Anderson and Sassaman 1996). There has not yet been a systematic spatial and statistical analysis of fluted points and their lithic sources to determine if the spatial ranges are consistent or if they fluctuate by region. By widening the scope of inquiry beyond the traditional borders of limited regions, a richer and more encompassing comparative framework can be offered.

The objectives of this thesis are first to determine if Fluted Point peoples had established territorial ranges, or if they continued an existence of free wandering; then secondly, to determine the size and extent of these ranges for Eastern North America, encompassing the Great Lakes region to southern Virginia to unglaciated north-eastern Canada (Figure 2) using the fluted projectile point as the primary data unit for this study, along with its locational, lithic, and typological attributes. This study takes an objective view of the myriad fluted points to understand their distribution patterning and it is from this premise that Exploratory Spatial Data Analysis (ESDA) is used to derive possible territories. Exploratory methods seek to describe *a priori* assumptions (Tukey 1977) within the data to help an analyst develop a hypothesis for the data (Bailey and Gatrell 1995: 23-24). These methods are graphical in nature and are aimed at pattern, relationship, and outlier detection. Furthermore, to address this, I need first to determine if cultural groups could be inferred from point morphology and second, to see how the movement of points from their lithic source to deposition structured group range can be hypthosized. The spatial analyses were performed on two parameters to describe the geographical data:

1. Distance and distribution from a given lithic source
2. Artefact typology

In order to achieve these results, a comprehensive literature review was undertaken along with quantitative analysis of the artefactual data. The literature provided the data required for fluted point attributes (location, lithic composition and morphological measurements), and lithic raw material source locations. This literature review also expanded my understanding of Paleo-Indian studies and provided an evaluation of the testable hypotheses. The data were evaluated using ESDA methodologies to examine the spatial distributions and patterning of lithic artefacts, which were then "overlaid" on the Late-Pleistocene Paleoenvironment, to relate potential territorial ranges to the landscape. This study has improved understanding on Fluted Point Paleo-Indian adaptation and shed further light on the existing regional hypotheses.

Figure 2: North America with area encompassed by this study outlined in red

Within Geography, the employment of geographical information systems (GIS) has a long history, beginning with Tobler (Tobler 1959; Conolly and Lake 2006:24) and continuing into the present with research and applied applications in human and physical geography. Within Archaeology the use of GIS has been more recent, starting in the 1990's (Wheatly and Gillings 2002), and while most archaeologists admit that it can be an important tool for site research, the adoption of many of the techniques for data analysis, specifically regional spatial analysis and data exploration, has been slow. This slowness is either due to Archaeology having its own methodological tradition that is well entrenched and fits the need of the discipline or because most archaeologists are unaware of the power that the spatial analytical techniques within GIS can offer. This thesis shows the usefulness of exploratory data analysis coupled with GIS to answer regional scale questions concerning the movement and grouping of Paleo-Indian peoples at the end of the Pleistocene.

Chapter 2:
General Background

The Arrival

Abundant Paleo-Indian and fluted point literature centres on the timing and distribution of original migrations into the Americas. The timing of the initial peopling of the Americas is still a hotly debated research problem forming two basic camps: Early-Entry, which suggests that people arrived in the Americas prior to 12,000 BP; and Clovis-First, which states that the first migrants to America arrived ca. 12,000 BP. Each position within this debate uses a limited number of sites and data to support their views. A number of books (and papers) have presented information supporting either the "Early Entry" model (cf. Bryan 1986; Bonnichsen and Turnmire 1999; Adovasio 2002), or the "Clovis First" model (Dixon 1999; Haynes G 2002).

Regardless of timing, the progression of human groups moving from Alaska into North and South America below the continental ice-sheet hsa been modelled using various routes. Two of the more widely accepted migration models include the ‘Ice-Free Corridor’ route (cf. V. Haynes 1969), and the Northwest Coastal route (Fladmark 1979). In these models, migrating groups come from Beringia, and once south of the ice-sheet spread across North and South America rapidly (Surovell 2000). Two other models include: the Isthmus of Panama route (Anderson and Gilliam 2000) which suggests that early migrants skirted the western coast of North America and established sites in South

America before moving north-ward; and the Mid-Atlantic route (Bradley and Stanford 2004), which has a European origin for the initial populating of the Americas.

The latter three hypotheses, Coastal route, Isthmus of Panama route, and the Mid-Atlantic route, are used to explain sites in the Americas dating before 12,000 BP. Many pre-Clovis sites have been put forward, but all have failed to be universally accepted, primarily due to dating issues. Two well-known sites, Meadowcroft (Adovasio et al. 1977) and Monte Verde (Dillehay and Collins 1988) appear to have better evidence, but are still being challenged by others (V. Haynes 1997). Monte Verde was originally dated at 12500 BP and with an earlier component at 33,000 BP (Dillehay and Collins 1988, Meltzer et al 1997), but has now been more securely dated at 12,000 BP (V. Haynes 1999, Dillehay 2002, Faught 2008). This site is widely accepted as the oldest in South America but still postdates some candidate sites in North America [Paisley 12,400 BP (Jenkins 2007) and Page Ladson 12,300 (Dunbar 2006)] by 300 years. The timing suggests that a north-to-south migration is possible. However, additional "fine-detailed" assemblage analysis is still needed for a more robust and complete record of colonization of the Americas (Curran 1999). Vance Haynes (1984:184) sums the inefficacy of this debate up nicely when he writes:

> "Only by having significant number of precisely dated stratified sites over the entire geographical distribution will we ever be able to learn the timing and direction of the Paleo-Indian movement throughout the Western Hemisphere."

Dating

Radiocarbon dating is the primary radiometric dating method that estimates the age of archaeological sites less than 58,000 years ago using organic remains (bone or carbonized plant matter). The dates herein are raw (uncalibrated) and reported in radiocarbon years before present (BP). The accepted range for Fluted Point peoples, as stated earlier, is ca. 11,500 to 10,000 BP, although "evaluation of existing dates and new 14C assays suggests that the initial fluted point culture more precisely dates to [11,200 - 10,800 BP]" (Goebel et al. 2008:1499), suggesting a younger and shorter range (Tankersley 2004). However, there are many fluted point sites, from both east and west that are dated younger than 10,800 BP (eg. Folsom (Holliday 2000) , Lindenmeier (Haynes et al. 1992), and Sheriden (Tankersley and Redmond 1999)).

Obtaining secure dates for sites in Eastern North America has proven problematic due to a lack of clearly stratified sites and well preserved organic remains in association with known Paleo-Indian artefacts (Tankersley 1998). One problem arises from the soil processes of temperate forests breaking down organic remains over time. Furthermore, extensive ploughing and bioturbation have mixed and scattered what might have remained (Dincauze 1993). For many years, age determinations have been based on morphological characteristics of fluted points in comparison to dated Clovis points (Gardner 1974); however a shared basic morphology does not necessarily imply that all fluted points were contemporaneous, as stylistic similarities may be temporally disparate (Meltzer 1988). As Gary Haynes (2002:110-111) cautions, "Unless each and every assemblage is solidly dated, we may not be able to distinguish changes in artefact class and types over time," though in southern Ontario and the regions surrounding the Great Lakes, affinities between point types and occupation ages have been strongly suggested (Ellis and Deller 2000, Storck 1983, Roosa and Deller 1982, Ellis et al. 1998).

Radiocarbon dating has been performed on approximately two dozen fluted point sites within the study area. The results from some (Gainey, Potts, Duchess Quarry Cave, and Williamson) have since been considered erroneous; others (Thunderbird, Bull Brook I and II, and Templeton) are less than reliable; leaving only eight sites within the study area (Arc, Debert, Hiscock, Paleo-Crossing, Shawnee-Minisink, Sheriden Cave, Whipple, and Vail) being defined as securely dated (Meltzer 1988, Faught 2008). These dates contribute to binding this area's occupation temporally to 11,200-10,500 BP. Mapping well-dated sites across the landscape can provide a way of understanding settlement patterns and population dynamics (Dincauze 1993, Anderson and Gilliam 2000, Faught 2008). Figure 3, which was derived using an inverse distant weighted trend surface analysis on eight dated sites, suggests no particular chronological trend in the lower Great Lakes and New York/Pennsylvania region, but does show a decreasing of age of possible south–north movement into the northeast.

In addition to radiocarbon dating, geochronological dating has been used to determine chronology, especially in the northern glacial and periglacial regions. Geochronological dating uses ice-derived deposits, post-glacial lake strandlines and other related features with associated Fluted Point group occupations. Some researchers argue that such dating is problematic because the information on the timing of ice advances, ice retreats, and lake sequences is fragmentary (Mickleson et al. 1981). Neither does the presence of fluted points on relic beaches ensure that they were deposited while the lake was present (Mason 1981). Roberts (1984) on the other hand, maintains that "Parkhill" points pre-date the drainage of Glacial Lake Algonquin (ca 10,500 BP (see Karrow et al 1975)) and there is no evidence of Kettle Point chert usage, which only appears after the lake levels declined. The exception to this is a single fluted point from the Fisher site (Storck 1997). Despite these issues, geochronological dating can provide minimum age boundaries, because these beach ridges have been selected by later groups (Ellis and Deller 1988).

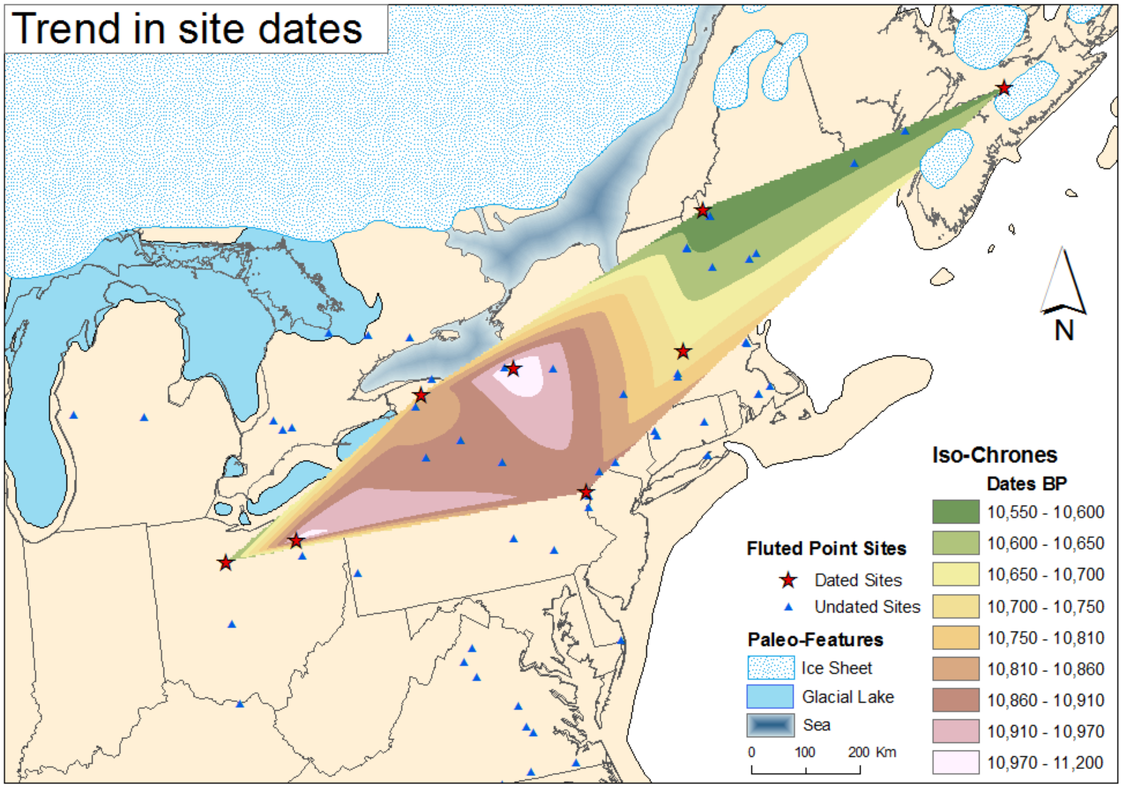


Figure 3: Iso-chrone map based on eight dated sites (stars)

The Paleoenvironment

Significant environmental reconstruction work has been done for most locations within the study area including the Great Lakes Region (Karrow et al. 1975, 2000), New England and the Maritimes (Hughes et al. 1985, Curran 1985), New York to Pennsylvania (Delcourt and Delcourt 1981), Ohio (Shane and Anderson 1993, Shane 1994), and the Mid-Atlantic (Jacobson et al. 1987), yet the environment of glaciated Eastern North America during the late Pleistocene is difficult to describe precisely.

At the height of the Late Wisconsin Glaciation (ca. 18,000 BP) the continental ice covered down to central Illinois, Ohio, and Pennsylvania (Figure 4). As the ice sheets began to retreat new deglaciated area progressed from tundra to areas of mixed deciduous/ coniferous and, in Virginia, even oak and hickory. This progress was halted with the onset of the Younger Dryas (ca 11,000 BP). The Younger Dryas is defined as a cool climatic reversal period during the Terminal Pleistocene that saw the readvancement of the Laurentian ice sheet, and the regression of non-tundra biomes. (Dyke and Prest 1987).

In the study area there were two broadly distinctive biomes: a periglacial tundra and an extensive boreal forest (Meltzer 1985:6). Both of these zones were time-transgressive as they moved northward (figs. 5 a-d). Tundra vegetation was the first to colonize newly exposed landscapes, followed by an open spruce parkland and then mixed hardwood forests (Watts 1983). Reconstructions by Bernabo and Webb (1977) and Davis and Jacobson (1985) shows that by ca.11,000 BP during a period of great change, only very small patches of tundra were present. Northern New England was characterized as spruce-dominated boreal forests and mixed woodlands. By ca. 10,000 BP, the dominant vegetation had changed to hardwood forests (Davis and Jacobson 1985). For New York and the Middle Atlantic region (down to Virginia) during the same time period, Dent (1985) shows spruce, fir, and pine forest quickly giving way to mixed hardwood forest which included ash, beech, oak and hickory.

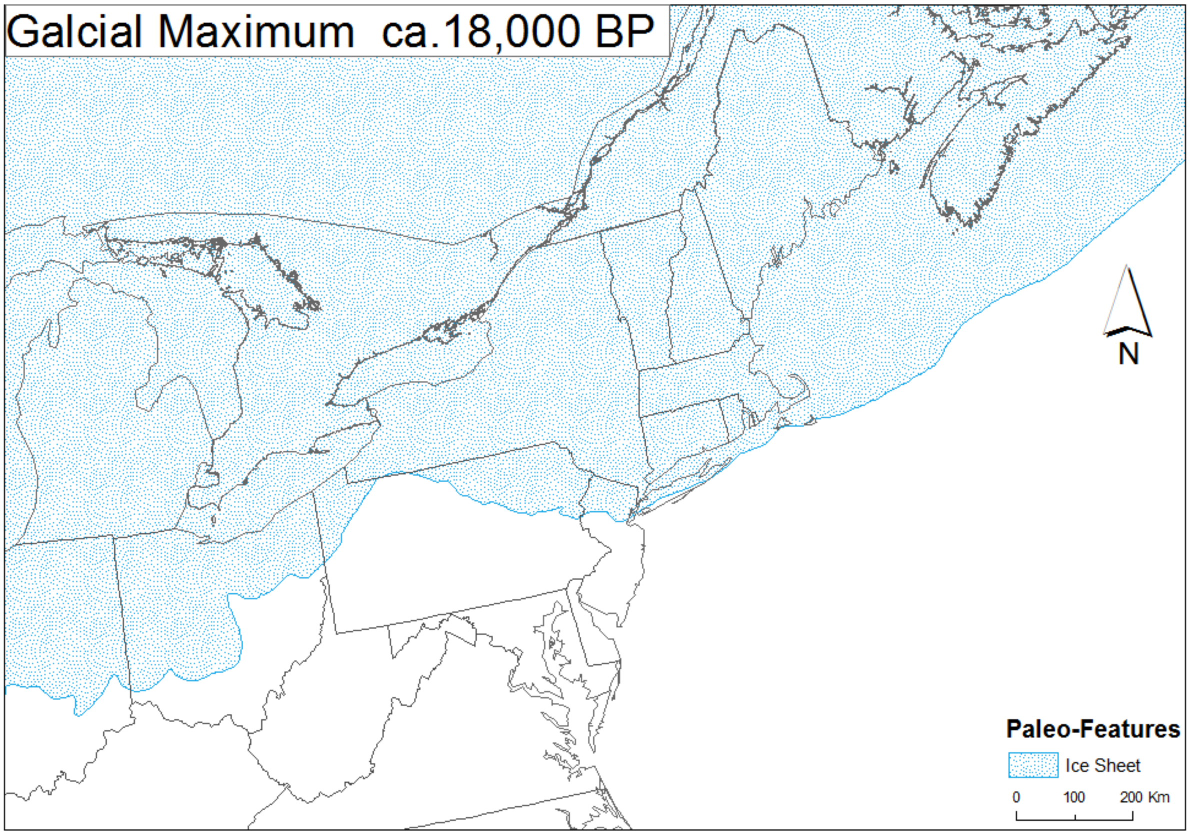
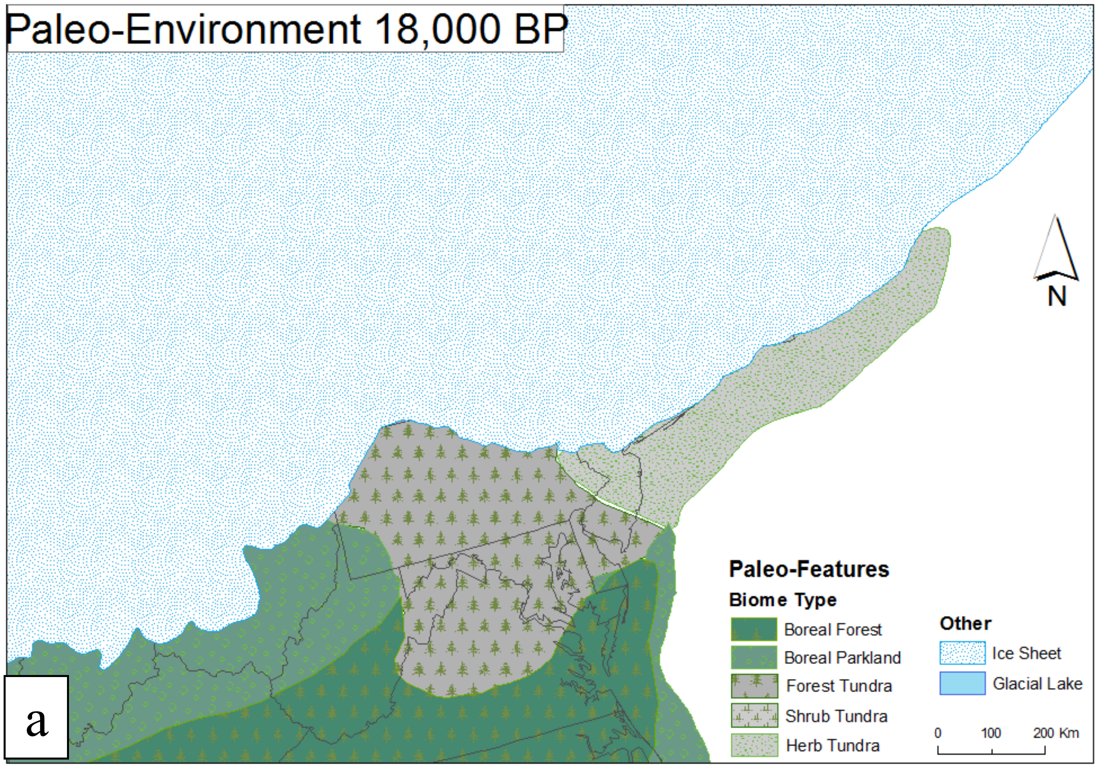
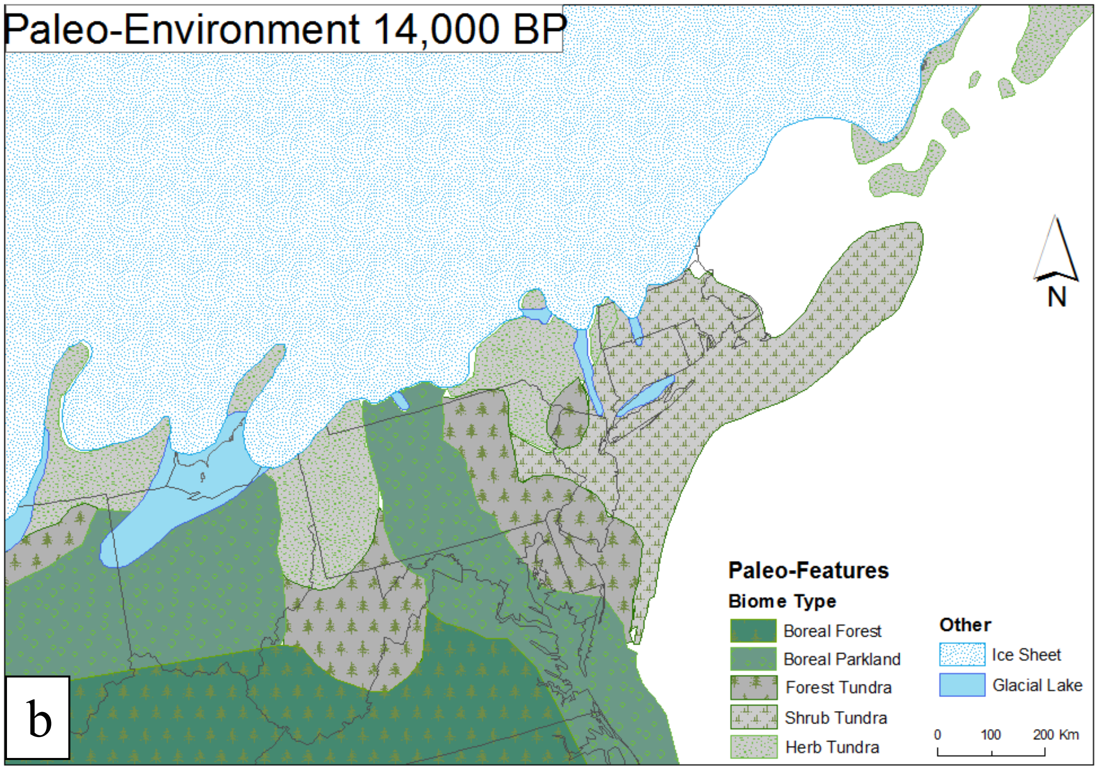


Figure 4: Extent of the Glacial Maximum, ca. 18,000 BP. From Dyke and Moore 2003.


Paleo-Environment 18,000 BP
a
N
Paleo-Features
Biome Type
Boreal Forest
Boreal Parkland
Forest Tundra
Shrub Tundra
Herb Tundra
Other
Ice Sheet
Glacial Lake
0
100
200 Km


Paleo-Environment 14,000 BP
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Herb Tundra
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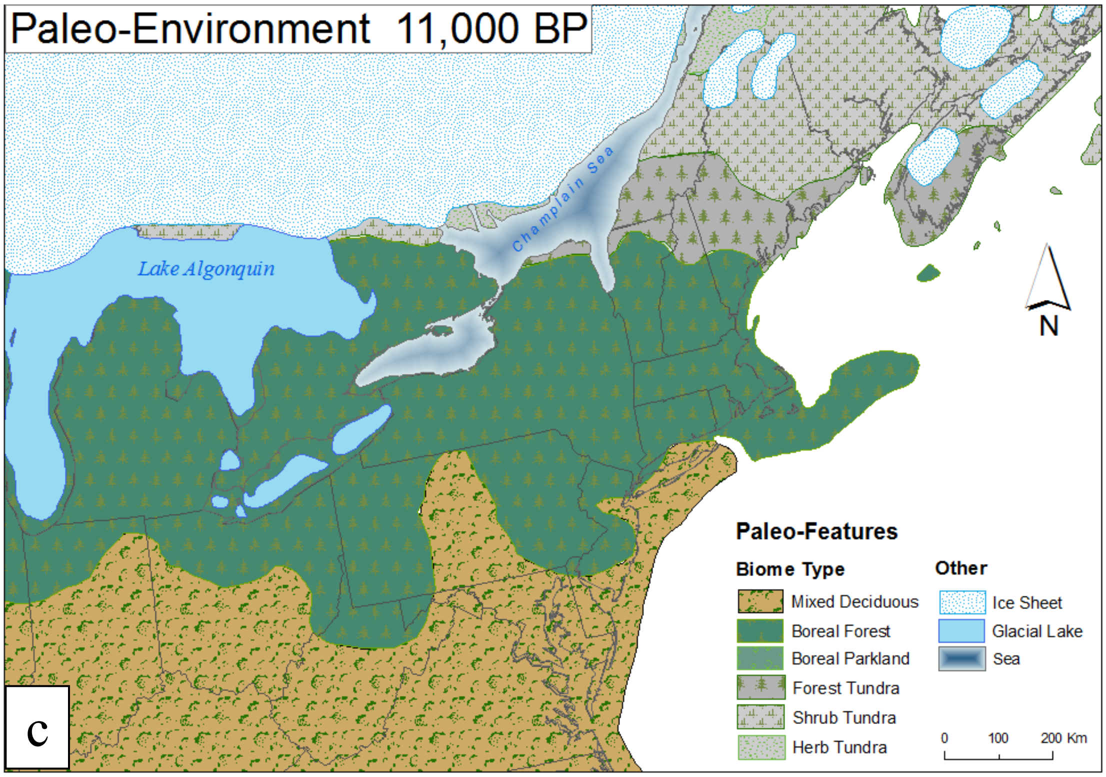


Figure 5a-c: Changes in Paleo-Environmental Biomes from 18,000 BP to 11,000 BP. Based on Delcourt and Delcourt 1981; Adams and Faure 1997; Dyke and Moore 2003; Dyke et al. 2004.

The introduction of large botanical and faunal computer databases derived from palynological studies, like Bernabo and Webb's (1977) large scale study of North-eastern North America, along with software like CLIMAP, COHMAP and FAUNMAP has shown that the composition and structure of the Terminal Pleistocene and Holocene landscape and the distributions, extents and abundance of species changed rapidly and continuously during this time (Webb et al. 1993). The resulting paleo-landscape was a mosaic based on differences in direction and timing responses of individual species (Graham and Grimm 1990; Grimm and Jacobson 1992).

The People and Subsistence

Originally, the makers of fluted projectile points were thought to be specialized "big-game" hunters efficiently downing extinct mega-fauna (Mason 1962; Martin 1973, 1990; Grayson and Meltzer 2002; Figure 6). Today, a convergence of data, including optimal foraging theory (Byers and Ugan 2005), provides evidence that the makers of fluted points were mobile hunter-gatherers living in band societies following the migrations of herd animals and exploiting a wide range of plant and animal resources (Waguespack and Surovell 2003, 2008; Waguespack 2007), while at the same time not responsible for the extinction of multiple species of mega-fauna (Martin 1990; Grayson and Meltzer 2002). In addition, a Paleo-Indian lifeway dependent on rapid movement and a subsistence adaptation reliant on large mammal hunting would allow inefficient use of a succession of local environments (Webb and Rindos 1997).

The FOLSOM MAN in COLORADO
... Archaeologists Reconstruct Fauna of 10,000 Years Ago

J. D. Figgins

Figure 6: From Rocky Mountain Empire magazine 1947. Photo: Treloar Bower

A “high technology forager” system (cf. Spiess 1984) has been used to explain this type of Paleo-Indian land-use (Kelly and Todd 1988). This system is characteristic of broad spectrum foragers (cf. Binford 1980), emphasizing high residential mobility based on resource abundance using search and encounter hunting tactics within large territories tied to a complex curative technology with lithic resources providing a fixed locus (Dent 1985, 2007). Thus, they were likely to be technology orientated rather than locus orientated, using their knowledge of plants and animal behaviour to adapt responsively to new regions (McWeeney 2007). Cannon and Meltzer (2008) furthered this position by using a patch choice foraging theory model, adding that subsistence strategies had regional variability due to a mosaic-like paleo-landscape. As regions differ in their environment, so the local inhabitants would have adjusted their strategies for subsistence, lithic utilization and lithic procurement accordingly. Thus, while Paleo-Indian groups share a technology specialized for meat procurement using fluted points (Dent 1985; Seeman 1994), differences in over-all toolkits may be indicative of regional subsistence differences (Haynes, G 2002).

In addition to acquiring food resources, lithic resources for their toolkits were also a crucial part of a groups day-to-day needs. The quality and selectiveness of the raw material that Fluted Point peoples used has been both well documented and discussed extensively. Their preference for particular raw materials has been shown throughout North America (Goodyear 1979, Storck 1988, Haynes 1990) and is differentiated from the abundant use of "local" igneous and metamorphic lithic material used by later peoples

(Goodyear 1979). The first question discussed is why there is such a preference for these cherts and other high silica stone.

One answer is risk management. Paleo-Indian peoples were highly mobile hunter-gatherers who developed strategies that minimized starvation, which became important for a colonizing or pioneering population. This preference for cryptocrystalline cherts may then be related to the curateability of the manufactured tool, specifically because these high quality cherts are amenable for flaking (Ritchie 1953; Crabtree 1967). The craftsmanship of fluted points with its need for a high level of controlled knapping is thought to be a prime motivator in using quality material (Gardner 1983). The adaptive benefit is that good cherts permitted greater control during the reduction process of the tool. In a maintainable system, tools are easily serviced and can be refashioned into new tool types (Bleed 1986). Being able to rejuvenate tools allows for less dependence on lithic sources that are uncertain or highly dispersed.

Chapter 3:
Methods

The research to determine regional territories used Exploratory Spatial Data Analysis (ESDA) to examine the spatial distribution of associated fluted point attributes, including; location, lithic source material and artefact morphology. In the early 1980s, archaeologists Kintigh and Ammerman (1982), dissatisfied with the current state of spatial analysis from the 60s and 70s set out a better approach using heuristics. Much of what was included in that paper is now part of ESDA. ESDA is a collection of techniques used to describe and visualize spatial distributions, to detect spatial associations or clusters, and to suggest forms of spatial heterogeneity (Anselin 1998, Bailey and Gatrell 1995). Spatial patterning describes phenomena in geographical space relating to the location of the attribute(s) in question, and being the discernment of the processes across this space (Cliff and Ord 1973; O'Sullivan and Unwin 2000; Csillag and Boots 2005). ESDA allows an examination of data without preconceived expectations while providing a sense of the nature of the data (Bailey and Gatrell 1995). ESDA is specifically useful due to its formal treatment of observations in spatial proximity matched with attribute correlation (Cliff and Ord 1981; Messner et al. 1999). Following the work of Dragićević et al. (2004) the stages in the ESDA process are:

1. Visually explore the data using GIS
2. Analysis of spatial patterns using statistical methods
3. Visualization and communication of the results in GIS
4. Repeat stages 2 & 3 as needed

5. Generation of final results in tables and maps

Past work on the nature of Fluted Point Paleo-Indian territories has been *ad hoc* with embedded expectations, usually directed by the findings of exotic cherts from one or a few sites. Previously, most of the work on fluted point "ranges" has been done either univariately (e.g. by lithic source; Gramly 1988) or bivariately (e.g. projectile point morphology and assemblage date; Ellis and Deller 2000) on point distributions. These are traditional models of spatial analysis (Kintigh and Ammerman 1982). However, there are exceptions (Tankersley 1998, Roberts 1984, Deller and Ellis 1992), where multi-site patterning has been seen in the literature.

For the first objective of determining if Fluted Point peoples had established territories or remained free wanderers, the particular technique employed focused on similarites of spatial autocorrelation. Spatial autocorrelation here refers to the coincidence of value (lithic source) similarities with locational similarities (Anselin 1994, 1998). Using the Moran *I* statistic as a measure of global spatial autocorrelation, no spatial association (free-wandering) or positive association (potential territories) can be assessed. If none of the data characteristics differ from random then spatial patterning analysis may be unsuitable (Csillag and Boots 2005:175) and a more formalised approach should be used.

The second objective, determining size and extent of the Fluted Point peoples territorial ranges, combined lithic distributions tied to one or more sources, with artefact morphology. The classification of fluted points based on morphological values was performed using cluster analysis. Cluster analysis is a form of numerical taxonomy (Adams and Adams 1991:206) that uses a wide range of techniques that classify each individual datum into groups that are similar to each other in some way (Baxter 1994:141). This method begins by considering all values to be separate, then builds groups from the most similar items, grouping them so that the out-group differences are greater than the in-group difference (Shennan 1997:221). This method of classification for fluted points has a long history within Paleo-Indian studies (cf. Fitting 1965; Wilmsen 1967; Ellis 1984, 2004; Morrow and Morrow 1999; Buchanan and Hamilton 2009). Once classified, these data were used as an overlay to determined ranges to examine the homogeneity of type (point morphology) within a territory.

The data were entered into the GIS program ArcMap 9.2 (ESRI 2009). GIS has been documented as a useful tool for discovering the past (cf. Scollar 1999; Wheatly and Gillings 2002; Lock 2003) due to its ability to store, organize, and transform the archaeological, geological and geographical data (assemblages, lithic sources, and landscapes) from the literature into large geodatabases that are spatially integrated (O'Sullivan and Unwin 2003:22). Zubrow (2006:27) assigns GIS as a method within a digital archaeological context of atheorectical techniques that can be used for questions of spatial and temporal focus for understanding past behaviour. The advantage of GIS is that data can be examined efficiently, visually and interactively in many relational directions, thus providing greater context for the question of possible territories (Bailey and Gatrell 1995:58). Using the compiling and data structural power of GIS in archaeology is not new, but still there are relatively few who use GIS beyond sequentialized mapping capabilities.

Data Sample

The data were gathered exclusively from published literature. The sample numbered 560 recorded points, out of an approximate population of 4300 fluted points within the study area (see PIDBA 2008). This is roughly 13% of the population, covering an area of approximately 825000 km^2. The sample included 68 archaeological sites (Figure 7) with 267 fluted points obtained, with the remaining 293 fluted points found as isolates (Figure 8). Many of the isolates were found during concentrated local surveys specifically for finding fluted points, including the Nottaway River Survey (McAvoy 1992) and the Ohio Valley Survey (Hyde 1960). The locational information for many of the isolates was vague or ambiguous, thus the coordinates may not be accurate. However at the scale that the project used, these small inaccuracies did not matter to the overall conclusions.

Sourcing

Identification of the geological sources used for fluted points was of primary importance for this study as it provided indications of movement and range. Movement of an artefact may be local or distant, but in knowing its lithic material one can see a direct path from its starting point to its final point of deposition. The assignment of a source to a

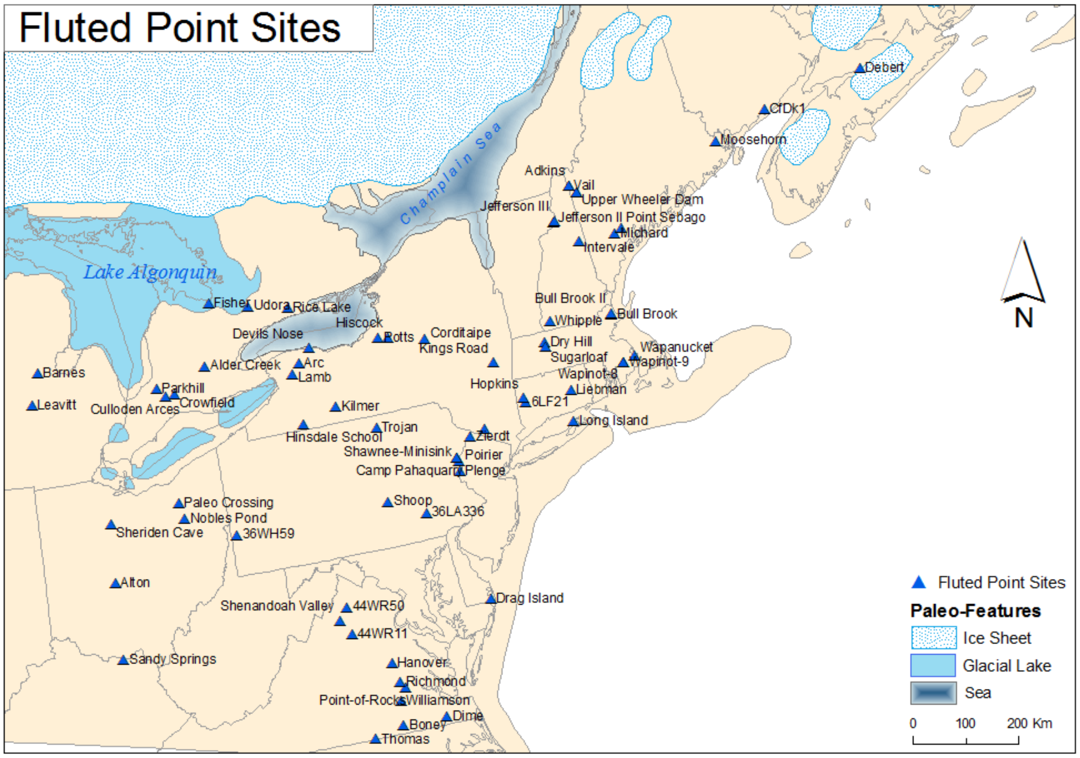


Figure 7: Excavated Archaeological sites that included more than a single fluted point

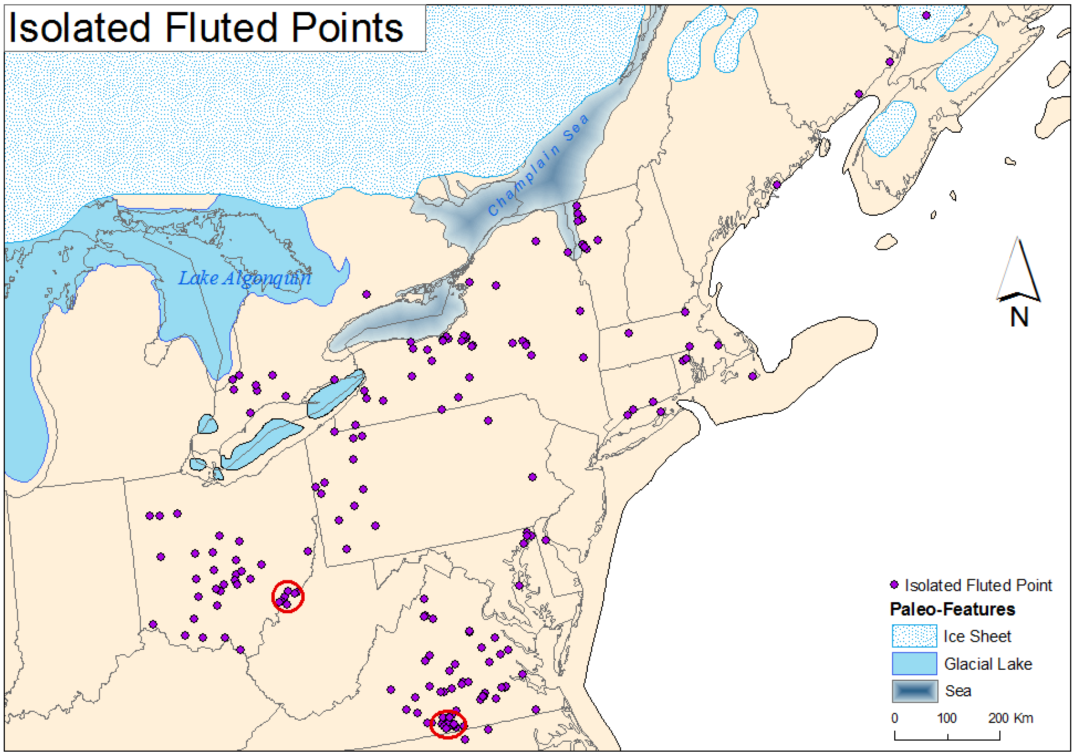


Figure 8: Isolated fluted point finds. Red circles indicate those found in local surveys

given point has traditionally been done by eye with the researcher relying on their experience and knowledge of known lithic outcrops. Though lithics are identified by colour and appearance, as most of the sampled artefacts have been, caution is needed as the colouring can be influenced by weathering, heat treatment or depositional circumstances (Tykot 2003:64).

Because researchers would rather be vague than incorrect, according to Fogelman (1987) a significant trait among fluted point assemblages within site reports is that many varieties of chert remain unidentified. This is because in order to identify both sources and artefacts accurately, an objective and replicable method needs to be employed (Luedtke 1979, Tankersley 1991). Tankersley (1991:288) describes a number of methods that can be used, based on differing levels of sophistication, complexity and cost. The use of techniques to identify samples positively by elemental analysis with Neutron Activation Analysis have been explored (e.g. Luedtke 1979) but its use is expensive and requires specialised equipment that may be out of reach for most researchers. Some more recent reports (e.g. Ellis and Deller 2000) have improved the identification, reducing the unknowns to 2%, while earlier reports (e.g. MacDonald 1968) and indices of isolated finds (e.g. McCary 1984) only provide colour and lithic types without source location. However, many varieties look similar to others, so proper identification can be difficult, for example variegated Coxsackie (NY) looks similar to Musungan (red/green) Christmas tree variety (Georgiady and Brockmann 2002:54). So, while only identified lithic material was appropriate for this study, there still remained enough data to have confidence in the results.

From this sample 62 individual lithic sources were determined (Figure 9; Table 1). The lithic source for each fluted point was primarily determined by the recording researcher. Occasionally, new lithic sources have been found after the original report, and "unknown" classified points were given a source. An example of this is Pollack *et al*'s (1999) association of the more recently discovered Munsungan lithic source to points found at Debert (see MacDonald 1968) 20 years earlier. Another example, from Virginia, is the association of Bolster's Store, Cattail Creek, and Mitchell lithic material to isolates found years earlier (McCary 1947 in McCary 1984).

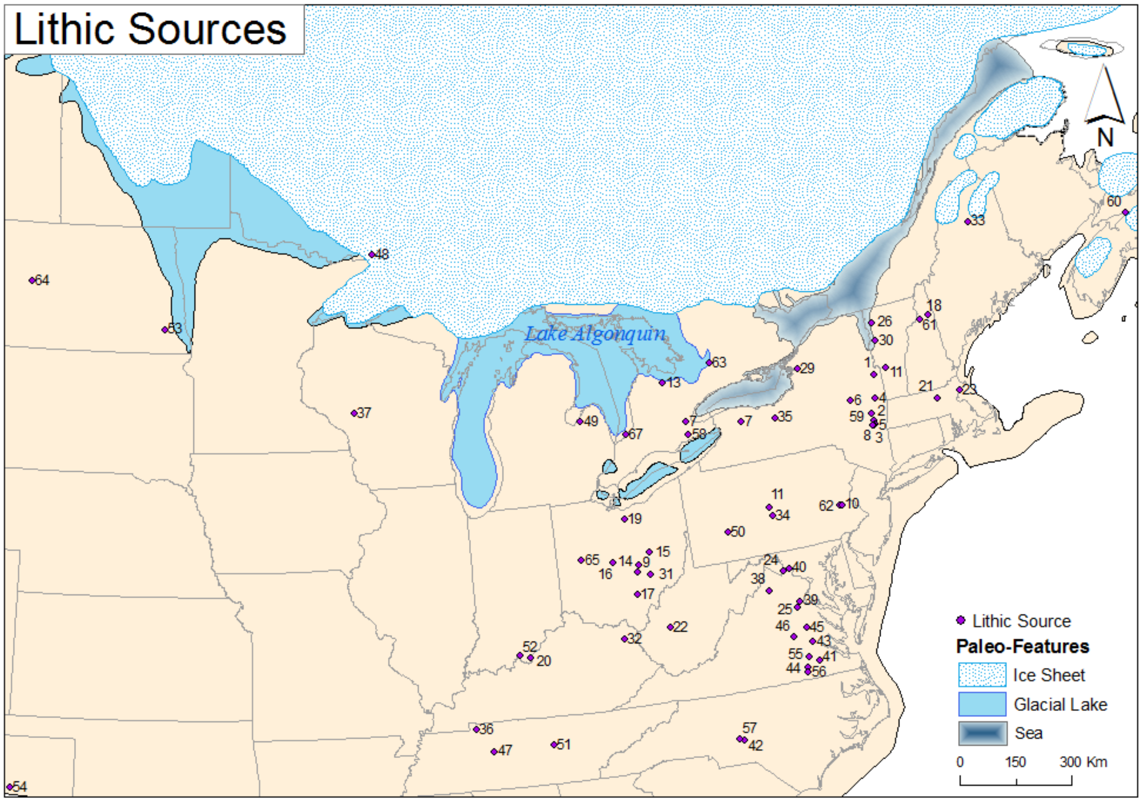


Figure 9: Location of Lithic Sources

Source#	Name	#	Name	#	Name	#	Name
1	Whitehall	18	Mount Jasper	36	Dover	53	North Dakota Moonstone
2	Deepkill	19	Pipe Creek	37	Hixton	54	Alibates
3	Coxsackie	20	Wyandotte	38	Flint Run	55	Cattail Creek
4	Normanskill	21	Sargus	39	Aquia	56	Bolster's Store
5	Normanskill	22	Kanawha	40	Maryland	57	Unwharrie
6	Little Falls	23	Marblehead	41	Sussex Petrified Wood	58	Haldimand
7	Western Onondaga	24	Harper's Ferry	42	Wolf Den	59	Kalkberg
8	Helderberg	25	Fredericksburg	43	Patuxent	60	Minas Basin
9	Flint Ridge	26	Colchester	44	Mitchell	61	Mt Jefferson
10	Pennsylvania Jasper	27	Bald Eagle	45	Weathered Amber Chalcedony	62	Macungie
11	Mt Independence	29	Leray	46	Bonnefort	63	Balsam Lake
12	Lockport	30	Cheshire	47	Brassfield	64	Knife River
13	Collingwood	31	Delaware	48	Thunderbay Gunflint	65	Logan
14	Upper Mercer	32	Paoli	49	Bayport	67	Kettle Point
15	Coshocton	33	Munsungan	50	Loyalhanna		
16	Delaware	34	Bellville	51	Fort Payne		
17	Zaleski	35	Moorehouse	52	Indiana Greenstone		

Table 1: List of Sources for Figure 9

Sampling

Because not all points could be used or measured for the study, a portion of the entire data set was sampled. Sampling is that part of statistical practice concerned with the selection of individual observations intended to yield some knowledge about a population of concern. One of the advantages of sampling is that it is possible to ensure homogeneity and to improve the accuracy and quality of the data because the data set is smaller and more representative. To determine a proper sample size, equation 1 was used.

$$n = \frac{z^2 * p(1-p)}{c}$$

Equation 1

Where n is the required sample size, z is the standard value of the confidence level at 95% (1.96), p is the estimated percent of population, and c is the margin of error at 4%

(0.04). Thus with a confidence level of 95% and a margin of error of 4% of the approximately 4000 fluted points in the study area, 522 were needed to be sampled to produce a measure of diversity (Kintigh 1984), which is less than the 561 fluted points recorded.

Next the richness of the sample was determined using a rank-order frequency accumulation curve (Figure 10) through "sampling to redundancy" (STR) (Dunnell 1986; Lyman and Ames 2007). In STR new samples are added successively to a collection until the value of the target variable is stable across several successive sample additions (represented by a flattened curve), so that the total sample is representative of the target variable because all information in new samples is redundant (Dunnel 1986) In Figure 10 the curve of the graph will ultimately flatten once unknown and unidentified sources are accounted for .

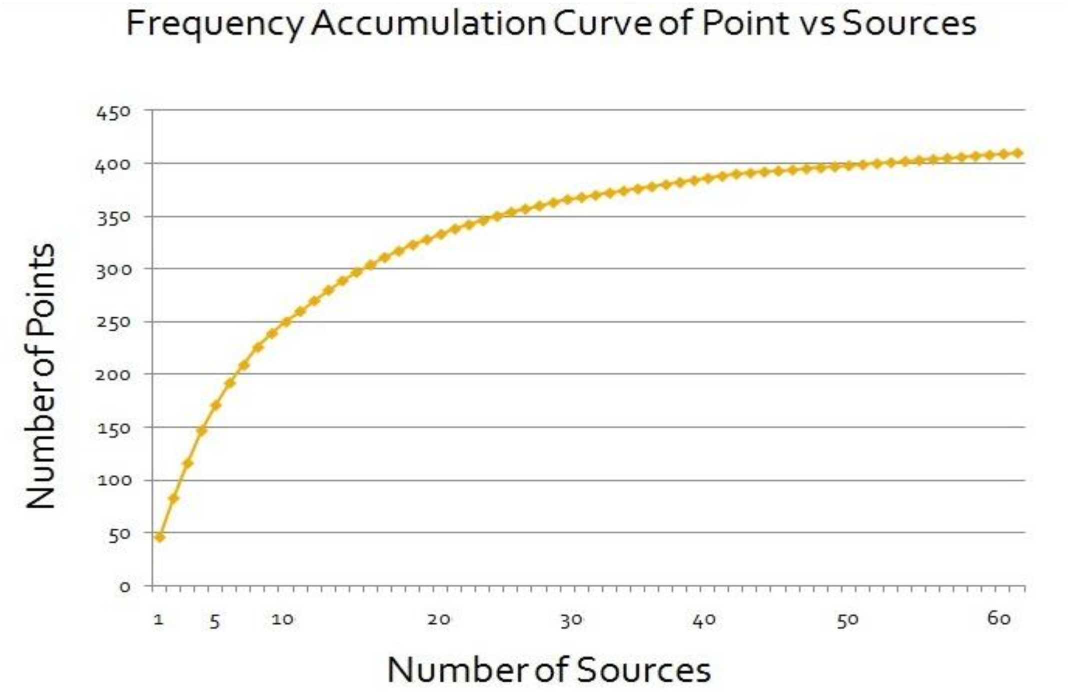


Figure 10: Rank Order Accumulation Curve

Data sample problems

From the literature there are several problems in recording the samples. First, not all points were able to be measured fully, usually due to their lack of completeness. This included only distal or basal ends, midsection with no basal, and points whose ears were considered to be too broken (Figure 11 for an example from the Debert site) These were excluded from the sample, except as lithic source place holders. Second, not all recorded points were illustrated or photographed, so their measurements could not be taken nor could they be identified to a lithic source.

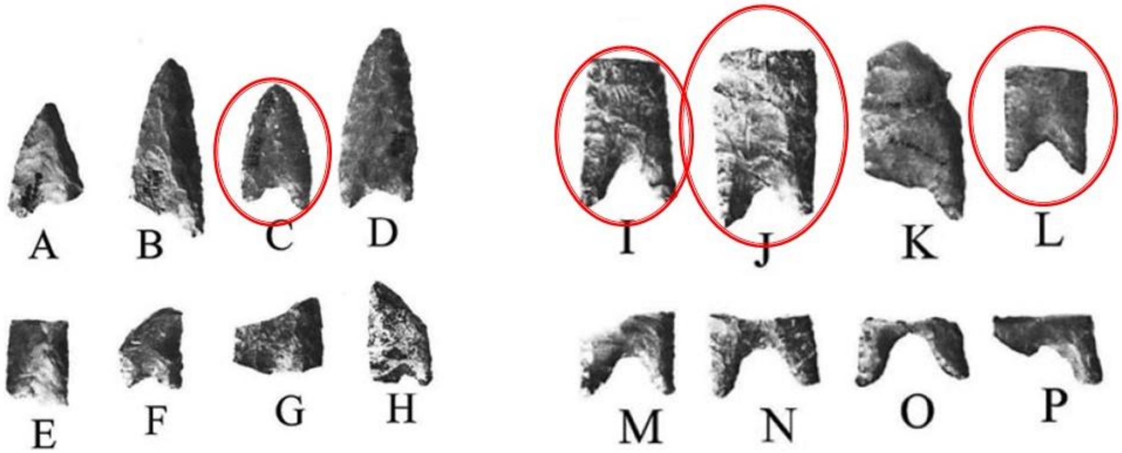


Figure 11: Fluted points for the Debert Site (MacDonald 1968). Red circles indicate those points that were complete enough to be measured

Measurements

Using descriptive and other statistics to describe qualitative and quantitative characteristics of fluted points for correlation analysis in comparing intra-site assemblages has a long tradition (cf. Mason 1958; Prufer and Baby 1963; Fitting et al. 1966; Mackenzie 1970). The collected metrics needed for this analysis came from a variety of measurements with the most comprehensive using 32 landmarks to create 12 variables (Buchanan and Hamilton 2009:283)

For this study the selection of measurements were based upon what could be measured from a photograph or illustration. Other measurements, which may have been recorded in the reports, like artefact thickness, were not considered because they were not available for every fluted point measured.

Also the length measurement was not used because many points had the distal end broken off, and even on whole/complete fluted points length may be more influenced by resharpening.

Core Measurements

The six measurements recorded (Figure 12) for this study are:

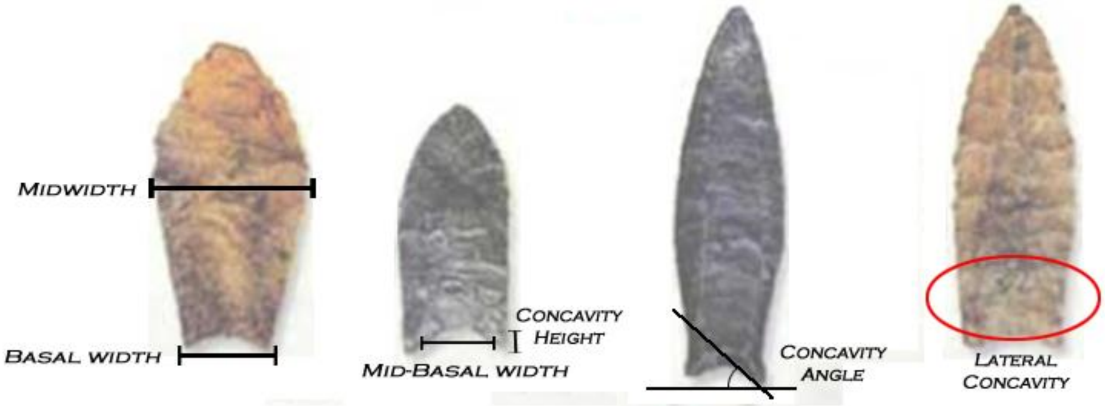


Figure 12: Location and Variable of Measurements taken

1. Midwidth (or measurement at the widest point)

2. Basal width, taken from ear to ear. If one ear was broken a measurement would be taken to the centreline of the artefact and then doubled. By testing this method on artefacts that had both ears, it was found that negligible difference was made.

3. Basal Concavity Height. This is taken from the apex of the basal concavity to the base of the artefact along the centreline.

4. Mid-basal Width is measured at half the basal concavity height across the inside of the basal concavity.

5. Concavity Angle, measured from the base on the medial side of the ear, along the inside of the concavity.

6. Lateral Concavity. Unlike the other measurements, which were ratio, this measurement was ordinal, following Ellis' (1984a) indicators of "none", "slight" and "full". This was later converted to numeric values (0, .5, and 1 respectively) for ease in statistical applications.

Ratio Measurements

Because the artefacts that were photographed or illustrated were presented at differing scales, some of which had no scale, ratio measurements were calculated from the recorded measurements. The two new values determined are :

1. Midwidth: Basal Width (mw:bw), which gives an indication of parallelness, narrowing or widening from the base towards the shoulder. The equation used is simply

$$mw{:}\,bw = \frac{mid-width}{basal\ width} \qquad \text{Equation 2}$$

2. Focal Length. This measurement was chosen to describe the parabola of the basal concavity and has not been seen in the literature. Using Mid-basal Width (mbw) and Concavity Height (ch) the equation is:

$$fl = \frac{-(ch*ch)}{mbw} \qquad \text{Equation 3}$$

To improve the correlation in the following clustering procedures (see Baxter 1994:168-169), using the above two characteristics these values were then normalized to have standard variance using:

$$z = \frac{x-\mu}{\sigma} \qquad \text{Equation 4}$$

where x is the raw score, μ is the mean and σ is the standard deviation.

One key descriptive measurement to determine differences in point types that was not used but has been shown to provide separation is the width:thickness ratio. However, Goodyear (1979:32) determined, using Pearson's (r) product moment correlation coefficient to test for the co-variance (thickness and width) that while there was a difference in the value between "Clovis" bifaces and Middle-Paleo ("Gainey" phase) points, it was not significant.

Morphology Classification

To add another distinction to each fluted point sampled, the points were classified based on morphology, that is to say the shape of the artefact with the aim of discovering patterns of groupings. Classification into groups is based on the premise that from the metrics, artefacts similarities within groups are more alike than between groups. To do this, three techniques were used; Discriminant Analysis, Hierarchical Clustering and Agglomerative Clustering. The statistical program SPSS version 16 was used in calculating the following results (SPSS 2009).

Discriminant Analysis

Prior to group classification of fluted points a discriminant analysis was performed. Discriminant analysis is a type of supervised feature extraction algorithm that can help determine which variable, if any, is the dominant variable that can then be used in additional classification tests. Discriminant analysis is a technique that divides the points into groups on the basis of independent criteria derived from the data (Shennan 1997; Martinez and Hamsici 2008). The test used lateral concavity (none, slight, full) as it basis using Focal Length and Mid-Width:Basal Width ratio as the key variables for this procedure. Testing was carried out to understand the importance of each variable so that they could be weighted, or not, in future analysis.

Part of the output from a discriminant analysis test is Wilk's lambda. Wilk's lambda is calculated to determine how group homogeneity is influenced in relation to the criterion variable (Aldenderfer 1982:66, Harris 2001:231-232).

Results

The results for discriminant analysis, particularly the Wilks Test, showed that while both variables were independent, neither were significantly dominant. The scores were 1.000 and 0.997. Using a stepwise procedure, all of the variance was accounted for in 26 steps. Thus in the following two classification procedures, neither variable was weighted.

Hierarchical Clustering

Hierarchical clustering is a type of cluster analysis that uses a top-down approach making use of numerical procedures to divide a given group of units into homogeneous sub-groups. Also known as *divisive,* all points begin as one group and are then recursively split into smaller and smaller clusters using nearest neighbour analysis to describe the inherent relationship between items (Adams and Adams 1991:281; Shennan 1997:235). This type of clustering creates a dendrogram, which is a visual representation of the relationship between types (Adams and Adams 2008:334) and was used to examine the number of potential classes

Results

Two dendrograms were calculated: one for no lateral concavity using 375 points and another for full lateral concavity consisting of 91 points. A dendrogram for slight lateral concavity was not produced due to the small sample size of 25. On close examination of the full concavity dendrogram, most points divided out around a distance of 5 steps. The number of identifiable clusters at this distance was four. The dendrogram for points with no lateral concavity indicated that at the similar distance of 5, six clusters were defined.

Agglomerative Clustering

Agglomerative classification uses a partitioning method that uses a predetermined number of clusters in which individuals are assigned to the cluster with the nearest mean (Shennan 1997:250-251). For this clustering technique, a k-means algorithm was used so that distance of within group means is minimized while the distance between groups is maximized (Hodson 1970:311-312). The number of initial clusters is based on the number of classes from the hierarchical clustering. The test was performed multiple times with $k = 4\text{-}9$ for no lateral concavity, $k = 2\text{-}7$ for full lateral concavity, and $k = 1$ for slight lateral concavity. As in the previous test, the key variables Focal Length and Mid-Width:Basal Width were used .

Results

The outcome of these tests led to 11 morphological groups. Six groups were based on points with no lateral concavity, four with full lateral concavity, and one group with slight lateral concavity. The average shape of each group is shown in Figure 13 for comparison. Within the "no lateral concavity" group, the shape seems to vary widely, especially between the parallel sided "Bullbrook" points and the high shouldered "Crowfield" points. In both the hierarchical classification and the agglomerative classification, the high shouldered points always separated out early. In contrast, the four groups with full lateral concavity have less variation in the MW:BW. Spatially (Figure 14:a-i), all 11 classes occupied all regions within the study area with many sites containing two, three or more classes. The varying concentrations seen were based on their abundance within the sample size.

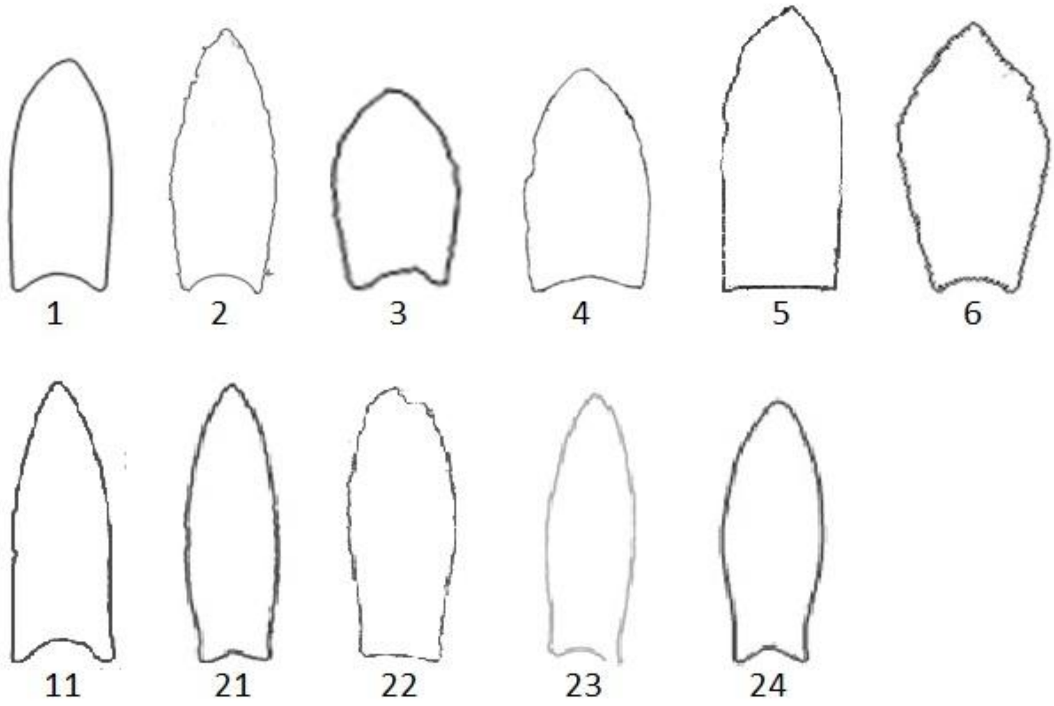
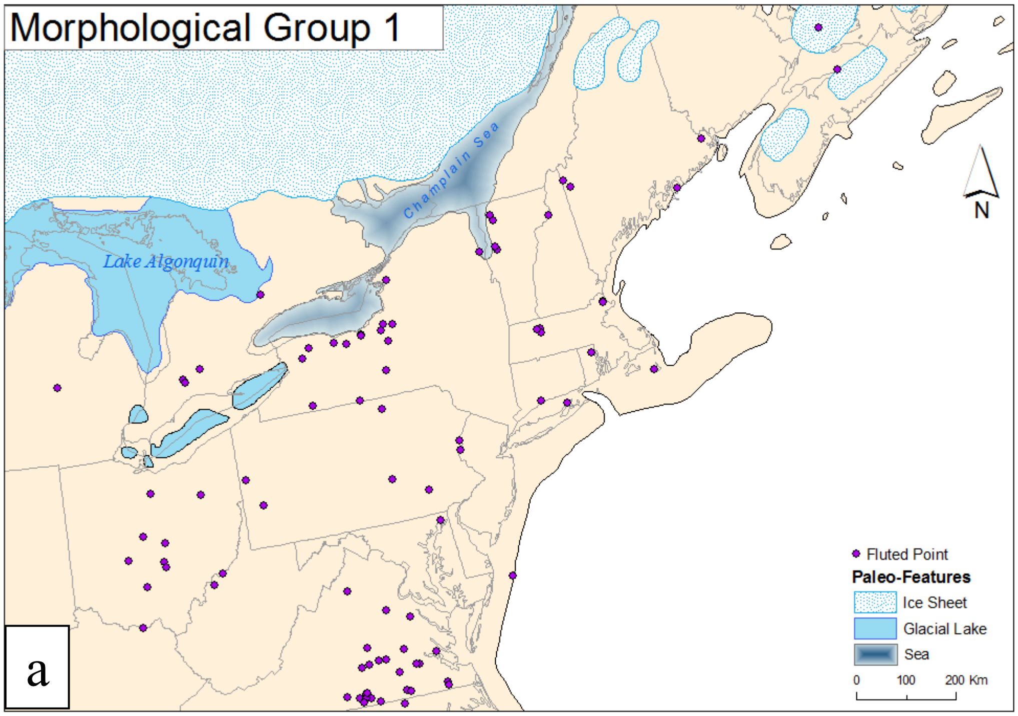
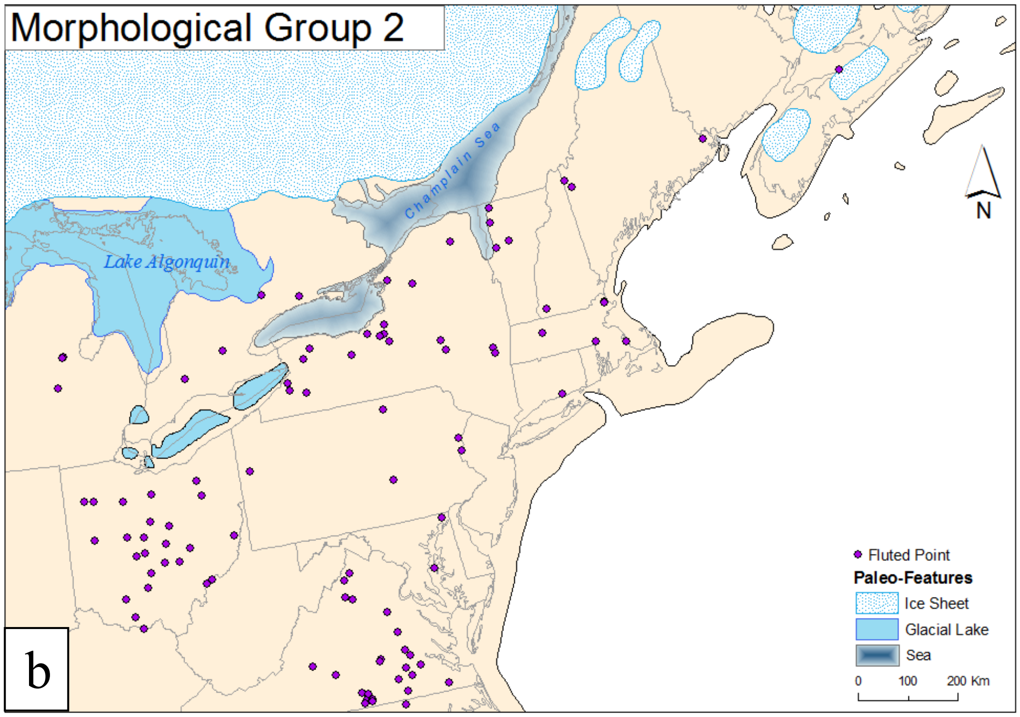
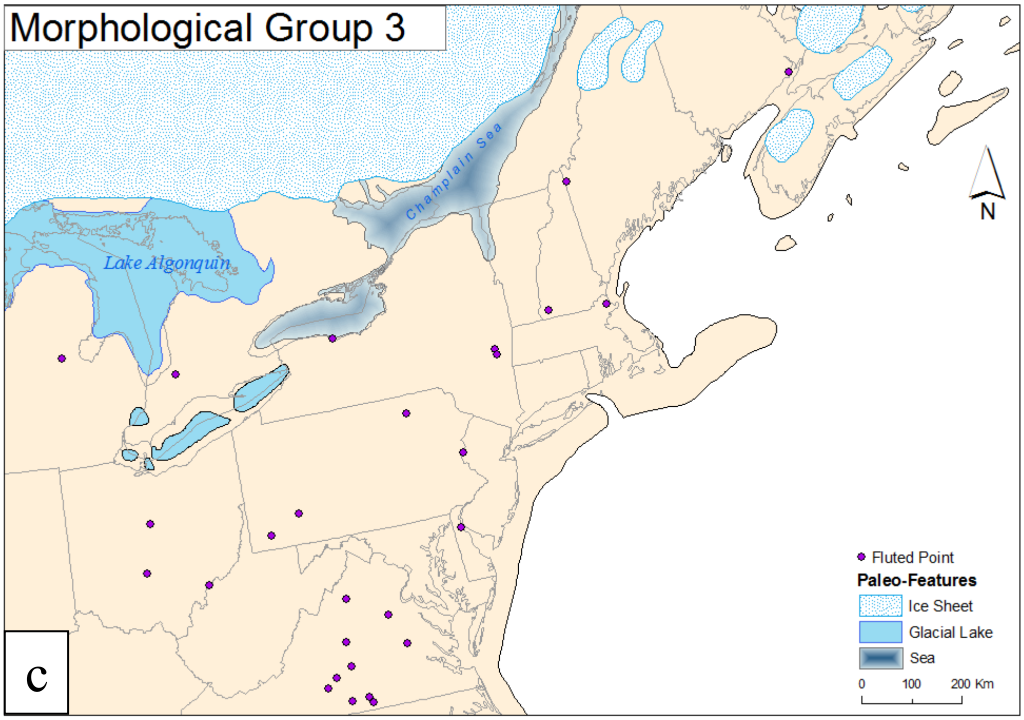
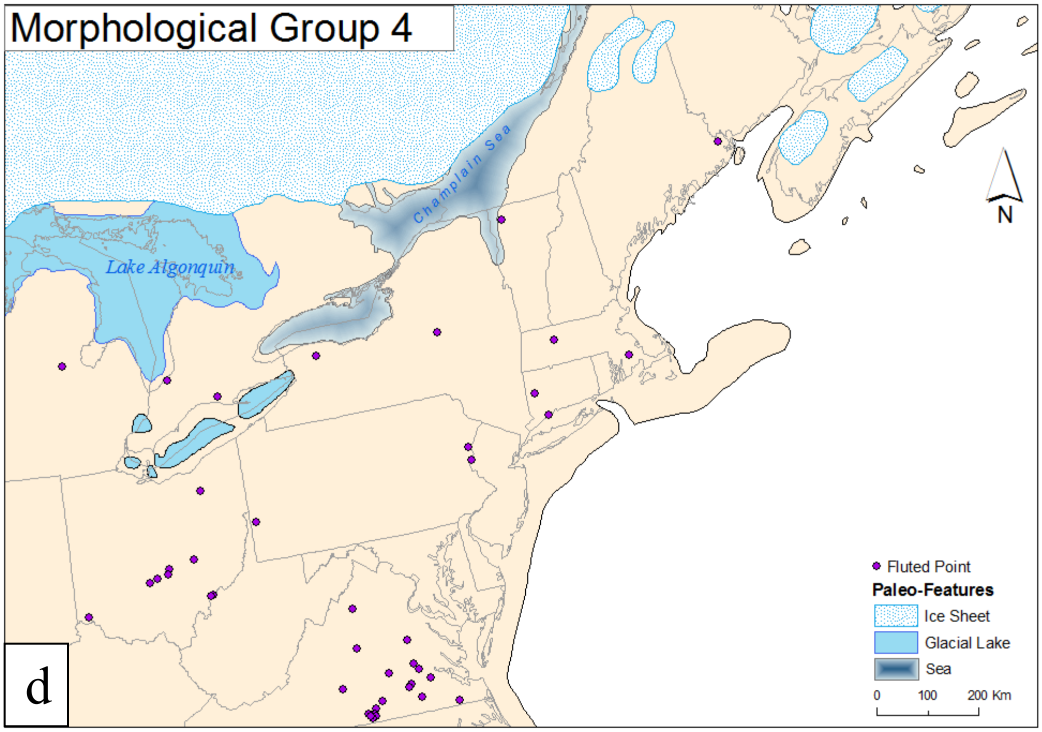


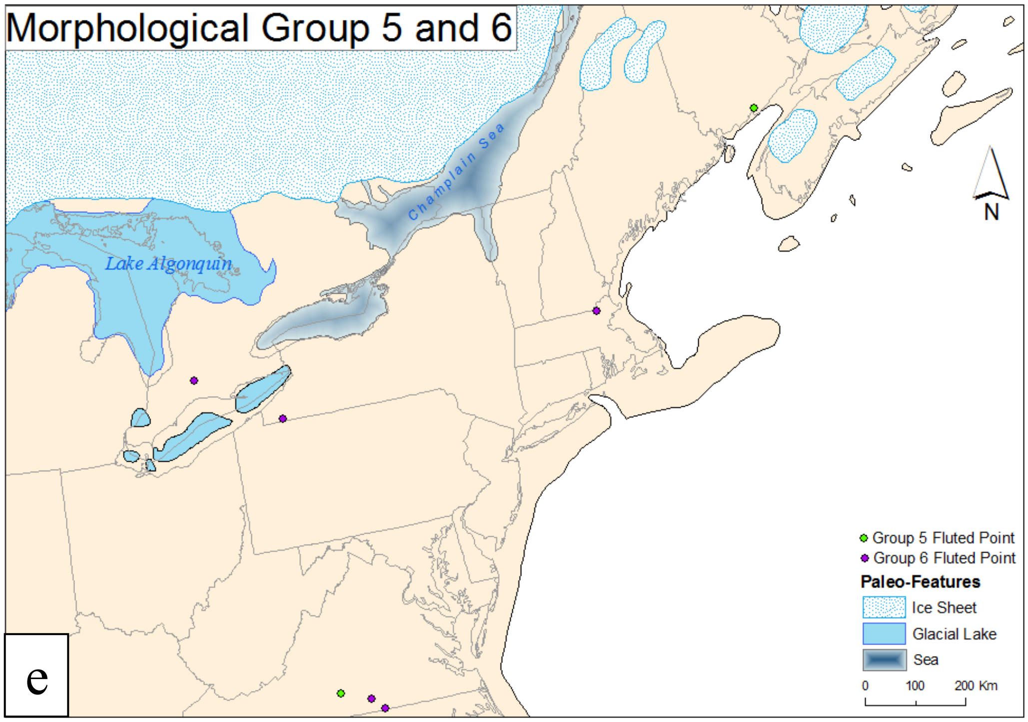
Figure 13: Average shape profiles for the determined Morphological Groups. Morphological Groups 1 – 6 have no lateral concavity. Morphological Group 11 has slight lateral concavity and Morphological Groups 21 – 24 have full lateral concavity.

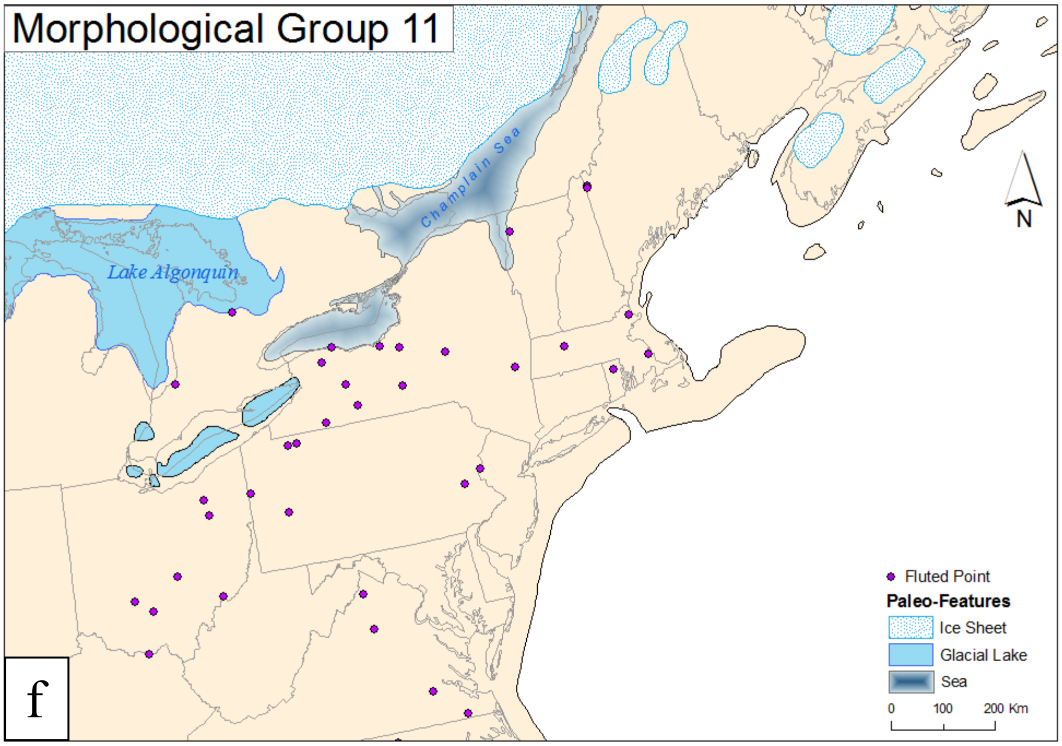


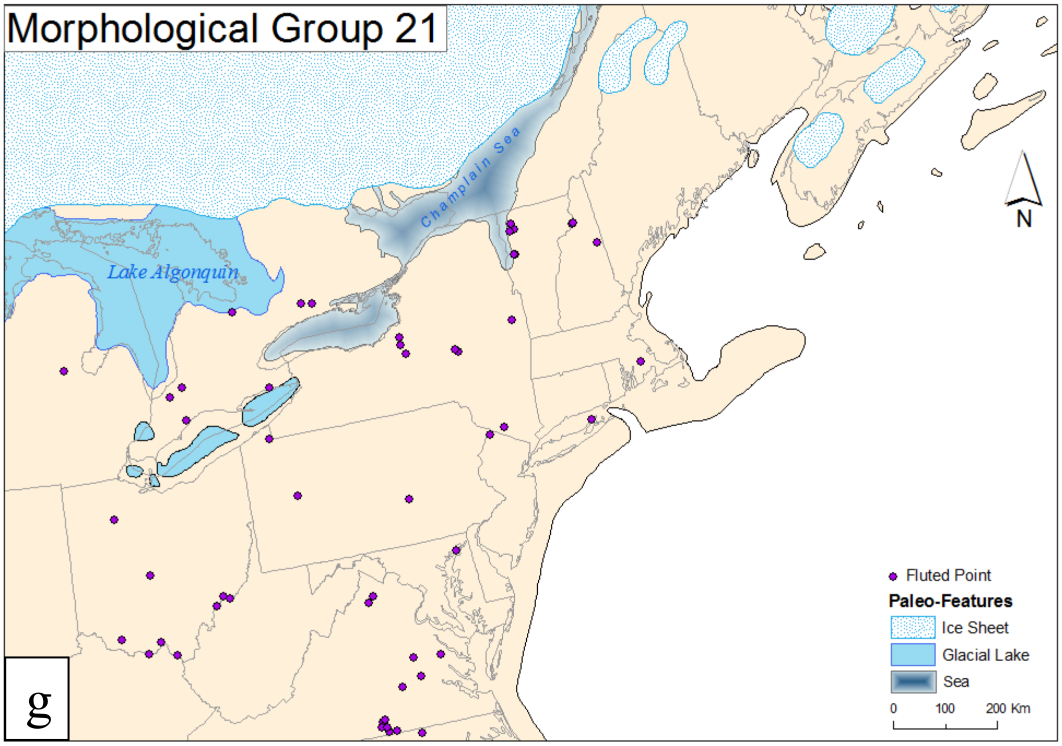

Morphological Group 2
Lake Algonquin
Champlain Sea
N
● Fluted Point
Paleo-Features
Ice Sheet
Glacial Lake
Sea
0 100 200 Km
b


Morphological Group 3
Lake Algonquin
Champlain Sea
N
● Fluted Point
Paleo-Features
Ice Sheet
Glacial Lake
Sea
0 100 200 Km
c


Morphological Group 4
Champlain Sea
Lake Algonquin
N
● Fluted Point
Paleo-Features
Ice Sheet
Glacial Lake
Sea
0
100
200 Km
d


Morphological Group 5 and 6
Champlain Sea
Lake Algonquin
N
● Group 5 Fluted Point
● Group 6 Fluted Point
Paleo-Features
Ice Sheet
Glacial Lake
Sea
0
100
200 Km
e


Morphological Group 11
Champlain Sea
Lake Algonquin
N
● Fluted Point
Paleo-Features
Ice Sheet
Glacial Lake
Sea
0
100
200 Km
f


Morphological Group 21
Champlain Sea
Lake Algonquin
N
● Fluted Point
Paleo-Features
Ice Sheet
Glacial Lake
Sea
0
100
200 Km
g

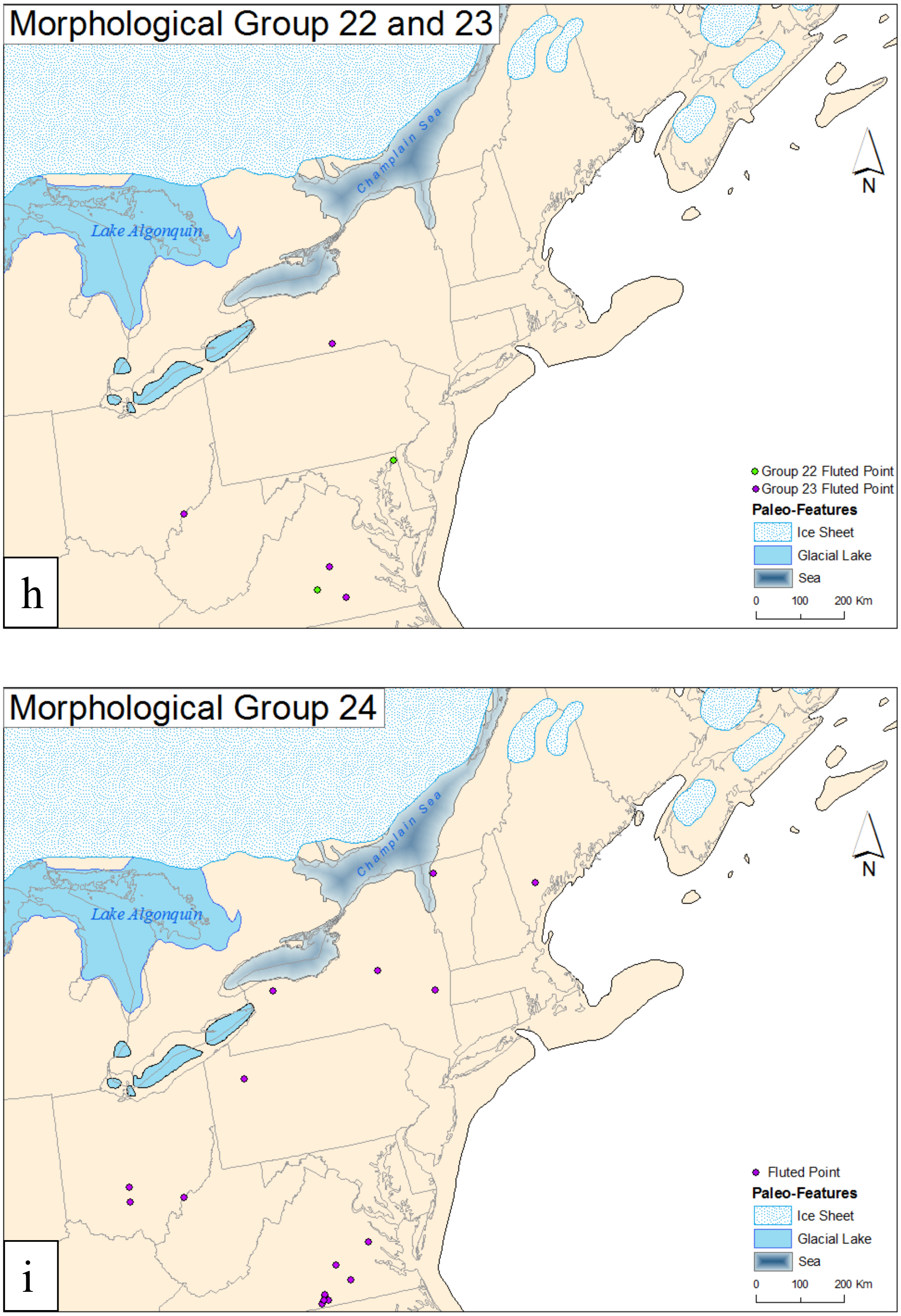


Figure 14a-i: Distribution of fluted points by Morphological Group. a) Group 1, b) Group 2, c) Group 3, d) Group 4, e) Group 5-6, f) Group 11, g) Group 21, h) Group 22-23, i) Group 24

Spatial Clustering

Part of the methods used in ESDA are suited for identification of clustering vs. random or dispersed point arrangements. To understand the point pattern two tests of spatial autocorrelation were performed. Spatial autocorrelation analysis includes tests and visualization of both global (test for clustering) Moran's I and local (test for clusters), using LISA (Local Indicators of Spatial Association) (Anselin 1995). The program GeoDa (Center for Geospatial Analysis and Computation 2009) was used for these tests.

Spatial Autocorrelation

Spatial autocorrelation is defined here as the coincidence of value similarity with locational similarity (Anselin 2000). Therefore there is positive spatial autocorrelation when high or low values of a random variable tend to cluster in space and there is negative spatial autocorrelation when geographical areas tend to be surrounded by neighbours with very dissimilar values.

The measurement of global spatial autocorrelation is based on the Moran’s I statistic, which is a widely used measure of spatial association (Cliff and Ord 1973, 1981; Upton and Fingleton 1985; Haining 1990). Moran's I is defined as:

$$I = \frac{N}{\sum_i \sum_j w_{ij}} \frac{\sum_i \sum_j w_{ij}(X_i - X)(X_j - X)}{\sum_i (X_i - \bar{X})^2}$$

Equation. 6

where *N* is the number of spatial units indexed by *i* and *j*; *X* is the variable of interest; $\bar{X}$ is the mean of *X*; and w_{ij} is a matrix of spatial weights.

Both morphological group and lithic source were used as variables of interest univariately, to determine if there is a correlation between type of point or lithic source and the location of the fluted point. The test for spatial autocorrelation was also done biavariately using Focal Length and Mid-Width: Base-Width ratio variables.

Results

Noting that positive (negative) values indicate positive (negative) spatial autocorrelation, Moran's I values range from −1 (indicating perfect dispersion) to +1 (perfect correlation) whereas values near zero indicate a no spatial autocorrelation.

For Morphological Groups the resultant Moran's I was 0.13 (significant $p<0.01$), indicating no spatial correlation. Whereas for Lithic Source, Moran's I was 0.59 (significant $p<0.01$), indicating that fluted points with the same lithic sources tend to more closely associated.

Local Indicators of Spatial Association (LISA)

Anselin (1995) defines a local indicator of spatial association as any statistics satisfying two criteria. First, the LISA for each observation gives an indication of significant spatial clustering of similar values around that observation; second, the sum of the LISA for all observations is proportional to a global indicator of spatial association.

Local analysis is based on the Local Moran statistic, visualized in the form of significance and cluster maps. These can be used as indicators of local spatial clusters.

The maps (Figures 15 and 16) depict the locations with significant Local Moran statistics and classify those locations by type of association. On cluster maps the high-high (red) and low-low (blue) locations (positive local spatial autocorrelation) are typically referred to as spatial clusters, while the high-low and low-high locations (negative local spatial autocorrelation) are termed spatial outliers (Anselin 2003:90). While outliers are single locations by definition, this is not the case for clusters.

The cluster is classified as such when the value at a location (either high or low) is more similar to its neighbours (as summarized by the weighted average of the neighbouring values, the spatial lag) than would be the case under spatial randomness. Any location for which this was the case was labelled on the cluster map.

Results

At the regional level, the above results from Moran's I can be visualized better. The local Moran statistic for Morphological Groups is -.0041, which indicated no spatial autocorellation. However, there was a small area of exception in Southern Virginia (Figure 15). For Lithic Sources, the local Moran's I was 0.64. This is reflected visually (Figure 16) in the concentration of like points in Virginia, around southwest Ontario and the north-south corridor to the east of Lake Ontario, south of the Onondaga bluff.

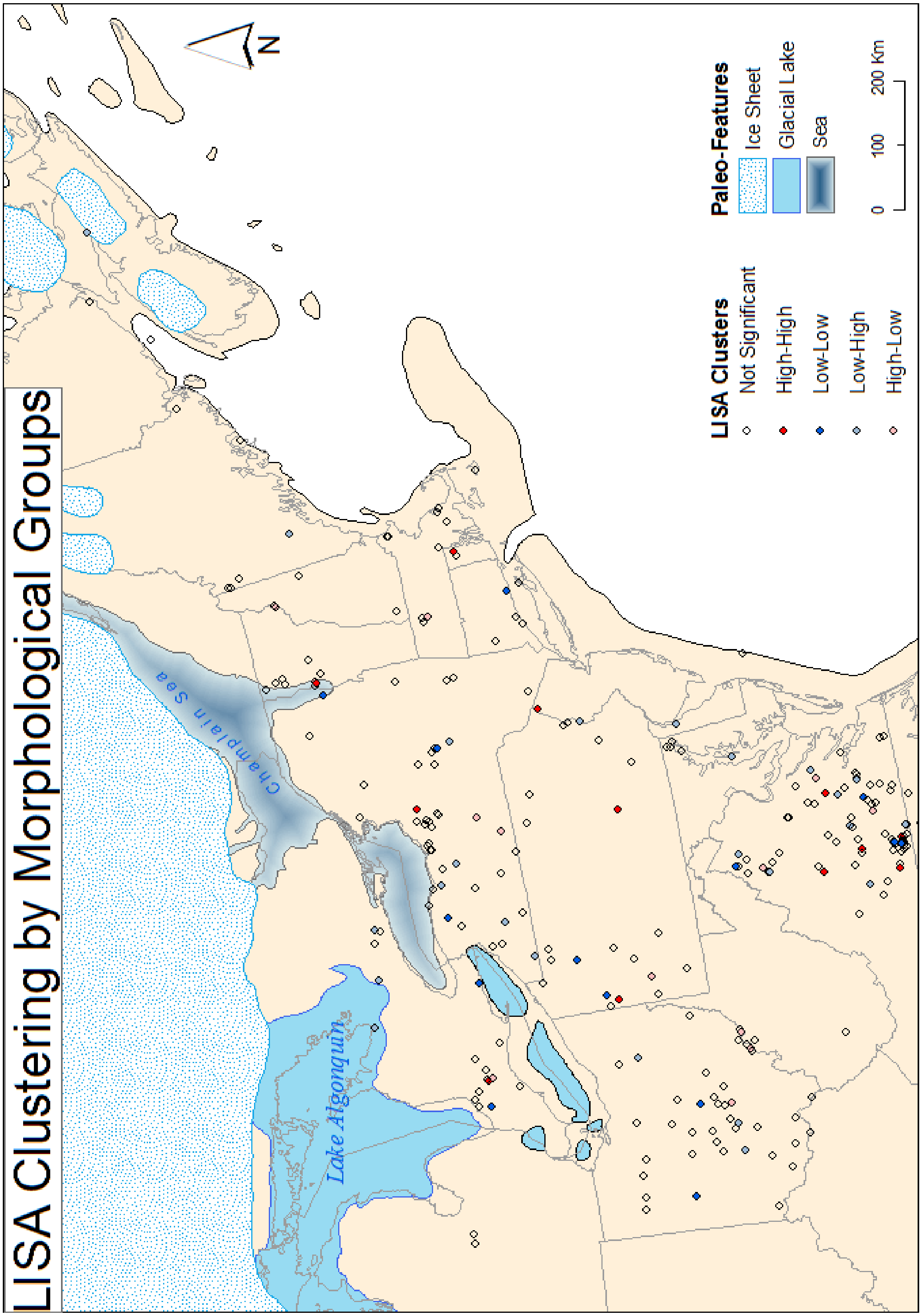


Figure 15: Localized Clusters using the Morphological Group variable

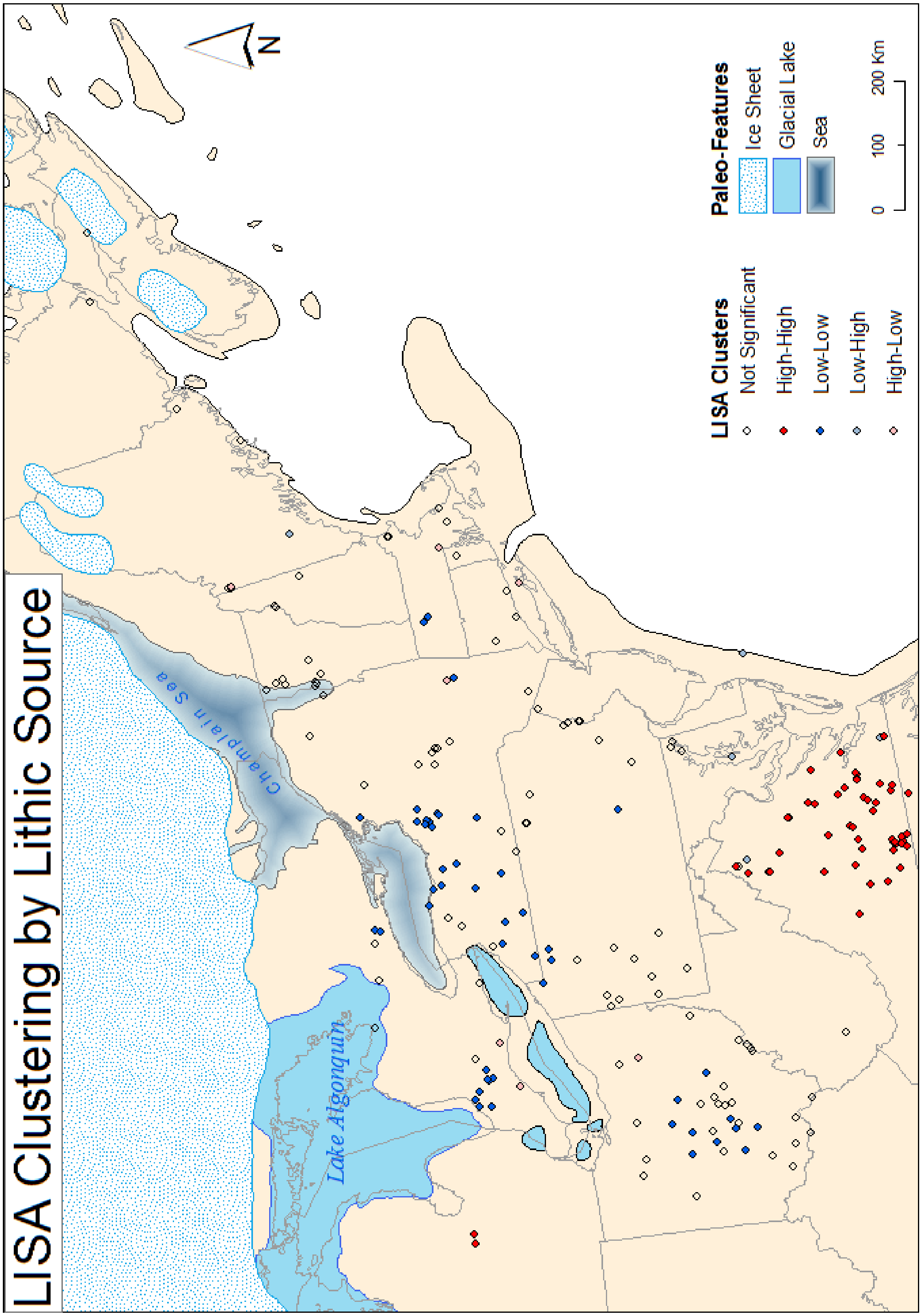


Figure 16: Localized Clusters using the Lithic Source variable

Directional Statistics

Using, what may be a very new approach to understanding territoriality, directional statistics can provide trends in the movement of lithic material away from the source. This will provide a proxy to determining territorial extents. Direction statistics uses vectors where there is a point of origin and in both planar and three dimensional space (Marida and Jupp 2000). Because directions are considered to be points on a circle, the statistical method uses angles (θ) and, radians θ (2π) to determine orientation. Momentum is used as an equivalent for distance. In this study summary statistics for mean direction and mean momentum are used. The equation is;

$$LDM = \arctan \frac{\sum \ \sin\theta}{\sum \ \cos\theta} \qquad \text{Equation 7}$$

where θ is the direction from a single angle (lithic source).

Results

The resulting directional means mapped in Figure 17 indicates the Euclidian path (directional arrows), the average distance the lithic material was moved (line length) and the volume of lithic transportation (line thickness). The figure further illustrates three trends. One, low volume but long distance movement from the west indicating direction of migration. Two, localized low volume transportation of lithic material, which may indicate movement within a possible range, and three, high volume movement between dominant lithic sources indicating the possible extents of a range. This will be expanded upon in the next chapter.

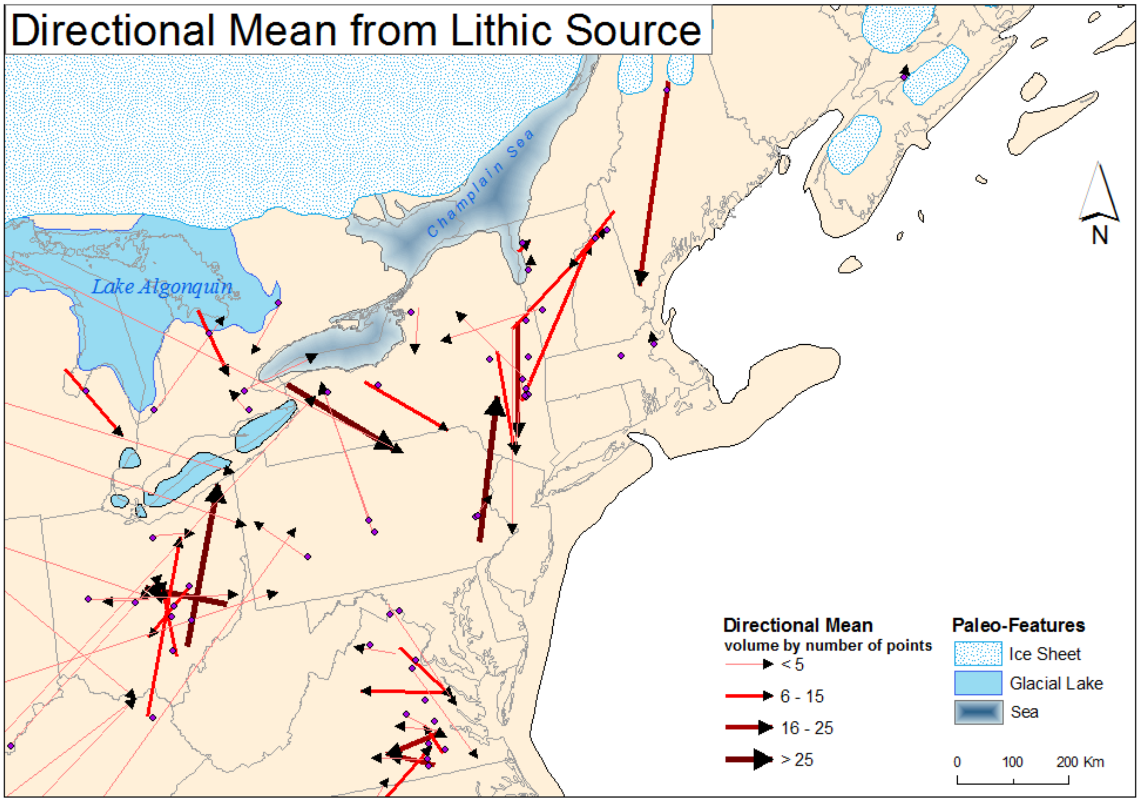


Figure 17: Direction Mean of the transportation of lithic material from the source.

Chapter 4:
Paleo-Territories

By defining territories for Fluted Point peoples, better information about settlement patterns can lead to a better understanding of social organization and adaptive subsistence strategies. Archaeologists, beginning with Hester (1972) at Black Water Draw, have hypothesized the establishment of territories used by Fluted Point peoples for their seasonal rounds. Territories are defined here as a geographically defined range that may be separated by a buffer zone or natural boundary, where a group has exclusive rights to the resources within (Beardsley et al. 1956; Storck and von Bitter 1989:181). The idea of a range is manifested as the cyclical bi-directional movement that can be inferred through the interchange of lithic material from different regions (Storck and von Bitter 1989:183). The bidirectional movement of lithic raw materials, is described by Storck and von Bitter (1989:187) as “settling in” and may reflect the establishment of regional territories, whereas “unidirectional flow of lithics reflects a pattern of colonization” (Tankersley 1991:296). Unidirectional movement has also been interpreted as exchange or trade between groups (Hayden 1982:117) and need not imply the movement of people or as a "recurrent long-term pattern of movement from lithic supply zones" (Hofman 2003:240). For this study, the use of lithic material for fluted points, especially those of a non-local origin, and their distance from the source are used to illustrate the movement of Fluted Point Paleo-Indians across the landscape.

Cautions

It is important to be cautious about mapping territories based strictly on distributions of lithic sources because source identification can be faulty (e.g. Lantz 1984, Gardner 2002) or influenced by the use of secondary cobbles, which have been transported by glacial activity (Meltzer 1985, Gardner 2002). Inaccuracy in sourcing lithic tools can be due to non-uniformity of lithic material from any given source, similarities among different sources or weathering. The Onondaga formation, for example, is 200 km in length and changes colour and composition across its range (Jarvis 1988); whereas the Limerock jasper outcrop in Rhode Island is similar to Pennsylvanian jaspers from the Vera Cruz outcrop (Georgiedy and Brockmann 2002:78,103). Also, when a fluted point is heavily patinaed, it is often difficult to identify the material from which it was made (Peck 1998).

Fluted Point Morphology

Morphological differences in overall fluted point shape have been proposed to identify regional variation based on group affinity (Sackett 1990) and temporal phases (Deller and Roosa 1982; Ellis and Deller 1986), with morphological differences increasing as territories become restricted (Ritchie and Funk 1973). The results from classification, however, indicate that a variety of differently shaped points were used across the study area and throughout the time horizon. Morphological similarities "may mark the spread and dispersal of a historically related population" (Meltzer 2002:160). The co-occurrence of different point morphologies has been noted in the West (Willig 1991:100) and is clearly illustrated in the Naco mammoth find (Haury 1953). The fluted points associated with the kill that got away have similar morphology to both "Gainey/Bullbrook" and "Barnes/Parkhill" points (Figure 18) and fit into the morphological schema presented. Variability in point morphology have been attributed either to stylistic idiosyncrasies (Storck 1994:29), discrepancies from errors in the knapping process (Spaulding 1960:66) or functional (Cotter 1938 in Gardner and Verrey 1979; Kraft 1973) . Buchanan and Collard (2007) explain this intra-assemblage variation as a rapid and repeated fissioning colonisation process. Similarities in morphology are attributed to tradition that withstands the time-transgressive expansion eastward and northward; whereas differences in morphology are attributed to "developmental drift". (Lothrop 1988: 37; Morrow and Morrow 1999; Hamilton and Buchanan 2009).

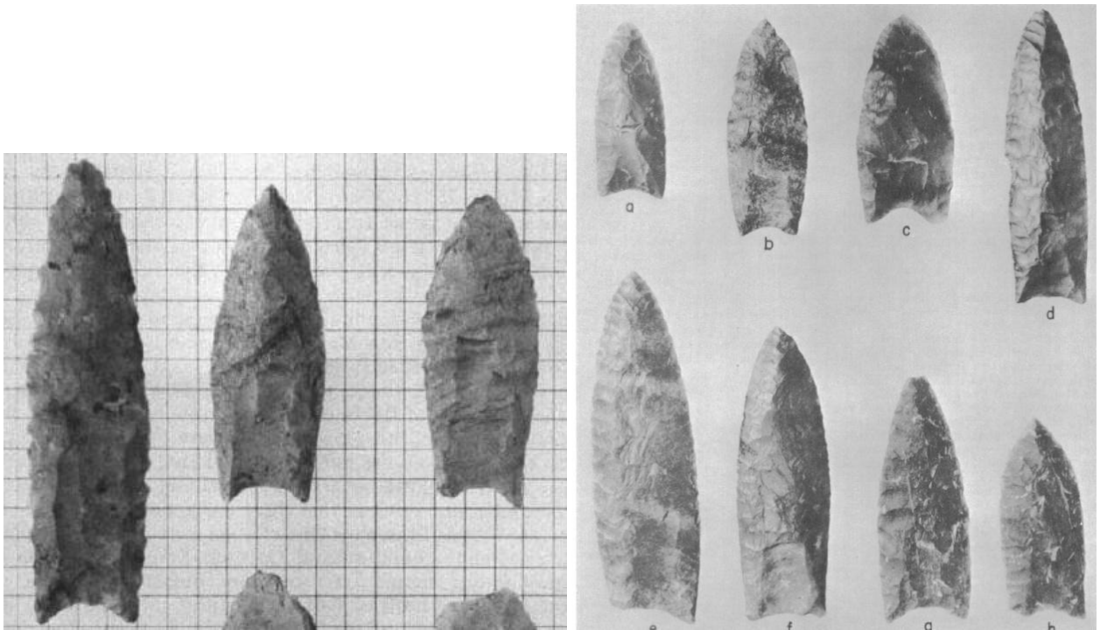


Figure 18: Left, Points from Parkhill, Ontario (Roosa and Deller 1982). Right, points from Naco Mammoth Kill, Arizona (Haury 1953)

Morphological group 1 (Figure 14a) is characterized by parallel sides and a proportionally deep basal concavity and accounts for 26% (140 of 532) of the sample.

The specimens are found throughout the study region from Nova Scotia to southern Virginia and have secure dates from 11,020 BP (Arc) to 10,550 BP (Vail). Even when metrics are used individually, like basal concavity height, fluted points are still widely dispersed. That this is a wide distribution for any given fluted point morphology and that differing morphological groups co-occur at single locus sites suggests Eastern North American Fluted Point peoples shared a common technological suite that did not contain regional distinction and was shared across the continent (Dragoo 1973; Gardner 1974; Kardulias and Yerkes 2003:1). This differs from a more traditional view where differences within Paleo-Indian toolkits suggest regional variation (e.g. MacDonald 1968; Haynes 1971; Cox 1972). Though, some regions may have a greater homogeneity in morphological shape that may prove useful in the analysis of territoriality.

Lithic Procurement

Several important questions have been raised over the procurement of lithic material and how it applies to movement patterns. One question is whether the procurement was direct or indirect. Direct procurement means that the lithic material used in fluted points was acquired at the source by the group using it. Indirect procurement can happen in two ways. Either the material was glacially or fluvially transported as cobbles from the original or unknown source or lithic material was obtained through exchange as either finished fluted points or raw cores.

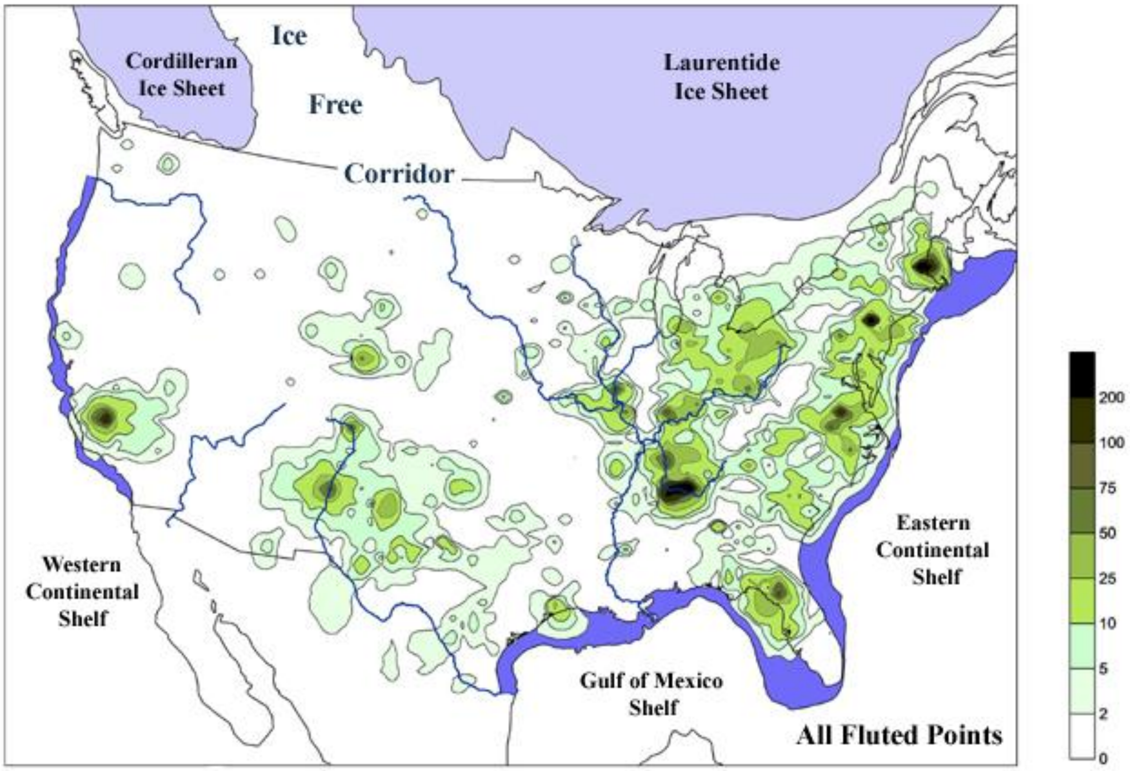
The majority of Paleo-Indian researchers indicate that direct procurement was the primary or only method of obtaining lithic material. The use of indirectly procured cobbles for tool manufacture has been proposed by a few researchers (Meltzer 1985, 1989; Moeller 2002). Moeller (2000: 92-93) argues against assuming that "physically characteristics" of a chert type indicates that it came from a known source. Rather, Moeller gives the example of finding cobbles "having traits similar to known distance sources (130 km) only 10 km away from 6FL21" (Moeller 1984). Spiess (2002:145) counters this position by saying "Never have I seen a cobble cortex on a piece of chert debitage from the region [Northern New England]".

The other indirect method, procurement of lithic material through exchange has also been suggested by Meltzer (1989, 2002). Wiessner (1982, 1983) considers that exchange among hunter-gatherers is an important means of risk-reduction. Risk-reduction, especially in widely dispersed, low-population geographical regions, can be through alliance networks, where mates, information and resources, including lithic material, could be exchanged (Wobst 1976; Hayden 1982; Meltzer 2004). However, Deller and Ellis (1988:252) see few effects of distance decay on chert variety frequencies in assemblages as distance from source increases (see also Roosa 1977), which ultimately means that with a few possible exceptions procurement and transportation of lithic material was directly from the bedded source.

Free-Wandering vs Territories

Two interpretations of this transportation are that pioneering Fluted Point people are Free-Wandering or that they had territorial ranges. Free-Wandering as a pattern of subsistence adaption is not known in modern or historically known hunter-gatherer peoples (Ellis 1989:181), yet has been theorized for the end of the Pleistocene (Beardsley et al 1956:135-136). The concept of colonization into an unoccupied landscape could back this theory, especially knowing that Fluted Point peoples were generalized hunter-gatherers who could provide subsistence in many geographical areas. To assess whether or not Fluted Point peoples were Free-Wandering, a test of global spatial auto-correlation was performed on the distribution of points and compared to a randomly generated sample of points.

Looking at the density pattern of fluted points (cf PIDBA; fig 19) the visual indication suggests clustering. However, this is biased by the high concentrations of artefacts recovered near quarry/workshop sites (e.g. Williamson) or from finds at large sites (e.g. Bull Brook, and Shoop). To reduce this bias in the test for spatial auto-correlation, each location in this study was only represented by a single point to show spatial patterning. The Moran's I using this data set was 0.17, whereas the Moran's I for the randomly generated points is 0.002. This suggests that the spatial pattern for recorded fluted points has some areas of point clustering.



Points per 1000 Square Miles, N=12,791 Points)
May 1999 Update

Combination of point varieties
11,500 - 10,000 rcybp

Figure 19: Density of fluted points. Darker areas indicate greater density of points. From PIDBA 2009.

The occurrence of some lithic sources used over and over suggests that groups either returned to restock, or other groups found the same sources. The evidence points to a return to a known a source especially when few low-quality fluted points are seen. Also, multi-occupation sites like Vail (Gramly 1982) point to a return to a known hunting area, and, when coupled with similar lithic material in each loci, argues strongly for a group following a annual cycle of movement.

Movement into the Study Area

Before territories could be established, an initial migration from west to east into the study area occurred (Witthoft 1950; Storck 1989; Tankersley 1991). Rivers provided initial movement corridors, while the Great Lakes, the Laurentide Ice Sheet and Mountains provided bounding. Peck (1998) provides examples of heavy concentrations of fluted points near multiple river drainages, (i.e. Plenge, Sloop, Welling, Nobles Pond) and Dincauze (1993: fig 1) illustrates higher concentrations along major river systems. This is supported with evidence that nearly half (264 of 556) of the fluted points used in this research are within 10 km of a major river (Figure 20) and additional sites like Vail, Adkins and Williamson are on smaller rivers. Also, 50% (34 of 68) of the sources are either along or within 10 km of a major river, with another 12% (8 of 68) on the boundaries of the Great Lakes.

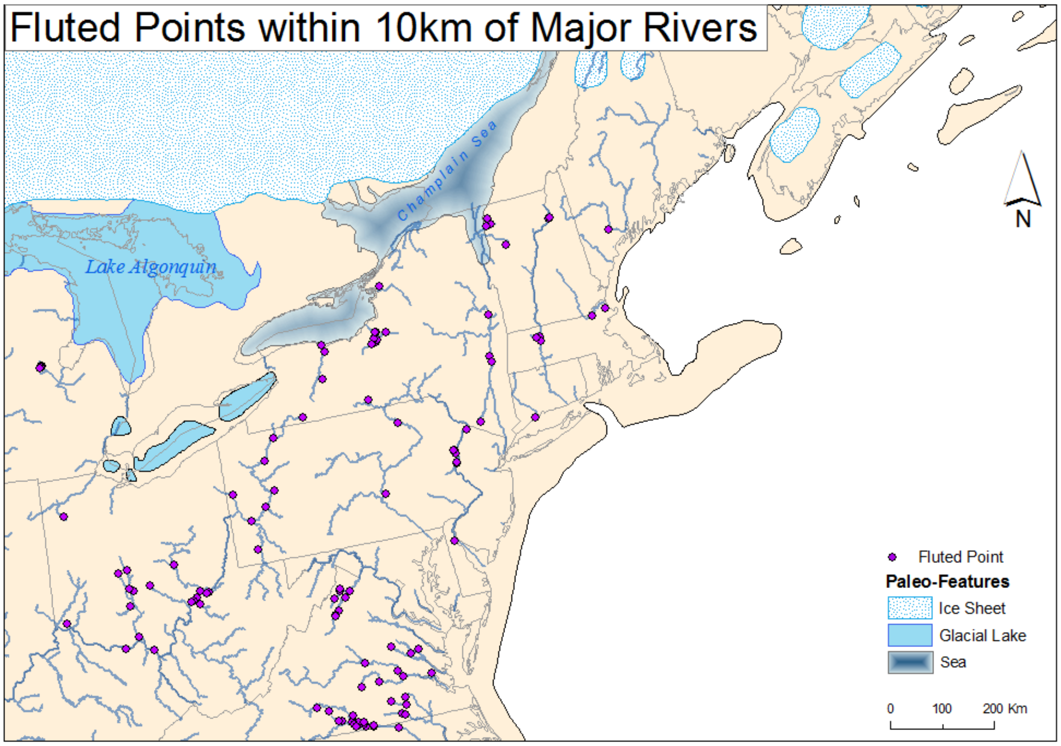


Figure 20: The distribution of fluted points that are within 10 km of a major river.

Eleven points recorded in the study area travelled greater than 700 km Euclidean distance, with four of those coming from lithic sources over 1000 km, and the greatest distance being close to 2000 km; a point made from Alibates chert located in Texas, deposited in south-eastern Pennsylvania (see Appendix A, "distance from source" field). The direction of movement for these points was primarily (9 of 11) west-east. Due to distance it is very unlikely that there was a return to the source, and thus can be considered unidirectional. At the site level, lithic diversity can also be used as an indicator of colonization (Curran 1999:20)

An example of this is the Lamb site (Gramly 1999). The Lamb site has two points made from sources more than 1000 km away and includes five widely spread lithic sources. Using the river system as a travel guide, an estimated one-way travel distance of 3350 km (Figure 21; black line) was needed to access all of the lithic resources. This makes a return trip to Knife River unlikely especially as known lithic sources were found closer. Isolated points of Knife River (Figure 21:orange star) and North Dakota Moonstone (Figure 21: blue star) are also found along the final leg of this migration. Additionally, the Sandy Springs site also includes a dispersed array of lithic sources, and mimics much of the same migration route (Figure 22). The bi-variate LISA results using source and morphological group as variables, shows significant outliers in south-western New York – north-western Pennsylvania. The sources of these points are all to the south-west, sugggesting this area was used as a route into the north. Other significant outliers also exhibit the use of material transported along possible migration routes.

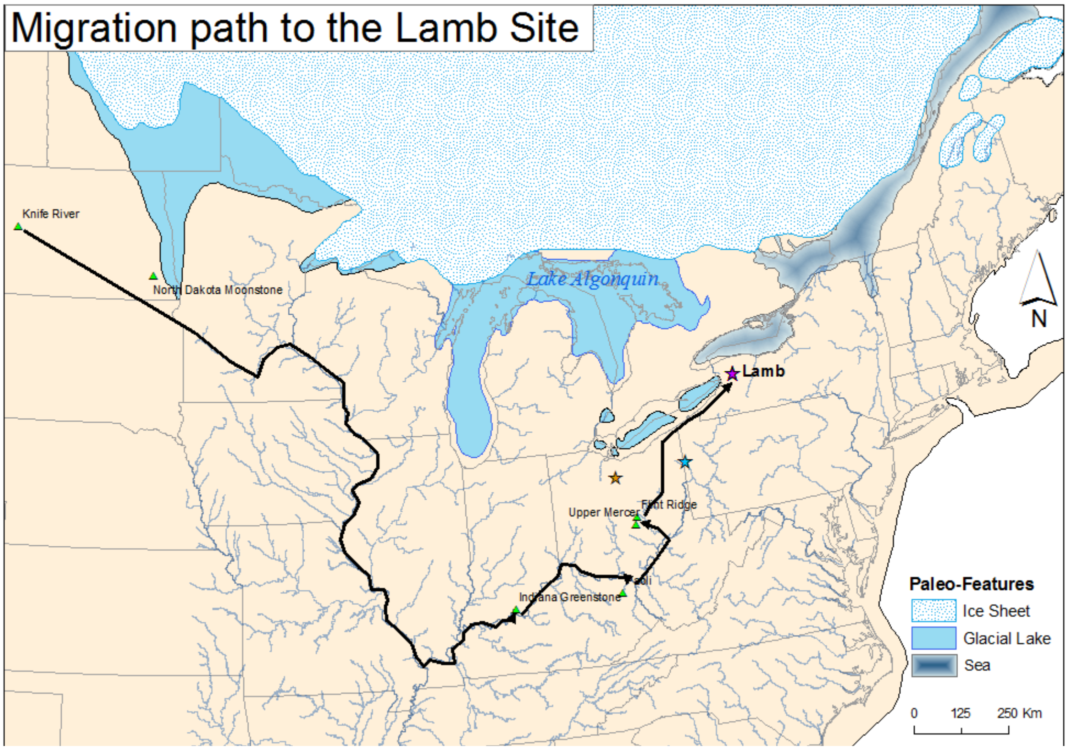


Figure 21: Migration route to the Lamb site, using major rivers to access assemblage lithic sources. The orange star is a fluted point made from Knife River flint, and the blue star is fluted point made from North Dakota Moonstone.

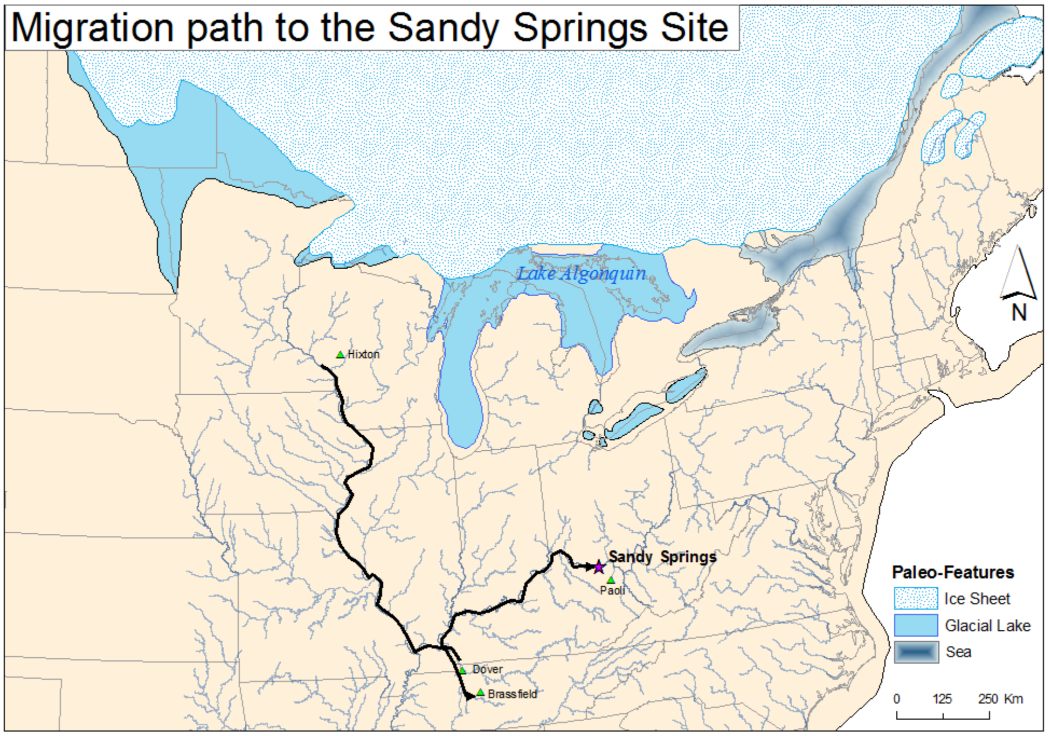


Figure 22: Migration route to the Sandy Spring Site using major rivers to access assemblage lithic sources

Possible Territories for Fluted Point Peoples

After the initial exploration and migration took place it is presumed that these pioneers became knowledgeable of the local resources and settled into an annual pattern of procurement. Returning to the results for global spatial auto-correlation for fluted points based on lithic source, the high Moran's I of 0.59 and concentrated clusters represented by local indications of spatial auto-correlation (LISA) (Figure 23) indicate that five possible territories were established by Fluted Point peoples within the study area. The results generated using the both global and local SAC, should be tempered by geography, both in terms of suitable habitation and ease of movement. The territories presented are generalised for the entire time-span of Fluted Point peoples (11,500 -10,400 BP) and may not reflect individual band annual ranges.

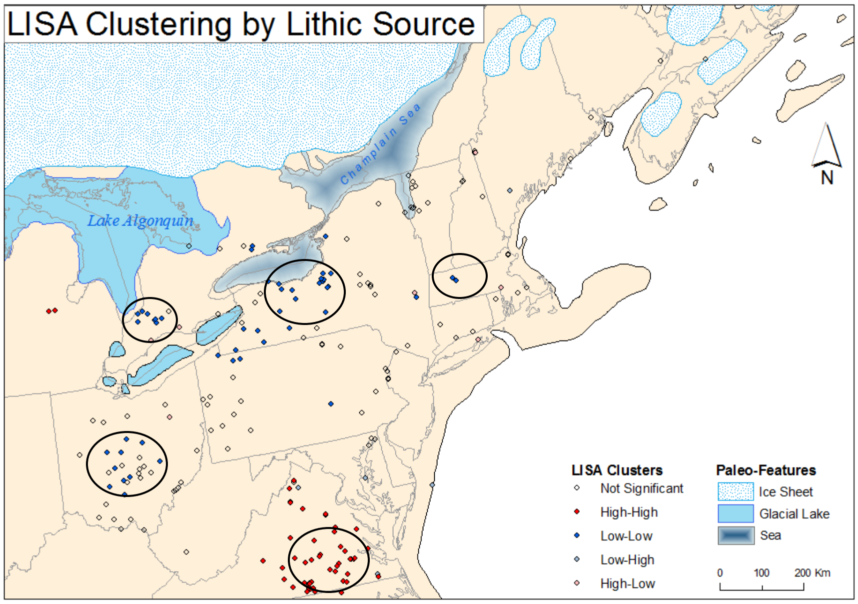


Figure 23: Localized Clusters by Lithic Source variable. Circles indicate loci of territories

Influence of Sources

While many of the long-distance and a few of local sources have been used on one or two fluted points at best, there are several key source areas that have provided regional context activity loci, that ultimately influenced the building of territories. Each source, all things being equal, has greater than 10 points and using direction mean analysis (Figure 17) provided indications of movement. The majority sources are presented in Table 2. This is not to say that the movement of people is wholly predetermined by resource patches (lithic and otherwise), rather that key lithic sources provide a focal point for procurement in a bi-directional interchange.

Source Name	Source #	Number of Fluted Points
Normanskill	5	15
Western Onondaga	7	48
Flint Ridge	9	33
Pennsylvanian Jasper	10	32
Mount Independence	11	11
Collingwood	13	13
Upper Mercer	14	38
Munsungan	33	17
Bayport	49	12
Cattail Creek	55	22
Bolster's Store	56	25

Table 2: Lithic sources that have greater than 10 fluted points manufactured from them

Ohio

Within Eastern North America, the Ohio region may be one of the earliest established territories. It forms a corridor bounded by Lakes Erie and Ontario to the north and the Ohio River and Appalachian Mountains to the east. The relative flat landscape made it easy for migratory herd animals to move throughout their range (R.MacDonald and Pihl 1994:32). The Paleo Crossing site (Brose 1994; Tankersley and Holland 1994) dated to ca. 11000 BP (Faught 2008), is a possible site of migration into the area, as is Sandy Springs (Figure 22). Paleo Crossing has a large number of fluted points (33) and is considered a base-camp (Simons 1997:116). The dominant lithic source is Wyandotte chert located 565 km to the south-east, with additional lithic sources (Upper Mercer, Zelaski and Pipe Creek cherts) all located to the south and east (Eren et al. 2004).

Within the Ohio region, the lithic focus is dominated by two sources; Upper Mercer and Flint Ridge. Fluted points from these sources have been found as far afield as Levitt and Gainy MI (Fitting 1973; Simons 1997), Sugar Loaf, MA (Gramly 1998), and southern Connecticut (Lantz 1984). The mean direction of fluted points from these sources shows movement northward, while fluted points of Western Onondaga chert are seen southward, with one within 20 km of the Upper Mercer outcrop (Figure 23). This lithic interchange strongly suggests a territory.

In contrast, transportation from minority sources (Coshocton, Delaware, Logan, Pipe Creek, and Zaleski) shows a much more localized distribution (Figure 24) and may suggest a smaller territory or the northern edge of a south facing territory. Tankersley (1989) uses assemblages with a single lithic comprising at least 50% to suggest that three main sources (Upper Mercer, Wyandotte and Hopkinsville) of a territory from central Ohio to south-western Kentucky. Due to the limited study area of this research, this cannot be corroborated.

Virginia Lowlands

Located on the Virginian lowlands and bordered to the west by the Appalachian Mountains this area represents the most concentrated territory, with a lower average

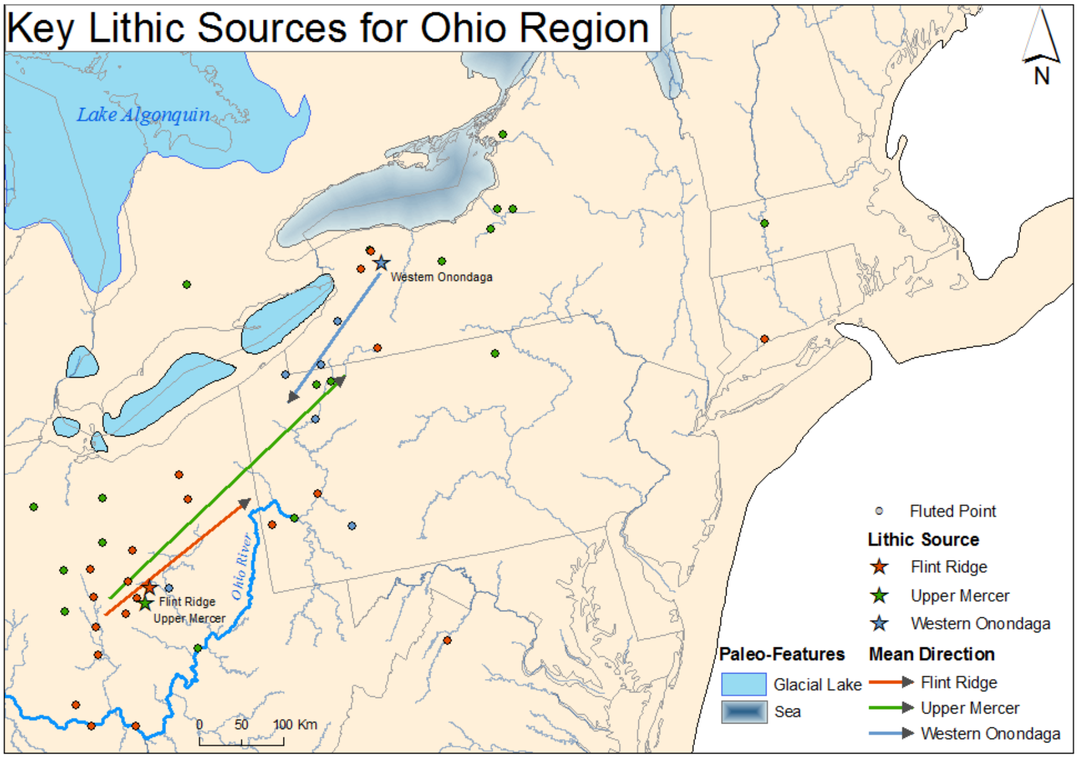


Figure 24: Location of fluted points from key lithic sources (Flint Ridge (orange), Upper Mercer (green), and Western Onondaga (blue)) and the mean direction for these sources

transportation length of 120 km. Initial migration appears to be from the south as seen by the unidirectional transportation of fluted points from the Unwharrie and Wolf Den cherts (for description see Daniel and Butler 1996) from Tennessee.

The spatial auto-correlation for lithic sources in the region was 0.196 indicating diverse lithic usage that was not concentrated in a specific area. However, this territory was strongly influenced by the Bolster’s Store and Little Cattail Creek chalcedony lithic sources (Figure 25). Over 50% of the fluted points in the region were manufactured from these two (out of 14) sources. The spatial auto-correlation for morphological groups was 0.06, as all morphological groups were present (including a "Crowfield" or Pentagonal

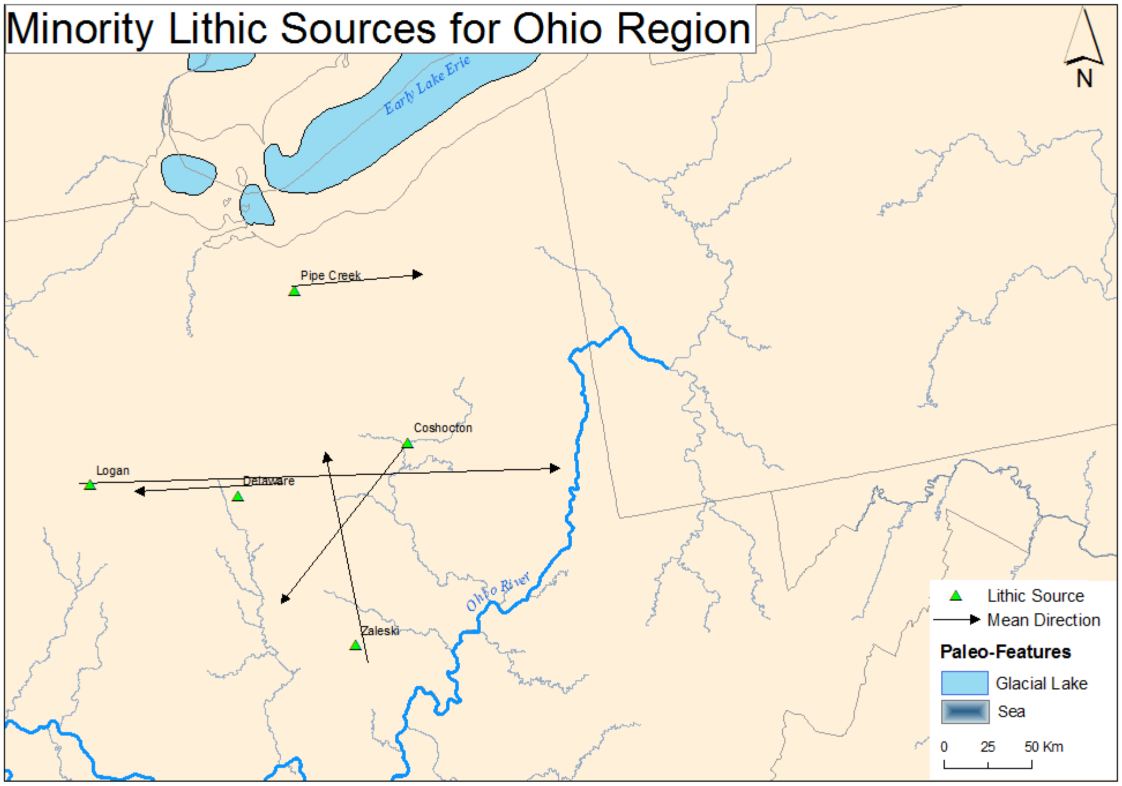


Figure 25: Location and mean direction of minority lithic sources in Ohio

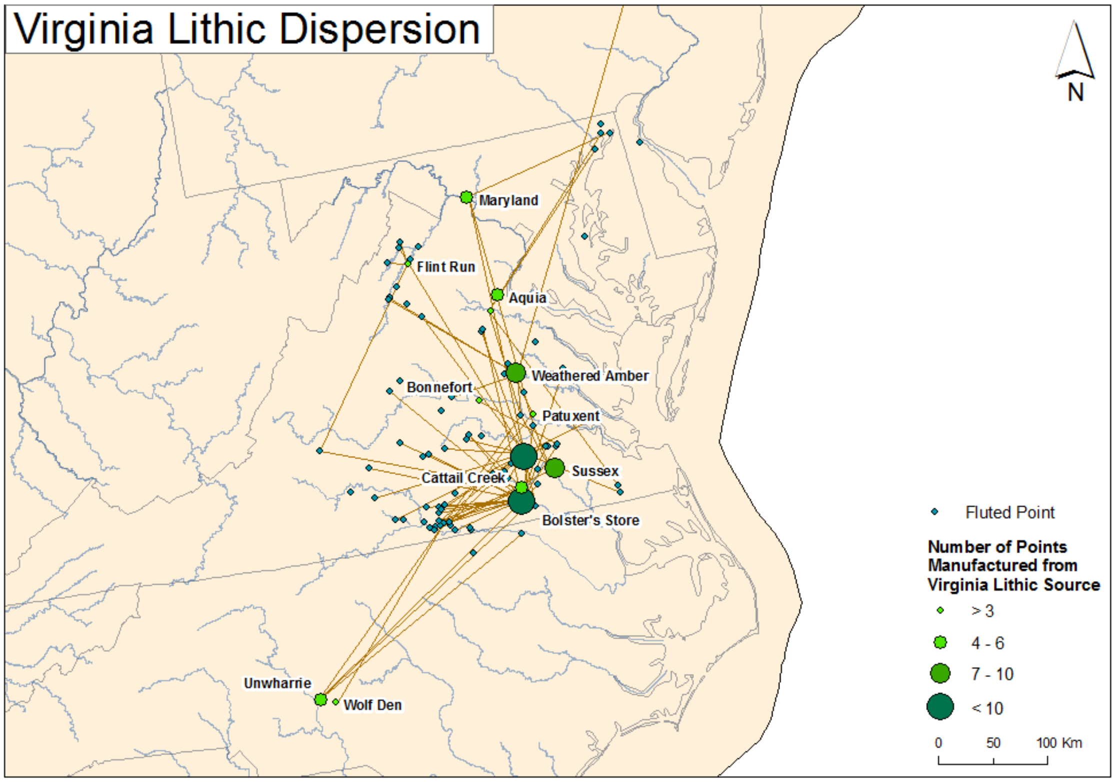


Figure 26: Dispersion of lithic sources for the Virginia Lowland territory

fluted point) without clustering. However, the results of a bi-variate LISA plot, shows single significant ($p < 0.05$) clusters near the Cattail Creek source and on the Roanoke River.

The mean directions for each source (Figure 26) indicate a pronounced westward trend. However, minor sources consisting of less than five points each from northern Virginia show southward movement back into the core area. It is probable that outlying areas where points were found as isolates or very small sites (the Paleo-Indian component of Thunderbird (Gardner 1974)) were logistical in nature, rather than residential. The average transportation distance of the two core sources (Cattail Creek and Bolster's Store) is 95 km and may indicate shorter moves with frequent returns to the prominent sources. This suggests a smaller annual range, compared to other proposed territories.

Gardner and Verrey (1979) suggested that the Shenandoah Valley around the Flint Run lithic deposit constituted a separate territory. However this area was well attached to the greater Virginian lowland territory, based on lithic movement. Furthermore, neither points found on Upper Chesapeake Bay (Dent 1995), are made from the more local Aquia and Maryland chert sources. Fluted points from both sources are found in southern Virginia and the sources mean direction also indicates southerly movement. Similar to the Shenandoah Valley, this movement connects this area to the greater Virginia Lowland territory.

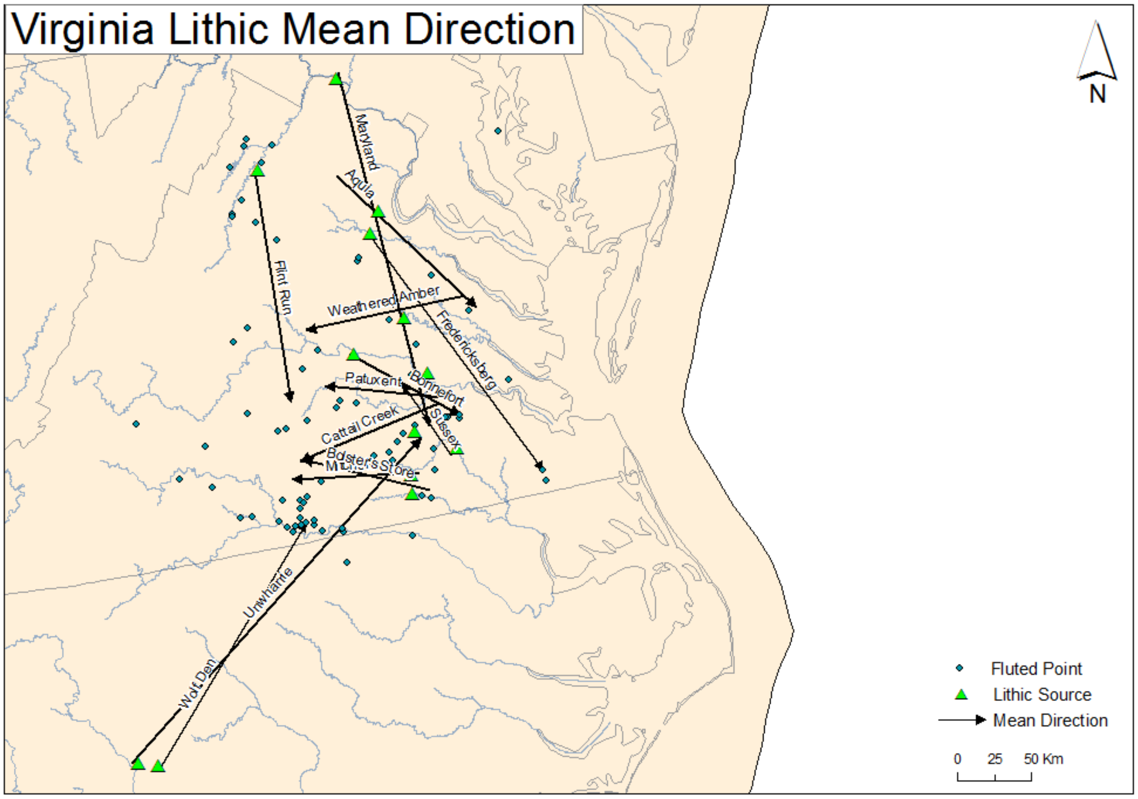


Figure 27: Mean direction of lithic sources used in the Virginia Lowland territory

In this study only 161 of the 900-plus known fluted points were measured, of which only 53% had identified sources. However, a re-examination of unknown source fluted points based on recently identified lithic sources could increase the number of indentified sources. An example of this is the large number of regional isolates only recorded as "Gray Flint" (McCary 1984), may be from the newly identified chert quarry, located just south in the Piedmont region of North Carolina (Lautzenheiser et al 1996). Goodyear (1989) has also recorded "Clovis" points of this chert outside the study area. Yet not all lithic sources have been surveyed. An example from the Richmond Site (Bottoms 1972), and isolates are fluted points from a still unknown source for white quartz. Additionally, the recording of the remaining points may help fill in the gaps.

The Williamson Site in Dinwiddie County (McCary 1951; MacAvoy 1992; Hill 1996) is considered a workshop and is situated close to the Cattail Creek chert outcrop. The Williamson Site is important for several reasons. First is the number of fluted points found in one site (33) and second the varieties of morphological forms, the fluted point takes, from shallow basal concavity and full lateral concavity (similar to "Barnes"), to parallel side medium depth basal concavity representing most of the morphological groups seen throughout the study area. Most of the points are from the local Cattail Creek, while eight are from other sources, possibly Bolster's Store, Patuxent, Aquia and an unknown source of rock crystal. This combination, in addition to the distribution of Cattail Creek material, suggests repeated bi-directional returns to the site and helps define the overall territory.

Southern Ontario

Situated between three Great Lakes and restricted northward by the ice-sheet, the defined Southern Ontario Peninsula territory consists of relatively few chert sources. This area does not have any secure dates but because many sites in southern Ontario border the Glacial Lake Algonquin strand line (Deller and Ellis 1986, Wight and Roosa 1966, Voss 1977) and are not below it (Roberts 1984, Jackson 1983) a minimum boundary date can be inferred from the date of lake drainage ca. 10400 BP (Karrow 1975).

The relatively few fluted points of Upper Mercer chert and their morphological type are associated with earlier Fluted Point peoples, with the unidirectional pattern of

Bayport chert from the west suggesting migration from the south and west, especially since Collingwood, Lockport and Bayport varieties are very rare or are not known to be present south of the lakes. After migration, Collingwood becomes the dominant lithic source and is used for all morphological groups. The pattern of dispersal for Collingwood is south and east and, along with Ontario Onondaga chert whose dispersal is west and north, forms a square (Figure 27). The mean direction from Collingwood and Onondaga (Figure 28), shows bi-lateral transport, with fluted points of Lockport chert fitting into this pattern and shows a mean direction moving northward. The spatial patterning in southern Ontario clearly presents the best case for a territory based on an annual cycle with embedded lithic gathering.

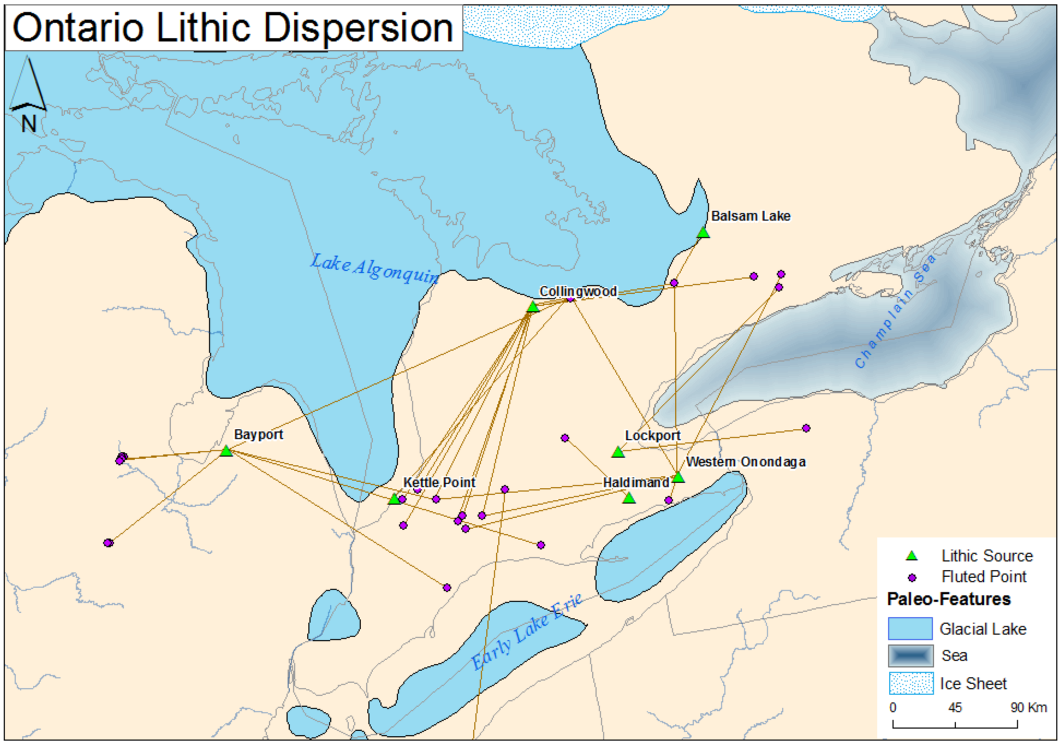


Figure 28:Lithic movement in the Southern Ontario territory

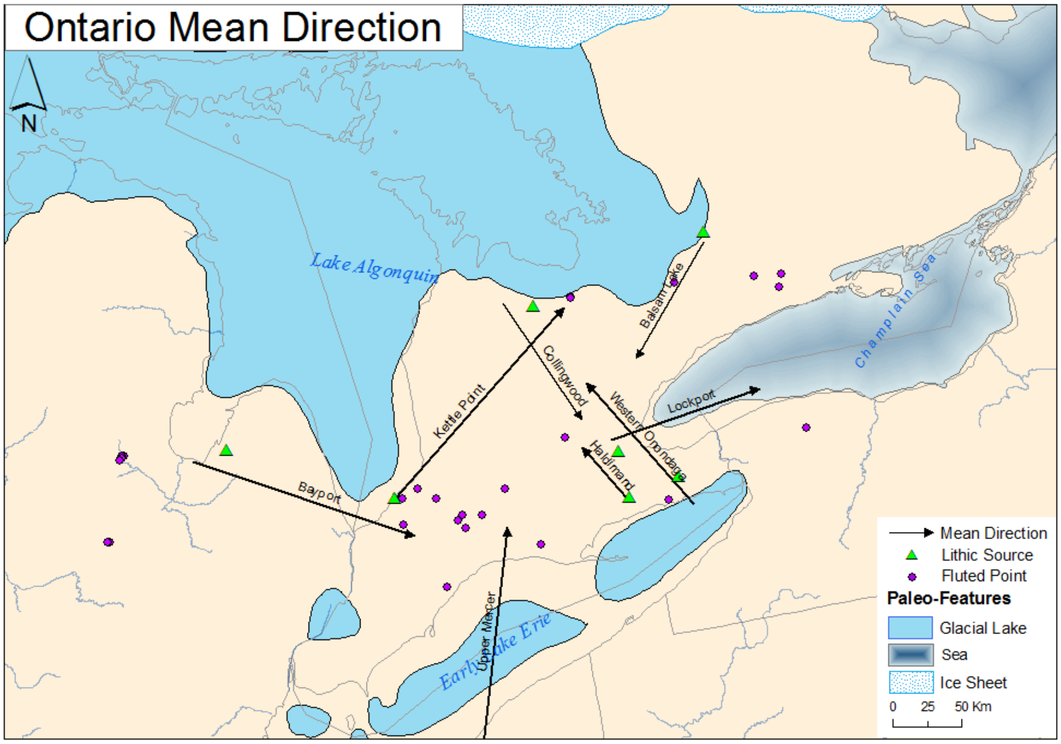


Figure 29: Mean Direction from Ontario Lithic Sources

New York/Pennsylvania

The region comprising southern NY, west of the Hudson River through eastern and central Pennsylvania is another area identified as an Early Paleo-Indian territory. Initial movement may be indicated by the Hiscock Site which represents the earliest site in the study area dating to 11022 BP (Faught 2008). The single fluted point recovered was manufactured on Upper Mercer chert from central Ohio approximately 650 km away. A similar fluted point in both morphology and source was also recovered nearby at the Potts Site (Ritchie 1969, Lothrop 1988).

Similar to most other regions, the spatial auto-correlation results for source shows an increase in clustering compared to the overall study area. However the spatial autocorrelation for morphological group actually decreases in the area indicating greater variety of point types. The major lithic sources are Onondaga chert, Pennsylvanian jasper and Normanskill chert with the minority cherts showing a similar distribution pattern (Figure 29)

The mean direction (Figure 30) for the region shows clear lines of bi-directional movement from the Vera Cruz quarry of Pennsylvanian jasper moving northward, Onondaga chert both from the Diver's Lake Area and the Moorehouse outcropping moving south-east and Hudson Valley cherts moving south-west. Within the region the major sites (Potts, Plenge, Shoop, Poirier) have lithic material from the key sources (Onondaga, Pennsylvanian Jasper, Hudson Valley). Two isolates of brown flint located in Central NY may be of a secondary colour for Deep Kill, and fits in the same westward transportation corridor as other Hudson Valley cherts. This further ties the region together using the Shoop and Plenge sites as the southern edge.

Northeast

The North-eastern territory is fairly heterogeneous defined by several lithic sources: Munsungan chert, Mount Jasper rhyolite, Mt. Independence jasper, plus several sources from the eastern Champlain Valley. The region is bounded by the Champlain Sea and Hudson River to the west, the Atlantic to the east, and the Laurentide Ice Sheet to the north.

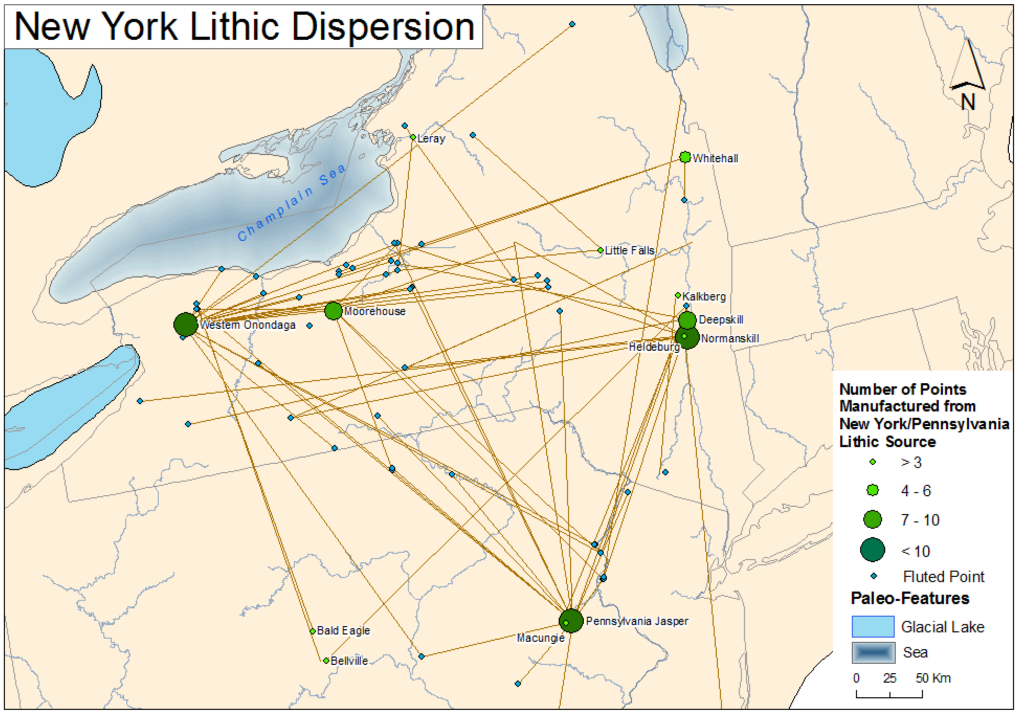


Figure 30: Lithic movement in the New York/Pennsylvania territory

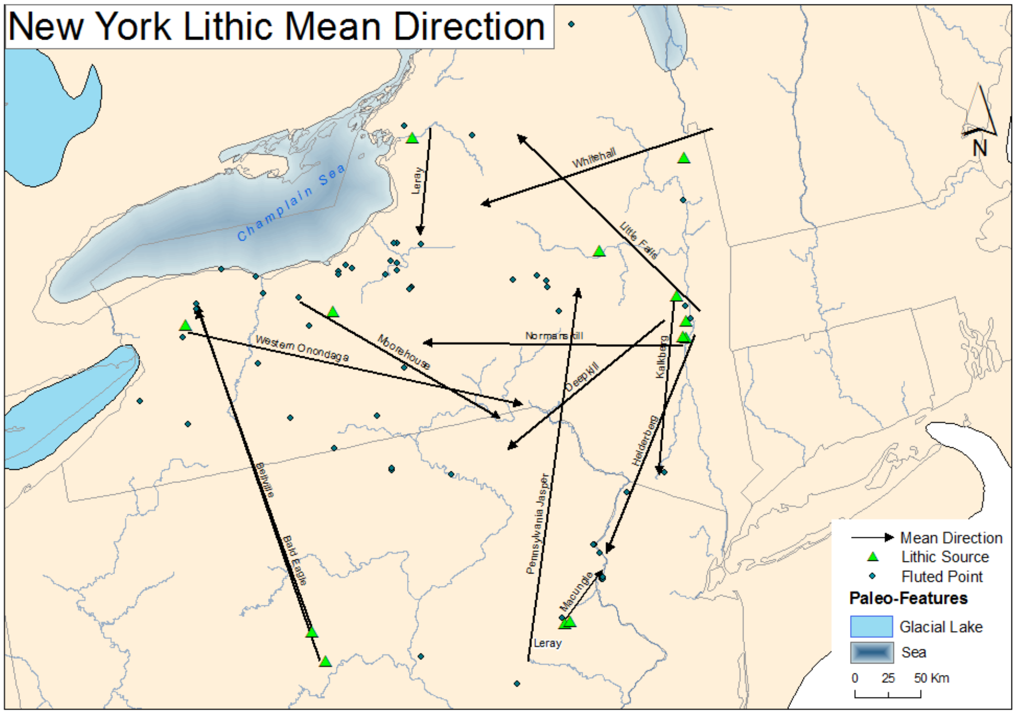


Figure 31: Mean Direction from lithic source in the New York/Pennsylvania territory

Migration into the area comes from two directions, northward along the Hudson River Valley to eastern Champlain Sea, bringing lithic material from Normanskill, Coxsackie, Deepkill and Whitehall and eastward towards the Massachusetts coast, crossing the Connecticut Valley with lithic material from Little Falls (75 km west of the Hudson River), Deepkill and Normanskill. Additionally, fluted points (and other tools) from a few sites (e.g. Dam, Bull Brook II) and a few fluted point isolates have been identified as Pennsylvanian jasper. The unidirectional (northward) and the greater distance travelled being posited as part of the colonizing process (Curran 1999) with the Dam site and its diverse set of cherts used as an example of the "earliest" pioneering phase (Borque 2001:33).

In the northern region the most important lithic source is the chert outcropping at Munsungan Lake consisting of two outcrops that contain known fluted point preforms (Bourque 2001). While these sites have not been dated via C14, their Terminal Pleistocene age is suggested from the time of glacial eroded channels (Pollack et al. 1999). Not originally known when some regional fluted points sites were excavated, Munsungan with its variety of colours (Georgiady andBrockmann 2002:27) has been later identified at sites from Vail to Bull Brook (Wray 1948, Beyers 1954) (Figure 31:blue line). The other key lithic source is Mt Independence jasper from western Vermont (Figure 31:orange line).

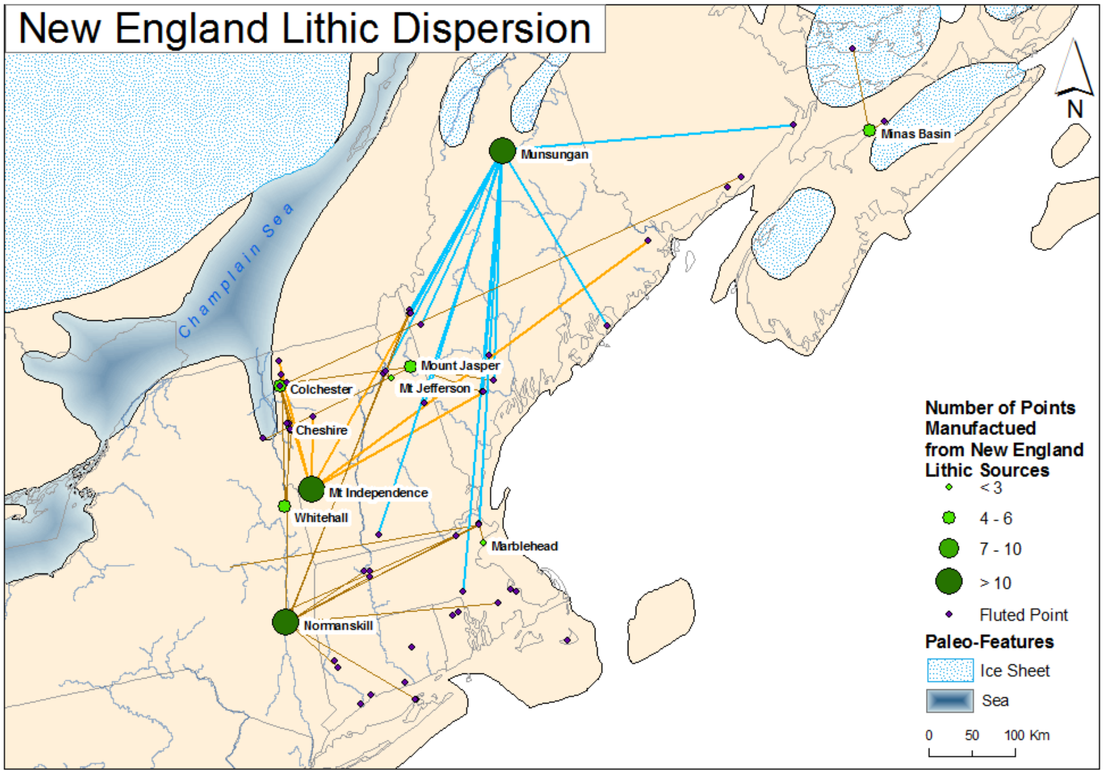


Figure 32: Lithic dispersion in the New England territory

The indications that the northeast was a territory are increasing spatial auto-correlation based on both lithic source (0.234) and morphological group (0.25) along with the directional means showing bi-directional movement between western Vermont (Colchester and Mt Independence) sources and Maine and eastern New Hampshire (Munsungan and Mount Jasper) sources (Figure 32). Fluted points manufactued from lithic sources found within the Northeastern region are not found west of the Hudson Valley, with the exception being an isolated fluted point of Mount Jasper rhyolite just west of the Champlain Sea.

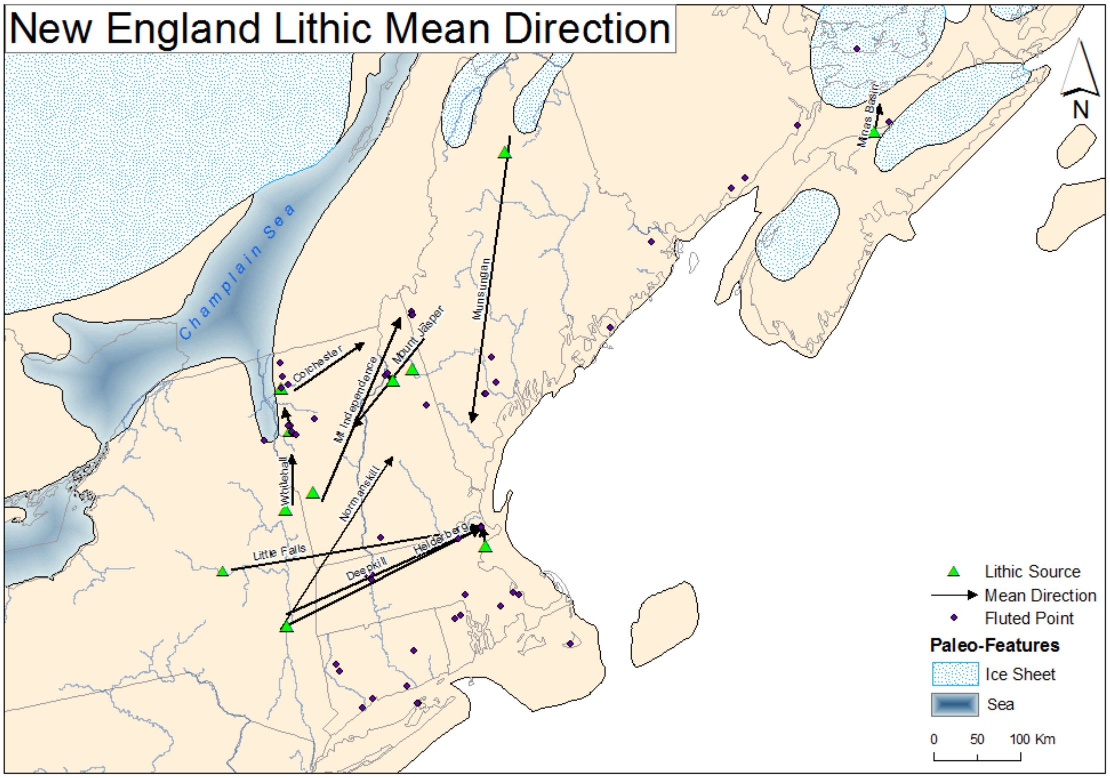


Figure 33: Mean Direction from lithic source in the New York/Pennsylvania territory

Vail and the associated Magalloway Valley Paleo-Indian Complex (Gramley 1982, 1988) is important for examining the seasonal rounds, because rather than being a single occupation site Gramley uses the 8 loci uncovered as indicators of multiple occupations. This again illustrates that at least by 10,600 BP (Haynes 1984) Fluted Point peoples in the northern regions did have some groups returning to the same place. The artefacts of Vail are made from Hudson Valley cherts and Pennsylvanian jasper to the south and Munsungan to the northeast indicating bi-directional passage through the area. Interestingly, a more local lithic source located 25 km north at the headwaters of Magalloway River does not appear to be used (Borque 2001:22) nor are there cherts from Mount Jasper or Mt Independence.

The Whipple site (Curran and Dincauze 1977) provides a southern edge of the territory, along with Bull Brook, as fluted points from Munsungan and Mount Jasper are present. An unsecure date of 10,700 BP (Curran 1994) is temporally consistent with other secure dates from Vail (10,550 BP) and Debert (10,600 BP) (Faught 2008:table 1). The Reagen site (Ritchie 1953) located in NW Vermont was not included in this study because of the poor quality in the artefact images too small to measure and the uncertainty of the source material for the included fluted points. However in reading the description of lithic material (Ritchie 1953:280) this site fits with others in the region.

The visual output, however, does not show clear group movement around the Maritimes. Munsungan chert was transported eastward (e.g. an isolate along the eastern shore of New Brunswick), but fluted points of Minas Basin chert, presumed submerged in Fundy Bay (MacDonald 1968), has only been identified locally at the nearby Belmont site and a isolate on Prince Edward Island (Keenlyside 1991:165-166) with no westward or southward transportation. This may indicate another smaller territory north of Maine, but additional sites and isolates are needed to test.

Territory Size

The definition of the territories presented (Figure 33) are based on best-fit scenarios from the analysis based on the spatial auto-correlation of lithic sources (Table 3) and the bi-directional interchange of lithic material from two or more sources. The areal size of the territories was an estimation based on the distribution of points assigned to territory after migration (Table 4). Ellis and Deller (1986:254-255) suggested that the resources necessary to attract and sustain human occupation were few and widely distributive, leading to large territories with low population. With the exception of the geographically constrained territory of Southern Ontario, the size of each territory decreases southward away from the ice front. There is a suggested relationship between territory size and productivity of the environment during different phases of the deglatiation (Cannon and Meltzer 2008). The New England territory is situated in a boreal forest and tundra biome, whereas the Virginia territory is wholly in a mixed deciduous biome. Furthermore, Gardner (1989) sees a split based on biotic differences: those who ranged north of the glacial maximum and those to the south, each with different subsistence adaptations.

Previous research has attempted to use ethnographic data from groups with similar biotic conditions, specifically those with low carrying capacities, to understand ancient lifeways (e.g. Binford 1977, 1980). For example MacDonald (1968) used the Naskapi-Montagnais of northern Quebec as an analogy, while Funk (1976) used the northern Alaska Nunamiut peoples. Custer and Stewart (1990) have shown that Eastern sub-Arctic groups have similar ranges to those proposed. However, analogies to modern hunter-gatherer groups are not sufficient because no group is similar to Paleo-Indian (Kelly and Todd 1988; Levine 1997). Thus, inferences between territory size and subsistence adaptation or movement patterns based strictly on other tundra adapted peoples should not be used.

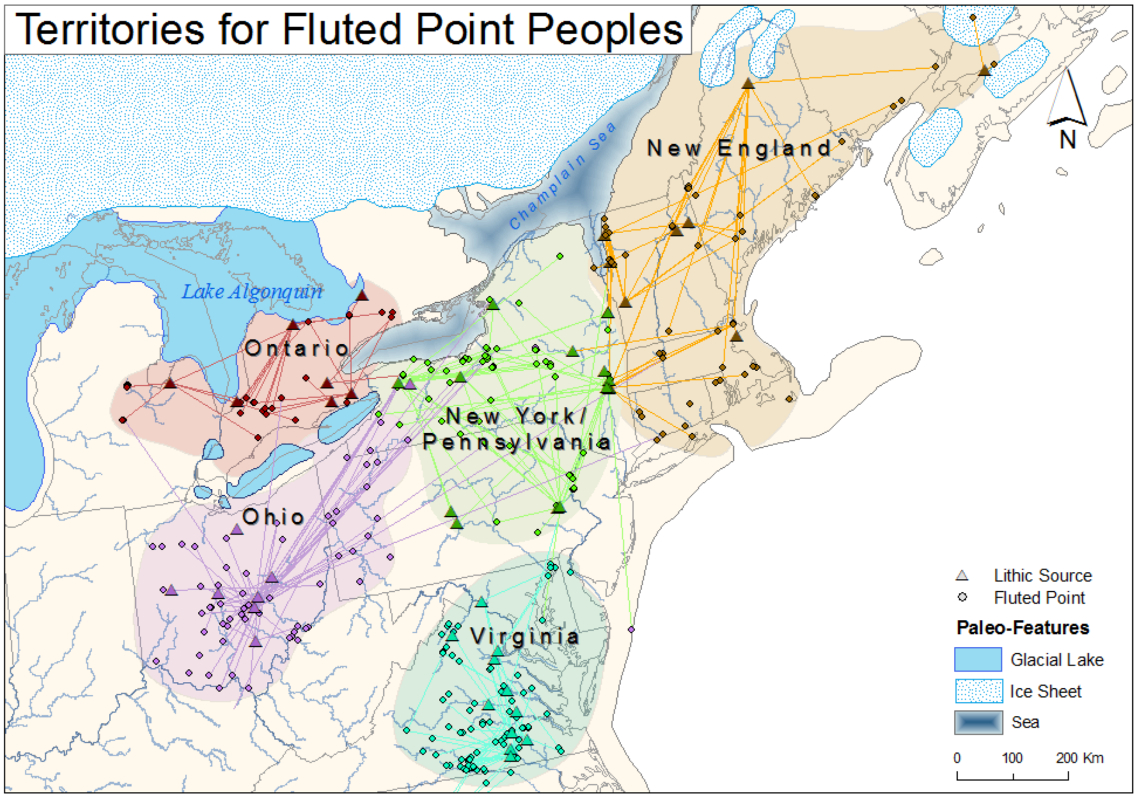


Figure 34: Proposed Territories for Fluted Point Peoples

Territory	Moran I
New England	0.26
New York/Pennsylvania	0.24
Ohio	0.27
Virginia	0.49
Ontario	0.38

Table 3: Moran I of territories by lithic source

Territory	Area km^2
New England	280000
New York/Pennsylvania	170000
Ohio	150000
Virginia	120000
Ontario	85000

Table 4: Areal size of territories for Fluted Point peoples

Chapter 5:
Conclusion

The definition of the territories presented are based on best-fit scenarios from the analysis based on the spatial auto-correlation of lithic sources and the bi-directional interchange of lithic material from two or more sources. The patterns in the distribution of lithic material reflect the lifeways of Fluted Point peoples in greater North-eastern North America. Because this thesis is based on data available from the literature, the data are used as presented, with a critical eye towards possible biases from conclusions reached by other researchers. It is important to re-evaluate data in novel ways to see if new insights or hypothesis can be found. This project's use of ESDA with its broad spatial analysis techniques and a fresh geographic perspective was vital to attaining new insight on understanding Fluted Point Paleo-Indian regionalization. Additionally, the research done and the conclusions forwarded should be viewed as another line of evidence in understanding the big picture of Early Paleo Indians rather than the definitive answer.

It was expected that this study should show that after initial migration into a given area, established territories with regional variation would exist, rather than a continuing free wandering or amorphous pattern. Additionally, territories would be sufficiently large to accommodate a people who practiced a generalized foraging adaptation, and who are influenced both by the paleoenvironment and the topography. The key conclusions from this research are:

One: That after entering an area where preferred lithic sources could be found, territories based on seasonal rounds were created.

***Two*:** The variation within fluted points does not show regionalization but rather different morphologies that may be functional, idiosyncratic or from curation.

Benefits of research

This thesis is contributing to the Paleo-Indian scholarship by presenting new conclusions in regard to group territoriality based on lithic remains and new approaches to on-going questions. The specific benefits are:

For Paleo-Indian researchers: New quantifiable conclusions on territoriality of the first peoples in the North-Eastern US and Canada during the Terminal Pleistocene.

For Archaeology: A case study in the use of Exploratory Spatial Data Analysis for large regional point based questions

Future Research

The research presented is not exhaustive and further research has potential to fill in additional details. By increasing the number of fluted points measured more depth to the defined territories could be seen. Also using Paleo-Indian sites without fluted points and expanding the lithic source to include all tool classes, would provide further comparative analysis. Focus on a large regional survey of points from sites and isolated finds has some benefits over examination of individual assemblages or even a group of sites. Thus by increasing the size of the study area to include all of North America, greater information on the movement of lithic materials during migration and annual rounds is achievable. One other idea for future research is to use a gravity model of lithic attractiveness to more fully understand the influence of each lithic source. Finally, more secure dates are needed to better understand the timing of exploration, migration and settling in.

Appendices

Appendix A: Recorded Fluted Points

ID	Mid-Width	Base Width	Mid-Base Width	Concavity Height	Angle	Lateral Conavity	Site	Lithic Source	Citation
28WA7-1	27.5	23.0	11.0	5.5	48	none	Camp Pahaquarra		Lattanzi 200
36BR149-b	18.0	15.0	8.0	3.0	35	none	Trojan	E Onondaga	McCracken 1989
36BR149-c	24.5	24.0	11.0	5.0	45	none	Trojan	Tbay Gunflint	McCracken 1989
36BR149-d	10.0	15.0	6.0	2.0	30	none	Trojan	E Onondaga	McCracken 1989
36BR149-e	14.0	12.0	7.0	1.5	38	none	Trojan	Upper Mercer	McCracken 1989
36BR149-x	0.0	0.0	0.0	0.0	0	none	Trojan	Penn Jasper	McCracken 1989
36LA336-1	24.0	23.0	14.0	5.0	36	none	36LA336	PA (fleetwood)	Smoker and Custer 1986
36WH59-1	23.5	24.0	15.0	4.0	34	none	36WH59	Flint Ridge	Lowry et al. 2007
46Pl5-14	25.5	24.5	11.0	4.0	25	none			Hyde 1960
46Pl9-9	28.5	23.0	12.0	5.0	40	full			Hyde 1960
46Wd1-12	22.0	23.0	17.0	2.0	18	full			Hyde 1960
46Wd1-3	33.0	27.0	18.0	3.0	19	full			Hyde 1960
46Wd1-4	36.0	28.0	16.0	3.0	32	full			Hyde 1960
46Wd15-16	32.0	26.0	15.0	5.0	35	none		Paoli?	Hyde 1960
46Wd1-6	22.0	15.0	8.0	5.0	58	none		Zaleski?	Hyde 1960
46Wd1-7	30.0	26.0	13.0	4.0	25	full			Hyde 1960
46Wd1-8	26.0	22.0	12.0	2.0	22	none			Hyde 1960
46Wd7-1	22.5	21.0	11.0	4.0	40	none		Upper Mercer?	Hyde 1960
46Wd7-2	27.0	24.0	14.0	3.0	27	none		Upper Mercer?	Hyde 1960
6LF21	35.0	31.0	19.0	5.5	37	none	6LF21	Normanskill?	Moeller 1980
7NCD4-74	18.5	11.0	5.0	3.0	35	none	Thomas	Cecil Black	Stanzeski and Hoffman 2006
AC-1	23.0	19.0	11.0	4.5	36	none	Alder Creek	Haldiman	Timmins 1994
Adk-1r	25.5	24.0	11.0	6.0	36	none	Adkins	Hudson Valley?	Gramly 1988
Adk-2l	33.0	30.0	12.0	7.5	38	none	Adkins	Lake Champlain	Gramly 1988
Adk-3	30.0	24.0	14.0	5.5	36	none	Adkins		Gramly 1988
Adk-7	21.0	21.0	10.0	5.0	45	slight	Adkins		Gramly 1988
Adk-x	0.0	0.0	0.0	0.0	0	none	Adkins	Munsungan	Gramly 1988
Alt-1	22.0	20.0	11.0	4.0	42	none	Alton	Wyandot	Tomak 1994
Alt-x	0.0	0.0	0.0	0.0	0	none	Alton	Derby	Tomak 1994
Arc1	15.0	15.0	8.0	2.0	22	none	Arc	W. Onondaga	Tankesley et al. 1997
Arc2	20.0	21.0	14.0	4.0	36	full	Arc	Flint Ridge	Tankesley et al. 1997
Arc3	18.0	19.0	10.0	2.0	12	none	Arc	C. Onondaga	Tankesley et al. 1997
Arc4	32.0	28.0	16.0	7.0	40	slight	Arc	W. Onondaga	Tankesley et al. 1997
Arc5	30.0	30.0	16.0	6.5	32	none	Arc	Penn Jasper	Tankesley et al. 1997
Arc6	26.0	24.0	14.0	5.5	32	none	Arc	Bald Eagle	Tankesley et al. 1997
Arc-x	0.0	0.0	0.0	0.0	0	none	Arc	Upper Mercer	Tankesley et al. 1997
Arc-y	0.0	0.0	0.0	0.0	0	none	Arc	Bellville	Tankesley et al. 1997
Arc-z	0.0	0.0	0.0	0.0	0	none	Arc	Lockport	Tankesley et al. 1997
BBII-1	18.0	16.0	9.0	4.5	40	none	Bull Brook II	Normanskill	Grimes et al. 1984
BBII-2	24.5	24.5	11.0	6.5	44	none	Bull Brook II	Marblehead?	Grimes et al. 1984
BBII-3	29.0	26.0	14.0	5.0	33	none	Bull Brook II	Munsungan?	Grimes et al. 1984
BBII-x	0.0	0.0	0.0	0.0	0	none	Bull Brook II	Penn Jasper	Grimes et al. 1984
Boney1	22.0	22.0	11.0	4.5	35	none	Boney	Cattail Creek	Peck 2004
Boney2	19.0	17.0	9.0	3.0	28	none	Boney		Peck 2004

Boney3	22.0	18.0	7.0	3.0	26	none	Boney	Unwharrie	Peck 2004
Brn-15	27.0	18.0	8.0	4.0	39	none	Barnes	Bayport	Wright and Roosa 1966; Voss 1977
Brn-16	30.0	23.0	8.0	4.0	43	none	Barnes	Bayport	Wright and Roosa 1966; Voss 1977
Brn-19	24.0	20.0	10.0	5.0	45	none	Barnes	Bayport	Wright and Roosa 1966; Voss 1977
Brn-5346	20.0	18.0	9.0	3.5	35	full	Barnes	Bayport	Voss 1977
Brns-a	23.0	20.0	12.0	6.0	42	none	Barnes	Bayport	Voss 1977
Brns-b	22.0	22.0	11.0	2.0	20	none	Barnes	Bayport	Voss 1977
BRPI-a	21.0	18.0	11.0	4.0	42	none			Johnson and O'Niel 1961
BRPI-b	17.0	14.0	8.0	2.0	30	none			Johnson and O'Niel 1961
Cf-1005	34.0	18.0	13.0	4.5	44	none	Crowfield	W. Onondaga	Deller and Ellis 1984
Cf-244	32.0	17.5	12.0	3.5	38	none	Crowfield	Collingwood	Deller and Ellis 1984
CfDk1-1	24.0	25.0	18.0	1.0	11	none	CfDk1		Turnbull and Allen 1978
ChVI-11	26.0	20.5	10.0	5.0	30	none		Hudson Valley?	Loring 1980
ChVI-12	20.0	24.0	10.0	5.0	30	full		Mount Jasper	Loring 1980
ChVI-15	23.0	23.0	15.0	5.0	40	none		Mount Jasper	Loring 1980
ChVI-16	22.0	21.0	11.0	3.0	28	full		Hudson Valley?	Loring 1980
ChVI-19	25.0	22.0	11.0	5.0	37	full		Cheshire	Loring 1980
ChVI-1a	24.5	26.0	15.0	4.5	27	none		Whitehall?	Loring 1980
ChVI-1b	23.0	24.0	13.0	5.0	36	none		Vermont	Loring 1980
ChVI-1c	24.0	25.0	14.0	4.5	32	full		Colchester	Loring 1980
ChVI-2	17.0	19.0	12.0	3.5	37	none		Colchester	Loring 1980
ChVI-23	30.0	26.0	18.0	7.5	50	none		Mt Independence	Loring 1980
ChVI-28	17.0	20.0	11.0	5.5	48	none		Vermont	Loring 1980
ChVI-3	16.0	21.0	12.0	4.5	38	full		Mt Independence	Loring 1980
ChVI-4b	22.5	24.0	12.0	3.5	32	slight		Cheshire	Loring 1980
ChVI-4c	26.0	21.0	10.0	4.5	39	none		Mt Independence	Loring 1980
ChVI-4d	23.5	24.0	11.0	4.0	37	full			Loring 1980
ChVI-5	22.0	24.0	11.0	6.0	50	none		Colchester	Loring 1980
Cord-1	30.0	25.0	14.0	4.0	25	full	Corditaipe	Moorehouse	Funk and Wellman 1984
Cord-2	40.0	34.0	20.0	4.0	27	none	Corditaipe	Moorehouse	Funk and Wellman 1984
Cord-x	0.0	0.0	0.0	0.0	0	none	Corditaipe	Normanskill	Funk and Wellman 1984
Cord-y	0.0	0.0	0.0	0.0	0	none	Corditaipe	Penn Jasper	Funk and Wellman 1984
CT54-2	19.0	20.0	11.0	2.0	31	none			Fowler 1954
CT54-3	18.0	17.0	9.0	4.5	35	none		Penn Jasper?	Fowler 1954
CT54-5	24.0	23.0	14.0	5.0	42	none		Flint Ridge	Fowler 1954
CT78-x	0.0	0.0	0.0	0.0	0	none	Hopkins	Mt Independence	
CT98-x	0.0	0.0	0.0	0.0	0	none	Liebman	Normanskill	
CT98-y	0.0	0.0	0.0	0.0	0	none	Liebman	Penn Jasper	
D1	23.0	19.0	11.0	3.0	20	none	Dime	Fredericksberg	Bottoms 1985
D2	25.0	25.0	12.0	5.0	28	none	Dime	Fredericksberg	Bottoms 1985
Dam-x	0.0	0.0	0.0	0.0	0	none	Dam	Penn Jasper	Speiss et al. 1998
Dam-y	0.0	0.0	0.0	0.0	0	none	Dam	Normanskill	Speiss et al. 1998
Dam-z	0.0	0.0	0.0	0.0	0	none	Dam	Mt Independence	Speiss et al. 1998
DbtVI-a	23.5	23.0	10.0	8.0	70	none	Debert		MacDonald 1968
DbtVI-b	22.0	22.0	10.0	9.0	66	none	Debert		MacDonald 1968
DbtVI-c	18.0	17.0	9.0	7.5	75	none	Debert	Minas Basin?	MacDonald 1968
DbtVI-d	18.0	16.0	8.0	4.0	72	none	Debert	Minas Basin?	MacDonald 1968
DbtV-I	14.0	14.0	6.0	5.5	65	none	Debert	Minas Basin?	MacDonald 1968
DEI40-18	24.0	18.0	11.0	3.0	38	none			Robinson 1940
DI1	22.0	22.0	10.0	2.5	22	none	Drag Island	Helderberg	Boldurain 2006
DN1	22.0	18.0	8.0	3.0	26	slight	Devils Nose	Onondaga	Tankersley 1994
DQ18	26.0	26.0	13.0	5.0	32	full	Duchess Quarry Cave	Kalkberg	Funk et al. 1969;
DR-267	32.0	32.0	14.0	7.5	35	none	Sugarloaf	Hudson Valley	Gramly 1998
DR-310	23.5	23.0	13.0	5.5	45	none	Sugarloaf	Normanskill	Gramly 1998
DR-311	23.0	20.0	12.0	5.0	45	none	Sugarloaf	Upper Mercer?	Gramly 1998
EPA-1	23.0	22.0	12.0	4.0	35	none		Upper Mercer	Lantz 1984
EPA-10	26.0	20.0	10.0	5.0	36	none		Onondaga	Lantz 1984

EPA-11	20.0	15.0	6.0	2.0	35	none		Alibates	Lantz 1984
EPA-2	24.0	20.0	10.0	3.5	34	slight		Flint Ridge	Lantz 1984
EPA-3	27.0	25.0	10.0	2.5	25	none		Loyalhanna	Lantz 1984
EPA-4	26.0	26.0	13.0	5.0	31	none		Penn Jasper	Lantz 1984
EPA-5	39.0	38.0	15.0	4.5	25	slight		Upper Mercer	Lantz 1984
EPA-6	24.0	20.0	11.0	7.5	50	slight		Upper Mercer	Lantz 1984
EPA-7	23.0	22.0	11.0	5.5	40	full		Onondaga	Lantz 1984
EPA-8	23.0	18.0	10.0	3.0	35	full		Fort Payne	Lantz 1984
EPA-9	26.0	22.0	11.0	6.0	40	slight		NDM	Lantz 1984
Fsh-1144	10.5	11.0	5.0	2.0	35	slight	Fisher	Collingwood	Storck 1997
Fsh-1654	13.0	12.0	6.0	2.5	35	full	Fisher	Kettle Point	Storck 1997
Fsh-1680	14.5	12.5	7.0	3.0	42	full	Fisher	Collingwood	Storck 1997
Fsh-474	12.5	11.5	5.0	3.0	41	slight	Fisher	Collingwood	Storck 1997
Fsh-54	12.5	10.5	5.0	2.5	40	slight	Fisher	W. Onondaga	Storck 1997
Fsh-x	0.0	0.0	0.0	0.0	0	none	Fisher	Bayport	Storck 1997
H1	24.0	22.0	11.0	2.5	21	none	Hanover	WAC?	McAvoy 1979
H2	20.0	19.0	9.0	3.0	28	full	Hanover	WAC?	McAvoy 1979
Hck-c24956	20.0	20.0	9.0	3.5	33	none	Hiscock	Upper Mercer	Laub 2003
HS-a	20.0	22.0	11.0	4.0	30	slight	Hinsdale School	Flint Ridge?	Gramly 1999
HS-b	22.0	22.0	13.0	4.5	30	slight	Hinsdale School	Upper Mercer?	Gramly 1999
HS-c	22.0	23.0	13.0	13.0	64	none	Hinsdale School	Coshocton?	Gramly 1999
ICRI-1	23.5	20.0	14.0	3.5	33	full		Onondaga	Myers and Myers 2007
Inv-1	38.0	29.0	14.0	5.0	38	full	Intervale	Munsungan	Spiess and Hedden 2000
JII-28-1	26.0	25.0	10.0	8.0	45	none	Jefferson II	Munsungan	Boisvert 1999
JII-28-2	26.0	27.0	13.0	4.5	31	full	Jefferson II	Mt Jefferson	Boisvert 1998
JIII-29	18.0	18.0	10.0	8.0	45	full	Jefferson III	Mt Jefferson	Boisvert 1998
Klm-1	14.0	15.0	8.0	2.0	27	slight	Kilmer	Normanskill	Tankersley et al. 1996
Klm-2	20.0	20.0	11.0	2.5	24	slight	Kilmer	Normanskill	Tankersley et al. 1996
KR1	44.0	34.0	18.0	6.0	30	none	Kings Road	Normanskill	Funk et al. 1969
KR2	30.0	32.0	16.0	4.5	34	full	Kings Road	Penn Jasper	Funk et al. 1969
KR4	27.0	25.0	13.0	5.0	30	none	Kings Road	Belleville?	Funk et al. 1969
Lamb-570/à	37.0	29.0	14.0	8.0	45	none	Lamb	Paoli	Gramly 1999
Lamb-60	28.0	22.0	11.0	6.0	49	none	Lamb	Indiana Hornstone	Gramly and Funk 1990
Lamb-61/73/88	22.0	19.0	9.0	6.5	53	none	Lamb	Upper Mercer	Gramly 1999
Lamb-74-87	19.5	17.0	8.0	5.5	52	none	Lamb	Flint Ridge	Gramly 1999
Lamb-77/124	34.0	28.0	14.0	9.5	50	none	Lamb	Upper Mercer	Gramly 1999
Lamb-86/94/106	21.0	20.0	9.0	6.5	53	none	Lamb	Upper Mercer	Gramly 1999
Lamb-98/101	22.0	19.5	11.0	7.0	51	none	Lamb	Knife River	Gramly and Funk 1990
LI-1	24.0	26.0	12.0	4.0	31	full	Long Island	Normanskill	Smith 1952
Lv-8227100	30.0	27.0	13.0	7.0	35	none	Leavitt	Bayport	Shott 1993
Lv-90070	23.0	23.5	9.0	5.0	31	none	Leavitt	Bayport	Shott 1993
Lv-x	0.0	0.0	0.0	0.0	0	none	Leavitt	Upper Mercer	Shott 1993
lwd-24	30.0	28.0	14.0	10.0	0	none	Lower Wheeler Dam		Gramly 1988
m-307	22.0	22.0	11.0	5.0	0	slight	Morss	Munsungan	Gramly 1988
MA54-1	17.0	16.0	9.0	2.0	31	none	Dry Hill		Fowler 1954
MA54-10	18.0	18.0	9.0	4.0	33	none	Bull Brook	Helderberg	Byers 1954; Fowler 1954
MA54-11	19.0	20.0	11.0	4.0	37	none	Bull Brook	Munsungan?	Byers 1954; Fowler 1954
MA54-13	20.0	18.0	10.0	4.5	40	none	Bull Brook	Munsungan?	Byers 1954; Fowler 1954
MA54-2	18.0	19.0	9.0	3.0	30	none			Fowler 1954
MA54-3	18.0	20.0	10.0	5.0	36	none		Normanskill	Fowler 1954
MA54-4	16.0	15.5	10.0	3.0	31	none			Fowler 1954
MA54-5	16.0	17.0	10.0	4.5	42	slight			Fowler 1954
MA54-6	22.0	18.0	10.0	3.0	51	none		Munsungan?	Fowler 1954
MA54-8	18.0	17.0	10.0	4.0	39	none	Wapanucket	Penn Jasper	Byers 1954
MA54-9	19.0	13.5	10.0	1.5	35	none	Bull Brook		Byers 1954

MA54-c	30.0	28.0	14.0	6.0	40	none	Bull Brook	Deepkill?	Byers 1954
MA54-e	26.0	25.0	12.0	7.0	40	slight	Bull Brook	Penn Jasper	Byers 1954
MA54-h	24.0	22.0	11.0	5.0	40	none	Bull Brook	Little Falls?	Byers 1954
MA54-i	26.0	26.0	14.0	6.0	35	none	Bull Brook	Munsungan?	Byers 1954
MA54-k	24.0	22.0	11.0	5.0	40	none	Bull Brook		Byers 1954
MA54-l	30.0	38.0	13.0	6.0	38	none	Bull Brook		Byers 1954
MA54-n	24.0	26.0	13.0	5.5	40	none	Bull Brook		Byers 1954
MA54-x	0.0	0.0	0.0	0.0	0	none	Bull Brook	Penn Jasper	Byers 1954
Mchd-1	30.0	30.0	18.0	4.5	36	full	Michaud	Munsungan	Spiess and Wilson 1987
Mchd-2	28.0	30.0	15.0	5.0	36	full	Michaud	Mt Jasper	Spiess and Wilson 1987
Mchd-x	0.0	0.0	0.0	0.0	0	none	Michard	Mt Independence	Spiess and Wilson 1987
McL-1	25.0	28.0	12.0	7.0	50	none	Culloden Arces	W. Onondaga	MacLeod et al.
ME54-8	23.0	24.0	13.0	4.0	45	none		Munsungan	Fowler 1954
Moose-1	26.0	28.0	18.0	5.0	29	none	Moosehorn		Bonnichsen et al. 1983
Moose-2	30.0	32.0	17.0	8.0	33	none	Moosehorn		Bonnichsen et al. 1983
Moose-3	32.0	27.0	14.0	3.5	25	none	Moosehorn	Mt Independence	Bonnichsen et al. 1983
Moose-4	30.0	29.0	15.0	4.0	38	none	Moosehorn	Mt Independence	Bonnichsen et al. 1983
MRV-3	39.0	20.0	11.0	4.0	45	none		Normanskill	Spiess and Bradley 1996
Mtwo-a	28.0	26.0	15.0	5.0	35	none	Moyer Two	Knife River?	Coovert 1970
Mtwo-b	26.0	25.0	15.0	6.0	45	none	Moyer Two		Coovert 1970
Mtwo-c	23.0	26.0	9.0	4.0	40	none	Moyer Two	Upper Mercer	Coovert 1970
Mtwo-d	24.5	22.0	10.0	4.5	42	none	Moyer Two	Upper Mercer	Coovert 1970
NBI-a	41.0	32.0	15.0	4.0	33	none		Munsungan?	Turnbull and Allen 1978
NP-a	24.0	21.0	12.0	6.5	36	none	Nobles Pond	Upper Mercer	Seeman et al. 1994
NP-e	27.0	26.0	11.0	6.0	40	none	Nobles Pond	Upper Mercer	Seeman et al. 1994
NP-f	25.0	25.0	12.0	5.0	38	none	Nobles Pond	Upper Mercer	Seeman et al. 1994
NP-h	19.0	18.0	9.0	4.0	40	none	Nobles Pond	Upper Mercer	Seeman et al. 1994
NP-j	27.0	24.0	10.0	5.0	43	none	Nobles Pond	Upper Mercer	Seeman et al. 1994
NP-m	23.0	22.0	11.0	4.0	33	none	Nobles Pond	Flint RIdge	Seeman et al. 1994
NP-n	24.0	23.0	11.0	4.0	35	none	Nobles Pond	Flint Ridge	Seeman et al. 1994
NP-o	23.0	22.0	12.0	4.5	42	slight	Nobles Pond	Flint Ridge	Gramly and Summers 1986
NP-p	22.0	19.0	9.0	4.0	32	none	Nobles Pond	Inidana Green	Seeman et al. 1994
NtR-c	17.0	16.5	10.0	4.5	35	none	Nottaway Survey	Maryland	Mc Avoy 1992
NtR-g	19.0	16.5	8.0	2.0	27	slight	Nottaway Survey	Bolster's Store	Mc Avoy 1992
NtR-j	22.0	19.5	13.0	1.5	19	full	Nottaway Survey	Cattail Creek	Mc Avoy 1992
NtR-l	23.0	18.5	10.0	3.0	32	none	Nottaway Survey	Cattail Creek	Mc Avoy 1992
NtR-n	23.0	22.5	13.0	2.5	25	none	Nottaway Survey	Unwharrie	Mc Avoy 1992
NYI-1	24.0	22.0	12.0	4.0	38	full		Onondaga	Ritchie 1957
NYI-10	15.0	15.0	5.0	1.5	23	none		Mt Jasper?	Ritchie 1957
NYI-12	14.0	12.0	7.0	4.0	45	none		Little Falls	Ritchie 1957
NYI-13	14.0	16.0	6.0	4.0	35	none		Onondaga?	Ritchie 1957
NYI-14	17.0	17.0	8.0	4.0	28	slight		Penn Jasper	Ritchie 1957
NYI-15	16.0	14.0	7.0	4.5	45	slight		Little Falls	Ritchie 1957
NYI-16	20.0	18.0	10.0	5.0	48	none		Upper Mercer	Ritchie 1957
NYI-17	13.0	14.0	7.0	3.0	33	slight		Leray	Ritchie 1957
NYI-18	13.0	12.5	6.0	3.0	32	none		Leray	Ritchie 1957
NYI-19	22.5	17.0	9.0	5.0	50	none		Onondaga	Ritchie 1957
NYI-2	26.0	26.0	14.0	5.0	32	none		Penn Jasper	Ritchie 1957
NYI-20	18.0	16.0	8.0	4.0	48	none		Onondaga	Ritchie 1957
NYI-21	13.0	15.0	5.0	2.5	35	full		Fort Ann?	Ritchie 1957
NYI-22	14.0	14.5	5.0	2.5	36	full		Onondaga	Ritchie 1957
NYI-26	15.0	14.0	7.0	4.0	50	full		Onondaga	Ritchie 1957
NYI-27	17.0	14.0	7.0	3.0	42	none		Western Onondaga	Ritchie 1957
NYI-28	16.0	13.0	7.0	3.0	43	slight		Leray	Ritchie 1957
NYI-29	17.0	15.0	7.0	3.0	58	none		Western Onondaga	Ritchie 1957
NYI-3	31.0	28.0	14.0	4.0	30	none		Onondaga	Ritchie 1957
NYI-30	18.0	19.0	9.0	4.0	43	none		Western Onondaga	Ritchie 1957

NYI-31	22.0	21.0	10.0	5.5	38	none	Western Onondaga	Ritchie 1957
NYI-32	18.0	17.0	9.0	2.5	45	full	Deepkill	Ritchie 1957
NYI-33	26.0	22.0	13.0	3.5	39	none	Upper Mercer	Ritchie 1957
NYI-35	27.0	17.0	13.0	4.5	45	none	Western Onondaga	Ritchie 1957
NYI-38	18.0	16.0	8.0	3.5	42	none		Ritchie 1957
NYI-39	15.0	17.0	9.0	5.0	51	slight		Ritchie 1957
NYI-40	16.5	17.0	7.0	3.0	35	none	Whitehall	Ritchie 1957
NYI-41	19.0	19.0	9.0	4.0	35	none	Whitehall	Ritchie 1957
NYI-42	27.5	22.0	19.0	3.5	32	full	Penn Jasper	Ritchie 1957
NYI-43	25.0	25.0	13.0	4.5	30	none	Normanskill	Ritchie 1957
NYI-44	22.0	22.5	11.0	6.0	42	slight	Normanskill	Ritchie 1957
NYI-45	22.0	22.0	13.0	4.5	40	none	Western Onondaga	Ritchie 1957
NYI-48	15.0	14.0	8.0	3.0	38	none	Helderberg	Ritchie 1957
NYI-49	14.0	11.0	6.0	3.0	43	none	Western Onondaga	Ritchie 1957
NYI-5	28.0	30.0	14.0	10.0	50	none	Onondaga	Ritchie 1957
NYI-50	21.0	11.0	7.0	2.0	32	none	Western Onondaga	Ritchie 1957
NYI-51	19.0	17.0	10.0	4.5	48	none	Deepkill	Ritchie 1957
NYI-52	17.0	17.0	9.0	2.5	30	none		Smith 1952
NYI-6	32.0	28.0	12.0	6.0	37	none	Deepkill	Ritchie 1957
NYI-7	38.0	33.0	18.0	8.0	38	none	Penn Jasper	Ritchie 1957
NYI-8	32.0	28.0	14.0	5.0	31	slight	Deepkill	Ritchie 1957
NYI-9	32.0	30.0	17.0	8.0	33	none	Upper Mercer	Ritchie 1957
OFPS1	18.0	14.5	8.0	3.0	38	none	Coshocton	Hothem 1990
OFPS10	18.0	15.0	7.0	2.5	25	full		Hothem 1990
OFPS11	14.5	14.5	10.0	0.8	8	none		Hothem 1990
OFPS12	22.0	18.0	10.0	2.5	20	none	Flint Ridge	Hothem 1990
OFPS13	15.0	13.5	7.0	3.0	33	none	Upper Mercer	Hothem 1990
OFPS14	14.5	13.0	8.0	2.0	20	none	Coshocton	Hothem 1990
OFPS15	18.5	16.0	9.0	2.5	18	full	Coshocton	Hothem 1990
OFPS16	15.0	12.0	7.0	1.5	25	none	Coshocton	Hothem 1990
OFPS17	13.5	12.5	6.0	2.0	29	none	Flint Ridge	Hothem 1990
OFPS18	18.0	18.0	11.0	4.5	39	none	Flint Ridge	Hothem 1990
OFPS19	20.0	17.5	11.0	3.5	32	none	Upper Mercer	Hothem 1990
OFPS2	16.5	15.0	7.0	2.0	30	full	Carter	Hothem 1990
OFPS20	20.0	19.5	12.0	4.0	34	none	Flint Ridge	Hothem 1990
OFPS21	18.5	17.0	7.0	3.0	29	none	Upper Mercer	Hothem 1990
OFPS22	21.0	16.5	8.0	2.5	28	none	Upper Mercer	Hothem 1990
OFPS23	20.0	16.0	7.0	2.5	30	none	Upper Mercer	Hothem 1990
OFPS24	22.0	18.5	9.0	2.0	29	none	Flint Ridge	Hothem 1990
OFPS25	23.5	20.0	9.0	4.5	39	none	Upper Mercer	Hothem 1990
OFPS26	23.0	23.0	11.0	3.5	40	none	Flint Ridge	Hothem 1990
OFPS27	13.5	9.5	6.0	1.5	20	none	Zaleski	Hothem 1990
OFPS28	15.0	15.0	8.0	3.0	34	none	Upper Mercer	Hothem 1990
OFPS29	17.5	16.0	8.0	4.0	40	none	Logan	Hothem 1990
OFPS3	16.5	13.5	7.0	2.5	28	full	Coshocton	Hothem 1990
OFPS30	22.0	21.0	10.0	5.0	35	none	Flint Ridge	Hothem 1990
OFPS31	18.5	19.5	9.0	3.0	31	none	Flint Ridge	Hothem 1990
OFPS32	20.0	17.0	9.0	4.5	40	none	Flint Ridge	Hothem 1990
OFPS33	19.0	18.5	9.0	3.0	30	none	Flint Ridge	Hothem 1990
OFPS34	22.0	18.0	7.0	2.5	28	none	Flint Ridge	Hothem 1990
OFPS35	19.5	17.0	9.0	3.0	32	none	Flint Ridge	Hothem 1990
OFPS36	18.0	16.0	7.0	1.0	13	none	Zaleski	Hothem 1990
OFPS37	21.0	20.0	9.0	4.0	36	slight	Delaware	Hothem 1990
OFPS38	17.0	15.0	9.0	2.5	28	none	Indiana Green	Hothem 1990
OFPS39	32.0	27.0	18.0	5.5	34	none	Flint Hill	Hothem 1990
OFPS4	17.0	15.0	8.0	1.5	15	none	Flint Ridge	Hothem 1990
OFPS40	27.0	25.0	12.0	3.0	30	none	Flint Ridge	Hothem 1990

OFPS41	27.0	21.0	10.0	4.0	34	full		Upper Mercer	Hothem 1990
OFPS42	34.0	31.0	16.0	7.0	34	slight		Flint Ridge	Hothem 1990
OFPS43	24.0	21.0	13.0	2.5	20	none		Onondaga	Hothem 1990
OFPS44	28.5	28.0	17.0	6.0	40	none		Coshocton	Hothem 1990
OFPS45	32.0	30.5	16.0	5.5	40	full		Flint Ridge	Hothem 1990
OFPS46	30.0	27.0	16.0	4.5	30	none		Flint Ridge	Hothem 1990
OFPS47	23.5	23.5	12.0	7.0	50	none		Indiana Green?	Hothem 1990
OFPS48	33.5	28.0	15.0	5.0	32	none		Zaleski	Hothem 1990
OFPS49	33.5	29.5	13.0	5.0	30	none		Carter?	Hothem 1990
OFPS5	16.0	15.5	8.0	3.0	25	full		Flint Ridge	Hothem 1990
OFPS50	33.0	27.0	15.0	4.5	30	full		Carter?	Hothem 1990
OFPS51	35.0	31.0	15.0	7.5	37	none		Flint Ridge	Hothem 1990
OFPS52	36.5	27.5	18.0	3.5	23	slight		Flint Ridge	Hothem 1990
OFPS6	14.5	14.5	7.0	2.0	25	none		Flint Ridge	Hothem 1990
OFPS7	12.5	12.5	6.0	2.0	26	none			Hothem 1990
OFPS8	20.5	17.5	8.0	2.0	23	none		Indiana Green	Hothem 1990
OFPS9	14.0	9.0	4.0	0.5	12	none		Coshocton	Hothem 1990
ONIf11-10	17.0	14.0	8.0	3.5	48	full		Collingwood	Deller and Ellis 1988
ONIf11-3	19.0	15.0	8.0	3.5	40	full		W. Onondaga	Deller and Ellis 1988
ONIf11-6	18.0	13.0	7.0	3.0	39	full		Collingwood	Deller and Ellis 1988
ONIf11-8	19.0	14.0	9.0	2.5	42	slight		Collingwood	Deller and Ellis 1988
ONIf11-9	18.0	14.0	10.0	2.5	42	full		Bayport	Deller and Ellis 1988
ONIf8-1	28.0	28.0	14.0	8.5	43	none		Upper Mercer	Deller and Ellis 1988
ONIf8-2	24.0	25.0	14.0	7.5	48	none		W. Onondaga	Deller and Ellis 1988
ONIf8-5	29.0	27.0	17.0	6.0	47	none		Collingwood	Deller and Ellis 1988
ONIf8-6	31.0	31.5	19.0	7.0	38	none		Bayport	Deller and Ellis 1988
ONIf8-8	27.0	25.0	13.0	4.0	34	none		Collingwood	Deller and Ellis 1988
ONI-Rla	23.0	21.0	9.0	2.5	22	full	Rice Lake	W. Onondaga	Jackson 1990
ONI-RLb	26.0	24.0	10.0	3.5	30	none	Rice Lake	Lockport	Jackson 1990
OV-Flynn-13	27.0	26.0	16.0	7.0	35	none			
OV-Mari-11	21.0	21.0	8.0	4.0	32	slight			
OV-Mari-12cen	19.0	18.0	8.0	3.0	30	full			
OV-Mari-12rt	22.0	21.0	13.0	3.0	34	slight		Zaleski	
OV-Mari-13	28.5	24.0	12.0	6.0	32	full			
OV-Mari-15	28.0	23.0	12.0	5.0	40	slight			
PAI-63	29.0	21.0	17.0	3.0	30	none		Penn Jasper	Royer 1963
Park-5.1c	17.0	13.0	8.0	3.5	39	full	Parkhill	Collingwood	Roosa and Ellis 2000
Park-5.1h	14.5	9.0	5.5	2.0	40	none	Parkhill	Collingwood	Roosa and Ellis 2000
Park-5.2c	19.0	13.0	8.0	4.0	42	none	Parkhill	Collingwood	Roosa and Ellis 2000
Park-x	0.0	0.0	0.0	0.0	0	none	Parkhill	W. Onondaga	Roosa and Ellis 2000
Park-y	0.0	0.0	0.0	0.0	0	none	Parkhill	Bayport	Roosa and Ellis 2000
PC-1	18.0	18.0	12.0	2.0	16	none	Paleo Crossing	Zaleski	Brose 1994
PC-2	26.0	22.0	10.0	5.0	33	none	Paleo Crossing	Wyandot	Brose 1994
PC-3	18.0	17.0	10.0	3.0	16	slight	Paleo Crossing	Pipe Creek	Brose 1994
PC-4	24.0	20.0	9.0	4.0	32	none	Paleo Crossing	Flint Ridge	Brose 1994
PEI91-e	27.0	25.0	13.0	9.0	46	none		Minas Basin	Keenlyside 1991
Pl-1	24.5	22.0	11.0	2.5	19	none		Penn Jasper	Solecki 1961
Pl-1a	36.0	33.0	18.0	11.0	65	none	Plenge	Penn Jasper	Kraft 1973
Pl-1b	18.5	17.0	9.0	3.5	42	none	Plenge	E. Onondaga	Kraft 1973
Pl-1c	32.0	28.5	15.0	5.5	29	none	Plenge		Kraft 1973
Pl-1d	22.0	18.0	9.0	4.0	53	none	Plenge	Macungie	Kraft 1973
Pl-1e	25.0	22.5	12.0	3.5	31	slight	Plenge	Macungie	Kraft 1973
Pl-1f	19.0	19.0	10.0	3.5	26	none	Plenge	Normanskill	Kraft 1973
Pl-2b	19.0	18.0	9.0	3.5	34	none	Plenge		Kraft 1973
Pl-2c	12.0	11.0	6.0	3.0	42	slight	Plenge	Penn Jasper	Kraft 1973
Pl-2d	13.5	13.0	7.0	2.0	27	none	Plenge	Penn Jasper	Kraft 1973

Pl-2g	25.0	24.0	16.0	3.5	31	none	Plenge	Penn Jasper	Kraft 1973
Pl-2i	23.0	23.0	12.0	3.0	30	none	Plenge		Kraft 1973
Pl-3b	32.0	22.0	14.0	8.5	58	none	Plenge	E. Onondaga	Kraft 1973
Pl-3c	23.0	15.0	8.0	2.5	35	none	Plenge	Mt Independence	Kraft 1973
Pl-x	0.0	0.0	0.0	0.0	0	none	Plenge	Lehigh	Kraft 1973
Pl-y	0.0	0.0	0.0	0.0	0	none	Plenge	Munsungan	Kraft 1973
Poi2	15.0	15.0	9.0	3.0	35	none	Poirier	Coxsackie	Fogelman and Poirier 1990
Poi3	9.5	10.0	6.0	2.0	37	none	Poirier	W. Onondaga	Fogelman and Poirier 1990
Poi6	11.0	11.5	6.0	3.0	32	none	Poirier	Onondaga	Fogelman and Poirier 1990
Poi7	15.0	14.5	10.0	3.0	31	none	Poirier	E Onondaga	Fogelman and Poirier 1990
PoR5	20.0	18.5	11.0	3.5	34	none	Point-of-Rocks	Bolster's Store	McAvoy 1979
PoR6	23.0	22.0	18.0	5.0	34	none	Point-of-Rocks	Maryland?	McAvoy 1979
PoR7	24.0	22.0	14.0	4.5	35	none	Point-of-Rocks	Maryland?	McAvoy 1979
PoR-x	0.0	0.0	0.0	0.0	0	none	Point-of-Rocks	Sussex PW	MacAvoy 1992
Pt-2989	25.5	24.0	13.0	4.0	21	none	Potts	C. Onondaga	Gramly and Lothrup 1984
Pt-455	17.0	18.0	11.0	4.0	40	full	Potts	W. Onondaga	Gramly and Lothrup 1984
Pt-L	25.0	25.0	14.0	7.5	40	none	Potts	Normanskill	Gramly and Lothrup 1984
Pt-Q	24.5	25.0	15.0	7.0	44	none	Potts	Upper Mercer	Gramly and Lothrup 1984
PtSeb-x	0.0	0.0	0.0	0.0	0	none	Point Sebago	Munsungan	Spiess et al. 1998
PtSeb-y	0.0	0.0	0.0	0.0	0	none	Point Sebago	Mt Jasper	Spiess et al. 1998
Pt-x	0.0	0.0	0.0	0.0	0	none	Potts	Penn Jasper	Lothrup 1988
Quc-x	0.0	0.0	0.0	0.0	0	none		Colchester	MacDonald 1985; Keenlyside 1991
R1	22.0	21.5	13.0	5.5	33	none	Richmond		Bottoms 1972
R11	16.0	15.5	7.0	3.5	40	none	Richmond		Bottoms 1972
R12	19.0	18.5	11.0	3.0	28	none	Richmond		Bottoms 1972
R13	21.0	19.0	7.0	2.0	22	full	Richmond		Bottoms 1972
R14	21.0	20.0	12.0	4.0	38	none	Richmond	Sussex PW?	Bottoms 1972
R15	22.0	21.5	11.0	2.0	33	none	Richmond	Aquia?	Bottoms 1972
R17	25.0	22.0	12.0	3.0	39	none	Richmond	Aquia?	Bottoms 1972
R18	25.0	21.0	12.0	4.5	41	none	Richmond	Unwharrie	Bottoms 1972
R19	18.0	18.0	9.0	5.5	46	full	Richmond	Sussex PW?	Bottoms 1972
R2	20.0	19.5	9.0	1.5	18	none	Richmond	Unwharrie	Bottoms 1972
R20	16.0	18.0	10.0	3.5	28	full	Richmond		Bottoms 1972
R21	17.0	15.5	8.0	1.0	15	none	Richmond	Sussex PW?	Bottoms 1972
R22	29.0	27.0	15.0	4.5	35	none	Richmond	Sussex PW?	Bottoms 1972
R23	21.0	20.5	11.0	4.5	34	none	Richmond	Aquia?	Bottoms 1972
R24	20.0	17.5	10.0	3.0	20	none	Richmond	Sussex PW?	Bottoms 1972
R25	14.0	12.0	5.0	2.0	30	none	Richmond	Sussex PW?	Bottoms 1972
R3	16.0	15.0	8.0	4.5	42	none	Richmond	Sussex PW?	Bottoms 1972
R4	17.0	16.5	8.0	1.5	21	none	Richmond	Sussex PW?	Bottoms 1972
R5	21.0	17.0	7.0	1.5	18	none	Richmond	Unwharrie	Bottoms 1972
R6	20.0	19.0	9.0	2.5	26	none	Richmond	Aquia?	Bottoms 1972
R7	21.0	19.0	11.0	2.0	14	none	Richmond	WAC?	Bottoms 1972
R8	20.0	20.0	10.0	3.5	33	none	Richmond		Bottoms 1972
R9	20.0	20.0	9.0	5.0	42	none	Richmond		Bottoms 1972
RI54-1	24.0	24.0	15.0	7.0	50	slight		Penn Jasper	Fowler 1954
RI54-6	15.0	15.0	8.0	3.0	38	none		Cheshire?	Fowler 1954
RRI-1	30.0	25.0	16.0	4.5	24	none		Unwharrie	Bottoms and Ramsey 1995
RRI-2	22.0	22.5	11.0	3.0	22	full			Bottoms and Ramsey 1995
RRI-3	19.0	19.0	9.0	2.5	18	none			Bottoms and Ramsey 1995
SC-1	27.0	25.0	16.0	6.0	46	none	Sheriden Cave	Delaware	Redmond and Tankersley 2005
SGL-31	23.0	23.0	15.0	4.0	36	none	Sugarloaf	Hudson Valley	Gramly 1998
SGL-35	28.5	27.0	14.0	5.5	36	slight	Sugarloaf	Marblehead?	Gramly 1998
Shp1	13.0	13.5	7.0	1.5	26	none	Shoop	Western Onondaga	Witthoft 1952
Shp12	14.0	11.5	5.0	2.5	35	none	Shoop	Western Onondaga	Carr and Adovasio 2002
Shp13	14.0	16.0	9.0	3.0	28	full	Shoop	Western Onondaga	Carr and Adovasio 2002
Shp15	17.5	15.0	8.0	4.0	37	none	Shoop	Western Onondaga	Carr and Adovasio 2002

Shp16	14.5	13.5	8.0	3.0	30	full	Shoop	Western Onondaga	Carr and Adovasio 2002
Shp18	18.0	15.5	6.0	2.5	35	none	Shoop	Western Onondaga	Carr and Adovasio 2002
Shp19	20.5	18.0	6.0	2.5	28	none	Shoop	Penn Jasper	Witthoft 1952
Shp2	10.0	11.5	6.0	1.5	17	full	Shoop	Western Onondaga	Witthoft 1952
Shp20	17.5	17.5	8.0	3.0	35	none	Shoop	Penn Jasper	Witthoft 1952
Shp3	12.0	11.5	5.0	3.0	41	none	Shoop	Western Onondaga	Witthoft 1952
Shp4	15.5	15.0	8.0	3.5	35	none	Shoop	Western Onondaga	Witthoft 1952
Shp5	13.0	14.0	8.0	2.5	35	none	Shoop	Western Onondaga	Witthoft 1952
Shp6	11.0	11.0	6.0	2.5	40	none	Shoop	Western Onondaga	Witthoft 1952
Shp8	13.0	14.0	7.0	3.5	35	none	Shoop	Western Onondaga	Witthoft 1952
Shp9	12.0	12.0	6.0	2.0	23	none	Shoop	Western Onondaga	Witthoft 1952
SM-1	25.0	24.0	14.0	4.0	26	none	Shawnee-Minisink	Onondaga	McNett 1985
SS-a	18.0	19.0	12.0	2.0	18	slight	Sandy Springs	Upper Mercer	Seeman et al. 1994
SS-c	17.0	16.0	8.0	4.0	45	full	Sandy Springs	Dover	Seeman et al. 1994
SS-f	16.0	15.0	9.0	3.0	30	none	Sandy Springs	Upper Mercer	Seeman et al. 1994
SS-g	22.0	20.0	10.0	4.0	33	none	Sandy Springs	Upper Mercer	Seeman et al. 1994
SS-h	18.0	16.0	9.0	3.0	28	none	Sandy Springs	Paoli	Seeman et al. 1994
SS-j	18.0	16.0	11.0	4.5	42	none	Sandy Springs	Flint Ridge	Seeman et al. 1994
SS-m	24.0	22.0	12.0	4.0	33	none	Sandy Springs	Upper Mercer	Seeman et al. 1994
SS-o	19.0	19.0	11.0	4.0	37	none	Sandy Springs	Brassfield	Seeman et al. 1994
SS-p	18.0	16.0	12.0	4.0	30	none	Sandy Springs	Hixton	Seeman et al. 1994
SVI-11	20.0	20.0	9.0	3.0	32	none	Shenandoah Valley		Gardner 1974
SVI-12	28.0	26.0	16.0	6.0	40	none	Shenandoah Valley	Cattail Creek	Gardner 1974
SVI-13	17.0	18.0	11.0	3.0	30	slight	44WR11	Cattail Creek	Gardner 1974
SVI-2	17.0	15.5	9.0	4.5	46	slight	Shenandoah Valley	Flint Run?	Gardner 1974
SVI-3	22.5	21.0	11.0	4.0	33	full	Shenandoah Valley		Gardner 1974
SVI-30	20.0	16.0	7.0	2.5	24	full	44WR50	Flint Run?	Gardner 1974
UCBI-1	29.0	30.0	16.0	6.0	0	full		Aquia?	Dilks and Reynolds 1962
UCBI-3	30.0	26.0	15.0	8.0	0	none			Dilks and Reynolds 1962
UCBI-4	31.0	29.5	18.0	2.0	0	full		Maryland?	Dilks and Reynolds 1962
UCBI-5	23.0	26.0	15.0	5.0	0	none		Aquia?	Dilks and Reynolds 1962
UCBI-6	22.0	21.0	12.0	6.0	40	slight		Coxsackie	Andrews 1999
Ud-g	18.0	18.0	9.0	4.0	44	none	Udora	Collingwood	Storck and Spiess 1994
Ud-h	20.0	19.0	10.0	6.5	55	none	Udora	W. Onondaga	Storck and Spiess 1994
Ud-x	0.0	0.0	0.0	0.0	0	none	Udora	Balsam Lake	Storck and Spiess 1994
uwd-2	20.0	20.0	10.0	6.5	0	none	Upper Wheeler Dam		Gramly 1988
V1	22.0	22.0	13.0	7.0	68	none			McCary 1984
V10	20.0	21.0	12.0	8.0	55	none			McCary 1984
V100	25.0	22.5	12.0	2.5	25	full		Mitchell?	McCary 1984
V101	21.0	20.0	10.0	3.0	35	none			McCary 1984
V102	19.0	22.0	12.0	3.5	32	none			McCary 1984
V103	25.5	25.0	12.0	3.0	21	none		WAC?	McCary 1984
V104	23.0	23.0	14.0	3.0	24	none			McCary 1984
V105	31.5	27.5	13.0	12.0	50	none		WAC?	McCary 1984
V106	26.5	26.0	13.0	3.5	24	none		Bolster's Store	McCary 1984
V107	31.0	25.0	15.0	2.0	20	none		Bolster's Store?	McCary 1984
V108	20.0	20.0	9.0	3.0	31	none		Bolster's Store	McCary 1984
V109	22.0	18.5	8.0	5.0	44	none			McCary 1984
V11	24.0	22.5	12.0	3.0	25	full		Patuxent?	McCary 1984
V110	33.0	28.0	19.0	4.5	31	none		Bonnefont?	McCary 1984
V111	30.0	23.5	15.0	3.0	26	none			McCary 1984
V112	32.0	23.0	14.0	3.5	32	none			McCary 1984
V114	23.0	21.0	10.0	2.5	24	none			McCary 1984
V115	31.5	26.0	14.0	3.0	18	none		Cattail Creek?	McCary 1984
V116	30.0	26.0	14.0	4.5	25	none		Flint Run?	McCary 1984
V117	24.5	22.0	13.0	4.0	33	none		Mitchell?	McCary 1984
V118	31.0	24.0	17.0	3.0	25	none		Bolster's Store?	McCary 1984

V119	25.0	32.0	14.0	3.5	25	full		Cattail Creek?	McCary 1984
V12	23.0	23.5	13.0	8.5	49	none		Bolster's Store?	McCary 1984
V120	24.0	24.0	11.0	6.0	48	none		Bolster's Store	McCary 1984
V121	32.0	25.0	14.0	11.5	58	none			McCary 1984
V122	33.0	26.0	13.0	3.0	24	full			McCary 1984
V123	29.0	22.0	13.0	5.0	52	full		Bolster's Store	McCary 1984
V124	18.0	18.0	9.0	2.0	24	none			McCary 1984
V125	27.0	26.0	16.0	3.5	24	none		Mitchell?	McCary 1984
V126	26.5	24.0	14.0	4.5	28	none			McCary 1984
V13	22.5	24.0	14.0	9.0	47	full			McCary 1984
V14	27.0	26.0	13.0	8.5	50	none		Bolster's Store?	McCary 1984
V15	18.0	17.0	10.0	3.0	26	full			McCary 1984
V16	22.0	21.0	14.0	5.5	38	none			McCary 1984
V17	25.0	25.0	15.0	8.5	55	full			McCary 1984
V18	25.0	23.5	11.0	6.0	36	none		Cattail Creek?	McCary 1984
V19	19.0	18.5	13.0	3.5	35	none			McCary 1984
V20	20.0	19.5	12.0	3.5	30	full		Cattail Creek?	McCary 1984
V21	30.5	30.0	22.0	5.0	34	none			McCary 1984
V22	27.0	22.0	13.0	7.0	50	none		Wolf Den?	McCary 1984
V23	26.0	23.5	11.0	4.5	37	full			McCary 1984
V24	18.5	19.0	10.0	2.0	29	none			McCary 1984
V25	31.0	29.0	13.0	5.0	40	full		Bolster's Store?	McCary 1984
V26	23.0	19.0	11.0	2.5	32	none		Bolster's Store?	McCary 1984
V27	24.5	17.0	8.0	3.5	50	full			McCary 1984
V28	30.0	29.0	21.0	7.0	5	full		Bolster's Store?	McCary 1984
V29	31.0	30.0	20.0	12.0	60	none		Cattail Creek	McCary 1984
V3	22.0	21.0	10.0	5.5	60	full			McCary 1984
V30	31.0	29.0	15.0	4.5	25	full		Bolster's Store?	McCary 1984
v-3019	31.0	31.0	17.0	11.0	0	slight	Vail		Gramly 1982
V31	21.0	21.0	14.0	2.5	28	full		Bolster's Store?	McCary 1984
V32	19.0	19.0	14.0	2.5	32	full		Cattail Creek?	McCary 1984
V33	21.5	16.5	12.0	1.5	22	none		Sussex PW	McCary 1984
V34	20.0	16.0	11.0	7.0	65	none		Bolster's Store?	McCary 1984
V35	29.5	23.0	14.0	9.0	55	full		Cattail Creek?	McCary 1984
V36	27.5	26.0	16.0	7.5	33	none		Bolster's Store?	McCary 1984
V37	17.0	16.0	10.0	3.0	24	none			McCary 1984
V38	24.5	23.0	12.0	4.0	25	full		Bolster's Store?	McCary 1984
V4	21.0	20.0	15.0	2.5	20	none			McCary 1984
V40	21.0	21.0	14.0	4.0	36	none		Bolster's Store?	McCary 1984
V41	18.0	15.0	8.0	3.0	30	full		Mitchell?	McCary 1984
V42	24.0	24.0	15.0	7.0	45	full		Bolster's Store?	McCary 1984
V43	17.0	18.0	12.0	4.0	35	none			McCary 1984
V44	19.0	20.0	10.0	3.5	29	none			McCary 1984
V45	24.5	21.0	11.0	3.0	18	full			McCary 1984
V46	27.0	23.0	17.0	1.5	14	full			McCary 1984
V47	26.0	25.0	10.0	3.5	28	none			McCary 1984
V48	29.0	29.0	12.0	1.5	20	full		WAC?	McCary 1984
V49	28.0	22.0	9.0	3.5	28	none		Bolster's Store?	McCary 1984
V5	26.0	26.0	12.0	5.0	40	full			McCary 1984
V51	29.0	29.0	12.0	9.0	46	none			McCary 1984
V53	22.0	21.5	11.0	3.0	35	none		Cattail Creek?	McCary 1984
V54	24.0	22.0	12.0	3.5	37	none		Cattail Creek?	McCary 1984
V55	18.5	19.0	9.0	3.0	34	none		Cattail Creek?	McCary 1984
v-5578	25.0	28.0	16.0	8.0	0	none	Vail		Gramly 1982
v-5582/10787	26.0	25.0	15.0	11.5	0	none	Vail	Munungan	Gramly 1982
V57	26.0	24.0	18.0	1.0	10	none		Cattail Creek?	McCary 1984
V58	23.0	22.0	10.0	3.0	20	none			McCary 1984

V59	43.0	44.0	34.0	9.0	36	slight			McCary 1984
V6	17.0	17.0	9.0	3.0	32	full			McCary 1984
V60	28.0	30.0	21.0	9.5	51	none			McCary 1984
V61	33.0	36.0	20.0	3.5	22	none			McCary 1984
V62	22.0	24.0	14.0	3.5	26	none		Cattail Creek	McCary 1984
V63	18.0	16.0	8.0	1.5	21	none			McCary 1984
V64	25.0	23.0	15.0	3.3	27	none		Cattail Creek	McCary 1984
V65	22.5	24.0	11.0	3.0	28	none			McCary 1984
V67	21.0	22.0	10.0	2.0	20	none			McCary 1984
V68	20.4	19.5	9.0	1.0	8	none			McCary 1984
V7	22.5	21.0	13.0	6.0	40	full			McCary 1984
V70	32.0	21.0	12.0	3.0	21	full			McCary 1984
V71	32.0	28.0	14.0	2.5	23	full			McCary 1984
V72	21.0	23.5	11.0	3.0	18	none			McCary 1984
V73	26.0	26.0	15.0	3.0	18	none		Cattail Creek	McCary 1984
V74	21.0	22.0	12.0	3.0	20	none			McCary 1984
V75	26.0	22.0	12.0	2.5	18	slight			McCary 1984
V76	18.0	16.5	9.0	2.0	21	none		Flint Run?	McCary 1984
V77	18.5	21.5	12.0	2.5	28	none			McCary 1984
V78	25.5	28.5	17.0	5.0	36	none			McCary 1984
V79	26.0	21.0	15.0	4.0	34	none		Cattail Creek?	McCary 1984
V8	23.0	23.0	16.0	7.5	48	none			McCary 1984
V80	26.0	25.5	15.0	5.0	44	none		WAC?	McCary 1984
V81	27.0	25.5	12.0	3.0	24	none		Patuxent?	McCary 1984
V82	20.0	20.0	10.0	4.0	32	none		Cattail Creek?	McCary 1984
V83	20.5	24.0	13.0	2.0	16	none			McCary 1984
V84	27.0	25.5	13.0	2.0	21	none			McCary 1984
V86	24.0	20.0	9.0	3.0	32	none			McCary 1984
V87	29.5	27.5	13.0	2.0	12	none			McCary 1984
V88	27.5	21.0	11.0	6.0	45	none		Bolster's Store?	McCary 1984
V89	22.5	22.5	13.0	2.5	18	none			McCary 1984
V9	28.5	27.0	13.0	6.5	28	full		Bolster's Store?	McCary 1984
V90	24.0	19.5	11.0	3.0	26	full			McCary 1984
V92	21.0	17.5	8.0	2.5	28	none			McCary 1984
V93	20.0	20.5	15.0	2.0	23	none			McCary 1984
V94	27.0	22.0	14.0	6.0	54	none			McCary 1984
V95	28.0	13.0	11.0	9.5	56	none		Bolster's Store?	McCary 1984
V96	28.5	24.0	12.0	2.5	17	none			McCary 1984
V97	34.0	27.0	17.0	4.0	26	none			McCary 1984
V98	52.0	34.0	21.0	4.5	27	none			McCary 1984
V99	29.5	26.0	13.0	3.5	20	none			McCary 1984
VI-310	15.5	14.5	8.0	5.0	56	none	Vail	Hudson Valley?	Gramly and Rutledge 1982
VI-316	16.0	16.0	9.0	6.0	55	none	Vail	Hudson Valley?	Gramly and Rutledge 1982
VI-317	16.0	16.5	9.0	4.0	54	none	Vail	Hudson Valley?	Gramly and Rutledge 1982
VI-333	15.0	15.0	8.0	4.5	58	none	Vail	Hudson Valley?	Gramly and Rutledge 1982
VI-336	13.0	13.0	9.0	5.0	57	none	Vail	Hudson Valley?	Gramly and Rutledge 1982
VI-352	13.5	13.0	7.0	5.0	52	none	Vail	Penn Jasper?	Gramly and Rutledge 1982
VI-49	15.0	15.5	9.0	6.0	55	none	Vail	Hudson Valley?	Gramly and Rutledge 1982
VI-500	47.0	30.0	15.0	9.0	50	none	Vail	Penn Jasper?	Gramly and Rutledge 1982
VI-717	15.0	15.0	9.0	5.0	54	none	Vail	Hudson Valley?	Gramly and Rutledge 1982
VI-718	16.0	16.0	9.0	4.0	50	none	Vail	Hudson Valley?	Gramly and Rutledge 1982
VI-8	14.0	14.0	8.0	4.5	55	none	Vail	Hudson Valley?	Gramly and Rutledge 1982
VI-9	16.0	15.5	9.0	5.0	51	none	Vail	Hudson Valley?	Gramly and Rutledge 1982
VT54-4	22.0	19.0	10.0	4.0	35	none		Mt Independence	Fowler 1954
W8-B	41.0	42.5	25.0	7.0	38	none	Wapanucket-8	Penn Jasper	Robbins and Agogino 1964
W8-D	44.0	45.0	22.0	8.0	33	none	Wapanucket-9	Normanskill	Robbins and Agogino 1964
W8-E	31.0	34.0	15.0	7.0	42	full	Wapanucket-10		Robbins and Agogino 1964

Wh-NH41-6	33.5	31.0	17.0	7.0	56	none	Whipple		Curran 1984
Wh-NLW1	30.0	26.0	17.0	8.5	55	none	Whipple		Curran 1984
Wh-NLW2	32.0	25.0	16.0	7.0	50	none	Whipple		Curran 1984
Whp-x	0.0	0.0	0.0	0.0	0	none	Whipple	Munsungan	Curran 1999
Whp-y	0.0	0.0	0.0	0.0	0	none	Whipple	Mt Jasper	Curran 1999
Will-12	21.0	17.5	10.0	2.5	26	none	Williamson	Cattail Creek	Peck 1998
Will-y	0.0	0.0	0.0	0.0	0	none	Williamson	Mitchell	Peck 1998
Will-z	0.0	0.0	0.0	0.0	0	none	Williamson	Bolster's Store	Peck 1998
Z1	19.0	22.0	10.0	4.5	25	full	Zierdt	Penn Jasper	Werner 1964

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