PERSISTENT PLACES IN THE LATE ARCHAIC LANDSCAPE

PERSISTENT PLACES IN THE LATE ARCHAIC LANDSCAPE: A GIS-BASED CASE STUDY OF CRM SITES IN THE LOWER GRAND RIVER AREA, ONTARIO

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TITLE: Persistent Places in the Late Archaic Landscape AUTHOR: Eric Tincombe, B.A. (Brock University) SUPERVISOR: Dr. Aubrey Cannon NUMBER OF PAGES: x, 100.

Lay Abstract:

My aim in this study is to identify persistent places—places of continued importance throughout the long-term occupation of a region—within the lower Grand River Area of what is now southern Ontario during a period known as the Late Archaic (ca. 2500 B.C.- ca. 1000 B.C). This was accomplished using GIS spatial analysis of data produced through commercial archaeological assessments. As a result of this analysis, I identified two persistent places within the study area: one near D'Aubigny Creek south of Brantford, and one surrounding Seneca Creek near Caledonia. I also investigated the environments surrounding these places to determine what may have made them continuously appealing for over a millennium. Both areas were found to contain environmental features that would have likely made them particularly resource-rich and appealing to hunter-gatherers. One of the most important findings was that both areas are in close proximity to walleye spawning grounds.

Abstract:

My aim in this study is to identify Late Archaic persistent places—places of continued importance throughout the long-term occupation of a region—within the lower Grand River Area of what is now southern Ontario. I accomplish this through the use of kernel density estimation applied to datasets containing the locations of Late Archaic (4000-2800 RCYBP) sites within this study area which were discovered through cultural resource management (CRM) survey and excavation. Areas identified as persistent places were investigated with regard to landscape features and environmental affordances that could have structured their consistent re-use throughout the Late Archaic, with particular attention paid to the hypothesis that persistent places may have developed around the riverine spawning grounds of spring-spawning fish. Two places with particularly intense concentrations of diagnostic materials dating to successive periods of the Late Archaic were identified: one surrounding Seneca Creek near Caledonia, and one near D'Aubigny Creek south of Brantford. The results show that the persistent use of these places would likely have been structured by the presence of landscape features which would have made these areas particularly rich in many different seasonal resources during the Late Archaic. Perhaps most significantly, both areas are located in close proximity to areas identified as walleye spawning grounds. The contributions of this thesis include the synthesis of the results of many years of CRM survey of the Grand River Area, evidence for the existence of Late Archaic riverine fishing sites related to the spawning runs of walleye, and an improved understanding of Late Archaic subsistence-settlement systems.

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LIST OF ABBREVIATIONS AND SYMBOLS

CRM: Cultural Resource Management
GC-MS: Gas Chromatography Mass Spectrometry
KDE: Kernel Density Estimation
OASD: Ontario Archaeological Sites Database
OMHSTCI: Ontario Ministry of Heritage, Sport, Tourism, and Culture Industries
OMNRF: Ontario Ministry of Natural Resources and Forestry
RCYBP: Radiocarbon Years Before Present

1. INTRODUCTION

In this thesis I have applied kernel density estimation (KDE) to a subset of the Ontario Archaeological Sites Database (OASD), which contains the locations of Late Archaic sites discovered in the course of cultural resource management (CRM) assessments in the Lower Grand River area. The resulting intensity surfaces were then analyzed and compared to identify places which contain particularly dense clusters of Late Archaic diagnostic materials that date to successive periods of the Late Archaic. Two places were identified as the locations of a particularly large number of sites containing Late Archaic components: an area near D'Aubigny Creek (south of Brantford), and an area near Seneca Creek in Caledonia.

Using the framework developed by Schlanger (1992) and refined by Thompson (2010), these locations are identified as persistent places—places that were used repeatedly throughout the long-term occupation of a region. I argue that the practice of visiting these places, which occurred within the context of past visits, constitutes a tradition, according to Pauketat's (2001) definition. This approach allows us to move beyond the general dichotomy of lakeshore and upland sites in our current understanding of Late Archaic settlement systems to identify particular places in the landscape which would have structured seasonal movement, and which would have likely been significant to the people who frequented them.

Persistent places are typically characterized by concentrations of resources and landscape features which make them appealing over long timescales and which structure their re-use. In order to identify what these features may have been, the immediate surroundings of the site clusters in Brantford and Caledonia were investigated by means of spatial analysis of environmental data, review of excavation and survey reports, and in-person site visits. Particular attention was paid to the hypothesis that persistent places may have emerged around riverine spawning sites of spring-spawning fish (see Ellis, Kenyon, and Spence 1990, 115). This analysis found that the areas identified as persistent places contained unique landscape features and environmental characteristics which would have likely made them particularly resource-rich in both cold and warm seasons. Significantly, both site clusters were found to be located in close proximity to modern walleye spawning grounds as identified by the Ontario Ministry of Natural Resources and Forestry (OMNRF 2006). The Caledonia site cluster was also found to contain several projectile points elsewhere dated to the end of the Small Point Archaic, which might suggest that this place took on regional significance as a site of aggregation and trade.

My analysis uses data produced by CRM survey and excavation. Although CRM assessments account for the vast majority of archaeological work in Ontario each year, research and academic publishing on these sites has not kept up with excavation, and as it stands most Late Archaic sites in southern Ontario exist only within the "grey literature" of CRM archaeological assessment reports. This is due largely to the sheer volume of sites, the small number of researchers with an Ontario Archaic focus, and the fact that most of these sites are plough-disturbed lithic scatters with poor faunal preservation, which, considered individually, can typically tell us little about the time period. In using CRM sites as the basis of my analysis, I take seriously Ellis, Kenyon, and Spence's (2009) call for "greater attempts by archaeologists to publish the results of CRM site investigations" (791), recognizing that without reckoning with this body of data, our interpretations about the Ontario Archaic are derived from incomplete evidence. In this sense, my thesis is also a case study which establishes the utility of KDE applied to the OASD as a method of analysis useful for synthesizing and making meaningful sense of the data produced by CRM archaeology.

In the chapter that follows, I provide a summary of relevant background information, including projectile point types of the Late Archaic and associated radiocarbon dates, an overview of Late Archaic subsistence-settlement systems as currently understood, and a review of Late Archaic fishing which establishes which fish species were the focus of Late Archaic fisheries and what types of tools and methods were used by Late Archaic fishers. In Chapter 3, I define my theoretical perspective. Chapter 4 concerns my methods, including details on the various parameters used in kernel density estimation, as well as the identification of persistent places. Chapters 5 and 6 include my results and a discussion of these results, and Chapter 7 summarizes my conclusions and suggests avenues for further research.

2. BACKGROUND INFORMATION

2.1 Study Area

The focus of this thesis is bounded temporally to the Late Archaic period and spatially to the study area. The study area is defined by a 15 km buffer on all sides of the Grand River, from its mouth near Port Maitland to the Parkhill Dam in Cambridge, as well as a 15 km buffer of a portion of the Nith River from its confluence with the Grand River to a point south of New Dundee, an area totalling 4028 km^2. This admittedly somewhat arbitrary boundary was devised in order to include a potential sample of both lakeshore and upland sites, sites to the north and south of the Grand River, and sites within both the Canadian and Carolinian biotic provinces. This area was chosen instead of the Lower Grand River watershed, a more natural boundary, because the watershed is irregularly shaped and becomes quite narrow toward the north shore of Lake Erie, which would bias the sample of sites in favour of those with a more upland orientation. The study area is comprised of nearly all of the Lower Grand River watershed, as well as parts of the Upper Grand, Credit, Niagara, Long Point, and Upper Thames watersheds (summarized in Table 1). Besides the Lower Grand River, which is entirely contained within the study area, major watercourses in the area include portions of the Upper Grand River, the Nith River, the Speed River, and the Welland River.

The study area is within the traditional territories of the Anishnaabe, Attawandaron, and Haudenosaunee peoples (see Warrick 2004). It encompasses much of the Haldimand Tract, an area of 10 km on either side of the Grand River from its mouth to its source which was granted in perpetuity to the Haudenosaunee Confederacy by the British Crown in 1784 (following its purchase from the Mississaugas) in return for their allegiance during the American Revolutionary War. Since that time, the majority of the Haldimand Tract has been sold or transferred to white settlers by the British and later Canadian colonial states without the consent of the Haudenosaunee Council. As a part of this ongoing land theft, subdivision developments and other recent construction projects have been carried out within the Haldimand Tract without consent. Some of the data used in this thesis were produced though archaeological assessment of these lands, at times without even the consultation of representatives of the Haudenosaunee

Traditional Council during archaeological survey and excavation. My use of this data is by no means an endorsement of the circumstances of its production-rather, it is hoped that its inclusion in my analysis will serve to help demonstrate the consistent, continued importance of the Grand River area to First Nations peoples.

Figure 1: Project study area

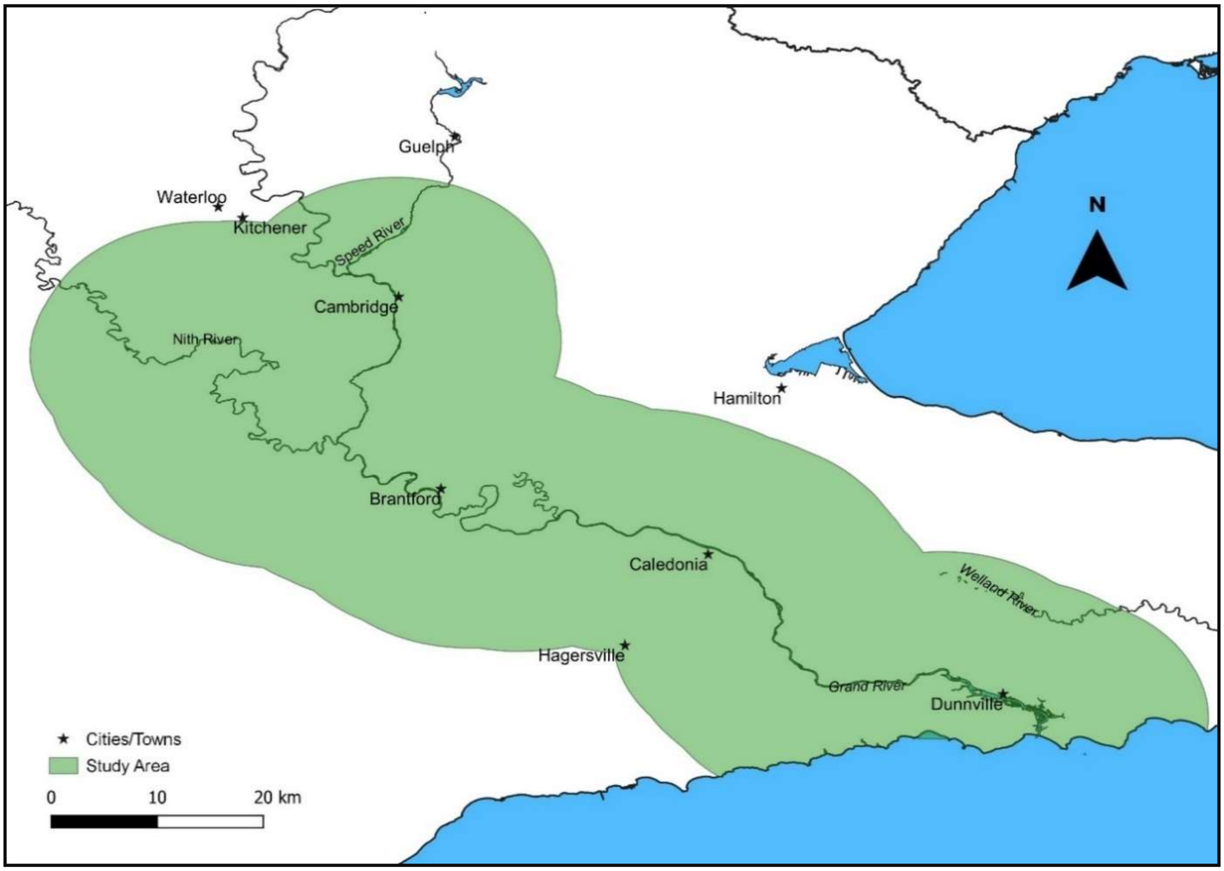


Table 1: Tertiary watersheds within study area by area in km²

Tertiary Watershed Name	**Area (km²)**
Lower Grand River	1914.25
Upper Grand River	1004.30
Niagara River	651.82
Long Point	384.14
Credit River	37.12
Upper Thames River	36.14

2.1.1 Paleoenvironment

During the Late Archaic, the climate in southern Ontario largely resembled historically documented conditions, except with slightly warmer summers, slightly cooler winters, and an overall slightly lower level of atmospheric moisture (Karrow and Warner 1990, 35). Pollen profiles indicate that Late Archaic forest composition within the study area was also comparable to historical conditions prior to extensive clearing, roughly divisible into two major forest zones, referred to here as "biotic provinces" following Dice's (1943) terminology (Ellis, Timmins, and Martelle 2009, 790). The boundary between these provinces is approximated by an imaginary line drawn from the western shore of Lake Ontario to the southeastern shore of Lake Huron near Sarnia. To the south of this line lies the Carolinian biotic province, a primarily deciduous forest which covers large parts of the eastern United States but which is represented only in the southernmost parts of the Ontario peninsula. It contains a diverse variety of deciduous trees, including sugar maple, (*Acer saccharum*) beech (*Fagus sp.*), white elm (*Ulmus americana)*, basswood (*Tilia americana*), red ash (*Fraxinus pennsylvanica*), white oak (*Quercus alba*), and butternut (*Juglans cinerea*), with beech and maple dominating in this most northern extent of the region (Dice 1943, 17). This region is also the northern limit of some species whose range extends farther to the south, including black walnut (*Juglans nigra*), Kentucky coffee tree (*Gymnocladus dioicus*), red mulberry (*Morus rubra*), and pawpaw (*Asimina triloba*). Many of these trees are nut or fruit-bearing species which would have been an important food resource for both people and animals (Rowe 1972).

The northern section of the study area, referred to as the Canadian biotic province, is covered by a mixed forest which includes many of the aforementioned deciduous species as well as conifers, including white pine (*Pinus strobus*) and red pine (*Pinus resinosa*), eastern hemlock (*Tsuga canadensis*), and white cedar (*Thuja occidentalis*). Hemlock, which was much more common in both biotic provinces in the time immediately preceding the Late Archaic, declined rapidly around 4000-5000 RCYBP, likely due to disease (Allison et al. 1986). Late Archaic environments probably supported animal populations similar to those found in historical times, with game species of varying importance including white-tailed deer, muskrat (*see* Thomas 1988), black bear, raccoon, wild turkey, and a variety of waterfowl. The now-extinct passenger pigeon would also have been exceedingly common. Faunal assemblages on Late Archaic sites support this picture of Late Archaic biodiversity.

2.1.2 Lake Levels

At the beginning of the Late Archaic, Lake Erie and Lake Ontario water levels were slightly higher than their modern equivalents as a result of changes in the Lake Huron basin during the Nipissing phase. Prior to around 5000-4500 RCYBP, Lake Huron drained into the Ottawa River, but isostatic uplift blocked this outflow route which caused the lake to rise until it could drain to the south into Lake Erie as it does today. This new influx of water caused the Lake Erie and the western Lake Ontario basins to swell briefly before they again fell around 4500 RCYBP and eventually reached their modern levels sometime in the Late Archaic. As a result of this, sites from the earlier Late Archaic which have been found some distance from the shores of the Great Lakes may have once been true shoreline sites, a process which has been documented on some stratified sites on the Lake Huron Shore (Ramsden 1976; Wright 1972).

2.2 The Late Archaic Period

The Late Archaic period, beginning ca. 4500 RCYBP and ending ca. 2800 RCYBP, is characterized by a mobile hunting and gathering subsistence mode as well as a lack of ceramic technology. The beginning of the Late Archaic is defined on the somewhat arbitrary basis of the appearance of a distinctive new projectile point style, although as previously noted, it is also the time when the Great Lakes began to reach their historically observed water levels. The end of the Late Archaic is defined by the advent of the ceramic producing Meadowood complex, however there is clear cultural continuity between the very end of the Late Archaic and the earliest Woodland manifestations (see section 2.3.3.3). The Late Archaic is traditionally divided into three complexes which are defined according to trends in projectile point morphology, referred to as "Narrow Point", "Broad Point", and "Small Point". These "complexes" are not meant to be taken as representative of three different "cultures"; instead, they should be understood as convenient ways of referring to archaeological time periods which are identifiable on the basis of projectile point characteristics.

2.2.1 Narrow Point

The Narrow Point Archaic is marked by the appearance of narrow, thick, and often poorly made projectile points with either expanding stems or side notches, which differ markedly from the preceding relatively broad-bladed side and corner-notched forms of the late Middle Archaic, such as Brewerton. Expanding-stem and weak to moderately side-notched narrow points are referred to as Lamoka points which are also found in Western New York and adjacent Pennsylvania (Ritchie 1961, 29). More deeply side-notched narrow point variants are termed "Normanskill" due to their resemblance to similar forms more common in Eastern New York (Ritchie 1961, 37). The Narrow Point complex is at present poorly understood in Ontario. Although Narrow Point diagnostics are widely reported from CRM excavations, only two sites containing exclusively Narrow Point components are reported in the Ontario peer-reviewed literature, both of which appear to be relatively small and briefly occupied sites. No radiocarbon dates that are considered reliable are available from Ontario sites, but a series of dates from New York Lamoka sites place the Narrow Point complex in the range of 4500-3800 RCYBP (Ritchie, 1965, xix; Hayes and Bergs, 1969). In other regions where both the Narrow Point and Broad Point complexes are present, there has been some suggestion (e.g. Custer, 1984, 79) that narrow points and broad points are differently-functioning aspects of the same toolkit, with narrow points used as projectile points and broad points actually functioning as knives. At the Peace Bridge site, Lamoka points were found in contexts which contained otherwise only Genesee diagnostics, which suggests that there may at least be some overlap between the use of narrow and broad points in Ontario (MacDonald and Steiss 1997, 324).

2.2.2 Broad Point

"Broad Point" (also "broadspear") is the name applied to a variety of large, broad-stemmed, and often broad-bladed flaked stone points which occur throughout Eastern North America in the Late Archaic. Broad points seem to have spread rapidly to the north from an apparent homeland near the Savannah River in Georgia, along the Atlantic coast to Maine, and ranging as far inland as the American Midwest. In the past there has been some debate (see Turnbaugh 1975 and Cook 1976) about whether this spread can be attributed to migration or diffusion, however more recent investigations suggest that while small-scale migrations may account for some of the Broad Point dispersal, the majority of transmission of Broad Point material culture can likely be explained by diffusion processes (Pagoulatos 2010). There has also been some question as to whether broad "points" were ever actually used as projectile points. Some have suggested that the points are typically too heavy to be shot as a projectile and therefore in actuality may be thrusting spearpoints or large, hafted knives (Cook, 1976; Ellis, Kenyon, and Spence 1990, 105). Custer (1991) suggests that Perkiomen, Savannah River, Lehigh/Koens-Crispin, and Susquehanna points were more frequently used as knives instead of projectile points, based on his analysis which showed that fractures associated with knife use were much more common with his study sample than fractures associated with projectile point use. On the other hand, Malleau's (2015) use-wear analysis of Genesee points from several southern Ontario sites suggests that fractures on Genesee points are consistent with use as either a projectile point or thrusting spear, with some indication of use as knives as well. Additional experiments firing hafted Genesee broad points into a deer carcass suggest that they would certainly have been effective as projectile points (Malleau 2015).

In southern Ontario, broad points are made from high-quality Onondaga chert in areas where the resource is readily available. In the southwestern-most regions of Ontario, away from the Onondaga outcrops of the Niagara Escarpment, broad points made on metasediments such as sub-greywacke are sometimes found. It is thought that because these large projectile points require very large flaw-free cores, less preferable material was sometimes resorted to in areas where high-quality lithic resources are less available (I. T. Kenyon 1980b). Broad points appear in the archaeological record of southern Ontario just before 4000 RCYBP and persist until ca. 3400 RCYBP (Ellis, Timmins and Martelle 2009, 815) The most common and widely distributed types in the region are Genesee and Adder Orchard. Perkiomen broad points are also present in lower numbers, and later broad point forms such as Susquehanna broad blade are marginally represented.

2.2.2.1 Adder Orchard

Adder Orchard points appear to be the earliest broad point type in southern Ontario, with radiocarbon dates clustering around 4000 RCYBP (Fisher 1997). These points have somewhat narrow, leaf-shaped blades and broad, straight stems. In some cases, spurs may be present at the basal corners. Adder Orchard points lack the characteristic wide, triangular blade shape of most broad point forms, however they do resemble other narrow-bladed broad-stemmed points, such as Etley points of the Titterington phase in Illinois and Steubenville stemmed points in West Virginia, which are sometimes (although not consistently) related to the Broad Point dispersal by their investigators (Ellis, Timmins and Martelle 2009, 815). Other artifacts associated with the Broad Point dispersal, including T-shaped drills and a winged bannerstone, have been recovered on Adder Orchard sites, although the bannerstone was found as part of the surface collection (Sears 1954, Dincauze 1972, Turnbaugh 1975, Fisher 1997, 35, 40). Traditionally, Adder Orchard points are considered to be part of the Broad Point complex in Ontario, and are categorized as Broad Point in the Ontario sites database. For present purposes, they will be included under the designation of Broad Point. Adder Orchard points are found throughout southern Ontario but seem to be most common in the farthest southwestern portion of the province. They are also found in neighbouring Michigan (I. T. Kenyon 1980b).

2.2.2.2 Genesee

Genesee points are the most common and widely distributed Broad Point type in southern Ontario (Ellis, Timmins and Martelle 2009, 814). These points have broad, triangular-shaped blades with large, straight, or slightly contracting stems. Radiocarbon dates for Genesee components in Ontario range from around 3800 to 3500 RCYBP (Williamson et al. 1997; I. T. Kenyon 1980a) (Ellis et al. 2014, 38). Genesee points are also found in central and western New York (Ritchie W. A., 1961) and are thought to be related to the slightly later-dating Snook Kill points found primarily in eastern New York, although the nature of this relationship is not entirely clear (Ellis, Kenyon, and Spence, 1990, 100).

2.2.2.3 Perkiomen

Perkiomen broad points are also reported in Ontario, although they appear to be considerably rarer than Genesee and Adder Orchard. These points have a wide, triangular blade which is often asymmetrical. The shoulders are frequently barbed, and the stem is expanding with a convex or flat base (Ritchie 1961, 42). No dates are available for Ontario, but in areas where they are more common, such as New York and Pennsylvania, these points appear to date to ca. 3650-3550 RCYBP (Ellis, Kenyon and Spence 1990, 101). At present, no single component Perkiomen sites have been reported in Ontario. The most detailed report of a supposed Ontario Perkiomen site is the Chaingate site in Burlington (Bursey 1994), however, Ellis, Timmins, and Martelle (2009, 815) call into question the validity of this site as a Perkiomen component, noting that many of the supposed Perkiomen bifaces from this site lack defining characteristics, and others seem to resemble Middle Archaic Neville points. Moreover, some of the notched and stemmed points at this site are clearly not Perkiomen, as noted by the original investigator, so the site is at best temporally mixed with a Perkiomen component. In terms of distribution, Ellis, Kenyon, and Spence (1990, 101) suggest that Perkiomen survey finds in Ontario are largely restricted to the Niagara Peninsula, and Roberts (1985, 102), reporting on the results of his survey of areas along the north shore of Lake Ontario, noted a high frequency of Perkiomen points in Durham region.

2.2.3 Small Point

The Small Point or Terminal Archaic refers to the time period of ca. 3500-2800 RCYBP. As the name implies, projectile points from this time period are much smaller than those of the preceding Broad Point complex, however, the term “Small Point” masks some considerable variation in size, as some “Small” points are actually medium-sized or even fairly large. Far more Small Point sites have been reported in the published literature in comparison to the preceding complexes. Small Point sites appear to be distributed throughout southwestern Ontario, and it is likely that the complex extends into eastern Ontario as well, although previous investigations may have underestimated its presence here. Several points from the McIntyre site (Johnston 1984) on the north shore of Rice Lake which were initially categorized as narrow points before the Ontario Small Point complex was well understood are now thought to more closely resemble small points (Ellis, Timmins and Martelle 2009, 815). Small-Point-associated mortuary sites are also attested in eastern Ontario (Ritchie 1949, 24-45). Small points are usually assigned to one of four major named types: Crawford Knoll, Innes, Ace-of-Spades, and Hind. Kenyon (1989), however, notes that there is considerable variation and overlap between these types, which may be better understood as convenient but somewhat arbitrary divisions of an underlying continuum of Small Point form variation. On the other hand, there is some logical basis for continued use of the four named types: radiocarbon dates do seem to suggest that some of the variation in Small Point forms is the result of changes through time, with particular named types consistently associated with particular time periods.

2.2.3.1 Crawford Knoll

Crawford Knoll points, named after the Crawford Knoll site in southwestern Ontario, are very small side- and corner-notched points which sometimes display serrated edges. Radiocarbon dates associated with Crawford Knoll suggest that they are the earliest of the Small Point types, ranging from 3690 to 3040 RCYBP, with most clustering around 3400 RCYBP (Ellis 1998, Kenyon and Snarey 2002, Wright 1972). Ellis, Timmins, and Martelle (2009, 819) note that Crawford Knoll points resemble Trimble side-notched and Merom expanding-stem points found in the American Midwest which are associated with the Riverton culture of Illinois (Winters 1969). This culture is securely dated to ca. 3490-3110 RCYBP, suggesting that these were at least contemporaneous developments (Ellis, Kenyon and Spence 1990, 107). Tests conducted by Snarey and Ellis (2008), which analyzed several attributes of a sample of Ontario small points in order to determine if they were consistent with those from known arrowheads, concluded that only Crawford Knoll points were ideally shaped for use as arrows. Somewhat perplexingly, later-dating small points and Early Woodland Meadowood points were found to have characteristics more indicative of atlatl darts. Snarey and Ellis (2008, 35) suggest it is possible that, following the use of specialized arrowpoints during Crawford Knoll times, general-use points came into favour which were suitable, although not ideal, for use as arrowheads, dart points, and perhaps knives.

2.2.3.2 Innes and Ace-of Spades

Innes points, named after a site in Brantford, are medium-sized expanding-stemmed points with slightly sloping to slightly barbed shoulders. These points often exhibit distinctive basal grinding which extends up the sides of the stem (Lennox 1986, 231). Ace-of-Spades points are nearly identical to Innes, the major difference being that the former are larger and broader than the latter. Since the two point styles occur at the same sites, it has been suggested that Ace-of-Spades forms may be knives or some other functional variant of Innes (Ellis, Kenyon and Spence 1990, 109). On the other hand, at the Innes site, Ace-of-Spades and Innes points are associated with southern and northern artifact clusters respectively. Lennox (1986) interprets the two loci as indicative of a multi-family camp, however it is also possible that they are the result of two occupations separated in time. Radiocarbon dates from the site seem to support the latter interpretation: a feature in the southern artifact cluster is dated to ca. 2620 RCYBP, and one from the northern cluster dates to ca. 3350 RCYBP (Lennox 1986, 265), suggesting an earlier date for Innes. Another date, this one from the Thistle Hill site near Hamilton, places Innes around 3440

RCYBP (Woodley 1990, 16). Innes points are noted to closely resemble Durst stemmed points found in Wisconsin (Ellis, Timmins and Martelle 2009, 819, Wittry 1959). Dates for these points overlap with those for Innes and Ace-of-Spades (Lovis and Robertson 1989, 235).

2.2.3.3 Hind

Hind points are corner-notched forms that are similar in appearance to Crawford Knoll points but are typically much larger than any of the other Small Point forms. They resemble Feeheeley points found throughout the western Lake Erie Basin (Stothers and Abel 1993a, 30). Hind points can be securely assigned to the very end of the Late Archaic, on the basis of both radiocarbon dates and on their continuity with Early Woodland developments. These points very closely resemble Meadowood points of the Early Woodland, and other aspects of material culture associated with Hind points are shared with Meadowood as well (Ellis, Timmins and Martelle 2009, 819). Hind burials are also frequently found in close proximity to Meadowood burials, often in the same cemeteries, suggesting continuity in burial practices. Radiocarbon dates consistently place Hind points in the 2800-3100 RCYBP range (Donaldson & Wortner 1995, Ellis et al. 1990, Ramsden 1976, 44, Wilmeth 1978, 125).

2.3 Late Archaic Settlement Systems

A brief overview of current ideas about Late Archaic settlement-subsistence patterns is presented here to contextualize my analysis of the CRM data. Overall, the archaeological evidence seems to show that there was some decrease in residential mobility during the Broad Point Archaic, and that seasonal settlement systems were variable and did not conform to a strict cold-weather upland/warm-weather lakeshore seasonal round. The summaries presented here include only information from published Late Archaic sites and do not include reference to the unpublished CRM sites used in my analysis.

2.3.1 Narrow Point

Only two single component Narrow Point sites have been reported in the academic literature, both of which are interpreted by their respective investigators as cold-weather occupations. The Canada Century site, located on the south bank of the Welland River 17 kilometres north of the Lake Erie shore (but which may have been closer to the ancient lakeshore), is interpreted by Lennox (1990) as a winter occupation based on the relatively large size of a possible house structure. Post moulds were not evident at this site, but the existence of a dwelling is inferred by Lennox from the presence of peaks in artifact density radiating outwards from a central concentration in an elongated pattern, thought to be the result of debris piling up along the edge of a house wall (1990, 45). If this pattern does indeed reflect the presence of a structure, it was roughly three times larger than those found at the Narrow Point Lamoka Lake site in New York. Lennox (1990) describes the Lamoka Lake structures as "summer occupations" (45), and although Ritchie, who excavated the site, suggested it was inhabited year-round (1965, 76), the absence of any indication that the structures were insulated does seem to favour Lennox's interpretation. Regardless, Lennox (1990) argues that the large size of the Canada Century structure is more suggestive of winter occupation based on the premise that winter dwellings would require more living space than summer dwellings so that activities which take place outdoors during the summer could be carried out indoors during the winter. Ellis, Timmins, and Martelle (2009) are not convinced by Lennox's interpretation of the artifact distribution as being indicative of such a large structure, and suggest the patterning could also be explained by the sweeping or clearing of debris away from the main activity area of the site towards its margins. Other potential indicators of seasonality at this site include the presence of charred walnut shell in features, however, a radiocarbon date on charcoal which was also recovered from one of the features returned a date far too recent to be associated with the Narrow Point occupation, which suggests that some or all of the other charred materials may be intrusive as well (Lennox 1990, 36).

The Winter site, located near Ospringe, ON, on the flood plain of a tributary of Lutteral Creek which flows into the Speed River, is interpreted by Ramsden (1990) as a fall/winter occupation largely on the basis of the characteristics of the surrounding environment. Although he notes that resources available within the immediate vicinity of the site would have likely made habitation possible in all seasons, Ramsden (1990) emphasises the fact that the site is located in close proximity to landscape features which are ideal fall and winter deer habitat (36). He also cites the large number of projectile points as suggestive of a deer hunting focus (1990, 36).

Potential houses have also been identified at the Winter site. Ramsden (1990) notes that the distribution of artifacts and features (including four post moulds) at this site suggests the presence of two habitations or activity areas, each with a radius of about two metres, dimensions which he claims are consistent with "the probable size of single family tents used by archaic hunting and gathering groups in the Northeast" (34).

In addition to the two single component sites, there is evidence for a Lamoka occupation at the multicomponent Peace Bridge site. Five Lamoka points, two Lamoka preforms, and one Lamoka gouge were recovered here (Austin and Williamson 2006, 525). Unfortunately, the nature of this occupation is not well understood due to the mixing of temporal elements (Williamson et al. 2006a).

Narrow Point settlement-subsistence patterns are better understood in New York, where sites are more commonly reported. The largest and best-preserved of these is the Lamoka Lake site, a lakeside occupation about three hectares in size and with very deep refuse deposits. This site was clearly returned to on many occasions, and evidence of both fishing and acorn processing suggest that occupation was not limited to one season (Ritchie 1965, 60). As mentioned above, Ritchie suggests that the site was actually inhabited year-round, although this is difficult to prove definitively, since repeated, long-term occupation of the site in various seasons, combined with annual seasonal abandonment, could produce the same assemblage. The lack of definitive winter dwellings and the existence of in-ground storage pits at the site seems to favour the latter explanation. Other New York Narrow Point sites are typically smaller and less intensively occupied. Ritchie (1965, 40) observes that overall, Lamoka sites are often located in close proximity to large rivers, lakes, and swamps. Fishing was of clear importance on these sites, as attested by the quantity and variety of fishing implements that have been recovered, including a very large number of notched netsinkers found on the Lamoka Lake and Geneva sites (Ritchie 1965, 45). No fishing implements have been found in association with Narrow Point sites in Ontario, however, excluding netsinkers, the fishing toolkit known from New York sites is made up entirely of bone and antler, and given that faunal preservation was poor on both upland Ontario Narrow Point sites, the absence of evidence for fishing should not be taken as evidence for absence.

Considering the relative dearth of published research on Ontario Narrow Point sites, it is not surprising that little can be said about Narrow Point subsistence-settlement patterns. If any general statements can be made, it is that the sites appear to be small, likely occupied by a small group, and only inhabited for short periods.

2.3.2 Broad Point

The largest Ontario Broad Point sites found to date are situated on major rivers near lakeshores. Extensive occupations dating to Broad Point times are noted especially along the Ausable River near the Lake Huron shore. By far the largest and best documented of these sites is the Genesee Broad Point component at the Davidson site, located on the east bank of the Ausable River. The site is about 12 kilometres inland from the modern shoreline, but it is just below the Nipissing phase shoreline. As the high waters of the Nipissing phase started receding at the beginning of the Late Archaic, the area on which the site is situated would have become dry and newly available for settlement. Since the receding of the Nipissing water level was a continual process, the site would have been located closer to the lakeshore during the Late Archaic than it is today. The Davidson site has only been partially excavated, however artifact clusters identified through meticulous surface survey of the site are interpreted by Ellis et al. (2014, 44) as indicative of contemporaneous habitation of the site by multiple small social units, possibly several extended families. In other words, the site was probably a Broad Point aggregation site. Magnetometer survey has revealed that the site is even larger than this surface survey indicates, with subsurface features extending over an area of 8,500 m^2 and the main concentration covering 4,800 m^2 (Eastaugh et al., 2013, 285). No houses associated with the Broad Point occupation have been identified so far, however the presence of a midden indicates that the site was inhabited for long periods (Eastaugh et al., 2013, 238). Floral and faunal evidence, which includes freshwater drum and softshell turtle remains as well as walnut shell, seems to suggest both warm and cold weather occupation, although the possibility of food storage makes it difficult to determine site seasonality (Ellis et al. 2014, 47-48). Several bell-shaped pit features identified as storage pits have been associated with the Broad Point occupation. Drawing on ethnographic evidence showing in-ground storage use by hunter-gatherers to be cross-culturally associated with resource caching and seasonal site abandonment (DeBoer 1988), Ellis et al. (2014, 52) suggest a spring-through-fall occupation for the Davidson site's Broad Point component, where stored food was buried for potential retrieval in the lean times of winter and early spring.

In the immediate vicinity of the Davidson site is the Adder Orchard site, which the projectile point style was named for. This large site extends over some 5000 m^2 on an elevated peninsula overlooking the Ausable River. Only a small portion of the site has been excavated, however information gained from these limited investigations suggests that the site was occupied on numerous separate occasions by Adder Orchard point-making peoples (Ellis, Timmins, and

Martelle 2009, 815). Faunal remains were poorly preserved, with deer being the only non-intrusive species identified (Fisher 1997, 95). The presence of both nutshell (butternut, black walnut, and oak) and raspberry seeds seems indicative of both late summer and fall occupation, although it not clear if seasonality remained consistent throughout the site's period of occupation, and without any evidence for middens or house structures, it cannot be said if the site was occupied continuously for much of the year or only visited briefly. Again, the possibility of stored food further complicates the determination of site seasonality on the basis of botanical remains alone. Fisher (1997, 783) identifies two deep basin-shaped features (5 and 6F) as storage pits, however the status of these features as storage pits is less certain than those found on the Davidson site, which had restricted openings and bell-shaped profiles which would have made it easier to seal off the opening for storage, similar to historically documented examples of in-ground storage (Ellis et al. 2014, 50).

Another large Broad Point occupation in southern Ontario has been documented at the Peace Bridge site at the mouth of the Niagara River. This is a large multi-component site with evidence of occupation from the Late Archaic through each subsequent time period and into historical times. As such, temporal elements are often mixed, and it can be difficult to determine to which time period non-diagnostic artifacts and botanical remains belong. The major component of the site is Genesee, although several Adder Orchard and Perkiomen broad points have been found as well (Austin and Williamson 2006, 525). Biface production was clearly a focus of activity on this site. Chert was quarried from an Onondaga outcrop on site, and was then reduced into bifaces, as indicated by the presence of large amounts of chipping debris, cores, and pentagonal Genesee preforms. Howarth and MacDonald (2012) identify the site as a walleye fishery situated to take advantage of the spring walleye spawn on the basis of site location, the large quantity of walleye bones found at the site, and the large number of netsinkers present. Since both netsinkers and walleye remains have been found in contexts with only Genesee diagnostics, it seems likely that this fishery operated in the Late Archaic as well as later time periods. Carbonized nutshell was found in many of the Late Archaic features, and in one instance a mortar and pestle were found in a Late Archaic context as well, suggesting a fall as well as a spring occupation, unless the nuts were stored (Williamson et al. 2006, 58). Many (>25) Genesee-associated pit and hearth features were found in one area close to the river. Some of these features, which were found in dense oval concentrations together with post moulds, are interpreted by the site's investigators as house floors (Robertson et al., 1997:499-500).

Other Broad Point sites in Ontario have generally been less extensively excavated. Some of these, including the Brodie site near Delaware and the Hamilton Golf Course site in Ancaster, are situated in more upland environments (Fisher 1987, Howey 1975, I. Kenyon 1980b). The stratified, multicomponent Johnston Flats site on the Grand River floodplain near Caledonia which yielded one Genesee point is tentatively interpreted by Parker (1995, 14) as a fall occupation, however this argument is made only on the basis of a general lack of fish bones found in the excavated area (though one sucker bone was found in the a layer directly below the one which contained the Genesee point—see section 5.1.2) . An argument for seasonality based on the absence of evidence is not particularly strong, especially considering post-depositional factors which negatively affect the preservation of fish bones (see section 2.4.4). Parker acknowledges the fact that the limited excavation (61 m^2) carried out at this site may not have produced a faunal sample that is representative of the entire site, which may be as large as one hectare (1995, 17). To date, no cold-weather house structures dating to Broad Point times have been found that would indicate the nature of Broad Point winter occupations.

Overall, Broad Point settlement systems are still not well understood. It is possible that the Broad Point Archaic was a time of decreased residential mobility compared to earlier periods, as hinted at by the presence of the Davidson midden—the earliest true midden in Archaic southern Ontario, though more corroborating evidence is needed. Seasonal aggregation, and seasonal abandonment of long-term residential sites seem to have been practiced, if we accept the existence of storage pits as evidence for this on the basis of comparison with ethnographic examples. It is worth noting that most of the information on Broad Point settlement systems was gained through excavation of the Davidson site, which is exceptionally well-preserved and well-researched. The insight gained from this site is invaluable, but it is only one site in one area of southern Ontario. More extensive research in other areas could help reveal if this type of settlement system is characteristic of the Ontario Broad Point Archaic as a whole or if variations exist in different time periods and/or regions within southern Ontario.

2.3.3 Small Point

Many more sites dating to the Small Point Archaic have been excavated in Ontario, and as a result more detailed information about subsistence-settlement patterns is available compared to earlier complexes of the Late Archaic.

A general model for Small Point Archaic seasonal settlement systems was outlined by Ellis, Kenyon, and Spence (1990, 114) which identified two types of sites: spring/summer lakeshore occupations and fall/winter upland camps. This model was developed based on evidence from a series of sites on the eastern Lake Huron shore, as well as the Crawford Knoll site near Lake St. Clair, both of which contained faunal evidence suggestive of warm weather occupation, as well as a series of small upland sites, usually with poor faunal preservation, situated in areas ideal for fall or winter deer hunting. Differences in toolkits from the two types of sites are also cited as evidence for a difference in season of occupation, with lakeshore sites containing more ground stone tools and fishing equipment and upland sites containing more scrapers and projectile points (Martelle 2001, 12). This model proved to be quite influential, at times leading researchers to "type" sites as cold weather occupations based solely on their location in upland environments (e.g. Esler, 2002, 26).

Woodley (1990, 33), in his interpretation of the Thistle Hill site, perceived another possibility, suggesting that the variety of micro-environments in the direct vicinity of the site could have furnished suitable resources for occupation in any season. Although, as Ellis & Spence (1997, 123) point out, the Thistle Hill site was most likely a cold weather occupation, as indicated by the presence of two semi-subterranean house structures with probable internal hearths and evidence of indoor flaking activity, Woodley was still right to question received wisdom regarding Small Point seasonal site occupation. Recent evidence has shown that Small Point settlement systems were probably more complex and variable than the spring-summer lakeshore/fall-winter upland dichotomy implies.

At the aforementioned Davidson site located near the old lakeshore, the most recent excavations of the Small Point component of the site have produced evidence that it was inhabited successively in both warm and cold weather. Several house structures have been identified, all of which belonged to the Small Point component of the site (Ellis et al., 2015). Three of these structures were pithouses which are indicative of cold weather occupation. All three pithouses exhibited evidence that they were insulated in some way: two of them were likely covered with turf roofs, and one had earth piled around the rim of its structure. In addition to these pithouses, one aboveground wall trench structure was also identified. Lack of evidence for a hearth within this structure suggests that its use was limited to the warmer parts of the year. Significantly, the wall trench structure was found intervening between two pithouses, indicating that site's seasonality shifted from cold weather to warm weather, and back to cold weather again over the course of the Small Point Archaic.

There is also some evidence of warm weather occupation in more upland environments. The Hillerman site (AjGv-51), a relatively small site located in Mississauga, is interpreted by Fisher (2004) as a warm weather campsite due to the presence of calcined turtle shell. The Sunnydale site, another upland site, this one located in north London, also provides evidence of greater diversity in seasonal settlement. The artifact assemblage did not contain any scrapers, which, if these are indeed hide processing tools as commonly thought, might be expected at a cold weather occupation, and are in fact more common on Small Point upland sites which are more convincingly identified as winter occupations. The artifact assemblage did contain several ground stone tools associated with woodworking (axes, adzes), which are not common on upland winter sites but are found on lakeshore sites. On this basis, Martelle suggests that the Sunnydale site may have been a specialized campsite involved in woodworking (perhaps canoe manufacture), possibly inhabited in warmer weather (Martelle 2001, 12).

In light of the mounting evidence for greater variation in settlement patterns and changing seasonal use of the same sites, Ellis et al. (2015, 59) acknowledge that researchers have often thought of Late Archaic settlement systems in oversimplified terms, assuming highly rigid and seasonally structured settlement patterns that are not seen in ethnographic examples. They argue that past settlement-subsistence patterns of Late Archaic hunter-gatherers could have been even more dynamic and variable than those observed historically and ethnographically, on the basis that modern hunter gatherers are typically restricted to highly marginal areas, whereas Archaic groups lived in an expansive and resource-rich environment in which many viable subsistence options may have been available at the same time. Furthermore, Ellis et al. (2015) point out that there has been a tendency to imagine all materials at a site as a "discrete, integral, archaeological assemblage" (59) resulting from a single seasonal occupation, when they could just as easily be the products of many occupations in different seasons and with different purposes, a sentiment reminiscent of Ebert's (1992) critique of the concept of the "site".

In contrast to Broad Point times, no Small Point aggregation sites have yet been identified. Assuming that all hunter-gatherer groups must aggregate at some point, Ellis, Kenyon, and Spence, in their 1990 synthesis of Archaic research, speculated that such sites might be located along rivers at good fishing locations situated in order take advantage of the spring spawning runs of river-spawning fish, such as sucker and walleye (1990, 114-115). This suggestion was made with reference to similar Middle Woodland settlement systems, as well as the existence of Terminal Archaic and Early Woodland cemeteries at upland riverine locations, which may have been used during seasonal aggregations. No such aggregation sites have been reported so far in Ontario, however Stothers and Abel (1993b, 50) noted that Late Archaic sites are clustered at "focal points" along rivers and their tributaries in all the major river valleys of the southwestern Lake Erie drainage. In the lower Maumee River Valley for example, site clusters have been discovered at each major rapids, which suggests the importance of spring fishing activities (Stothers and Abel 1993b, 50). The possibility that Late Archaic riverine site clusters within the study area are related to fishing will be explored in detail in the discussion section of this thesis. To provide the necessary context, a review of Late Archaic fishing practices is presented here.

2.4 Overview of Ontario Late Archaic Fishing Practices

Despite considerable evidence for the importance of fish as a food resource to Late Archaic peoples in southern Ontario, and their speculated role in Small Point seasonal aggregation, no comprehensive overview of Ontario Late Archaic fisheries has yet been published. This section will therefore summarize the currently available evidence of fishing in Late Archaic southern Ontario, including the distribution of sites, fish species of particular importance, methods of capture, and factors affecting the preservation of fish bones.

Evidence of fishing has been found on six southern Ontario Late Archaic sites: Crawford Knoll (Kenyon and Snarey 2002), George Davidson (Ellis et al. 2014, I. Kenyon 1980a), Inverhuron (W. Kenyon 1957), Knechtel I (Wright 1972), Peace Bridge (Williamson and Macdonald 1997, Williamson, Austin, and Robertson 2006) and Rocky Ridge (Ramsden 1976).[1] Materials from these sites indicate that a wide variety of fishing methods were employed, some of which required a significant time and labour investment into the production of fishing gear. Evidence from the Peace Bridge site especially suggests that mass capture of spawning fish was practiced during the Broad Point Archaic. It is difficult to establish just how significant fish were in Late Archaic diets, however information gained from the stable isotopic analysis of a dog skeleton associated with the Broad Point occupation of the Davidson site offers some insight. The results of this analysis indicate that the dog's diet consisted of a relatively large amount of fish, and given that the dog was likely being fed by humans or scavenging out of refuse piles, fish must have made up a sizeable portion of the diets of the Broad-Point-making peoples, at this site at least (Morris 2015).

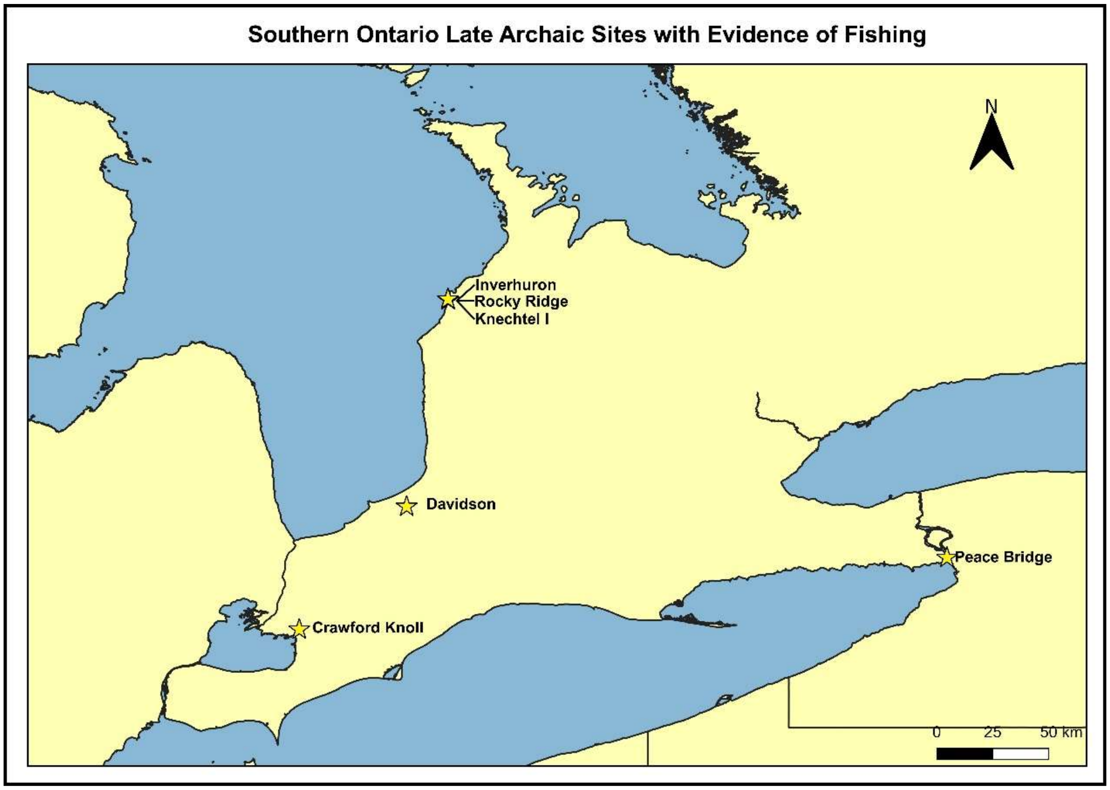
2.4.1 Distribution of Sites

All southern Ontario Late Archaic sites at which there is either faunal or artifact evidence for fishing are lakeshore settlements near the mouths of rivers. The Rocky Ridge, Knechtel I and Inverhuron sites are all located on the eastern Lake Huron shore near the mouth of the Little Sauble River. The Davidson site, also near the eastern Lake Huron shore, is located near the

[1] Omitted from this list is the McIntyre site (Johnston 1984), which is located much further to the east than other sites mentioned and for which Late Archaic projectile point style and temporal affiliations are not entirely clear (*see* Ellis, Timmins, and Martelle 2009, 818)

mouth of the Ausable River. The Peace Bridge site is situated at the mouth of the Niagara River in Fort Erie, and the Crawford Knoll site is on the St. Clair River delta near Lake St. Clair. No fish remains have been found on Late Archaic upland riverine sites. It is possible that the absence of this evidence reflects the fact that fishing only took place at lakeshore sites, although another possibility is that this pattern is the result of differential faunal preservation in different environments and soil types.

Figure 2: Late Archaic sites with evidence of fishing in southwestern Ontario



2.4.2 Fish Species

Fish bones are present in the faunal assemblages from six southern Ontario Late Archaic sites. It is somewhat difficult to compare these assemblages because faunal analysis varies in comprehensiveness from site to site. Probably the best documented is the Peace Bridge site, where a large amount of fish bones have been found and for which detailed faunal analysis has been completed (see Needs-Howarth and MacDonald 2012). Unfortunately, it is difficult to assign a time period to these remains due to the intermixing of temporal elements from the Late Archaic through historic Euro-Canadian periods. At the other end of this spectrum is the Rocky Ridge site, where only part of the assemblage was analysed due to funding and time constraints (Ramsden 1976, 25). The level of specificity with regard to taxa identification varies from site to site, ranging from the identification of family to that of species, and bones are not identified by element in most published reports. Due to the inconsistency of detailed faunal data, I have not attempted to calculate the total number of identified specimens for each fish species found on Late Archaic sites. Instead, common fish species are presented in Table 2 where they are indicated to have been either present or absent from each site, with an asterisk (*) indicating that the site's investigators note that the species was particularly common. Some species found in smaller numbers at the Peace Bridge site have been omitted here, on the basis that they cannot be positively assigned to the Late Archaic and are not found on any other Late Archaic site and should therefore not be considered representative of Late Archaic fishing practices. With these caveats in mind, the most common fish species found on Late Archaic sites appear to have been freshwater drum, *Sander* (walleye or sauger), sucker, and catfish. These four fish are present on almost all Late Archaic sites where fish remains have been found.

Table 2: Summary of fish species on Late Archaic sites. Asterisks indicates that species was particularly common.

Site Name	Freshwater Drum	Catfish	*Sander* (Walleye or Sauger)	Sucker	Bass	Gar	Pike	Bowfin	Cisco	Lake Sturgeon
Crawford Knoll	**X***	**X**	**X**	**X**		**X**	**X**	**X***		
Davidson (Broad point)	**X**									
Inverhuron		**X**								
Knechtel I	**X***	**X***	**X***	**X***	**X**		**X**		**X**	**X**
Peace Bridge	**X**	**X**	**X***	**X**	**X**	**X**	**X**	**X**	**X**	**X**
Rocky Ridge	**X***	**X**	**X**	**X**	**X**	**X**				

2.4.2.1 Freshwater drum (Aplodinotus grunniens)

Freshwater drum are noted as especially common by several excavators (Kenyon and Snarey 2002, Ramsden 1976, Wright 1972). These fish inhabit large, relatively shallow bodies of water, and are tolerant of various levels of turbidity, though they seem to prefer clear water. Freshwater drum in Ontario are typically in the range of 1.5-3 lbs but can grow larger given enough time, with specimens as large as 24 lbs recorded in the Great Lakes (Scott and Crossman 1973, 815). Spawning occurs from mid June to mid July in Lake Erie. Drum migrate from deeper water into warmer, shallower water to spawn and return to deeper water in the fall (Bur 1984, 57). Sassaman (2010, 164) observes that freshwater drum are common on Archaic sites throughout the Great Lakes. Their importance in comparison to other fish species may be somewhat overestimated, however, due to the relative ease of identifying freshwater drum bones, particularly the pharyngeal plates which are large and very distinctive (Sassaman 2010, 170), and the otoliths, easily recognizable due to their "L" and "J" shaped markings. Drum, while not a particularly sought-after fish by contemporary anglers, are often caught while fishing for other species with hook and line (Scott and Crossman 1973, 815). Prowse (2003, 89) suggests that freshwater drum at the Middle Woodland Bluewater Bridge site were caught while spawning, on the basis that the majority of drum remains found on that site were of spawning-age individuals. The large numbers of fish represented within each occupational layer suggests some form of mass capture— likely seine nets, in Prowse's (2003, 89) estimation.

2.4.2.2 Sauger/Walleye (Sander sp.)

Sander were by far the most common genus of fish remains found at the Peace Bridge site and are noted as relatively common at the Knechtel I site as well. Fish of the genus *Sander* (formerly *Stizostedion*) may be either sauger (*Sander canadensis*) or walleye (*Sander vitreous*). The two fish are quite similar, and it is difficult to differentiate between their skeletal remains. Sauger and walleye occupy similar habitats, both favouring large, shallow, turbid lakes and rivers, although sauger seem to require a higher level of turbidity. Both species spawn in relatively shallow water, either in rivers and there often in white water below impassable rapids or on gravelly bars, or in the coarse gravelly shoals of lakes (Colby, McNicol, & Ryder 1979, Scott and Crossman 1973, 771, Jennings, Claussen, and Philip 1996, 978). The presence of gravelly or rocky substrate is important as protection for the eggs, since no nest is built (Ecologistics Ltd. 1982, 10). Walleye are known to return to the same spawning location year after year (Crowe 1962). Walleye spawning typically occurs when water temperatures reach 6.7-8.9 °C (Scott and Crossman 1973, 771), which, in extreme southern Ontario, usually occurs in March or April (Ecologistics Ltd. 1982, 6). The sauger spawn usually occurs shortly after that of the walleye, often in the same locations. The two species have even been known to hybridize in nature (Scott and Crossman 1973, 763).

If available calories were the main concern, walleye were more likely to have been favoured as they are larger and more numerous in the region (Scott and Crossman 1973, 772). If historically observed populations of these two species are any indication of Late Archaic populations, walleye would likely have been more plentiful. Fisheries data for Lake Erie available from 1867 onward suggest that sauger were not particularly common in Lake Erie, at least in the nineteenth century (Baldwin et al. 2009). Walleye also have the advantage of spawning earlier than sauger, and large walleye spawns would have been an attractive food source in the lean times of early spring. In later precontact times, walleye seem to have been the targeted species. A detailed study of a sample of *Sander* remains found in a collapsed ceramic vessel dating to the Transitional Woodland period (radiocarbon date of 1330 ± 60 BP) at the Peace Bridge site found that all specimens that could be identified to the species level were *Sander vitreous* (Thomas 1997, 497).

Complicating matters further is the existence of the blue walleye, a now-extinct colour morph of *Sander vitreous* that was once common in Lake Erie (Haponski and Stepien 2014). The blue walleye, once thought to have been a distinct subspecies, preferred deeper water, and may have spawned even earlier than the extant yellow walleye (Scott and Crossman 1973, 769). Since the fish are nearly indistinguishable in terms of skeletal remains (although blue walleye are thought to be slightly smaller overall), and since comparative blue walleye samples are not easily accessed, it has not been possible to determine whether the walleye remains on Late Archaic sites are blue or yellow walleye, or both. Given the overall similarity, however, a distinction between blue and yellow walleye is unlikely to significantly change interpretations of Late Archaic fishing practices.

Walleye can be captured individually any time of year, since they are active throughout the winter, but are most easily captured in large numbers during their spring spawning run. Needs-Howarth and MacDonald (2012, 89) argue that the Peace Bridge site was annually visited to target spawning walleye. Although temporal elements are mixed at this site making the dating of the fish remains difficult, *Sander* remains were found in several contexts that included only Late Archaic diagnostic materials (Genesee projectile points), suggesting that this practice dates back to Late Archaic Broad Point times. (Williamson and MacDonald 1997, Williamson, Austin, and Robertson 2006). Based on the large amounts of netsinkers found at this site, some of which were also found in association with Genesee points, seine or gill netting seems to have been a primary method of capture.

Walleye can also be easily taken in large numbers while spawning with the use of spears. Since spawning takes place mostly at night, torches may be used to locate and attract the fish. This method is particularly effective with walleye—the fish can be easily located in the dark due to light reflecting off of the *tapetum lucidum*, the light sensitive layer of the walleye's eye which gives it its distinctive appearance. This practice is noted among several historic period Indigenous peoples of the Great Lakes (Kane 1859, 31-32[2], McKenney 1827, 152) and is important to present-day First Nations groups in the Great Lakes region (Nesper 2002).

2.4.2.3 Sucker (Catostomus sp.)

Sucker on Late Archaic sites are rarely identified to the level of species but are most likely white sucker (*Catostomus commersoni*) or longnose sucker (*Catostomus catostomus*), the most common species in southern Ontario (Scott and Crossman 1973). Through much of the year, white suckers can be found in small numbers in nearshore habitats and streams. Longnose suckers, on the other hand, occupy very deep lake bottoms except when spawning, making them relatively inaccessible to shallow-water anglers outside of the spawning season (Scott and Crossman 1973, 534). Both species are most easily captured en masse during their spring spawning runs. The run occurs from mid April to mid May for the longnose sucker and late April to early June for the white sucker, often in the same locations. During the run, suckers ascend streams in exceptionally large numbers (Scott and Crossman 1973, 540). Spawning usually takes place in tributary streams in shallow water with a gravel bottom, but suckers may also spawn in rapids or in lake margins. Like walleye, suckers home to particular spawning streams, and walleye and sucker have been known to share the same spawning grounds (Corbett and Powles 1986). Spawning suckers can be quite easily captured by various methods including angling, spearing, dipnetting, with the use of baskets, or even by hand. Weirs may be used in conjunction

[2] Kane identifies the fish caught by Menominee fishermen on the Fox River as "salmon", however since Atlantic salmon were not indigenous to the upper Great Lakes (excepting the landlocked population in Lake Ontario) (Bogue 2000, 19-27), this is unlikely. Lister (2012, 22) identifies the fish as most likely walleye, which are sometimes referred to as "white salmon" or "jack salmon" (Becker 1983, 871). The size of the speared fish depicted in Kane's *Fishing by Torch Light* is consistent with a walleye.

with the aforementioned methods. Seine netting may also be possible, although the water that suckers spawn in may be too shallow for seine nets to be effective. The exploitation of sucker spring spawning runs was an important part of the subsistence base of Ontario Middle Woodland populations.

2.4.2.4 Catfish (Ictalurus sp.)

Catfish, when identified by species, are always channel catfish (*Ictalurus punctatus*). These fish are found in lakes and moderate-to-large rivers, in deep, clear, cool water (i.e. not turbid water). They often occupy deep holes with the protection of rocks or logs. In Canada, they are typically 2-4 lbs in weight, although they can get considerably larger, at times surpassing 30 lbs. Channel catfish spawn in late spring or early summer, when water temperatures reach a point between 23.5 C° and 29.5 C° (Scott and Crossman 1973, 607). They may or may not migrate into rivers to spawn, depending on habitat. Spawning takes place in nests built by males in holes, log jams, rocks, or undercut banks—evidently some form of shelter is needed for spawning to take place (Scott and Crossman 1973, 607). Unlike the species previously mentioned, spawning behaviour in channel catfish does not significantly increase their availability, since they do not aggregate in spawning shoals and instead seek out isolated, protected nests. Many methods can be used to catch these fish. Hook and line angling, spearing, and netfishing are all possibilities, varying in effectiveness depending on the season and time of day. Trot lines, set fishing lines with multiple baited hooks attached at intervals, are often used by modern anglers to catch catfish.

2.4.2.5 Bowfin and Others

Bowfin were also noted as being particularly common, though only at the Crawford Knoll site (Kenyon and Snarey 2002, 15). This is likely due to location—in the Late Archaic, the Crawford Knoll site was surrounded by a large swamp, an ideal habitat for bowfin (Scott and Crossman 1973, 111). Other species present in lower numbers include gar, lake sturgeon, bass, cisco, and pike.

All fish found on Late Archaic sites are spring or summer spawners, with the exception of the fall-spawning cisco, which is rare. It appears that exploitation of fall fish spawning runs was not a component of the Late Archaic seasonal round. The emphasis on spring spawning fish makes it unlikely that fish were dried and stored for winter consumption, given that the stored fish would not be likely to survive the warm, humid southern Ontario summer without spoiling. Notably, anadromous fish species are entirely absent from Late Archaic assemblages. This is not unexpected. As Sassaman (2010, 160) observes, anadromous fish remains are rare on Archaic sites all throughout northeastern North America, despite past assumptions about the importance of these species to Late Archaic economies (e.g. Turnbaugh, 1975). Overall, the focus of Late Archaic fisheries seems to have been the capture of spring-spawning fish that can be caught in relatively shallow water. Worth noting is the fact that walleye/sauger, sucker, and drum all spawn in succession from early spring to early summer. It is possible that lakeshore camp locations were chosen so as to take advantage of these consecutive fish spawns.

2.4.3 Methods of Capture

Artifacts identified as fishing equipment found on Late Archaic sites suggest that netfishing, linefishing, spearfishing, and the use of fish weirs were all methods of capture practiced by Late Archaic populations in Ontario. The presence or absence of tools indicative of these methods at Late Archaic sites is summarized in Table 3.

Table 3: Late Archaic fishing methods by site

Site Name	Netsinkers	Copper fishhooks	Gorges	Harpoons /Fixed Spears	Barbs (for composite fishhooks or leisters)
Crawford Knoll	**X**			**X**	**X**
George Davidson	**X**	**X**	**X**	**X**	
Inverhuron				**X**	**X**[3]
Knechtel I	**X**	**X**	**X**		**X**
Peace Bridge	X				
Rocky Ridge	**X**		**X**		**X**

2.4.3.1 Netfishing

The practice of netfishing in the Ontario Late Archaic is indicated by the presence of netsinkers on several sites. Netsinkers are stone cobbles often modified with notches on one or two sides which are fastened to the bottom of a net in order to sink it to an appropriate depth and/or to stabilize it. They are typically used in conjunction with floats which counteract the force of the sinkers to keep the net open. Netsinkers have been recovered from five sites: Crawford Knoll, George Davidson, Knechtel I, Peace Bridge, and Rocky Ridge. These sites are all associated with either the Small or Broad Point Archaic. At present, no Ontario Narrow Point sites have produced netsinkers, although over 8,000 netsinkers were found at the Lamoka Lake Narrow Point site in New York (Ritchie 1944).

[3] A bone implement made from a channel catfish spine found at the Inverhuron site was interpreted by the original excavator as an awl (W. Kenyon 1957, 13), however it bears similarity to items referred to as "barbs" on other Late Archaic lakeshore sites. Under Wright's (1972, 51) classification, this object is considered a bone barb.

There are two possible types of nets which require netsinkers that may have been in use in the Late Archaic: gill nets and seine nets. No evidence of the organic mesh portion of the nets has been preserved which would indicate for certain which type of net was used.

2.4.3.1.1 Gill Nets

Gill nets work by trapping fish of a particular size behind their opercles and gills. The pressure of the net causes the fish's opercles to spread out, and the net then catches behind them (Gabriel et al. 2005, 275). As a result, the fish are unable to move forward or backward once caught in the net. Gill nets are necessarily designed to ensnare a particular size of fish. Smaller fish will be able to swim though the weave of the net, while larger fish will be blocked by the net but not ensnared. Fish caught by means of a gill net will therefore be fairly uniform in size. Because the fish are hopelessly caught in a gill net, this type of net can be used as a passive means of fishing in that they can be left unattended to catch migrating fish and hauled up at a later time (Prowse 2010).

2.4.3.1.2. Seine Nets

A variety of seine net forms exist (Gabriel et al. 2005, 434) but the general principle is the same: rather than ensnare the fish as with a gill net, seine nets form an impenetrable barrier which blocks the movement of the fish. Once the fish have been enveloped by the seine net, the net can be dragged to shore and the fish taken in. The size of the mesh in a seine net must be quite small in order to effectively block the fish, and as a result a variety of sizes of fish may be caught at once (Prowse 2010, 71). Seine nets are not as effective as a passive fishing method since the fish are not actually trapped in the mesh of the net and may eventually escape. As such, the nets are usually set and hauled in at once, instead of being left to catch fish passively as with some gill nets.

It is not possible at present to say with complete confidence what sort of nets were used in the Late Archaic. It may be possible to determine net type by analyzing the range of sizes of fish, assuming that gill nets will take fish of generally the same size and seine nets will take a wider variety of sizes, however the thorough re-examination of faunal remains that this would entail is outside the scope of this thesis. As a general rule, however, gill nets are more effective for capturing fish in deep water while seine nets are more effective in shallow water (Prowse 2010, 73). Since most of the fish species found in the Ontario Late Archaic faunal assemblages can be taken in large numbers in shallow water while spawning, it is more likely that the Late Archaic net fishery was a seine net fishery rather than a gill net fishery. Prowse (2010, 76) notes that at the Blue Water Bridge Site (AfHo-7) located at the mouth of the St. Clair River, Middle Woodland populations exploited spawning drum and walleye in the summer and spring, probably setting seine nets across one or more of the river channels which existed at the time and dragging the catch into the shallows where they could be speared or taken by hand (Prowse 2010, 76). Interestingly, she suggests that channel catfish and bowfin may have been unintentionally caught as well with this method (Prowse 2010, 76). Given the similarity of fish species found at the Blue Water Bridge site to those found on Late Archaic sites, it is possible that similar methods were employed in the Late Archaic as well.

The practice of netfishing suggests that fishing was not a peripheral aspect of the subsistence base of Late Archaic peoples, nor was it practised only opportunistically. The production of nets is labour intensive and requires a certain level of expertise. According to Prowse (2010, 92), netsinkers would have to be carefully selected or manufactured in order to achieve the appropriate weight for the size of net, buoyancy of the opposing floats, and current of the river channel or lake. Depending on the method of netfishing, considerable coordination of labour may have been needed in setting and hauling in the nets.

It is interesting to note that at the Peace Bridge site, nearly 40 percent of netsinkers recovered were treated with red ochre (Austin and Jenkins 2006, 399). The significance of this practice is unknown, however the use of red ochre in Late Archaic burials is documented in Ontario and neighbouring New York. Site investigators suggest that these red ochre stained netsinkers may have originally been included in shallow burials that were dispersed by plowing activity (Austin and Jenkins 2006, 400). If this is the case, it may suggest that netfishing was highly socially significant in the Late Archaic.

2.4.3.2 Linefishing

The evidence suggests that Late Archaic populations practiced several methods of linefishing. At the Davidson, Knechtel I, and Rocky Ridge sites, bipointed implements made of mammal bone or channel catfish spines were recovered which have been interpreted by various researchers as gorges (Ellis et al. 2014, 47, Ramsden, 1976, 23, 35, Wright, 1972, 32, 37). Copper fishhooks have also been recovered at the Knechtel I and George Davidson site. These various types of hooks may have been set on individual hand lines or as parts of multi-line fishing rigs. Wright (1972, 56) suggests that gorges may have been set on trot lines. This method can be used to catch many fish at once and may be left unattended and checked only periodically.

2.4.3.3 Spearfishing

Among the items identified as fishing gear on Late Archaic sites are leister barbs and barbed spearpoints or harpoon tips. All are made of bone, antler, or copper.

2.4.3.3.1 Leisters

A leister is a type of spear with a central striking point and two or more peripheral side prongs which may be barbed, the function of which is to secure the fish and aid in its retrieval (Rostlund 1952, 109). In the historical period, leisters are noted as being the form of spear used for torchlight fishing from canoes (Rostlund 1952, 106). Objects referred to as "bone barbs" have been recovered at the Crawford Knoll, Inverhuron, Knechtel I, and Rocky Ridge sites. They are manufactured from either mammal bone or catfish spine (often with the natural barbules intact) and range in size from 35 mm to 73 mm. Some are beveled on one end. Detailed morphological analysis is needed to determine the exact function of these objects, but they are generally considered to be fishing gear and are interpreted as the barb portions of either composite fishhooks (Wright 1972, 16) or leister spears (Ramsden 1976, 23). Ritchie (1965, 50) suggests the same function for similar bone implements found on Lamoka sites in New York. Some of the larger examples resemble objects from the Blue Water Bridge site interpreted by Prowse (2003, 45) as leister points.

2.4.3.3.2 Harpoons/Barbed Spears

Barbed bone or antler projectile points have also been found at the Crawford Knoll and Davidson sites. These objects are referred to as harpoons by investigators, though it is not clear if they are harpoons in the strict sense. True harpoons have detachable projectile point tips which are secured to a line. When the target is struck with the harpoon, the tip detaches from the spear or javelin, and the line can be used to reel in the fish or attach brakes or anchors to slow its escape and exhaust it (Christensen et al. 2017, 238). Harpoons are particularly useful in capturing very large fish or aquatic mammals (e.g. Christensen et al. 2017, 241). There is no description of holes or cordage marks on the Crawford Knoll or Davidson barbed bone points which would indicate that they are true harpoons, although both examples are fragmentary and such elements may be missing. These objects may be more accurately described as barbed spearpoints, which would have been fixed to a wooden shaft and were not detachable in the manner of a harpoon. Barbed spears may be hafted singly, or together with multiple points in the form of a leister. These implements could also be used to hunt terrestrial or aquatic mammals or birds.

At the Inverhuron site, a cone-shaped copper object was recovered which is interpreted as a harpoon or projectile point. This object has a hole near its tip, which W. Kenyon (1957, 13) suggests may have been for attaching a line. This object may thus be the only example of a true harpoon from the Ontario Late Archaic.

2.4.3.3.3 Stone Spearpoints

There has been some suggestion that broad points may have functioned as fishing spears. Kinsey (1972, 346-7), referring to the broad points of the Upper Delaware River Valley, suggested this on the basis that broad points would make for poor projectile points due to their wide shoulders which he claimed would make it difficult for them to penetrate a deer's hide. According to Kinsey (1972), this same feature would have made them effective fishing spearpoints, since the wide blade would act as a barb preventing struggling fish from escaping. Similarly, Turnbaugh (1975, 62), who attributed the Broad Point dispersal to a subsistence model that relied on the exploitation of anadromous fish spawning runs (now considered unlikely due to the dearth of anadromous fish remains on Broad Point sites), suggested that the reason for the ubiquity of broad point forms throughout much of Eastern North America could be because they functioned as harpoon points, a key piece of technology in this supposed fishing economy.

These claims have proven unlikely for a number of reasons. Ethnographic examples show that fishing spearpoints are typically narrow, barbed implements made from organic materials, such as wood or bone, and very seldom from stone (Ellis 1997, 41-45, I. Kenyon 1980b, 22). The reason for this becomes fairly clear when we consider the mechanics of spearfishing. As Malleau (2015, 39) points out, ethnographically documented examples of spearfishing (e.g. Nesper 2002, 22) indicate that even experienced fishers miss in excess of one third of the time. With a brittle material like chert, each strike that misses the fish and hits the potentially rocky bottom of the lake or river is likely to result in a broken point, necessitating repair or replacement. This is not so much of a problem with more flexible materials like wood or bone which are more likely to survive this impact. It is indeed difficult to imagine why large, stone points, which require large flaw-free cores for their production, would be manufactured for a task for which even sharpened wood points are perfectly suitable. Finally, it is clear from Malleau's (2015) experimental study with Genesee points that Kinsey's claim that broad-shouldered points would not easily penetrate a deer's hide was false.

This is not to say that broad points are unlikely to be associated with fishing in any capacity, however. Several researchers (e.g. I. Kenyon 1980b, Kinsey 1972, Pagoulatos 2010, Turnbaugh 1975) have commented on the marine and riverine orientations of Broad Point sites throughout eastern North America, which could be indicative of the importance of fishing to these groups. One possibility is that broad points, which use-wear studies show functioned as knives at least some of the time, were used for fish processing tasks in addition to functioning as projectile points.

2.4.3.3.4 Weirs

Stakes from the Mnjikaning weirs at the Atherly Narrows have been dated to the very beginning of the Late Archaic period (the four radiocarbon dates from weir stakes average to slightly older than 4500 BP). These wooden fish weirs, among the oldest preserved examples in North America, were built in a channel connecting Lake Couchiching and Lake Simcoe. Excavators note that these fish weirs were most likely situated to capture spring spawning species, such as walleye, suckers, bullheads, catfishes, yellow perch, and pike (Johnston and Cassavoy 1978, 707). Archaeological evidence from the nearby Dougall site (Wright 1971) indicates that use of the weirs extended well into the Woodland Period. Remarkably, the Mnijkaning weirs were evidently still being used and maintained by the Wyandot thousands of years after their initial construction, as described in Chaplain's 1615 account (Biggar 1922, 56-57). This example illustrates the potential for fishing sites to be continuously used over very long time spans. Johnston and Cassavoy (1978, 707) suggest that the weirs would have likely required annual maintenance, probably carried out in the spring shortly after ice break-up.

2.4.3.3.5 Other Possibilities

It is worth noting that many of the most basic forms of fishing gear can be made entirely out of wood and other plant materials and are thus unlikely to be preserved except in rare instances. Rostlund (1952, 83) suggests that dipnets were likely known and used where any other method of net fishing was practised. Possibly the simplest form of net technology, this implement consists of a long wooden pole ending in a circular net. Dipnets can be operated from shore or from a canoe, usually in areas where fish naturally congregate such as rapids, or spawning grounds.

Wooden versions of fishing instruments known from bone, antler, or copper examples may have also been used. Spears or leisters made entirely of wood are effective in spearing all but the most armoured of fish. Fishhooks are even sometimes made from plant materials—at the Owasco site in New York, compound hooks made from hawthorn spikes were recovered (Ritchie 1944, 88).

Other minor fishing methods documented among First Nations peoples by contact-period writers, such as the use of fish poison (see Rostlund, 1952, 127-133), may have been practised in the Late Archaic as well. A well-known fish poison can be produced using black walnut (*Juglans nigra*) hulls, a species common to southern Ontario and one which has been documented on several Late Archaic sites.

2.4.4 Factors Affecting Faunal Preservation

Fish bones are less likely to be preserved in faunal assemblages than mammal bones since they are considerably more fragile and less resistant to mechanical damage (Wheeler and Jones 1989, 63). In southern Ontario, where much of the land has been subject to ploughing, fish bones in particular are likely to have been destroyed.

Possibly the most important factor affecting faunal preservation is soil pH. Fish bones are rarely preserved in acidic soil (Wheeler and Jones 1989, 63). Soil Landscapes of Canada identifies large areas of southern Ontario as having acidic soil, particularly in the Haldimand Clay Plain which makes up a significant portion of the present study area (Soil Landscapes of Canada Working Group 2010). At the Thistle Hill site near Hamilton, where no faunal remains of any kind were recovered, Woodley (1990, 15) observed that the soil pH averaged 6.92, which is low enough to be detrimental to faunal preservation.

The best-preserved fish remains are often found at stratified, waterlogged sites where deposits were rapidly buried and protected by organic refuse (Wheeler and Jones 1989, 63). Of the existing Ontario Late Archaic sites, such favourable conditions are found on lakeshore sites, particularly Knechtel I and Rocky Ridge. The protection afforded by refuse and rapid soil deposition may explain why fish bones are more numerous in the lower strata of both sites (Ramsden 1976, 43, Wright 1972, 55).[4]

Similar factors affect the survival of fishing gear. Besides netsinkers, all fishing implements found on Late Archaic sites are made from organic material and are unlikely to survive where faunal preservation is poor. There is thus a bias towards the survival of tools associated with hunting over fishing implements since the former are more frequently made of stone.

With this in mind, we should be wary of interpreting the lack of fish bones and fishing gear on upland sites as evidence that fishing did not occur on these sites or that they were all cold-weather occupations. Here it is worth considering what riverine spring fishing sites, which have long existed as a conjectural aspect of Late Archaic settlement systems (see Ellis, Kenyon, and Spence. 1990, 115, Ellis, Timmins, and Martelle 2009, 821), might actually look like on the ground. Much of the land surrounding the lower reaches of rivers in southern Ontario is made up of acidic, plough-disturbed soil, an environment in which fish remains are unlikely to be preserved, unless the site was quickly buried by a river flooding episode soon after its abandonment. Sites like Johnson Flats (Parker 1995) and Grand Banks (Walker et al. 1997), at which small amounts of deeply-buried Late Archaic materials have been found in close

[4] This is interpreted by the sites' respective investigators as indicative of a gradual change in site function from fishing to the hunting of terrestrial mammals, however the fact that fishing gear is consistently present in all occupation levels and that netsinkers are actually more common in the upper layers of both sites seems to suggest that differential faunal preservation is a better explanation.

proximity to the Grand River, attest to the possibility that larger preserved Late Archaic riverine deposits might exist. This is an area of research certainly worth pursuing, although to date only small areas have been investigated, apparently due to the cost and amount of labour involved in larger-scale excavations of these types of locations (Parker 1995, 2).

Fishing sites might alternatively be identified by the presence of netsinkers, however if any of the other fishing methods documented at Late Archaic sites were used at riverine sites, they would be unlikely to have left a trace. If deposits were not immediately buried, poor faunal preservation would mean that riverine fishing sites associated with spring spawning runs might only be visible as large concentrations of Late Archaic materials in close proximity to potential spawning grounds of river spawning species. Since the river spawning fish in question return to the same locations year after year, we can expect that the locations of sites associated with spring fishing would remain fairly consistent through time, which could be indicated by clustering of diagnostic artifacts dating to successive complexes of the Late Archaic.

2.5 Summary

This review of Late Archaic projectile point styles, settlement-subsistence patterns and fishing practices has established several points which are especially significant for the present purposes, briefly summarized here.

Available radiocarbon dates for Ontario and related regions suggest that the three Late Archaic complexes—Narrow Point, Broad Point, and Small Point—do correspond to three consecutive time periods, though some temporal overlap is suggested between Narrow and Broad Points. Radiocarbon dates for individual projectile point styles suggest that Adder Orchard points are earlier dating than Genesee points in Ontario, and Small Point forms likely date consecutively, Crawford Knoll being the earliest, followed by Innes, followed by (but possibly contemporaneous with) Ace of Spades, and finally followed by Hind points which are clearly related to later Meadowood developments in the Early Woodland.

Although Late Archaic subsistence-settlement patterns are still far from well-defined, evidence from more recently excavated sites like Davidson and Peace Bridge suggest that site function and seasonality was more fluid and less seasonally restricted than implied by the earlier model of warm weather lakeshore settlement and cold weather upland camps. During Small Point times at least, cold weather habitation was evidently not restricted to upland sites, and sites appear to have been used for different purposes in multiple seasons. Seasonal site abandonment and storage of resources seems to have been practiced during the Broad Point Archaic. It is also clear that sites should probably not be thought of as “snapshots” relating to one single season of habitation or site function, but as archaeological palimpsests built up over time through multiple habitation episodes (Bailey 2007).

The review of evidence for fishing on Late Archaic sites indicates that fishing was a significant subsistence activity based on the skill, labour, and coordination that went into the construction and use of nets and weirs. Fishing was not merely opportunistic or peripheral to other subsistence pursuits but instead most likely structured seasonal movement, probably in time with major fish spawning events. It also seems unlikely that fishing faded in importance over time as was initially suggested at several sites on the Lake Huron shore. Here, the paucity of fish bones from the upper strata at these sites is more adequately explained by differential faunal preservation rather than a shift in subsistence focus to terrestrial mammals.

From the available faunal evidence, it is clear that spring spawning, shallow water fish were the preferred species to the exclusion of nearly all other types. Drum, walleye/sauger, catfish, and sucker are most common, and walleye were clearly the focus of the net fishery at the Peace Bridge site. Both walleye/sauger and sucker are river spawning species that are most easily taken during their spawning run, sometimes in the same locations. Many fishing methods were practised, often with the use of tools made from organic materials. Although netsinkers are the most archaeologically visible, their presence should not be taken as the only indication that fishing was carried out. Organic fishing implements and fish bones alike would be unlikely to survive on upland, plough-disturbed sites, and as a consequence, a lack of fish bones or netsinkers does not necessarily mean that an upland riverine site was not associated with fishing.

3. THEORETICAL PERSPECTIVE

I approach my study of the Ontario Late Archaic from a theoretical perspective that considers the distribution of artifacts in relation to landscape features and can be broadly defined as landscape archaeology. Recognizing the strengths and limitations of the predominantly multi-component and non-stratified archaeological record of the study area, understood as a cumulative palimpsest (Bailey 2007), I turn my attention to long-term, repeated occupations of certain areas using the concept of the persistent place and Pauketat's (2001) definition of tradition. This approach contrasts with the site-based perspective typically employed within CRM and most academic publications.

3.1 Orthodox Approaches within Ontario Late Archaic Archaeology

Late Archaic academic research and funding has overwhelmingly been focused on two types of sites: stratified lakeshore or former lakeshore sites and "single component" sites (sites that contain only one type of diagnostic tool) found in the ploughzone, where agricultural activity has destroyed any existing stratification. These sites afford a relatively fine degree of temporal resolution, which has been essential in establishing a Late Archaic chronology, determining which artifacts and feature types can be associated with certain time periods, and developing an understanding of the nature and seasonality of well-preserved, usually short-term occupations. Individually, these types of sites provide more information than multi-component plough-disturbed sites, where the temporal affiliation of artifacts is unclear. It must be recognized, however, that an understanding of the Late Archaic derived mostly from the analysis of these rare sites is an incomplete one. Stratified sites make up only a small portion of the Archaic archaeological record compared to the large number of plough-disturbed sites. Not to engage with these much more common sites is to overlook the majority of Late Archaic evidence. An understanding of Late Archaic settlement systems derived from only a small portion of the archaeological record may underestimate the importance of ephemerally but persistently inhabited places in favour of what are often thought to be single-episode occupations which may not be representative of the longer-term occupation of the region. Moreover, a focus on single occupation sites favours greater temporal resolution over evidence for, and the study of, repeated occupation of certain places in the landscape over long time spans—places which were not only important economically but would also have likely had historical significance to the people that frequented them.

In southern Ontario, most plough-disturbed sites, and therefore the majority of Late Archaic sites, are excavated by consultant archaeologists carrying out archaeological assessments for construction projects. These sites are typically published exclusively in the form of archaeological assessment reports which are held on file with the OMHSTCI and which are accessible to licensed archaeologists. CRM site reports have a descriptive rather than interpretive focus. Their scope is the individual site, the boundaries of which are determined according to the Ontario Standards and Guidelines for Consultant Archaeologists (Ontario Ministry of Tourism and Culture 2011). While site reports must fulfill ministry requirements to document known archaeological sites within a one-kilometre radius of the study area, this aspect of the report amounts to a list of nearby sites rather than a regional synthesis. Typically, interpretation (of site function, seasonality, etc.) is accomplished by way of comparison to publications on sites within the academic literature. As a result, newly found CRM sites become situated within an established understanding of the Late Archaic derived from a relatively small number of sites and generally do not challenge this understanding, with some exceptions (e.g. Martelle 2001). In many cases, plough disturbance makes interpretation difficult, as the presence of assemblages where components have been thoroughly mixed makes it impossible to determine which artifacts belong to which occupation. Even when these sites are deemed single-component, there is often no way to be sure that non-diagnostic tools and flaking debris belong to the same occupation or time period as diagnostic artifacts since they could instead have been formed by combined surface deposits built up over an unknown time span, a criticism of site-based archaeology often made by proponents of “non-site” or “off-site” approaches (see Dunnell and Dancey 1983, Ebert 1992, Foley 1981). When sites are considered individually, the ploughzone archaeological record can often tell us frustratingly little, however, this may be a case of asking the wrong questions of this kind of archaeological record.

3.2 **The Ploughzone Archaeological Record as a Cumulative Palimpsest**

These ploughzone contexts, where stratification is typically not present and artifacts dating to various time periods are mixed, correspond to what Bailey (2007) has termed a cumulative palimpsest, that is: “[a palimpsest] in which the successive episodes of deposition, or layers of activity, remain superimposed one upon the other without loss of evidence, but are so re-worked and mixed together that it is difficult or impossible to separate them out into their original constituents” (12). The palimpsestic nature of the archaeological record limits the level of time resolution which is possible in analysis. Since it frequently cannot be determined if artifacts found on a site correspond to the same occupation or even the same general time period, analysis of short-term events (such as single site occupations) is made difficult. This kind of archaeological record is more conducive to the analysis of processes which occur on the longer timescale, and which may not be apparent when the archaeological record is approached from a site-based perspective. One such process is the formation of persistent places. Cumulative palimpsests, as the material result of repeated occupations of the same area over long periods of time, are a way to recognize persistent places in the Archaic landscape.

3.3 Persistent Places

The concept of the persistent place is defined by Schlanger (1992) as “a place that is used repeatedly during the long-term occupation of a region" (92). As summarized by Thompson (2010), persistent places: "1) consist of physical locations characterized by concentrations of resources that make them particularly suitable for use; 2) have natural or cultural features that structure reuse; and 3) are created through practice over an extended period of time" (218). Persistent places can range in size from larger useful areas such as swamps or river stretches, to more localized spots such as rock shelters, vantage points, or re-used campsites (Moore and Thompson 2012). Persistent places may not have been visited for the same purpose over the course of their long-term occupation. Their function, season of occupation, and intensity of use may have fluctuated through time, and as a result these places may have taken on a succession of meanings and associations. In this sense, they resemble Bailey's (2007) "palimpsests of meaning", a concept originally used in reference to the successions of meanings assigned to artifacts or human-made structures, but which could be similarly applied to "natural" places not marked by durable architecture. This understanding of persistent places recognizes that past models of hunter-gatherer settlement systems may have over-relied on observations made from short-term ethnographic and ethnohistorical accounts. Long-term settlement patterns are likely to have been more variable than those observed in these accounts, and indeed, site seasonality and function seem to have been more in flux than initially thought in the Late Archaic.

3.4 Persistent Places and Tradition

Persistent places can be understood through the lens of tradition, according to Pauketat's (2001) definition of tradition as "some practice brought from the past into the present" (2). With this (albeit broad) definition, tradition is understood not as some passively received way of doing things, but as a dynamic process of cultural construction that is continuously negotiated between people through practice within historical context (Pauketat 2001, 3). Traditions in this sense do not always stand in opposition to social change, but on the contrary can be the media through which it occurs. Since tradition is enacted through practice, and since practice always occurs within novel circumstances and with unanticipated associations, practice always alters and does not simply perpetuate tradition, though the changes may be imperceptibly subtle (Pauketat 2001, 8). Importantly, Pauketat's definition of tradition extends to practices which are not consciously understood as "traditions" by the people who reproduce them, but are nevertheless reproduced through habitual practice. The imperfect reproduction of both habitual, unconscious practices, and highly conscious, often politicized practices can explain the variation evident in human societies—how people developed distinct identities and particular ways of doing and thinking.

Like the making of a particular style of pot or a specific way of securing architectural posts, the practice of visiting and re-visiting particular places in the landscape can be understood as a tradition. In this sense, persistent places are more than just redundantly occupied locations, but would likely have been places with historical significance and ancestral associations—associations which could at times have been mobilized to political ends. The re-visiting of particular places, although undoubtedly structured by the availability of resources, was not a mere matter of "behaviour" resulting from some environmental stimuli, but one of practice contingent on historical context.

To identify persistent places within the study area, I use kernel density estimation to highlight areas with clusters of sites found through CRM assessments which contain diagnostic artifacts dating to successive periods within the Late Archaic, indicative of their repeated use over this time span of some one thousand years. The vast majority of these sites are found within the ploughzone and thus lack stratigraphy. While it may be objected that places would often be revisited merely by chance and without knowledge of many past visits, I believe that particularly dense concentrations of diagnostic artifacts in the same area, dating to successive time periods, suggest that the re-use of these places in particular was not just the result of chance. With these areas identified, I consider what particular characteristics of the landscape and associated available resources were likely to have been present and which could have structured their re-use throughout the Late Archaic. Here I focus especially on the hypothesis that persistent places may have emerged as sites related to the mass capture of fish during their spring spawning run. In recognition that these places may have been used for more than one purpose and in more than one season, I consider other important resources that are likely to have been available in these areas as well. This focus on the economic affordances of persistent places is not meant to imply an adaptationist perspective. Instead, the repeated use of certain places should be understood as practice within a historical context, a context which includes knowledge of the past availability of resources within the landscape.

The advantage of this approach is that it considers the landscape as a whole, instead of dividing it into individual sites whose materials may or may not belong to the same time period. This change in scale, from the level of site to the level of the landscape, facilitates the identification of areas larger than the individual site which were subject to intensive occupation over long periods of time, understood as persistent places. With this approach, the palimpsestic nature of the archaeological record is not considered an obstacle, and in fact is the very characteristic that makes this type of analysis possible.

4. METHODS

4.1 Data Preparation

All site location data for the present analysis were obtained from the Ontario Archaeological Sites Database. The OASD, maintained by the OMHSTCI, is a permanent database which stores the locations of archaeological sites in Ontario. In addition to location data, site attributes, such as survey and excavation history, environmental data, time period and cultural affiliations, site type, researcher information, and references to published and unpublished reports, are also included in the database (von Bitter et al. 1999, 101). The OASD is mainly used by consultant archaeologists in their background research for archaeological assessments of locations of proposed construction projects. To assess archaeological potential, the OASD is queried to determine the number of archaeological sites in the immediate vicinity of the location in question.

The database is updated by archaeological license holders who are required to submit their findings in the form of site record forms. The vast majority of the sites in this database were discovered through archaeological assessment completed by CRM firms. These assessments are carried out in accordance with the Ontario Standards and Guidelines for Consultant Archaeologists (Ontario Ministry of Tourism and Culture 2011). Depending on the nature and quantity of archaeological material recovered at the site, the intensity of archaeological survey carried out varies from fieldwalking/test-pitting to full-scale block excavation.

There are two fields in the database which include information on the site's date: "Time Period" and "Technological Tradition". Time Period describes the date of the site in the most general terms (e.g., "Late Archaic", "Early Woodland"), while the technological tradition field describes the diagnostic projectile point styles present at the site, which are associated with a range of dates. The dataset I received from the MHSTCI was produced by querying the OASD to return only sites with an entry for "Late Archaic" in the Time Period field. This dataset as received contained 887 entries. For 445 of these entries, the time period was listed as "Late Archaic", however the technological tradition field was left blank. These sites could not be assigned to any of the major complexes of the Late Archaic, and the basis for dating them to the Late Archaic in the first place was not clear. No additional information or site reports were available on the MHSTCI's online database of site reports. It is likely that if these reports are still in existence, they are held as unpublished reports in storage with either the MHSTCI, local municipalities, or CRM firms in Ontario. Obtaining reports for each of the 455 sites and updating the database with any additional information would greatly increase the scope of this project. Since I could not determine with complete confidence that these sites truly contained Late Archaic diagnostic artifacts, and since it would not be possible to include these entries in my projectile point style-specific analyses, I made the decision to omit sites only listed as "Late Archaic" from my analysis.

Further inspection of the database also made it clear that some sites were recorded as duplicates because a separate entry was made for each of the four possible stages of archaeological assessment. These duplicate entries were removed, and only the entry from the most advanced stage of assessment was retained. When necessary, fields for this entry were updated to include information gained from earlier stages of assessment.

Finally, for many of the sites in this database, the "Technological Tradition" field was given only to the level of specificity of "Narrow Point", "Broad Point" or "Small Point" (i.e., without reference to the specific projectile point style). For these entries, I consulted the CRM site reports and updated the database entries to include the specific projectile point types found at the site if they were listed in the report. If the information in the report was not any more specific than the database entry, I did not attempt to assign the projectile points to a more specific category myself, since I could not confidently type them using the photographs and descriptions provided in the report alone. Often, these projectile points were somewhat ambiguous or were fragmentary and lacked defining features (e.g., some large, broad-stemmed points which could be confidently typed as broad points were broken at the shoulder, making it difficult to determine for certain whether they resembled Adder Orchard or Genesee forms).

Once duplicates and sites lacking key information were removed, 299 sites remained in the database. This database was then queried to produce individual datasets for each Late Archaic point style, and cumulative datasets for each of the three Late Archaic complexes.

Of the 299 sites, 69 had a Narrow Point component, 77 had a Broad Point component, and 192 had a Small Point component. Many of these sites are multi-component, which accounts for the discrepancy between the total number of sites and the sum of the number of sites by projectile point style. The number of sites containing each specific projectile point style are presented in Table 4. Site locations for each dataset are presented in Figure 3 through Figure 11. Visual comparison of these site distributions alone suggests that Late Archaic sites belonging to all three complexes are similarly distributed, however patterns in site distribution will become clearer following kernel density estimation.

Table 4: Number of sites in each dataset

Point Style	**Number of sites**
All Late Archaic	299
All Narrow point	69
All Broad point	77
All Small point	192
Lamoka	43
Normanskill	9
Adder Orchard	22
Genesee	31
Perkiomen	8
Crawford Knoll	104
Innes	39
Ace of Spades	20
Hind	17
Unspecified Narrow Point	18
Unspecified Broad Point	18
Unspecified Small Point	26

Figure 3: All Late Archaic sites in the study area

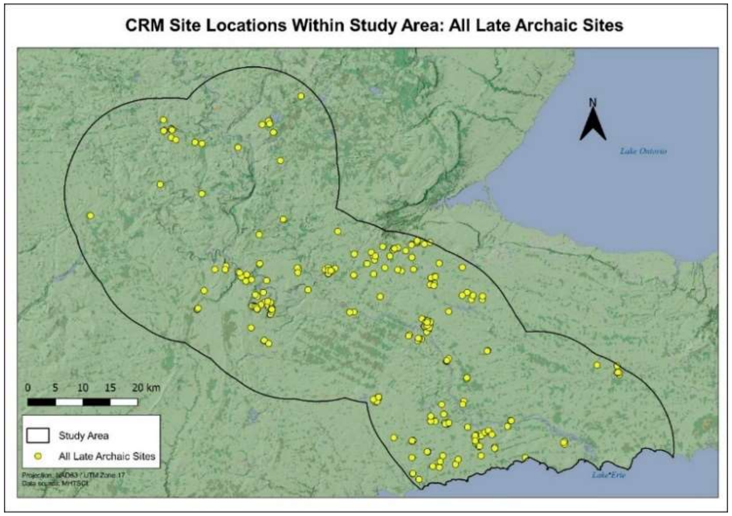


Figure 4: All Narrow Point sites in the study area

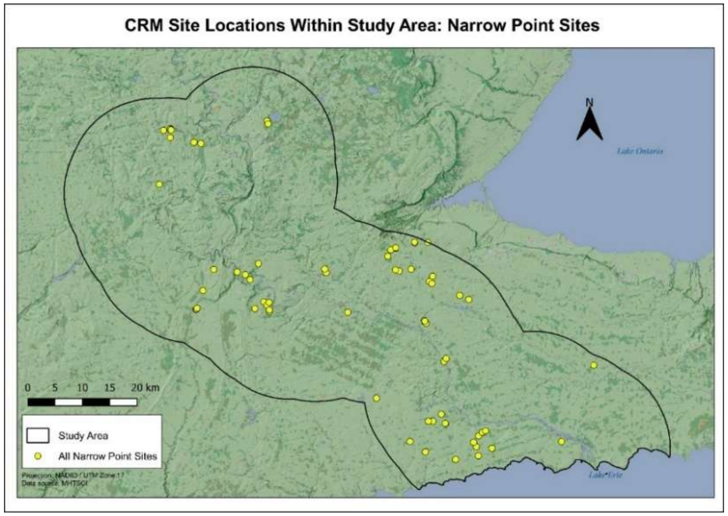


Figure 5: All Broad Point sites in the study area

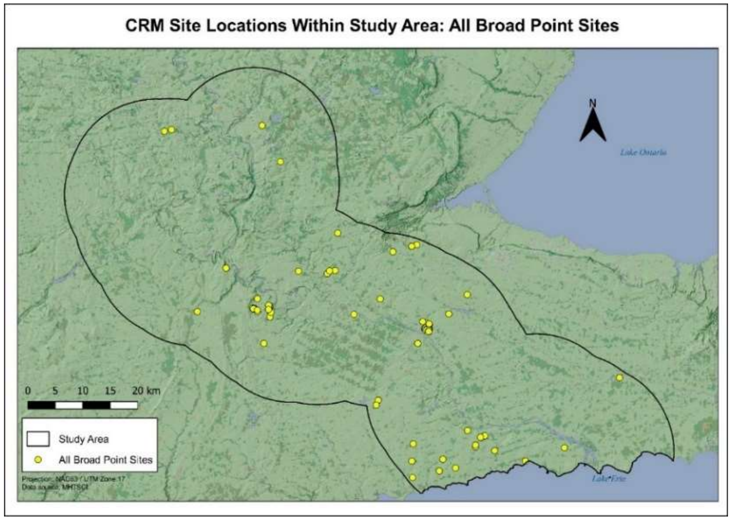


Figure 6: All Small Point sites in the study area

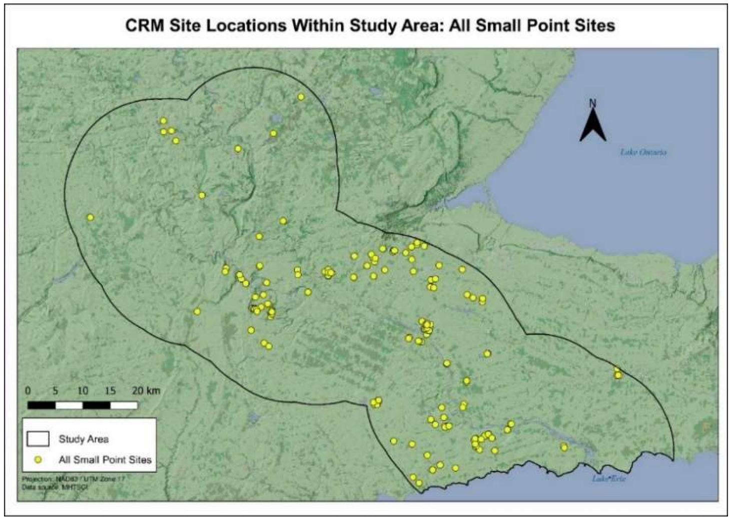


Figure 7: Normanskill sites in the study area

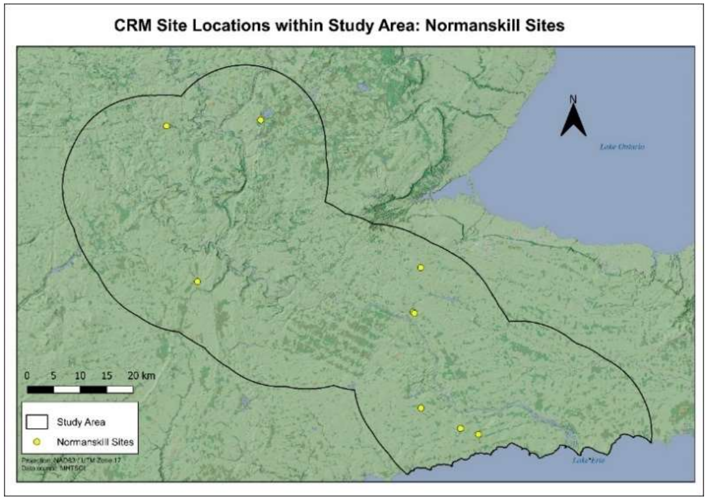


Figure 8: Lamoka sites in the study area

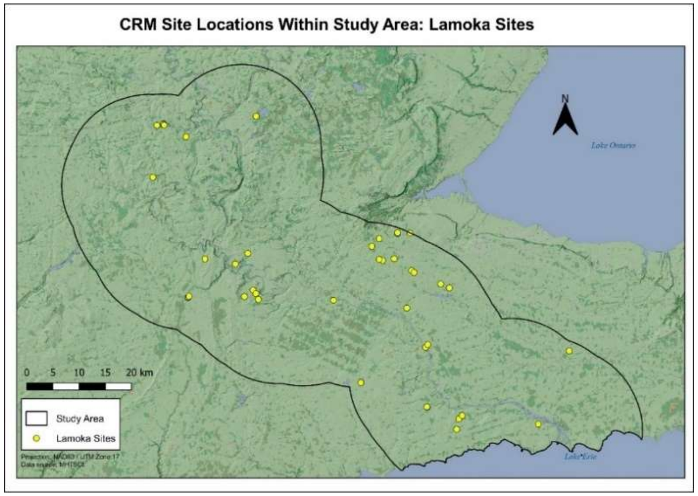


Figure 9: Adder Orchard sites in the study area

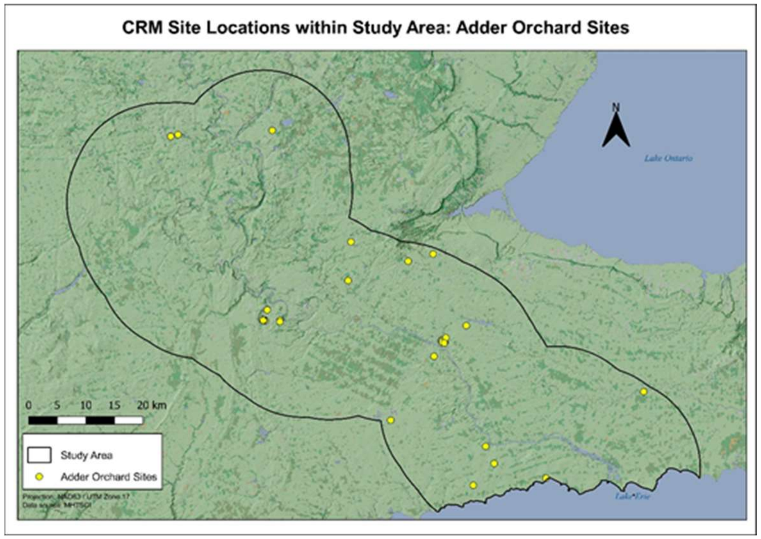


Figure 10: Genesee sites in the study area

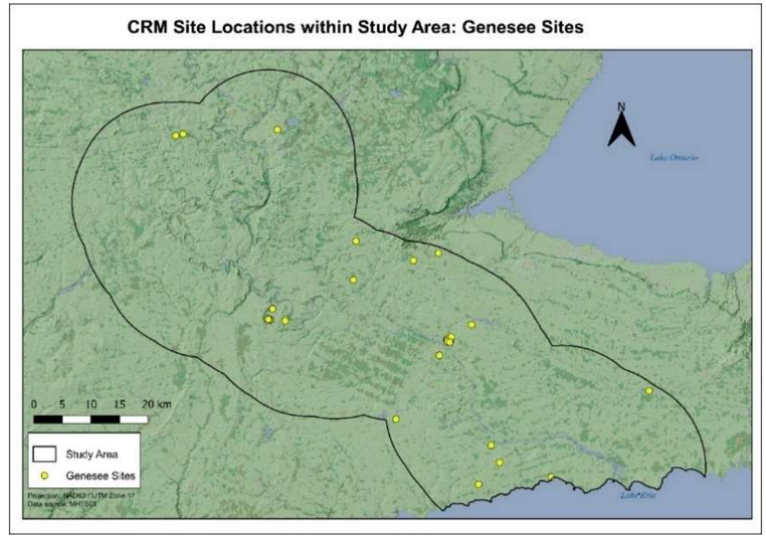


Figure 11: Perkiomen sites in the study area

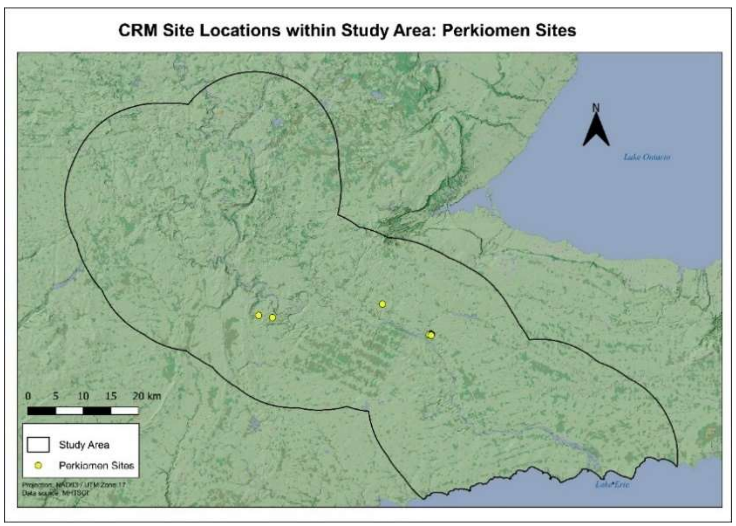


Figure 12: Crawford Knoll sites in the study area

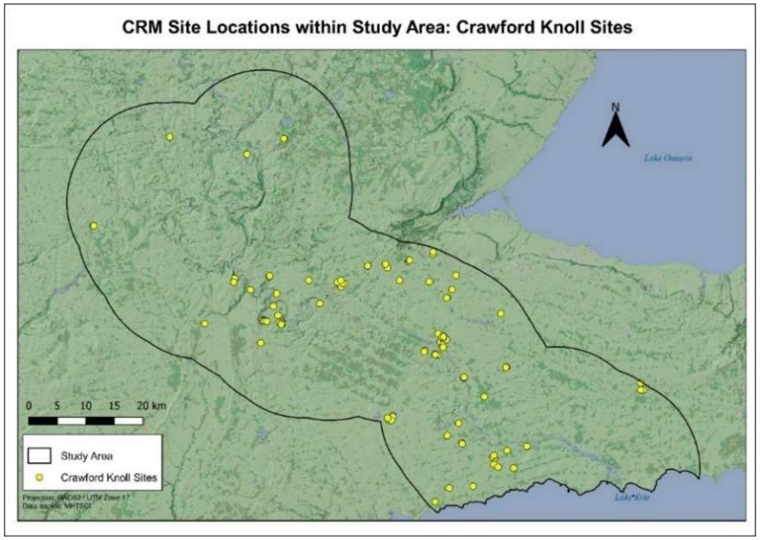


Figure 13: Innes sites in the study area

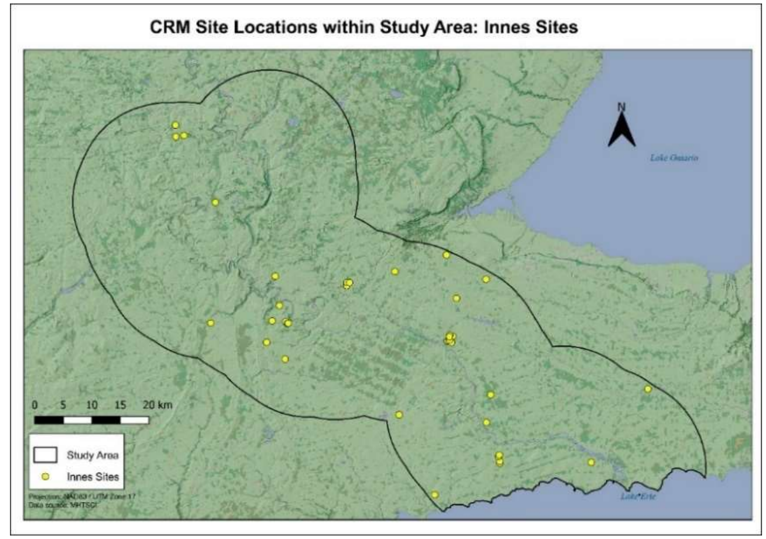


Figure 14: Ace of Spades sites in the study area

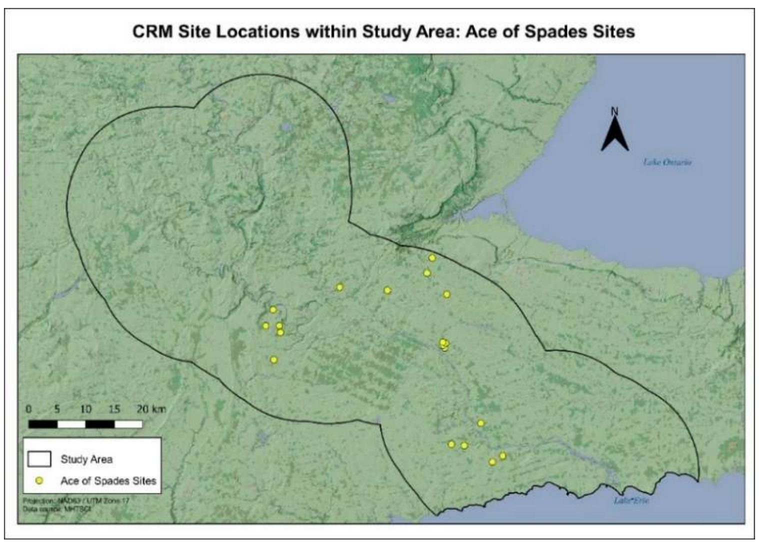
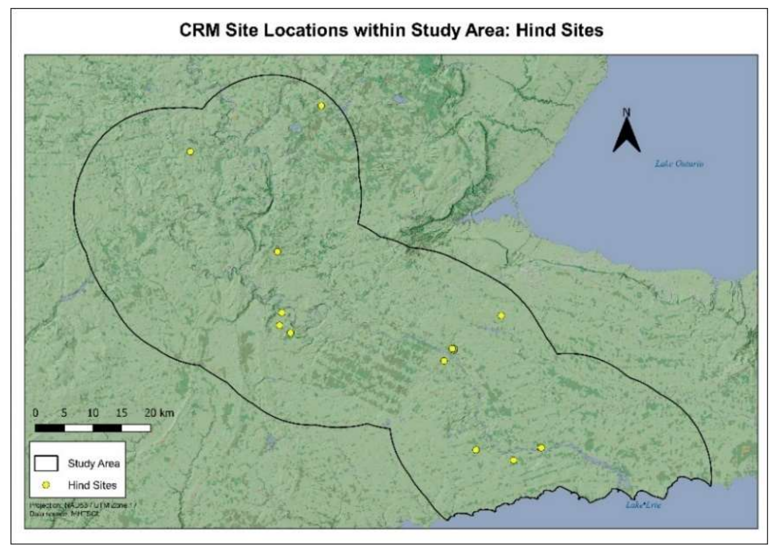


Figure 15: Hind sites in the study area



4.2 Nearest Neighbour Analysis

Once the data were cleaned and normalized, a nearest neighbour analysis was performed to determine whether the distribution of sites in the landscape could be characterized as clustered, random, or evenly spaced. This test was carried out on the entire database containing all Late Archaic sites, as well as on datasets containing sites belonging to each individual complex and projectile point style.

It is important to note here that nearest neighbour analysis is not a foolproof method for identifying clustering. Since it is only meant to detect clustering between a point and its very nearest neighbour it does not detect clustering at multiple spatial scales. Furthermore, the shape of the study area can influence the detection of clustering. Areas with large amounts of empty space are likely to result in a reading that suggests the data are clustered. Despite these drawbacks, in the present case nearest neighbour analysis is considered a useful if imprecise tool for exploratory data analysis, since the shape of the study area is fairly regular, and since it was used only to determine whether sites can be said to be clustered within the study area at all, not to determine cluster membership or the optimum number of clusters. More sophisticated cluster identification was accomplished via kernel density estimation.

Nearest neighbour analysis detects clustering by comparing the mean observed distance between each point and its nearest neighbour within a given dataset (R_o) and the expected mean distance between a point and its nearest neighbour in a random distribution (R_e) (Conolly and Lake 2006, 165). This is expressed mathematically as:

$$R = \frac{R_o}{R_e}$$

The statistic R, here referred to as the nearest neighbour index*,* is the ratio of R_o to R_e. In the case of a random distribution, the value of R_o is equal to that of R_e, and the value of R will thus be equal to 1. If data points are clustered, the observed mean distance between a point and its nearest neighbour will be less than the mean distance between a point and its nearest neighbour in a random distribution, and thus the value of R will be less than 1. If the points in the dataset in question are more evenly spaced than those of a random distribution, the value of R will be greater than 1. The nearest neighbour indices for each dataset were calculated and are summarized in Table 5. In every case, $R<1$, suggesting that all datasets are clustered to some degree, although the R value for sites with Normanskill components was 0.94, indicating that these sites are only very slightly clustered, if at all. It is probable that the small sample size for sites with Normanskill components within the study area is a factor here.

It is also possible to test the null hypothesis that the sites are randomly distributed within the study area by using a z-test which takes the variance of mean distances between neighbours in a random distribution ($V[R_e]$) as the denominator of the equation, since $V[R_e]$ can be estimated as:

$$V[R_e] = \frac{4 - \pi}{4\pi\lambda n}$$

where λ is the density of points in the study area and n is the number of points (Rogerson 2001, 162). This yields a z-test formula of:

$$z = \frac{(R_o - R_e)}{\sqrt{V}[R]}$$

The null hypothesis can be rejected at a 95% confidence interval if the resulting z-value is greater than 1.96, indicating that the sites are uniformly distributed, or less than -1.96, indicating that the sites are significantly clustered. The results, summarized in Table 5, indicate that the null hypothesis can be rejected, and the data can be considered significantly clustered in every dataset except for Normanskill. It is worth noting, however, that although Normanskill sites themselves do not appear to be clustered, they do appear to be clustered together with other Narrow Point Lamoka sites, as indicated by a z-score for the cumulative Narrow Point dataset of -9.08. It is also apparent from visual comparison of the Normanskill and Lamoka datasets that the few Normanskill sites in the study area are all located in close proximity to Lamoka sites.

Table 5: Nearest Neighbour Indices and z-test scores

Complex or Projectile Point Style	**Nearest Neighbour Index**	***z*-test score (*z*)**
All Late Archaic	0.38	-20.62
All Narrow Point	0.43	-9.08
All Broad Point	0.53	-7.97
Small Point	0.41	-15.64
Lamoka	0.56	-5.55
Normanskill	0.94	-0.35
Genesee	0.63	-3.97
Adder Orchard	0.77	-2.08
Perkiomen	0.18	-4.45
Crawford Knoll	0.44	-10.93
Innes	0.76	-2.89
Ace of Spades	0.38	-5.28
Hind	0.68	-2.51

4.3 Choice of Method of Density Analysis

Once it could be established that for most of the datasets the distribution of sites was clustered, the next step was to identify the locations of clusters in a way which could be easily visualized for the purpose of comparing site clusters between projectile point styles and with other spatial data. There are several methods of identifying clusters which generally fall into the three categories of hierarchical, partitioning, and density-based approaches (see Conolly and

Lake 2006, 168). Density analysis was selected as the method for identifying clusters in the present case due to its strength in assigning cluster membership when there are a large number of points (relevant especially for datasets in which the number of sites exceeds 100) and in situations where cluster boundaries are "fuzzy" or difficult to define (Conolly and Lake 2006, 173). Density analysis also has the benefit of producing results that can be understood intuitively and which can be easily compared.

Density analysis, sometimes called intensity analysis, refers to methods of spatial modelling which allow the researcher to describe and visualize the changing frequency of observations within a given area. At the most basic, this involves dividing the study area up into a series of regular grid squares and counting the number of data points which fall into each grid square. Although this simplistic method has a long history of use in archaeological survey, it suffers a major problem in that the size of the chosen grid square has a profound effect on the analysis, and there is no real way to determine the optimum grid size (Ebert 1992). For this reason, kernel density estimation, a more sophisticated method of intensity analysis, was used.

4.4 Kernel Density Estimation

Kernel density estimation is a non-parametric method of intensity analysis used to estimate the varying intensity of data points within a given area. KDE produces a raster, or matrix of cells which represents the estimated density of a given phenomenon within the study area by assigning a density value to each raster cell based on its proximity to observed instances of that phenomenon. This raster surface is typically referred to as a "heatmap" because when the raster cells are assigned a colour based on their density value, the resulting visualization has the appearance of "hot" and "cold" spots indicating areas of high and low density. KDE can be said to "smooth" the data in the sense that it transforms what can be thought of as a probability surface with spikes of data at certain points into a continuous intensity surface.

Kernel density estimation is accomplished by placing a two-dimensional probability function referred to as the "kernel" over each point in the dataset. The kernel function spreads from the centre of each point, where its value is closest to 1, outwards to a defined distance, referred to as the bandwidth or radius and denoted by h, at which point the value of the function reaches 0. All points between the extent of the function defined by h and the centre of the function are therefore fractions of 1. The density value for each cell in the raster produced by KDE is calculated by the summation of the values of each function where they intersect with each raster cell. Since the value of the kernel function decreases as it approaches the limit set by h, the closer a point is to a given raster cell, the more it will contribute to the density value of that cell.

4.4.1 Calculating h

The value chosen for h has a profound effect on the resulting heatmap. A large value will result in an "oversmoothed" appearance, whereas a small value will produce peaks or "hotspots" which do not reflect the overall distribution of data (Conolly and Lake 2006, 177). Determining a value for h can be accomplished by experimentation, however this method is less than ideal since it ultimately relies on subjective visual analysis of the resulting surface.

In the present case, there is also the issue of selecting an h value for datasets with different numbers and dispersion of points within the study area. If one h value were chosen for all datasets, the results might be comparable, however it is unlikely that this one value would be well suited to any of the datasets. If an h value was chosen on the basis of experimentation with each dataset individually, the chosen h values would likely be better suited to the individual datasets, however, the resulting KDE heatmaps might be less easily compared, since they were produced by kernel functions with different-sized radii.

For these reasons, a better approach is to use some method for determining an optimum value for h which is calculated using the characteristics of the specific dataset. This way, although the values for h will differ between datasets, they will have still been determined by the same underlying logic and the resulting heatmaps will thus be comparable. In my analyses, I have used an h optimization method described by Fotheringham et al. (2000, 147), referred to hereafter as the h_{opt} method. This method has a tendency to slightly oversmooth, however, as the authors note, this slight oversmoothing has its advantages, since any peaks or hotspots identified through this method are very likely to be "real", in the sense that they are truly reflective of the overall distribution of the data points, and not the product of undersmoothing (Fotheringham et al. 2000, 147). This method for determining h_{opt} is expressed as:

$$h_{opt} = \left(\frac{2}{3n}\right)^{\frac{1}{4}} \sigma$$

where n= the number of points in the dataset, and σ = the standard distance, a statistic measuring the compactness or dispersion of the points in the dataset and which is defined as "the root mean square distance of each point in the dataset from the mean centre" (Fotheringham et al. 2000, 136). Standard distance is calculated using the formula:

$$\sigma = \frac{\sum_{i=1}^{i=n}(x_i - \widehat{\mu_x}) - \left(y_i - \widehat{\mu_y}\right)}{n}$$

where $\widehat{\mu_x}$ and $\widehat{\mu_y}$ are the x and y coordinates of the mean centre of the dataset, which is calculated by averaging the x and y coordinates of each point in the dataset.

The standard distances and h_{opt} values calculated for each dataset are given in Table 6.

Table 6: Standard distances and h_{opt} values

Site type	**# of sites (*n*)**	**Standard Distance (*σ*) (km)**	**h_{opt} (km)**
All Sites	299	22.98	4.99
Narrow Point	69	27.28	8.55
Broad Point	77	21.61	6.59
Small Point	192	22.13	5.37

Lamoka	43	27.72	9.78
Normanskill	9	29.38	15.33
Genesee	31	24.25	9.28
Adder Orchard	22	22.46	9.37
Perkiomen	8	12.77	6.86
Crawford Knoll	104	21.47	6.07
Innes	39	25.21	9.11
Ace of Spades	20	17.63	7.53
Hind	17	25.35	11.28

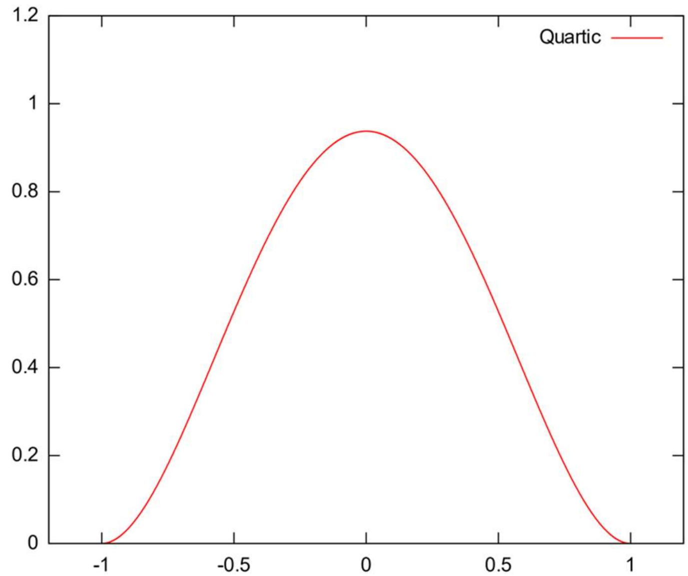
4.4.2 Other Parameters

In addition to h, several other KDE parameters can be manipulated. Most relevant are kernel shape and pixel size. Kernel shape refers to the form of kernel function used and controls the rate at which the influence of a given datum point drops off as the distance approaches h. Kernel shape can affect the appearance of the resultant heatmap produced by KDE, however its impact is far less significant than that of h. For my analysis, the kernel shape was set to "quartic", the default shape in QGIS, defined as:

$$K(x) = \frac{15}{16}(1 - d^2)^2$$

where *K* refers to the estimated density value for a given point, and *d* refers to the distance between a point with a known value (i.e., the data point on which the kernel is placed) and the point with an unknown value being estimated by the kernel function. The above function is standardized with an *h* of 1, so the particular shape of the kernel function differs depending on the specific value of *h* calculated for each dataset.

Figure 16: Quartic Kernel Function visualized



Pixel size refers to the size of the raster grid squares and can be thought of as the resolution of the heatmap. For my analyses, I chose a pixel size of 10 metres by 10 metres, on the basis that this would provide a significantly fine resolution for identifying hotspots without requiring inordinate amounts of time and processing power to produce.

4.4.3 Weighted Kernel Density Estimation

In some applications it may be desirable to "weight" the kernel function by using some variable to control the bandwidth value. For instance, bandwidth size could be increased or decreased on a site-by-site basis according to some parameter such as the size of each site or the number of artifacts recovered. In the present case, the kernel function was not weighted, meaning that each site in the analysis was treated as having equal "influence" and thus an equally-sized kernel function. Large sites covering multiple hectares with thousands of artifacts are thus given the same "weight" as projectile points deemed isolated findspots. There are several reasons for this decision: firstly, the multicomponent, palimpsestic nature of the ploughzone archaeological record is such that it often cannot be said for certain whether nondiagnostic artifacts are actually associated with the same occupation event as diagnostic artifacts, even in so-called "single component" cases where only one type of diagnostic artifact was found. More likely is the possibility that sites represent mixed surface deposits spanning unknown time periods, in which case it is not possible to determine the actual size or intensity of occupations dating to the time period in question. Secondly, site boundaries are defined according to arbitrary standards (i.e., the point at which artifact counts per unit drop below ten), and may end abruptly at property lines or at the edge of project study areas, making site size in spatial terms an ineffective weighting parameter. Moreover, what constitutes a site warranting stage 3 assessment versus an isolated findspot which does not warrant further assessment is arbitrarily defined by the Ontario Standards and Guidelines for Consultant Archaeologists and changes based on geographic area (Ontario Ministry of Tourism and Culture 2011, 40). Lastly, quantitative methods of weighting, such as site size or artifact count, will be determined largely by the level of survey intensity completed in the archaeological assessment—sites that have undergone stage 4 excavation will typically have a larger number of artifacts than those that have only completed stage 3, yet these numbers may not be representative of the actual density of artifacts in the area. For these reasons, I take the individual diagnostic artifact, rather than the site, as my basic unit of analysis, and thus treat all sites as equally influential in terms of their contribution to kernel density estimation.

4.4.4 Rendering and hotspot identification

KDE was carried out on each dataset using the "Heatmap (Kernel Density Estimation)" tool in QGIS 3.6.2 with *h* values derived from the above optimization method. Although the nearest neighbour analysis suggests that Normanskill sites are not clustered, KDE was carried out on this dataset anyway for the sake of comparing site distributions. The resulting heatmaps were then rendered using the "Singleband Pseudocolour" style setting in QGIS. This assigns a colour shade to each KDE raster cell as determined by its density value, with darker shades indicating greater density, thus allowing for easy identification of "hotspots".

4.5 Identification of Persistent Places

Persistent places are defined as places that were continuously re-visited throughout the long-term occupation of a region (Shlanger 1992, 92). Materially, they can be identified by the presence of high concentrations of diagnostic artifacts dating to multiple consecutive time periods, indicative of their consistent, diachronic re-use. In order to recognize persistent places in the study area, I analyzed the KDE results for each dataset and identified areas that were the site of particularly intense clusters of diagnostic projectile points dating to consecutive Late Archaic time periods. This was accomplished by identifying the most intense site clusters within the KDE results for each projectile point style, and assigning each cluster an intensity rank from one to a maximum of four, with one representing the greatest kernel density value measured at the approximate centre of the cluster on the raster produced by kernel density estimation. These clusters were given a name referring to the nearest municipality as a landmark, and organized in a chart along with their intensity rankings (Table 8). Areas with clusters that had high intensity rankings for multiple consecutive time periods are identified as persistent places. For easy visual comparison, ellipses were drawn around these site clusters/hotspots and overlain on a single map (see Figure 31).

4.5.1 Factors Structuring Re-use

Persistent places are characterized by concentrations of resources that make them especially appealing, as well as the presence of natural or cultural features that structure their re-use over long time periods (Thompson 2010, 218). Areas identified as persistent places were investigated with regard to these factors via a combination of methods:

1. Review of site reports: all site reports for sites within the areas identified as persistent places were reviewed for references to cultural features containing exclusively Late Archaic diagnostic materials. Sites with unique or rare characteristics were also noted. Analyses of carbonized plant material, including wood charcoal, recovered from any pre-contact features were reviewed in order to get an approximate picture of the Late Archaic vegetative and forest cover.

2. Comparison with spatial datasets: areas identified as persistent places were compared with spatial datasets containing the locations of landscape features and environmental data thought to be associated with resource concentrations (see Table 7). These datasets include physiographic features, soil characteristics, hydrological features including tributary streams and wetlands, soil drainage, elevation, slope and slope direction, chert outcrops, and areas of interest to wildlife. Special attention was paid to features unique to the region located near site clusters.
3. Visiting the area in person: areas identified as persistent places were visited in person in order to see landscape features in closer detail and to note any features not recognized through GIS spatial analysis. When possible, native plant species present in the area were identified. Although vegetation and forest composition has been impacted by forest clearing, agriculture, and the import of invasive species, native plant species in the area are thought to be indicative of possible Late Archaic land cover given the essentially modern climate conditions and forest composition of the Late Archaic, as indicated by climate records and pollen profiles. This information was used in conjunction with species identified through analysis of carbonized plant remains, as well as predictions of past forest cover based on soil types and drainage.

Table 7: Datasets used in analysis of site cluster environments

Dataset	*Source*
Physiographic features	Physiography dataset (OMENDM 2019) derived from Chapman and Putnam 1984
Elevation	Ontario Provincial Digital Elevation Model (OMNRF 2019a)
Slope and Slope Aspect	Produced via slope and aspect analysis of Ontario Provincial Digital Elevation Model (OMNRF 2019a)
Soils	Ontario Soil Survey Complex (OMAFRA 2018)
Hydrology	Enhanced Watercourse and Integrated Waterbody datasets, both part of Ontario Integrated Hydrology (OMNRF 2019b)
Wetlands	Wetlands dataset (OMNRF 2019c)
Chert Outcrops	Dataset produced from coordinates of chert outcrops given in Eley and Von Bitter 1989

Fish Spawning Areas	Query of Fish Spawning Areas dataset (OMNRF 2006)
Deer Overwintering Areas	Query of Wildlife Value Areas dataset (OMNRF 2020)

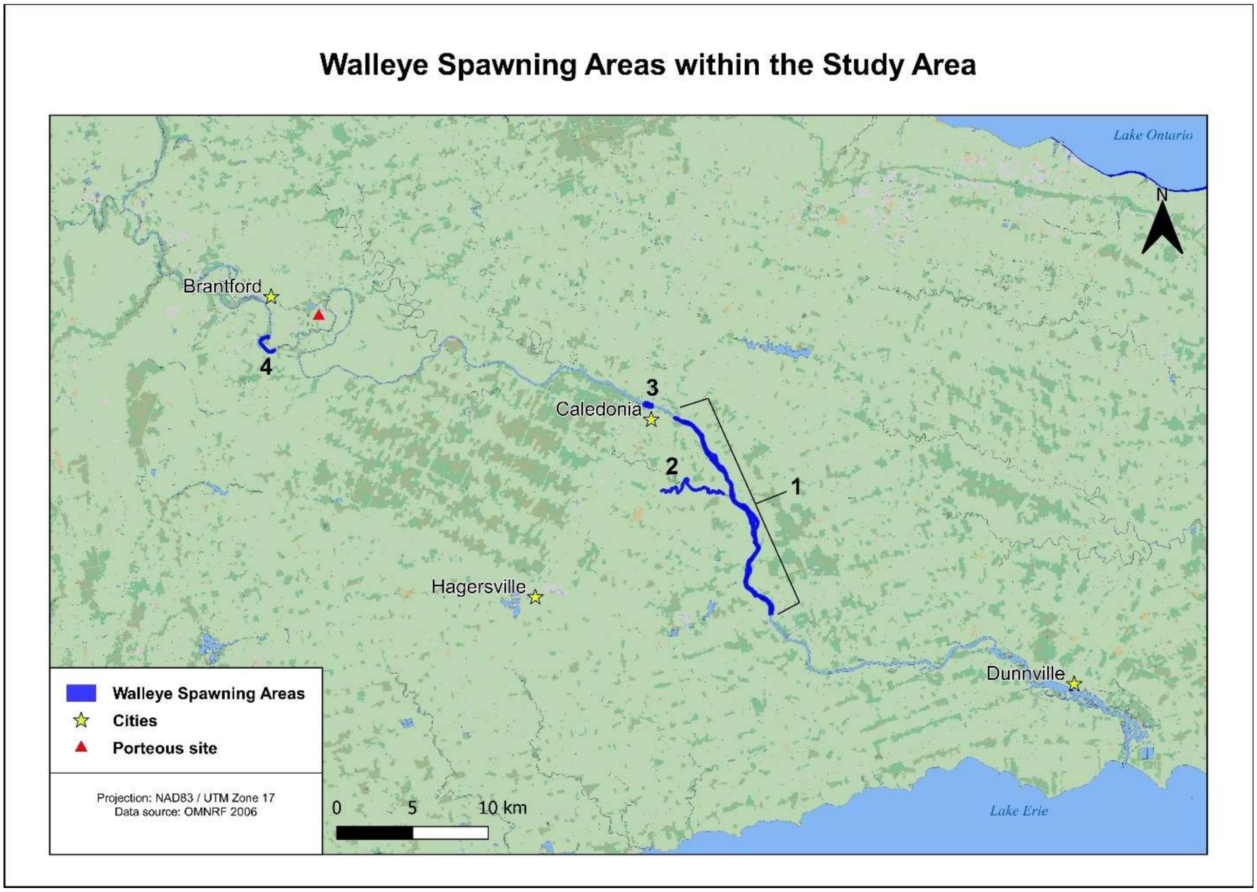
4.5.1.1 Fish Spawning Areas

Particular attention was paid to the hypothesis that persistent places may have emerged as sites related to the mass capture of spring-migrating fish, the basis for which was outlined in Chapter 2. Briefly summarized, an overview of Late Archaic fishing practices showed a near-exclusive focus on spring spawning species, and while fish remains are mostly found on lakeshore sites, fish bones would be unlikely to survive in the acidic soil and plough disturbed soil of upland riverine areas. Additionally, methods of fishing using tools made of organic material are evident from Late Archaic sites and are likely to have been the primary method used on shallow riverine sites, where seine nets would have been less effective or unnecessary. These fishing tools, being made of organic materials, are also unlikely to have been preserved, so there is a possibility that the importance of riverine fishing sites has been overlooked in initial excavation reports. In the absence of more concrete forms of evidence, the hypothesis that persistent places may have emerged as fishing sites related to the mass capture of spring spawning fish was evaluated by comparing the locations identified as persistent places with a dataset from the OMNRF containing the locations of known walleye spawning areas in the Grand River (OMNRF 2006). This dataset, which was created in 1997 and last revised in 2011 (Land Information Ontario 2011), records areas where fish are known to habitually spawn, according to the observations of OMNRF employees (Land Information Ontario 2012, 3). The dataset was queried to return spawning sites for fish of the genus *Sander* (sauger and walleye) and the most relevant fish of genus *Catostomus* (longnose sucker and white sucker). Of these, only walleye returned results within the study area, with a total of nine spawning areas identified. The reason for the discrepancy in results between these fish species is no doubt due to the disproportionate amount of research interest into the spawning habits of walleye owing to their status as one of the most important commercial freshwater fish, as well as their great importance to recreational anglers, a status not shared with fish of the genus *Catostomus*. Given the similarity in spawning habitat preferences between *Sander* and *Catostomus* (see section 2.4.2) however, it is likely that the areas identified as walleye spawning sites are suitable for spawning suckers as well, and indeed the remains of both fish are often found on Middle Woodland and later-dating sites associated with spring spawning runs.

Of the nine walleye spawning site locations within the study area identified by the OMNRF, five were omitted from the analysis since it could be reasonably surmised that their status as spawning areas is due entirely to human interventions in the modern era in the form of fish stocking, deliberate habitat construction, or damming. Four locations immediately below the Dunnville Dam were omitted because they appear to be less-preferred spawning areas for walleye that would otherwise proceed further upstream if not for their progress being blocked by the dam, which was a total impediment to their upstream movement before the construction of the Dunnville fishway and which still presents a considerable barrier to access to upstream spawning areas (MacDougall et al. 2007). Furthermore, this area has been the site of attempts to alter the substrate of the river specifically for the purpose of improving it as a walleye spawning habitat through the addition of cobble and gravel by the OMNRF and conservation groups in 1997, 2001, and 2002 (MacDougall et al. 2007, 105). A spawning area located on a shoal between two islands in Puslinch Lake, a kettle lake northeast of Cambridge, was omitted because the walleye in Puslinch Lake are known to be an introduced population which were released into the lake some time in the 1940s (Bonter, Steffler, and Timmerman 2000, 7). The remaining four walleye spawning areas are described below, and their locations are presented in Figure 17.

1. A long section of the Grand River spanning from Caledonia to Cayuga which is characterized by shallow water, gravelly substrate (Ecologistics Ltd. 1982), and a number of river bars (208 hectares).
2. A section of Mackenzie Creek, from its confluence with Boston Creek to approximately 500 m from of its confluence with the Grand River (10 hectares)
3. An area surrounding a pair of gravelly river bars approximately 900 m downstream from the Caledonia dam (10 hectares). Although the proximity to the Caledonia dam is probably a contributing factor to the significance of this location as a walleye spawning area, the large river bars in this area would still make it attractive to spawning walleye in the absence of the dam.
4. A river oxbow south of Brantford, known to anglers as “green waters” which is considered a high-quality walleye spawning habitat (13 hectares) (OMNRF 2006). This spawning area is notably in close proximity to the Princess Point-affiliated Porteous site, which produced a large number of *Sander* and *Catostomus* bones, even despite a lack of sieving (Burns 1977, 295).

Figure 17: Walleye spawning areas within study area



5. RESULTS

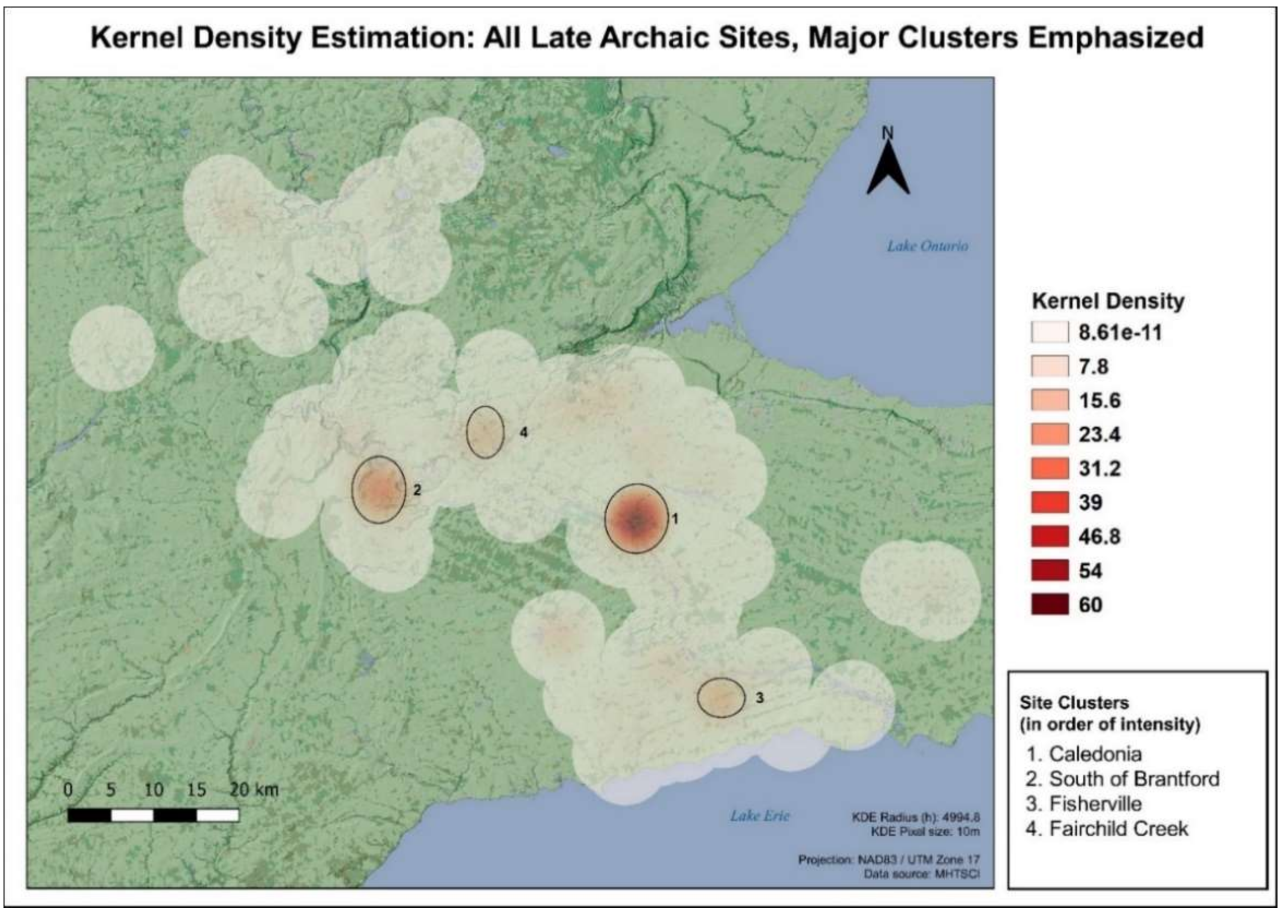
Figures Figure 18 through Figure 30 show the results of the kernel density estimation for each dataset. The most intense "hotspots" or site clusters are circled in black for emphasis and labelled according to their level of intensity, with "1" representing the most intense.

5.1 KDE Results by Dataset

5.1.1 All Late Archaic Sites

Kernel density estimation of the dataset containing all Late Archaic sites suggests that when considered in aggregate (i.e., without distinguishing between complex or specific projectile point style), Late Archaic sites are most densely concentrated in an area just east of Caledonia, about 1 km from the Grand River (1). The next most intense cluster is located just south of Brantford (2). Less intense clusters are located east of Fisherville in Haldimand County (3), and near Fairchild Creek in Brant County (4).

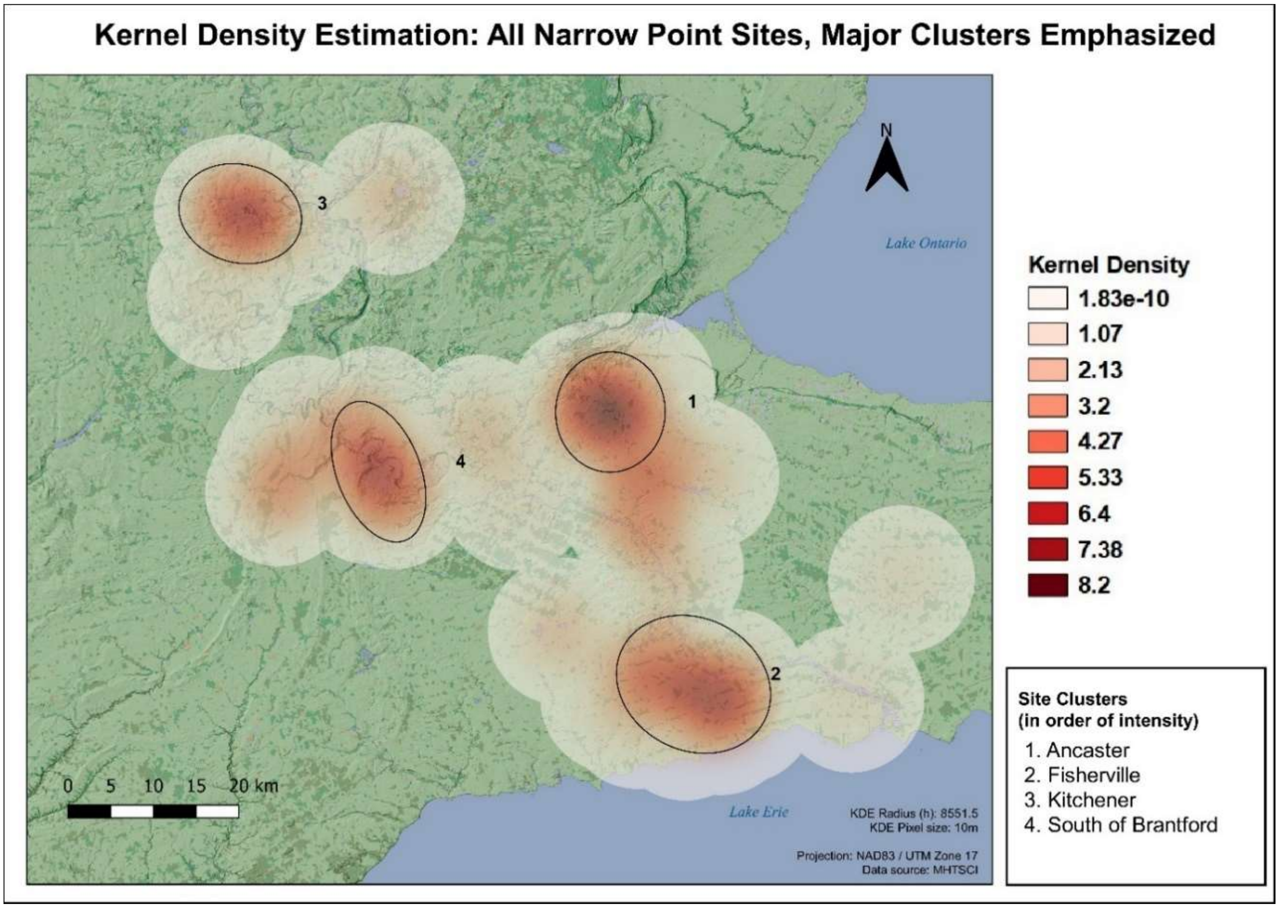
Figure 18: KDE results for all Late Archaic sites, major clusters emphasised and ranked in order of intensity



5.1.2 Narrow Point Sites

The KDE results for the dataset containing all Narrow Point sites indicate clusters in Ancaster (1), east of Fisherville (2), Kitchener (3), and south of Brantford (4).

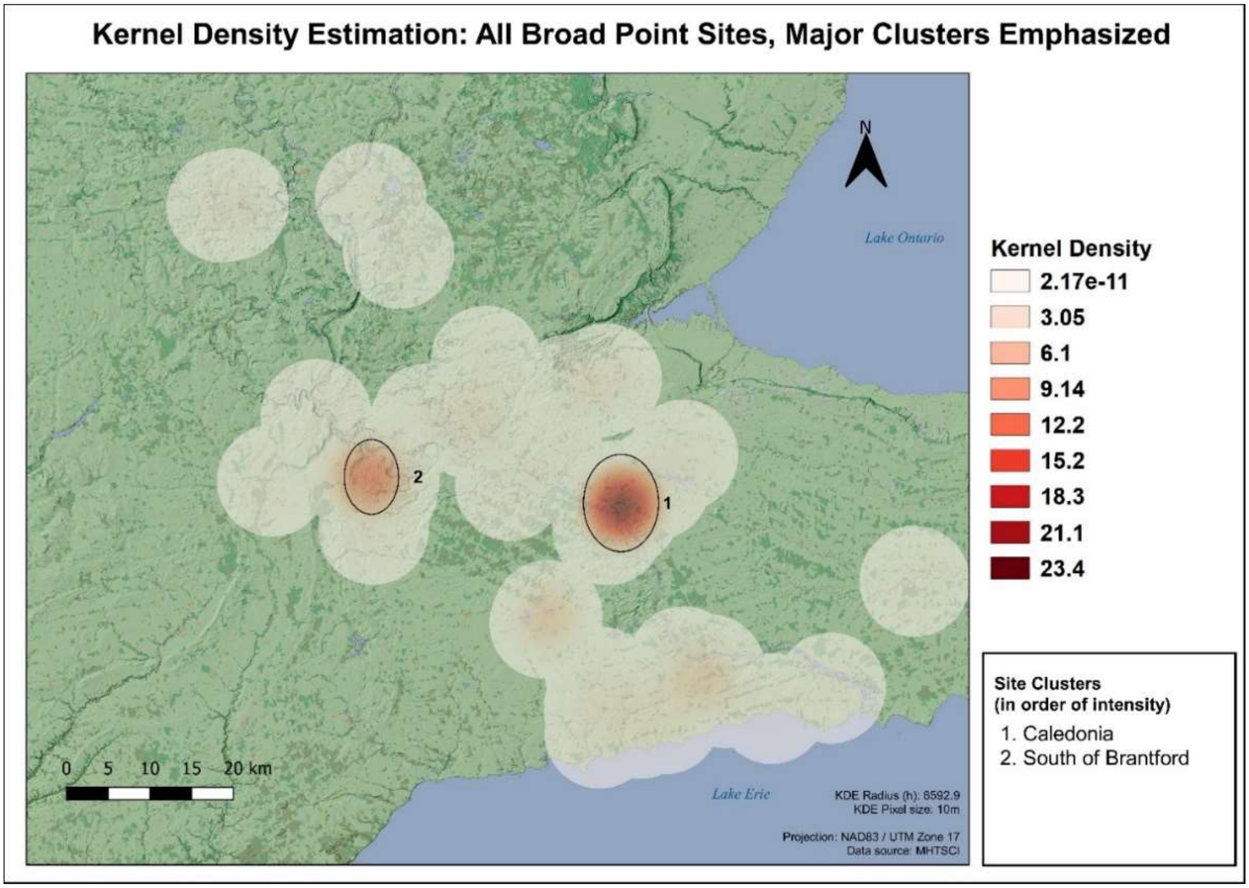
Figure 19: KDE results for all Narrow Point sites



5.1.3 Broad Point Sites

Broad point sites are overwhelmingly clustered in Caledonia (1) and south of Brantford (2). Very faint hotspots can also be seen in Hagersville and east of Fisherville (not emphasized in Figure 20).

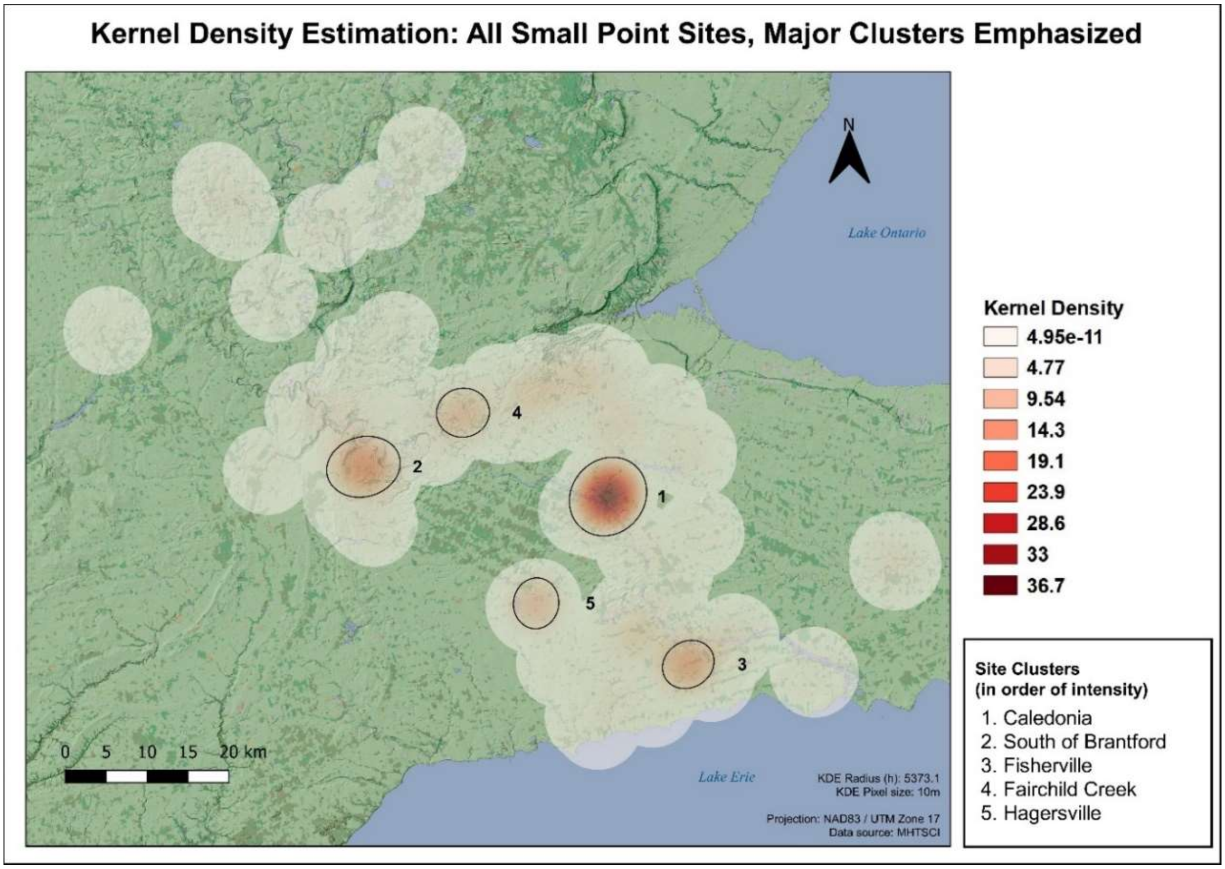
Figure 20: KDE results for all Broad Point sites



5.1.4 Small Point Sites

Small Point sites are most intensely clustered again in Caledonia (1), followed by a cluster south of Brantford (2) and another east of Fisherville (3). Less intense clusters are evident in Brant County near Fairchild Creek (4) and in Hagersville (5).

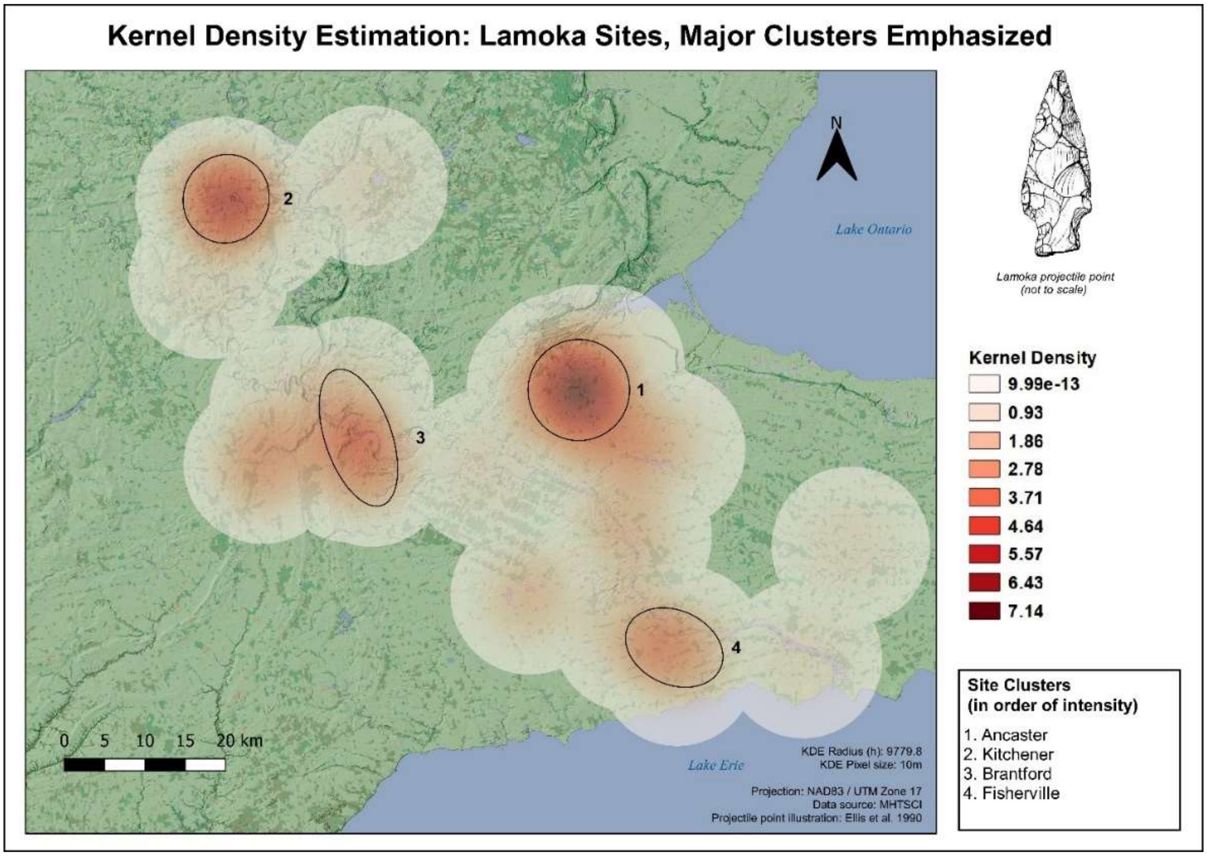
Figure 21: KDE results for all small point sites



5.1.5 Lamoka

Lamoka sites are most intensely clustered in Ancaster (1), followed by Kitchener (2). Less intense clusters are evident south of Brantford (3) and east of Fisherville (4).

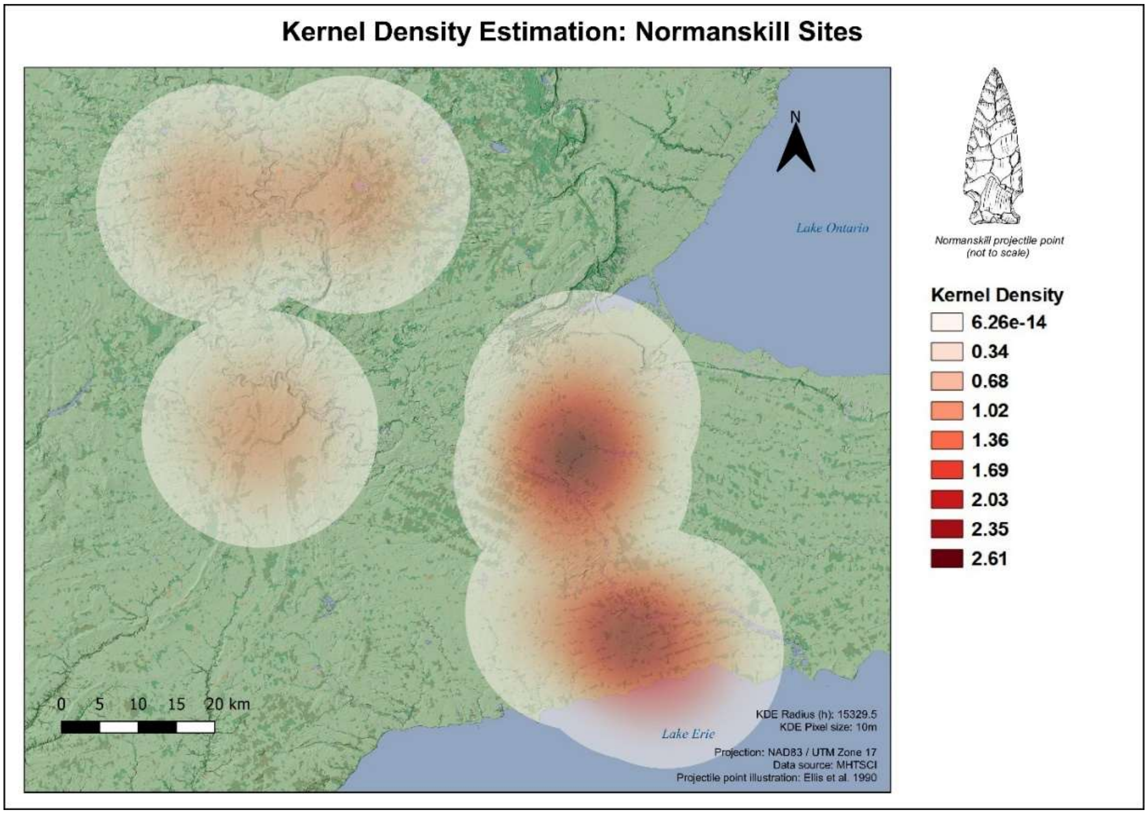
Figure 22: KDE results for Lamoka sites



5.1.6 Normanskill

Normanskill sites were determined by nearest neighbour analysis not to be significantly clustered within the study area, as previously discussed. The results of the kernel density analysis are presented here to visualize the distribution of sites. Normanskill sites are most common near Caledonia and near the Lake Erie shore.

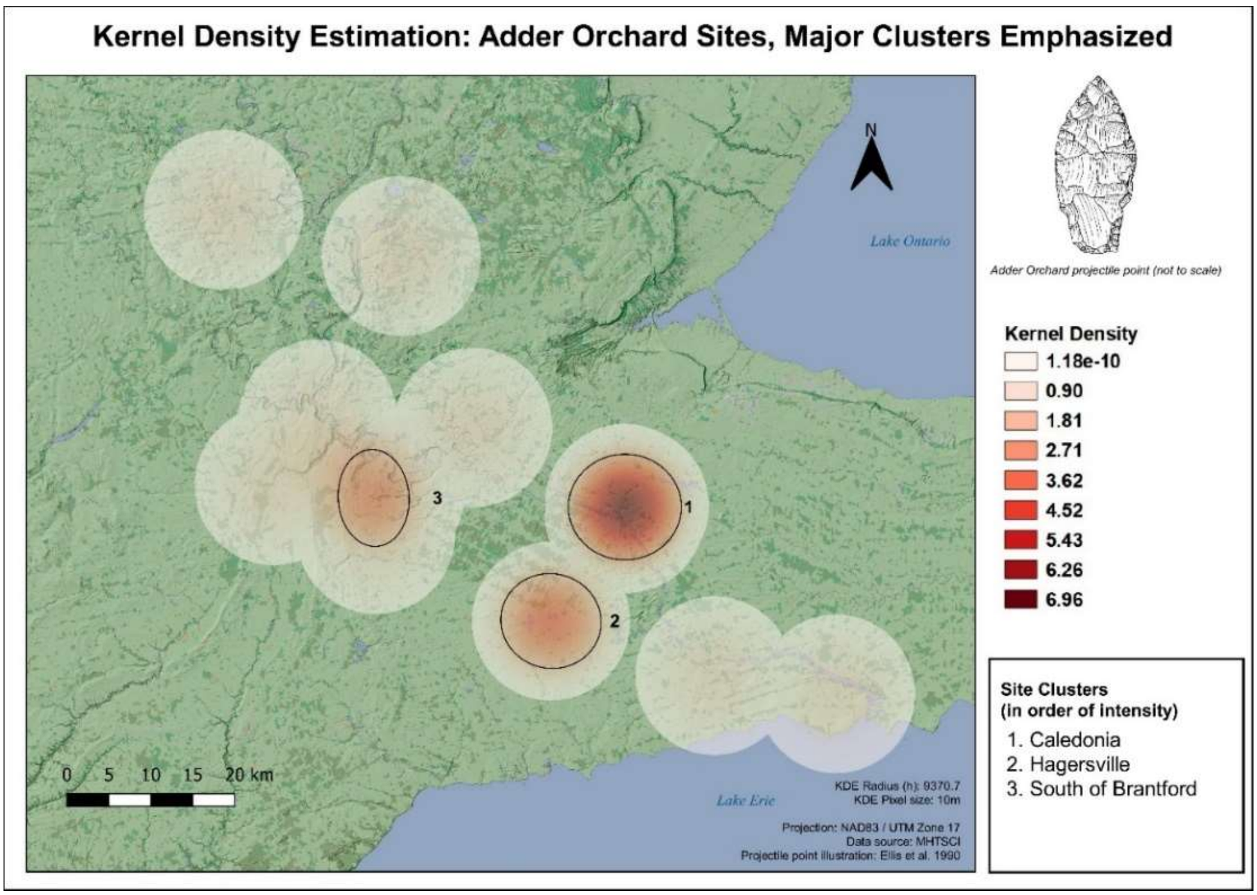
Figure 23: KDE results for Normanskill sites



5.1.7 Adder Orchard Sites

Adder Orchard sites appear to be most intensely clustered in Caledonia (1), Hagersville (2), and south of Brantford (3). Inspection of the sites within the Hagersville cluster reveal, however, that the intensity of this cluster is in part due to a site location recording error. The four sites in this cluster, AfHa-941, AfHa-944, AfHa-945, and AfHa-946, all share the exact same coordinates. As a result of this, the amplitudes of the kernel function for each of the sites are combined at their highest point, resulting in an exaggerated density value of the raster squares in the vicinity. Despite this flaw, the CRM site report for the archaeological assessment through which these sites were discovered (ASI 2017a) indicates that while these sites do not share the exact same location, they are all located within the same 800 m by 400 m survey study area, and thus while the density of sites in this area is overstated, the degree of error is minimal.

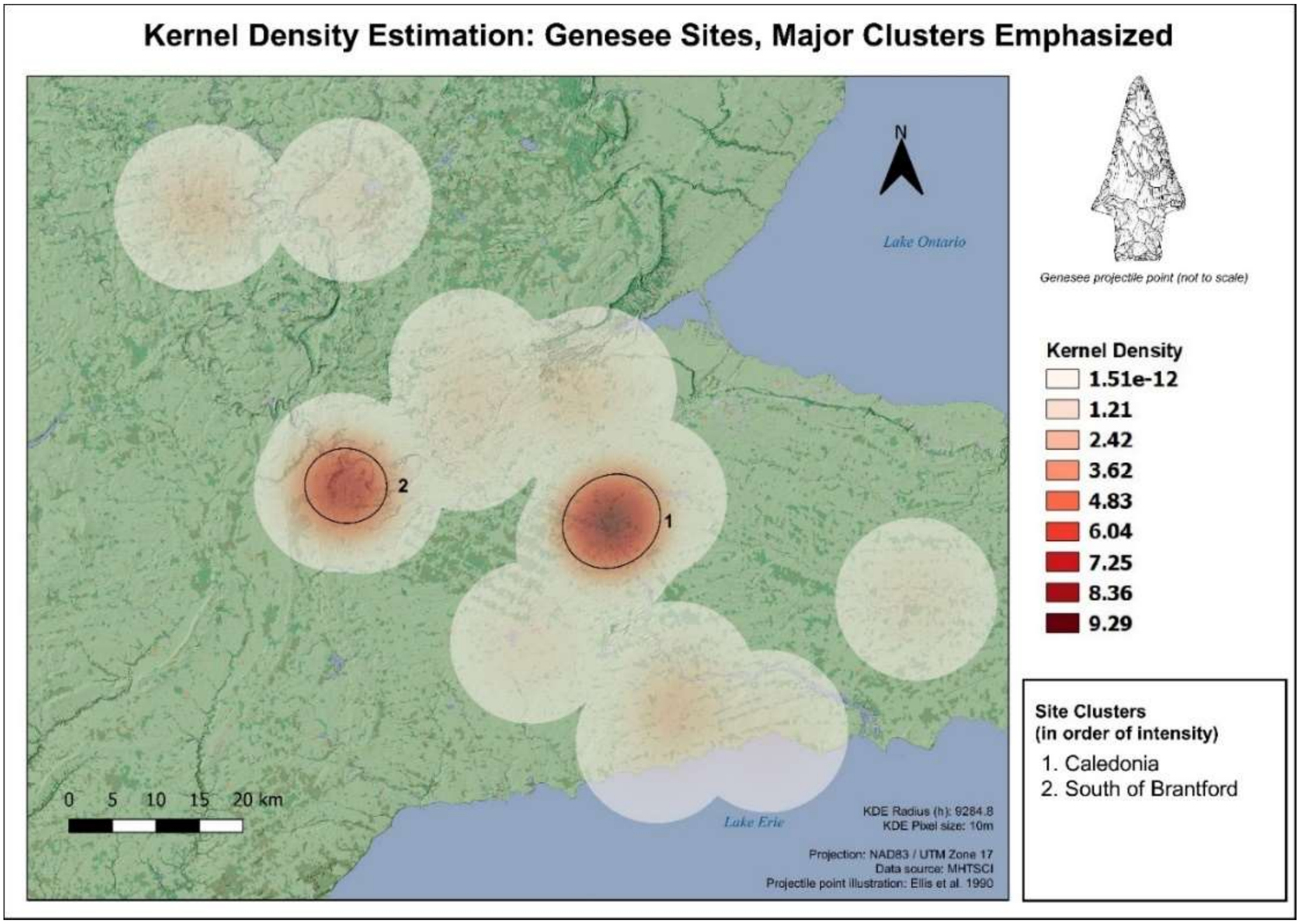
Figure 24: KDE results for Adder Orchard sites



5.1.8 *Genesee*

KDE results indicate that Genesee sites are most intensely clustered in Caledonia (1) and south of Brantford (2). Very faint hotspots can also be detected east of Fisherville and near Kitchener (not emphasized in Figure 25).

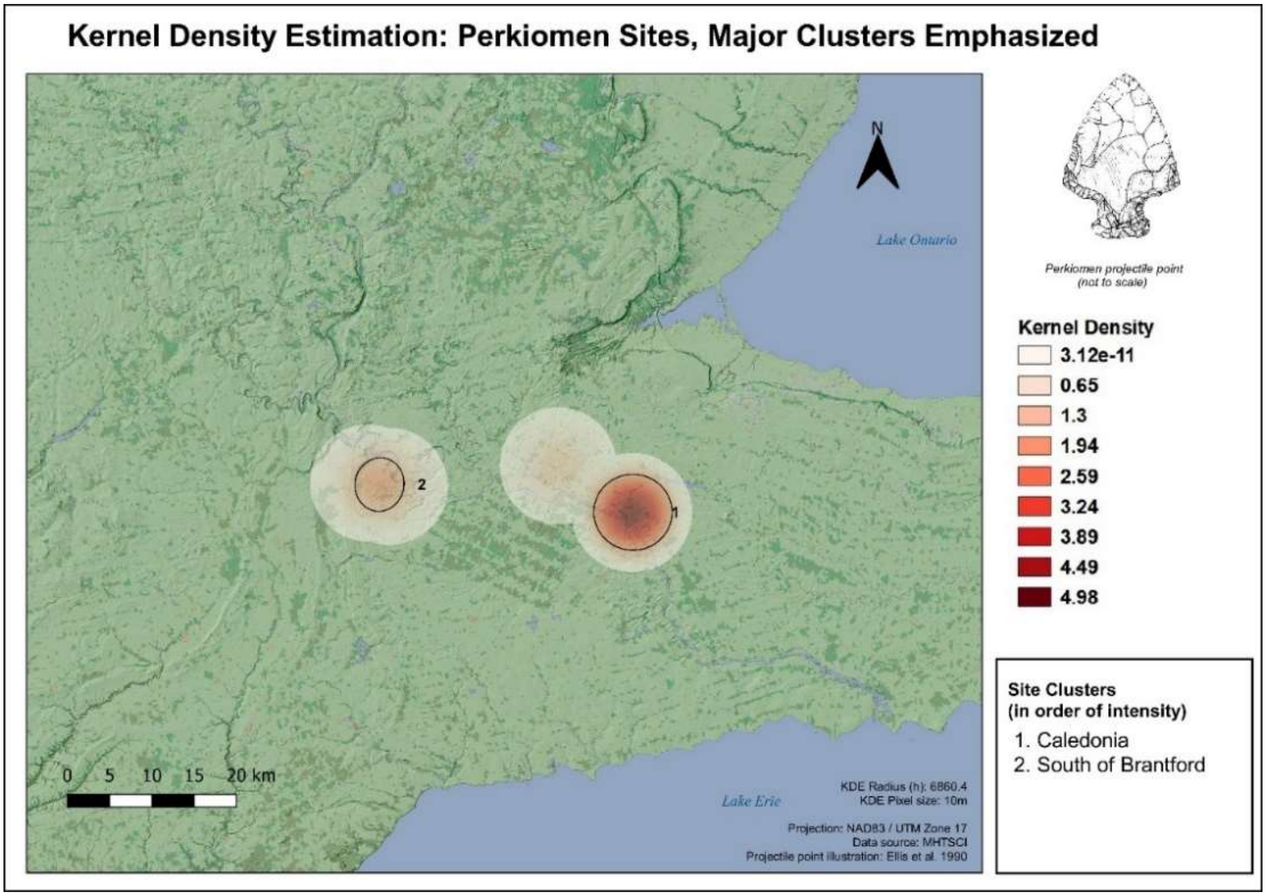
Figure 25: KDE results for Genesee sites



5.1.9 Perkiomen

Perkiomen sites are clustered in Caledonia (1) and Brantford (2). They are virtually absent elsewhere in the study area.

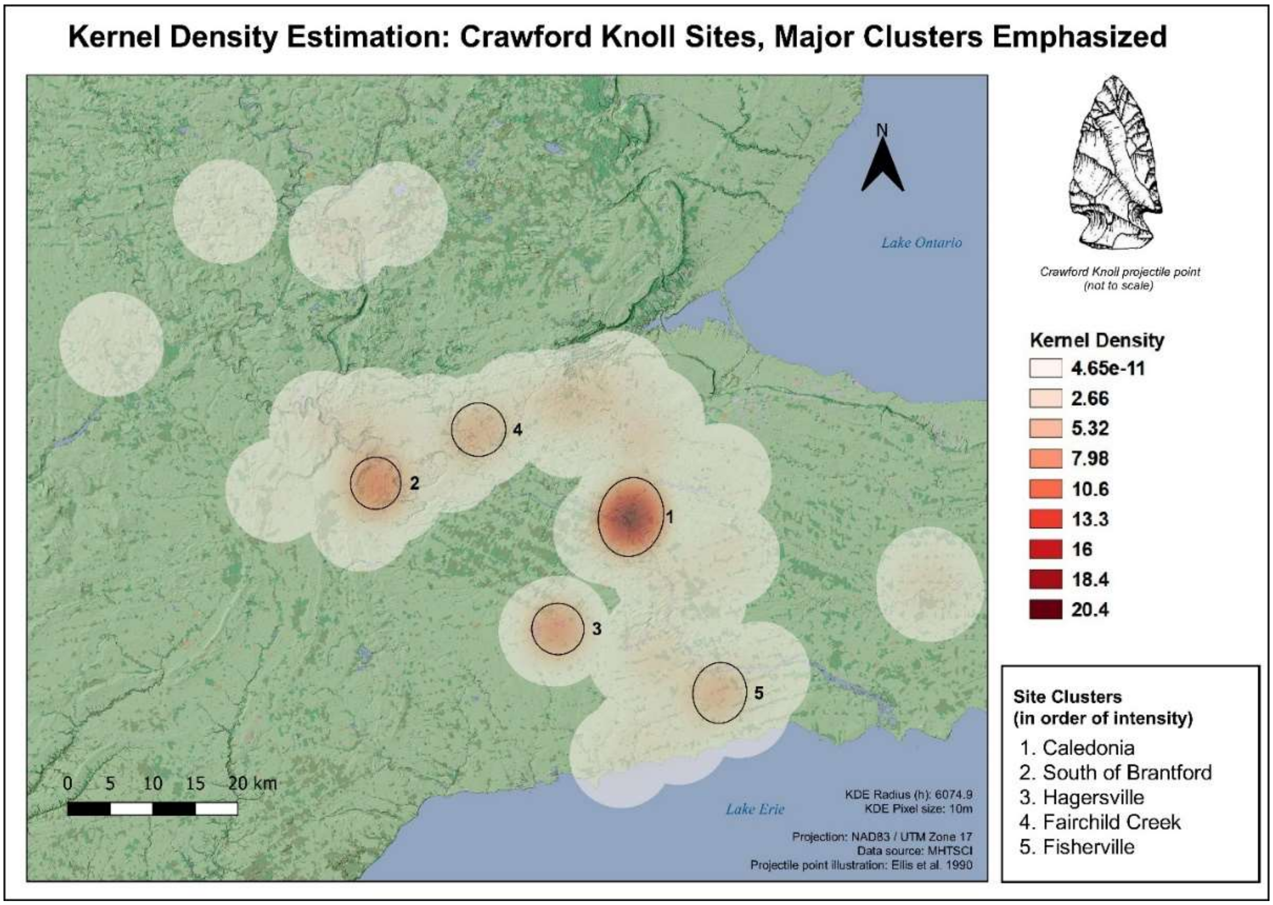
Figure 26: KDE results for Perkiomen sites



5.1.10 Crawford Knoll

Crawford Knoll sites are most intensely clustered in Caledonia, followed by a cluster south of Brantford, and another in Hagersville. Less intense clusters are also evident near Fairchild Creek and east of Fisherville. The cluster in Hagersville is once again somewhat overestimated, since sites AfHa-941, AfHa-944, AfHa-945, and AfHa-946 are recorded as having the same coordinates, as are AfHa-933 and AfHa-934. Again, as was the case with the Adder Orchard sites in this area, the sites are all located within the same 800 m by 400 m survey area, so the degree of error is considered to be minimal (ASI 2017a).

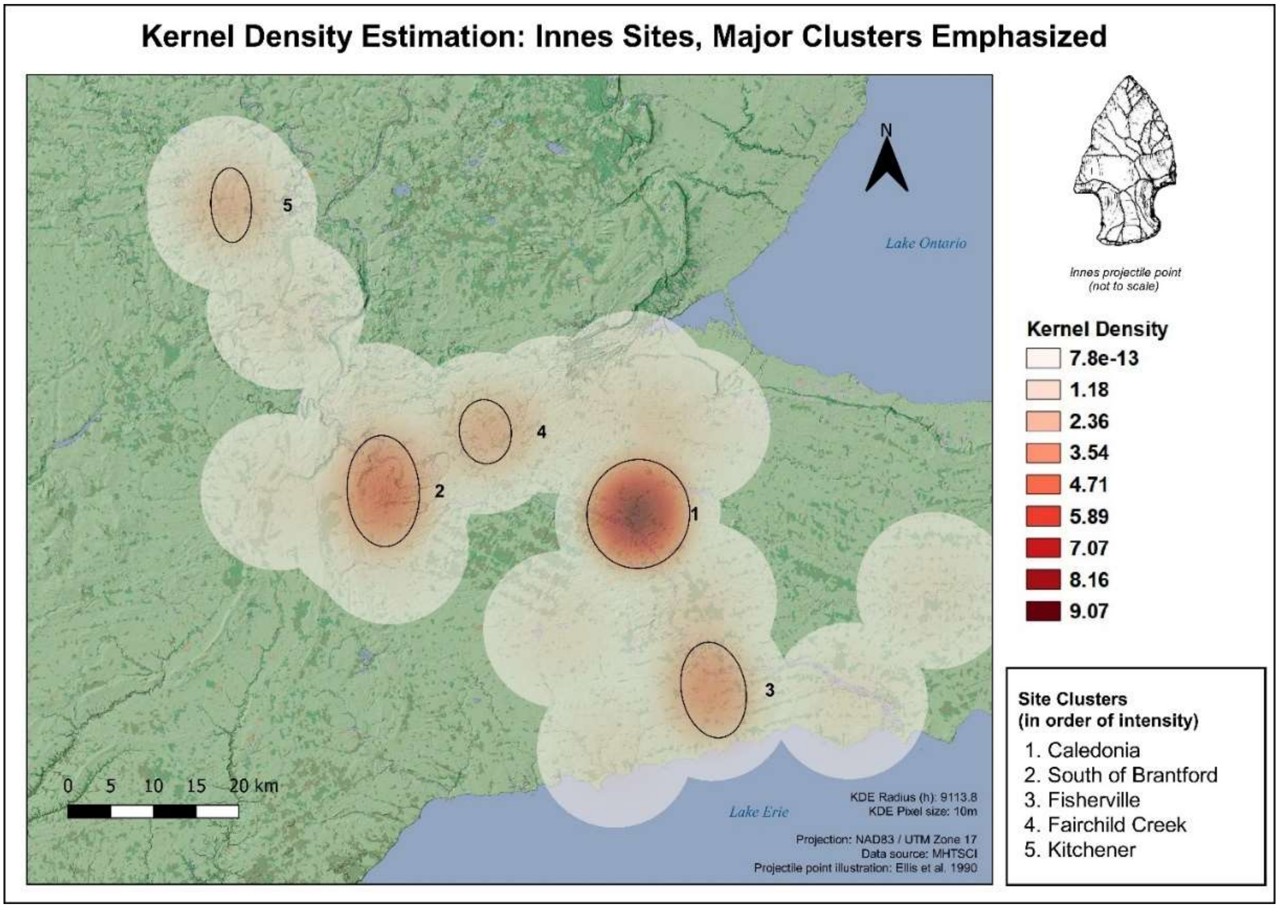
Figure 27: KDE results for Crawford Knoll sites



5.1.11 Innes

Innes sites are most intensely clustered in Caledonia (1) and south of Brantford (2), as well as east of Fisherville (3), in Brant County near Fairchild Creek (4), and near Kitchener (5).

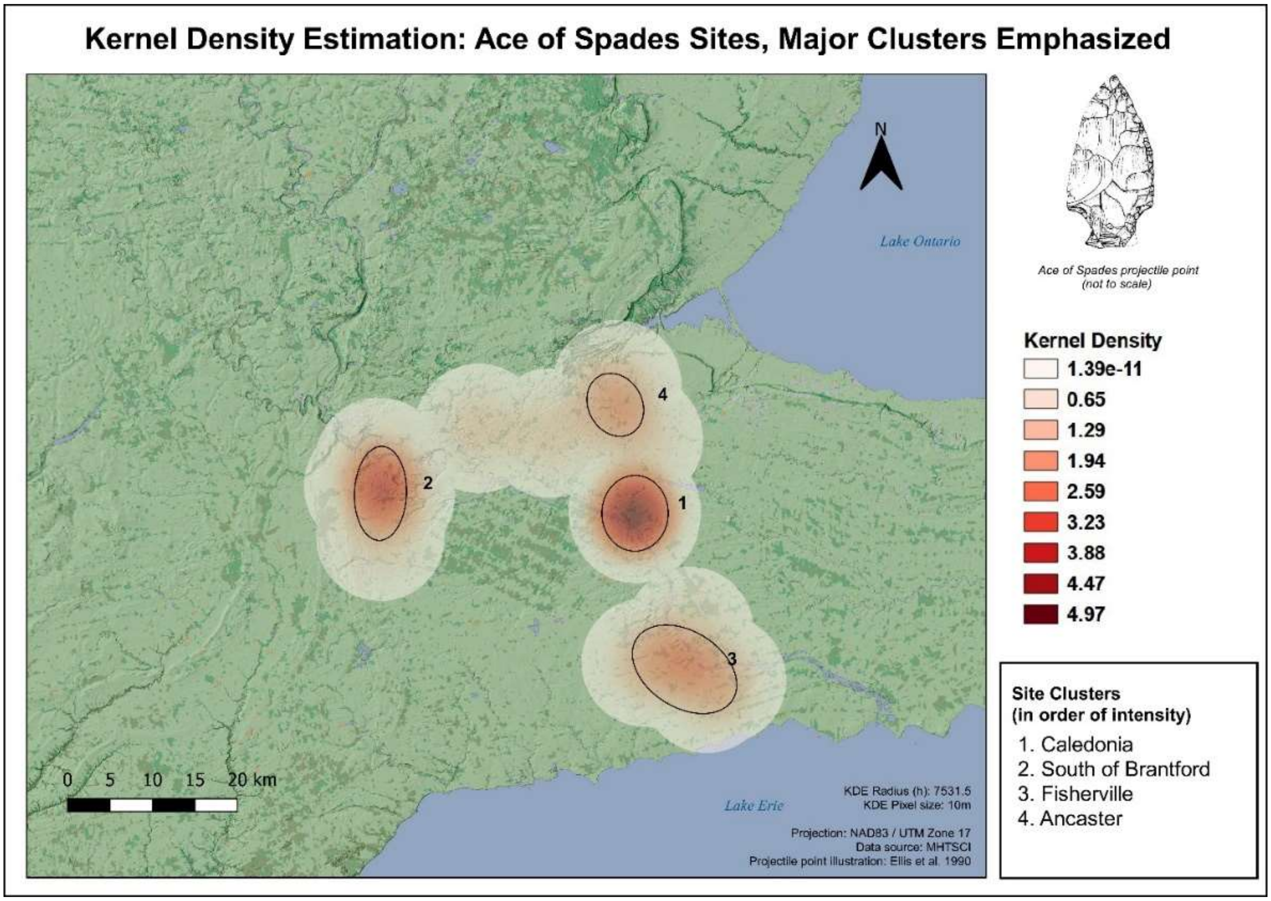
Figure 28: KDE results for Innes sites



5.1.12 Ace of Spades

Ace of Spades sites are most intensely clustered in Caledonia (1) and south of Brantford (2). Less intense clusters are also evident east of Fisherville (3) and in Ancaster.

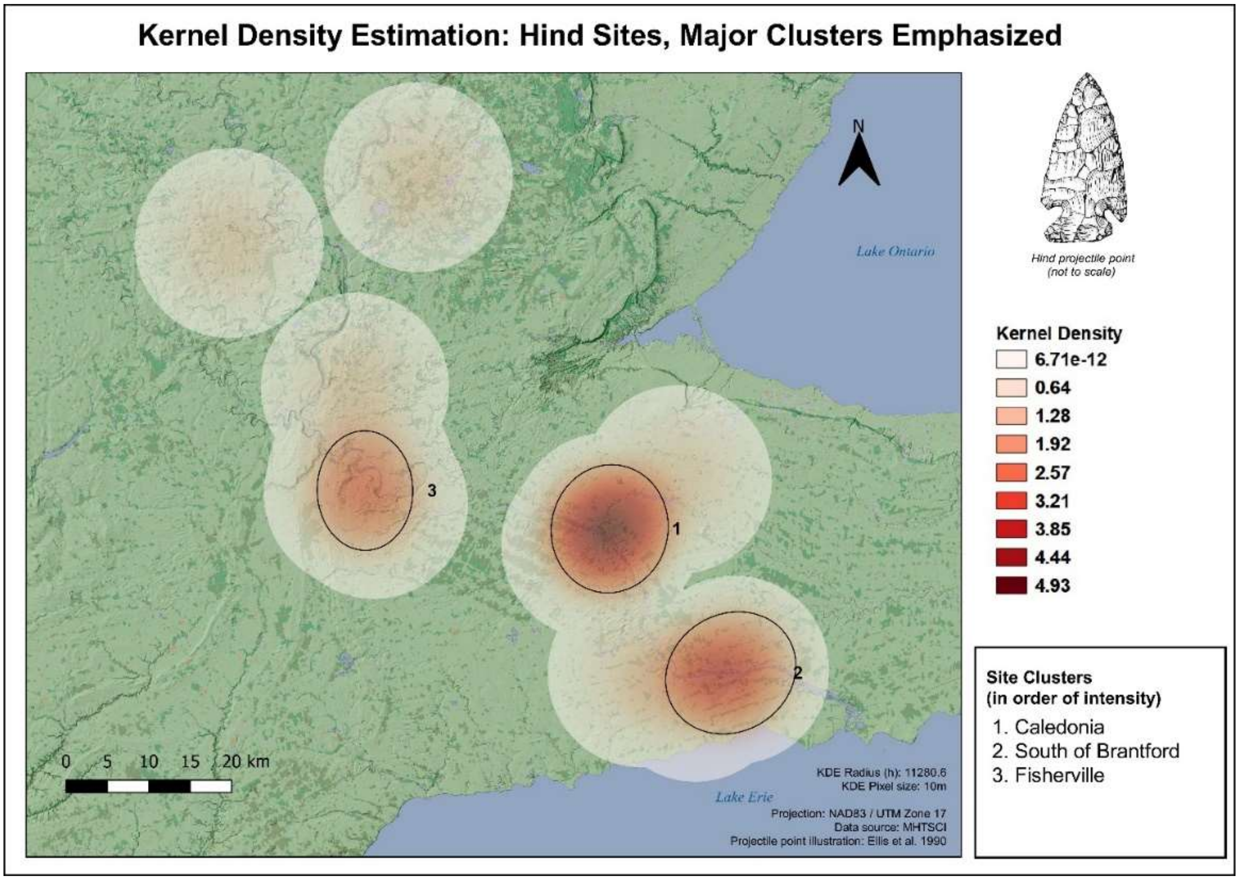
Figure 29: KDE results for Ace of Spades sites.



5.1.13 Hind

Hind sites are most intensely clustered in Caledonia (1), followed by the area east of Fisherville (2), and south of Brantford (3).

Figure 30: KDE results for Hind sites



5.2 Comparison of Site Cluster Locations and Identification of Persistent Places

The comparative distribution of major site clusters for each dataset is visualized in Figure 31. TablesTable 8 and Table 9 show the locations of major site clusters for each dataset, along with each cluster's intensity ranking for comparison. Immediately apparent from this comparison is the fact that Broad and Small Point site clusters share close similarities in their distribution, with site clusters from both complexes occurring in many of the same places, whereas Narrow Point site clusters appear to follow a different distributional pattern, although there is some overlap with Broad and Small Point sites, particularly in the Brantford area. This could indicate that a change in settlement systems beginning in the Broad Point Archaic established certain important places in the landscape that remained a focus of activity throughout the Small Point Archaic. More research is needed to determine if this pattern holds outside of the study area, however a significant change in the distribution of sites between the Narrow Point and Broad Point Archaic could indicate that the arrival of Broad Points in southern Ontario was the result of a migration of people, rather than the diffusion of technology by means of trade and emulation.

Notably, Narrow Point sites were found to cluster around a series of small kettle lakes within the Horseshoe Moraines physiographic region near Cambridge. The orientation of these sites recalls that of the Wimmer site (AiHb-110), a likely Narrow Point (Normanskill) occupation located near the north shore of Little Lake, which was part of a more extensive wetland surrounding Puslinch Lake during the Late Archaic (Timmins 1996). The exploitation of lacustrine environments near smaller lakes seems to have been characteristic of Narrow Point settlement systems and can also be observed among Narrow Point sites in New York state, including the eponymous Lamoka Lake site (Ritchie 1965).

The fact that Narrow Point site clusters exist in areas that are not the sites of particularly intense Broad or Small Point clusters (and vice versa) is also significant because it indicates that the intensity of sites in an area is not merely the result of higher survey intensity in that area. If this were the case, we would expect to see nearly identical site cluster distributions across all categories.

It is also evident from the results of the KDE that certain locations within the study area are the sites of particularly intense clusters for multiple projectile point styles generally thought to date to consecutive periods. One area, approximately 8 km^2 in size located near Seneca Creek just east of Caledonia, was the location of the most intense site cluster for seven out of the eight projectile point styles analyzed (Normanskill excluded). This location was also the most intense cluster when all Late Archaic sites were considered together.

An area roughly 15 km^2 in size located near D'Aubigny Creek south of Brantford was found to be either the second or third most intense site cluster for every projectile point style involved in the analysis. This area also had the second greatest intensity of Broad and Small Point sites overall, and the fourth greatest intensity of Narrow Point sites.

An area of approximately 25 km^2 east of Fisherville in Haldimand County was also the location of multiple clusters, either the second or third most intense for each Small Point projectile point style, as well as for Lamoka projectile points. This location was however not a particularly intense site cluster for Broad Point sites. Clusters from more than one projectile point style were also present in Ancaster, Kitchener, near Fairchild Creek, and in Hagersville.

Of these areas, the Caledonia and Brantford clusters are most convincing as Late Archaic persistent places. These areas both show evidence of particularly intense occupation throughout consecutively dated periods of the Late Archaic and are fairly restricted in terms of size and thus more likely to be associated with particular landscape features, rather than covering a larger area containing many distinct environments. Caledonia, while evidently not a focus of Narrow Point settlement, had the most intense site clusters for all other Late Archaic projectile point styles. Brantford, while not the site of the most intense cluster for any single projectile point style, was consistently one of the most intense site clusters for all projectile points in the analysis, including Narrow Point styles, suggesting that it held importance throughout all periods of the Late Archaic. These two areas will be the focus of the discussion section that follows.

Figure 31: All site cluster locations

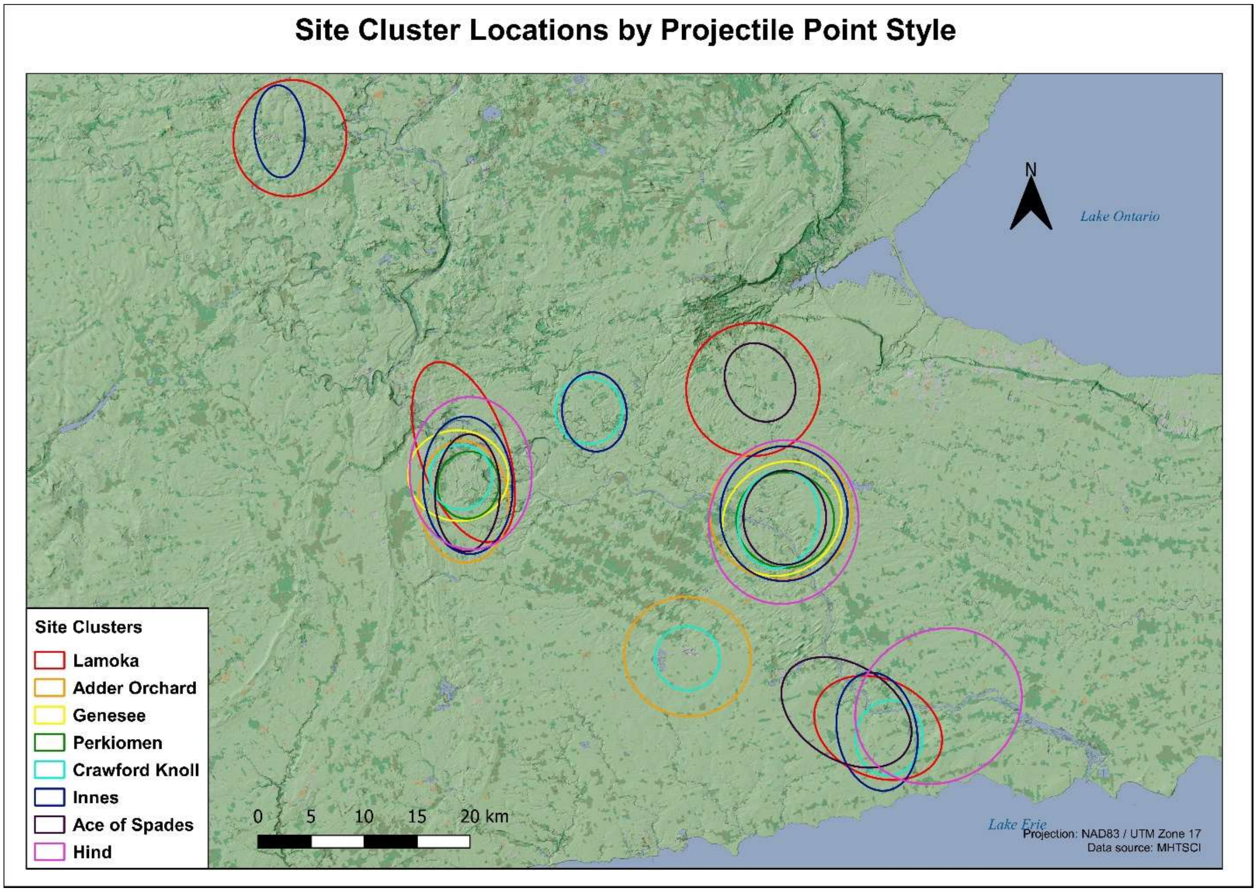


Table 8: Site cluster locations by projectile point. Number indicates the intensity rank of the cluster, with 1 being the most intense

	Caledonia	S of Brantford	E of Fisherville	Ancaster	Hagersville	Kitchener	Fairchild Creek
Lamoka		3	4	1		2	
Adder Orchard	1	3			2		
Genesee	1	2					
Perkiomen	1	2					
Crawford Knoll	1	2	5		3		4
Innes	1	2	3			5	4
Ace of Spades	1	2	3	4			
Hind	1	3	2				

Table 9: Site cluster locations by complex. Number indicates the intensity rank of the cluster, with 1 being the most intense

	Caledonia	S of Brantford	E of Fisherville	Ancaster	Hagersville	Kitchener	Fairchild Creek
Narrow Point		4	2	1		3	
Broad Point	1	2					
Small Point	1	2	3		5		4

6. DISCUSSION

Two locations in the study area were identified through kernel density estimation as Late Archaic persistent places: one near Seneca Creek in Caledonia, and one south of Brantford near D'Aubigny Creek. These areas were found to have particularly dense concentrations of diagnostic artifacts dating to consecutive periods of the Late Archaic, indicative of their sustained importance throughout the period. It is probable that the particular environmental characteristics and landscape features in the vicinity of these places structured their persistent re-use over long periods. In order to identify what these features may have been, the environments surrounding these site clusters were investigated, using a combination of spatial analysis, review of relevant site reports, and site visits. The results of these investigations form the basis of the "physiography, environment, and resources" sub-headings for each major site clusters that follow.

This discussion centres largely on the environmental affordances which would have made persistent places appealing over long timescales, however, this is not meant to imply that these places would have held only economic significance to Late Archaic peoples, or that their persistent use was merely a response to environmental stimuli. Rather, it is important to recognize that the practice of visiting the places identified in this study would have occurred within the context of other past visits, known through personal experience, communication with others, or through the observation of signs of past human action evident in the landscape. Trails, past campsites, or other human constructions and alterations would have attested to the historical use of these places and imbued the landscape with a sense of temporality (Ingold 2000). Also part of this historical context would have been the knowledge of the seasonal availability of resources, and especially the locations of particularly resource-rich places in the landscape, knowledge that was transferred from person to person and generation to generation. These places were thus places with histories, likely with ancestral or perhaps even mythological associations. Their persistent use can be understood as a tradition, in the sense of past practices continually brought forward into the present (Pauketat 2001).

6.1 Caledonia Sites

The greatest concentration of Late Archaic diagnostic materials within the study area is located within an area roughly 8 km^2 in size on either side of the Grand River near Caledonia. The site cluster contains a total of 66 sites, all of which contain at least one Late Archaic component. Of these sites, 60 are located on the east side of the river, and 6 on the west. Of these 66 sites, 4 had a Narrow Point component, 24 had a Broad Point component, and 41 had a Small Point component. The number of components by projectile point style are presented in Table 10.

Table 10: Site components within Caledonia cluster by projectile point style

Projectile point style	# of components within Caledonia cluster
Lamoka	1
Normanskill	2
Adder Orchard	7
Genesee	9
Perkiomen	5
Crawford Knoll	23
Innes	9
Ace of Spades	5
Hind	5

Unspecified Narrow point	1
Unspecified Broad Point	3
Unspecified Small Point	1

6.1.1 Caledonia CRM Sites Excavation History

All sites within this cluster were found during stage 2 archaeological assessments for various proposed construction projects in the Caledonia area. Stage 2 survey work consisted of either pedestrian surface survey or test pitting depending on the ground cover as required by *Ontario Standards and Guidelines for Consultant Archaeologists* (Ontario Ministry of Tourism and Culture 2011). Since much of the area was recently under cultivation at the time of survey and could thus be ploughed and weathered, most of the survey work conducted in this area was pedestrian surface survey. A total of 66 sites with Late Archaic diagnostic materials were found as a result of the stage 2 surveys.[5] Of these, 36 were determined to require stage 3 assessment, and of these, 7 required stage 4 assessment. As of May 2019, when I received the data from the MHSTCI, ten of the proposed stage 3 assessments and three of the proposed stage 4 assessments had been completed. The sites in this cluster range in size from "findspots" of single diagnostic artifacts to large lithic scatters spanning several hectares. All were found within plough-disturbed soil and thus lack stratigraphy. In nearly all cases, faunal materials were not preserved, with the exception of AgGx-630 from which a single unidentified faunal specimen was recovered (ASI 2018d, 28). AgGx-630 was also the only site to contain features, although most other sites have not been completely excavated and there thus remains the possibility that other features will be discovered in the course of future excavations. None of the features from AgGx-630 have been dated to a particular time period, and since the site contains diagnostic materials from a wide range of time periods, they cannot be confidently assumed to date to the Late Archaic. Thirteen of the sites were multicomponent, nine of which contained diagnostic materials dating to time periods outside of the Late Archaic. Of the 53 single component sites, 30 were classified as diagnostic tool findspots according to the *Standards and Guidelines* (Ontario Ministry of Tourism and Culture 2011).

6.1.2 Johnson Flats Site (AgGx-214)

One of only a handful of stratified Late Archaic sites ever found in southern Ontario, the Johnson Flats site is located within the Caledonia site cluster, on the west side of the Grand River on a floodplain immediately adjacent to the current riverbank and walleye spawning area 1 (see Figure 32). The site is situated on a raised area of a former river bar between the current riverbank and an abandoned channel. The excavated area is relatively small (46 m^2), since it is limited to the area directly impacted by the pipeline, however Parker (1995, 16) suggests that the true extent of the site may be over 1 hectare if the archaeological deposits cover the entirety of the raised area on which the excavated portion is located. The site was found during a 1994

[5] Stage 2 surveys for the McClung Development Lands subdivision project, a project which led to the discovery of the majority of the sites within this cluster, were initially carried out by Amick Consulting, Ltd., however the OMHSTCI found this survey to have been inadequate, and requested re-assessment. This re-assessment was carried out by Archaeological Services Inc. (Wai Hadlari, OMHSTCI, pers. communication, July 27th, 2020).

archaeological assessment for a proposed natural gas pipeline (ARA 1994). It contained diagnostic materials dating to the Early, Middle, and Late Archaic, as well as the Terminal Woodland Princess Point Complex (Parker 1995, 9-12). Despite being a site with a Late Archaic component which was discovered through CRM survey, the Johnson Flats site was not included in the OASD subset containing all Late Archaic sites. This is due to an error in the site form entry for this site, which lists the site as “Middle Archaic”, neglecting the presence of the other components which are well documented.

The cultural layers of the Johnson Flats site are buried beneath approximately 30 cm of alluvial deposits, which accumulated as a result of post-1800 flooding caused by large scale clearing of the area (Parker 1995, 2). Two cultural layers were encountered: Layer C, a paleosol containing Princess Point and Late Archaic materials (a Genesee preform as well as end scrapers resembling those associated with the Small Point Archaic), and Layer D, which contains Early and Middle Archaic artifacts. Layer D may be the subsoil of Layer C or may be a paleosol itself which has been subject to leeching (Parker 1995, 6).

In contrast to the plough-disturbed sites in the Caledonia cluster, the Johnson Flats site contained preserved faunal materials. White-tailed deer and muskrat remains were found in Layer C. Layer D contained deer, muskrat, and a single sucker bone. Parker (1995, 16) notes that the relative paucity of fish bones from a site so close to the river is surprising and suggests that the site may be a cold weather occupation for this reason. He also notes the possibility that fish bones are plentiful in other areas that were not excavated and that these remains were simply missed because the excavated area is so small. Yet another possibility is that fish remains were simply not preserved owing to being overall more delicate and less resistant to mechanical damage compared to mammal bones (discussed in section 2.4.4).

This site is especially significant because it demonstrates the likelihood that more Late Archaic materials in the Caledonia area lie deeply buried within the Grand River floodplain. If sites similar to Johnson Flats are present all along the floodplain of the Grand River in Caledonia, the site cluster as known from the present analysis may be only be a small portion of Late Archaic cultural deposits in the area. These areas are unlikely to be surveyed through CRM work because of their location within floodplains, which makes them unsuitable for most construction projects. As a result of this, the CRM archaeological record has somewhat of an upland bias, and may underestimate the importance of truly riverine sites, including those situated on former river bars. Exploratory test-pitting or core sampling of the deep alluvial soils of the floodplain would aid in determining the extent of Archaic (or otherwise) occupation of the areas immediately adjacent to the Grand River itself.

Also significant is the presence of fish remains on this site. Albeit limited to a single sucker bone in the layer below the Late Archaic site, this nevertheless indicates the presence of sucker in the Grand River before or during the Late Archaic. While sucker can be found throughout the year in streams, they are by far most easily taken in the spring during their spawning run, and this is especially true of the longnose sucker. The presence of the sucker bone may indicate therefore that the site was occupied during the spring and that it may be located in proximity to a spawning site.

6.1.3 Caledonia Sites: Physiography, Environment, and Resources

Investigation of the environment surrounding the Caledonia site cluster suggests that this location would have been particularly rich in resources in both the spring, due to the presence of spawning walleye, and the fall, due to the presence of mast-producing trees and the animals attracted by this food source. This availability of a variety of seasonal resources may explain why the site was clearly a focus of activity for Small Point- and Broad Point-making peoples of the Late Archaic.

The Caledonia site cluster is located within the Haldimand clay plain physiographic region, the surface geology of which consists of a series of parallel clay belts deposited by the ancient glacial Lake Warren which extend from the Niagara Escarpment to Lake Erie (Chapman and Putnam 1984, 156-157). Sites on the east side of the Grand River are located along Seneca Creek, a primary tributary of the Grand River (see Figure 32). An unnamed tributary stream of Seneca Creek runs through approximately the middle of the site cluster. At the eastern extent of the cluster is another unnamed tributary stream which flows directly into the Grand River. These waterways would have provided direct, quick access to the Grand River by boat. The presence of Seneca Creek on the east side of the Grand River likely influenced settlement on this side rather than the west side of the river at this location. Sites within this cluster that are west of the Grand River are situated along unnamed low-order streams which eventually flow into McKenzie Creek, itself a primary tributary of the Grand River. While these sites are technically within the sub-watershed of McKenzie Creek, they are closer to the Grand River itself.

One of the unique landscape features associated with the Caledonia site cluster is the Caledonia drumlin field, the only geological feature of its kind in extreme southern Ontario. These glacial drumlins afford some relief to the otherwise fairly flat landscape (see Figure 33). The soils of the Haldimand clay plain are generally heavy in texture and poor in drainage, however, the soils around Caledonia are notably well-drained, and this is especially true of the drumlins (Figure 34) (Chapman and Putnam 1984, 157). In southern Ontario, drier soils are known to support a number of mast-producing tree species: principally red oak (*Quercus rubra*), black oak (*Q. velutina*), and shagbark hickory (*Carya ovata*), but in association with these are also found white oak (*Q. alba*)*,* American chestnut (*Castanea dentata*), and black walnut (*Juglans nigra*) (Maycock 1963, 389). While not necessarily xerophytic species per se, these trees are less common in the more ideal mesic soils which are dominated by sugar maple (*Acer saccharum*) and beech (*Fagus grandifolia*), and thus exist in larger stands in the dry soils to which the aforementioned species are less adapted (Maycock 1963, 410). The drumlin soils have long been cleared for agriculture and as such there are few trees present today, however in the bottomlands near the creek edges and floodplains, which are not subject to cultivation, *Juglans nigra*, a species which also thrives in wet conditions (Nelson et al. 2014**,** 354), are present.

The importance of these mast-producing trees to Late Archaic peoples, particularly during Broad Point times, has been emphasized by several researchers. Ian Kenyon (1980, 20) and Ellis, Kenyon, and Spence (1990, 105) both note an association between Broad Point sites and well-drained sand plains which once supported oak-hickory forests. Charred nutshell and/or nut processing tools have been found on many Late Archaic sites belonging to all three major

Late Archaic complexes (e.g. Ellis et al. 2014, 46-47, 56, Kenyon and Snarey 2002, 15, Lennox 1986, 239, Ritchie 1965, 44, Williamson et al. 2006, 58). In addition to their importance as human sustenance, nuts from the above species also attract game. White-tailed deer in particular rely heavily on acorns in the fall, and when a sufficient crop is available, they prefer this food source over all others (McCullough 1985, 688). The presence of these mast resources, as well as the animals they attract, would have made this area ideally situated for fall hunting and gathering camps.

Comparison of Caledonia site locations with the walleye spawning area dataset (OMNRF 2006) indicates that the Caledonia site cluster is in close proximity to two locations identified as walleye spawning grounds: one which covers a lengthy section of the Grand River from Cayuga to Caledonia (Figure 17:1), and another which surrounds a pair of river bars roughly one kilometre downstream from the Caledonia dam (Figure 17:3). The sites within this cluster are located within an average of 1.4 km of either spawning site, the closest being 340 m, and the farthest 2.2 km.

Review of site reports for sites within this cluster did not yield any references to the recovery of fish bone, excepting the single sucker bone found at the Johnson Flats site. While this may seem to cast doubt on the existence of a relationship between this site cluster and the nearby walleye spawning areas, the lack of fish bones should not be taken as confirmation that these sites are truly unrelated to fishing. Even preserved mammal bone, which is more resistant to mechanical damage (e.g. by agricultural activity or trampling) than fish bone was exceedingly rare on these sites, and given both the plough-disturbed nature of sites within this cluster, and the acidic soils of the Haldimand clay plain, it is likely that the lack of faunal evidence is the result of poor preservation.

Similarly, site reports for sites in this cluster did not contain any reference to artifacts that could be positively associated with fishing. This too calls into question the association of these sites with walleye spawning areas, however, it is also the case that most forms of fishing equipment found on Late Archaic sites are made of organic materials, such as bone, antler, or wood, which are unlikely to survive in areas with poor faunal preservation (as discussed in section 2.4.3). A notable exception to this is stone netsinkers, which have been found on shoreline sites, however the use of seine nets with stone netsinkers is unlikely to have been necessary or effective given the shallow water level of the spawning areas adjacent to the site clusters. More likely methods of mass capture include the use of dipnets or spears/leisters to haul in large numbers of spawning fish. Perhaps the most effective method would have been spearfishing by torchlight, a practice which has been documented in ethnographic examples of traditional walleye fishing (Nesper 2002). Given the relatively high turbidity of the river in these areas, torches, which provide a light source which reflects off the *tapetum lucidum* of the walleye's eyes, could have aided in locating spawning fish in the murky water.

To summarize, the resources that would likely have been available in the vicinity of the Caledonia site cluster suggest that it would have been particularly suitable for hunting, fishing, and gathering in both the spring and fall. No features indicative of long-term residential occupation or occupation through the winter (such as Late Archaic middens or substantial cold-weather dwellings like those found at the Davidson site) have been found to date. Rather, present evidence seems more consistent with the repeated use of the area for short-term hunting or fishing-related camps. The identification of walleye spawns and mast resources as likely factors in the apparent consistent use of the area throughout the Late Archaic is reminiscent of findings at the Peace Bridge site, where evidence was found for both the mass capture of walleye during their spawning run and the harvesting and processing of nuts (Williamson, Austin, and Robertson 2006). This practice of returning to the same areas in different seasons in order to exploit differently seasonally available resources seems to have been characteristic of Late Archaic subsistence-settlement patterns and is also seen at the Davidson site on the Lake Huron shore (Ellis et al. 2015).

Figure 32: Caledonia site cluster: topography, site locations, and relevant points of interest

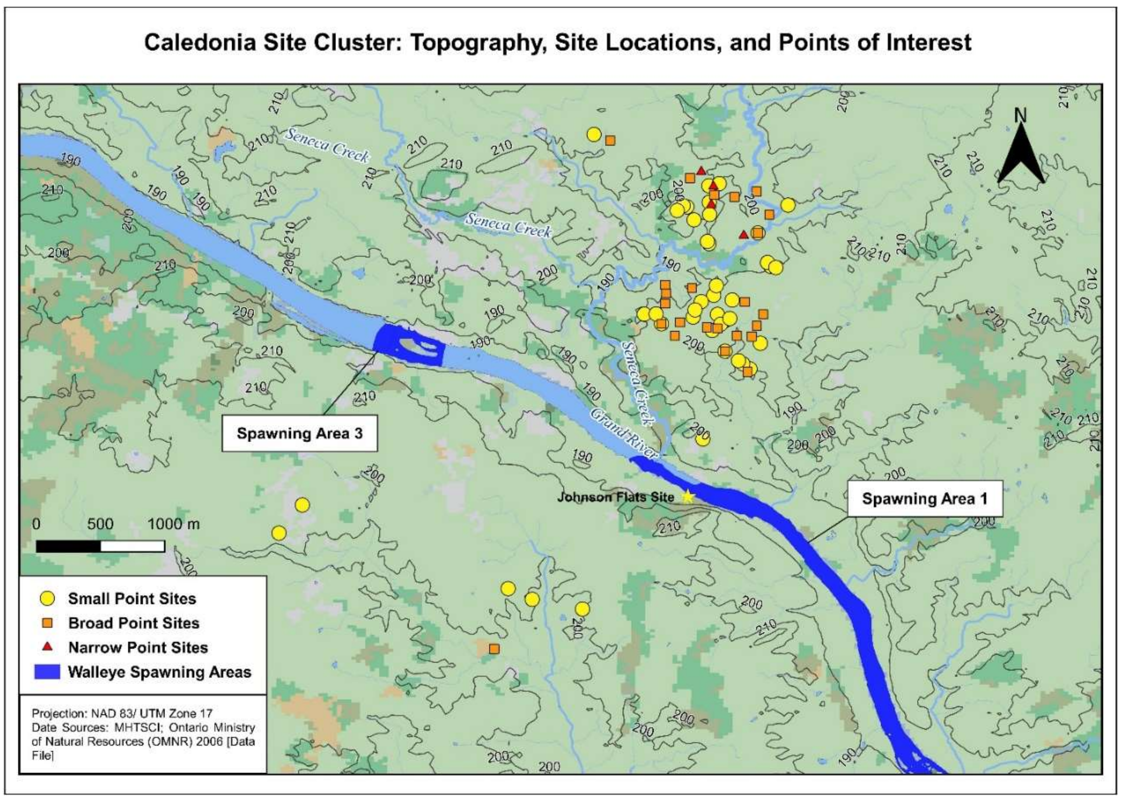


Figure 33: Caledonia drumlin field and Late Archaic sites

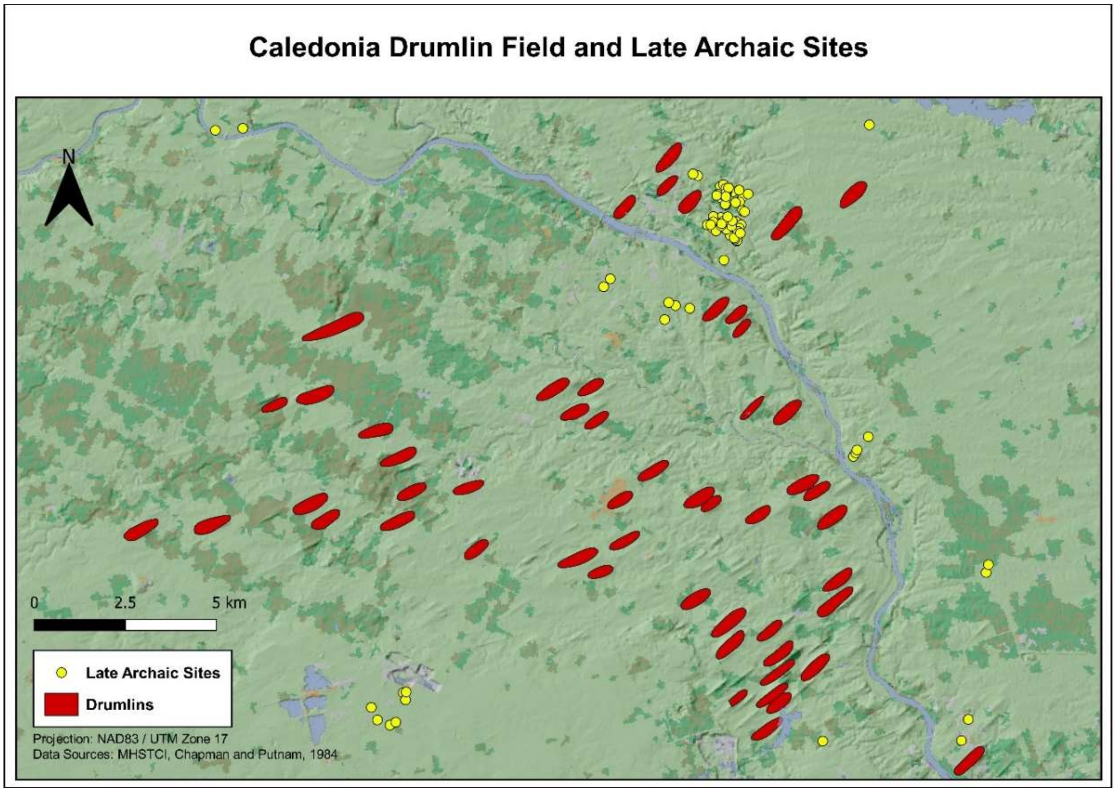
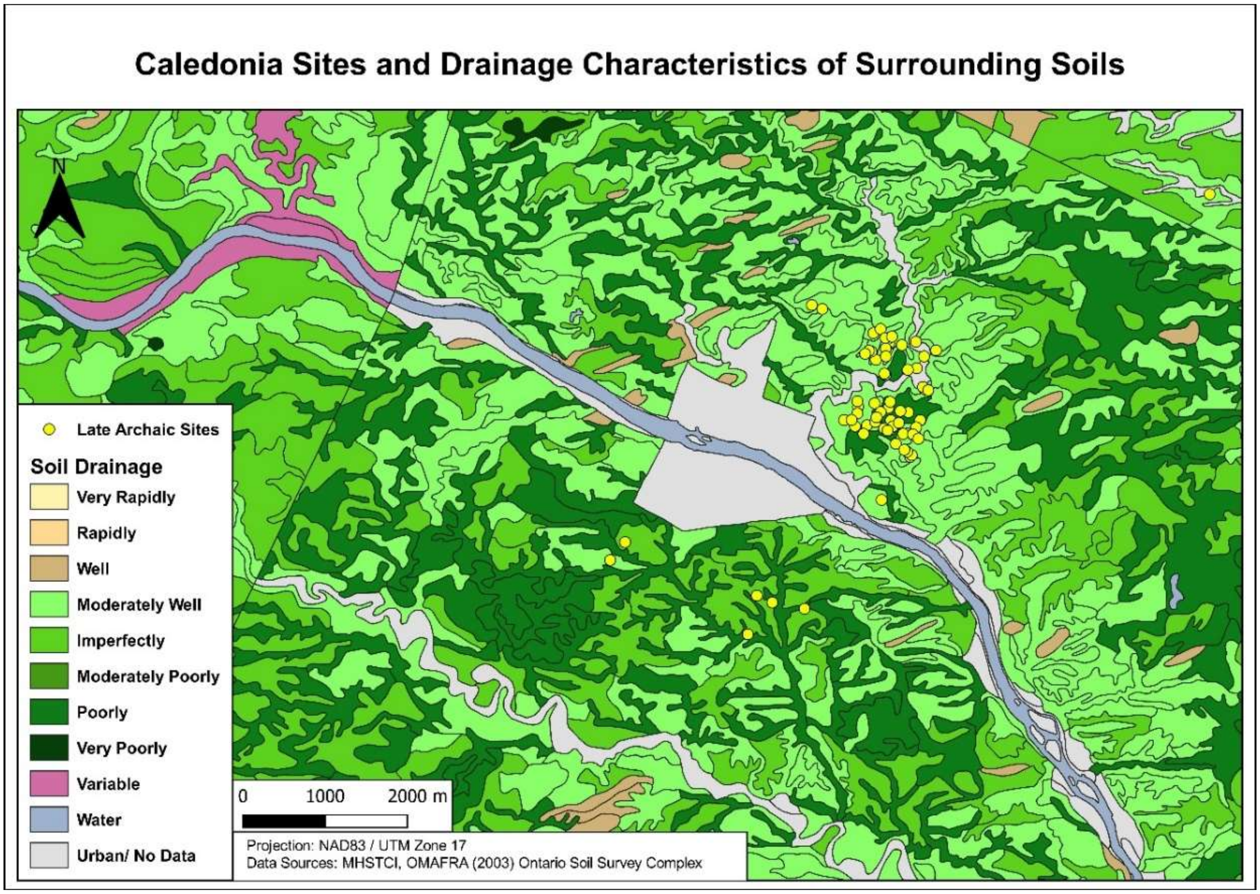


Figure 34: Caledonia sites and drainage characteristics of surrounding soils



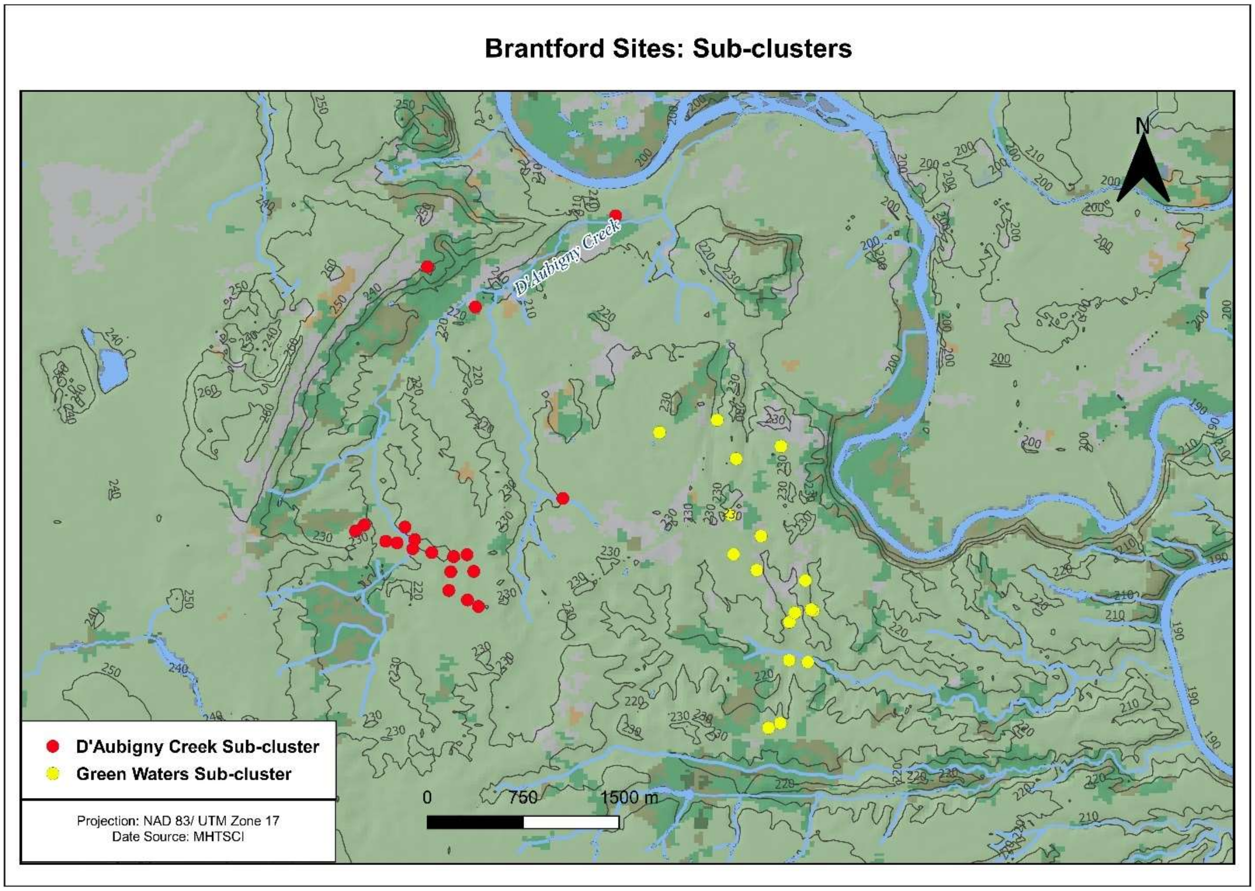
6.2 Brantford Site Cluster

The second most intense concentration of Late Archaic sites within the study area is a cluster approximately 15 km^2 in size just south of Brantford which contains a total of 36 sites. Of these sites, 6 have a Narrow Point component, 14 have a Broad Point component, and 21 have a Small Point component. It is apparent from closer visual inspection that sites within this cluster can be divided into two sub-clusters: one immediately adjacent to spawning area 4 ("Green Waters") containing 17 sites, and the other more closely associated with D'Aubigny Creek and the D'Aubigny Creek swamp containing 19 sites. Within the Green Waters sub-cluster are five Narrow Point components, six Broad Point components, and nine Small Point components. Within the D'Aubigny Creek sub-cluster are one Narrow Point component, seven Broad Point components, and twelve Small Point components. The number of components by individual projectile point style are presented in the table below (Table 11).

Table 11: Components within Brantford site cluster by projectile point style

Projectile point style	# of components (D'Aubigny Creek sub-cluster)	# of components (Green Waters sub-cluster)	# of components (Total)
Lamoka	1	3	4
Normanskill	0	0	0
Adder Orchard	2	1	3
Genesee	6	2	8
Perkiomen	1	1	2
Crawford Knoll	7	5	12
Innes	2	3	5
Ace of Spades	2	2	4
Hind	2	1	3
Unspecified Narrow Point	0	2	2
Unspecified Broad Point	0	2	2
Unspecified Small Point	2	0	2

Figure 35: Brantford sub-clusters



6.2.1 Brantford CRM Sites Excavation History

Sites within the Brantford cluster were discovered during stage 2 archaeological assessments for various residential and municipal construction projects. Since much of the land had recently been under cultivation at the time of assessment, pedestrian surface survey was the most common method, although test-pitting was carried out in areas which could not be ploughed, in accordance with the *Ontario Standards and Guidelines* (Ontario Ministry of Tourism and Culture 2011). Of the 36 Late Archaic sites found during stage 2 assessment, 11 either did not meet the requirements for stage 3 assessment or measures to avoid the site's destruction by construction activities were put into place. The remaining 25 were recommended for stage 3 excavation, 13 of which have been completed. Of these, three either did not meet the requirements for stage 4 excavation or were protected from further disturbance from construction. At the time of writing, stage 4 excavation had been completed for eight of the sites within this cluster. Additional data are expected to be forthcoming with the completion of remaining stage 3 and stage 4 excavations.

6.2.2 Brantford Sites: Physiography, Environment, and Resources

The Brantford site cluster is located within the Norfolk Sand Plain physiographic region (Chapman and Putnam 1984, 153). It is bordered to the east by a section of the Grand River characterized by several large oxbows and to the west by a glacial till moraine, along which runs D'Aubigny Creek, a primary tributary of the Grand River.

Like the Caledonia site cluster, some sites within the Brantford cluster are also located in close proximity to a portion of the Grand River identified by the OMNRF (2006) as walleye spawning habitat. On average, sites within this cluster are approximately 2.1 km from spawning area 4, the closest being 430 m, and the farthest 3.75 km. Of the two sub-clusters identified, sites within the Green Waters sub-cluster are more convincingly associated with walleye spawning area 4. On average, these sites are 980 m from spawning area 4 (closest 430 m, farthest 1.7 km). For comparison, sites within the D'Aubigny Creek sub-cluster are on average 3 km from walleye spawning area 4 (closest 2.1 km, farthest 3.8 km). Given the considerable distance of some sites within this sub-cluster to the Grand River, these sites are less likely to be associated with the harvesting of spawning walleye, and are more likely situated to take advantage of resources available within D'Aubigny Creek and its surrounding wetlands, especially deer, as will be discussed further below. No fish remains or fishing equipment were found within either cluster, however, like the Caledonia site cluster, faunal preservation was generally poor. A total of only four sites from both the Brantford site cluster produced faunal remains of any kind: AgHb-265, AgHb-266, AgHb-466, and AgHb-544. In all cases it was not possible to be certain whether faunal evidence was associated with the Late Archaic occupation of the site, and all sites in question were multi-component. In the case of AgHb-544, most of the faunal evidence was found in an area of the site which also had the highest concentration of Indigenous ceramics, suggesting that it is most likely of Woodland origin (ASI 2018a). Faunal remains were often highly weathered, making identification difficult, however where identification could be made, mammal bone was by far the most common, and when identification could be made to the species level, white-tailed deer (*Odocoileus virginianus*) dominate the assemblage. A small sample of avian bone was also identified (ASI 2017b).

Sites within the Green Waters sub-cluster are located on land which was recently under cultivation at the time of their discovery. The topography of the area is characterized by rolling plateaus and vales, intercut by seasonal streams which drain to the south into an unnamed primary tributary of the Grand River. Some sites within this sub-cluster are noted to overlook wetlands to the south (Timmins Martelle Heritage Consultants Inc. 2018, 4, 58). Since the area was recently under cultivation, forest cover was not observed, however the relatively well-drained clay loam and sandy loam soil could have supported maple-beech and/or oak-hickory stands (Maycock 1963, 389). Analysis of charcoal found within a feature at site AgHb-466 within the Green Waters sub-cluster also gives some indication of the forest composition of the immediate area. Species identified include ash (*Fraxinus* sp.), beech (*Fagus* sp.), cottonwood/poplar (*Populus* spp.), elm (*Ulmus* sp.), hickory (*Carya* spp.), hop-hornbeam (*Ostrya virginiana*), maple (*Acer* spp.), and walnut (*Juglans* sp.). Also noted were indeterminate varieties of diffuse-porous deciduous trees (a category which includes beeches, maples, poplars, birches, and others), ringporous deciduous trees (includes oaks, elms, ashes, chestnuts, hackberries, and others), semi-ring porous deciduous trees (includes butternuts and walnuts), unidentifiable varieties of coniferous trees with resin canals (includes pines, spruces, and larches), indeterminate varieties of deciduous and coniferous trees, and other unidentifiable genera (ASI 2017b, 22).

Sites within the D'Aubigny Creek sub-cluster are situated within an area of gently rolling topography which drains through seasonal tributaries into D'Aubigny Creek. The very wet conditions within the lower-lying areas of the creek valley support a thicket swamp dominated by red osier dogwood (*Cornus sericea*) and grey dogwood (*Cornus racesmosa*). On the valley slopes north of the creek, white cedar (*Thuja occidentalis*) are interspersed with dogwood and small shrubs, and as elevation increases and moisture decreases to the north, white cedar become more common, eventually culminating in a dry coniferous forest. To the south of the creek, red oak *(Quercus rubra)*, white oak (*Q. alba)*, black walnut (*Juglans nigra*), and willows (*Salix sp.*) grow in the bottomlands, while the upland areas not currently under cultivation are covered by maple-beech forest. Analysis of charcoal found within features at site AgHb-543 identified beech (*Fagus sp*.), maple (*Acer sp.*)*,* and white oak (*Quercus alba*), as well as other unidentifiable varieties of ring-porous and diffuse-porous deciduous trees (ASI 2018b).

The proximity of the site cluster to the nearby D'Aubigny Creek swamp is likely a factor which influenced its continued importance throughout the Late Archaic. Wetlands, with their high levels of biodiversity, would have been reliable sources of faunal and floral resources for the purposes of both food and medicine. The D'Aubigny Creek area would also likely have been especially attractive for hunting deer in the winter. White-tailed deer tend to congregate in certain areas for food and protection when snow becomes too deep and makes movement difficult (Severinghaus and Cheatum 1956). This behavior, known as yarding, helps the deer to conserve energy at a time when food is less available. These yards are often located in cedar swamps, with white cedar providing both protection from the elements and an important food source (Severinghaus and Cheatum 1956, 140). Present-day vegetation in the D'Aubigny Creek swamp, namely white cedar and dogwood, are among the most important winter browse species for white-tailed deer (Smith and Verkruysse 1983, 10). The local topography is also significant in the choice of winter deer habitat. South and southeast-facing slopes are preferred, due to the increased sun exposure resulting in decreased snow depth (Severinghaus and Cheatum 1956, 140). Aspect analysis of the D'Aubigny Creek area shows that slopes along the north side of D'Aubigny Creek, where the white cedar are currently most common, are predominantly south and southeast facing (see Figure 37). The area is presently a winter refuge for deer, and a dataset produced by the OMNRF identifies the D'Aubigny Creek swamp as a "deer overwintering area" (Figure 38).

As is the case with the Caledonia site cluster, sites within the Brantford site cluster are situated in an area which would likely have been particularly appealing due to the concentration of different seasonally available resources. Again, no features indicative of long-term Late Archaic residential occupation have been found to date at this site—no Late Archaic middens or house structure remains of any kind were noted in any of the available site reports. With present evidence, it seems likely that the habitation of Brantford site cluster was characterized by multiple short-term visits related to the harvesting of seasonal resources. Spring occupation would likely have been related to the capture of spawning fish in the nearby oxbow. The presence of the D'Aubigny Creek wetlands would have made the area appealing in all seasons, but especially in the winter, where it was likely a place where overwintering deer could reliably be found. Although no winter house structures like the Davidson site insulated pit house have been found in this site cluster, it is possible that Late Archaic short-term winter dwellings differed from those occupied for longer periods, and were less durable and less labour-intensive to construct.

Figure 36: Brantford site cluster: topography, site locations, and points of interest

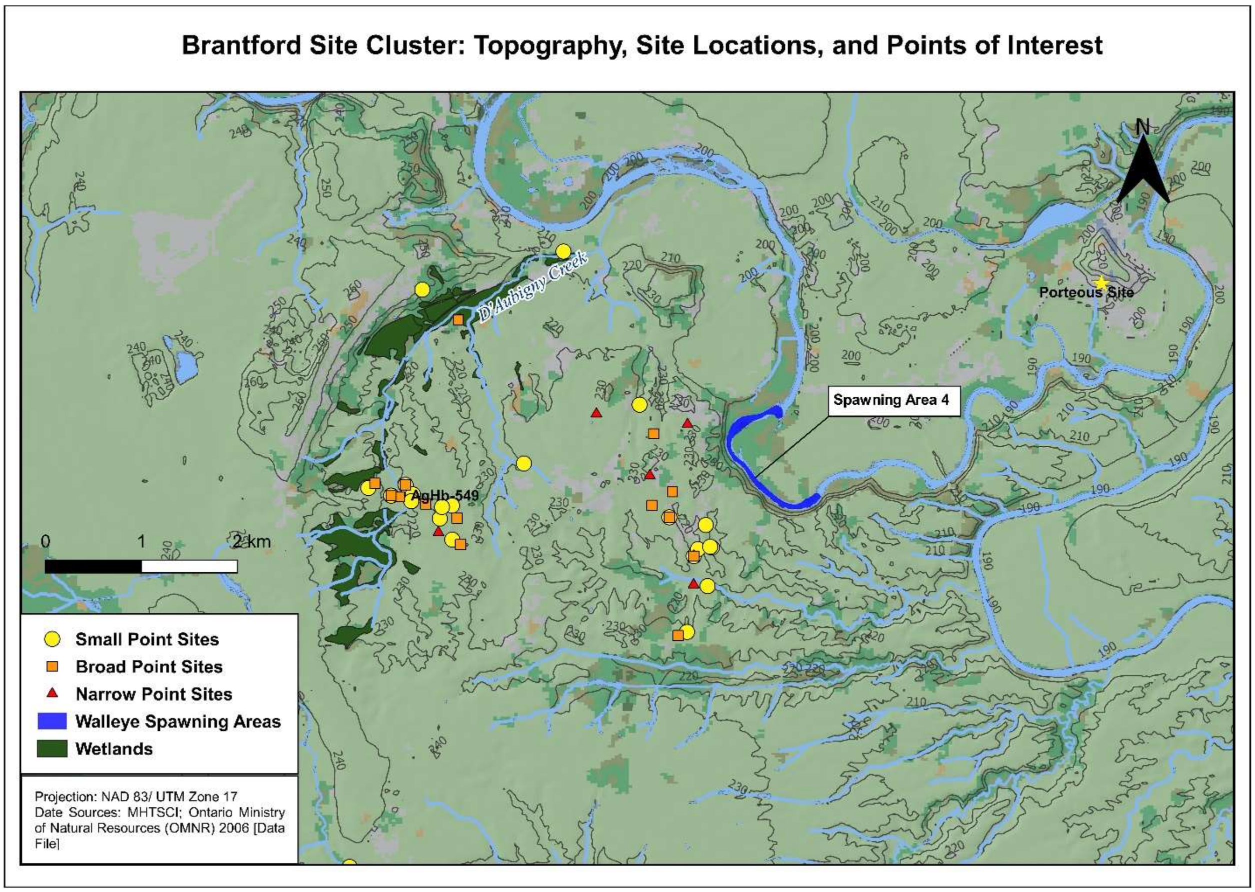


Figure 37: South and southeast facing slopes within the D'Aubigny Creek swamp area

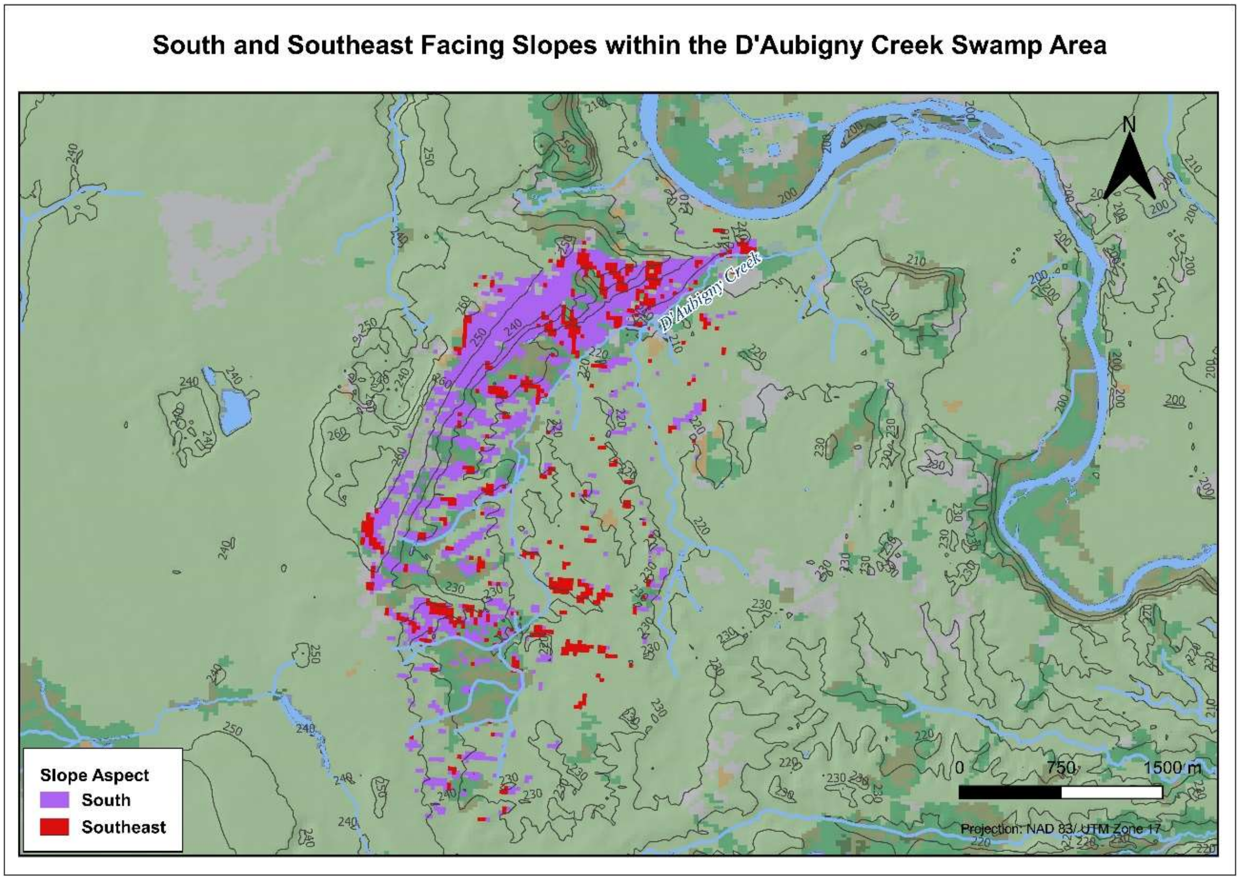
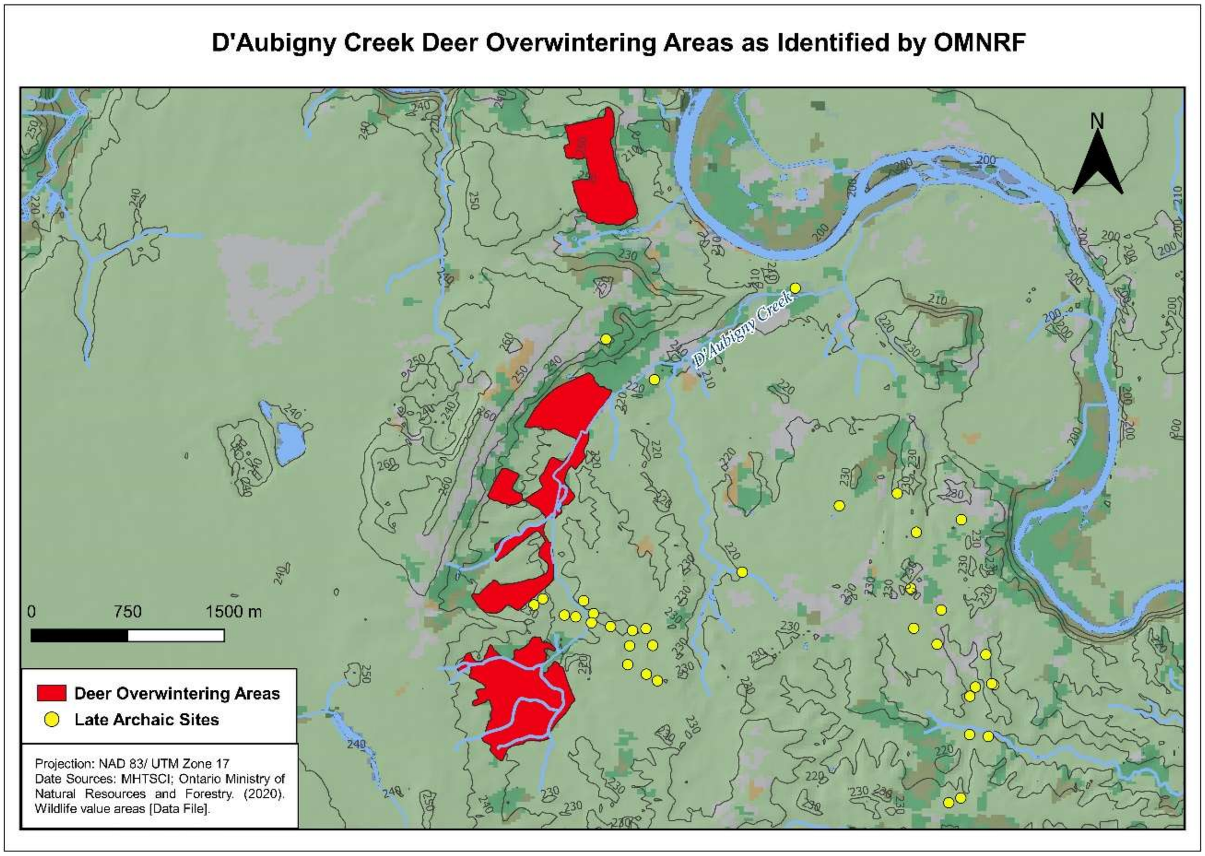


Figure 38: D'Aubigny Creek deer overwintering areas



6.2.3 Biface Cache (AgHb-549)

Site AgHb-549, located within the D'Aubigny Creek sub-cluster, produced a combined 38 Onondaga chert bifaces, 1 uniface, and 35 pieces of flaked lithic debitage from all three levels of archaeological assessment (ASI 2018c). Due to the high proportion of formal tools to lithic debitage within the lithic assemblage, the site's excavators suggest that it most likely represents a biface cache which was dispersed by agricultural activity (ASI 2018c, 8). Douglas Todd, ASI's lithic specialist, is of the opinion that the the bifaces are related to the Late Archaic Broad Point horizon, based on their method of production and the lack of Indigenous pottery on the site and on sites in the surrounding area (ASI 2018c, 8).

Broad Point caches are sometimes included in cremation burials in the Great Lakes region, although definitive examples of this have not been found in southern Ontario (Ellis, Kenyon, and Spence 1990, 105). No human skeletal remains were found at site AgHb-549, however, the possibility remains that a burial was once present which was destroyed by a combination of acidic soil and agricultural disturbance. Considering the overall paucity of Archaic faunal materials on sites in this area, it is unlikely that the burial would have been preserved.

Biface caching in non-mortuary contexts is well documented in southern Ontario and appears to have been practiced for both secular and religious/ceremonial purposes. Perhaps the most straightforward reason for caching is the storage of surplus tools which were intended to be retrieved at a later time. Usewear analysis of a Middle Woodland biface cache found near Brantford suggests that the retrieval of cached bifaces was practiced on some occasions, at least in the Middle Woodland. This analysis showed that a coating of limonite, which had formed on one of the bifaces as a result of its initial burial, had been partially eroded by use before a second layer of limonite accumulated after a second caching episode (Williamson 1996, 4).

Storage and retrieval, however, cannot explain all instances of caching. Some caches were clearly intended to be inaccessible after deposition, and this is especially true of Adena biface caches, which were often deliberately deposited into bogs or swamps (Williamson 1996, 3). In these cases, caches may be better understood as votive offerings, perhaps meant to express gratitude to or gain favour with supernatural entities (Osborne 2004). Williamson (1997) suggests that the practice of biface caching relates to a specifically hunter-gatherer-fisher worldview, noting that the near disappearance of biface caches from the archaeological record at end of the Middle Woodland period coincides with the adoption of agriculture, and with it “new rituals, reflecting an economy focussed on the growing, harvesting, and consumption of cultigens” (7) which “appear to have gradually supplanted older ones that probably revolved around naturally-occurring resources and the tools necessary for their exploitation” (7). While it may be argued that increasing sedentism following the adoption of agriculture can explain the disappearance of caching for the sake of storage, this does not account for the concomitant disappearance of “inaccessible” caches that were not intended to be retrieved as well.

The specific context of AgHb-549 cache is unknown, since it was destroyed by agricultural activity, and so the likelihood that it was meant to be retrieved cannot be evaluated. If it was deposited as a votive offering, its specific purpose or intention cannot be inferred. If it was intended to be recovered, this implies that whoever buried the cache expected to return to the same area in the future, an interpretation which is consistent with identification of the D’Aubigny Creek area as a persistent place which was re-visited throughout the Late Archaic. This cache could have been deposited when chert sources were in good supply, shortly after the bifaces were obtained via quarrying or trade, with the intention that it could be retrieved at a time when supplies had dwindled and were less easily replenished, perhaps upon returning from an area farther away from the Onondaga sources along the shore of Lake Erie.

6.3 Continuity of walleye spawning habitat

One of the most significant findings of this study is the fact that the most intense concentrations of Late Archaic diagnostic artifacts, especially those of the Broad and Small Point Archaic, are located in close proximity to areas that have been identified as walleye spawning habitat. This suggests that riverine fish spawning sites were an aspect of the Late Archaic seasonal round. An important consideration to address, however, is the question of whether walleye are likely to have spawned in the same areas in the Late Archaic as they do today. Since the Grand River, like all major rivers in southern Ontario, has been impacted by the construction of dams and large-scale forest clearing by European settlers, it may be thought that modern walleye spawning areas are likely to differ significantly from those of the Late Archaic period. Although it is of course difficult to prove this with absolute certainty lacking Late Archaic faunal evidence, several other lines of evidence suggest that the locations currently identified as walleye spawning areas by the OMNRF were also used by spawning walleye in the Late Archaic.

Most significant is the fact that walleye tend to return to the same places year after year to spawn (Crowe 1962, Olson and Scidmore 1962). This "homing mechanism" has been shown to have a heritable genetic basis and is not the case of younger walleye being guided to suitable spawning habitat by following more experienced spawners, a situation which would obviously result in the disruption of long-held spawning habits by the construction of dams. In one study, walleye young produced in an artificial hatchery from the roe of both lake-spawning and river-spawning populations were introduced into a habitat which had no native population of walleye but which had suitable lake and river spawning habitats. When the fish reached sexual maturity, those taken from lake-spawning populations were found to spawn in the lake, and the inverse was true of river spawners (Jennings, Claussen, and Philip 1996). Since no existing population of walleye was present in the area, Jennings, Claussen, and Philip (1996, 978) surmised that walleye have heritable genetic traits which guide them to suitable spawning locations by responding to certain yet-unidentified environmental cues. This heritability of spawning behaviour appears to extend beyond a simple preference for lakeshore or river spawning habitat and instead seems to draw fish to specific areas. This is well-illustrated by the results of efforts in the 1980s and 1990s to stock the Grand River with adult walleye from the Thames River, which were largely unsuccessful due to the tendency of the introduced fish to return to the Thames River (MacDougall et al. 2007, 112). It is worth noting here that Grand River walleye are known to be genetically distinct from all other Lake Erie walleye (McParland, Ferguson, and Liskauskas 1999, Shaefer and Wilson 2002), which suggests that an exclusively Grand River spawning population has existed for a considerable time.

Ultimately, it is still not clear whether this "homing mechanism" leads walleye to return to the exact same locations (i.e. the same shoals or river bars) over longer time spans, or whether the final stop on their journey upstream is more variable. There are, however, several reasons to believe that the particular places in the Grand River which are currently walleye spawning areas were also suitable spawning grounds in the Late Archaic. Excavations at the Johnson Flats site near Caledonia indicate that a river bar existed in the Grand River at this location in the Late Archaic (Parker 1995, 16), a feature of the river which is presently used by spawning walleye about 2 km upstream. Excavations at the Porteous site (900-1000 A.D.), a Princess Point village located approximately 3.6 km from spawning area 4, produced a significant number of *Sander* bones (n=94) (Burns 1977, 29), a finding which is consistent with the site being in close proximity to a walleye spawning area.

Water depth is a commonly cited factor in determining what makes a given area suitable for spawning walleye, which prefer shallow water (Colby, McNicol, and Ryder 1979). Since river damming can drastically change water levels, it is here useful to refer to a description of the Grand River by French missionaries François Dollier de Casson and René de Bréhant de Galinée from 1669, who observed the river prior to damming and extensive land clearing. In their account, the Grand River south of approximately Brantford was characterized by fast moving water and a water level so low in some spots that canoes had to be dragged rather than paddled—

a description which holds true for the modern Grand River and which indicates the presence of suitable shallow water levels for spawning walleye (Dollier de Casson and de Bréhant de Galinée 1903, 51). Given that climatic conditions in southern Ontario have been relatively stable since the Late Archaic, it is likely that a similar description would apply to this stretch of the Grand River in the Late Archaic as well. Overall, it seems likely that the correspondence of walleye spawns to Late Archaic sites near Caledonia and Brantford is more than a coincidence.

6.6 Evidence for Aggregation

Ethnographic evidence from a wide range of hunter-gatherer groups attests that seasonal gatherings or "trade fairs" where long-distance trade is possible often occur during peaks in the availability of aquatic resources, when surpluses can be produced for exchange (Jackson 1991). It has been suggested that in the Ontario Late Archaic, such seasonal aggregation took place at riverine fishing sites during the spawning runs of spring spawning fish such as walleye and sucker (Ellis, Kenyon, and Spence 1990, 115). Walleye spawning areas, which are consistent in both time and place of spawning and which could supply food for a larger-than-usual population, would make ideal meeting places for such aggregations. In these settings, fish oil could have been produced from the large number of spawning walleye, which would allow for the preservation of a food source otherwise at risk of spoiling, and which could also have been used as a valuable trade good.

It is clear from the results of the kernel density estimation that during the Late Archaic, spawning areas near Brantford and Caledonia were some of the most intensively-occupied areas within the Lower Grand River area, and that these places were revisited throughout the Late Archaic, particularly by Broad Point- and Small Point-making people. It is difficult to discern if the concentrations of sites found in these areas are can be attributed to aggregation episodes. No radiocarbon dates are available for the sites in question, and no exclusively Late Archaic-associated features, which could give us an idea of settlement patterns and spacing of house structures or hearths, have been identified within either cluster (though this may of course change with ongoing excavation). On the other hand, the presence of some Late Archaic projectile point forms not common in the region, especially within the Caledonia site cluster, does suggest that these may have been sites of seasonal regional aggregation and trade.

As is evident from Figure 26, Perkiomen points are present in the study area only within the Caledonia and Brantford site clusters, with the exception of one example located west of Caledonia near Big Creek (AgHa-320). These projectile points, which are the least common of the major Broad Point forms found in southern Ontario, (see section 2.2.2.3) are most frequently found in eastern New York and Pennsylvania. Their distribution also extends into central New Jersey, Virginia, Ohio, and to a lesser extent, eastern Indiana (Ritchie 1961, 43, Justice 1987, 169-170). The presence of Perkiomen points within the Caledonia and Brantford site clusters and virtually nowhere else could indicate the presence of Perkiomen point-making peoples whose territory did not usually extend into the Grand River valley except during times of aggregation.

Also recovered within the Caledonia site cluster were three other Late Archaic point forms, all of which are fairly uncommon in southern Ontario: one Susquehanna broad point, one

Orient Fishtail point, and one Harrison-stemmed Turkeytail point. These points were all found within 200 m of other Late Archaic projectile points more typical of southern Ontario, and, in one case, on the same site.[6] The presence of these points could indicate the actual presence of groups who infrequently visited southern Ontario but who travelled to the area during times of aggregation, or they could have been obtained via trade elsewhere and were transported to Caledonia by more local groups. Either explanation is consistent with the identification of the Caledonia site cluster as an aggregation site where trade took place, however the former explanation is considered more likely, since all three points were made from locally available Onondaga chert. This is especially significant in the case of the Turkeytail point, as is discussed in further detail below.

The Susquehanna broad point was found during stage 2 survey of site AgGx-825, which also produced an Adder Orchard projectile point (ASI 2019, 29). Susquehanna points typically date within the range of 1700-2700 B.C. and have been found in stratigraphic layers immediately below those containing Early Woodland Vinette I pottery (Justice 1987, 167, McCann 1962, 55). Susquehanna broad points are found throughout much of the northeastern United States to the east coast, but the centre of their distribution seems to be the Juniata and Susquehanna River valleys in eastern New York and Pennsylvania (Justice 1987, 167, Ritchie 1961, 53). They are typically made on purplish rhyolite from local outcrops in Pennsylvania, and Onondaga chert in New York (Ritchie 1961, 54). These points have only a marginal presence in Ontario, thought to be limited mainly to the Niagara Peninsula (Ellis, Kenyon, and Spence 1990, 101).

The Orient Fishtail point was found during stage 2 survey of site AgGx-874 (ASI 2019, 29). These points are best known from eastern and central New York, especially the Hudson River valley and Long Island where the Orient phase was first recognized. Their distribution also extends, although more sporadically, into southern New England and northern and central New Jersey (Ritchie 1961, 39). The Orient phase in New York dates to the Late Archaic and transition to Early Woodland (Ritchie 1961, 39). Orient Fishtail points are typically made of quartz or quartzite pebbles on Long Island, and elsewhere of regional high-quality cherts (Ritchie 1961, 39). Orient Fishtail points are uncommon, but not unheard of in southern Ontario. Notably, several were found at Orchid Site B, in close proximity to the Peace Bridge site, along with the rimsherd of a steatite vessel (Granger 1976, 28).

The Turkeytail point was reported from stage 2 survey of site AgGx-678 (Amick Consultants Ltd. 2017). This point was partial, and only the base and part of the blade are present, although identification was still possible due to the distinctiveness of the Turkeytail form. These points were extensively traded throughout the Midwest, Great Lakes, and Northeast regions in the Late Archaic and Early Woodland periods (Didier 1967, 5, Justice 1987, 179), and are frequently found in mortuary contexts of the Red Ochre complex (Ritzenthaler and Quimby 1962). Turkeytail points are overall uncommon in Ontario, but a few have been reported (e.g.

[6] Although statistically we should expect to encounter the greatest diversity of projectile points types from the area with the largest total sample of projectile points, it is worth noting that such "exotic" points were not found within any other area identified as a particularly intense cluster of Late Archaic diagnostics.

Greenman 1953, 177, Spence, Williamson, and Dawkins 1978, 36). These points are highly restricted in terms of the raw material of their manufacture, which is overwhelmingly the distinctive Harrison County flint of southern Illinois and Indiana, the area which seems to have been the centre of their manufacture and distribution (Krakker 1997, 7). Turkeytails are also sometimes, although much less frequently, made of unidentified “white chert”, examples of which have been found in Wisconsin, Indiana, and New York (Didier 1967, 14-19). Notably, the Caledonia specimen was made of a light-coloured chert which was determined by the site’s investigators to be Onondaga chert (Amick Consultants Ltd. 2017, 111). Although this identification was made on the basis of visual analysis alone (i.e., no petrographic analysis was carried out), it is likely correct since Onondaga chert is the lithic material with which lithic analysts working in southern Ontario are most familiar. The identification of the material as Onondaga chert is significant, since this material is available locally in outcrops along the Lake Erie shore (Eley and von Bitter 1989). A possible explanation for the presence of this Turkeytail point made from local chert is the presence of Turkeytail point making-people in southern Ontario, perhaps involved in regional aggregation related to fish spawning. Light-coloured Onondaga chert may have been considered a suitable alternative material for making Turkeytail points in the absence of Harrison County chert, just as other white cherts were throughout the area within which Turkeytail points were traded.

To summarize, the presence of Perkiomen and less common projectile point forms made from Onondaga chert within particularly dense Late Archaic site clusters located near walleye spawning areas is circumstantial evidence that these sites were the places of regional aggregation and trade. This is most convincing with the Caledonia cluster, which contains more sites as well as more “exotic” point forms. This place, which was already the site of persistent use during the Broad Point and early Small Point Archaic, may have thus taken on a broader, more regional significance by the end of the Small Point Archaic.

This has interesting implications when considered within the context of the transition from the Late Archaic to the Early Woodland period and the invention of pottery in northeastern North America. On the basis of the results of gas chromatography mass spectrometry (GC-MS) analysis of lipids extracted from Early Woodland Vinette I pottery samples (including samples from the Peace Bridge site), which suggest that the newly invented ceramic technology was primarily used for cooking aquatic faunal resources, Taché and Craig (2015) argue that the invention and widespread use of pottery in Early Woodland northeastern North America developed within the context of large seasonal gatherings related to the cooperative harvesting of fish, and possibly the production and trade of fish oil.[7] Since there is generally thought to be some continuity between Vinette I-making peoples of the Meadowood interaction sphere and the Hind point-producing peoples of the Late Archaic, it is likely that the social context within which the first ceramics in Ontario emerged has its origins in Late Archaic seasonal aggregation at

[7] The adoption or independent invention of pottery among hunter-gatherer groups has also been linked to cooperative harvesting of aquatic resources in such geographically disparate cases as Jomon Japan (Craig et al. 2013) and the Ertebølle culture of Northern Europe (Craig et al. 2011).

fishing sites. While the scope of this present study does not include analysis of Early Woodland sites, it is worth mentioning that diagnostic materials dating to the Early Woodland period, including Meadowood points, have been found within the Caledonia and Brantford site clusters. Further analysis of these site clusters focusing on the transition from the Late Archaic to the Early Woodland Period could evaluate the continuity of settlement-subsistence strategies.

7. CONCLUSIONS

Kernel density estimation of a subset of the Ontario Archaeological Sites Database containing the locations of Late Archaic sites discovered during CRM excavations in the Lower Grand River area was used to identify persistent places in the Late Archaic landscape. These persistent places were identified in the lands surrounding Seneca Creek near Caledonia, and south of Brantford near D'Aubigny Creek. Particularly intense concentrations of Late Archaic diagnostic materials dating to successive time periods within the Late Archaic attest to their consistent importance throughout the period, particularly during Broad and Small Point times. Although seemingly ephemerally inhabited, with no indications of prolonged residential stays, these places would have nonetheless structured seasonal movement and likely held special importance to the people that frequented them. These were places that would have been full of the signs of past human action in the forms of trails, former campsites, and other humanly made alterations which would have attested to their historical significance and imbued the landscape with a sense of temporality (Ingold 2000).

These persistent places were investigated with regard to landscape features and environmental affordances which would have made them attractive for use over long periods of time. This analysis found that unique concentrations of resources available in both warm and cold seasons would likely have been present in these areas. At both the Caledonia and Brantford site clusters, spawning fish would have likely been available in the Grand River in the spring, and a variety of nuts would have probably been available in the fall in stands of mast-producing trees—a resource which would have also attracted game, particularly deer. In the vicinity of the Brantford site cluster, the D'Aubigny Creek wetlands would have undoubtedly been a source of food, useful plants, and medicine. This cedar thicket swamp is also ideal habitat for overwintering deer, making it perhaps especially attractive in the winter. These findings, which focus on the multi-seasonal viability of these persistent places, are in line with recent re-thinking of the nature of Late Archaic settlement-subsistence systems prompted by the discovery of both cold and warm weather dwellings at the Davidson site (Ellis et al. 2015), a discovery which confirms that, at least during the Small Point Archaic, seasonal site use was more fluid than initially thought. These findings also resemble Woodley's (1990) interpretation of the Thistle Hill site. Despite the then-prevailing assumption that Late Archaic groups generally spent the cold seasons in upland sites and the warm seasons on lakeshore sites, Woodley (1990) remarked that the immediate area surrounding the upland Thistle Hill site featured several diverse micro-environments making the site suitable for occupation in any season.

Perhaps one of the most significant findings of this study is that Late Archaic sites in the study area are clustered near sections of the Grand River that have been identified as walleye spawning habitat. Although these are modern walleye spawning areas, there is reason to believe, due to the particulars of walleye spawning behaviour, that these may have been the same areas where walleye spawned in the Late Archaic. This suggests that the harvesting of spring spawning fish at upland riverine sites was an aspect of Late Archaic subsistent-settlement systems—an aspect once speculated to exist by Ellis et al. (1990). This clustering of sites at "focal points" along the river resembles similar findings along major rivers of the southwestern Lake Erie drainage, where they are also interpreted as related to the capture of spring spawning fish (Stothers and Abel 1993b, 50).

The presence of several Late Archaic projectile point styles uncommon to southern Ontario within the Caledonia site cluster may attest to its importance as a place of trade and aggregation. This is consistent with ethnographic observations that hunter-gatherer "trade fairs", where goods and people are exchanged, often occur at times and places where a surplus of aquatic resources are available (Jackson 1991). That these aggregations may have occurred here, at what was already a persistent place in the Late Archaic landscape, would indicate that an already locally significant place took on new, broader importance towards the end of the Small Point Archaic.

In addition to the above contributions, this thesis illustrates the utility of a landscape-based perspective when dealing with the types of large datasets produced by CRM archaeology. This perspective, which focuses on the distribution of diagnostic artifacts in the landscape rather than bounded "sites", can help make meaningful sense of highly palimpsestic, plough-disturbed lithic scatters which make up most of the Late Archaic archaeological record in southern Ontario. As a method of analysis, kernel density estimation has been shown to be useful in identifying areas with particularly intense concentrations of sites from a given time period, which can then be examined in greater detail and synthesized for more meaningful interpretations than individual lithic scatters can typically yield alone. This method also helps overcome a major limitation of CRM archaeological reporting—the restricted focus on the details of a single, specific site, which rarely allows for the synthesis of roughly contemporary sites within the same area. Without this landscape-based approach, it is unlikely that the correlation between site clusters and walleye spawning locations would have been noticed.

The results of this thesis suggest several avenues for future, related research. For one, studies focusing on other watersheds which have been subject to a great deal of CRM survey (particularly the Thames River) would help establish whether similar upland, riverine Late Archaic site clusters exist on other major watercourses in southern Ontario. Secondly, deep test-pit or core sample survey of the flood plain zones along the Grand River near Caledonia, which are not typically surveyed in CRM assessments due to building restrictions on flood plains, could be undertaken in order to locate other deeply-buried Late Archaic deposits like those found at the Johnson Flats site. Stratified sites such as these typically have better faunal preservation, and their excavation could provide more definitive evidence of walleye fishing in the areas identified in this study. Finally, investigation of the distribution of Late/Terminal Archaic sites compared with Early Woodland sites, especially those containing Vinette I pottery, could shed light on the continuity of Late Archaic settlement systems into the Early Woodland period, and assess the hypothesis that the seasonal aggregation of Early Woodland groups at sites with an abundance of aquatic resources—the context within which pottery was invented in northeastern North America—had its origins in the Late Archaic.

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