THE McLEOD SITE

THE McLEOD SITE:

A SMALL PALEO-INDIAN OCCUPATION IN SOUTHWESTERN ONTARIO

By

JOSEPH MULLER, B.A.

A Thesis

Submitted to the School of Graduate Studies

in Partial Fulfilment of the Requirements

for the Degree

Master of Arts

McMaster University

MASTER OF ARTS (1998)
(Anthropology)

McMaster University
Hamilton, Ontario

TITLE: The McLeod Site: A Small Paleo-Indian Occupation in Southwestern Ontario

AUTHOR: Joseph Muller, B.A. (University of Waterloo)

SUPERVISOR:

NUMBER OF PAGES: xiv + 232

ABSTRACT

This thesis deals with the Early Paleo-Indian (EPI) component at the McLeod site. It explores issues of regional paleoecology for southern Ontario, and relationships among tool and lithic assemblages with respect to site size and activities. These topics are examined on a regional scale, placing the McLeod site within an environmental and cultural context.

Data were compiled from 130 pollen sites in southern Ontario and adjacent areas, and critical percentages in the pollen profiles of *Betula*, *Picea*, *Pinus*, and non-arboreal pollen dated and evaluated by interpolation. Proposed vegetation colonization and succession patterns were confirmed using quadratic surface trend analysis, and evidence of old carbon in poorer-grade ^{14}C samples validated the date evaluations. Fossil *Coleoptera*, oxygen isotope and faunal data were combined with these results to synthesize a vegetation chronology, and review paleoecological and subsistence implications for the EPI occupation in the southern Ontario post-glacial.

McLeod site lithic tools and debitage were analyzed using established typologies, with data from other EPI sites compiled and standardized for comparison. The root of variation in tool assemblages, reflecting site activity specialization or being a function of sample size, was studied in two ways. First, relationships among size, richness, evenness, and heterogeneity in tool kits were analyzed, determining that only site size and richness are weakly related. Second, a study comparing tool and lithic debitage assemblages concluded that they are closely related. Activity variation rather than sample size accounts for assemblage variation in both analyses.

These analyses identify McLeod as a small, Parkhill complex site within the EPI tradition in southern Ontario. It comprises two large clusters and three ephemeral scatters, yielding a very rich tool assemblage that indicates generalized site activities. It is likely a base camp, unique in its higher degree of richness for its small size. The site was located at the headwaters of a pro-glacial lake estuary, ***ca*** 1km from the lake, set in spruce-parkland vegetation.

Acknowledgements

I owe a lot of people big time on this project. First and foremost, I am very grateful for the assistance, support, patience, data, ideas, editing, photographic aid, and general input of Chris Ellis. If not for his willingness to go above and beyond the call, this thesis would not have been started, and certainly not finished, however many years down the road. Thanks also go to Peter Ramsden, for accepting those calls and emails out of nowhere, reassuring him that this project was still a going concern, however slowly it might actually be going. Laura Finsten is likewise appreciated for accepting the task of being a defence committe member for Joe, who?

I greatly appreciate the assistance and data that Jock McAndrews provided, and for allowing me to survey his palynology course. His unique perspective provided useful insights on the issues at hand, and I likewise am grateful for his editorial comments on the paleoecology chapter. I owe thanks to Pierre Richard and Richard Futyma for supplementary pollen data, Ian Campbell for information on sedimentation curves, Jean-Nicolas Hass for ^{14}C calibration discussions, Amy Ruggles for words of advice on GIS issues, and Nick Adams for supplying me with a southern Ontario map template. Bruce Oddson and Jim Molnar provided me with assistance in my statistical assault, and I am grateful to them for helping me how learn how to understand and apply the formulae. Joe Archaeologist[tm], MCMI, and AM Archaeological Associates provided needed computer hardware, software, and net access over the course of this project, without which life would have been much more difficult. Thanks also to Carl Murphy for conducting the project's macrobotanical analysis.

I also owe much to the Ontario Heritage Foundation, both for funding this research project, and for their patience in the wait for my grant report (ARG-488). MczCR is also appreciated for granting me an archaeological licence (90-051) for the field work component, for likewise being patient for the licence report, and Penny Young in particular for assisting with my data requests.

In addition to owing much thanks to Chris Ellis for his editorial guidance, I also owe my gratitude to Jacqueline Fisher and Paul Muller for editorial assistance on various chapters, as they progressed through assorted iterations.

On the fieldwork side of the equation, thanks go out to Al McGregor for access to his fields for excavation activity, and tolerance for related crop damage to his red and soy beans. I also appreciate the assistance of D. Brian Deller in discussions on site location(s!). I am also thankful to Peter Storck for lending the power auger to the project, and his visit to the site. Accomodation for the project was generously provided by Bob Lewis and Sheilagh Harvard, a/k/a the Sylvan General Store and funky hang-out.

Finally, I am very grateful to my field crew for the excavations in the summer of 1990, who went above and beyond to help get the job done, under extenuating circumstances: Frank Albanese, James Bandow, Heidi Bohaker, Sara Breau, Jacqueline Fisher, and Sheenagh McMahon. It is stating the obvious, but nothing could have been done without you, and I deeply appreciate your valiant efforts.

While I have received much assistance, any oversights and errors in this thesis remain my own. Individuals or institutions wanting a copy of this thesis may contact me via relic@hwcn.org in order to obtain paper or cdrom copies of this work.

Contents

Tables

Figures

Plates

Appendices

1.0 INTRODUCTION

This thesis presents a description and analysis of information recovered from the McLeod site, an Early Paleo-Indian (EPI, fluted point associated) site in southwestern Ontario. An attempt is made to refine our understanding of the broader context of the EPI occupation of the eastern Great Lakes area and: 1) the paleoenvironmental context of the occupation, particularly as represented through fossil pollen data, and 2) the significance of inter-assemblage variation, specifically among small EPI site assemblages. Knowledge of both these aspects is essential to our understanding of Paleo-Indian cultural systems, but as will become clear below, there exists much debate on both of these concerns in the current literature.

1.1 BACKGROUND AND SIGNIFICANCE

The McLeod site (AhHk-52) is located several kilometers west of the town of Parkhill (Figure 1), on Lot 20, Concession XX, West Williams township, Middlesex County, Ontario. It was brought to the attention of Dr. Brian Deller by Randy Laye, Gary Laye, and Ray Baxter in 1972 (Deller and Ellis 1982:111; Roosa 1975:1), and Dr. William B. Roosa (University of Waterloo) during his excavations from 1973 to 1975 at the Parkhill site (AhHk-49). In 1975, Dr. Roosa directed test excavations at the McLeod site, identifying several areas of Paleo-Indian and later occupations. The author returned to the McLeod site in 1990 to excavate an area of the site identified as Paleo-Indian by Ed McLeod to Dr. Brian Deller (Ellis 1997 per comm), but not tested during the 1975 research. Subsequent to the 1975 excavations at the McLeod site, and prior to the 1990 research, surface collection was carried out by D. Brian Deller.

The author returned to the McLeod site in 1990 with several goals. The field work focused on excavating the Paleo-Indian cluster at the McLeod site identified but not tested during the 1975 excavations. The objectives were to relocate and define this focus, and through excavation obtain an additional sample of the Paleo-Indian component at the site.

The data obtained through surface collection, and site excavations in 1975 and 1990, are

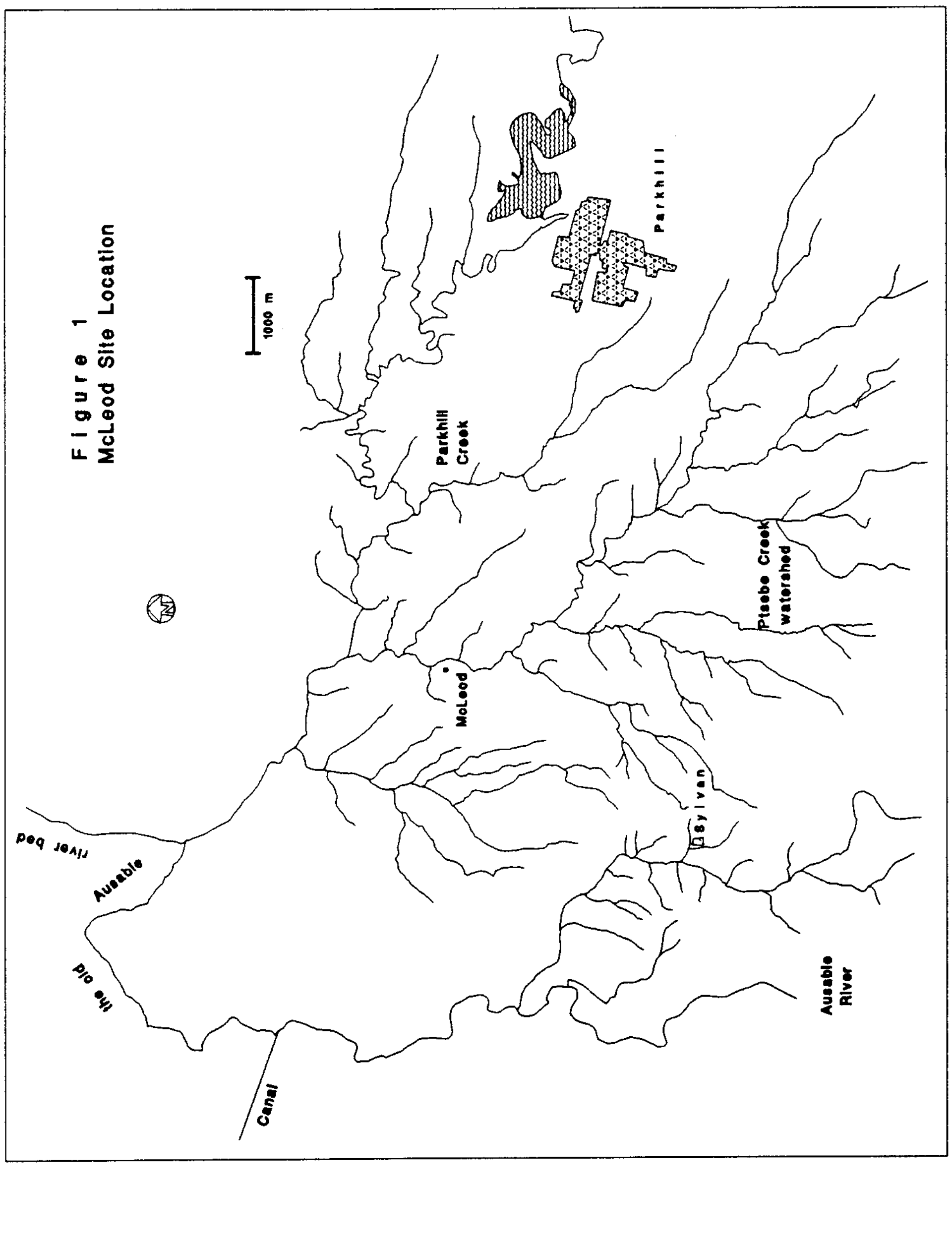


Figure 1
McLeod Site Location

used in this thesis to determine the nature of the EPI occupation at the McLeod site by comparing it with other EPI sites. Patterns of lithic tool and debitage frequencies within site or cluster assemblages are studied through intersite comparison, to determine whether variation in assemblage composition represents activity specialization at different sites, or primarily reflects the effect of sampling error.

The results of this work, including analysis and interpretation of the artifact assemblage with respect to these issues, comprise most of this thesis. A synopsis of EPI research to date in the lower Great Lakes area in section 1.2 provides a framework for the discussion.

The paleoecological component of this study summarizes and analyzes geological, palynological and additional paleoenvironmental data for the area, including that obtained by Dr. A.V. Morgan in association with the research project at the Parkhill and McLeod sites directed by Dr. Roosa. These data are placed within a regional context, modeling the late Quaternary and early Holocene ecology in southern Ontario, providing a setting for the EPI occupation in the region. This environmental backdrop is used to briefly discuss the subsistence implications it has on the EPI phase in southern Ontario.

These subjects divide the two broad components of this paper into its chapters. The first chapter consists of an introduction to, and synopsis of, EPI research in the lower Great Lakes region to date. It provides a context for the McLeod site project, and includes a summary of EPI sites identified in the study area, a brief description of current EPI cultural chronology and subsistence/lifeways models, and a precis of the late Quaternary and early Holocene geology and paleoecology in the region. Current issues in EPI studies of the lower Great Lakes region are outlined, and arguments that form the focus of this paper are identified. This discussion provides a framework for the final portion of this chapter, outlining how this research project addresses some of the issues identified. It outlines the research design and proposed theses to be evaluated using the data procured and analyzed by this project.

Chapter Two deals with the paleoecological component of the research. It provides a chronology for the post-glacial physiography of southern Ontario, and details relevant pro-glacial processes, landforms and lakes in the vicinity of the McLeod site. Fossil pollen, *Coleoptera*, and isotope data are presented, analyzed, evaluated and interpreted, providing a summary paleoecological model for the lower Great Lakes region over the EPI horizon. In particular this section addresses the issues of whether colonizing vegetation transgressed across the landscape, if the early post-glacial vegetation reflected climatic conditions or were affected by a lag effect, and the nature of the plant assemblages in this setting.

Chapter Three reviews field work at the McLeod site, documenting survey and excavation techniques used in 1975 and 1990, and survey methodology conducted over the intervening years. Chapter Four describes the analysis conducted on the McLeod site artifact assemblage obtained in the excavations and surveys as detailed above, and reviews the premises and rationale behind the typologies used for the tool and debitage artifact classification systems.

Site interpretation opens Chapter Five, leading to intersite comparison of tool and debitage assemblages, contrasting McLeod with other EPI sites in the lower Great Lakes area. Intersite comparison focuses on whether variation in the composition of these assemblages is due to site activity specialization (***i.e.*** site function) or can be attributed to sampling error, being a reflection of site size more than function. The analysis and evaluation statistically describe and compare lithic tool and debitage assemblages from the sites sampled. The role of the McLeod Site within these analyses of the site sample is then discussed. Chapter Six summarizes the research project, by reviewing the conclusions presented in prior sections, and synthesizing these results.

Data nomenclature

Dates identified as 'bp' are referring to uncorrected ^{14}C years before 1950 AD. These dates were not calibrated, as discussed in section 2.3. The acronym 'asl' is used to denote measures of elevation in metres above sea level, using modern topographic data. When seasonal or annual temperatures are described, degrees Centigrade on the Celsius scale are used. Tool and flake metrics are in millimetres (mm) and degrees ($^{\circ}$), except where noted.

1.2 PROJECT BACKGROUND

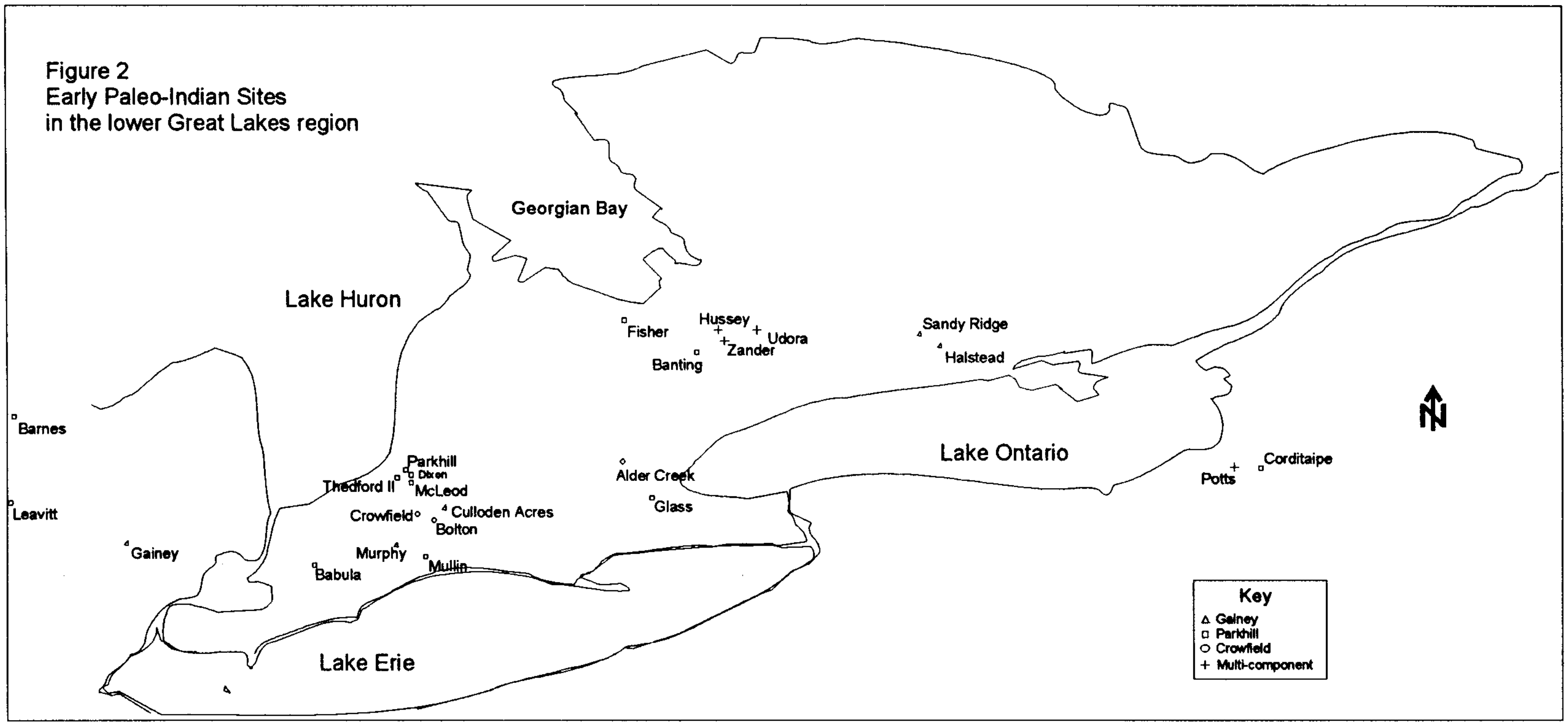
Research on the Paleo-Indian cultural horizon in Ontario was initiated when EPI artifacts (fluted points) were first identified by Patterson in 1933, confirming that the cultural horizon was present in the province (Davis 1991:35). Initial Paleo-Indian investigations were sporadic and opportunistic, with little coherent research design. From the early 1970's onward, research efforts focused on the identification and excavation of Paleo-Indian sites in the region, and continue today. Earlier researchers (Deller, Roosa, and Storck) were joined by Dibb, Ellis, Jackson, Julig, Stewart, and Timmins, whose work has resulted in a sizable research base for the Early and Late Paleo-Indian phases in Ontario.

1.3 PALEO-INDIAN RESEARCH IN THE LOWER GREAT LAKES

While Deller surveyed for Paleo-Indian sites in southwestern Ontario from the mid-1960's onwards (Deller 1988:6), the first 'modern' EPI site excavations in southern Ontario occurred in the early 1970's, at the Parkhill, McLeod (Roosa 1975, 1977a), Banting, and Hussey sites (Storck 1979). With more researchers working on Paleo-Indian projects in southern Ontario, field work increased exponentially at many sites including Fisher (Storck 1997), Udora (Storck and Tomenchuk 1990) Thedford II (Deller and Ellis 1992a), Crowfield (Deller and Ellis 1984), Sandy Ridge and Halstead (Jackson 1994), and Zander (Dibb 1985). Work in the 1990's included Murphy (Jackson n.d.), Culloden Acres (Ellis and Deller n.d.), Bolton (Deller and Ellis 1996), Alder Creek (Timmins 1994), Caradoc (Deller and Ellis 1999 in press), Weed and Ferguson (Deller 1988), and further excavations at McLeod (Muller 1995). Survey work since the 1960's has also identified additional sites, including Stott Glen, F. Wight, Babula, Glass, Schofield, Dixon, Mawson, Arkona, Mullin (Deller and Ellis 1992b), and Heaman (Deller 1976) (Figure 2).

Predating the above work in Ontario, research excavations at the Barnes site (Roosa 1963; Wright and Roosa 1966; Voss 1977) provided an initial setting for subsequent work in southern Ontario. Research in the surrounding lower Great Lakes region has continued with additional excavations at the Gainey (Simons, Shott and Wright 1984a; Simons, Shott and Wright 1984b),

Figure 2
Early Paleo-Indian Sites
in the lower Great Lakes region



Leavitt (Shott 1993), Dobbelar (Roosa 1977b), Dewitt (Payne 1982), Potts (Lothrop 1988), and Corditaipe (Funk and Wellman 1984) sites (Figure 2).

Based on the above work, a chronology for the EPI in southern Ontario was proposed (Deller and Ellis 1988). The EPI is divided into three sequential phases: Gainey, Parkhill, and Crowfield. This is based on typological dating and contextual seriation of the three established diagnostic point types (Deller and Ellis 1988:255), Gainey, Barnes, and Crowfield. As detailed in section 5.1, there is evidence that the lithic industries of these phases also differ (Ellis and Deller 1997; Deller and Ellis 1988:258; 1992a:126-7), while retaining broadly similar EPI horizon patterns. However, it is also recognized that the point types identified are arbitrary segments of a "temporal continuum of morphological and technological change" (Deller and Ellis 1992a:36).

Crowfield, the terminal EPI phase, is argued to evolve into the first complex of the Late Paleo-Indian horizon, marked by the appearance of unfluted Holcombe points (Deller and Ellis 1988:258). The end of the EPI occupation in this region is linked with the demise of Main Lake Algonquin/Ardtrea (***ca***. 10 400 bp, Ellis and Deller 1997:1; Deller and Ellis 1988:258), as in section 2.1. EPI occupation in the region is established between ***ca***. 11 000 bp and 10 500 to 10 200 bp, based on ^{14}C dates to the west and east of the Great Lakes (Haynes ***et al***. 1984:187-189) and sites in adjacent New York state (Ellis ***et al***. 1998:154-159). EPI phase timing in southern Ontario is not as clearly defined, although it was argued that the Gainey occupation spanned ***ca.*** 11 000 to 10 700 bp, with the Parkhill complex occupation spanning ***ca***. 10 700 - 10 600 bp, and Crowfield ending ***ca***. 10 400 bp (***e.g.*** Deller and Ellis 1988:255, 258). The probable effect of ^{14}C plateaus on the chronology is an underestimate of occupation span. While the EPI horizon spans about 600 ^{14}C years (section 2.3), it likely lasts closer to 1 000 sidereal years, so attempting to attribute the complexes to specific dates is suspect.

The lack of ^{14}C dates at EPI sites in southern Ontario results in dating through association with comparable, adjacent, and dated cultural horizons (***e.g.*** Deller and Ellis 1992a:128) or geologic features and/or events (section 2.2). Attempts have been made to date a site (Udora) by presumed associations with pollen profiles and fauna (Storck and Speiss 1994:133-134). The latter type of dating technique is tenuous, based as it is on modern analogs for vegetation and faunal assemblages, in addition to inferred subsistence strategies. The apparent fit of this interpretive dating is discussed in section 2.3.

1.4 EPI LITHIC MATERIALS

Patterns of chert use during the EPI occupation of southern Ontario are almost unique to this cultural horizon. The most notable lithic fingerprint of the EPI occupation in southern Ontario is a highly preferential use of good quality, bedrock source chert, to the exclusion of other chert types (Ellis 1989:139). This pattern is noted across the EPI horizon in the lower Great Lakes and northeast North America, with some variation among complexes and geographic regions.

The most prevalent chert used in the Gainey and Parkhill phases in southern Ontario is the Collingwood variant of chert originating from the Fossil Hill formation, referred to here as Collingwood chert (von Bitter and Eley 1997). Bedrock outcrops of Collingwood chert are located at the southern end of Georgian Bay, near Collingwood, with additional outcrops along the Bruce Peninsula near Lion's Head and Dyer Bay (von Bitter and Eley 1997:227-228) (Figure 3). It is often used as an EPI indicator in southern Ontario, although later horizons also use this material (von Bitter and Eley 1997:223). However, at significant distances from the bedrock source (***e.g.*** in southwestern Ontario, west of London), it is exclusively associated with EPI occupations (Deller and Ellis 1992b:40; Deller 1979:15).

Collingwood chert is utilized throughout the Gainey, Parkhill, and Crowfield EPI complexes. It is a distinctive light (pale brown to beige to grey-white), fine-grained material, opaque to slightly translucent, often speckled with or pitted by iron oxidation, and is often (not always) banded. Weathering causes patination, lending the chert visual and tactile characteristics distinct from a freshly exposed surface (Deller and Ellis 1992a:12). Heat treatment increases the luster, and can be associated with a colour change, resulting in a pinkish hue (Pavlish and Sheppard 1983:793). Collingwood chert is not the only material associated with EPI occupations in southern Ontario. Three additional cherts are also used as EPI indicators:

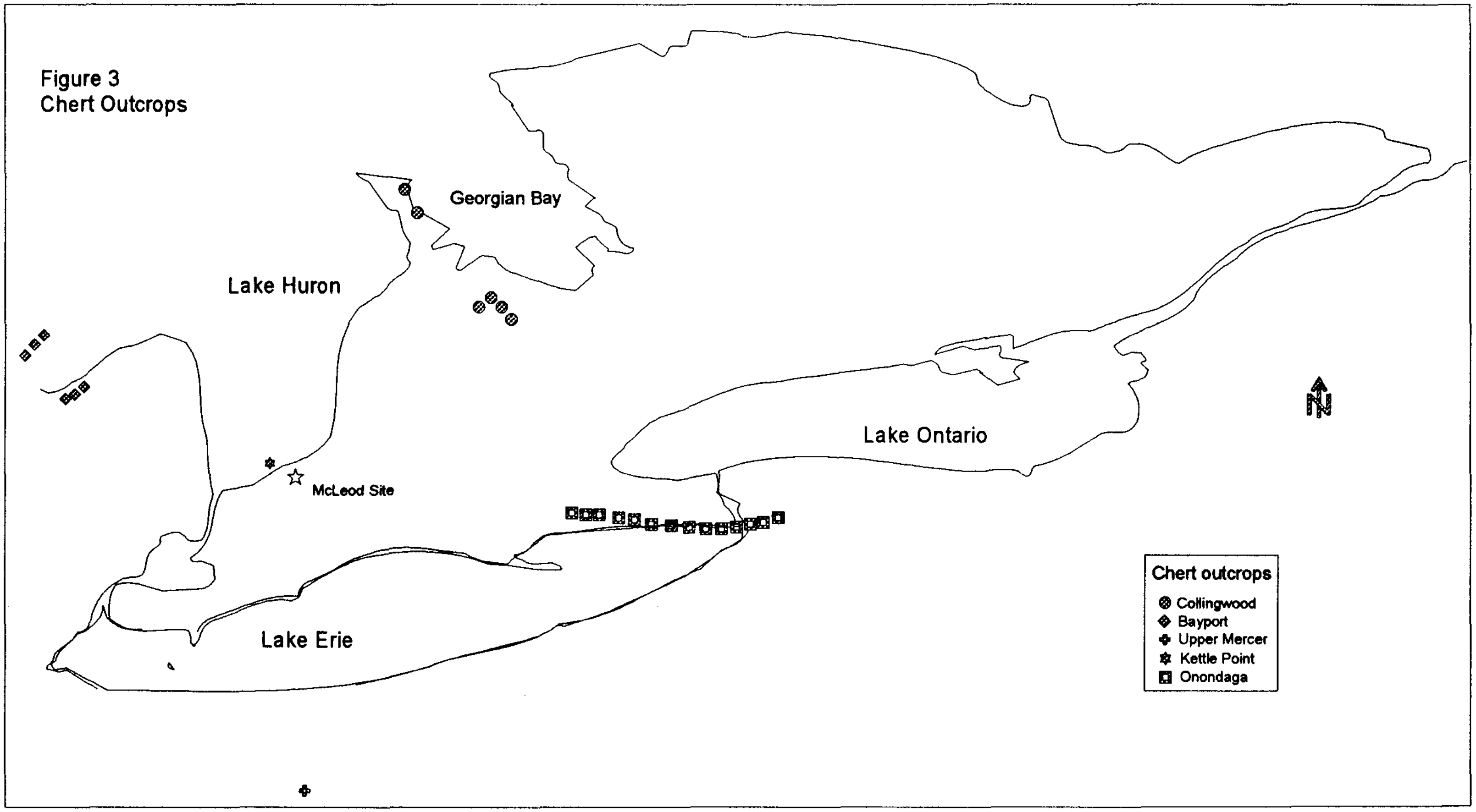


Figure 3
Chert Outcrops

Onondaga (southern Ontario); Upper Mercer (Ohio), and Bayport (Michigan). Onondaga chert ranges from light to very dark blue, and none through to extensive quantities of limestone intrusions (Parkins 1977), so the quality of Onondaga chert ranges widely, although Deller and Ellis identify an EPI preference for higher grade material (Deller and Ellis 1996). The two remaining cherts are usually found in only trace quantities. Upper Mercer chert varies from dark black to blue-grey or light blue-grey, and is usually fine grained (Shott 1993:17). Bayport is usually concentrically banded, occurring mainly in nodules. It is a relatively fine grained, darker blue-grey, with lighter speckling caused by microfossil inclusions (Shott 1993:15), resembling Selkirk chert from southern Ontario, and one must go beyond colour to identify these two types.

In Ontario, Upper Mercer chert is associated exclusively with Gainey complex sites, and Bayport is most closely linked with Parkhill complex assemblages (Deller 1989:211-215). The presence of EPI sites in Michigan which have yielded trace quantities (and one with a very high frequency) of Collingwood chert (Ellis 1997 per. comm), and of Michigan cherts in southern Ontario, suggests ongoing interaction between EPI groups in southern Ontario and Michigan. Upper Mercer chert in the earliest Gainey assemblages may also represent some degree of founders' effect, with exotic chert imported during the Gainey complex colonization of southern Ontario (Ellis 1989:148-9). Bayport chert appears to represent a continuation of this contact (Deller and Ellis 1992a:135). The absence of 'cross-border' cherts in Crowfield assemblages may infer a decline or cessation of such interactions. While Collingwood chert remains present in the Crowfield complex, the presence is diminished (Deller and Ellis 1992b:39), and higher frequencies of Onondaga chert (Parkins 1977) begin to appear in lithic assemblages (Deller 1989:215). This change in the use of lithic materials among the three EPI complexes in southern Ontario may represent range shifts (Deller and Ellis 1992b:47-50) and/or reduction in range size, from when the region was first colonized to the end of the EPI horizon, inferring changes in subsistence and social patterns (Ellis and Deller 1997:15-17).

In southwestern Ontario there is isolated evidence at the Parkhill site that Kettle Point chert (Janusas 1984) may have been utilized by EPI to a very limited extent (section 4.1.1; see also

Storck 1997 for southcentral Ontario). However, the material used is likely till chert, and the exception appears to be a case of expediency, not systematic use (Ellis ***et al.*** n.d.).

1.5 PALEOECOLOGY

The suite of paleoecological interpretations for the EPI occupation in southern Ontario, and by extension the whole northeast, ranges from tundra occupied by arctic foxes, potentially herding (tundra subspecies) caribou, arctic hare and the like (Storck and Speiss 1994:126, 128) to a closed woodland environment (Custer and Stewart 1990:308), populated by small groups of woodland caribou (among other cervids), and an assortment of woodland fauna (Dincauze 1989; Levine 1997:237-9). A middle road, some combination of the two extremes, is also suggested (Ellis & Deller 1997; Deller and Ellis 1988; Shott 1986; Curran 1998), with broad vegetation zones bordered by shifting ecotones. These are varyingly based on broad climatic models, referring to regional pollen analyses for northeastern North America (Gaudreau 1988; Davis 1983; Jacobson and Davis 1988:32-33), specific pollen profiles near excavated sites (Storck 1997:273), and predicted associations of EPI groups with tundra subsistence-oriented strategies (Meltzer 1988:43). For southern Ontario specifically, no current regional pollen syntheses exist, and so paleoecological models are derived from smaller sets of pollen and other ecological data or comparison to adjacent models (***e.g.*** Storck and Spiess 1994; Jackson 1994:104-105).

The ecological transition during the EPI occupation in southern Ontario is another issue, given that the early post-glacial environment represents an unusual situation resulting from climatic change sufficient to halt the Wisconsin glaciation. Interpretations of this scenario, and the impact on the EPI in southern Ontario, are also broadly ranging. It has been argued that the demise of the EPI is marked by the development of closed forests (Meltzer 1988:43). Others (Ellis and Deller 1997:18-20) argue that the EPI adapted to such vegetation shifts relatively readily, with adaptations to new subsistence strategies reflected in projectile point technology shifts from the Gainey to Parkhill to Crowfield phases over time. For example, in this model, projectile point design is altered from an optimal thrusting or "short throw" spear design (Gainey points), evolving through Barnes points (Parkhill complex) to a throwing spear design, more effective for targets at a greater distance (Crowfield points). This gradual change is argued to reflect the transition from herd hunting to much smaller groups or individual fauna, linked with the change from open tundra/'parkland' environments to closed forests. Likewise, shifts in the patterns of lithic material used and in settlement patterns would reflect changes in subsistence strategies, as responses to paleoenvironmental change (Ellis and Deller 1997:15-20).

1.6 EPI SITES DATA CRITIQUE

Paleo-Indian focused surveys in southern Ontario were for some time centered on fossil beaches and strand-lines of late-Quaternary main Lake Algonquin (Storck 1982). Many of the sites described above, such as Thedford II, Parkhill, Heaman, and Dixon, found in the vicinity of the McLeod site, are no exception.

The strand-line strategy of surveying for Paleo-Indian occupations is based on predictive modeling suggested elsewhere in the Great Lakes basin, and was successfully applied in the 1960's to southern Ontario where few Paleo-Indian sites had been as yet identified (Deller 1988:7-8). It remained the central strategy into the 1980's, with few exceptions (Jackson and McKillop 1991:39-42). The resulting sample of EPI sites excavated was biased towards large sites, located on or very close to Lake Algonquin strand lines.

Initial research focused on the excavation of large sites, such as Parkhill, Fisher, Thedford II, and Udora. The existence of small EPI sites was recognized, but until the end of the 1980's few small EPI sites had been excavated (exceptions being Banting, Hussey, and McLeod). With the onset of the 1990's, researchers began to redirect the emphasis towards smaller and/or non-strandline oriented EPI sites, with excavation at the Murphy, Culloden Acres, Bolton, Sandy Ridge, Halstead, Alder Creek, and McLeod sites. Work on these sites was carried out to broaden the data sample for the EPI occupation in southern Ontario by encompassing elements of lifeways represented by smaller and/or interior sites, potentially not observed at larger sites. In addition, the excavation of smaller sites can offer clearer definitions of artifact distributions. With large sites comprising larger artifact assemblages and site areas, the effect of such longer term and/or more intensive occupations can be a blurring of data resolution, caused by overlap of activity areas, repeated reuse of areas for differing activities, and relocation of artifacts during occupation and reoccupation. Small sites tend to represent shorter term, single occupations. As such, it is argued that the link between site activity and artifact assemblage will be less distorted (Deller and Ellis 1996:5). The contrast between large and small sites (and thereby assemblages) is currently a focus of debate as to whether variation observed in assemblages reflects activity specialization or is a function of sample size (and therefore, sampling error) (*e.g*. Shott 1997).

1.7 THESES

Several of the issues identified above are explored in this paper. The first deals with the paleoecology of the EPI horizon in southern Ontario. It is proposed that a regional pollen synthesis can describe vegetation concurrent with the EPI occupation in southern Ontario, and a metachronic model of the plant succession across the landscape. The degree to which the floral assemblage is in equilibrium with the paleoclimate is explored by comparison with alternate proxy data. It is argued that the floral colonization of southern Ontario in the early post-glacial is characterized by vegetation lag, and does not accurately reflect paleoclimatic conditions. The implications of this with respect to potential subsistence strategies of the EPI in this region are also discussed.

The remaining issues deal with the cultural component of the project, pertaining to the relationship between site artifact assemblages and site function. As noted above, it has been argued that variation in tool assemblages at EPI sites is attributable primarily to sample size factors, rather than behavioural elements manifested as site activities or functions (*e.g.* Shott 1997). It is proposed here that, contrary to such arguments, site activities reflecting behaviour play a dominant role in accounting for variation in tool assemblage composition, even among the smallest of sites.

This debate is studied with data from McLeod and other EPI sites in the lower Great Lakes region, using two approaches. The first attempts to replicate the methodology described and provided by Shott (1997), contrasting results using two tool typologies, the first used by Shott, the second an alternate, more detailed system developed by Deller and Ellis (1992b:12, Table 5; Ellis and Deller n.d.:62, Table 10). A second line of evidence compares lithic debris, a byproduct of lithic activities at a site (Ellis 1979:5), with the associated tool assemblage. Based on the results yielded by these two analytical paths, it is argued that the role of behaviour ranks above sample size in accommodating variability in the composition of tool assemblages at the EPI sites examined.

In addition, while the McLeod site is situated in reasonably close proximity to a pro-glacial lake strand-line (*ca.* 1 km away), it is not a 'lakeshore-focused' occupation: if anything, the site is more likely biased towards nearby riparian resources, as well as terrestrial ones. On this basis, and given that it is a very small site, it is proposed that such atypical sites are difficult to fit within classic site type definitions. It is proposed that the McLeod site is a small, low-intensity base-camp occupation of short duration, not readily comparable to larger base camps or other site types.

2.0 PALEOECOLOGY

The discussion of McLeod site paleoecology includes post-glacial physiography, the relation of the Early Paleo-Indian (EPI) horizon to this regional context, vegetation profiles, other climatic indicators, fauna, and subsistence implications. This chapter focuses on an outline of trends of principal vegetation genera and groups across the landscape, and some implications of these and other data on paleoecology and subsistence potential for the EPI interval.

2.1 PHYSIOGRAPHY

The origins of the landscape on which the site is located are glacial. As elsewhere in southern Ontario, proglacial lake sediments are the predominant soil parent material in the area, underlain by unsorted glacial till. The site is on the bed of Lakes Whittlesley and Warren, fossil beaches of which are found on the Wyoming Moraine, the southern boundary of this flat locale (Chapman and Putnam 1984:64). In the succession of proglacial lakes Whittlesley (***ca***. 13 000 bp), Warren (***ca***. 12 700 bp), and potentially Grassmere and Lundy (***ca***. 12 400) (Eschman and Karrow 1985:84-87), the McLeod site area was under water, awash, or subject to storm flooding at this time (Chapman and Putnam 1984:21, 23-4; Cooper 1979:4). Since glacial Lake Lundy (***ca***. 189 m asl), it has not been subject to any subsequent lake transgressions.

The drop in levels from Lundy halted at the early Algonquin elevation (***ca***. 12 200 bp), about 184m asl. Early Lake Algonquin ended ***ca***. 11 900 bp with the Kirkfield regression (Karrow and Warner 1990:15), followed by the Main Algonquin phase at 184 m asl. Another interpretation is that the beach traditionally called Main Algonquin (Figure 4) is actually post-Algonquin Lake Ardtrea (Kaszycki 1985). Regardless, Main Lake Algonquin/ Ardtrea was present from ***ca***. 11 300 bp to ***ca***. 10 400 bp at modern levels of approximately 184 m asl in this portion of the Lake Huron basin, a situation not affected by its name (Jackson *et al* 1995:13; Storck 1997:250-251). As fluted projectile points have not been recovered below this Main Lake Algonquin/Ardtrea level, while late Paleo-Indian sites do occur below it (Ellis and Deller 1986), geological evidence

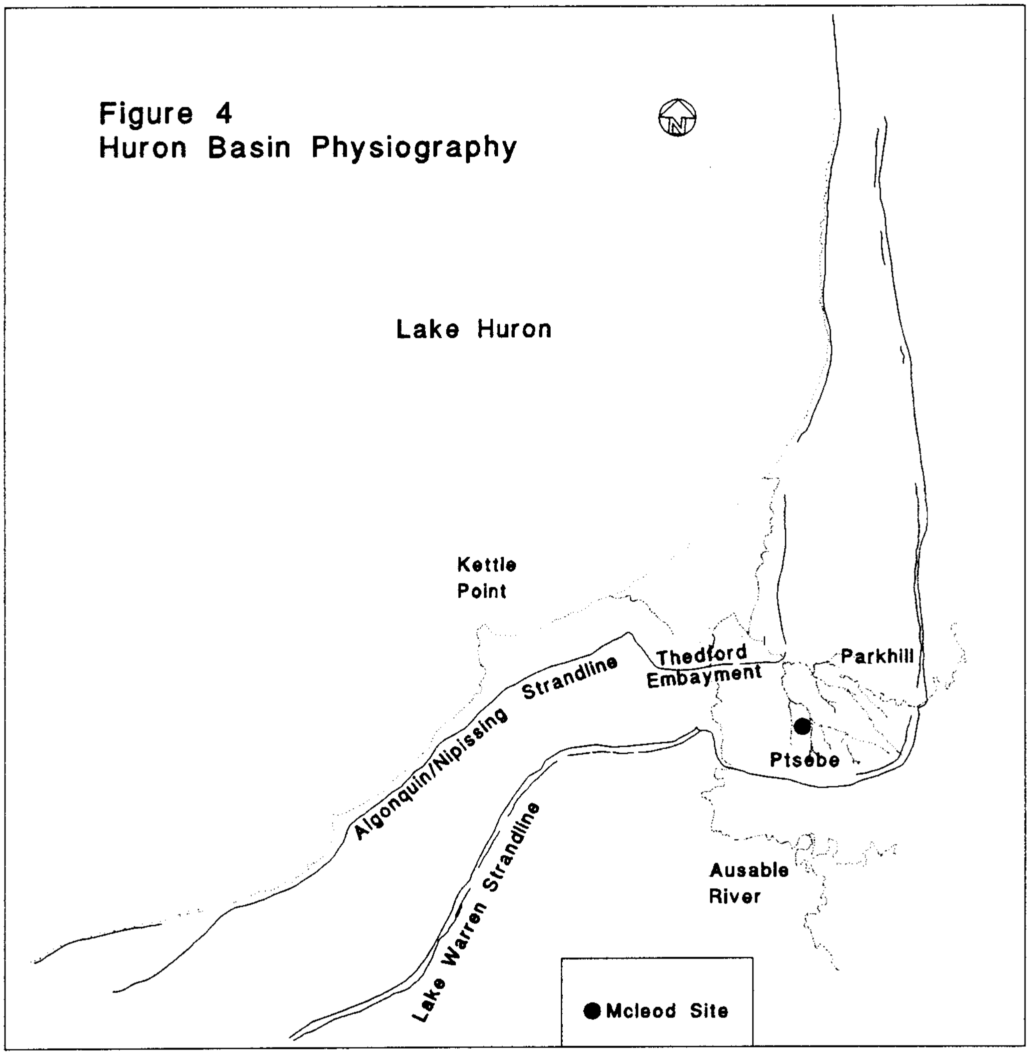


Figure 4
Huron Basin Physiography
Lake Huron
Kettle
Point
Thedford
Embayment
Parkhill
Algonquin/Nipissing Strandline
Ptsebe
Lake Warren Strandline
Ausable
River
Mcleod Site

provides the most substantial relative dating for EPI sites within southern Ontario.

Although the region was deglaciated by ***ca.*** 13 500 B.P. (Karrow and Warner 1990:13-14), it remained under the influence of the remnant Wisconsin glaciation. To the north, the ice dam routed drainage of Early Lake Algonquin through the Lake Erie basin. Wastage of the glacial dam opened the northern drainage route, while isostatic rebound gradually elevated the northern end of the Huron basin, tilting towards the southern end of the Lake Huron basin. The initial result was a shift in the Great Lakes drainage, with flow through the Kirkfield outlet and substantial regression in the Lake Huron basin, marking the termination of the Early Lake Algonquin phase (Karrow and Warner 1990:17; Eschman and Karrow 1985:89-90).

Isostatic rebound at the French/Mattawa/Ottawa outlet raised water levels in the Huron basin to an elevation above the St. Clair/Detroit drainage to the south, and the upper Great Lakes watershed resumed flow through the Lake Erie basin through Port Huron for Main Lake Algonquin/Ardtrea. The resulting transgression and regression in the Huron Basin formed fossil beaches along the Thedford embayment. Much later (***ca***. 5 000 bp) Lake Nipissing phase beaches definitely formed at the 184m asl level, also attributed to Early Main Lake Algonquin/ Ardtrea in this area (Karrow and Warner 1990:21).

The Main Algonquin/Ardtrea phase spanned **ca.** 11 000 to 10 400 bp, followed by the precipitous drop to Lake Stanley levels, much lower than the modern Lake Huron elevation. The EPI occupation in southwestern Ontario is most closely associated with the Main Algonquin/ Ardtrea phase. By ***ca***. 5 000 bp the Huron basin water levels had returned to the Main Algonquin/Ardtrea levels at the Nipissing phase (elevation ***ca.*** 184m). Excluding the Algoma regression event, post-Nipissing phase lake levels gradually dropped to the current Lake Huron elevation of 175.8 m asl (Karrow and Warner 1990:21; Eschman and Karrow 1984:90-91).

Based on these elevations, unlike the Parkhill site to the north, the McLeod site does not display a beach focus site ***per se***. Given its elevation of ***ca.*** 195 metres asl (versus 185 m asl at the Parkhill site), it is not on a beach, but rather is situated ***ca.*** 1 km inland from the south-east limits of the Thedford embayment, the strand-line attributed to the Lake Nipissing phase, and by association, to Main Lake Algonquin/Ardtrea (Figure 4). However, the Ptsebe valley was inundated by the transgression of Main Lake Algonquin/Ardtrea from the prior Kirkfield low level, as the elevation of the Ptsebe flood plain adjacent to the McLeod site is approximately 184 m asl. The implication is that the Ptsebe Creek valley formed a convoluted estuary of Main Lake Algonquin/Ardtrea, and so the lakeshore, in the form of an inlet, was closer to the site than inferred by the main beach at the Thedford embayment.

The Parkhill and Ptsebe creek valleys are the only marked topographic features around McLeod and other nearby Paleo-Indian sites. Areas north and west of these creeks are flat and marshy, while the drained plain to the south is bordered by the Wyoming Moraine, the southern boundary of the Parkhill and Ptsebe Creek watersheds. The size and extent of this drainage system in the immediate post-glacial environment is not well defined. However, the coring of Ptsebe Creek ***ca.*** 400m from the McLeod Site (Figure 5) determined that the valley was established prior to Main Lake Algonquin/Ardtrea (Jackson ***et al.*** 1995; Morgan ***et al.*** in prep).

2.2 CULTURAL CONTEXT

The McLeod site is in close proximity to a number of other fluted point finds and sites related to the Parkhill complex, including the Parkhill type-site, Thedford II, Wight, Dixon, Schoefield, Mawson and Arkona (Figure 6). Extensive work has been conducted on the Parkhill (Roosa 1977a; Deller and Ellis 1992b) and Thedford II (Deller & Ellis 1992a) sites, and cultivated fields within the area have been blanketed by surveys for Paleo-Indian sites (Deller 1988).

EPI sites in the area, including McLeod, are associated with the Main Lake Algonquin/ Ardtrea phase. As implied above, the association is based on the observation that, despite intense survey, no EPI sites or find spots have been located below (***i.e.*** offshore from) the Main Lake Algonquin/Ardtrea/Nipissing strand-line. Late Paleo-Indian and early Archaic sites and find spots located below this strand-line have been water-rolled, predictable as these sites were later inundated by the transgression of Lake Nipissing phase to the Nipissing strand-line (Ellis and

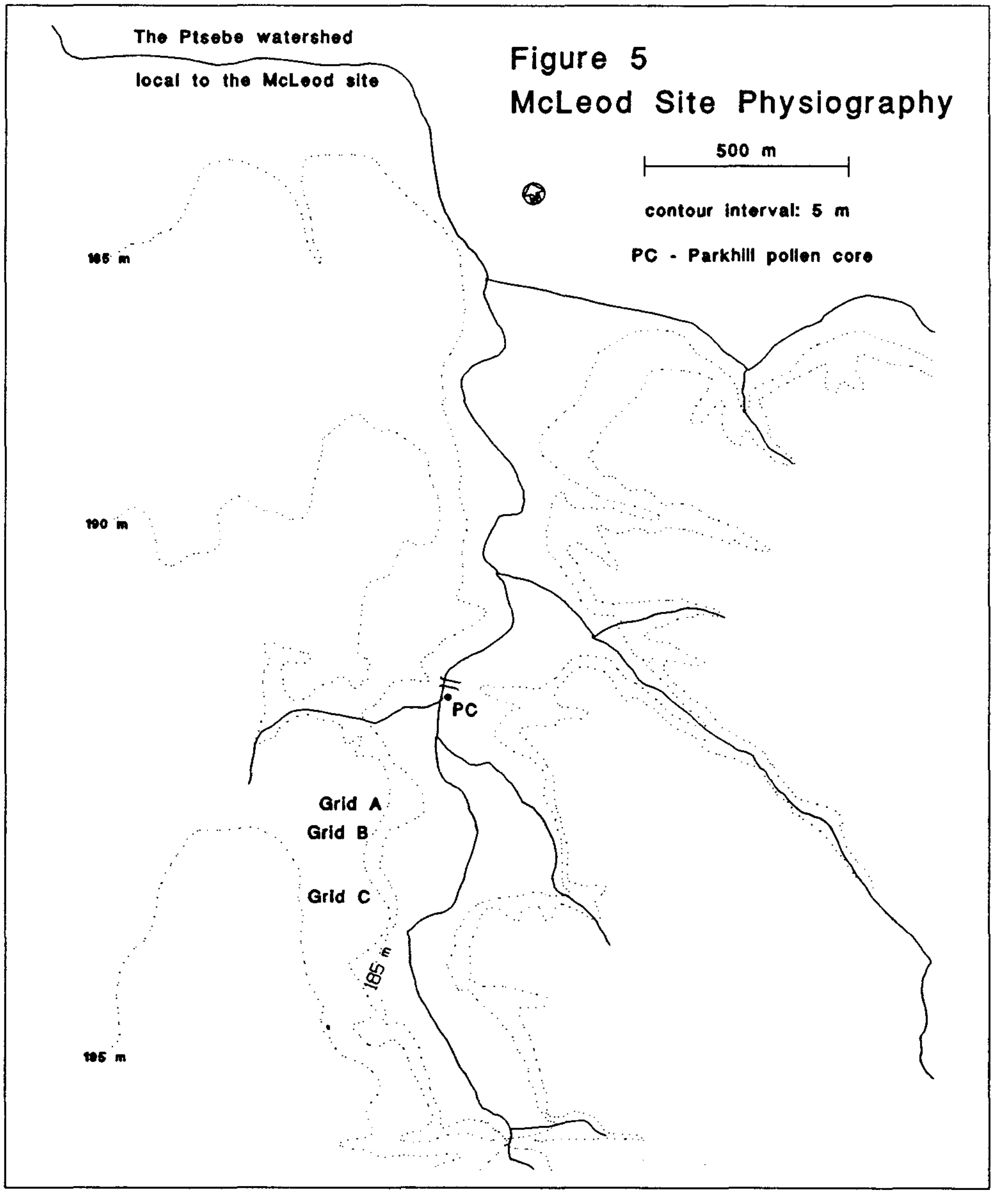
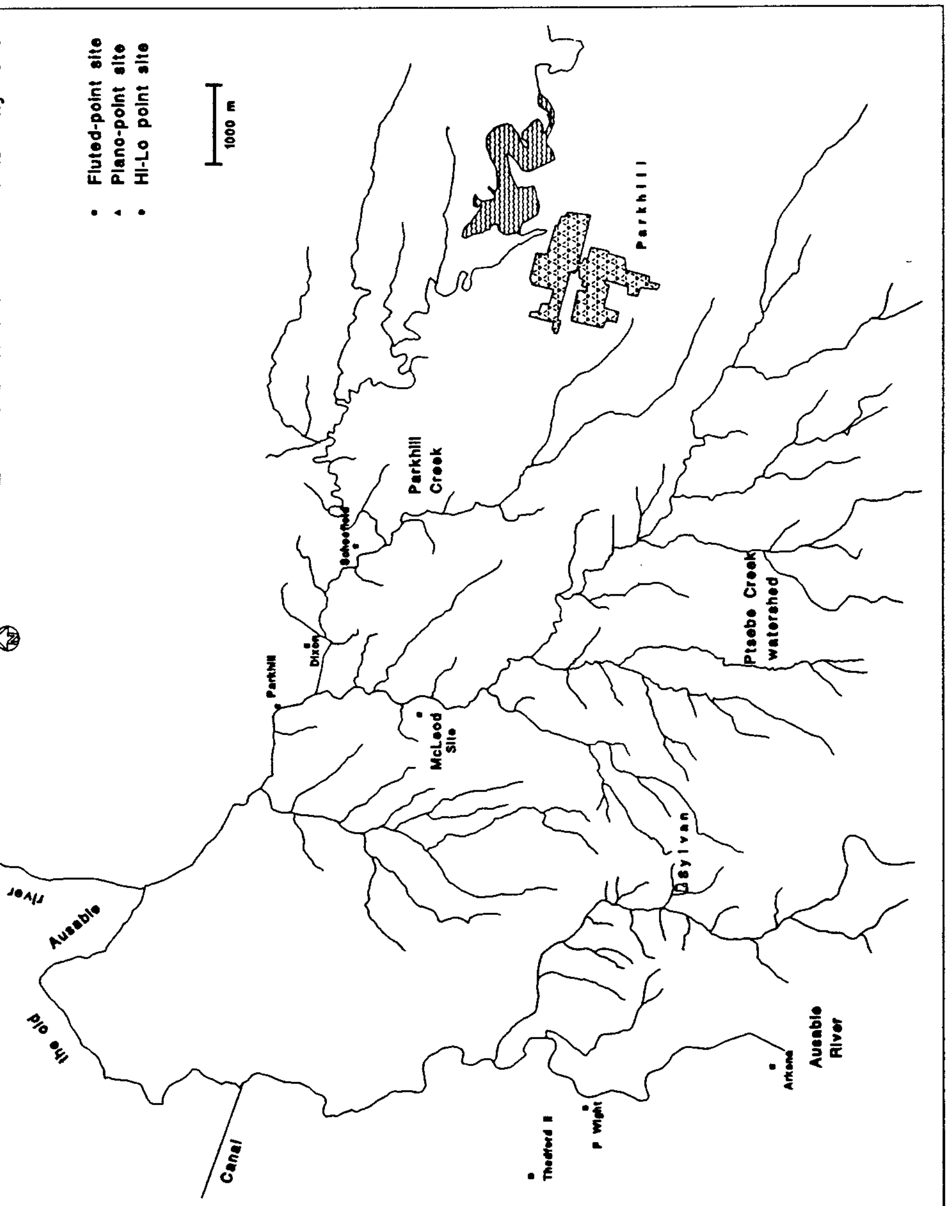

The Ptsebe watershed
local to the McLeod site
Figure 5
McLeod Site Physiography
500 m
contour interval: 5 m
PC - Parkhill pollen core
185 m
190 m
PC
Grid A
Grid B
Grid C
185 m
195 m

Figure 6
EPI Sites at the Thedford Embayment



Deller 1986:54-55). The absence of EPI horizon material on the lakeward side of the strand-line, but the frequent identification of later cultural horizons below it, infers that the EPI occupation in the area was contemporary to Main Lake Algonquin/Ardtrea (Deller and Ellis 1992a:8).

2.3 REGIONAL POLLEN ANALYSIS

The pollen core obtained ***ca.*** 400m (Figure 5) north of the McLeod site along a tributary of Ptsebe Creek in 1975 was part of the Parkhill and McLeod site research. The pollen data provide a general environmental model for these sites. The core deposition sequence has an unconformity, caused by a ***ca.*** 5 000 year hiatus between the drainage of Main Lake Algonquin/ Ardtrea and return to Lake Nipissing phase levels. The base of the profile comprises Algonquin/ Ardtrea sediments, the top of which was truncated by erosion during the low-water period between Algonquin/Ardtrea and Nipissing phase, overlain by the Nipissing stratum, and capped by modern stream deposits (Morgan ***et al.*** in prep.).

The pollen core is used in the following regional synthesis of pollen data to provide a paleovegetational context for the Paleo-Indian occupation at McLeod, and more broadly for the Paleo-Indian occupation in all of southern Ontario. The sample analyzed consists of 130 pollen sites (Figure 7, Table 1, Appendix A), obtained primarily from southern Ontario, but includes data from adjacent northern Ontario, western Quebec, western and upstate New York, Michigan, and Ohio, to provide a regional context for the study main study area. Southern Ontario is identified here as the region south of the Canadian shield, bounded by Lakes Huron, Erie and Ontario, covered by glacial till or proglacial fluvial and lake deposits (Chapman and Putnam 1984:9).

Percentages of selected pollen types were measured at points in the profiles, and dates for these points interpolated (Campbell 1996) between ^{14}C dates, or between ^{14}C dates and a dated synchronic pollen zone boundary (***e.g.*** the ***Tsuga*** decline, dated to ***ca.*** 4 800 bp: Davis 1983: 177). Dates were not interpolated across real or suspected unconformities in cores. Based on comments by Dr. John McAndrews (1998 per. comm.), ^{14}C dates were evaluated by the material dated. Grading was used as a data filter in the analysis to reduce noise caused by inaccurate

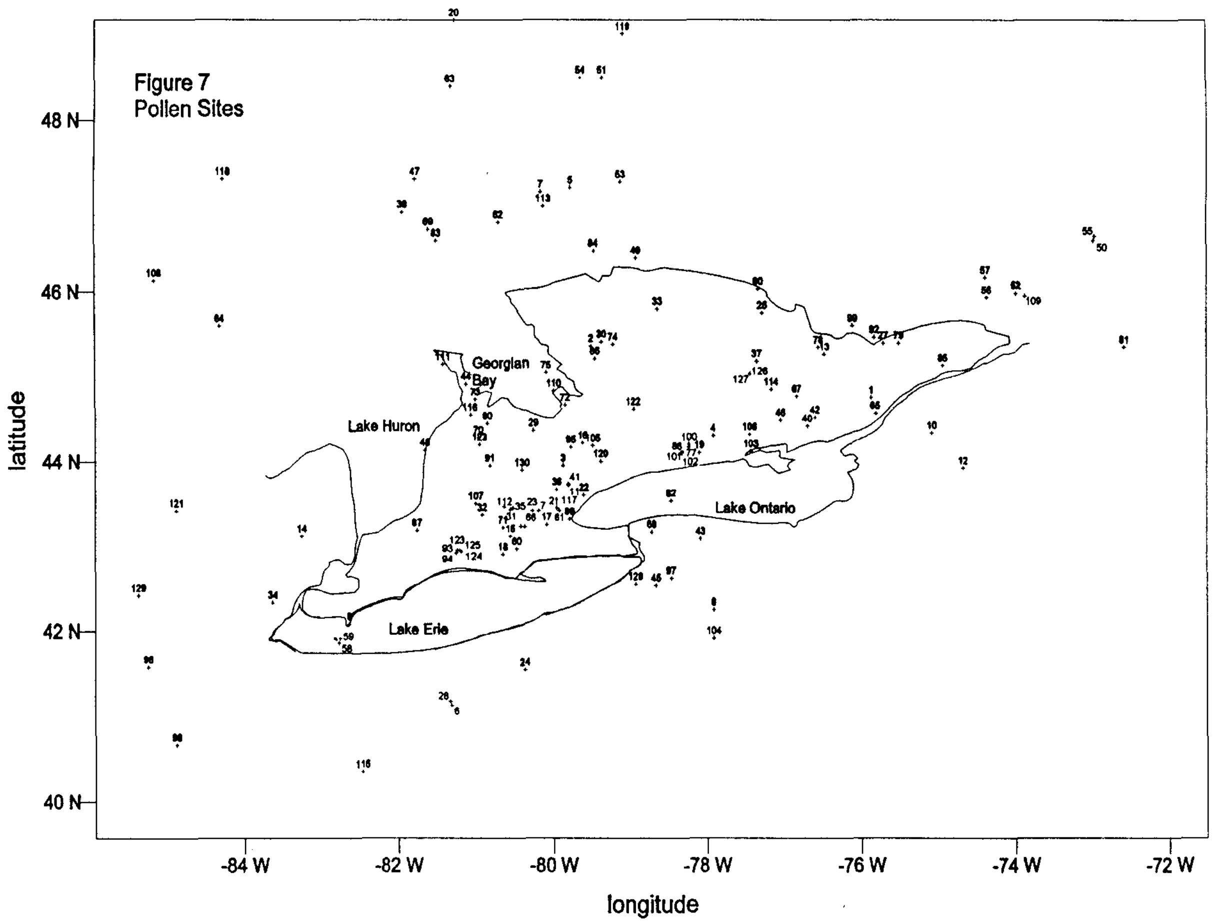


Figure 7
Pollen Sites
Georgian Bay
Lake Huron
Lake Ontario
Lake Erie
48 N
46 N
44 N
42 N
40 N
-84 W
-82 W
-80 W
-78 W
-76 W
-74 W
-72 W
latitude
longitude

Table 1: Pollen Sites					
Pollen site name	#	Pollen site name	#	Pollen site name	#
Atkins Lake	1	Houghton Bog A+B	45	Peatsah Site	89
Axe Lake	2	Inglesby Lake	46	Perch Lake	90
Ballycroy Bog	3	Jack Lake	47	Pike Lake	91
Barry Lake	4	Kincardine Bog	48	Pink Lake	92
Baseball Bog	5	Lac Bastien	49	Pond Mills I	93
Battaglia Bog core 1	6	Lac Castor	50	Pond Mills Pond	94
Bear Bog	7	Lac Clo	51	Porqui Pond	95
Belmont Bog	8	Lac Geai	52	Pretty Lake core A	96
Bondi Site	9	Lac Louis	53	Protection Bog	97
Boyd Pond	10	Lac Yelle	54	Pyle Site 1980D	98
Brampton Esker Bog	11	Lac a Sam	55	Ramsay Lake	99
Brandreth Bog/Lake	12	Lac a St-Germain	56	Rice Lake McIntyre	100
Cataraqui River Marsh	13	Lac aux Quenoilles	57	Rice Lake core B	101
Chippewa Bog	14	Lake Erie 1244	58	Rice Lake core E	102
Colles Lake	15	Lake Erie 68-6	59	Roblin Lake	103
Cookstown Bog	16	Lake Hunger	60	Rose Lake US	104
Copetown Bog	17	Lake Medad	61	Rose Swamp	105
Cornell Bog	18	Lake QC	62	Ross Lake	106
Cranberry Lake	19	Lake Six	63	Rostock Mammoth Site	107
Crates Lake	20	Lake Sixteen	64	Ryerse Lake	108
Crawford Lake	21	Lambs Pond	65	Saint-Calixte	109
Creditview Wetland	22	Little Lake	66	Second Lake Core 4	110
Crieff Kettle Bog	23	Little Round Lake	67	Shouldice Lake	111
Crystal Lake	24	Lockport Gulf Section	68	Sunfish Lake	112
Daber Lake	25	Loon Lake	69	Three Pines Bog	113
Decoy Lake	26	Louise Lake	70	Tonawa Lake	114
Dows Lake Bog Site 3	27	Maplehurst Lake	71	Torren's Bog core TB-4	115
East Twin Lake Ohio Etl2	28	Marl Lake	72	Townline Lake	116
Edward Lake	29	Mary Lake	73	Twiss Marl Pond	117
Fawn Lake	30	Mayflower Lake	74	Upper Mallot Lake	118
Fischer-Hallman Site	31	McCarston's Lake	75	Val St. Gilles	119
Forest Pond	32	McCormick Point Wetland	76	Van Nostrand Lake	120
Found Lake	33	McIntyre Site Marsh 3	77	Vestaburg Bog core 1	121
Frains Lake	34	McLaughlan Lake	78	Victoria Road Bog	122
Gage Street	35	Mer Bleue Peat Bog	79	Wales Site	123
Georgetown Site	36	Minesing Swamp	80	Walker Pond I	124
Graham Lake	37	Mont Shefford	81	Walker Pond II	125
Greenbush Swamp Man 3	38	Nichols Brook Site 2	82	Weslemkoon Lake Core 1	126
Hams Lake	39	Nina Lake	83	Weslemkoon Lake Core 2	127
Harrowsmith Bog	40	North Bay Bog	84	Winter Gulf Site Section 1	128
Heart Lake ON	41	Northfield Bog	85	Wintergreen Lake	129
High Lake	42	Nutt Lake	86	Wylde Lake Bog	130
Hiscock Site	43	Parkhill Creek	87		
Hope Bay	44	Paynter Site	88		

^{14}C dates. Six discrete ^{14}C quality levels were identified: wood is the level (7), followed by; (6) peat; (5) gyttja; (3) heterogenous sediment (some combination of peat, gyttja, muck, silt, sand, plant detritus or fibre); (1) old-carbon rich materials (marl, calcite, shell, collagen), and (0) unknown sources. Interpolations made between dates of differing quality levels were attributed to the lower date grade. Unknown sources were excluded from all analyses due to uncertain error. Radiocarbon dates are not corrected in this discussion as the conversion to sidereal time is not a finalized process, and the validity of converting interpolated dates is unknown. One pollen core, Loon Lake, was dated by varve counts. For comparative purposes, these sidereal dates were converted to equivalent ^{14}C years.

As another factor, ^{14}C plateaus exist due to variations over time in the ratios of atmospheric carbon isotopes, notably between 13 000 bp and 9 000 bp (Lotter 1991:326-7). Plateaus most relevant to this study centre around 9 600 bp and just before 10 000 bp (Fedje ***et al***: 1995: 105), where as many as 400 sidereal years may pass with no change, or reversals, in ^{14}C years (Ellis ***et al*** 1998:152; Ellis and Deller 1997:5). Another plateau may exist at ***ca***. 10 600 bp (Curran 1996:8). When ^{14}C dates obtained from within plateau periods are used in chronologies, they may misrepresent the number of sidereal years which have taken place within this span. It is likely that the ^{14}C span of 11 000 to 10 000 bp actually represents ***ca***. 1 700 sidereal years, and thus the EPI occupation of southern Ontario (***ca***. 11 000 to 10 400 bp) actually spans more than 1 000 sidereal years (Spiess ***et al***. 1998:238). There is little that can be done other than to acknowledge this problem in existing data, and recognize that it has an effect on pollen and cultural chronologies alike. The impact is minimized by using ^{14}C dates adjacent to these plateau zones, to interpolate chronologies across the plateaus.

Three pollen types and one pollen group were examined, on the basis of their probable association with the early and late Paleo-Indian occupations of southern Ontario; *Picea* (Spruce) *Pinus* (Pine), *Betula* (Birch), and terrestrial non-arboreal pollen or NAP (grasses and sedges such as *Cyperacae*, *Ambrosia*, *Artemesia*, and *Graminae*). Criteria were set for inclusion of pollen profiles in the analysis. An internally dated, metachronic data-set was required, spanning a portion of the period under examination: indirectly dated profiles were rejected. Within this time span, the pollen profile had to display a datable pollen transition within at least one of the study groups. Systematic pollen analysis of the core through the time span identified was required: single point or constricted analyses of monochronic event samples were excluded. Percentages of terrestrial pollen were the standard measure; the sum was arboreal pollen plus terrestrial non-arboreal pollen. Pollen data not presented in this format (actual pollen counts, or percentage of pollen sum calculated separately for arboreal and non-arboreal pollens) were converted to the above format in order to standardize the analysis.

Pollen transitions within the identified study groups were defined as follows. For *Picea*, two points in the pollen profile were dated: the last peak in pollen frequency (above 20%), and the final decline in pollen frequency below 20%. *Pinus* was measured for the first rise above 20%; first maximum percentage, and final decline below 20%. *Betula* was dated at its first rise above 5%, and NAP where it first dropped below 5% in the post-glacial. The term peak, in reference to elevated frequencies in the occurrence of *Picea* or *Pinus* pollen, does not conform to definitions of biostratigraphic zone peaks detailed in the Code of Stratigraphic Nonmenclature (Anonymous 1961:655-656). As defined by McAndrews (1981), pollen zones 1 and 2 would constitute *Picea* and *Pinus* biostratigraphic peak zones respectively, in accordance with the Code.

The critical pollen frequencies differ between *Picea/Pinus* and *Betula*/NAP (*e.g.* 20% and 5% respectively) due to differential rates of pollen production and dispersal. These levels are used because they are significant transition points in the representation of each type, determined from data observations and Gaudreau's analysis (1988). In the latter, *Picea* pollen frequencies over 20% are used by Gaudreau to identify a spruce-rich forest, and *Pinus* pollen frequencies of between 20 and 40% define a pine-rich forest. She did not track *Betula* or NAP separately, and the 5% levels used in this analysis are based on a survey of the data. The pollen transitions or peaks do not correspond with pollen zones (***e.g.*** McAndrews 1984; Fuller 1997; Campbell ***et al.***

1997). Pollen zones represent large suites of pollen types, and the transitions between zones constitute changes in a broader range of pollen types than considered here.

Two of the above three genera (*Picea* and *Pinus*) and NAP groups were used because they are closely associated with the Late Quaternary and Early Holocene post-glacial environment in the lower Great Lakes. The three groups define pollen zones 1 (*Picea* peak and NAP present) and 2 (*Pinus* dominant) described by McAndrews (1988:161-162). They are associated with the EPI occupation in this region, by dating of occupation horizon and inferred subsistence strategies grounded in vegetation assemblages. *Betula* was selected for comparison with the three other groups to track a non-coniferous arboreal genus in the region. In modern pollen rains, shrubby *Betula* is associated with both tundra and the forest-tundra zones, with higher percentages in tundra (McAndrews 1981:323). This genus was used by Gaudreau in the *Betula-Acer-Fagus-Tsuga* group in a large scale analysis of pollen trends in northeastern North America (1988:234).

Site data were plotted by latitude and longitude (x, y), and date-values (z), with z-values trend surface analyzed by quadratic regression, to plot isochrones over the region. Regression variance (S_x and S_y) was calculated using coefficient residuals between data points and the trend surface using x- and y-axes data, as was the covariance value (S_{xy}). The r and r^2 values were derived from these statistics, providing a measure of the trend surfaces' fit with the data, using $r=S_{xy}/(S_x{*}S_y)$. Trend surfaces were calculated and plotted using Surfer 6.04, while the associated statistical analyses of variance, covariance and r-values were produced with Quattro 7.0.

A 500 year isochrone interval was used based on the data. With a +/- 155-227 year range of error for ^{14}C dates within one standard deviation (66.7% confidence), an interval under 500 years was not used to avoid suggesting finer data resolution than is the case. The error level is exacerbated by the ^{14}C plateau issue identified above, where radiocarbon dates imply an unwarranted precision in calendar years (Lotter 1991). In actuality, the trend surface is a continuum, so a series of 1 year contour intervals is possible, but misleading. The analysis also does not take into account elevation, where lapse rates suggest that higher areas would lag behind general vegetation succession (*e.g.* Gaudreau 1988:248; Yu 1997:153). Elevations were not readily available for many of the sites used, and the complexity of factoring this component into the mode is beyond the scope of the analysis, which is focused on broader trends.

The analysis results are informative. Variance in r^2 fit values is minor across the analysis of different quality levels of ^{14}C dates, contradicting the prediction that low grade ^{14}C dates might introduce more noise into the model, resulting in lower r^2 values. The implications of this pattern are beyond the scope of this paper. Regardless, no r^2 values fell below 0.85, so the correlation between the surface trend mapped by isochrones and actual pollen site dates is strong. The results indicate that when all sites are used, not filtering out lower grades of data, the pattern of succession is delayed by *ca*. 200-500 ^{14}C years. This pattern is anticipated, as old carbon is more likely to be present in material providing lower grade ^{14}C dates, such as marl. Differences between sets using grades three and up and those using levels five and higher are minimal. However, use of data sets consisting of only grade five and higher ^{14}C dates reduces the sample set markedly. The compromise presents trend surfaces using grade three and higher ^{14}C dates, unless otherwise noted. Data sub-sets used are chosen to best illustrate the interpretation. Overall, the high r^2 values argue strongly for a directional vegetation gradient, contradicting Storck and Spiess (1994:133), who propose that there is no evidence for such a gradient.

The results indicate early post-glacial tundra, consisting of expansive, open areas, based on the presence of *Betula* in southcentral Ontario by 12 000 bp (Figure 8: r^2=0.996; McAndrews 1981:323). *Picea* is also present early in the deglaciated environment (Figure 9: r^2=0.887), following the rise of *Betula* by approximately 300 ^{14}C years. It moves into the southern limits of the Ontario peninsula prior to 12 000 bp, with peak frequencies extending to the northern boundary of southern Ontario by *ca.* 10 500 bp.

The appearance of *Picea* in significant numbers is interpreted as a succession of the tundra, supplanted by what is described here as 'spruce parkland', consisting of open areas populated by herbs and shrubs, interspersed with spruce stands in sheltered areas. The change is marked by a rise in *Picea* pollen levels, while high NAP levels continue. Spruce parkland is modeled on aspen parkland (Bird 1961:4; Campbell 1994:360-361), although the former is without modern analog. In western Canada, aspen parkland consists of open, grassy uplands broken by stands of aspen in low-lying or sheltered areas (Bird 1961:4), often a colonizing assemblage responding to fire or drought (Campbell 1994:360). Spruce parkland is a post-glacial analog of the aspen model for northeastern North American, as *Picea* colonizes areas dominated by open vegetation. The patchy distribution, marked by high NAP levels, arises from colonization and environment factors of soil fertility and stability (Yu 1997:145, 153, 216; Pennington 1986:105-118), and microclimate (section 2.4), rather than seed dispersion (McAndrews per. comm 1998). It is not the equivalent of the northeastern transition zone (Rowe 1972:28) sometimes informally referred to as spruce parkland (Winn 1977:71) or taiga open spruce forest (Winn 1972:109).

As *Picea* peaks northward, it declines in the south, starting between 10 500 and 11 000 bp in the southwest, to 9 500 bp at the region's northern boundary (Figure 10: r^2=0.913). The *Picea* drop is preceded by a drop in NAP, marking the transition from open parkland to a closed forest (Figure 11: r^2=0.925) ***ca.*** 11 000 bp in the southwestern tip of Ontario, reaching the northern boundary ***ca.*** 10 000 bp.

Pinus moves into southern Ontario at significant frequencies (***e.g***. 20% and higher) ***ca.*** 10 500 bp (Figure 12: r^2=0.930, ^{14}C grade five and higher), trending north-northeastward and spreading to the northern limits of the region by between 10 000 and 9 500 bp. The *Pinus* peak occurs ***ca.*** ^{14}C years behind this initial rise (Figure 13: r^2=0.895), and the *Pinus* decline ***ca.*** 1 000 years after this (Figure 14: r^2=0.910). The movement of *Pinus* into the region is concurrent with the decline of *Picea*, suggesting a supplanting of the latter by the former. The *Pinus* rise occurs ***ca***. 500 years after the NAP drop, inferring that as *Pinus* moves in to replace *Picea*, it enters a spruce-dominated, closed forest. This evidence contradicts previous interpretations (***e.g***. Ellis and Deller 1990) that the first closed forests in the area arrived with pine.

As a model, it is suggested (Ellis 1998: per. comm.) that the EPI chronology in southern

Figure 8
Betula pollen rise

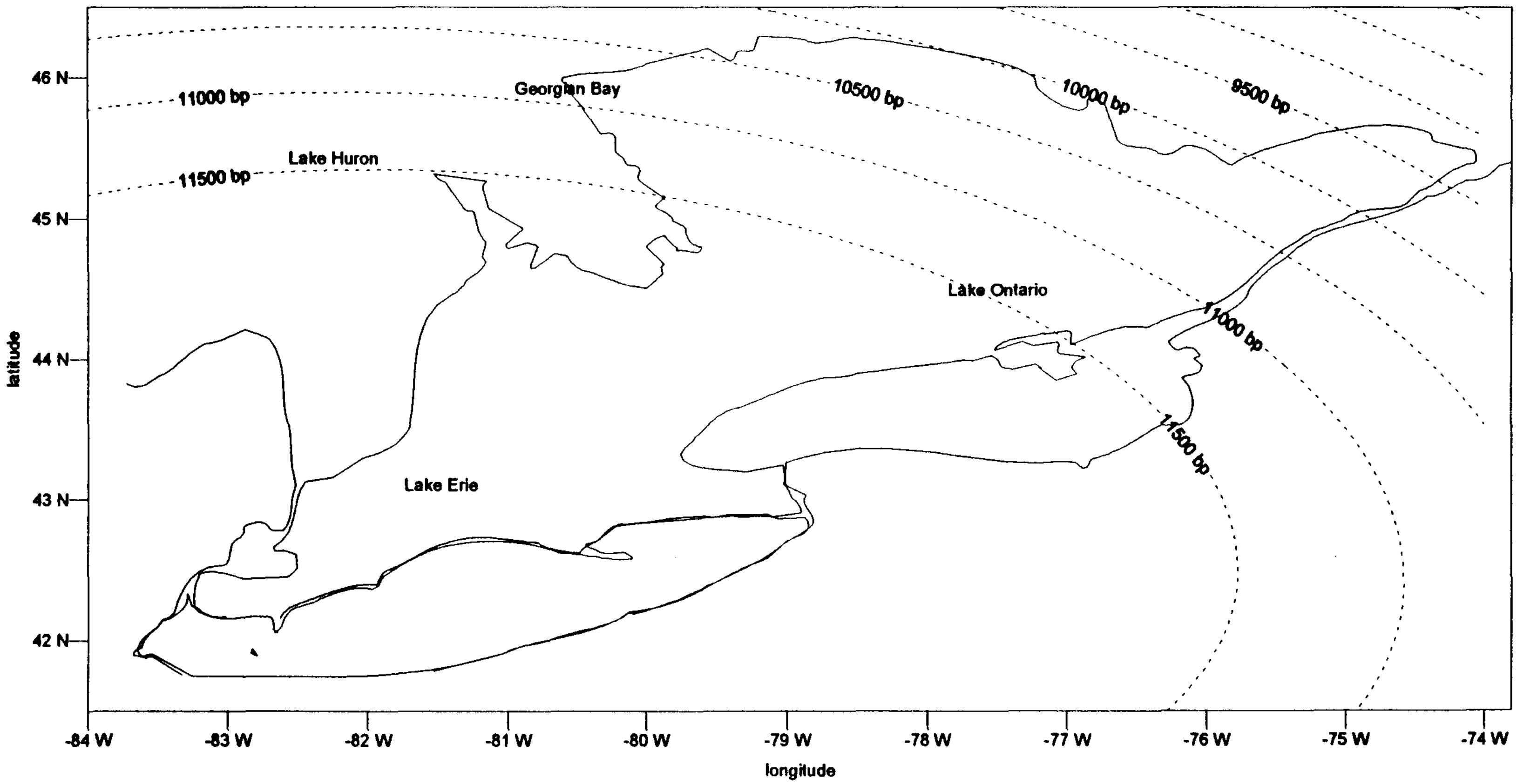


Figure 9
Picea pollen peak

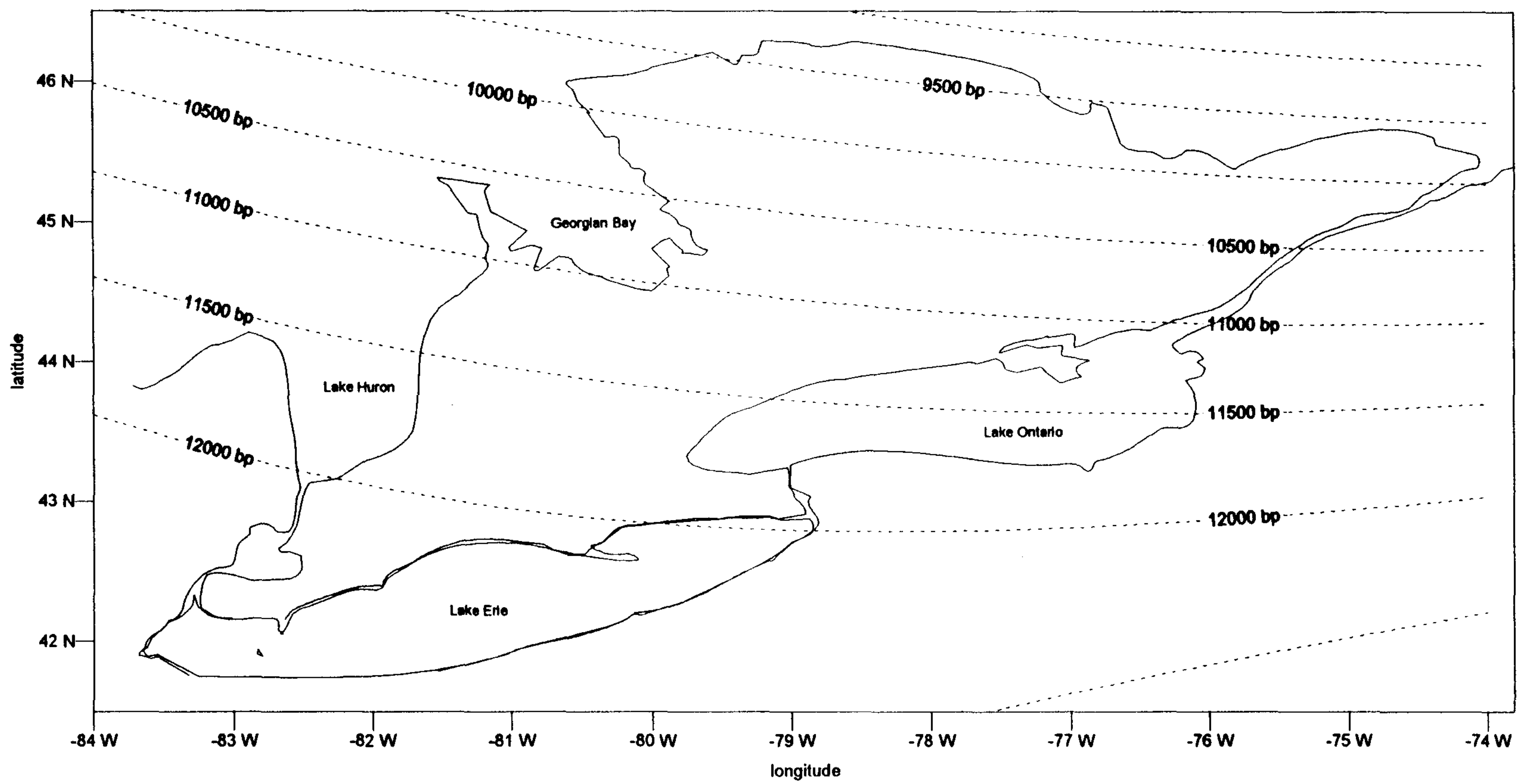


Figure 10
Picea pollen drop

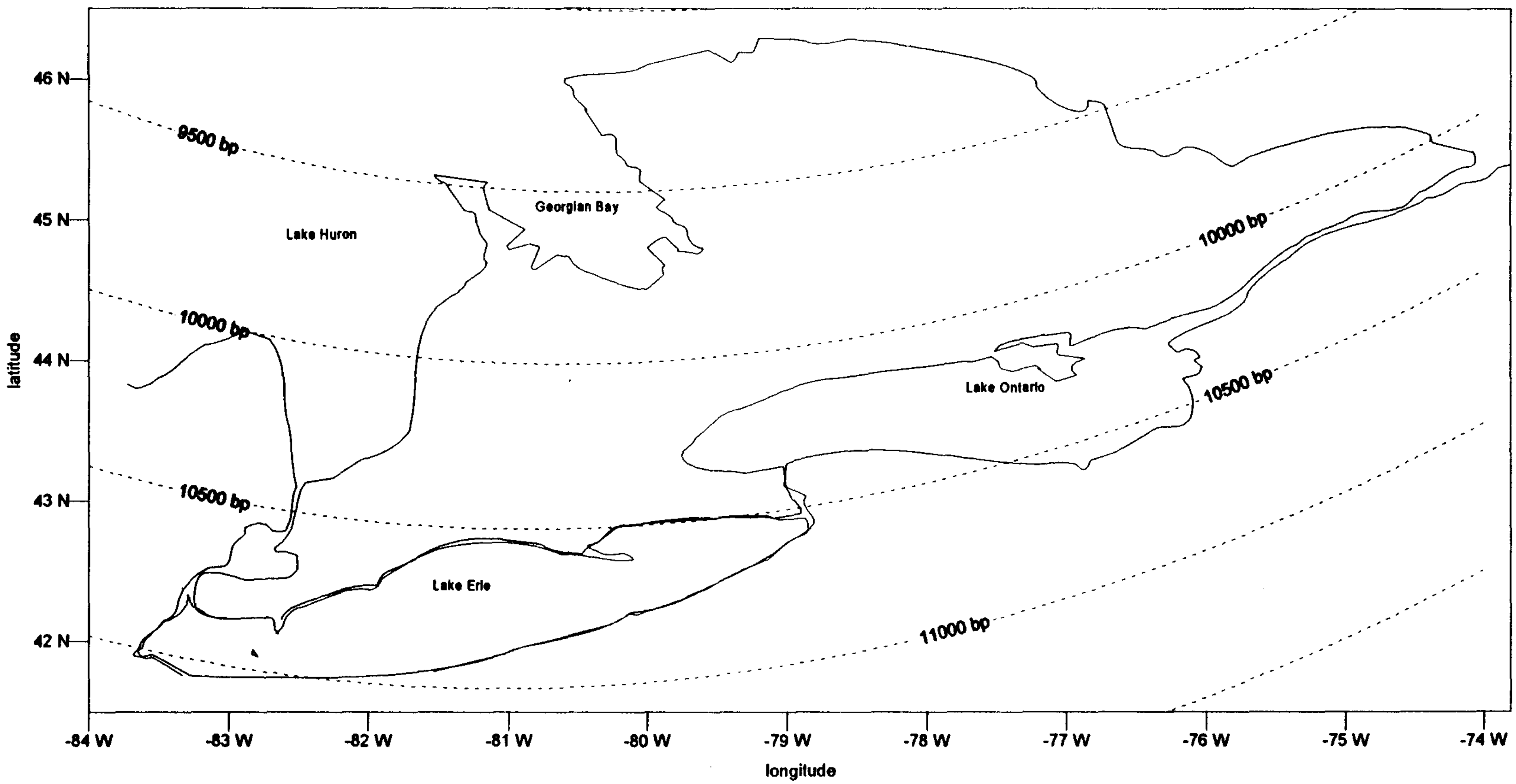


Figure 11
NAP pollen drop

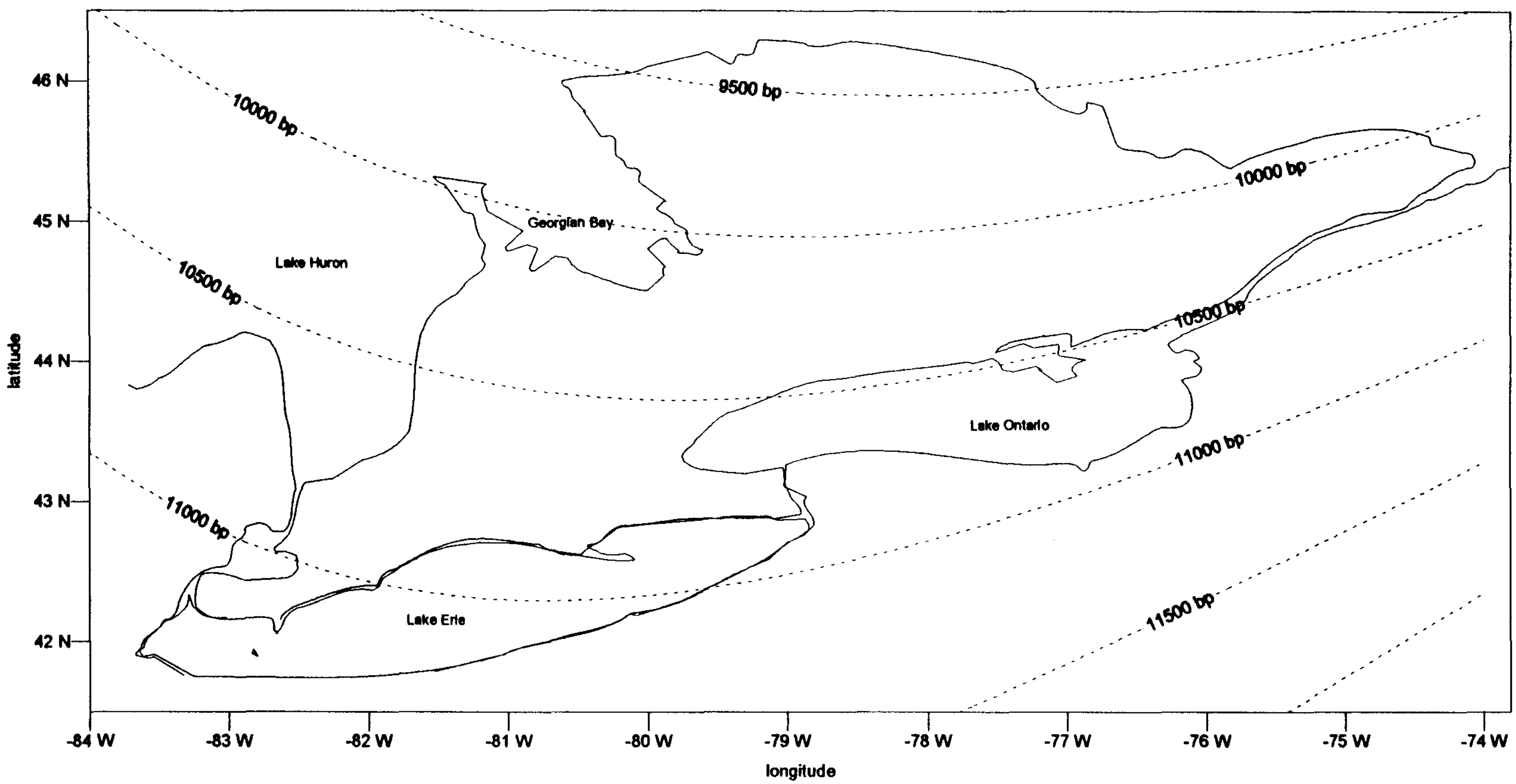


Figure 12
Pinus pollen rise
(level 5 dates plus)

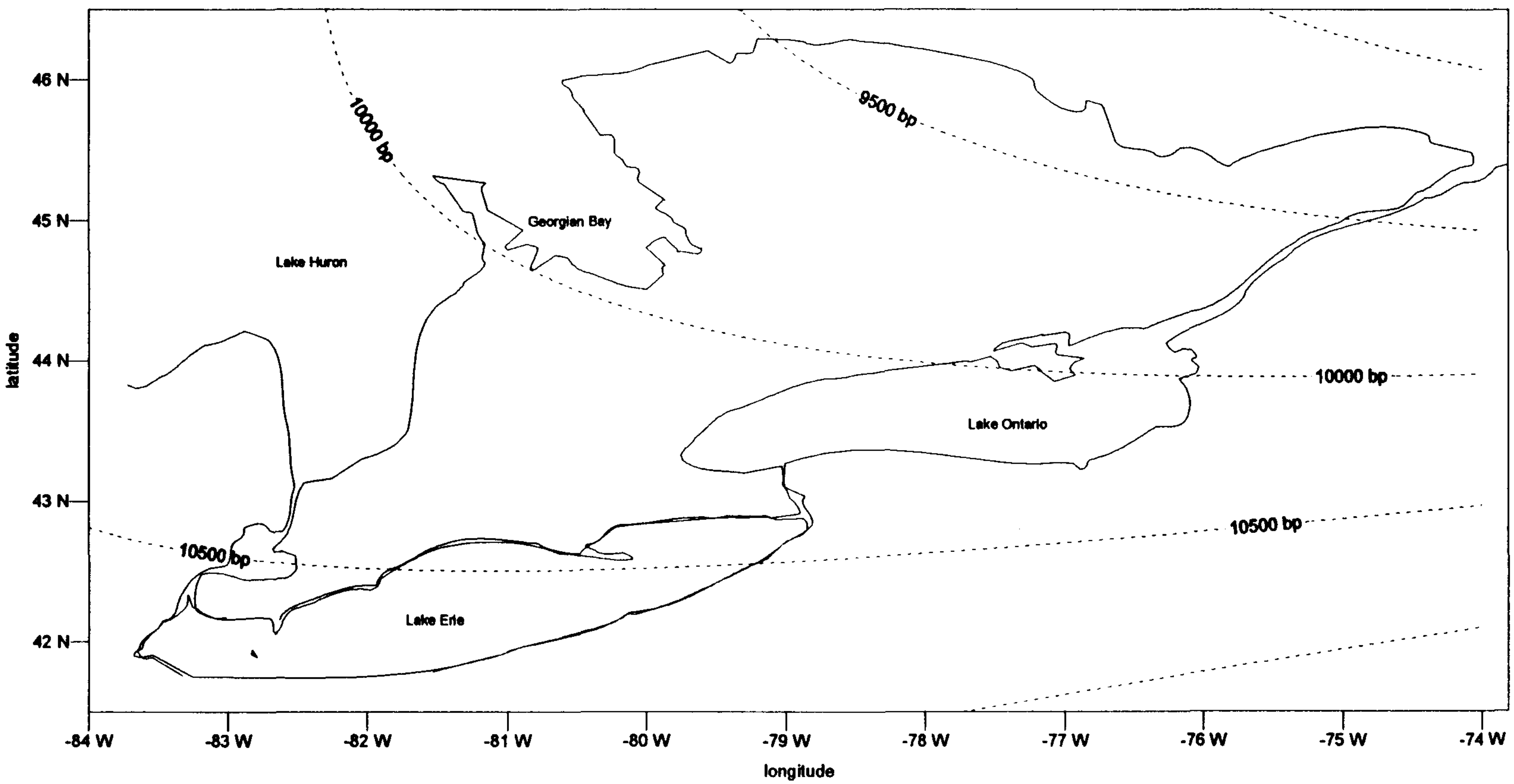


Figure 13
Pinus pollen peak

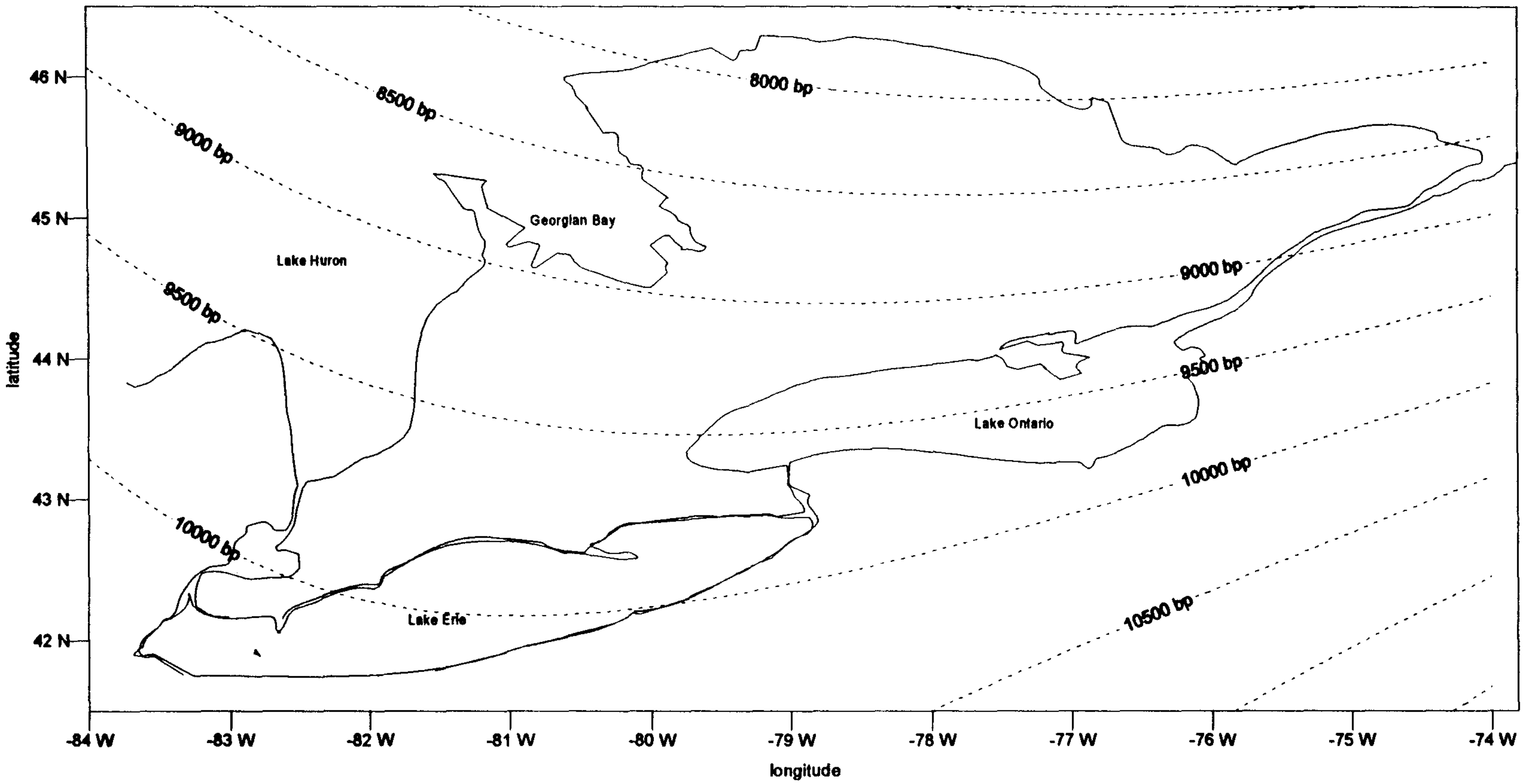
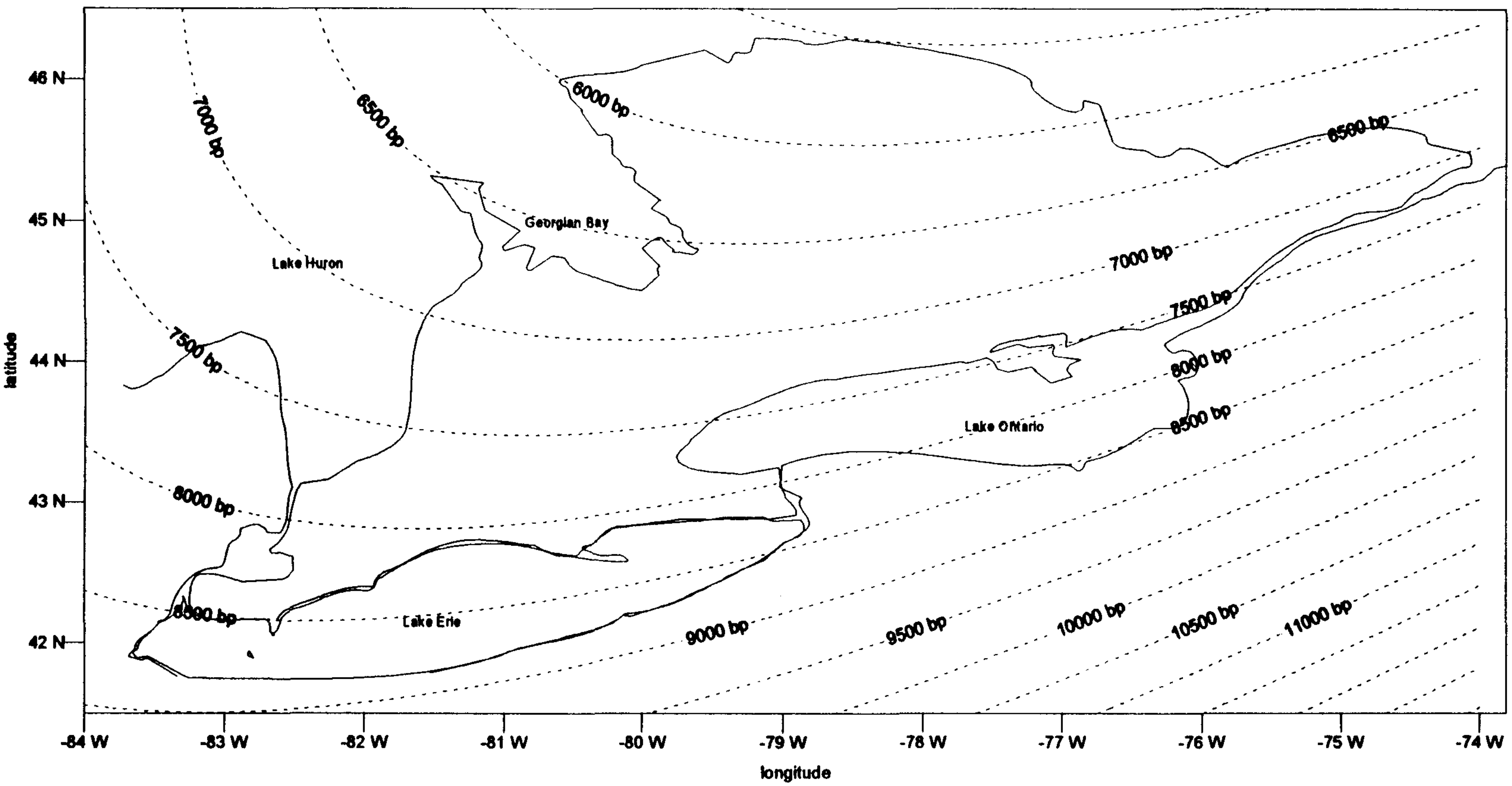


Figure 14
Pinus pollen drop



Ontario can be postulated using a gradualistic approach. The association with Main Lake Algonquin/Ardtrea noted earlier, as well as confirming data from sites in adjacent areas (Ellis ***et al.*** 1998 for a summary) suggests an age of ***ca.*** 11 000 to 10 400 bp. On this basis, each of the three phases can be said to cover approximately the same time span - ***ca.*** 200 ^{14}C years. The Gainey complex thereby colonizes the area beginning around 11 000 bp, with the transition to Parkhill complex at ***ca.*** 10 800 bp. Crowfield appears at approximately 10 600 bp, and the end of this complex is marked by the draining of Main Lake Algonquin/Ardtrea, ***ca.*** 10 400 bp. Given the current lack of actual ^{14}C dates in the study area, it is a reasonable chronology. The ^{14}C plateau problem remains, however, meaning that the spans of these complexes are longer. The gradualism premise does not take into account the possibility that rapid subsistence strategy changes might drive some form of technological punctuated equilibrium instead.

The current model for EPI colonization of southern Ontario sets the Gainey complex entering a spruce parkland environment ***ca.*** 11 000 bp. The Gainey to Parkhill complex shift occurs near the transition from spruce to pine dominance, and closure into a boreal forest. The final EPI Crowfield complex occurs prior to the demise of Main Lake Algonquin/ Ardtrea, ***ca.*** 10 500 to 10 400 (Deller and Ellis 1992a:8: Deller and Ellis 1988). No major vegetation transition is attributed to the latter transition, although it is suggested that it may be related to the closure of lake margins from open areas to boreal forest (Ellis and Deller 1997:17).

The interpretation based on the data analysis results here, and using the cultural chronology proposed, concurs. In the later stage of spruce-domination, the forest closes with a drop of NAP values to near zero. In southern Ontario this places the Gainey complex in spruce parkland, with spruce-dominant forest present only in the southwestern tip of the Ontario peninsula. The Parkhill complex occupation in southwestern Ontario takes place primarily in a closing, spruce-dominated forest, while in southcentral and southeastern Ontario the vegetation remains spruce parkland. During the Crowfield complex occupation, the *Picea*-climax closed forest is present across southwestern Ontario, with *Pinus* gaining dominance at the southwestern limits of Ontario.

Southcentral and southeastern Ontario remain spruce parkland, although the ecotone has moved northward. In this context the Gainey complex occupies almost solely spruce parkland. The Parkhill occupation is in a closing spruce forest in the southwest, with large areas of spruce parkland in the remainder of the study area. The Crowfield complex occurs in both closed, spruce-dominated forest in the southwestern limits of the range, through closing spruce forest and spruce parkland to the north, traversing these ecotones within their ranges.

The placement of Fisher site occupants (Parkhill complex) in a spruce-parkland (Storck and Spiess 1994:134-135) is supported with the above data. In this area, the *Picea* peak occurs ***ca***. 11 000 bp, and a NAP drop at ***ca***. 10 300 bp indicates that the vegetation remains open until this time. While *Pinus* enters the record in significant numbers at ***ca***. 10 300 bp, the *Picea* decline does not take place until approximately 9 700 bp, indicating a closed forest co-dominance. With the premise that the Fisher site is occupied when the region remains open parkland (equivalent to woodland - Storck and Spiess 1994:134), the occupation is placed between approximately 11 000 and 10 300 bp. After this period in north-central southern Ontario, forest closure is complete, while the location of the Fisher site itself on the edge of a proglacial lake ensures that the site locale is open parkland, as discussed below. While they argue that such "pollen dating" techniques may provide more precision than ^{14}C methods (Storck and Spiess 1994:134), the vast majority of dated pollen profiles use ^{14}C for age determination. The premise that a spruce-pine transition and forest closure model at ***ca***. 10 500 - 10 600 bp for southern Ontario as a whole (1994:133) can be used to mark the boundary between the (parkland) Gainey and (closed forest) Parkhill phases is contradicted by the vegetation transgression and succession model arrived at in this thesis. Associating the Parkhill phase with the spruce-pine transition, the Gainey-Parkhill boundary would date to ***ca***. 9 700 bp, an untenable hypothesis.

McAndrews (1973:74) attributes some of the arboreal pollen in late Quaternary and early Holocene profiles to wind-borne and recycling (glacially transported) sources. While this is probable, and explains anomalous patterns of pollen frequency in early post-glacial till, the degree to which this may impact subsequent pollen zones (*i.e.* spruce parkland or spruce and pine closed forests) has not yet been ascertained.

Based on the pollen analysis, the paleoclimate during the EPI occupation of southern Ontario was not hospitable. In describing the tundra and forest-tundra (parkland) average temperatures, McAndrews estimates mean average temperatures of -7° C or colder and -3° C respectively (1981:330). He also states that by 10 500 bp mean annual temperatures rose above -3° C, permitting boreal forests south of 46.5° latitude. As described below, this paleoclimatic model may require some reconsideration.

2.4 OTHER PALEOENVIRONMENTAL INDICATORS

The early post-glacial environment in the study area marks a substantial climatic shift, with no modern analogs (Webb 1986:76; Terasmae and Matthews 1980: 1094). Vegetation present during the EPI occupation of southern Ontario is probably affected by lag due to the rate of glacial till developing into a soil supporting trees, and the speed at which seeds were dispersed across the recently exposed landscape (Webb 1986:76, 83). *Picea*, for example, colonizes raw (relatively inorganic soil) better than other trees (Wright 1964:442). On this basis, it is argued that the vegetation present in southern Ontario during EPI colonization does not closely reflect the paleoclimate. In part this point is moot. Despite the actual paleoclimate (*e.g.* mean January/ July/annual temperatures, annual precipitation), the actual vegetation assemblage delimits potential subsistence strategies of all organisms directly or indirectly dependent on plants. As well, the trend surfaces outlined above are general, and do not address micro-environmental factors, such as the impact of lapse rates at elevated sites, the amelioration of cold climates by sheltered refugia, the hostility of local conditions at downwind margins of proglacial lakes, *etc*.

Some paleoenvironmental data do suggest a climate warmer than that inferred by the tundra-forest transition zone or boreal forest, used as modern analogs for the EPI environs. Fossil *Coleoptera* (beetles) are used in several analyses (Ashworth 1977; Morgan *et al.* 1982; Morgan & Morgan 1980; Schwert *et al.* 1985; Fritz *et al.* 1987), with the premise that both modern and post-glacial *Coleoptera* species were adapted to the same environments.

These studies recognize a lack of modern analogs for the early post-glacial environment, but do conduct some finer resolution environmental interpretations. Fossil *Coleoptera* analysis in the valley of a northern Main Lake Algonquin/Ardtrea river (Eighteen Mile River) suggest a cold climate, typical of the forest-tundra transition zone in northern Canada (Ashworth 1977:1632). This microenvironment is caused by cold westerlies which, along eastern lake margins, would lead to "locally rigorous microclimates" (Ashworth 1977:1633).

However, Morgan and Morgan note that for southern Ontario as a whole

> "The evidence derived from the insect faunas indicates that the tundra plant assemblages are not reflecting thermal conditions so much as pioneering communities. Many of these plants fix nitrogen and are, therefore, able to colonize recently deglaciated areas. The insects reflect more thermophilous conditions than are being suggested by the plants" (1985:1124).

Fossil *Coleoptera* provide evidence of vegetation colonization lag, impacted less by climatic variables than soil fertility and drainage (Davis 1983:168). Schwert ***et al*** note that for the Gage Street site, an interior upland location, all *Coleoptera* present in the early pine-dominant closed forest portion of the profile occur in modern southern Ontario, suggesting climatic conditions warmer than indicated by the vegetation (1985:224). Morgan ***et al.*** (1982) conclude that the transition of spruce to pine in southern Ontario was a case of succession, not associated with any major climatic change. They note that for *Coleoptera* recorded in southwestern Ontario dating between 11 000 and 10 000 bp, none are resident in modern arctic or alpine tundra, but instead all are found in modern boreal forests in central and southern Ontario (1982:385).

The climatic data provided by fossil *Coleoptera* indicate an environment more temperate than inferred by pollen profiles of spruce-parkland and closed spruce- or pine-dominant forest. It also suggests that some microclimates are less hospitable, like lake margins exposed to westerly winds (Ashworth 1977:1632; Morgan ***et al.*** 1982:385; Morgan 1988:204-205). *Coleoptera* data represent microclimates more accurately than most pollen samples, with a more rapid response than plants to rapid climatic change typified by the early post-glacial environment. This result is predictable given the differing degrees of mobility between plants and insects.

Fritz ***et al.*** (1987) reach similar conclusions, using pollen, *Coleoptera*, and oxygen isotope ratios from Gage Street, Nichols Brook and Inglesby Lake. These data show no rapid climatic change at the transition from spruce-parkland to spruce closed forest to pine closed forest, with a general systemic increase in mean July temperatures of 4° C between ***ca.*** 12 600 bp to 10 000 bp, and an increase in mean annual temperatures of 3° C in the same time span (1987:199). The change occurs after an initial Wisconsin glaciation retreat, implying more substantial climatic shifts prior to these observations (***e.g.*** Davis 1983:166). Yu (1997: 151-3, 216) also conducted isotope and carbonate analyses, showing that *Picea* peaks occur after peaks in oxygen isotopes and carbonates, concluding that vegetation generally lagged behind climatic warming.

Additional climatic data, based on the presence of permafrost ice-wedges ***ca.*** 13 000 bp, supports the argument that recently deglaciated landscape was tundra (Morgan 1972). These conditions changed rapidly, and despite the ice front in the Lake Huron and Ontario basins, relatively thermophilous insects appear in the record. Faunal (*Coleoptera*) and vegetation assemblages are out of phase at this juncture (Morgan and Morgan 1980:1124), a situation continuing beyond the EPI occupation of this region. From *Coleoptera* data, Morgan ***et al.*** suggest a July mean temperature range of between 16° to 18° C for southwestern Ontario between 11 000 and 10 000 bp (1982:385), ***vs.*** modern July means of 21° C for London, 18° C in North Bay, and 17° C in Sault St. Marie. The inference is not that this is a warm climate, but more hospitable than tundra (<12° C), comparable to modern boreal forest.

2.5 FAUNA

The faunal assemblage yields of EPI sites in southern Ontario are sparse, while those from the surrounding regions are somewhat more productive, both in material and debate. This section consists of a brief review of materials recovered in southern Ontario, the surrounding region, and a discussion of the arguments at hand to provide a basic research context, rather than an in-depth study of EPI faunal subsistence strategies.

Reported faunal assemblages dating to the late Quaternary and early Holocene in southern Ontario and environs are numerous, but association with a cultural component is very rare. Outside of any cultural affiliation, a wide variety of species and genera have been identified, including mammoth, mastodon, musk-ox, caribou, elk, deer, moose, bison, beaver, chipmunk, marten, and bear (Jackson 1988:31). The list is not comprehensive, but shows that the region was well populated by fauna after deglaciation. It is probable that some of these were used by EPI in the study area, in addition to other fauna present but not currently found or reported on. However probable such associations are, they remain to be demonstrated. For example, in the case of mammoth and mastodon, ***ca.*** 100 are identified in southern Ontario. However, none show any cultural affiliation (McAndrews and Jackson 1988), and it remains unlikely, although this evidence does not impede arguments that they were concurrent and possibly associated with EPI elsewhere in the northeast (*e.g.* Spiess ***et al.*** 1998:226-227). As a result, the focus of this discussion is on faunal assemblages associated with EPI sites.

Faunal remains have been reported from two EPI sites in southern Ontario: Udora (Storck and Spiess 1994) and Halstead (Jackson 1994). At Udora, one feature yielded the faunal assemblage. Initial analysis identified three mammalian families: Cervidae (white-tailed deer and caribou); Leporidae (varying hare or rabbit), and Canidae (fox) (Prevec 1987). Re-analysis by Spiess identified the same families, and refined the identification of some material as *Rangifer* (caribou), *Lepus* (varying, snowshoe or arctic hare), and arctic fox (Storck and Spiess 1994:126, 128). Fish, bird, and reptile are absent.

Halstead yielded a definite *Castor* tooth, a cervid bone (likely white-tailed deer, but possibly small caribou), and an unidentified mammal mandible. They are all calcined, and along with the single-component nature of the site, are attributed to the EPI occupation (Jackson 1994:173-4). Calcined bones were also recovered at Sandy Ridge, identified to mammal and cervid, although the direct association of the cervid with the EPI occupation is ambiguous (Jackson 1994:83-5).

Outside southern Ontario in the northeast, faunal remains were recovered at Holcombe in

Michigan (caribou) , Bull Brook in Massachusetts (caribou and beaver), Whipple in New Hampshire (caribou), cervid and medium and large mammal bone at Sugarloaf/DEDIC site (Spiess ***et al.*** 1998:224), and Michaud in Maine (cervid) (Spiess ***et al.*** 1984-5), which also yielded a charred seed (Spiess ***et al.*** 1998:223). Duchess Quarry in New York bore caribou, fish, and large bird bone, but in poor association with the EPI occupation (Funk and Steadman 1994). The Shoop site in Pennsylvania (Hyland ***et al.*** 1990) and Belmont site in Nova Scotia (Davis 1991) have artifact residue attributed to caribou blood, although identifications made on this basis are not consistent (Spiess ***et al.*** 1998:226). At Shawnee-Minisink, fish bone and hawthorn seeds were recovered in a hearth (Eisenberg 1978:65), and Dent and Kauffman (1985:72-3) describe hackberry, blackberry, plum, and grape seeds. The role of Shawnee-Minisink as a model of EPI behaviour for other northeastern EPI sites is questionable, however, given its more southerly location (Spiess ***et al.*** 1998:224). Grape seeds (*Vitis sp.*) were also recovered at the Hedden site in Maine (Spiess ***et al.*** 1998:223-224), although it is uncertain whether these are associated with the EPI occupation (Gramly and Funk 1990:24).

The Udora faunal assemblage is used by Storck and Spiess to infer open parkland to closed boreal forest for both the caribou and hare, while the fox is "more specific" as a tundra inhabitant, although they may move into the northern limit of the boreal forest in winter and early spring (1994:131). The presence of the arctic fox is used to place the site within a tundra-forest ecotone (Storck and Spiess 1994:132). The validity of such an analogy is tempered with information that the paleoclimate is more moderate than represented by pollen profiles due to vegetation colonization lag, as discussed above.

Reports discussing the association of caribou and Paleo-Indian occupations in the northeast note the wide degree of habitats which historic woodland and tundra caribou inhabited, and the wide range of behavioural patterns (Spiess ***et al.*** 1984-5:156-7; Shott 1993:13). However, there is speculative bias towards an EPI focus on caribou of the tundra variety, serving to define both environment and subsistence strategies (***e.g.*** Jackson 1994:345; Storck 1984:284-8; Gramly

1988:15-16). Meltzer (1984-5:17) interprets the EPI use of exotic cherts as an indication of tundra caribou exploitation, while Jackson and McKillop (1991:51) suggest that the distribution of EPI sites in southern Ontario be used "to reconstruct hypothetical caribou ranges".

2.6 SUBSISTENCE IMPLICATIONS

Levine (1997:233-9) reviews the paleoecological model for Paleo-Indians in the Northeast, and while this critique is polemical, it addresses the focus of some researchers on finding tundra caribou at EPI sites. As described in 2.5, faunal assemblages at EPI sites in the Northeast yield a reasonably diverse range of faunal resources, given the small sample and poor preservation typical of the sites in this region. That said, there is a predominance of cervid, and specifically caribou, recovered from those sites yielding faunal material, as well, as lesser numbers of small mammal. There is a pattern in the literature of placing Paleo-Indian sites in a caribou context, whether they are interior locales (Simons 1997:121-7; Jackson 1997:140-160) or fossil beach strand-lines (Storck 1997:273; Deller and Ellis 1992a:8). Sites along the Thedford embayment, for example, may also use lacustrine resources, such as fish (Karrow 1975 ***et al.***:65), waterfowl, and other fauna, as well as caribou. The McLeod site location has little apparent potential for intercepting caribou, but the proximity to a small creek and estuary of Main Lake Algonquin/ Ardtrea suggests that this physiographic feature might yield resources other than water.

The assertion "it seems safe to assume that plant foods did not play a major role in the diet of Paleo-Indians in the (lower Great Lakes) area" (Deller and Ellis 1992a:9) reflects the flora of the time. It is likely that few plant resources were available, with the spruce parkland and closed (coniferous) forest during the EPI occupation in this region. Vegetation was directly utilized as a resource, both for food (***e.g.*** ground berries) and other uses (structural, hafting, ***etc.***) which might drive an element of settlement and subsistence strategies. The significance of seed recovery at Shawnee-Minisink (in a hearth) and Hedden is tempered by the distance (physical and, by extension, analogical) of these sites, and the question of whether the seeds are associated with the EPI occupations, or are simply seeds on the ground, in the case of Hedden.

More issues are raised when considering the validity of modern analogs for the behavior of potential resources such as cervids, hare, fox, and beaver. The early post-glacial environment was in flux, not relatively stable as are modern systems. The rapidly changing ecology and suite of extinctions in the terminal Pleistocene (Kelly and Todd 1988:232) implies that fauna were under more system stress, and behaviour was therefore less predictable (more resilient - Holling 1973), than observed historically. Rapid adaptation to colonizing situations in rejuvenating early post-glacial vegetation assemblages may play a stronger role in the distribution of fauna than temperature ranges. The climate close to the glacial front might resemble that of the modern tundra-parkland ecotone (Morgan 1972), but spruce-parkland and closing spruce and pine forests may have provided the only substantial sources of fodder for large herbivores.

However, despite these ***caveats***, it is probable that caribou was an important resource, along with other mammals observed, such as fox, hare, and beaver. The degree to which subsistence strategies of EPI groups in Ontario was focused on the caribou is not established. The subsistence strategy of EPI groups is difficult to model in an environment without modern analog, and where the behaviors of terrestrial, aquatic, and avian fauna are not predictable.

2.7 SUMMARY

This paleoecological review for the EPI occupation of the lower Great Lakes leads to several conclusions and additional observations. The classic vegetation model for this time span is one of an open spruce-parkland, becoming a closed boreal forest (pine-dominated) by the end of the EPI horizon. The regional pollen synthesis alters this model, with spruce-parkland more persistent than previously noted, beginning ***ca***. 11 000 bp in the southwestern tip of Ontario moving in a north-northwesterly direction (Figure 11), and spruce-dominance preceding pine when the parkland becomes closed forest. *Pinus* begins to supplant *Picea* ***ca.*** 10 500 bp, following the same route as the NAP decline, at the end of the EPI horizon. The inference is that closed, spruce-dominated forest begins to transgress across southern Ontario only at the mid-point of the EPI horizon in southern Ontario. The Gainey occupation of southern Ontario takes place in a spruce-parkland, with closed spruce-dominant forest only in the far southwest corner of the region. The Parkhill and Crowfield complexes could occupy two ecological zones: a closing or closed spruce-dominant forest to the south, and an open spruce-parkland as one moves to the north. This evidence could support the argument that both the Parkhill and Crowfield complexes appear in higher frequencies further north than Gainey, following an environment more amenable to EPI patterns of subsistence (Ellis and Deller 1997:17).

Throughout this time period, the climate was more temperate than the vegetation record infers, as contrasted with fossil *Coleoptera* and oxygen isotope data. The inferred vegetation lag is supported by the lack of evident climatic shifts during the transition from parkland to closed spruce- and pine-dominated forests. The proposed transitional paleoecology shows no modern analog, and is likely typified by low stability and high resilience (Holling 1973:21), driven initially by the substantial climatic shift causing the rapid termination of the Wisconsin glaciation.

The lack of ecological equilibrium does not support the idea that faunal assemblages in the lower Great Lakes region have modern analogs, nor that the behaviour of these fauna would by default be comparable to that observed in historic (post-European contact) times (Simons *et al.* 1984:267). However, the data suggesting a dominance of spruce parkland throughout the EPI occupation in southern Ontario lend credence to a parkland-oriented model of faunal behaviour, albeit retreating towards north-central and northeastern southern Ontario during the Parkhill and Crowfield complex occupations. It is suggested that within these closed forest environments, zones of parkland surrounded the Huron basin glacial lake margins (Ellis and Deller 1997:17). Suppositions that similarly residual groups of herding caribou could still be found here would also have to take into account the probable vulnerability of such populations to hunting, both by EPI groups and other adversaries, and susceptibility to a rapid demise. That closed forest made up significant portions of the territory used by Parkhill and Crowfield complexes in southwestern Ontario suggests such areas also played a role in EPI subsistence strategy.

A subsistence strategy focused on hunting herd caribou remains plausible in parkland areas, but is less likely in closing or closed forest environments. Placing the Gainey complex in a parkland context throughout their range means that there is no seasonal or geographic limit for such a subsistence strategy (except in far-southwestern Ontario where the forest is closing). The Parkhill and Crowfield complexes occur in both parkland and forested environs, with northern EPI sites situated in parkland, probably as warmer-season occupations *(i.e.* spring-summer-fall) rather than winter. However, the behaviour of historically observed arctic fox, herding (tundra) caribou, and (potentially) arctic hare predicts that these mammals would likely be found in the parkland during winter and early spring (Storck and Spiess 1994:129-131). It is therefore likely that the behaviour of the arctic fox and hare has changed, and/or that the hare is varying, not arctic, and/or that the caribou behave less like tundra than woodland, in comparison to modern analogs. The Parkhill and Crowfield subsistence strategies were also likely modified to adapt to the changing ecology within their ranges. With transgression of closed forest into the southern range of the territory, options would include following the familiar vegetation northward, or modifying subsistence strategies. Based on the continued presence of the EPI horizon across southern Ontario, it would appear that some combination of these choices was adopted.

In summary, the Gainey complex occupation of southern Ontario took place in a parkland environment, which fits the traditional EPI subsistence model. The later Parkhill and Crowfield complex occupations in southern Ontario span an ecotone, and more diverse resources drawn from fauna and flora appearing in both closing/closed forest (Levine 1997:237-9; Custer and Stewart 1990:309-310) and parkland (Deller and Ellis 1992a:8) environments. The subsistence strategy shift from Gainey to Parkhill complexes appears to be substantial in scale, based on the significant change in the subsistence environments, and a diversion in settlement patterns (with Gainey more interior and Parkhill more "coastal"). By contrast, Parkhill and Crowfield complexes occur in similar environmental conditions, with closing and closed spruce-dominant forest to the south and spruce parkland to the north. The differences between these two complexes appear to be more a case of degree rather than adoption of a new subsistence paradigm. Based on the timing of the *Picea* drop, it appears that *Pinus*-dominant forest did not appear until the post-EPI occupation in all but the furthest reaches of southwestern Ontario.

3.0 METHODOLOGY

3.1 SITE BACKGROUND

The McLeod site is situated in an area of low topographic relief, on sand plains underlain by glacial till clay (Chapman and Putnam 1984:161). The nearest large rise in elevation is at the Wyoming Moraine, **ca.** 7 km to the south. Lake Huron is the nearest major water body, 12 km west-northwest of the site. The physiography between the McLeod site and current Lake Huron shoreline is markedly flat, consisting of the Thedford embayment. This flat plain is defined inland by remnants of fossil beaches associated with the transgression of Lake Nipissing and the earlier proglacial Main Lake Algonquin, discussed below (Figure 4). Land on the lakeward side of these strand lines shows very low relief. The landward side is also fairly level due to the higher elevation of proglacial lakes predating Lake Algonquin, but a more established drainage system and greater physiographic relief have developed in the areas above the Nipissing level.

Due to the flat topography, stream- and river-cut valleys are responsible for most of the relief in this locale. The poor drainage within the Thedford embayment resulted in the area being marshy. With a very low energy watershed in this area, the Ausable River meandered substantially within the embayment, parallel to the Lake Huron Shoreline. The route of the Ausable was modified with the excavation of a canal from the Ausable River to Port Franks, and the enhancement of drainage in the area of the embayment also drained of the bulk of the Thedford Marsh (Chapman and Putnam 1984:161).

In the site vicinity, local tributaries of the Ausable River are Parkhill and Ptsebe Creeks. The major course of Ptsebe Creek runs along the northern and eastern limits of the McLeod Site, before merging with Parkhill Creek approximately 1.5 linear km downstream, to the north. The McLeod Site is bracketed by the main course of Ptsebe Creek to the east and a small tributary of the creek to the north. While the Ptsebe is a relatively small creek, owing to its age and stage of development, the valley is sizable (Figure 5), with the valley flood plain *ca.* 10m below the adjacent fields in the vicinity of the site. The site itself is bifurcated by a seasonally active drainage channel, separating the two excavation grids (A and B) to the north from the main portion of grid C. This erosional gully drains into the main Ptsebe valley, originating between the C-west and C-north sections. While the overgrowth and thick trees in the areas of Grids A and B were too heavy to permit a topographic survey, it was observed that these grids are 50-100 cm higher in elevation than Grid C.

The fields on which the McLeod site is located have been cultivated since the turn of the century. Modern farming practices, including deforestation and ploughing, are responsible for some erosion, such as increased on-field wind and water erosion. The current native vegetation cross-section comprises a blend of Carolinian and Canadian zones (Cleland 1966), predictable given the location of the site.

One area yielding surface scatters of Early Paleo-Indian (EPI) artifacts in two loci (Figure 5) was surveyed and a controlled surface pick-up was conducted (Figure 15). The site was defined on the basis of this surface scatter, and the two clusters were the focus of limited excavations in 1975 (Figure 16). A third area ***ca*** 200 metres to the south (Figure 5) was later identified by Ed McLeod and described by D. Brian Deller in 1979 (Deller and Ellis 1982:111), with 8 diagnostic Paleo-Indian tools recovered through uncontrolled (grid provenience) surface collection.

Following the 1975 excavations, the field containing grids A and B was converted to a pine tree farm. At the time of the 1990 excavations these grids were thickly treed and unavailable for further excavation. Grid C remains under cultivation and was the focus of the 1990 research.

3.2 PROJECT METHODOLOGY

Similar approaches were taken in excavating the McLeod site in both 1975 and 1990. Contrasts in field methods largely arise from the timing of the projects: provenience in 1975 was measured in imperial units (tenths of feet), while in 1990 metric/SI (metres) were used. The provenience grid in 1975 was aligned approximately 20 degrees east of magnetic north, while the grid in 1990 was oriented to magnetic north. Artifacts recovered prior to and in 1975 were cataloged using an independent site designation system, with artifacts identified by a University

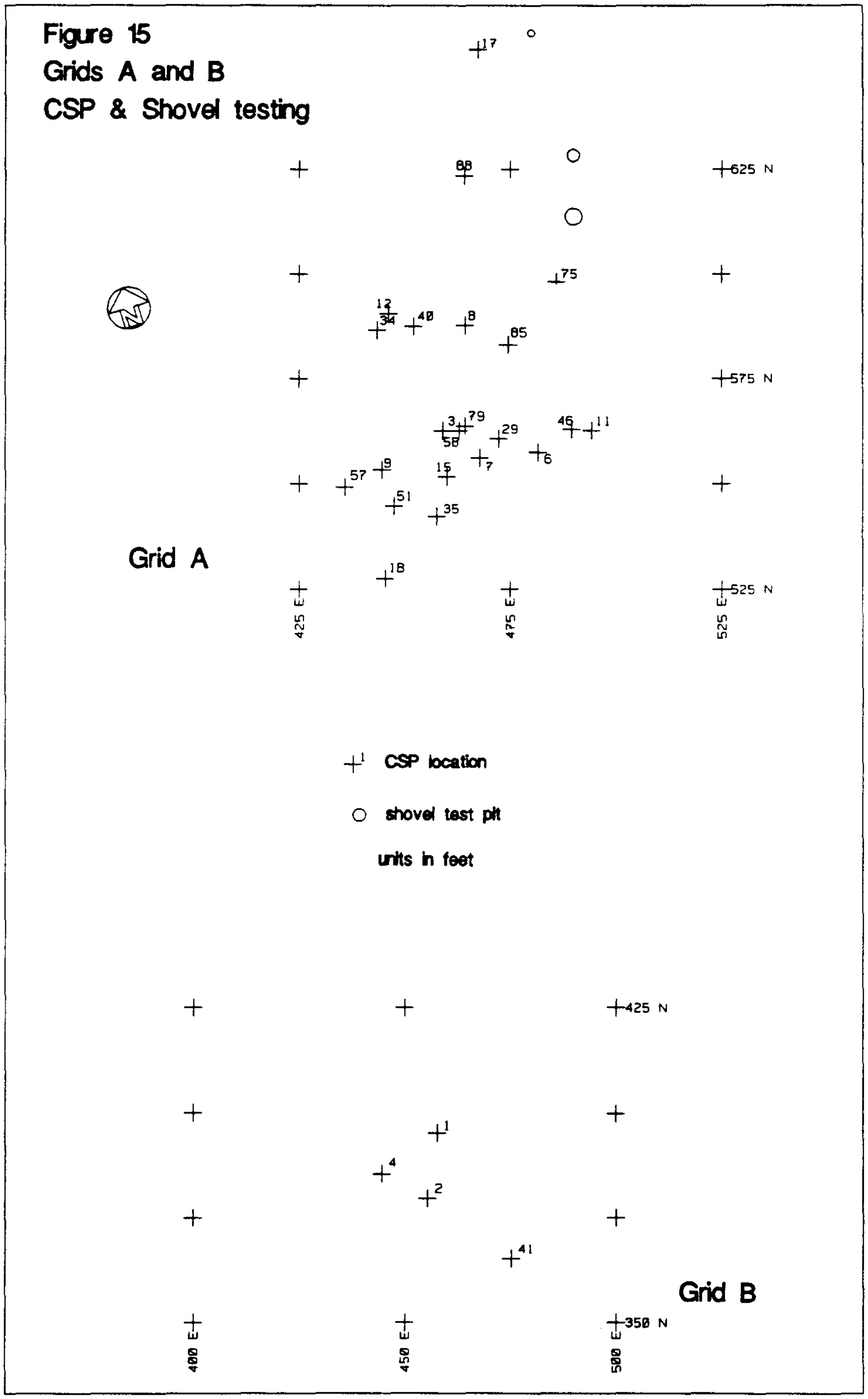
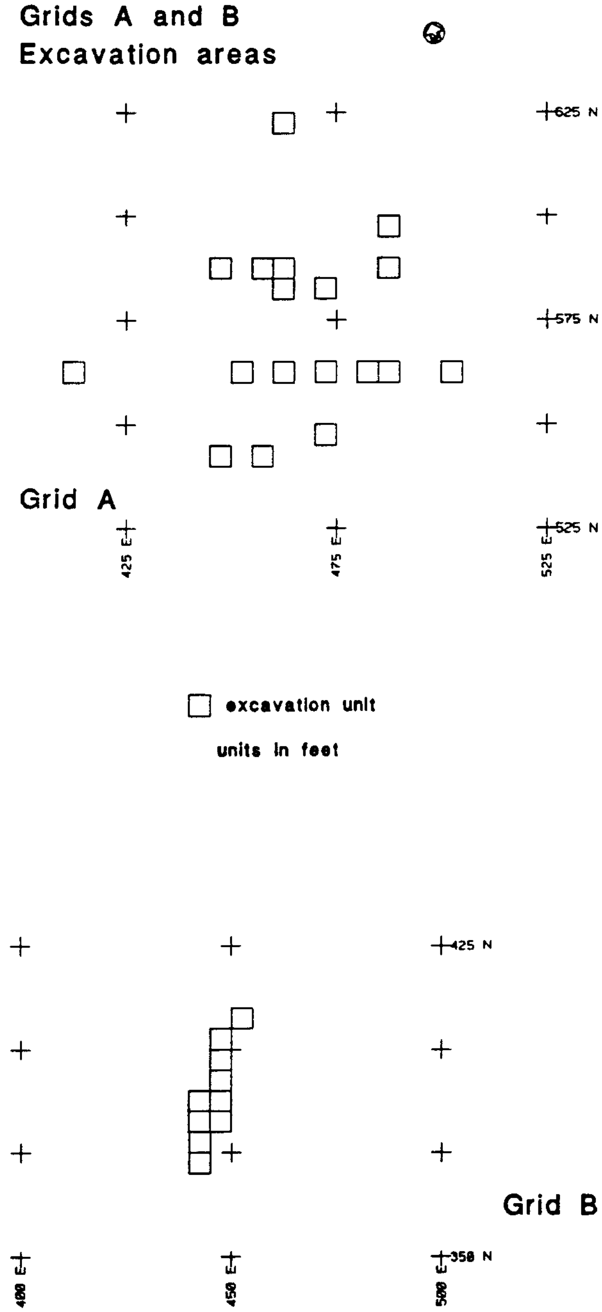


Figure 15
Grids A and B
CSP & Shovel testing
Grid A
625 N
575 N
525 N
425 E
475 E
525 E
CSP location
shovel test pit
units in feet
Grid B
425 N
350 N
400 E
450 E
500 E

Figure 16
Grids A and B
Excavation areas



of Waterloo system site label ($m_1w_1s_1$-1), appended by the artifact number (***e.g.*** $m_1w_1s_1$-1:1). This applies to the artifacts recovered from Grids A and B. Artifacts recovered after 1975, from Grid C, were identified by the McLeod site Borden number (AhHk-52), with artifact numbers appended (***e.g.*** AhHk-52:1). These systems differentiate artifacts recovered in Grids A and B from Grid C. For more sorting, artifacts recovered in 1990 were numbered in the thousand range. The methodologies for both projects are very similar, or represent different ways of achieving similar goals in data acquisition. These similarities and differences are noted below.

3.2.1 Survey & Piece-Plotting

Two types of surveys have been conducted on the McLeod site. Uncontrolled surface collection was carried out before and after the 1975 research project, up to 1990, without an established reference system or grid for mapping artifact finds. When artifacts associated with the Paleo-Indian occupation were recovered, the surveyor has subsequently been able to attribute artifacts to specific site areas. Controlled surface pick-up (CSP), with the locations of artifacts measured in through reference to established data points, was conducted both in 1975 and 1990, in preparation for excavation activities at the site.

The same CSP techniques were utilized to map artifact locations in 1975 and 1990, using transit and tape or stadia rod to obtain the bearing and distance of find spots from a datum. Artifact locations were also recorded by taping the distances and noting the direction from two reference points: provenience posts with surface collections, or corners of an excavation unit in the case of artifacts recovered in excavation.

These methods allow accurate mapping of surface and excavated artifact scatters, and correlation of these with the reference grid. The degree of error with transit-stadia locations is approximately 1%, based on the distance conversion formulae and precision of stadia rods observed in 1990. Tape measurements can be more precise, but tape stretching was observed in both 1975 and 1990, likely resulting in a degree of error similar to that arising through measurement with transit and stadia rod.

3.2.2 Shovel Testing/Coring

Shovel testing and/or coring were conducted in association with both the 1975 and 1990 research projects. In 1975 it occurred to a limited degree, with three test pits of varying diameter excavated off the ploughed field. This was done to assess the potential for an EPI component, and to examine the stratigraphy, away from the known grids (Grids A and B) (Figure 15).

In 1990, a series of 46 test cores (Figure 17) 30 cm in diameter and either 0.5 or 1.5 m deep were excavated using a power auger both at 5 m intervals and opportunistically across Grid C, in cultivated and wooded areas. This increased the extent of sampling for EPI loci in the area, including the bush adjoining the field, and provided a background sample of data for subsoil typology, stratigraphy, and topography. In both 1975 and 1990, the soil removed from these test pits was screened through 6 mm (one-quarter inch) hardware cloth to recover artifacts.

3.2.3 Site Excavation

1975 Methodology

On identification of the EPI clusters through CSP, a five foot provenience grid was laid out, with grid north oriented 19° 40' east of magnetic north and the north-south baseline transecting both EPI clusters (identified as Grids A and B). An arbitrary, off-site datum (0 north, 0 east) was used, and provenience posts were laid out along north-south and east-west axes, by transit and tape. The grid was tied in by mapping two geographical reference points from the secondary, on-site datum. Individual five foot by five foot excavation squares were laid out with pins, and unit provenience defined by the northing and easting of the southwest corner.

Excavation of the ploughzone was conducted in arbitrary, two-tenths of a foot (2.4", or approximately 6cm) levels. The first two-tenths of a foot of ploughzone in each unit was excavated using 3mm (one-eighth inch) hardware cloth, while the remainder of the ploughzone down to the subsoil surface was excavated using 6mm (one-quarter inch) hardware cloth. The subsoil surface was cleaned off by trowel and examined for natural and cultural features, and documented accordingly. If no features were present, subsoil excavation proceeded in the same

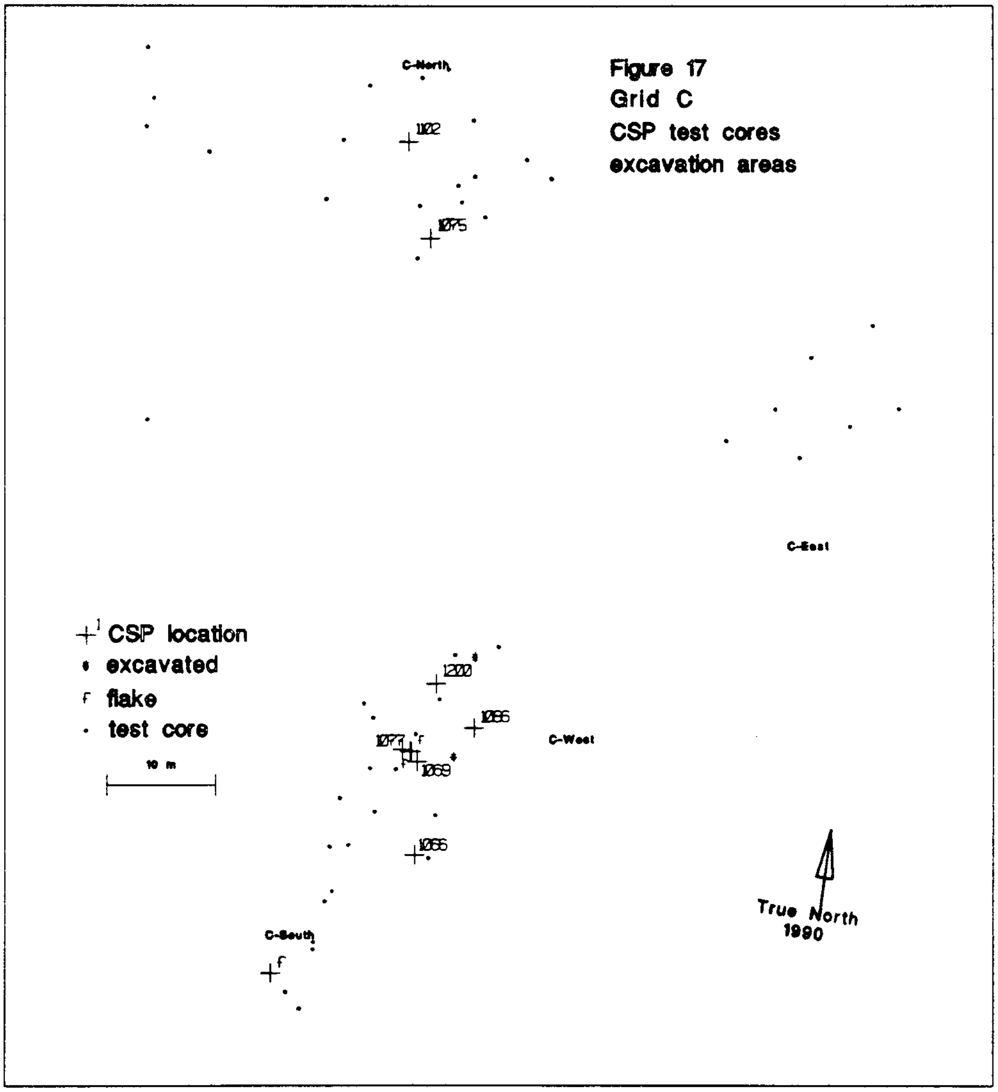
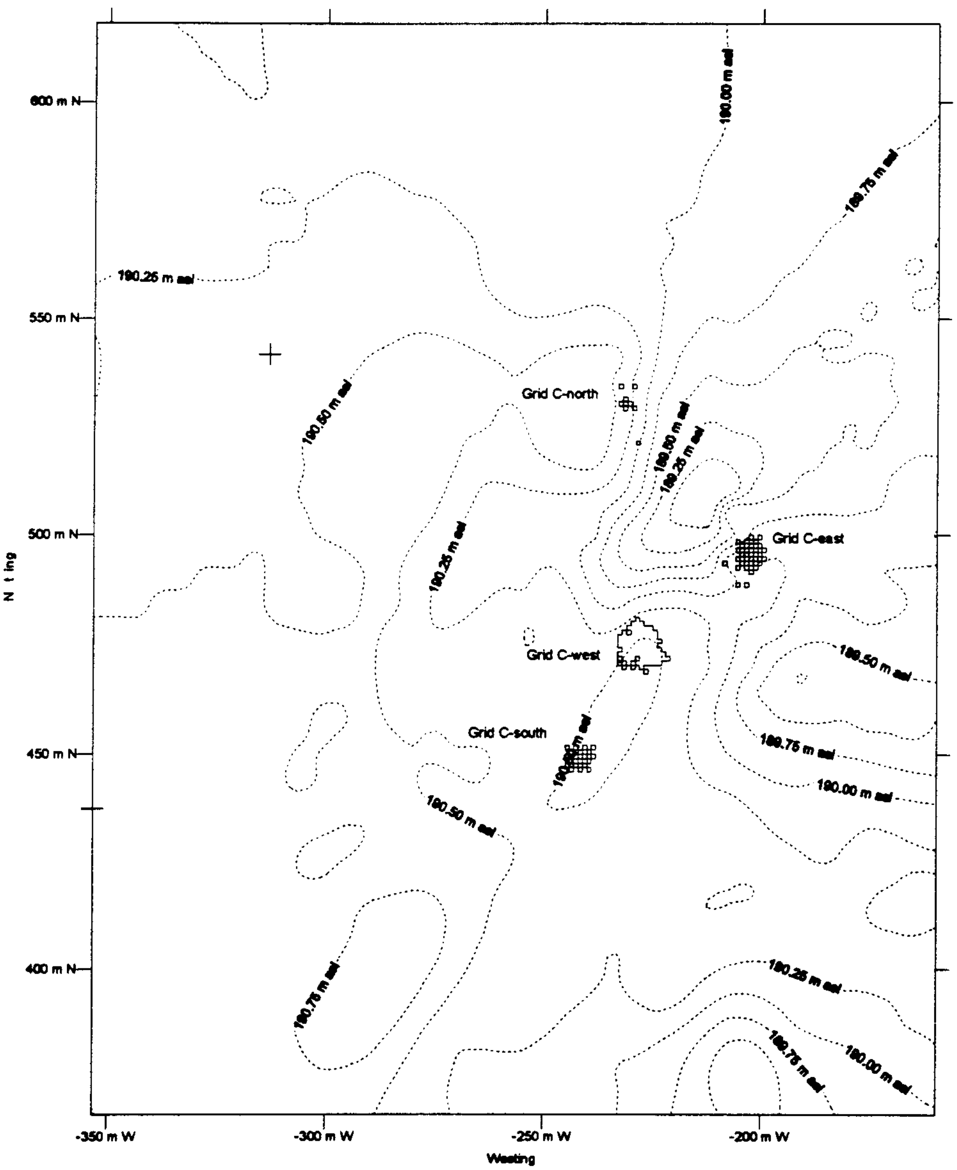


Figure 17
Grid C
CSP test cores
excavation areas
C-North
1102
1075
C-East
CSP location
excavated
flake
test core
10 m
1200
1086
C-West
1077
1069
1066
C-South
True North
1990

Figure 18
Grid C
Excavation and Relief



arbitrary levels until cultural sterility was confirmed. Units which encompassed areas of heavy clay were not fully excavated: soil was excavated from around the clay, and screened.

1990 Methodology

After a series of initial surveys and CSP's conducted to relocate Grid C as described in 1982 (Deller and Ellis), and using documentation with consultation, a 3 metre grid was laid out in the predicted site area, with grid north oriented along magnetic north-south and east-west axes, in reference to an arbitrary off-site datum (0 north, 0 west) (Figure 18). The 3m provenience unit was defined by the northing and westing of the southwest corner, and 1m^2 sub-units excavated within the 3m provenience unit were identified by letter (Figure 19). Four potential Paleo-Indian areas were identified within Grid C, based on prehistoric artifact clusters identified by survey, and using documentation in consultation with previous researchers.

Figure 19

a	b	c
d	e	f
g	h	i

The areas under examination were initially subjected to controlled testing, by the excavation of 1m^2 units at a 3m interval, in order to identify and delineate artifact concentrations and to determine their association with the Paleo-Indian occupation. Areas targeted for more intensive investigation were excavated in contiguous 1m^2 units. Since all such work was conducted in ploughed areas, this consisted of excavating the ploughzone as one stratigraphic unit. Using a combination of random and selective sampling, approximately 20% of the 1m^2 sub-units were processed using 3mm hardware cloth, while the remaining units were screened through 6mm hardware cloth. Sampling with 3mm mesh was carried out in order to obtain a more representative sample of the lithic activities present at the site (Ball and Bobrowski 1987).

The ploughzone-subsoil interface was cleaned by trowel and examined for artifacts and features. The ploughzone layer of several adjacent units was removed before subsoil excavations proceeded, to examine larger areas of the subsoil surface. If no significant features or stratigraphy were identified, excavation into the subsoil proceeded in arbitrary 5cm levels using 3mm mesh until the sterility of the subsoil horizon was established.

3.2.4 Feature Excavation

Because all prehistoric site clusters identified and excavated were situated in actively and intensively cultivated areas, any potential cultural and natural features would be truncated above the existing subsoil horizon. Subsequently, after the ploughzone layer had been excavated, the top of the subsoil surface was cleaned and examined for remnants of features which might have extended into the subsoil through the overlying original topsoil horizon. Any potential features, indicated by artifact yields, organic content, soil colour and/or textural anomalies from the general matrix, or any combination of the above were noted, delineated, and mapped.

1975 Methodology

Potential features exposed at the surface of the subsoil were cleaned by trowel, sketched, photographed, and prepared for excavation. Excavation was in 2/10th foot (approximately 6cm) layers, processing excavated soil through 6mm hardware cloth. At the boundary of each excavation layer the feature plan was sketched and photographed. Numerous soil samples were recovered, generally consisting of one to two litres, from features or elements of features. Excavation of potential features continued until it became evident that the feature was not cultural or the feature had been fully excavated.

1990 Methodology

Prospective features were cleaned off by trowel, mapped, photographed, and prepared for excavation. Small (10 cm or less diameter) potential cultural features were excavated in cross-section, and larger features were excavated in quadrants. Large features were bisected with two perpendicular axes approximating the maximum length and width of the feature. Two of the four resulting quadrants were excavated in diametric opposition, providing profiles along the major and minor axes for the full length and width of the feature. The material excavated from the first two quadrants was screened with 3mm mesh. Large soil samples (9-20 litres) were taken from the remaining two quadrants for flotation processing, with the remainder of the soil from these quadrants processed through 3mm hardware cloth. Features were photographed and mapped in plan and cross section at significant excavation stages.

3.2.5 Treatment of Organic Material

A small quantity of carbonized organic material was recovered in the 1990 excavation in several excavation units, from which four samples were obtained. These were removed using trowels (washed with distilled water prior to the removal of the carbonized material), and stored in aluminum foil until analyzed by a specialist for identification. No radiocarbon dating has been carried out on these carbonized remains. One rodent tooth was obtained, from the plough-zone, which did not require special recovery or storage treatment. No significant organic elements were noted as being recovered during the 1975 excavation.

3.2.6 Treatment of Flotation Samples

Flotation samples obtained from the potential cultural feature in 1990 were removed from the surrounding matrix, stored in plastic bags, and processed in the wet lab at McMaster University. Light fractions were screened with 0.425 micrometer filters, while the heavy fractions were processed through 0.75 mm screens. Processed materials were then dried, and examined for artifacts. The 1975 flotation samples have yet to be processed, as they were obtained from features yielding diagnostic Archaic artifacts, not associated with the Paleo-Indian occupation.

3.2.7 Treatment of Soil Samples

Soil samples were systematically collected from the top of the subsoil horizon in and around the area of one large feature. Single samples were collected from the centre of each $1m^2$ excavation unit, using trowels washed with distilled water. These were obtained for the purpose of chemical analysis, to explore whether there was any significant chemical distinction between the feature and surrounding subsoil matrix. These samples have not yet been analyzed.

3.3 RESULTS

1975 Excavations

The 1975 research project on the McLeod site began on July 8 and ended on August 8, 1975. The initial CSP recovered 14 uniface tools and utilized flakes, two bifaces, and two uniface retouch flakes either diagnostic to or likely affiliated with the EPI occupation at the site. Additional surface artifacts were recovered and piece-plotted throughout the course of the excavation component of the project. The first CSP yields identified and delineated Grid A and Grid B as Paleo-Indian artifact clusters, and excavation in these areas was initiated.

Soon after work began on the site, it was evident that both grids were multi-component in nature. The EPI component was minor in relation to the entire artifact assemblage, but yields were sufficient to warrant continued sampling of the site area. After a month of excavation it was decided that the site had been sufficiently sampled, and excavations at the site were terminated.

3.3.1 Grid A

A total of 22 piece-plotted artifacts (four flakes, 13 unifaces in CSP, three unifaces and two flakes in excavation) were recovered in this area in 1975, and 17 five-foot excavation units (425 square feet, approximately 38.25m^2) were excavated. Three exploratory shovel test units were also excavated in Grid A (Figure 20). Most excavation in this grid was not contiguous, consisting of individual five-foot test squares. The interval between these test units was generally between five and ten feet, although some outlying excavation units and the shovel tests were excavated between 20 and 30 feet away from the nearest unit. Two small areas were contiguously excavated: one comprised three conjoined units, the second two adjacent squares.

The excavations at Grid A yielded the greatest number of artifacts attributable to the EPI Indian component in 1975, consisting of 16 unifaces (including utilized flakes), and 47 items of flaking debris (Figure 21). An additional three flakes were recovered during informal surveys, and are provenienced to the general Grid A area.

3.3.2 Grid B

The CSP in Grid B recovered four uniface tools. As this was a less productive scatter, a smaller area was excavated in this grid, and all of the ten five-foot square units (250 square feet, approximately 22.5 m^2) were excavated contiguously (Figure 22). The quantity of artifacts attributed to the EPI horizon from this area was much smaller than recovered in Grid A,

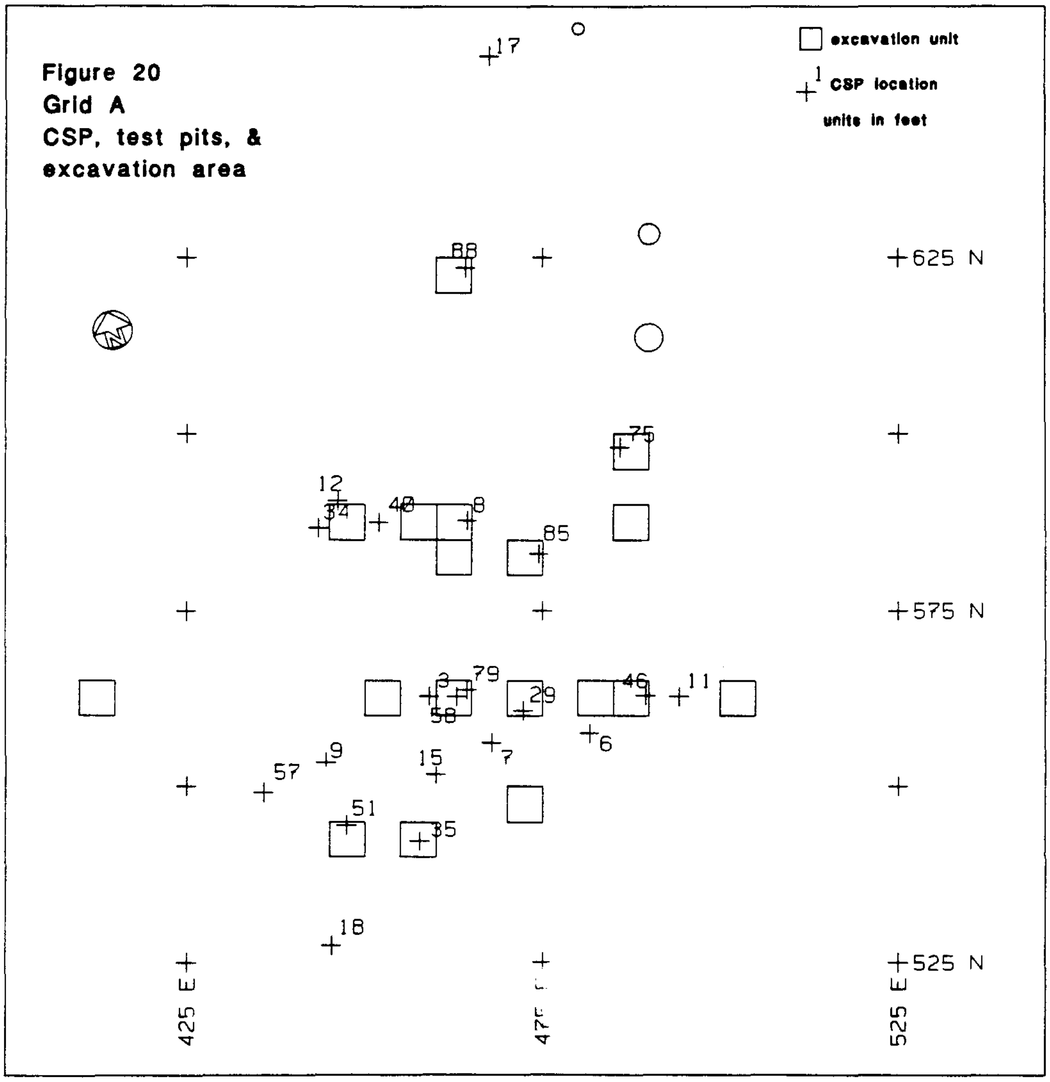


Figure 20
Grid A
CSP, test pits, &
excavation area
excavation unit
CSP location
units in feet
625 N
575 N
525 N
425 E
525 E
17
88
75
12
34
40
8
85
3
79
58
29
46
11
6
7
9
57
15
51
35
18

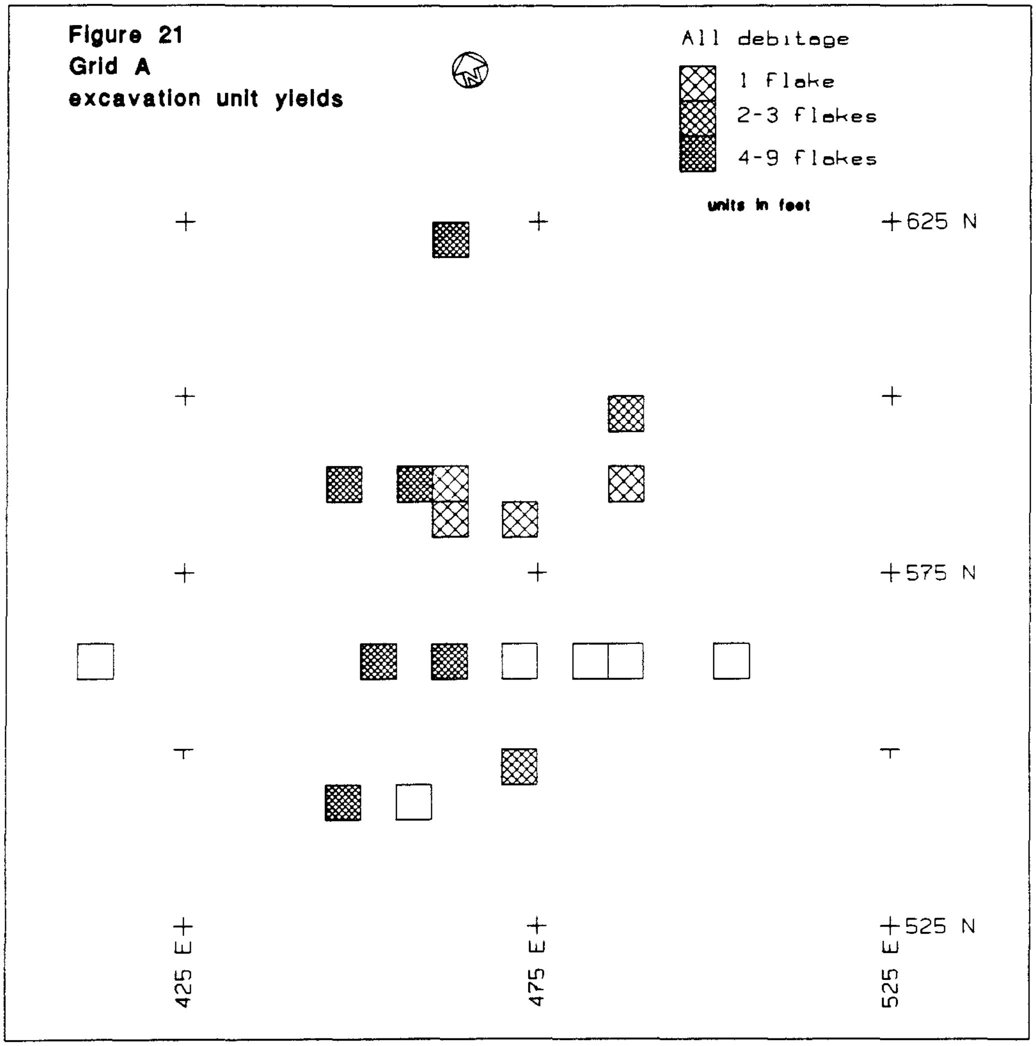


Figure 21
Grid A
excavation unit yields
All debitage
1 flake
2-3 flakes
4-9 flakes
units in feet
625 N
575 N
525 N
425 E
475 E
525 E

with two flakes recovered in excavation (Figure 23), and no additional tools. Excavations did identify a large cultural feature which was excavated: it did not yield EPI horizon artifacts. On the basis of diagnostic artifacts recovered, it is affiliated with the Archaic component at the site.

1990 Excavations

The author returned to the McLeod site in 1990 to conduct further investigations. The initial survey identified four clusters of prehistoric artifacts, identified as Grids C-East, C-North, C-West and C-South (Figure 17). C-East was the first area tested, on the basis of a thin lithic scatter and site inspection by a previous researcher. C-North was a fluted point find-spot identified on a preliminary survey of the property. C-South consisted of a sparse surface scatter of non-diagnostic artifacts, investigated because of their close proximity to the probable EPI site area. The C-West grid also yielded an artifact attributable to the EPI horizon, and in addition was the largest cluster of prehistoric artifacts in general.

Although testing was initiated in Grid C-East, it soon became apparent that there was no evident EPI association with this area, nor did test cores yield any significant artifact yields off-field. Resurvey of the field was carried out, and additional test cores were bored (Figure 17), in order to relocate Grid C as described by informants: Grid C had not previously been mapped, either as part of the work in 1975 or in subsequent surveys. Combined with these survey techniques, test excavation in all of these grids established that while three yielded Paleo-Indian artifacts, only one did so in numbers warranting further excavation at the time.

Informal surveys of the Grid C area in general prior to initiation of the 1990 research project recovered five flakes(AhHk-52:26, 31, 45, 50, 51) and seven unifaces (AhHk52:24, 27, 28, 30, 32, 39) attributable to the Paleo-Indian occupation. One biface (AhHk-52:36), a complete fluted point, was recovered from an area identified at Grid D, which was not defined. Given the extent of the Grid C area encompassed by the 1990 project, which yielded artifacts attributable to the EPI horizon as detailed below, the biface attributed to Grid D is grouped with the artifacts recovered from Grid C. It is the author's opinion that Grid C-South may represent the area identified by Dr. D.B. Deller as Grid D.

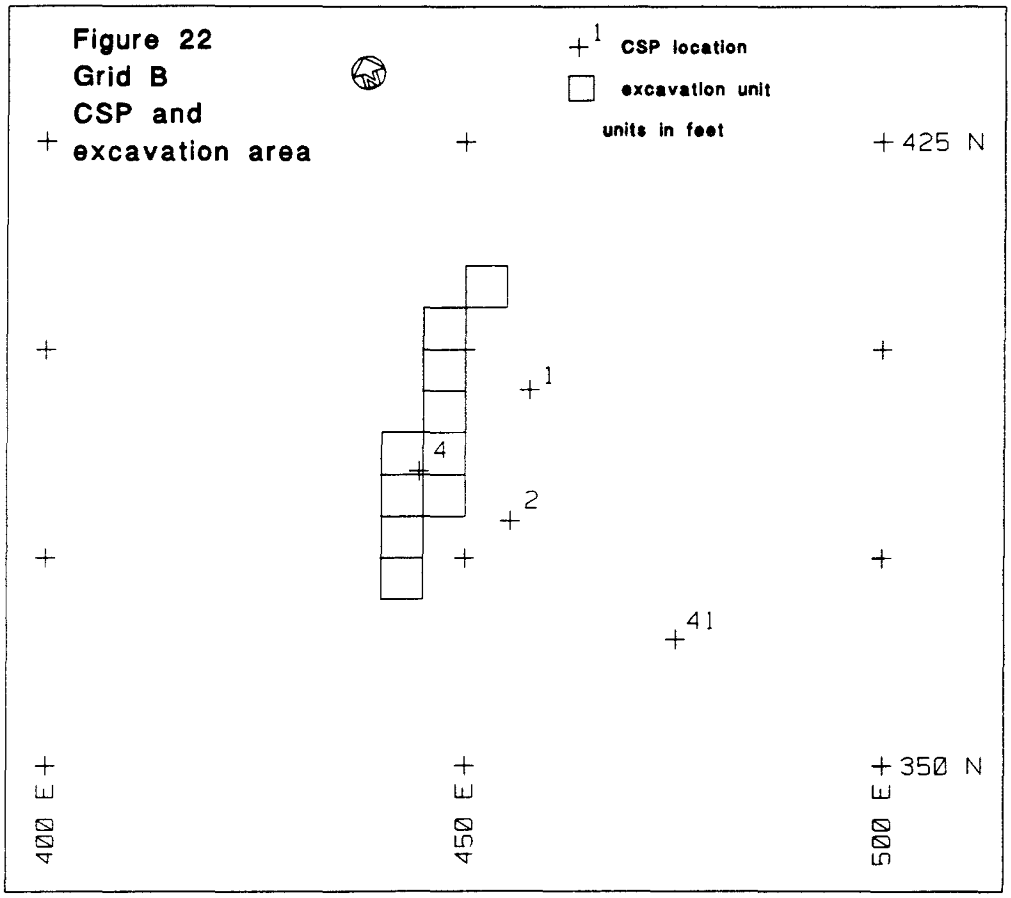


Figure 22
Grid B
CSP and
excavation area
CSP location
excavation unit
units in feet
1
4
2
41
425 N
350 N
400 E
450 E
500 E

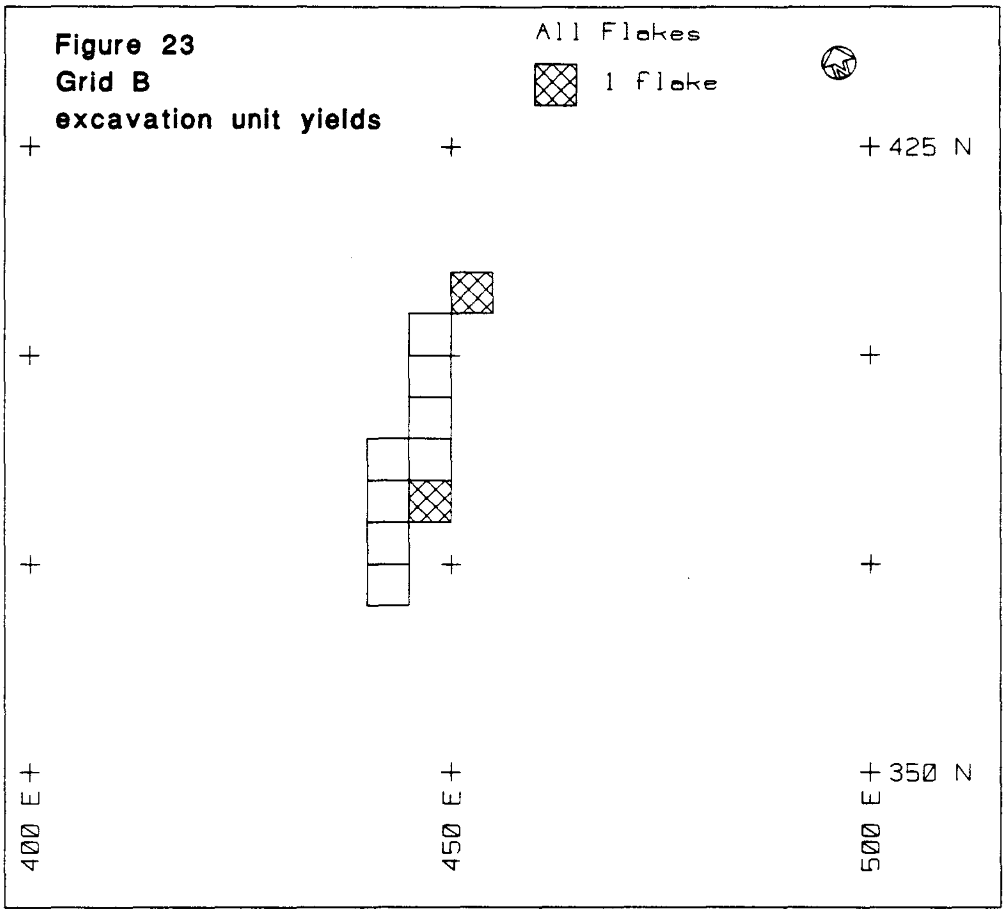


Figure 23
Grid B
excavation unit yields
All Flakes
1 flake
425 N
350 N
400 E
450 E
500 E

3.3.3 Grid C-East

A total of 29 1m^2 controlled test units were excavated in the C-East grid, resulting in the recovery of 36 chert flakes (Figure 24). The distribution was scattered thinly over the sampled area, showing no spatial clustering. The two material types present were Onondaga and Kettle Point cherts, with trace quantities of unknown chert and quartzite/metasediment.

No Paleo-Indian artifacts were identified in this area, nor were any subsoil features noted. On this basis, in addition to the results of resurvey along the field in the site vicinity and further consultations with previous researchers, work in this area was terminated.

3.3.4 Grid C-South

Visual survey in the C-South area yielded one Collingwood chert channel flake. Based on this, a total of 20 1m^2 controlled test units were excavated to assess this scatter. One additional Collingwood flake, and two Selkirk flakes, were recovered.

No cultural subsoil features were noted in these excavations. The recovery of only three additional flakes indicative of a Paleo-Indian occupation was not sufficient to warrant further investigation in this area (Figure 25).

3.3.5 Grid C-North

On the pre-excavation survey of the site area with Dr. Peter Storck in the spring of 1990, the tip of a fluted point on Collingwood chert (Table 2; AhHk-52:1102; Plate 1) was recovered. Intensive and repeated resurveys failed to recover any additional Paleo-Indian diagnostic artifacts, although other materials (Kettle Point, Onondaga and unknown cherts) were identified. Eight 1m^2 test units were excavated in the vicinity of the point find and surface scatter (Figure 26), recovering a single unifacial tool of Collingwood chert (Table 2; AhHk-52:1074; Plate 2), and 42 flakes on the other cherts. Due to time constraints and the limited quantity of the Paleo-Indian material yielded by the excavations in comparison to the C-West area, C-North was not subject to further examination.

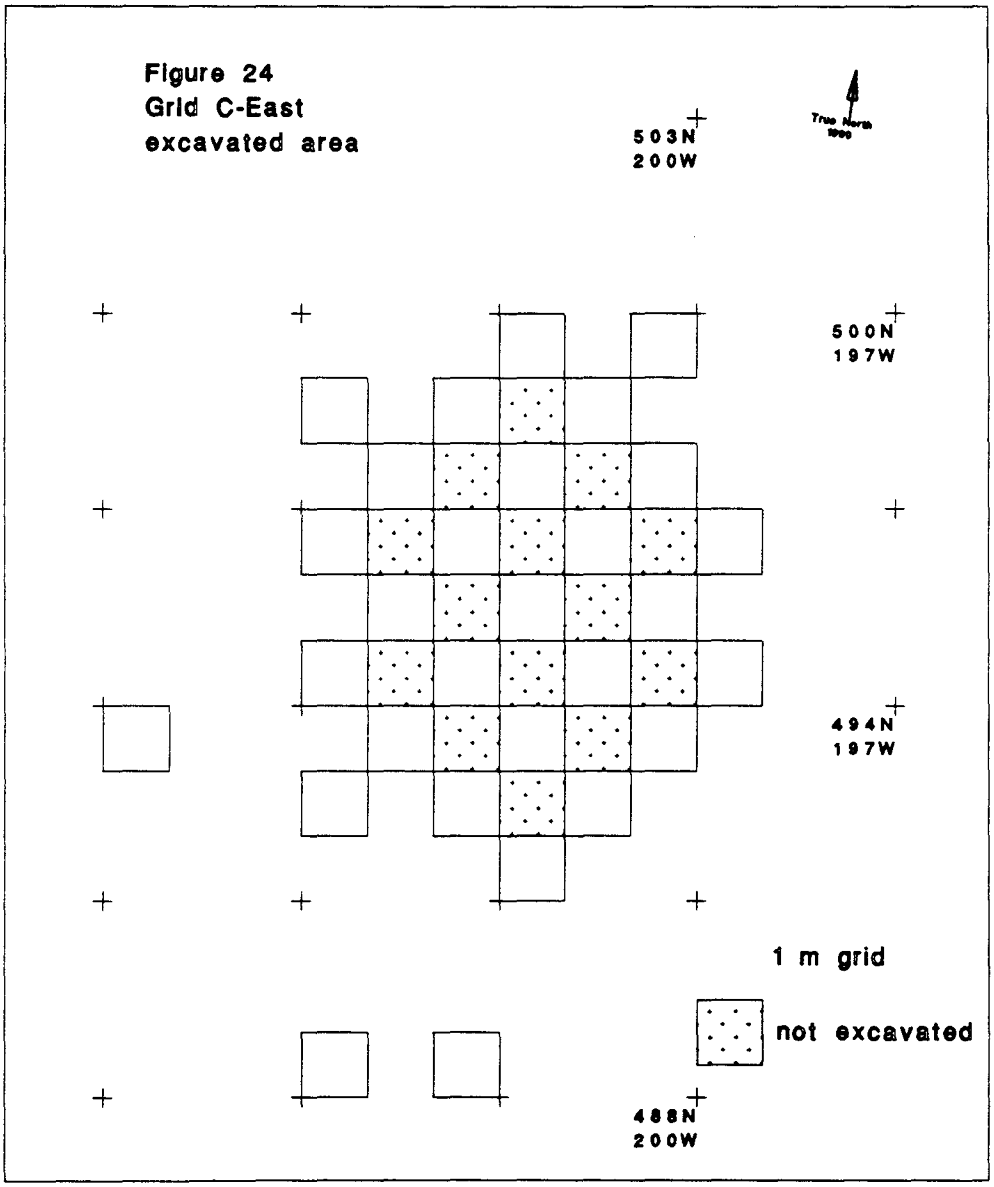


Figure 24
Grid C-East
excavated area
503N
200W
True North
500N
197W
494N
197W
1 m grid
not excavated
488N
200W

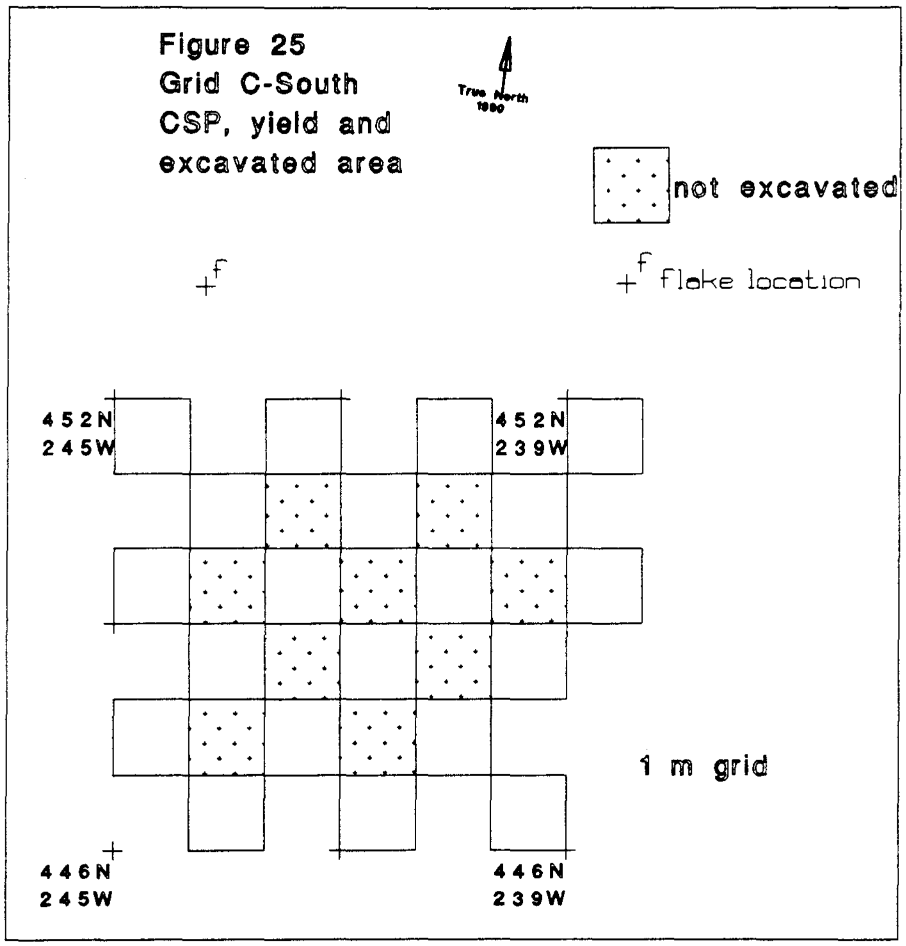


Figure 25
Grid C-South
CSP, yield and
excavated area

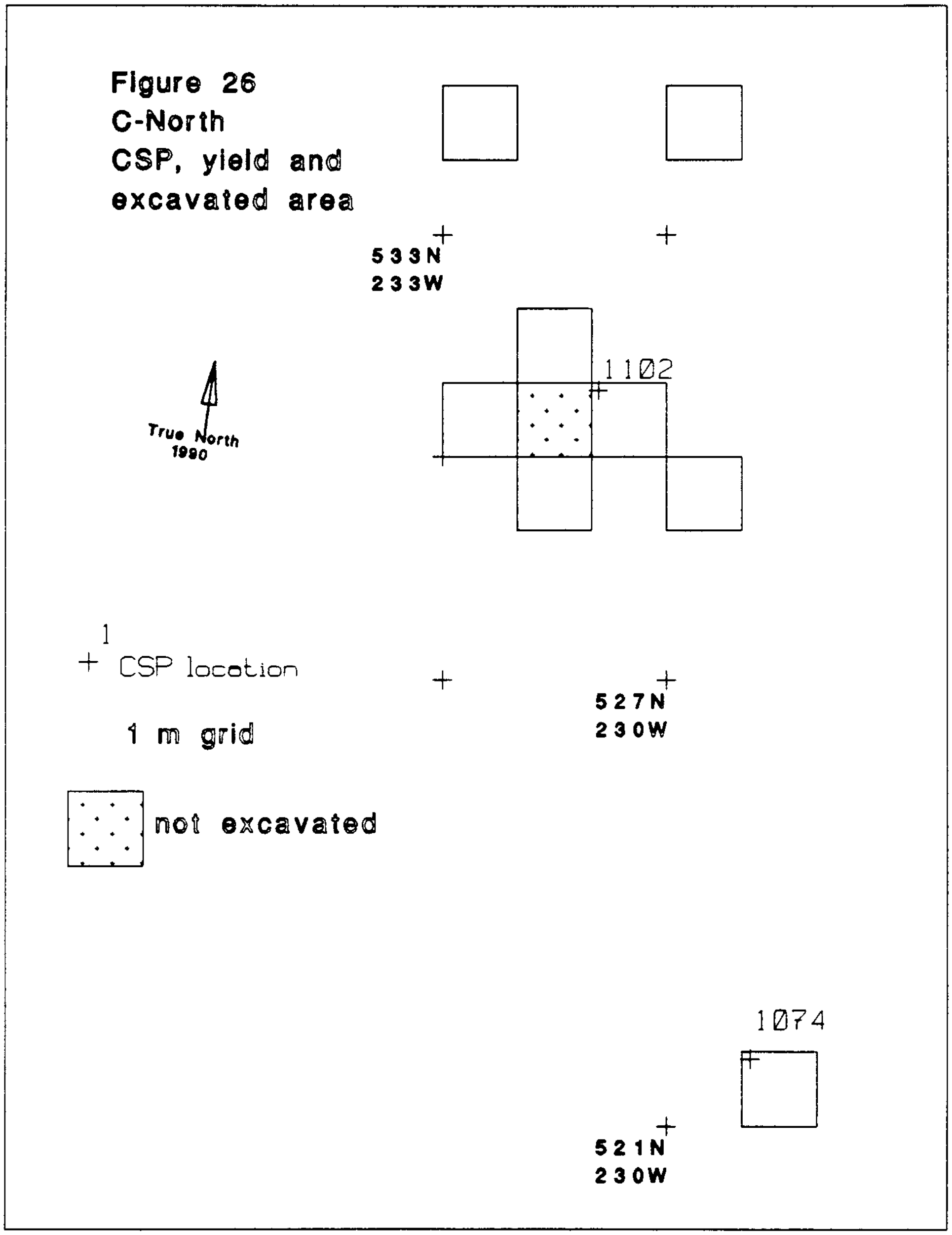


Figure 26
C-North
CSP, yield and
excavated area
533N
233W
1102
True North
1990
1
CSP location
1 m grid
not excavated
527N
230W
1074
521N
230W

Table 2: Artifact Catalog		
artifact prefix	**catalog #**	**Description**
m1w1s1-1	1	concave side scraper
AhHk-52	1	concave side scraper with graver
m1w1s1-1	2	convex side scraper
m1w1s1-1	3	trianguloid end scraper
m1w1s1-1	4	uniface backed knife
m1w1s1-1	6	hafted perforator
m1w1s1-1	7	convex narrow end scraper
m1w1s1-1	8	trianguloid end scraper recycled into graver
m1w1s1-1	9	fragmentary end scraper
m1w1s1-1	11	trianguloid end scraper
m1w1s1-1	12	uniface tool fragment
m1w1s1-1	13	snapped tool fragment
m1w1s1-1	15	retouched flake
m1w1s1-1	17	retouched flake end scraper
m1w1s1-1	18	denticulate
AhHk-52	24	concave convergent side scraper
AhHk-52	27	concave convergent side scraper
AhHk-52	28	end-of-blade end scraper
m1w1s1-1	29	narrow end scraper
AhHk-52	30	compass graver
AhHk-52	32	convex side scraper
AhHk-52	36	fluted point: Barnes type
AhHk-52	39	denticulate
m1w1s1-1	40	retouched backed and snapped flake
m1w1s1-1	41	denticulate
m1w1s1-1	46	backed and snapped uniface
m1w1s1-1	51	backed and snapped uniface
m1w1s1-1	57	convex side scraper with bend break retouch
m1w1s1-1	75	denticulate
AhHk-52	1066	graver
AhHk-52	1069	narrow end scraper
AhHk-52	1074	trianguloid end scraper
AhHk-52	1077	convex side scraper
AhHk-52	1086	retouched channel flake
AhHk-52	1102	fluted point tip: Barnes type
AhHk-52	1200	small tool fragment with retouch

3.3.6 Grid C-West

The C-West portion of Grid C was the largest of the four scatters examined in this project. A visual survey recovered numerous flakes and tool fragments of Kettle Point, Onondaga, Selkirk, Bayport, and unknown cherts. One Collingwood chert microdebitage item was recovered, and subsequent testing in the area resulted in the retrieval of several flakes and tools fragments of Collingwood chert, attributable to the EPI horizon. Based on the scatter size, and the recovery of both EPI lithic debris and unifacial tool fragments, it was decided that this portion of the site warranted the most extensive and intensive investigation. Subsequently, an area totaling 88m^2 was excavated, yielding a wide variety of material and cultural lithic types, including 33 items of lithic debris and six tools and tool fragments attributable to the Paleo-Indian horizon (Figure 27).

Grid C Paleo-Indian Horizon

The results pertinent to the research focus of this project were modest in volume, but the author notes the nature of the project design, studying low-intensity, short-term Paleo- Indian occupations, which are inherently small scatters of lithic debris and occasional tools. As a result, not only are such sites difficult to find, but the artifact assemblage is minimal in size, particularly in comparison to other, more substantial Paleo-Indian sites in the area, as well as post Paleo-Indian sites. In addition, substantial quantities of Paleo-Indian and other artifacts have been recovered from the surface of the site in the years since its identification. The informal surface collection by Deller (per comm.) have resulted in a significant assemblage of surface finds which are included in this analysis. It is probable that unreported collection has also occurred, but the impact of such activities on the recorded assemblage is unknown, and immeasurable.

A total of 32 flakes and five uniface tools on Collingwood chert, in addition to one uniface tool and one flake on Bayport chert, were recovered in the excavation of the C-West grid, in addition to post-Paleo-Indian artifacts. One cultural feature yielding both Paleo-Indian and post Paleo-Indian artifacts was identified (Feature 2 - Figure 28). In addition, two Collingwood chert flakes were recovered from Grid C-South, and one biface and one uniface were recovered from Grid C-North, along with the five flakes, seven unifaces and one biface recovered on informal surveys prior to the 1990 research project.

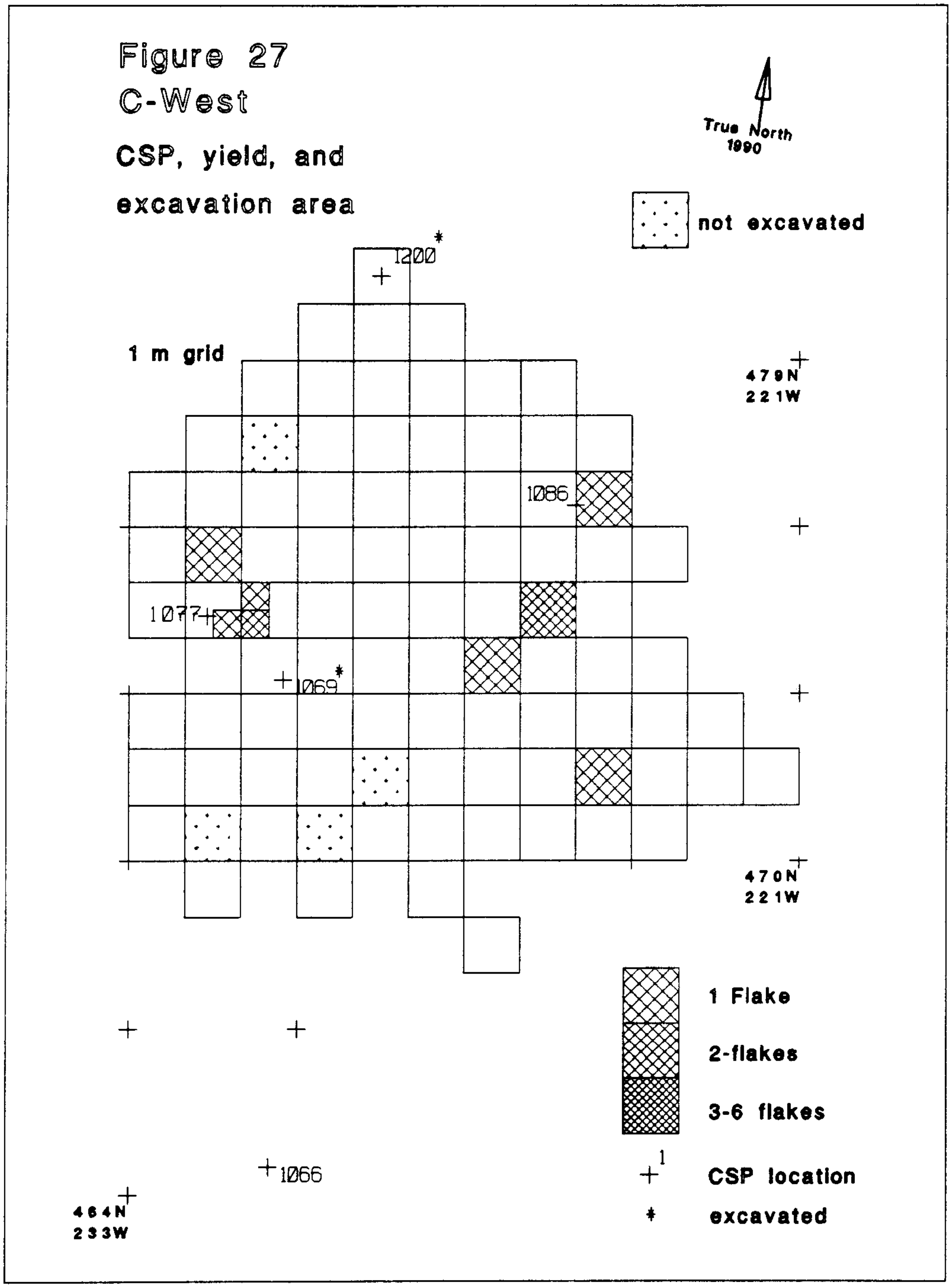


Figure 27
C-West
CSP, yield, and
excavation area

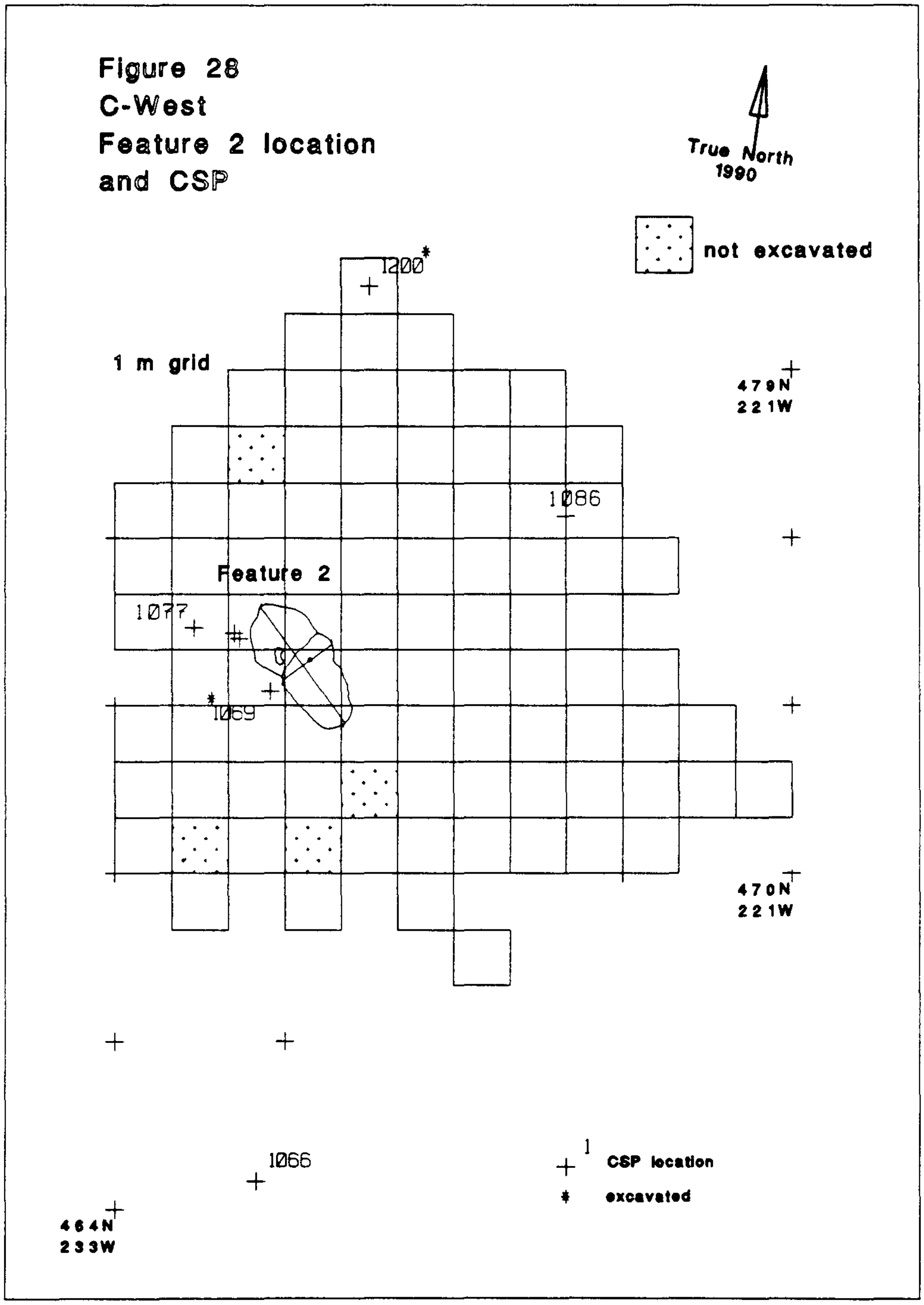


Figure 28
C-West
Feature 2 location
and CSP
True North
1990
not excavated
1 m grid
1200
479N
221W
1086
Feature 2
1077
1069
470N
221W
1066
CSP location
excavated
464N
233W

4.0 <u>ASSEMBLAGE ANALYSIS</u>

A complete catalog of artifacts recovered during the 1975 and 1990 research projects, and intervening surveys, assigned to the Early Paleo-Indian (EPI) occupation, is in Appendix B. A catalog of all artifacts recovered on the 1990 research at McLeod is in Muller (1996).

4.1 LITHIC MATERIAL

The vast majority of artifacts recovered from the site are lithic, primarily chert flakes and tools, with some metasediment. Fire-cracked rock was also retrieved. The chert types present include local material, like Kettle Point (Janusas 1984) and till cherts, in addition to non-local sources; Onondaga (Parkins 1977), Selkirk, and Collingwood chert originating from the Fossil Hill formation (Eley and von Bitter 1989; von Bitter and Eley 1997). Trace quantities of artifacts on Bayport chert from Michigan (Shott 1993:15-16) were recovered, as were unknown materials, including unidentifiable cherts and chert types unknown to the analyst. A quartzite flake was recovered during the excavations, and several quartz flakes also displayed flaking attributes.

Lithic materials present which do not display flaking attributes are predominantly fire-cracked rock, but include two coarse ground stone tools recovered from Grid C. One of these is granite, while the other is a sedimentary banded silt stone.

4.1.1 Material Filter

The McLeod site is multi-component, yielding artifacts diagnostic of EPI, Archaic and Woodland horizons. Although it is difficult to attribute most of the lithic debris and non-diagnostic artifacts to specific cultural horizons, two exceptions can be made.

Collingwood chert artifacts in southwestern Ontario (*i.e.* southwest of London, Ontario) are exclusively associated with Paleo-Indian occupations (Deller and Ellis 1992a:11). All diagnostic artifacts on Collingwood chert associated with Grids A, B, and C at the McLeod site are EPI, a pattern found at other EPI sites in the vicinity, including Parkhill and Thedford II (Ellis *et al.* in prep.; Deller and Ellis 1992a:11). The corollary, that no diagnostic EPI artifacts appear on chert other than Collingwood, is a pattern repeated in this assemblage.

Bayport chert is also frequently associated with EPI, Barnes complex sites in southern Ontario, and rarely with any other horizon (Deller and Ellis 1992b:39-40). On this basis, two artifacts on Bayport chert are grouped with the EPI artifact assemblage.

The premise that artifacts of Collingwood and Bayport cherts are equated with an EPI occupation is made in the following analysis of the McLeod site artifact assemblage. It is not argued that the EPI occupation at the McLeod site is represented solely by Collingwood and Bayport cherts, and may include Onondaga, Selkirk, unknown and till cherts. EPI use of Kettle Point chert in trace quantities is present at Parkhill (Ellis 1997: per. comm.). The role of Kettle Point chert in the EPI component of the McLeod site is likely of marginal significance because all of the material analyzed is of primary (bedrock) origin.

Kettle Point is the most frequent lithic material on the McLeod site, but using the premise that this EPI occupation is concurrent with Main Lake Algonquin/ Ardtrea, the primary (formation) sources of Kettle Point chert were submerged a significant distance offshore (*ca.* 7 km from the nearest Algonquin/Ardtrea shoreline) and depth below water (*ca.* 15 metres). It is presumed that this would prevent access to primary sources, limiting use to secondary deposits of Kettle Point chert in glacial till. No Kettle Point chert EPI diagnostic artifacts were recovered.

The potential information loss resulting from the use of this material filter is tolerable, as it permits the separation of the EPI horizon from subsequent occupations and minimizes the inclusion of non-Paleo-Indian artifacts within the analysis of the EPI assemblage. Although inclusion of material that may be EPI would increase the sample size, the interference caused by spurious data (non-Paleo-Indian artifacts included in the EPI assemblage) would negate any benefits the use of a larger sample may offer. The cost of a reduction in sample size due to the material filter is outweighed by the benefit gained in isolating the EPI component from the entire multicomponent assemblage. In short, the material filter improves the signal which is the focus of this research, the EPI occupation at the McLeod site, while minimizing the noise level of other cultural horizons at this multi-component site. The focus of discussion and interpretation in this analysis is on the Paleo-Indian component of the McLeod site lithic assemblage.

4.2 LITHIC MORPHOLOGY

Formal and informal lithic tools are identified in this analysis according to generic morphological and ascribed functional categories, such as projectile points, preforms, cores, scrapers, choppers, and retouched/utilized flakes (see Table 18, section 5.3.2). The tool metrics are recorded using the same system as Deller and Ellis (1992a:147-148 - Appendix A).

Residual lithic material falls into the category of lithic debris or debitage. These items were analyzed using a typology from Ellis (1984) and Muller (1988), modeled on lithic reduction paths. Using a variety of criteria, like platform angle, morphology, dorsal scarring attributes, size, and lateral edge orientation, flakes are identified within a series of types, representing stages of a lithic reduction model (Appendix C). A summary of the flake taxonomy utilized follows.

Primary flakes are large, with an entirely cortical dorsal surface and large, unprepared platforms forming an obtuse angle with the dorsal surface. This form of flaking debris originates from the initial reduction of cores. Secondary flakes are similarly large, with cortex on the dorsal surface broken by flaking scars, though, while platforms are usually smaller, and form a less obtuse intersection with the dorsal surface. Secondary flakes represent intermediate stages of core reduction. Tertiary reduction flakes do not have any cortical surface, and have a platform approximately perpendicular to the dorsal surface. The platform is smaller, and may show some preparation. This class of flakes arise from the final stages of core reduction and tool finishing. General tertiary flakes are fairly nondescript. There are, however, two sub-categories of tertiary flakes which are more clearly defined, consisting of biface and uniface flakes.

Biface flakes are small, with extensively flaked dorsal surfaces, and usually have a smooth ventral surface. Platforms are typically very small, forming an acute angle with the dorsal surface. A platform may be isolated or lipped, and can show preparation by grinding, along with a lenticular or faceted surface. These typically result from late stages of biface reduction, thinning, and finishing, or tool resharpening related to bifacial tool manufacture and repair.

Unifacial flakes are attributed to the manufacture and repair of unifacial tool edges. These are typified by a flat platform, usually perpendicular to the dorsal surface. Dorsal curvature is common, in addition to remnants of usewear on or near the platform, which is a remnant of the tool's underside. Flake scars on the dorsal surface are generally parallel.

Additional categories of flakes include flat flakes (fragments identifiable as portions of flakes, but without adequate attributes to identify them to a more specific flake type), shatter (not displaying flaking attributes, but probably the result of core collapse), and pebbles (generic split or intact nodules of till-chert). Cores are generally larger, and generally show a consistent pattern of flake removal and preparation for flake removal. Blanks are large flakes obtained from cores, which are typically reduced to preforms and/or tools. Preforms represent varying intermediate stages in tool production, prior to tool completion.

The preceding flake typology is adequate for post-Paleo-Indian lithic assemblages. On the basis of earlier work however (Ellis 1979, 1984), the argument is made that Paleo-Indian lithic technology was based on a more formalized lithic reduction strategy and process, permitting (and demanding) a more stringent typology for both the biface and uniface categories.

With biface flakes, work by Deller and Ellis (1992a) has identified several sub-types, which are used in this analysis. Biface thinning flakes arise from the reduction of bifaces through removal of flakes across the face of the biface, either perpendicular to the longitudinal axis using the lateral edges as platforms (normal biface thinning flakes: Deller and Ellis 1992a:80-81), or using either end of the biface as the platform, removing flakes from the face of the biface down its length (end biface thinning flakes: Deller and Ellis 1992a:82-83). Biface thinning flakes in retouch are similar to general biface thinning flakes, but arise from thinning activities after the biface margins have been retouched, whether through edge preparation for more precise thinning, or after utilization of the biface prior to completion of the tool (Deller and Ellis 1992a:83). Channel flakes, resulting from the fluting of projectile point preforms, are another distinctive type, in terms of both morphological attributes and activity identification (Deller and Ellis 1992a:84). Biface finishing flakes arise from finishing bifacial tool margins, in addition to resharpening edges (Deller and Ellis 1992a:85-6). Biface reduction flake errors arise from faults in flaking technique, or in the flaking material, which cause abrupt termination of the flake or collapse of the tool edge (Deller & Ellis 1992a:86).

There are two subcategories of uniface flakes. Normal uniface retouch flakes originate from the normal finishing and resharpening retouch of uniface tools, rejuvenating the dorsal surface. Ventral or inverse uniface retouch flakes arise from retouch of the ventral surface of uniface tools (Deller & Ellis 1992a:86-7).

Although the character of the Paleo-Indian lithic reduction strategy facilitates the utilization of a more precise typology for analysis of the lithic debitage, not all lithic debris conform to these specific sub-types. When this was the case, flakes were identified to the higher order of classification, such as generic biface and uniface flakes, or tertiary flakes. Appendix C contains a detailed description of the criteria used in the lithic analysis, as well as the coding system used to record this information in database format.

The function of this lithic typology is to allow interpretation, based on the analysis of lithic debris, of the nature of lithic activities occurring at a site. Frison (1968:154) stated that "...as much or more information, concerning activities performed (at the site), was derived from the retouch flakes as from the tools." It has been argued (Collins 1975:19; Ellis 1979:12-13; Muller 1988:31-32) that the flaking debris assemblage present at a site is likely more representative of site activities than the assemblage of tools discarded there. Debitage results from lithic activities occurring at a site. Tools recovered at a site represent some or all of these lithic activities. However, if the use-life of tools utilized at a site exceeds the site occupation, and they are neither discarded nor lost, their absence would inaccurately suggest that the site occupation did not entail use of these tools. Analysis of lithic debris focuses on the byproducts of lithic activity, and so while tools may be absent from the tool assemblage, debitage indicative of their presence and use allows the researcher to argue that they were included in the tool-kit used at a site.

4.2.1 Collingwood Chert

Banding of Collingwood chert, parallel to the bedding plane and cortical surfaces (above and below), can be present, although it also occurs in unbanded forms. In banded form, the lateral edges of the chert bed are marked by a cross-section of these bands (Deller and Ellis 1992a:12). When banding is present in artifacts, it provides an orientation of the bedding plane in relation to the artifact, permitting identification of how the flake blank was struck from the original formation: from the "top", face, side, or corner of the quarry block (Deller and Ellis 1992a:13) (Figure 29). The term top refers to the cortical surface either above or below the chert bed. When bedding planes are visible on tools, in the analysis below their orientation is used to describe the artifact as top, face, side, or corner struck.

4.3 LITHIC ANALYSIS

The following analysis examines the lithic assemblages of the McLeod site. The artifacts analyzed include those recovered during the excavation activities, and through surface collection, on both CSP's and informal surveys. The provenience of these materials is noted in the discussion of specific artifacts or of artifact classes.

Altogether, 52 flakes and 21 uniface tools (n=73) were recovered on informal surveys, CSP and excavation activities in Grids A and B at the McLeod site. The majority of these (n=63, 86.3%) were recovered from Grid A. Some EPI artifacts from the initial finds of the Layes and Ray Baxter (three flakes and one uniface - 5.5%) are provenienced to the overall Grid A and Grid B area. Because the artifacts recovered from Grid B (four unifaces and two flakes) make up only 8.3% of the collection, the assemblage from this grid is too small for valid statistical analysis, and the collections from Grids A and B are grouped together for analysis. Grids A and B are also in relatively close proximity, separated by 135 feet or approximately 40 metres, while Grid C spans an area of approximately 82 metres. This grouping also accommodates those artifacts which are provenienced to the Grid A and B area as a whole, although the sample is likely biased to Grid A, given the distribution of artifacts provenienced to each specific grid.

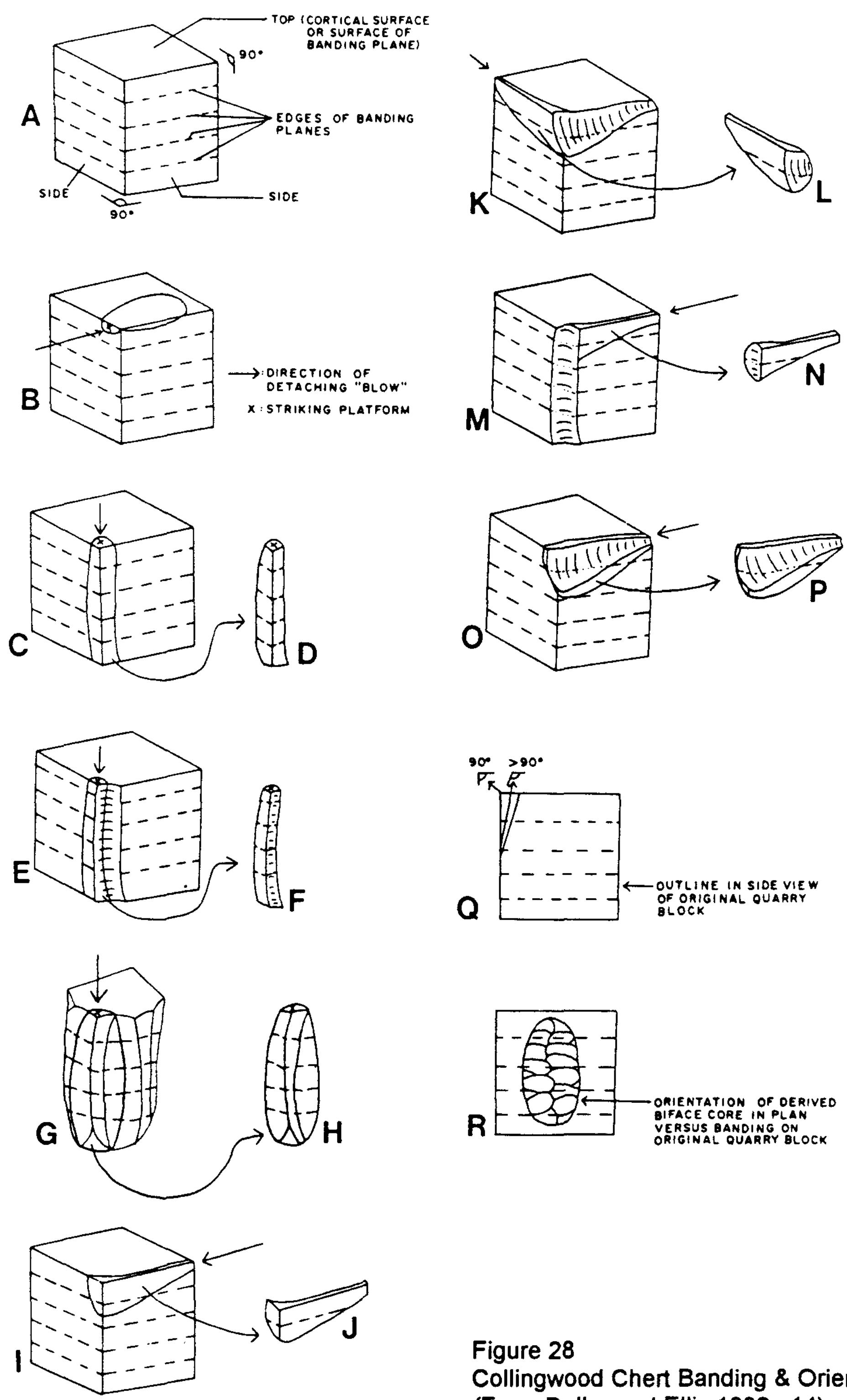


Figure 28
Collingwood Chert Banding & Orientation
(From Deller and Ellis 1992a:14)

The assemblage recovered from Grid C, in excavations, CSP and informal survey, consists of 41 flakes of lithic debitage, 13 unifacial tools and utilized flakes, and two bifaces. Of the lithic debitage, 39 items (95.1%) were from Grid C-West (the two exceptions were recovered from Grid C-South). Because of this distribution, the lithic debitage portion of the artifact assemblage is considered a single group attributed to Grid C. This also accommodates the inclusion of the five items of lithic debitage which were collected on informal surveys, with a general Grid C provenience, representing 8.5% of the lithic debitage from this site grid.

Subsequently, the lithic debitage from Grids A and B is analyzed as a single group. Grid C debitage is likewise analyzed as a group separate from Grids A and B. The remainder of the assemblage, recovered from Grids A, B, and C, and consisting of the formal tools and utilized flakes, is analyzed on the basis of artifact type, with grid provenience noted in the discussion.

4.3.1 Grids A and B - Lithic Debitage Analysis

Fifty-two items of lithic debris attributed to the Paleo-Indian occupation were recovered in Grids A and B at the McLeod site. All but one of these are Collingwood chert, three of which were exposed to heat, whether incidentally or deliberately. The remaining flake is Bayport chert.

The most frequent flaking debris category (n=22, 42.3%: Table 3) is normal uniface retouch flakes, outnumbering even flat flakes (n=18; 35.3%). Two secondary nodes occur at much lower frequencies. Biface reduction flakes (n=5) represent 9.8% of the assemblage, consisting of three channel flakes and two biface finishing flakes. General tertiary reduction flakes (n=5) form the other secondary node, also representing 9.8% of the assemblage. One primary reduction flake and one secondary reduction flake round out the remainder of the assemblage.

The nature of this lithic assemblage is unusual. Most notable is the high frequency (n=22, 42.3%) of uniface retouch flakes, indicative that the finishing and resharpening of uniface tools, notably end scrapers, is a predominant activity within this area of the McLeod site. The importance of this activity is emphasized by degree to which uniface tool retouch activity is usually under represented in assemblages of lithic debitage in comparison to biface reduction activities. This is largely due to uniface reduction flakes being typically smaller and more difficult to recover than biface reduction flakes when 3 mm hardware cloth is not used, and because reduction and retouch of any given uniface tool produces fewer flakes than a given biface (Deller and Ellis 1996:29; Jackson 1994:256; Collins 1975:32). Uniface tool resharpening, rather than finishing of new uniface tools, appears to have been the most significant activity, as 19 of the 21 (90.5%) uniface retouch flakes recovered in this area of the McLeod site show extensive signs of chatter and usewear immediately below the platform.

The frequency of flat flakes is unusually low. Most of the lithic activity at the site centers around uniface resharpening, which produces a fewer flat flakes (Jackson 1997:14; Deller and Ellis 1992a:87). While some bifacial flakes are present, these are in relatively low proportions, significant because flakes resulting from bifacial reduction activities are usually over-represented in lithic assemblages, producing a larger proportion of flat flakes than unifacial reduction activities in general (Deller and Ellis 1992a:87, 89), and unifacial resharpening in particular (Deller and Ellis 1992a:89). All of these factors suggest that the predominant lithic reduction activity occurring at this portion of the McLeod site, as represented by the lithic debitage, is unifacial, with a minimal degree of bifacial reduction activities. This result holds across both Grids A and B, although the sample from Grid B is very small (n=2, both uniface retouch flakes).

Table 3: Lithic Debitage	Site Grid		
Flake type	A & B	C	totals
Primary reduction	1 (1.9%)		1 (1.1%)
Secondary reduction	1 (1.9%)	1 (2.4%)	2 (2.2%)
Tertiary reduction	5 (9.6%)	2 (4.9%)	7 (7.5%)
Generic biface reduction		3 (7.3%)	3 (3.2%)
Normal biface reduction		5 (12.2%)	5 (5.4%)
Finishing biface reduction	2 (3.8%)	4 (9.8%)	6 (6.5%)
Channel flake reduction	3 (5.8%)	2 (4.9%)	5 (5.4%)
Biface retouch		5 (12.2%)	5 (5.4%)
Biface reduction errors		2 (4.9%)	2 (2.2%)
Normal uniface reduction	22 (42.3%)	5 (12.2%)	27 (29.0%)
Flat flake	18 (34.6%)	12 (29.3%)	30 (32.3%)
totals (%)	52 (99.9%)[1]	41 (100.1%)	93 (100.2%)

NB: 1: percentage totals may not equal 100.0% due to rounding

The remaining debitage consists of tertiary reduction flakes, with secondary and primary reduction activities minimally represented. Primary and secondary reduction activities produce large quantities of debitage when present (*e.g.* Fisher site - Stewart 1997:173). As discussed in the outline of the lithic typology used, the bifacial and unifacial flake reduction categories are subsets of the tertiary flake type, all of which represent terminal lithic reduction activities. The data suggest that the main lithic activities occurring across Grids A and B are the final stages of uniface lithic reduction and resharpening. This is also supported by the low average flat flake mass (n=18, x=0.09 g, sd=0.078), suggesting their origin in later stages of lithic reduction.

Given the small number of flakes recovered from Grid B, and the minimal degree of contiguous excavation in Grid A, it is difficult to derive any significant pattern of flake distribution across this site area. In Grid A, which yielded the majority of flakes, the general distribution is indicative of the site presence (Figure 20), but does not provide any strong suggestion of differential flake or flake type distribution across the site (Figures 30, 31).

4.3.2 Grid C - Lithic Debitage Analysis

A total of 41 items of lithic debris attributed to the Paleo-Indian were recovered from Grid C at the McLeod site. All but one of these are Collingwood chert, with five (12.2%) showing signs of incidental or deliberate exposure to intense heat. The remaining flake is Bayport chert. A few additional flakes and fragments in the assemblage are probably Bayport chert, but cannot be positively identified to material type. As a result, these are not included in the analysis.

The flaking debris category showing the highest frequency (n=21; 51.2%: Table 3) is the aggregate category of biface reduction flakes, outnumbering flat flakes (n=12; 29.3%). The main biface reduction flakes present are biface retouch, normal biface reduction, finishing biface reduction, channel, and generic biface reduction. Normal uniface retouch flakes occur at a markedly lower frequency than in Grid AB (n=5, 12.2%, versus 42.3%). A single general tertiary reduction flake was also recovered. Flakes arising from early stages of lithic reduction are only nominally represented by one secondary reduction flake.

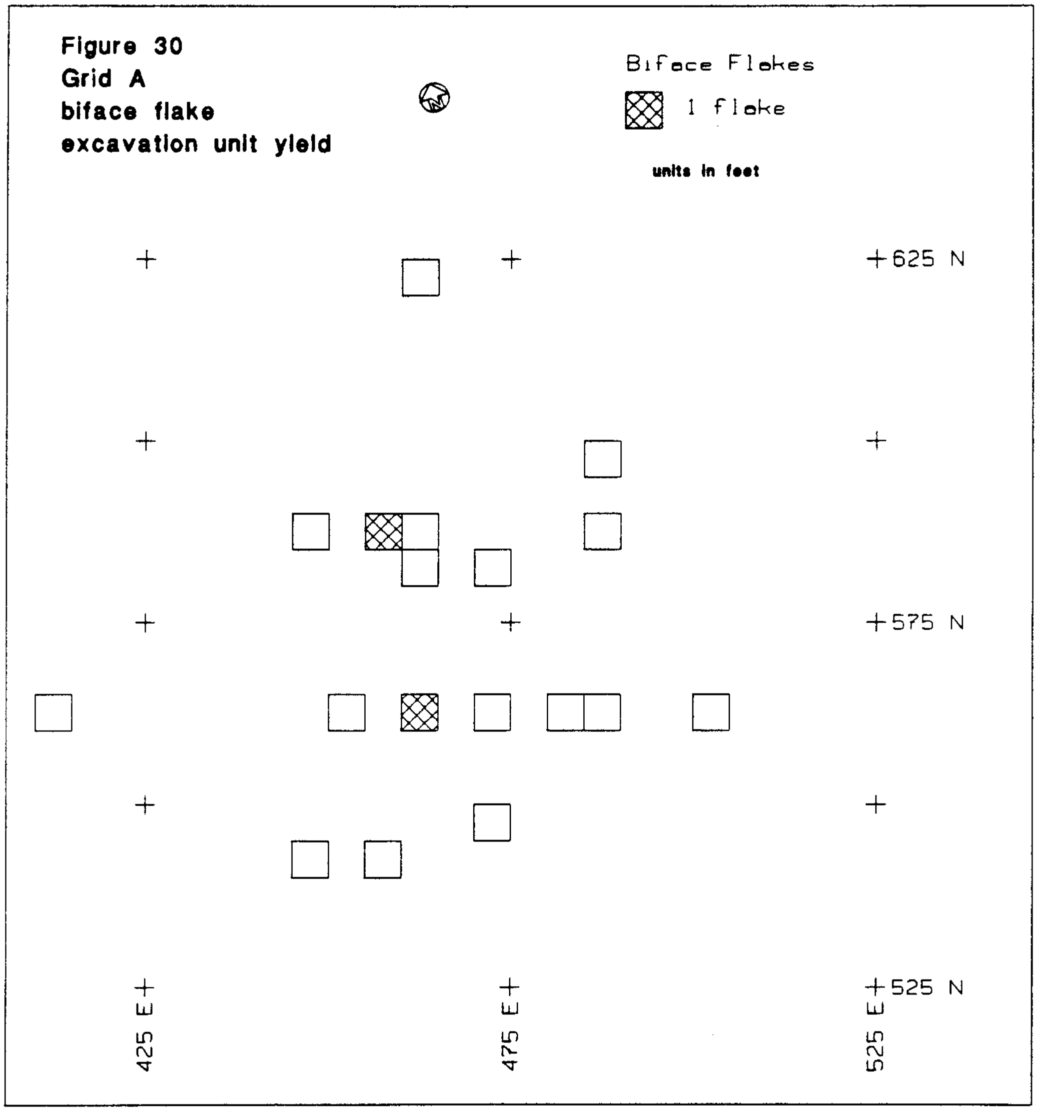


Figure 30
Grid A
biface flake
excavation unit yield
Biface Flakes
1 flake
units in feet
625 N
575 N
525 N
425 E
475 E
525 E

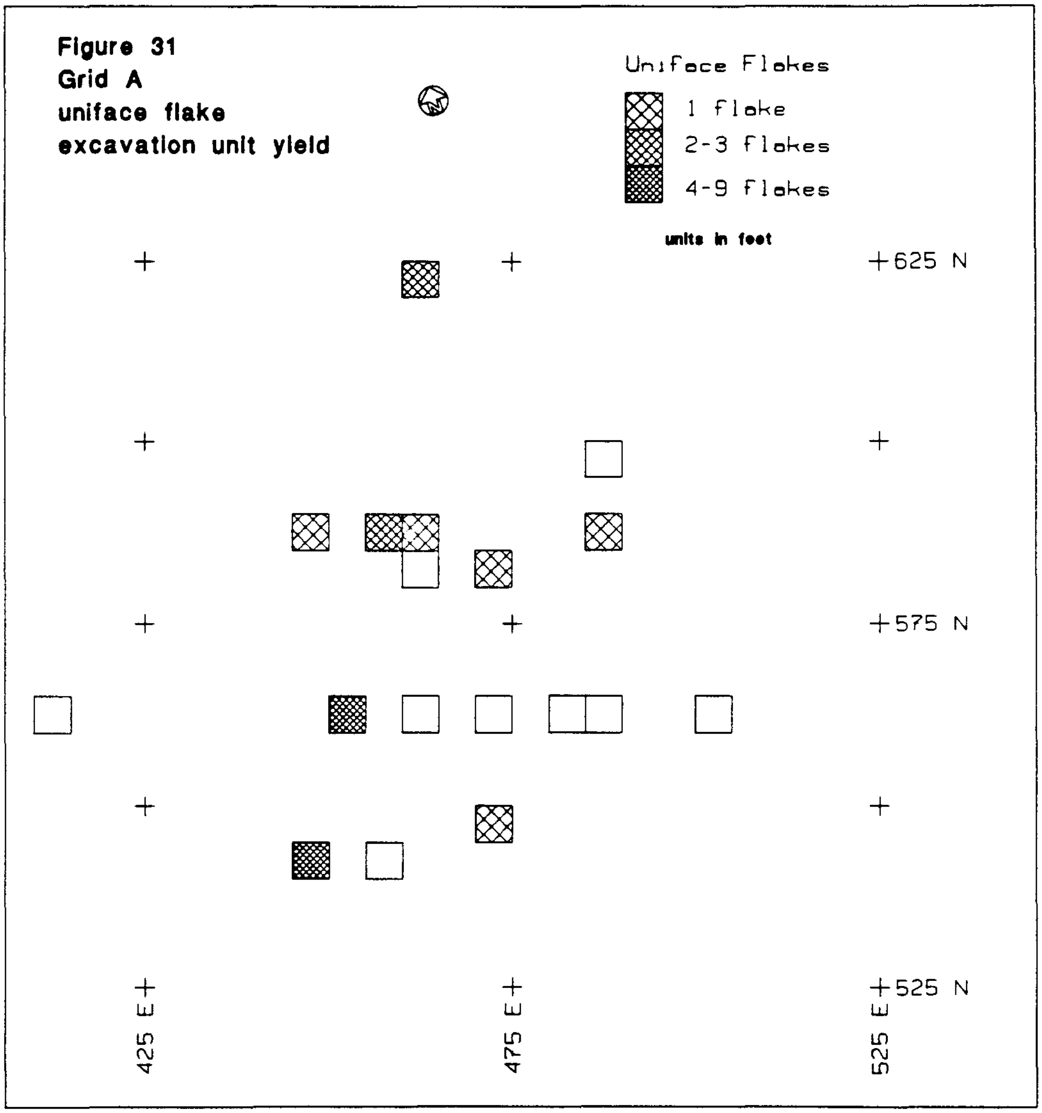


Figure 31
Grid A
uniface flake
excavation unit yield
Uniface Flakes
1 flake
2-3 flakes
4-9 flakes
units in feet
625 N
575 N
525 N
425 E
475 E
525 E

The nature of this lithic debitage distribution of flake types is indicative of late stages of lithic reduction, with essentially no early lithic reduction taking place. The most notable characteristic of the Grid C flaking debris is the higher frequency of biface reduction flakes, indicating that the finishing and resharpening of bifacially worked tools is a more prominent activity within this area of the McLeod site. The importance of this activity, as discussed above, is somewhat moderated by the degree to which biface reduction activity is usually over represented in assemblages of lithic debitage, in comparison to uniface reduction activities (section 5.3.3, and Deller & Ellis 1996:29). Although biface reduction flakes are the largest group of flakes represented in the assemblage, the broad representation of most biface reduction flake types infers that a wide range of activities were carried out at this location. These include bifacial thinning and finishing, in addition to retouch of existing bifacial tools, and the fluting of one or two point preforms. One of the channel flakes was also retouched/utilized, but it is included in this section because the retouch is minor, and is not likely a curated tool, but was probably produced and utilized at the site. This artifact (AhHk-52:1086) is discussed in further detail below, in the retouched/utilized flake component of the uniface tools section, and in the discussion of channel flakes within the biface tool section.

The activity of uniface tool reduction is also present at the site, probably to a larger degree than the numbers indicate (n=5, 12.2%), given the degree to which uniface reduction flakes are normally under represented in assemblages of lithic debitage (Deller and Ellis 1996:29). As is the case in Grids A and B, the main activity association with working unifacial tools is tool resharpening rather than manufacture.

The frequency of flat flakes (n=12, 29.3%) is relatively low, more notable as biface reduction is frequently associated with higher proportions of flat flakes (Jackson 1997:14; Deller & Ellis 1992a:87). This result is likely due to the formal Paleo-Indian lithic reduction strategy in general, and that the main activities at the site are tool finishing and resharpening. The data suggest that the primary lithic activity occurring across Grid C consists of terminal stages of both uniface and biface lithic reduction and resharpening. Their light mass, although slightly higher than that of Grid A and B (n=12, x=0.12 g, sd=0.14), suggests that the flat flakes originate from later stages of lithic reduction. Primary and secondary reduction activities, such as those found at quarry sites, tend to produce large quantities of larger flat flakes if they are significant activities at a site (see below in 5.3.). This must be tempered by the fact that small flat flakes are also subject to poor recovery when 6 mm hardware cloth is used to process excavated soils.

Because of the small size of the artifact sample, it is difficult to note any significant clustering of flake types across any of the Grid C areas. The one single focus (Figure 32), marks the location of Feature 2, which yielded 23 of the 33 flakes (70.0%) recovered at Grid C-West attributable to the Paleo-Indian occupation, and more than half (56.1%) of the 41 flakes recovered from Grid C as a whole, in excavation and survey.

4.3.3 All Grids - Unifacial Tools

A total of 21 unifacial tools, tool fragments, and utilized flakes were recovered from Grids A and B at the McLeod site. An additional 13 unifacial tools, tool fragments, and utilized flakes were recovered from Grid C. With the exception of two tools, a graver and a denticulate both on Bayport chert, all of these artifacts are on Collingwood chert. Many of the tool types fall within a range of categories described by Deller and Ellis (1992a), some of which are described as being diagnostic of Paleo-Indian lithic assemblages in the lower Great Lakes region (Ellis and Deller 1988). A detailed description of the tool metrics is presented in Appendix B.

End Scrapers

Six end scrapers were recovered from Grids A and B, with three retrieved from Grid C. All of these tools are on Collingwood chert. The tool typology follows closely the description of the types identified in Deller and Ellis (1992a:55-7). The premise of tool use differentiation is inferred by the systematic clustering of specific attributes used to define certain tool types. The metrics recorded include size, angle and location(s) of working edges, along with secondary characteristics such as notches, spurs, and lateral edge retouch. In part, this is an extension of the description of certain tool types which Ellis and Deller (1988:115-120) hypothesize are

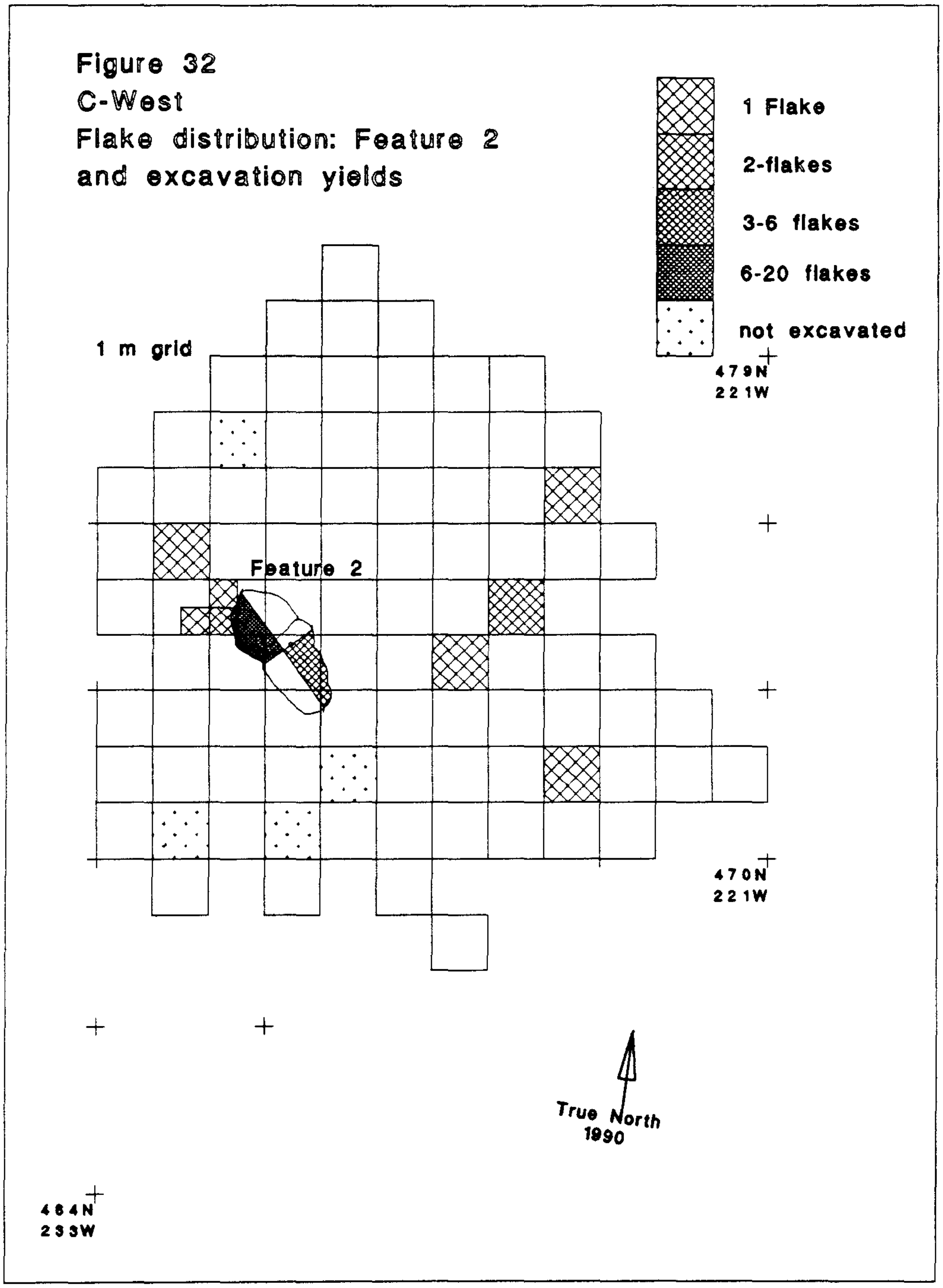


Figure 32
C-West
Flake distribution: Feature 2
and excavation yields
1 Flake
2-flakes
3-6 flakes
6-20 flakes
not excavated
1 m grid
Feature 2
479N
221W
470N
221W
464N
233W
True North
1990

diagnostic of the EPI horizon in the lower Great Lakes. Some of these diagnostic tool forms are present at the McLeod site, and some of the tools recovered at McLeod are comparable to some of those identified at Thedford II (Deller & Ellis 1992a). The relation of the McLeod site tool assemblage to other Paleo-Indian sites is noted in the discussion below.

Trianguloid End Scrapers

Two trianguloid end scrapers were obtained from Grid A (Figure 19:$m_1w_1s_1$-1:3,11), and one was recovered from Grid C-North (Figure 26). One end scraper from Grid A is complete (Plate 2: $m_1w_1s_1$-1:3 & 11; Table 4), while the other from Grid A is snapped proximally (Plate 2: $m_1w_1s_1$-1:11; Table 4). The trianguloid end scraper from C-North (Plate 2: AhHk-52:1074) has a partially snapped bit, a modern break. In addition, one trianguloid end scraper recycled as a graver (m1w1s1-1:8) was recovered from Grid A. The distal end of this end scraper appears to have collapsed, snapping most of the working edge off ventrally, rendering it unusable. The proximal end of this tool was subsequently retouched to form a graver, as detailed below.

Table 4: Triangular End Scrapers

variable	n	r	x	sd
length	2	26.9-30.9	28.9	2.8
width	4	19.7-29.6	24.5	4.76
thickness	4	5.2-7.2	6.1	1.0
bit width	3	18.9-30.1	23.0	6.1
bit depth	3	2.9-4.3	3.5	0.7
bit thickness	3	2.9-6.4	5.2	2.0
bit width/depth ratio	3	4.7-9.0	6.7	2.2
curvature	3	6-8	7.3	1.2

NB: n=frequency of observations, r=range, x=average, sd=population standard deviation

These trianguloid end scrapers are based on sizable flakes, likely originating from large bifacial cores. They show moderate to minimal longitudinal curvature, have a roughly triangular plan outline, and their original plano-convex cross-section has been trimmed to trapezoidal shape by lateral retouch. Bits are centered on the distal end of the flake, with fine and steep normal retouch. The bits are broad but relatively shallow, while retouch extends up the lateral edges of the tool, inferring modification to standardize these edges to facilitate hafting. The retouch straightens the lateral edges, resulting in a consistent lateral edge orientation of 30°-50°, and makes these edges more robust. These attributes suggest that these scrapers are hafted through insertion into a socket type of handle.

Retouch also forms two additional features on these end scrapers: notches and spurs. Between two and five notches are present on the lateral edges of two of these scrapers ($m_1w_1s_1$-1:3, 11). The first ($m_1w_1s_1$-1:3) has three notches on the left side and two on the right, both distally and proximally, while the other ($m_1w_1s_1$-1:11) has one notch on each side, both located distally. The notching may infer another hafting technique, with proximal notches aiding to secure the scraper into a split shaft. However, the need for another hafting technique is not borne out by any significant difference in width or thickness between the end scrapers with and without notches, nor is there any notable differentiation in lateral edge orientation between them. As an alternate explanation, they may represent tool recycling into a side scraper or graver tool. The most extensively notched end scraper, with the only proximal notching is $m_1w_1s_1$-1:3, which is smaller, although the remaining end scraper potential does not appear to be fully spent. Scraper $m_1w_1s_1$-1:11 is larger, but only has distal notching.

Potential utilization is less likely with distal notching, and these may possibly be tool accessories. It has been noted elsewhere (Deller and Ellis 1992a: 55) that as the bit is resharpened towards the notches, a spur can be formed between the notch and the bit, but this was not noted on any of the triangular end scrapers in the McLeod assemblage. Although the sample size is small, the metrics and ratios of these artifacts fall within the ranges noted for trianguloid end scrapers from Thedford II (Deller and Ellis 1992a: 55).

Narrow/'Beaked' End Scrapers

Narrow or beaked end scrapers have been identified by Ellis and Deller (1988:117-9) as diagnostic Paleo-Indian tool types in the lower Great Lakes region. One narrow end scraper was recovered from each of Grids A (Figure 19; $m_1w_1s_1$-1:29) and C-West (Figure 27; AhHk-52:1069) respectively. As is inferred by the name, these are end scrapers with very narrow, steeply retouched bits, showing very low bit width to depth ratios (Table 5). They also exhibit steep lateral retouch, both to narrow the edges approaching the bit, and also likely to strengthen the bit (Deller and Ellis 1992a: 60-63). All retouch is normal on these tools.

Table 5: Narrow End Scrapers

variable	n	r	x	sd
length	1	43.59		
width	2	11.4-19.0	15.2	5.4
thickness	2	3.8-6.8	5.3	2.1
bit width	1	5.21		
bit depth	2	2.6-2.8	2.7	0.1
bit thickness	2	2.5-4.9	3.7	1.7
bit width/depth ratio	1	1.85		
curvature	2	15	15	

NB: n=frequency of observations, r=range, x=average, sd=population standard deviation

The narrow end scrapers recovered (Plate 2: $m_1w_1s_1$-1:29, AhHk-52:1069) match these characteristics, although the tool from Grid C has a snapped bit. It is manufactured on what is likely a corner struck flake, as there is a prominent ridge running down the middle of the dorsal surface, lending the flake a near-triangular cross-section along much of length. The narrow end scraper from Grid A is on a more irregular flake with more extensive lateral retouch, but is probably a top-struck corner flake.

The sample of narrow end scrapers from the McLeod site is small, and therefore statistical comparisons are of limited use. They do fall within the range of variation described by Deller and Ellis (1992:60b), although the bit width to bit depth ratio is particularly low: this is based on a sample of one, however, so the significance of this is unknown. In general, the narrow end scrapers recovered from the McLeod site are smaller than those described for the Thedford II site, but again, sample size limits the weight of any interpretation.

Miscellaneous End Scrapers

Several end scrapers were recovered as individual examples of types, or which fall into a generic end scraper category. One end-of-blade end scraper was retrieved in Grid C prior to 1990, on a general surface collection (Plate 2: AhHk-52:28, Table 6). It is a heavy end scraper, on a top-struck corner blank of Collingwood chert. Due of the blank type, the dorsal surface of the blank is a 90° ridge along the longitudinal axis, slightly offset to the right, consisting of two planes of unflaked surface. The surface is broken only by a proximal flake scar resulting from the removal of the blank from the tabular core, lateral retouch, and the terminal retouch along the steep working edge. The tool has a lateral concavity half way between the proximal and distal ends along the right edge, forming a tool accessory, the presence of which suggests that the tool was hand-held, not hafted. This inference is supported by the large size of the tool, inferring a convenient grip for holding and usage that would not be improved by hafting.

Table 6: Miscellaneous Uniface Tools

tool description	end of blade end scraper	convex narrow end scraper	flake end scraper
catalog number	AhHk-52:-28	$m_1w_1s_1$-1:7	$m_1w_1s_1$-1:17
length	48.5	52.7	58.6
width	24.2	49.9	32.7
thickness	13.0	13.0	5.4
bit width	26.7	14.6	25.4
bit depth	14.25	8.1	6.4
bit thickness	6.15	11.0	1.3
bit width:depth	2.3	1.8	4.9
bit angle	85	70	55
curvature	13	13	13

A massive convex narrow end scraper, with extensive normal retouch along convex and concave edges, was recovered in Grid A (Figure 19: Plate 3: $m_1w_1s_1$-1:7, Table 6). This is a multi-function tool, judging from the diversity of accessories. The material is a variant of Fossil Hill chert which does not have banding, so flake origin is uncertain. It is a very large blank, probably hand-held due to the irregular character of its shape and retouched edges.

A generic end scraper was recovered from Grid A (Figure 19) during the initial CSP (Plate 2:$m_1w_1s_1$-1:17, Table 6). It is a large, long flake from a biface core, with shallow normal retouch on the left side at the distal end of this flake. The lateral edges are not retouched. The cross-section is generally planoconvex, but has a prominent ridge along the dorsal surface at the proximal end, feathering out distally. Colouration of the tool indicates that it was exposed to intense heat, whether deliberately or accidentally.

Side Scrapers

Like end scrapers, several side scrapers types are present in the McLeod tool assemblage, characterized through the identification artifact attribute clusters. Typical of these is normal retouch along lateral flake edges, forming convex or concave working surfaces, with bit angles that are more acute than those of end scrapers. None display hafting characteristics, although several exhibit retouch that would accommodate a more positive and safer grip during tool use.

Table 7: Side Scrapers

artifact #	2	1077	$m_1w_1s_1$-1:1	27	24	57	AhHk-52:1	32
Side scraper tool type	convex	convex	concave	converge	converge	convex w/bend break	concave w/ graver	convex
blank origin	biface	top corn	top diag	top face	top face	top face	side face	biface
length	45.9	58.2	58.7	29.4	51.6	47.0	57.3	29.7
width	18.8	40.1	27.9	26.6	33.2	21.2	29.3	40.3
thickness	5.4	9.2	7.6	9.1	10.9	13.7	13.0	10.7
L-edge form	convex	-	-	concave	concave	convex	concave	-
L-bit thickness	3.2	-	-	6.8	5.7	6.6	6.34	-
L-edge angle	65	-	-	70-90	90	60	75	-
L-retouch type	normal	-	-	normal	normal	normal	normal	-
R-edge form	-	convex	concave	straight	straight	distal bend break	distal chisel	convex
R-bit thickness	-	1.4	6.2	3.5	2.6	2.1	4.1	1.4
R-edge angle	-	70	55	60-65	65	90-120	90	50
R-retouch type	-	normal	normal	normal	normal	both	normal	normal
comment				broken			UCSP	

Two of the unifacial tools recovered from Grid B were side scrapers, with a single side scraper from Grid A, and five from Grid C. All of these tools are on Collingwood chert. The discussion is based on the tool descriptions in Deller and Ellis 1992a (55-7), with types defined by use differentiation as inferred by systematic clustering of attributes including size, angle and location(s) of working edges, along with secondary application characteristics such as notches, spurs, and lateral edge retouch.

Convex Side Scrapers

Two convex side scrapers were recovered from the McLeod site. The first (Plate 3:$m_1w_1s_1$-1:2, Table 7) was surface collected from Grid B (Figure 21). It is a flake from a biface core with a minor ridge running parallel to the long axis. The lateral edges of the flake form a "twist" approximately 30° around the longitudinal axis from the proximal to distal end, although there is no distal curvature ***per se***. The retouch is dorsal along the right lateral edge of the tool. The opposite lateral edge shows heavy chatter along the upper two-thirds of the dorsal surface, likely arising from earlier platform collapse, prior to separation of the blank from the core. This is a blade-like tool, approximately 2.4 times longer than its width.

The second convex side scraper (Plate 3: AhHk-52:1077, Table 7) was excavated in Grid C-West (Figure 27). The massive side corner struck face blank retains a long, thin cortical surface which forms a steep right lateral edge, meeting the remainder of the dorsal surface at a 90° angle. This cortex forms a 'back' for the retouched portion of the tool. Curvature of the blank is distal and pronounced. Shallow dorsal retouch is continuous along two proximal convex surfaces on the left lateral edge of the tool, separated by a concavity. Aside from the limited retouch, the flake is not otherwise modified. Due to the tool size, it is possible that it is early in the tool life, and could be extensively resharpened or finished into another tool form.

Concave Side Scraper

One concave side scraper (Plate 3:$m_1w_1s_1$-1: 1, Table 7) was recovered on the surface collection in Grid B at the McLeod site (Figure 21). This tool is a top diagonal strike blank, with the cortical surface serving as the platform. The concave working surface is deeply and continuously retouched along the right lateral edge, backed by both the platform surface and some additional retouch along the left lateral edge that has had a blunting effect, likely to accommodate grip of the tool. All retouch is normal on this tool.

Concave Convergent Side Scrapers

Two distinct tools, first described by Ellis (1984:226-7) as concave convergent side scrapers, were both surface collected from Grid C prior to 1990. These tools (Plate 3:AhHk-52:24&27, Table 7) are on top struck face blanks, one of which has cortical remnants on the platform $m_1w_1s_1$-1:24). Both examples have lateral edges which initially expand from the platform, whether naturally or accentuated through limited retouch. They have two main retouched elements, both distally located on the lateral edges and formed by normal retouch.

The first element is a retouched, flat and fairly acute lateral edge, in both cases on the right side. The second element is on the opposite edge, with steep retouch forming a sharp indentation or concavity on the lateral edge. In plan, the intersection of the curve of the concavity is perpendicular to the lateral edge. Although the lateral edge outside of the indentation is not retouched, the combined effect of the expanding lateral edge and the sharp angle the concavity makes with the lateral edge creates a large spur below the concavity. The concavity then tapers to form a straight reworked edge, still with a steep bit angle, which intersects with the opposite lateral edge, forming a sharp tip. One of these tools is complete (AhHk-52:24), while the tip of the other is broken above where the concavity tapers into a the flat lateral surface.

This tool form has not been formally identified at any other Paleo-Indian sites within the lower Great Lakes. Its highly retouched nature suggests a fairly specialized application, or alternately, provides a variety of applications within a single tool type. The tool form may also represent a distinct activity, as yet not noted on sites excavated in the lower Great Lakes region. As they are both from the same area of the site, this tool could also represent an individual toolmaker's idiosyncracy. A similar tool may have been recovered from the Banting site (Storck 1979:14; Plate 5-L, artifact 973.448.95), although it has not yet been inspected first-hand.

Miscellaneous Side Scrapers

Three additional side scrapers were recovered from the McLeod site which do not readily fit into any defined categories. One, excavated from Grid A (Figure 19), is a single convex side scraper with retouch on a bend-break edge (Plate 3: $m_1w_1s_1$-1:57, Table 7). This tool is on a top struck face blank, with a prominent dorsal ridge along the long axis, offset to the left of centre. The left lateral edge forms the convex, normally retouched surface, with some retouch flake scars extending up the dorsal surface to the ridge. The bend-break forms the distal end of the blank, a step fracture analog. Retouch along the dorsal and ventral edges of this break is both normal and inverse. Although it is shallow and not fully contiguous, the retouch is extensive along these edges. Deller and Ellis (1992a: 69) suggest that bend-break tools may be the Paleo-Indian equivalent of burins, and note their presence in Folsom contexts.

The second tool was recovered through surface collection of Grid C prior to 1990. This is a concave side scraper with a normally retouched distal chiseled spur, and some lateral chatter or retouch on the dorsal surface (Plate 3:AhHk-52:1, Table 7). The tool is on a side struck face blank, with some unflaked surface remaining on the platform. The concave retouch is on the left lateral edge. It is relatively steep (85°) and small, as is the adjacent chiseled graver component. The chatter and/or retouch is also on the left lateral edge, running proximally from the concave retouch to near the platform. The item appears to be a multi-function tool.

The final side scraper is generic tool, a utilized flake from a biface core (Plate 3:$m_1w_1s_1$-1:32, Table 7). The acute retouch is distal. Some chatter is present on the dorsal surface to the right of the platform, which may have served to blunt the edge for grip optimization. This tool was also recovered on an informal survey in Grid C prior to 1990.

Miscellaneous Uniface Tools

A variety of additional unifacial tools were recovered from all areas of the McLeod site, with six from Grid A, two from Grid B, and four from Grid C. One significant tool type included in this category is backed and snapped unifaces, a tool form Ellis and Deller (1988:119-20) identify as diagnostic of the Paleo-Indian horizon in the lower Great Lakes region: the McLeod site yielded two such tools. A hafted perforator was also recovered from the site, another tool form Ellis and Deller (1988:119) identify as a type diagnostic of the Paleo-Indian occupation in the lower Great Lakes area. Seven gravers and denticulates were recovered from the site, as well as one backed knife. One graver is on Bayport chert, while the remainder of these tools are on Collingwood chert. This category also includes retouched or utilized flakes, which are relatively expedient tools showing limited retouch arising from tool preparation or usewear. Two of these were recovered from Grid A. One additional retouched or utilized channel flake is from Grid C-West: this item was included in the debitage analysis, but is also discussed in this section. Finally, this section deals with pieces of tools which, owing to their fragmentary nature, cannot be ascribed to a particular tool type. Two of these were recovered from Grid A, one has general Grids A and B provenience, with a final single tool fragment from Grid C-West.

Backed and Snapped Unifaces

Two backed and snapped unifaces (Plate 4:$m_1w_1s_1$-1:46&51, Table 8) were recovered during the 1975 excavations in Grid A (Figure 19). They are both rectanguloid in outline, with an offset or an edge-scraper triangular, transverse cross-section, made on fragments of face blanks. The unifacially reworked edge, slightly convex, is on the thin edge of the wedge, backed by the thick edge, a planar surface which shows minimal ($m_1w_1s_1$-1:51) or no ($m_1w_1s_1$-1:46) flaking. The snaps are either ($m_1w_1s_1$-1:46) or both ($m_1w_1s_1$-1:51) a proximal and distal end of the tool and consequently of the retouched uniface edge. These snapped surfaces are also retouched, although to a more limited degree, both on the snapped surface and the ventral and dorsal surfaces of the original flake. Retouch on the snaps tends to focus around the comer or spur the snaps form with the backed uniface edge, although not exclusively, inferring that one function of the snap was to generate a strong working comer. One of the tools ($m_1w_1s_1$-1:46) displays a colour change indicative of exposure to high temperatures, whether deliberately or incidentally.

Table 8: Backed and Snapped Unifaces				
variable	n	r	x	sd
Length	2	26.5-30.3	28.4	2.7
Width	2	14.4-18.8	16.6	3.2
Thickness	2	8.5-10.2	9.3	1.1

NB: n=frequency of observations, r=range, x=average, sd=population standard deviation

Ellis and Deller (1988:119-120) identify this tool type as a technological development unique to the lower Great Lakes area, and so this form is an artifact type diagnostic of the Paleo-Indian horizon in this region. The backed and snapped unifaces recovered at the McLeod site fall within the group 1 category of artifacts from Thedford II, as described by Deller and Ellis (1992a: 69). Dimensionally, the tools recovered from the McLeod site are shorter and narrower than those from the Thedford II site, although they fall within the same range of thickness.

Hafted Perforator

One EPI perforator was recovered from the McLeod site, collected on the Grid A controlled surface pick up in 1975 (Figure 19). It is a thick (9.49 mm) Collingwood chert face blank, with a prominent ridge along the long axis of the dorsal surface (Plate 4:$m_1w_1s_1$-1:6). It is long (52.3 mm) and narrow (17.4 mm), resembling a narrow end scraper, but at the distal end the bit undergoes a final narrowing or waisting through normal retouch which reduces it to an acutely angled tip in plan view, with a bit angle of 50°. Extensive retouch along the lateral edges adjacent to the platform strongly suggests hafting modifications, as does a narrowing of the proximal end which would accommodate a socketed haft, comparable to some trianguloid end scrapers. The hafted perforator is another tool type identified as a form distinct to, and diagnostic of, the Paleo-Indian horizon in the lower Great Lakes and adjacent regions, although it occurs in low frequencies for most sites and Paleo-Indian tool kits (Ellis and Deller 1988:119).

Gravers and Denticulates

The McLeod site yielded a high number of gravers (or piercers, n=3) and denticulates (n=4), forming 20% of the tool assemblage, all but one example of which are Collingwood chert. One graver, from Grid A (Figure 19), has already been discussed briefly. It is a broken triangular end scraper on a face blank, subsequently recycled into a graver with a single proximal spur (Plate 4:$m_1w_1s_1$-1:8, Table 9). Retouch on the tool is extensive, arising largely with the manufacture of the end scraper, but the retouch directly related to the single spur is localized to the immediate spur area. The second graver is a multi-spurred (n=7) tool on a Collingwood chert face blank with extensive retouching around the entire circumference of the flake (Plate 4: AhHk-52:30, Table 9), collected in Grid C prior to 1990. Tomenchuk and Storck suggest that this graver may represent an additional tool type (single scribe compass graver), similar to those identified in the Fisher site collection (1997:508). The compass graver type is argued to be a pan-Paleo-Indian and Siberian neolithic tool, comprised of two or three adjacent spurs, utilized for graving and/or boring in a circular pattern, using one spur as an axis point, with the other(s) orbiting around it. Examination of the tool by Tomenchuk (1998: per. comm.) for attributes typical of the compass graver described (Tomenchuk and Storck 1997:511-513) supports a positive identification, with interspur polish, spurs displayed radial flake scarring, along with parallel flake scars and asymmetrical use wear. On this basis, this graver is ascribed to the compass graver type. The final graver is on a Bayport chert biface reduction flake (Plate 4: AhHk-52:1066), with a single spur intact; remnants of another are present but not sufficient to obtain metrics. Retouch on this tool is local to the spurs, with the remainder of the flake unmodified. This graver was recovered from Grid C-West (Figure 27), in surface collection. Retouch on all gravers is normal.

Table 9: Gravers				
variable	n	r	x	sd
length	3	29.8-33.2	31.6	1.7
width	3	20.6-27.4	23.7	3.4
thickness	3	4.1-5.2	4.7	0.6
spur length	8	1.9-3.2	2.2	0.7
spur width	9	1.9-3.1	2.7	0.4
spur thickness	9	0.9-3.0	1.9	0.8

NB: n=frequency of observations, r=range, x=average, sd=population standard deviation

Three denticulates are on Collingwood chert, while the remaining one is Bayport. The Bayport denticulate was collected during the CSP of Grid B (Figure 21: Plate 4:$m_1w_1s_1$-1:41), while two of the Collingwood denticulates (Plate 4: $m_1w_1s_1$-1:18&75) were recovered from Grid A (Figure 19). These three tools are on flakes removed from biface cores, all characterized by straight serrated working edges. The remaining denticulate (Plate 4: AhHk-52:39) is on a top face blank fragment, and was recovered on a survey of Grid C prior to 1990 (Table 10).

Table 10: Denticulates				
variable	n	r	x	sd
length	4	27.8-40.9	33.9	6.6
width	4	15.8-29.2	24.6	6.1
thickness	4	4.2-7.8	5.8	1.5
# of denticulations	4	4-6	4.75	1.0

NB: n=frequency of observations, r=range, x=average, sd=population standard deviation

Artifacts $m_1w_1s_1$-1:18 and $m_1w_1s_1$-1:41 show retouch along one edge, in the immediate locale of the serration. $m_1w_1s_1$-1:75 displays retouch along the serrated edge, and along the back of the tool. The latter may reflect additional utilization as a scraper or additional serrated edge, or may simply reflect backing to optimize gripping attributes for the tool. The distal end of this tool is also snapped, but not retouched. It resembles a backed and snapped uniface in this sense, aside from the lack of utilization of the snap element. Despite this snap, the tool is long and narrow, and can also be considered a blade. The final denticulate (AhHk-52:39) is larger, in part owing to its origin as a top diagonal strike face blank. It has five prominent serrations along the convex distal edge, giving it a 'coronet' profile. Retouch is limited to the denticulation.

Knife

One backed uniface knife ($m_1w_1s_1$-1:4) was recovered in during the CSP of Grid B (Figure 21: Plate 4). This artifact is a large Collingwood corner blank, with a wedge-shaped outline in transverse cross section. The thick edge of the wedge serves as the knife backing, with extensive but shallow marginal retouch and chatter on the acutely angled opposite edge. Viewed on edge, the blade has a sinuous pattern, with the edge blunted by the chatter. The distal end of the tool is broken, which likely occurred subsequent to deposition. It measures 47.4 mm long, 25.1. mm wide and 12.7 mm thick, with retouch 32.5 mm long, a bit depth of 6.2 mm and bit thickness of 4.7 mm. Retouch is both normal and inverse along the length of the working edge, although the bifacial retouch is marginal, not extending beyond the immediate bit area on either the dorsal or ventral surfaces. This lack of extensive bifacial retouch distinguishes this tool type from the backed bifaces noted by Ellis and Deller (1988:114-5).

Utilized Flakes

Two utilized flakes were recovered from Grid A, both of which are Collingwood chert (Figure 19). Artifact $m_1w_1s_1$-1:15 was identified during the initial survey and CSP. Acute (70°) normal discontinuous retouch extends 34.7 mm along one straight edge of this tool, a triangular portion of a top struck face blank. Some percussion bulb flake scars are present, and the thick cortical surface backing the retouched edge is collapsing due to weathering and lack of physical integrity. Retouch edge depth along the working edge is 2.0 mm, while retouch thickness is 4.5 mm.

Artifact m $m_1w_1s_1$-1:40 was recovered in excavation. It is a large blank fragment (47.7 mm X 27.9 mm X 11.4 mm), with the two 'lateral' edges formed by snaps. The convex worked edge has steep (95°), continuous, normal retouch, on one of these snap surfaces. The working edge loosely resembles a broad end scraper bit, with a bit width of 9.6 mm, retouch depth of 1.8 mm and bit thickness of 5.9 mm. The opposite snapped edge backs the retouched surface.

One of the channel flakes recovered from Grid C-West (AhHk-52:1086, Plate ABC-channel) shows marginal retouch along one lateral edge, with a length of 15.6 mm, retouch depth of 2.5 mm and retouch thickness of 1.6 mm. The channel flake is a long (25.5 mm) medial fragment, with a maximum width of 14.2 mm and thickness of 2.8 mm. Retouch is normal and acute (45°) along the right lateral edge. The flake is characteristic of channel flakes, with multiple transverse flaking scars across the dorsal surface, with a plano-convex cross section. As this is a medial flake, both ends are broken by step or snap fractures, likely arising from the separation of the flake from the preform being fluted. Frison and Bradley (1980:111-112) note that the extensive preparation for fluting makes the resulting predictable channel flakes analogous to Levallois flakes. As noted earlier, this item was included in the analysis of lithic debitage.

Tool Fragments

A total of four tool fragments were recovered from the McLeod site, three from Grid A and the fourth from Grid C. These artifacts are too fragmentary for identification to tool type, although some inferences may be made on their probable origin.

Artifact #'s $m_1w_1s_1$-1:9 and $m_1w_1s_1$-1:12 were recovered in the CSP of Grid A (Figure 19). Artifact #9 is a large flake fragment, retaining a platform. The lateral edges are retouched, inverse on the right, normal and inverse on the left, while the distal end is a snap. It may be a proximal fragment of an end scraper, or a miscellaneous tool blank. Artifact #12 is a small flake from a biface core, with limited retouch along one lateral edge. There are two large transverse fractures perpendicular to each lateral edge truncating the distal edge of the flake, making it difficult to determine the origins of this tool fragment.

Artifact $m_1w_1s_1$-1:13 has general Grid A and B provenience. This fragment is a large, proximal segment of a face blank, with a transverse fracture or snap removing the distal end of the blank. Some continuous inverse retouch is present along the left lateral edge, continuing to the fracture edge, and there is some discontinuous normal retouch along the right lateral edge, also bordering the fracture. It may be a portion of a side scraper, but this is speculative.

The final tool fragment (AhHk-52:1200), is a very small a flake. Some potential retouch along the distal end of one lateral edge is broken by a transverse fracture or snap. The tool origin is unknown, although the small size of the flake may suggest it would be limited in size, likely a retouched or utilized flake. It was recovered in Grid C-West (Figure 27).

4.3.4 All Grids - Bifacial Tools

Two bifaces attributable to the Paleo-Indian horizon were recovered from the McLeod site. Neither the 1975 research project nor any preceding surveys yielded any biface tools, and so Grids A and B are activity areas which did not involve biface tool discard or loss, based on the artifact assemblage. The first biface from the McLeod site was identified on an informal survey prior to the 1990 research project. The projectile point provenience was attributed to Grid D, an unmapped area subsequently subsumed within the more extensive Grid C as defined by the work in 1990. As this projectile point was not mapped in, provenience is limited to general grid association. A second biface, a projectile point fragment, was identified and mapped to Grid C-north on a preliminary inspection of the McLeod site in 1990, prior to excavation.

Projectile Points

As discussed, the two projectile points associated with the EPI occupation are provenienced to Grid C at the McLeod Site. Both of these are on Collingwood chert, and both are Barnes points, fitting within the Parkhill complex, as detailed below. The complete point (AhHk-52:36, Table 11, Plate 1) was recovered by a local collector prior to 1975. This small point has two fluting scars on one face, and a single fluting scar on the obverse side. The fluting scars extend from the base over three-quarters the length of the point and the base has Barnes finishing, although this latter feature is not diagnostic of Barnes points. The chert colouration is indicative of exposure to high temperatures, either deliberately or incidentally.

The other projectile point (Table 11:AhHk-52:1102, Plate 1, Figure 26) was recovered on a CSP with the 1990 research project. The point tip resulted from a transverse break just below the maximum width of the projectile point, where the lateral edges begin to narrow toward the base of the point. It is likely in the same size range as AhHk-52:36. The fluting scar present on one face was flaked over during the completion of the tip, suggesting that the original channel flake removal may have terminated in an outré passé fracture (Deller & Ellis 1992a:33-34), or that at least one fluting flake scar extended more than three-quarters up this face of the point.

Banding of the chert is not observable on the complete point, but on the tip fragment the banding is oriented 85° from the longitudinal axis of the point, a pattern found at Thedford II, Parkhill, and Fisher (Deller and Ellis 1992a:45). The significance of this banding at the McLeod site is very limited, given that it is observable on only one biface, and therefore cannot reflect the variability present in larger assemblages.

Table 11: Projectile Points

metric	n	r	x	sd
length	1	37.4		
width	2	18.5-18.9	18.68	
thickness	2	5.6-6.6	6.11	
flute width	3	4.6-9.4	7.25	2.75
flute length	3	16.5-31.5	24.0	7.49

NB: n=frequency, r=range, x=average, sd=population standard deviation

The projectile points, on the basis of morphological attributes, are identified as Barnes points, representative of the Parkhill complex. The EPI chronology discussed in Chapter Two is used in the following discussion, providing a framework for a definition of the projectile point types. Based on the chronology argued by Deller and Ellis (1988:255-258) for the lower Great Lakes region, it is possible to place the McLeod site within this regional cultural context.

In addition to the attributes described above, the fluted points from the McLeod site have moderately expanding lateral edges, as measured from the base of the one relatively complete biface (95°), as distinct from the postulated earlier Gainey points which are parallel sided, and the later Crowfield points that show a greater degree of expansion (Deller and Ellis 1992a:41-43). The length of the complete point (37.4 mm) fits within the range of Barnes point metrics, on the small end of the scale, comparable to the Parkhill and Fisher sites (Table 12), as is the case with the maximum widths of both points from the McLeod site. Maximum point thickness of the two

McLeod points clusters closely with other Barnes points (Table 12), and falls outside of the main size ranges for both Gainey and Crowfield points, which are respectively thicker and thinner, on the whole (Table 13 in Deller and Ellis 1992a:44; Figure 36 in Deller and Ellis 1992a:44). Owing to the fragmentary nature of the one point, and broken ears of the other, it is not possible to measure basal concavity or basal width for comparison. Banding orientation of the one example in the McLeod assemblage corresponds with other Barnes points (Deller and Ellis 1992a:45), but the significance of this characterization is limited, given the small size of the sample.

Table 12: Intersite Projectile Point Metrics

	length				width				thickness			
metric sources	n	r	x	sd	n	r	x	sd	n	r	x	sd
isolated finds[1]	4	49.5-77.5	57.4	12.15	8	19.0-26.5	22.3	2.70	10	4.7-7.3	6.0	1.04
Thedford II Site[1]	3	88.0-105	94.5		5	22.0-25.7	25.5	2.16	6	5.2-7.5	6.1	0.95
Parkhill Site[1]	5	37.1-52.2	45.6	6.37	21	11.1-24.6	20.4	3.02	26	4.6-7.9	5.6	0.84
Barnes Site[1]	0				0				3	5.0-6.0	5.3	
Fisher Site[1]	4	34.8-49.2	43.1	6.42	18	10.4-22.4	17.0	2.95	16	4.2-6.6	5.3	0.65
McLeod Site	1	37.4			2	18.5-18.9			2	5.6-6.6		

NB: 1 - data drawn from Deller and Ellis 1992a:41
n=frequency of observations, r=range, x=average, sd=population standard deviation

In terms of discrete attributes, the McLeod bifaces also fit within the Barnes definition. Maximum width of both points occurs at or just below the midpoint in length, and while the fishtails are missing on the one near-complete point, remnant scars from their removal are present. The McLeod bifaces are symmetrical, not displaying any shouldering as found within the Crowfield type, and the outline is not pentagonal, a pattern which can arise with the resharpening of Crowfield points (Deller and Ellis 1992a:45). The points from the McLeod site have one or two flutes, no more, per side, whereas Crowfield points frequently have more than two flutes per face. The flutes on the McLeod points generally extend to or above 75% of the point length on one or both faces, a pattern noted within the Barnes type, while fluting on Crowfield, and probably Gainey, point types is consistently shorter (Deller and Ellis 1992a:48).

To summarize the McLeod site projectile points, although the sample size is small, they are confidently identified as Barnes projectile points, representative of the Parkhill complex in the Paleo-Indian horizon of the lower Great Lakes (Deller and Ellis 1992b:16-19). The cluster of attributes characterizing the fluted projectile points from the McLeod site distinguishes them from both Gainey and Crowfield types. The Cumberland point type, of which Barnes points are sometimes treated as a subset or local variant (Justice 1987: 25-27), is seen to have significant problems by its definition. Variation in the Cumberland type is wide, and no type site is noted for this point style. As such, it is too loosely defined to be useful for the purposes of this paper, in particular within the context of the lower Great Lakes early Paleo-Indian cultural chronology (Deller and Ellis 1992b:16-19).

Deller and Ellis (1992a:125) have refined their initial point chronology for the lower Great Lakes region, outlined earlier (Deller and Ellis 1988:255-258). It is argued that the general trend of Barnes points within the Parkhill complex is for a reduction in size over time, following the overall pattern from longer, thicker Gainey points through the Barnes points to the smaller (shorter and thinner) Crowfield points. The Barnes points recovered from the Thedford II and Parkhill sites are larger, and are described by Deller and Ellis (1992a:125) as sharing attributes with the Gainey type. Based on the Paleo-Indian chronology, then, these are early Barnes points, representing an early Parkhill complex occupation. The fluted points recovered from the McLeod and Fisher sites, for example, are smaller and share some attributes with the Crowfield point type. Because these are closer in style (and therefore age) to the later Paleo-Indian Crowfield phase, it is argued that they represent a later component of the Parkhill complex occupation in the lower Great Lakes (Deller and Ellis 1992a:125; Jackson 1994:45).

In addition to the projectile points, five channel or fluting flakes were retrieved at the McLeod site, three in Grid A and two in Grid C (one each from C-South and C-West). On the basis of maximum channel flake width, despite the small sample size, two different populations may exist, representing Grids A and C respectively. The channel flakes from Grid A are narrower (Table 13), than those from Grid C. As a group the range broadens, with a distribution similar to that of Parkhill and Thedford II, although having a large standard deviation. Including data from the point with the channel flake metrics, the deviation is reduced further, and the metrics come closer to matching those of Thedford II and Parkhill. The difference in fluting flake sizes between the two grid areas may be more apparent than real, due to the small size of the assemblage, and it is not possible to offer meaningful statistical support to either interpretation.

Table 13: Intersite Channel Flake Metrics				
site source	n	r	x	sd
McLeod Grid A	3	8.2-11.3	9.7	1.59
McLeod Grid C	2	14.1-16.0	15.0	
McLeod Grids A and C	5	8.2-16.0	11.8	3.2
McLeod Grids A, C and points	8	8.2-16.0	11.0	3.0
Parkhill [1]	87	4.8-16.7	11.0	1.94
Thedford II[1]	23	8.0-16.0	11.8	2.34

NB: 1 - data drawn from Deller and Ellis 1996:27
n=frequency of observations, r=range, x=average, sd=population standard deviation

Although the maximum sample size is small, the average widths of these Barnes channel flakes tends to be >1 mm narrower than those examples from Gainey sites such as Halstead, Murphy, Gainey and Culloden Acres (Table 5, Jackson 1995). This aspect is quite likely a factor of point width, as Gainey points are on average wider than Barnes points (Jackson 1994:292-303), although Barnes points, unlike Gainey, sometimes show double fluting on a point face, which would presumably result in two thinner fluting flakes (as is the case with AhHk-52:36). Although Crowfield points are consistently multiply fluted, they can be markedly wider than both Gainey and Barnes points, and so there appears to be little difference in width. As a result, however, channel flakes arising from the fluting of Crowfield points have parallel channel flake scars on the dorsal surface, and lack a symmetrical planoconvex cross-section, unlike channel flakes arising from the fluting of Gainey and Barnes points (Deller and Ellis 1996:29).

As noted in the debitage and uniface analysis sections, one of the channel flakes (AhHk-52:1086), consisting of a medial section, has retouch along a lateral edge. The significance of this retouch/utilization is unknown, although Frison and Bradley do argue that channel flakes are a new world analogue to Levallois flakes, because they are predictable flakes removed from highly prepared "cores" (unfluted preforms) (1980:111-112). This pattern is noted at Parkhill (Ellis, per. comm.) and in Folsom assemblages (Judge 1973). Also at the Parkhill, Thedford II and Fisher sites, Parkhill complex channel flakes are sometimes retouched into miniature fluted points, although none have been so modified in the McLeod assemblage. While the role of such miniature tools as toys (Roosa 1977:107; Moeller 1980:53; Storck 1988:247) or shamanistic tools (Ellis 1994:263-264) is not immediately relevant to the McLeod site, such a formal reduction process will consistently manufacture a certain type of flake. Thus, as inferred by Frison and Bradley's argument, one tangible benefit of having a formal fluting procedure may not only be to obtain a fluted point, but also to retain the subsequent channel flake for use, whichever form it may take on. The Levallois analog is not strong in a broad functional sense, given that the production of miniature fluted points does not appear to be a common occurrence. It is valid in that, in the case of channel flakes, the flake product is a known quantity early on in the reduction process and whether it is to be used as a toy, shaman's tool, or scraping instrument, its future presence can be predicted and largely relied upon by the tool manufacturer.

4.4 FEATURES

Grids A and B

No cultural features yielding Paleo-Indian horizon artifacts were identified in Grids A or B. The features excavated are attributed to post-Paleo-Indian, Archaic occupations on the basis of diagnostic artifacts recovered when the features were excavated.

Grid C

Only one feature (Figure 28) could be attributed to prehistoric occupations, on the basis of artifact yields. Feature 2 (Figure 33) was a large, irregular ovoid, approximately 1.7 X 1.0 m along the major and minor axes respectively.

Features were excavated carefully, as lithic distributions of Collingwood chert in the ploughzone above suggested a Paleo-Indian artifact cluster, and the presence of an underlying feature inferred some potential cultural affiliation. On definition of the feature, excavation by diametrically opposed quadrants (northeast and southwest) proceeded, to facilitate profiles of both major and minor axes (Figure 34).

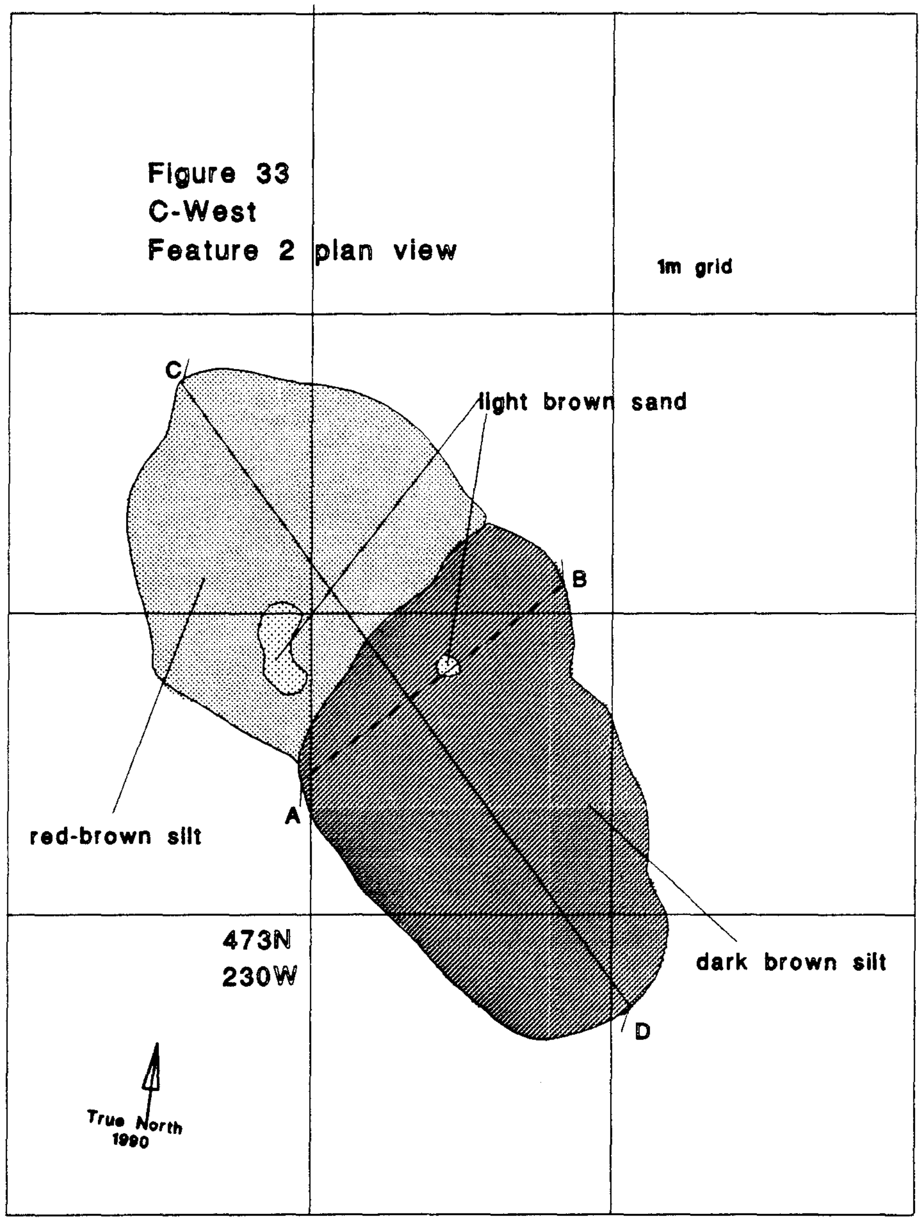
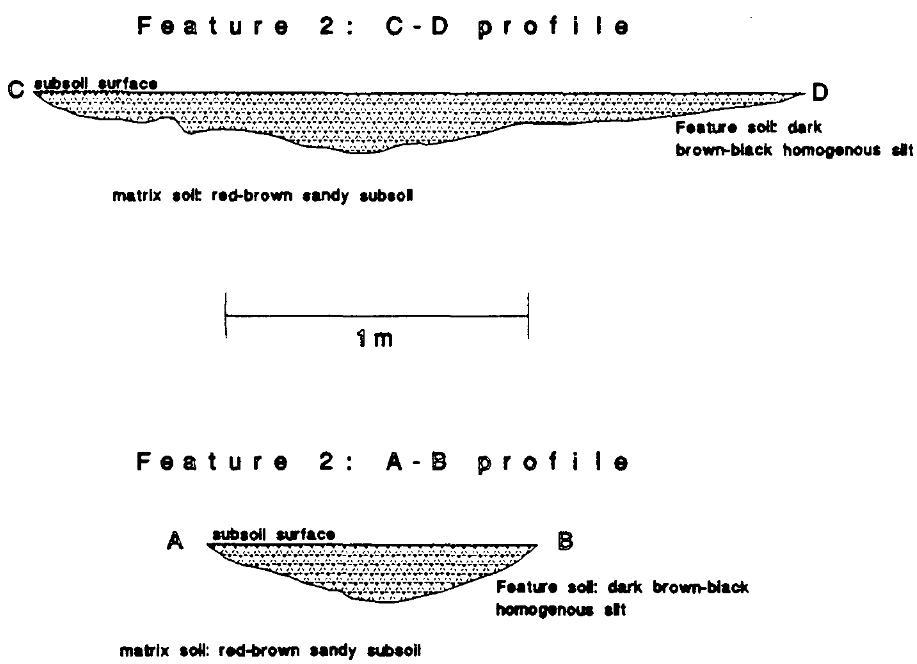


Figure 33
C-West
Feature 2 plan view
1m grid
C
light brown sand
B
A
red-brown silt
473N
230W
dark brown silt
D
True North
1990

Figure 34
C-West
feature 2 profiles



No microstratigraphy was noted within the feature: the matrix soil appeared homogenous throughout. Lithic distribution varied widely between the defined quadrants, however, suggesting some spatial differentiation within the feature as a whole. Organic samples (carbonized wood fragments) were also recovered from the feature. Soil samples for flotation processing were taken, which on processing yielded additional flakes, but no identifiable light fraction.

Lithics

The lithics obtained from the feature included 23 Collingwood chert flakes, linked to the EPI occupation, and 31 flakes and debris of Kettle Point chert. No tools diagnostic of Paleo-Indian or other occupation horizons were recovered from the feature. Two of the Collingwood chert flakes recovered from the feature show signs of being subjected to high temperatures.

Organic

Carbonized wood samples were recovered from the northwest and southeast quadrants of Feature 2. All of the samples were analyzed for identification. The fragments from the southeast quadrant were too fragmentary for identification, but the sample from the northwest quadrant was partially identifiable, representing Beech, Maple sp. and unknown shrub or root (Carl Murphy 1994: per. comm.). The nature of the Feature 2 organic material implies that this is a tree-related feature. The potential explanations for the feature may include a tree encroaching on one or more cultural features, a tree-burn or throw displacing lithics into the subsoil horizon, some combination of these factors, or other events not described here.

4.5 ORGANIC

The only significant organic samples recovered from the McLeod site, during both the 1975 and 1990 research projects, are those obtained from Feature 2. On the basis of identified species it is unlikely that the macrobotanical materials are associated with the EPI occupation. Regional pollen profiles show that Beech and Maple were not present in significant numbers prior to 8 000 bp. Dates obtained from these samples would have little bearing on the EPI occupation other than confirming that Feature 2 represents a later event, which has impacted and absorbed some earlier material. Because of this, the wood samples have not been subjected to ^{14}C dating, and will remain untested until such action can be justified (see Levine 1990).

Two additional organic samples, from natural features or in the subsoil, were recovered. The material from Feature 4, a natural disturbance, is Sugar Maple, while an additional sample obtained from the subsoil excavation of unit 473N 233W - sub square B, not associated with any feature, is identified as ring porous (Carl Murphy 1994: per. comm).

5.0 INTERPRETATION

The information from the McLeod site project allows comparison to contemporaneous sites excavated nearby in southern Ontario, extending to the lower Great Lakes basin, and across northeastern North America. To do this, the nature of the McLeod site pertaining to the early Paleo-Indian horizon (EPI) in the lower Great Lakes is outlined below.

The first section is a review of the Parkhill complex EPI toolkit as defined for the lower Great Lakes region. The McLeod site assemblage is compared with this toolkit, and with those defined for other suggested EPI complexes in the region.

The second section of this chapter reviews the McLeod site EPI artifact assemblage, discussing the collection as an aggregate, and examining the distribution of tool types across the different excavation grids. The assemblage is then analyzed to provide a measure of the degree of tool variation in relation to the site/assemblage size, and a calculation of the tool to debitage ratio, as indicators of site function. These analyses are used to define the site as a whole, and to offer some comparison between the patterns found at the different site grids.

The final chapter section examines the McLeod site in relation to select Paleo-Indian sites in the lower Great Lakes and northeastern North America. The intent of this artifact assemblage comparison is to note differences and similarities among sites, and determine any potential patterns of site characterization on the basis of toolkit and lithic debris.

5.1 PARKHILL COMPLEX

The McLeod site tool assemblage comprises tool types representative of both the lower Great Lakes EPI horizon in general, and of the Parkhill complex in particular, identified by Barnes points recovered at the site. The absence of specific artifact types or attributes also implies that this site is distinct from those of alternate EPI complexes in the region.

In their discussion of the EPI chronology for the lower Great Lakes region, Deller and Ellis (1992a:127) suggest specific toolkit assemblages distinct to each of the three phases of this horizon: Gainey; Parkhill, and Crowfield. The McLeod tool assemblage fits this toolkit model, both in terms of what is present and of what is absent.

Excluding general artifact forms common to all Paleo-Indian manifestations, such as gravers or side-scrapers, Ellis and Deller argue that the following more specific artifact types are characteristic of Parkhill complex toolkits: 1) narrow or beaked end scrapers; 2) backed and snapped unifaces; 3) proximal end and side scrapers; 4) channel flake points (and possibly other miniature tools - Ellis 1994:260); 5) offset end scrapers, and 6) hafted perforators (Ellis and Deller 1988:119). The McLeod site yielded three of these 'marker' tool types: narrow or beaked end scrapers; backed and snapped unifaces, and a hafted perforator. Two diagnostic Barnes points were recovered, by definition exclusive to Parkhill complex assemblages, along with backed and snapped unifaces (Deller and Ellis 1992a:127) and hafted perforators (Ellis and Deller 1988:119), while narrow or beaked end scrapers are also present in the Crowfield toolkit.

Artifacts diagnostic of the other (EPI) phases in this region that are not part of the Parkhill complex toolkit include pièces esquillées and burins, indicative of Gainey complex sites, as well as shouldered fluted points, leaf-shaped bifaces, and rod-like bifaces (drills), reported so far only for the Crowfield complex (Deller and Ellis 1992a:127). None of these tools are in the McLeod assemblage. In addition, the trianguloid end scrapers recovered at the McLeod site show distal notching close to the bit corners. Gainey triangular end scrapers are also frequently notched, but usually also include proximal notching, likely related to hafting, which is rare to absent on Parkhill complex specimens (Deller and Ellis 1992b:47; Jackson 1990:122; Jackson 1994:371).

The McLeod data support the toolkit model proposed by Deller and Ellis, as the recovered artifacts fit the predicted toolkit assemblage. A compass graver was recovered, that Tomenchuk and Storck (1997:508) identify as a new tool type, likely with pan-american (1997: 518) and Siberian (1997: 520) distribution. The concave convergent side scraper is unique to the McLeod site, so its cultural significance is not known, although a similar tool occurs in the Banting site assemblage (Storck 1979:13; Plate 5-L, #973-448-95). The presence of this scraper, along with other tools that appear to show a broad range of applications, concurs with the observation by

Frison & Bradley (1980:67) that the role of composite tools is strong in the Paleo-Indian toolkit.

The lithic material preferences at McLeod also support the above cultural affiliation, yielding patterns similar to those recognized at other Parkhill complex sites in southwestern Ontario. No Upper Mercer artifacts were recovered at the site, a material typically associated with the earlier Gainey complex at Paleo-Indian sites in the area (Jackson 1995:37). Trace quantities of Bayport chert were identified at the site (a graver recovered in grid C-west, and a denticulate recovered from grid B), which in EPI assemblages dominated by Collingwood chert are described as "diagnostic of the Parkhill phase in southwestern Ontario" (Deller and Ellis 1992b:39-40). The McLeod site, like Parkhill Grid C, yielded two uniface tools on Bayport chert, unusual among other reported Parkhill complex sites Ontario, where Bayport chert appears primarily in the form of points and large bifacial tools (Deller and Ellis 1992b:49).

The lack of any other cherts, such as Onondaga or Kettle Point, cannot be used in an argument regarding the McLeod site, as these were excluded from the analysis. However, no diagnostic Paleo-Indian tools were recovered on material other than Collingwood chert.

5.2 SITE INTERPRETATION

A total of 16 artifact types are identified in the assemblage of 29 tools recovered from the McLeod site, not including retouched or utilized flakes and tool fragments (Table 14). Grid A yielded eight types and three additional types were recovered from Grid B, totaling 11 different artifact types from this area. Ten artifact types were recovered from Grid C.

Both Grids A and Grid C have a similar representation of end scrapers. Side scrapers make up two of the four tools from Grid B, and a substantial number of side scrapers were recovered from Grid C, including the distinct concave convergent side scraper and compass graver. None of these tool classes were recovered from Grid A, which yielded the only bend-break and backed and snapped scrapers recovered at the McLeod site. Denticulates and gravers were represented across all grids. The single hafted perforator was recovered from Grid A, the only backed uniface knife from Grid B, and the only biface tools from Grid C (although channel flakes were recovered from both Grids A and C). The categories of retouched/utilized flakes and tool fragments were retrieved from Grids A and C, but none originated in Grid B.

Table 14: Tool Distribution	Site Excavation Grid			
Tool type	Grid A	Grid B	Grid C	total (%)
trianguloid end scraper	2		1	3 (8.3)
narrow end scraper	1		1	2 (5.6)
end-of-blade end scraper			1	1 (2.8)
generic end scraper	2			2 (5.6)
convex side scraper		1	1	2 (5.6)
concave side scraper		1		1 (2.8)
generic side scraper			2	2 (5.6)
concave convergent side scraper			2	2 (5.6)
bend-break side scraper	1			1 (2.8)
backed and snapped scraper	2			2 (5.6)
hafted perforator	1			1 (2.8)
graver	1		1	2 (5.6)
compass graver			1	1 (2.8)
denticulate	2	1	1	4 (11.1)
backed uniface knife		1		1 (2.8)
fluted point			2	2 (5.6)
retouched/utilized flakes	2		1	3 (8.3)
tool fragments	3		1	4 (11.1)
total (%)	17 (47.2)	4 (11.1)	15 (41.7)	36 (100.3)[1]

NB: 1 percentage totals may not equal 100.0% due to rounding

The spatial proximity of Grid B to Grid A, and its small size, imply that it is a peripheral scatter related to the larger Grid A. The premise that any of the clusters are contemporaneous cannot be assumed, though, as no artifact mends have been made between any of the grids. The relatively broad suite of tools from each of the major site areas (Grids A and B grouped, and the Grid C clusters) suggests that a fairly wide range of activities was occurring in each. Grid C was composed of one large and two small Paleo-Indian clusters, but their close proximity, and the large number of artifacts with general Grid C provenience collected on surveys prior to 1990, result in the treated of this area as a single entity, although each cluster is examined briefly.

5.2.1 Tool Assemblage Richness

The range of tools at the McLeod site is broad, given the small assemblage size. Ellis and Deller argue that smaller sites are less rich (diverse) either due to site function specialization, or as a product of sampling error, with small sites representing brief occupations, shorter than the use life of the tools utilized but not discarded there (Ellis and Deller N.D.:62-63). The corollary, that assemblage richness is closely and directly related to its size, is statistically significant (Ellis and Deller N.D.:62). Shott (1997) reaches the same conclusion, but the small range of tool types used in the latter analysis may constrain its scope. Shott argues that statistical correlations between assemblage size, richness, and evenness (of tool-type distribution) reflect the effect of sample size, with the same activities occurring at all sites. The short occupation span of small sites results in not all activities being represented in the tool assemblage. On this basis, Shott argues that site function cannot be considered in the interpretation of smaller assemblages until the effect of sample size (effectively, sampling error) has been taken into account (1997:228-229). Ellis and Deller (N.D.:63-65) dispute this interpretation.

This matter is discussed in further detail below, but generally the model of a broader range of tool types occurring at a site resulting primarily from assemblage size is contradicted by the McLeod site, which is very rich despite its small size. With a total of 16 distinct tool types in an assemblage of only 29 tools (excluding fragments and retouched/utilized flakes) the proportion of separate tool types within the overall tool assemblage is 16:29 (55.2%), a low ratio.

Table 15: Tool Richness	Tool Assemblage		
	Grids A & B	Grid C	McLeod Site
Tool types	11	10	16
Assemblage size	16	13	29
diversity ratio	69.5%	76.9%	55.2%

N.B. Tool types and assemblage size do not include retouched/utilized flakes or tool fragments

The ratios show a higher degree of richness within each main cluster (11:16 and 10:13 at Grids A & B and Grid C respectively: Table 15). The decrease in richness by aggregating the two clusters indicates that there is duplication of tool types between these two focal areas. This implies that, despite the high richness of the assemblages as a whole, and recognizing that the clusters are not redundant, they do share some basic tool types (trianguloid and narrow or beaked end scrapers, gravers, and denticulates).

5.2.2 Debitage to Tool Ratio

The lithic debitage to tool ratio of the McLeod site, and discussion of its significance, is examined in more detail in 5.3.3, but is introduced here to explore similarities or differences between the grids. As other analyses used only 6 mm (0.25") mesh in excavation (*e.g.* Tables 6 & 7, Deller and Ellis 1996:30), comparisons were normalized by the removal from analysis of flaking debris which would pass through 6 mm mesh, but was recovered in 3 mm mesh or flotation. Both cases, and comparisons with the inclusion and exclusion of tool fragments, are presented in Table 16. To standardize ratios with other available data sets (*e.g.* Deller and Ellis 1996:30), retouched/utilized flakes are not included in the calculation of these ratios.

Table 16: Tool:Debris Ratios

	tool and lithic debris assemblage					
	McLeod Site		Grids A & B		Grid C	
mesh size sample size	3 mm n=93	6 mm n=4	3 mm n=52	6 mm n=22	3 mm n=41	6 mm n=19
tools only	3.2 : 1	1.4 : 1	3.3 : 1	1.4 : 1	3.2 : 1	1.5 : 1
tools/fragments	2.8 : 1	1.2 : 1	2.7 : 1	1.2 : 1	2.9 : 1	1.4 : 1

N.B. 3 mm indicates all lithic debris is considered in calculating ratio
6 mm indicates only lithic debris recoverable by 6 mm mesh considered in calculating ratio
tools/fragments includes tools and fragments (no retouched/utilized flakes) in ratio

The tool to lithic debris ratios are very similar between the two major artifact grid clusters, and for the site as a whole, suggesting that the nature of the site activities did not vary greatly between the two site clusters. The comparison is interesting when noting the differences, and similarities, reflected in the tool and debris assemblages between the two clusters. As discussed above, it was suggested (Deller and Ellis 1996:29; Collins 1975:32) that bifacial reduction results in a larger number of flakes than reduction related to unifacial tools. One might infer, with the presence of the only bifacial tools from the site (n=2) and the highest proportion of bifacial reduction flakes, that Grid C might be more closely related to bifacial reduction, and would likely have a higher flake to tool ratio. Such a pattern is not strong in the data, although the ratio is slightly higher for 6 mm mesh in Grid C, in line with the observation that 3 mm mesh will recover a greater proportion of smaller scraper retouch flakes (Table 16). However, in the case of the

McLeod site, only two biface were recovered in grid C, and one of these is a projectile point tip, not likely related to lithic reduction activities in grid C. The relationship between the proportion of biface tools and quantity of lithic debris in an assemblage is detailed in 5.3.3.

5.2.3 Grids A and B

The EPI occupation in Grids A and B consists of a diverse assemblage of tools and a small scatter of lithic debitage. All tools recovered from this locale are unifaces, which corresponds to the nature of the lithic debitage, overwhelmingly the product of uniface reduction (Table 3). One uniface retouch flake mends to the bit of an end-scraper recovered in this area. The recovery of three channel flakes and several additional biface reduction flakes means that some general terminal bifacial reduction and fluting took place on the site, making the reasonable assumption that the channel flakes were removed from bifaces on site.

The toolkit (Table 14) consists of a cross-section of end scrapers, side scrapers, gravers, denticulates, utilized flakes, and bend-break snapped scrapers, as well as individual examples of a bend-break side scraper, a hafted perforator, and a backed knife. Several tool fragments, not identifiable to tool type, were also recovered. With the exception of one denticulate on Bayport chert, all of the tools are on Collingwood chert.

Aside from defining two EPI occupation clusters, Grids A and B, within this site area, there is little spatial analysis that can be carried out, given the limited extent of contiguous excavation yielding Paleo-Indian artifacts. The CSP maps (Figures 19, 21) do not identify any substantive artifact distribution patterns within each grid. There is some distinction between Grids A and B, as discussed above, however the significance of this is suspect, given the very small sample of artifacts from Grid B.

A general interpretation of this northern site cluster is that it is a multi-function site area. The wide variety of tool types present suggests that a broad range of tasks, both specialized and generalized, were carried out here. Grid A may represent a focal activity area, while Grid B is likely either a peripheral activity area (if the occupation of Grid B is concurrent with Grid A), or Grid B may be a transient, episodic find-spot, if the occupations were not concurrent. The lithic debris supports either model, in that the range of activities occurring broadens to encompass some biface finishing, although the vast majority of uniface retouch flakes also suggest that end scraper resharpening, and by extension use, were predominant lithic activities in this site area.

The relatively extensive range of tool types in relation to the size of the artifact assemblage and the area of the site, with no exclusive tool type specialization, suggests that Grid A, and if affiliated, Grid B, represent a short-term occupation for a small group of individuals, such as a primary family unit. The heterogeneity of the activities occurring at the site, inferred by the generality of the toolkit, suggests that the occupants of this site were not a specialized task-group, and that the site itself does not represent such a specialized group of activities as a gearing-up or rearmament location, but rather a multiple activity location (Wilmsen 1965:151) or base camp (Judge 1973:205-7), albeit one dominated by uniface related activities

5.2.4 Grid C

Grid C comprises three separate clusters of Paleo-Indian artifacts. Two of these are very small, consisting of two flakes in one case (C-south), and a point tip and trianguloid end scraper in the other (C-North). The majority of the lithic debitage from the site, along with five tools and tool fragments, are from C-West, while nine tools have general Grid C provenience. All of the clusters are in relatively close proximity to the central C-west area. On this basis the assemblage is considered a single entity for interpretation, although the implications of the spatial separation of these clusters are examined.

The tools recovered from Grid C are unifacial, with the exception of two Barnes projectile points: one complete, and one tip. The majority of lithic debitage is from biface reduction activities (51.2%), although a substantial portion (29.0%) of the debris is from uniface reduction (Table 3). Biface reduction at the site encompasses terminal biface thinning and finishing, and preform fluting, while the uniface work is general, not specific to end scraper retouch.

The toolkit from Grid C represents a wide range of tool types, including end scrapers, side scrapers, gravers and points, a denticulate, a compass graver, a retouched/utilized flake, and a tool fragment (Table 14). All of the tools are on Collingwood chert, with the exception of one graver, on Bayport. Other than one flake of Bayport chert, all lithic debitage is Collingwood. Six additional flat flakes are probably Bayport chert, but are not large enough for positive identification, and are not part of this analysis.

The roles of the two small clusters peripheral to grid C-west are difficult to ascertain. No mends were made among any of these areas, and so the argument that they are contemporary is speculative. C-south is likely a small chipping station related to the fluting of a preform, with a channel flake recovered here. C-north yielded a projectile point tip and scraper and may indicate a working area separate from C-West. The point tip, broken at the mid-section, might infer a kill recovery location (Gramly 1984; Deller 1988:197; Deller and Ellis 1992b:31), or the disposal of a broken point recovered in butchering, while the broken trianguloid end scraper might reflect some initial kill processing activity, or the disposal of another broken tool. If these small areas are concurrent to C-west, then they would be small peripheral activity areas. If not contemporary to C-west, then they are isolated, transient find spots, marking brief episodic activities.

The C-west grid, with its variety of tools, is likely a generalized activity area. While the tools show a bias towards uniface activities, lithic debitage resulting from biface finishing, resharpening, and at least one fluting event, represents a larger component of the flaking debris. While uniface reduction activities are present, it is in lower frequencies (Table 3). The proportions of biface and uniface flakes in this assemblage must be weighted by the argument that biface reduction activities tend to be over represented by quantities of lithic debitage, while uniface reduction tends to be under represented (see section 5.3.3). This explanation accounts for the disparity between the distribution of unifaces and bifaces in the tool assemblage on the one hand, and the majority of flakes related to biface reduction in the lithic debitage on the other.

A study of spatial distribution for all three clusters does little other than to identify these as two small, and one large, discrete clusters. Areas C-north and C-south are too small for the detection of differential distribution patterns within the clusters, while C-west shows a single main artifact cluster, focused around Feature 2, and minimal peripheral artifacts and flakes outside of the concentration. The majority of the tool assemblage has been recovered through informal survey, with general Grid C provenience, and does not provide any insight on artifact distribution.

The main cluster at Grid C-west consists of a variety of tool types, and the nature of the lithic debitage recovered from the area does not suggest that it was the focus of a limited range of activities. To the contrary, this area is one that the tool and lithic debitage assemblages suggest was the location of a broad range of activities. Site activities do not appear to be specialized, as would represent the activities of a focused task group, but rather those of a non-specific social unit, such as a core family group. The small size of the collection suggests that the site does not represent a large or long-term occupation. One or both of the peripheral foci, C-north and C-south, may be contemporary to the main C-west occupation, but this is not possible to ascertain, based on the data available. The potential roles of these small scatters, as outlined above, would be either as peripheral activity areas, or as isolated event locales.

5.2.5 McLeod Site

The McLeod site consists of two primary elements: two larger clusters of lithic artifacts and debitage, and three smaller, peripheral clusters. The contemporaneity of these clusters cannot be established. Given the distribution of artifacts diagnostic of the Parkhill complex across the entire site area, and the lack of any artifacts indicating the presence of other phases of the EPI horizon, it is presumed that all of the site areas represent Parkhill complex occupations.

The smaller clusters consist of too few artifacts to typify their character, other than as small, peripheral scatters of under ten artifacts (flakes and tools combined). The two larger areas (Grid A and Grid C-west) are both typified by a relatively wide range of artifact types, given the small size of the assemblages as a whole, an attribute reflected in their similar artifact diversity ratios (Table 15). The toolkits of each of these clusters are not redundant, but do show a notable degree of overlap with some tool types, suggesting that certain activities (represented by triangular end scrapers, side scrapers, gravers and denticulates) are common across both clusters. There is distinct differentiation between each toolkit as a whole, summarized in 5.2.1.

The toolkit differences are partially tempered by the nature of the lithic debris assemblages from each cluster, with debris arising from biface reduction in Grid A, although no bifaces were recovered in this area. Fluting flakes were recovered across three of the clusters at the McLeod site (Grid A, Grid C-west and Grid C-south), and a fluted point tip was recovered from a fourth, in C-north. The trace quantities of biface activities in four of the five artifact clusters comprising the McLeod site suggests bifacial reduction was a significant activity, if not in quantity, then in terms of presence, and permits identification of the occupation as Parkhill complex. The presence of channel flakes at the site is indicative of fluting activities, in line with the presence of lithic debitage representing like terminal phases of biface finishing and resharpening. However, the absence of projectile point bases in the recovered assemblage infers that hafting was not a significant activity, suggesting this is not a gearing up or rearmament camp, where broken bases are removed and replaced by hafting of new or repaired projectile points (Judge 1973:205-7).

While the lithic debitage assemblage shows a broad similarity between both of the large clusters (*i.e.* that areas did not exclusively entail either uniface or biface reduction activities), differences are reflected in the activity focus in each area. Compared to Grid C, Grid A is biased towards end scraper resharpening activities, with minor biface reduction present. Grid C is focused on biface reduction, and while uniface reduction activities are still notably present, they are not focused on end-scraper resharpening as in Grid A (Table 3). This comparison supports the argument that the toolkits are similar, but not duplicates. The corollary follows that the activities occurring at each large cluster largely overlap, although they are not identical. In short, on the basis of both the toolkits and lithic debris recovered from each area, the two large clusters are very similar, though not fully redundant, thereby representing some activity differentiation.

Arguments that the site represents a single, concurrent occupation, or one or more reoccupations, are equally viable. Redundant use of areas by Parkhill complex Paleo-Indians is probable (Deller and Ellis 1992b:48), and so reuse of the McLeod site area, for similar functions, would not be unexpected. Conversely, concurrent occupation of an area by two or more individual groups is a pattern observed at other Parkhill complex sites (Deller and Ellis 1992b:49). Each case is plausible for the larger clusters, while the smaller activity areas could be associated with one, both, or none of these.

The similarities between the major clusters goes beyond the toolkits and lithic debris. The size of each cluster (number of artifacts) is comparable, although one factor differs: the extent of excavation. In 1990 a total of 116 m^2 was excavated in the Paleo-Indian occupation areas within Grid C, in both test and contiguous excavation, while in 1975 excavations in Grids A and B totaled approximately 60.75 m^2. These area totals do not include test-coring or shovel testing.

In summary, the EPI component of the McLeod site comprises two main clusters, with three peripheral scatters, representing components of the Parkhill complex. The links between the five areas are not known. Arguments that they are concurrent or sequential occupations are equally valid and speculative. Although differing somewhat, both larger clusters appear to represent generalized activity areas, showing similar ranges and types of activities, as well as intensities of occupations. This resemblance could indicate repeated use of this area over time by one or more small groups, or a single occupation episode by two such groups. The close similarity of these two areas is accentuated in the intersite comparison below. The smaller scatters may reflect very brief, transient locations, or activity areas peripheral to the main site area(s).

Activity specialization at each main cluster is minimal, with a high level of tool richness, and the degree of toolkit overlap between them. The toolkit represents primarily unifacial activities, although the presence of bifaces in Grid C and channel flakes in Grid A indicates that biface reduction is occurring. Lithic debris at Grid A is focused on end scraper retouch. Grid C-west has a higher degree of biface finishing, but the Grid C toolkit consists mainly of uniface tools.

Both of these clusters probably represent short-term occupations by small social units (***e.g.*** primary family), rather than field camps occupied by a specialized logistical group (Binford 1980:10). Whether these represent residential camps ***per se*** is unknown, however, as they are so small. It may reflect the minimal residential camp, owing to the presumed brevity of occupation in relation to those Binford refers to (1980:7). Such short-term, low-intensity occupations may span only several days, as essentially lay-over camps, for core family units in transit on seasonal rounds. This interpretation may fit with the site type suggested by Ellis and Deller, at which various activities occur that are not seen as fitting together "functionally", although their argument describes multiple, sequential occupations (n.d:85)

5.3 INTERSITE COMPARISON

The McLeod site is a Parkhill complex EPI occupation. The focus of this section is a comparison of EPI sites (including McLeod) in the lower Great Lakes basin and adjacent areas. It comprises a comparison of artifact assemblages, both tools and debitage, across these sites, examining them for patterns of site assemblage, forming the remainder of the chapter. This comparison is undertaken in order to understand the McLeod site activities and the site's place in Paleo-Indian settlement systems.

5.3.1 EPI Site Assemblages

To compare assemblages of lithic tools and debris with a substantial number and range of other EPI sites, the geographic scope of this study was extended beyond the lower Great Lakes to include several sites further to the east, placing both the McLeod site and Parkhill complex within a regional context. Overall, the priorities of the data collection were: 1) to obtain data from as many Parkhill complex sites as possible in the lower Great Lakes region; 2) to obtain data from other EPI complex sites in the lower Great Lakes basin and, 3) to collect data from other EPI complexes in northeastern North America.

In the following sections, when regression analyses are plotted, the solid line indicates the regression best fit. The Broken lines mark the upper and lower two standard deviation limits in the regression fit. The standard error used to plot the standard deviation is obtained from the analysis of variance y-intercept. When data are subjected to logarithmic conversions, to normalize data distribution, the log(10) function is used. Statistical information utilized in conjunction with these diagrams, or when addressed in the text, is described with a 95% confidence level. These regressions and statistical results were calculated using Quattro 7.0.

5.3.2 Toolkit Richness, Evenness, and Site Function

As introduced in 5.2.1, a current debate in small-assemblage analysis centers around the issue of whether tool diversity is related to site size primarily due to task specialization at smaller sites (Ellis and Deller n.d.), or is largely because of sample size (Shott 1997). In the latter case, it is argued that many tool lives are longer than the duration of the site "life", with differences in tool frequencies at small sites representing sampling error that results from differential tool disposal rates. With this interpretation, differences between sites must first take into account sampling error, before explaining contrasts in tool assemblage composition as a result of differing site functions, or other factors (Shott 1997:228).

The analysis below examines how differing tool typologies - represented by the general "lumper" typology used by Shott (1997) versus the detailed "splitter" one of Ellis and Deller (n.d.) revised by Muller (1998) and referred to as the EDM typology - and scales of analysis affect measurements of richness, evenness, and heterogeneity in tool assemblages. Using the results of this examination, the validity of these arguments is considered. In addition, the potential role of such analyses in the systematic description and comparison of assemblages is evaluated.

Richness, or diversity, is a basic measure of the range of tools (defined by a typology) present in an assemblage. Richness is the term used here, following the terminology of Dunnell (1989) and Shott (1997). Assemblages with a high degree of richness have a large number of tool types in relation to the universe of defined tool types as illustrated by a hypothetical example on Figure 35. Evenness is a measure of dispersion of proportional frequencies of tool types present in an assemblage (Shott 1997:206-207), typically using the standard deviation of proportional frequencies of tool types in the measure of evenness. Assemblages with a high degree of evenness show a flat distribution across defined artifact types, while a low measure of evenness indicates a "spiky" tool distribution across the type set (Figure 36).

Heterogeneity is a measure of the distribution of tools present in an assemblage across the universe of defined tool types, and is a statistic that combines measures of both richness and evenness (Shott 1997:207). Systems showing a high degree of heterogeneity have a large number of tool types represented, with tool frequencies spread relatively evenly across the set defined by the typology. Low heterogeneity is typified by a lower diversity of tool types, having an uneven or spiky distribution in types across the data set. The equation used by Shott (1989,

Figure 35
High vs. low richness sites

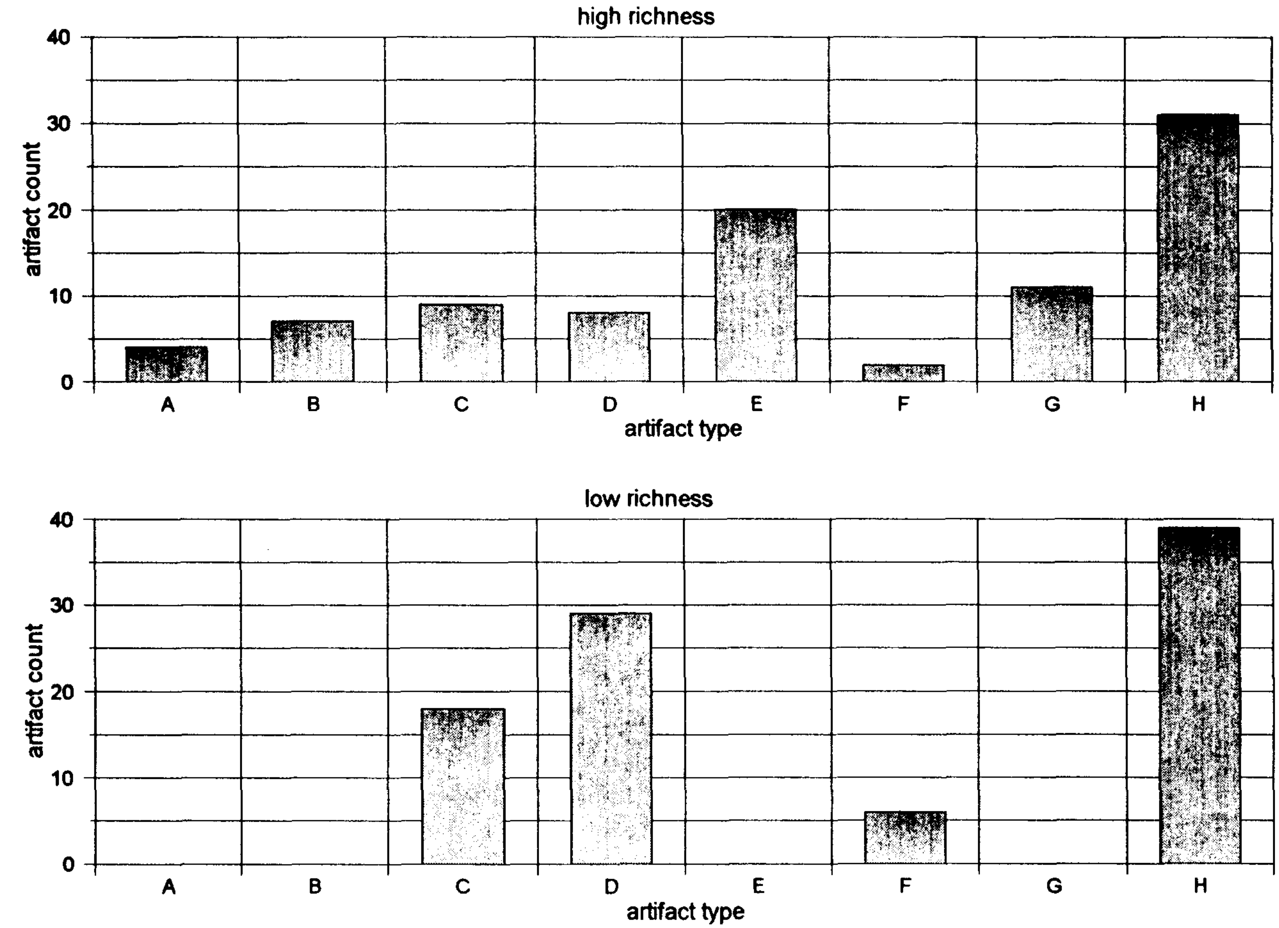
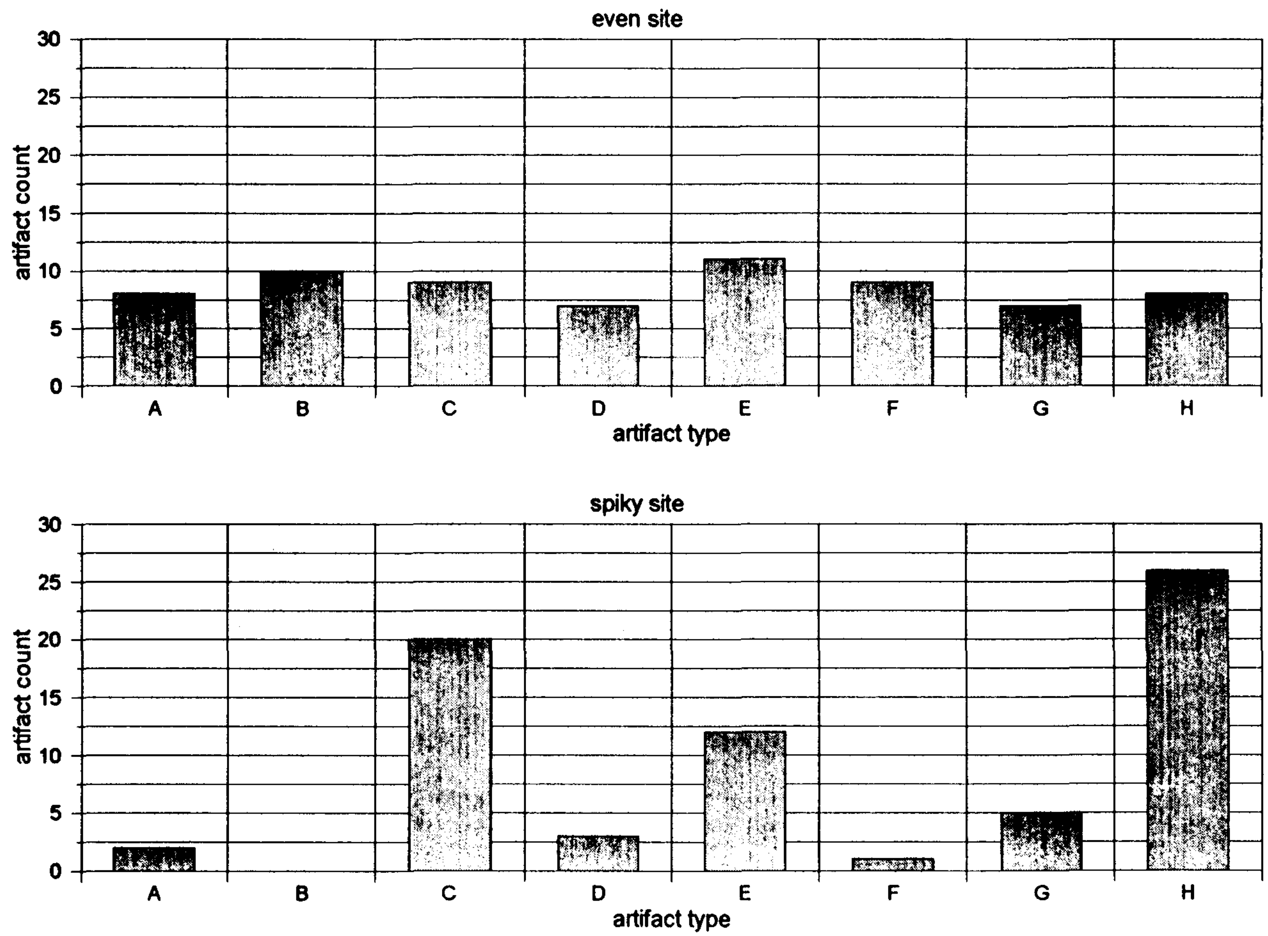


Figure 36
Even versus spiky distribution



1997) is the Shannon-Weaver index, with

$$H'_6=-S(n_i/N*\ln(n_i/N)$$

where n_i is the number of tools in type i, and N is the population of the assemblage. Measures of heterogeneity are used in a variety of fields such as ecology (Dunnell 1989).

Regression models have their own weaknesses (Kaufman 1998:75; Bobrowski and Ball 1989:6-8), such as exaggeration of richness and heterogeneity. The argument is less relevant with the EPI tool typologies analyzed here, as they are small (n=8 for Shott, n=30 for the EDM typology). Gerrard argues that despite this, heterogeneity is preferable to the richness and evenness metrics alone (1993:237). Kaufman's Jackknife technique of measuring diversity was examined, but heterogeneity is used here to replicate Shott's methodology, and provide a separate data set based on the EDM typology for direct comparison.

The duplication of Shott's (1997) data set of source sites was attempted. Some site data used by Shott (1997) were not used in this analysis because the original typology did not permit conversion to the EDM typology (Leavitt, in Shott 1993), data were not readily available (Eamon Pond, ArcA-D: Shott 1997), or data did not meet requirements used to make the data set more consistent. The criteria stipulate that sites included in the analysis be at least partially excavated (Schofield, Wight, Stott-Glen, Dixon, and Mullin are solely surface collected; Deller & Ellis 1992b), that all of the artifact data from these sites, not select samples, are available (at Udora only one feature is reported on; Storck & Tomenchuk 1990), and that the EPI component at sites was single complex EPI (Hussey is multi-EPI component; Storck 1979). Surface collections recovered within the site or cluster excavated were included in the analysis if adequately provenienced. Collections from clusters not excavated were not included in the analysis.

The main focus with this analysis is on the Parkhill complex EPI occupation of the lower Great Lakes. Some Gainey and Crowfield complex sites are included in the toolkit analysis, but the majority of data are from Parkhill complex sites (Table 17). Excluding the Barnes site, all sites providing data in this toolkit analysis are located in southern Ontario.

Table 17: EPI Data Site Sample

Symbol	Site/Cluster name	EPI complex	Sources
AC	Alder Creek Site[1, 2]	Crowfield	Timmins 1994
Ad	Adkins Site[2]	EPI	Gramly 1988
Bl	Bolton Site[1, 2]	Crowfield	Deller and Ellis 1996
Bn	Barnes Site	Parkhill	Wright and Roosa 1966, Voss 1977
Bab	Banting cluster ab[1, 2]	Parkhill	Storck 1979
Be	Banting cluster e[1, 2]	Parkhill	
Bw	Banting cluster w[1, 2]	Parkhill	
Bt	Banting Site[1, 2]	Parkhill	
CA	Culloden Acres Area A[1, 2]	Gainey	Ellis and Deller n.d.
Ch	Crowfield heated[1]	Crowfield	Deller and Ellis 1984
Cu	Crowfield unheated[1]	Crowfield	
Cw	Crowfield Site	Crowfield	
D	Dixon[1]	Parkhill	Deller and Ellis 1992b
FB	Fisher B cluster[1, 2]	Parkhill	Storck 1997
FC	Fisher C cluster [1, 2]	Parkhill	
Fce	Fisher C-e cluster[1, 2]	Parkhill	
FD	Fisher D cluster[1, 2]	Parkhill	
FF	Fisher F cluster[1, 2]	Parkhill	
Fb	Fisher b cluster[1, 2]	Parkhill	
Fc	Fisher c cluster[1, 2]	Parkhill	
Fi	Fisher Site[1, 2]	Parkhill	
Hs	Halstead Site[1, 2]	Gainey	Jackson 1994
Lv	Leavitt Site[1]	Parkhill	Shott 1993
Mab	McLeod grids AB[1, 2]	Parkhill	
Mc	McLeod grid C[1, 2]	Parkhill	
MC	McLeod Site[1, 2]	Parkhill	
Mr	Murphy Site[1, 2]	Gainey	Jackson n.d.
Pb	Parkhill cluster b[1, 2]	Parkhill	Ellis, Deller, and Roosa i.p.
Pc	Parkhill cluster c[1, 2]	Parkhill	
Pd	Parkhill cluster d[1, 2]	Parkhill	
Pk	Parkhill Site[1, 2]	Parkhill	
Pta, Ptb	Potts loci a, b[2]	EPI	Gramly and Lothhrop 1984
Pt	Potts Site[1, 2]	EPI	
SR	Sandy Ridge Site[1, 2]	Gainey	Jackson 1994
T2	Thedford II Site[1, 2]	Parkhill	Deller and Ellis 1992a
Tane	Thedford II A-ne cluster[1,]	Parkhill	
Tae	Thedford II A-e cluster[1, 2]	Parkhill	
Taw	Thedford II A-w cluster[1, 2]	Parkhill	
Tac	Thedford II A-c cluster[1, 2]	Parkhill	
Tase	Thedford II A-se cluster[1,]	Parkhill	
Tb	Thedford II B cluster[1, 2]	Parkhill	
Va-Vh	Vail loci A through H[2]	EPI	Gramly 1982
V	Vail Site[2]	EPI	

Nb: 1 - used in section 5.3.2 analysis; 2 - used in section 5.3.3 analysis

The two typologies examined exhibit the classic lumper *vs.* splitter taxonomic dichotomy. The Shott typology (Table 18) is basic, with six generic tool categories and two additional non-tool artifact types. The EDM typology, based on Ellis and Deller (N.D.) and Deller and Ellis (1988) with some modification (Muller 1998), approaches the other end of the spectrum, with 30 identified tool types and classes (Table 18). The EDM typology bases more specific classification taxa on morphological attributes expressed regularly across a set of tools, indicating some consistent degree of design or manufacturing within a given type sub-set of a tool class.

The degree to which tool types or classes differ from each other is not treated here. That discrete types tools are identifiable systematically based on morphological attributes indicates

Table 18: Tool Typologies	
Tool typology from Ellis and Deller N.D.	**Added to Ellis & Deller N.D. (Muller 1998)**
fluted points	concave-convergent side-scrapers
shouldered fluted points	uniface knives
large beveled bifaces	compass gravers
backed bifaces	bend-break and snapped tools
channel flake points	miniature "ideo"-tools
drills	
leaf-shaped bifaces	
pièces esquillées	**Shott artifact typology (1997)**
preforms	fluted bifaces
trianguloid end-scrapers	other bifaces
large parallel sided end-scrapers	channel flakes
narrow end-scrapers	bifacial cores
offset end-scrapers	end scrapers
other end-scrapers	side scrapers
proximal end- and side-scrapers	gravers
concave side-scrapers	retouched/utilized flakes
other side-scrapers	
backed and snapped unifaces	
denticulates/retouched flakes	
beaks	
hafted perforators	
micro-piercers	
chisel gravers	
notch/borer/denticulates	
other unifaces	

significant differentiation between them, recognized both by researcher and manufacturer/user. It is likely that differential tool forms are indicative of like variation in tool function(s). While a suite of uses is likely for any given tool, class or type, it is presumed that despite the probable overlap, tools were consistently fabricated in distinctive forms for one or more reasons, and one of these reasons was related to the intended function of the tool (Ellis and Deller 1988:122-128).

The Shott tool typology is generalized, while the EDM typology is more specific. The Shott typology does include two artifact types not included in the EDM typology, not considered tools in the latter system: Bipolar cores and channel flakes. The EDM typology would only recognize these artifact types as tools, rather than byproducts of lithic reduction, when there is evidence of subsequent modification or use, such as miniature projectile points or utilized/retouched flakes made on channel flakes.

Table 19: Typology Translation Shott:EDM

Shott	EDM
[f] fluted bifaces[2]	[f] fluted points[2]
[f] other bifaces[2]	[f] unfluted preforms[2]
channel flakes	no equivalent
bifacial cores	no equivalent
[e] end scrapers[1]	[f] trianguloid end-scrapers[1]
[e] side scrapers[1]	[f] proximal end- and side-
[e] gravers[1]	[e] micro-piercers[1]
[e] retouched/utilized flakes[1]	[e] denticulates/retouched flakes[1]
no equivalent	[f] miniature tools[1]
	[e] pièces esquillées
	[e] other unifaces[1]
	[e] notch/borer/denticulates[1]
	[f] hafted perforator[1]
	[f] beaks[1]
	[f] uniface knives[1]

NB: 1- unifacial tool in analysis; 2 - bifacial tool in analysis; f - formal tool in analysis; e - expedient tool in analysis

As the EDM typology is more specific, Shott's classes tend to represent clumping of two and often many more EDM types (Table 19), reducing the data resolution. The predicted result is a reduction in the capacity to distinguish between tool assemblages with different artifacts.

Examining the issue in more detail, the EDM typology is based on the argument that types can be systematically defined within the general classes used by Shott. For example, EDM recognizes both fluted points discarded after use and fluted preforms discarded in manufacture. These are distinct activities, the differentiation of which is not recognized in the Shott typology. The EDM refinement of tool typology permits identification of the broader functional variation represented by tool assemblages (Ellis and Deller 1988:128). By reducing the resolution of the data to categorization by broad artifact classes, the Shott typology has two effects. It reduces the potential range of variation that can be observed in tool assemblages by minimizing the number of tool types recognized. With a smaller set of types used to define assemblages, fewer potential combinations of artifacts can be described, and more overlap of assemblage "types" is predicted. In addition, it distorts the representation of activity by grouping different tool types, associated with different tasks, into the same class. This homogenizing of the assemblage makes it difficult to identify specialized activities occurring at sites, as the classes represent only very general ranges of behaviour. In summary, the EDM typology may reveal patterns in site formation activities, and thereby site "function", that the Shott typology is not designed to discern. However, it must also be noted that several categories in the EDM typology remain catch-alls, such as other unifaces and other bifaces. The presence of these generic classes continues to limit the acuity with which tool assemblages are defined.

Another issue arises from the conversion of data between typologies. Data obtained from sites researched and reported by Storck (Banting: Storck 1979; Fisher: Storck 1997) were converted into both EDM and Shott typologies (Table 20). Conversion was also necessary to break down Shott's whole site data-sets into smaller sets representing the clusters within sites. While Shott (1997) and Ellis and Deller (N.D.) divided some sites into their constituent clusters for analysis (e.g. Parkhill B, Parkhill C, and Parkhill D), this was not done for all (Thedford II, McLeod, and Banting). In this analysis data were analyzed at two scales: sites as aggregates, and as separate clusters. This procedure introduced complications, as exactly how Shott (1997) treated other researchers' data (e.g. McLeod, Thedford II, Banting, etc.) is not documented. As a result, it was necessary to "reverse-engineer" these conversions.

The data are analyzed at two scales to compare the results of running the same data set at different levels of resolution. While some sites are single clusters (Alder Creek, Murphy, Culloden Acres, Barnes), analyzed with the same resolution for both levels of analysis, other sites are aggregates of distinct, discrete clusters, which may or may not have been concurrently occupied (*e.g.* Parkhill, Fisher, Banting, McLeod, Thedford).

Table 20: Typology Translation Shott:Storck:EDM

Shott	**Storck**	**EDM**
utilized flakes	utilized flakes	other unifaces
gravers	gravers	
	miscellaneous	
side scrapers	spokeshave	side scrapers
utilized/retouched	worked/utilized	other unifaces
end scrapers	end retouch	other unifaces
	triangular end	trianguloid end
	rectangular end	large $\|$ sided end
gravers	micro-piercers	gravers
	miniature tools	channel flake points
		miniature end
	pièces esquillées	pièces esquillées

Although the analysis of these site clusters approaches intra-site comparison, it is argued here that the aggregation of spatially discrete assemblage clusters blurs the potential resolution of these data. Analyzing sites by their component clusters permits independent analysis of each assemblage, allowing comparison with other clusters at the same and other sites. The conversion of aggregate site data presented in Shott (1997) and Ellis and Deller (n.d.) to cluster data was viewed as necessary to fulfill this task.

Conversion was accurate, with controlled cases yielding an error rate of between 2-5%, based on total artifact counts. The conversion of Storck's tool assemblage data resulted in a similar degree of error. These are unlikely to affect the analysis adversely.

Typological differences between EDM and other sources such as Storck (Banting: 1979; Fisher: 1997), and Wright and Roosa (1966), Roosa (1977) and Voss (1977) for Barnes may cause a lack of full representation of the actual tool assemblages. A bias may result from imperfect conversions and less specific data in the original documents (notably in subset classifications of end scrapers and side scrapers in the EDM data sets for these sites). Other than re-analyzing the tool assemblages in question, however, it is difficult to address the degree to which this occurs, or has affected the analysis. This limitation is inherent in a field where a detailed standard artifact typology is absent.

This standardization shows an advantage of the Shott typology over EDM: with very general tool classes, categorization of tools across a broad range of data sources is simple, and not subject to change. With the specialized EDM typology, it is harder to ensure that artifact counts represent tool assemblages to the full resolution of the typology. Tool classes and types must be rigorously defined and applied, and as new tool types are defined (e.g. Tomenchuk and Storck 1997; Muller 1998), assemblages must be re-examined to determine if they are present in the collection. Such a typology is organic, with all of the benefits and drawbacks.

Despite these caveats, reasonable efforts were made to minimize the potential effects of these problems. While errors and inaccuracies will exist in the data sets used, to the extent that they have been identified it is unlikely that they negate the effort to provide an accurate measure of tool assemblage richness, evenness, and heterogeneity using a more specific typology.

Assemblage Richness, Evenness, and Heterogeneity

Figure 37 plots assemblage size vs. richness (using the Ellis and Deller n.d. typology: Table 18) for a sample of EPI sites in southern Ontario, based on data from Ellis and Deller (n.d.: Table 10, Table 11). The inference (Ellis per. comm.; Shott 1987:207) is that tool assemblage size corresponds closely to richness in the assemblage, in a linear manner when log transformations of both variables are used. The correlation is strong using the data for this graph (Ellis and Deller n.d.): ($r=0.860$, $df=11$, $p=0.001$), with sample size responsible for 74.0% ($r^2=0.740$) of variation in the number of tool types/classes (Table 21). These results differ slightly from Ellis and Deller (n.d.:62-63) due to updated tool counts for the McLeod site.

Data sets (Appendix D) were reorganized according to the typologies and scales described

Figure 37
Tool assemblage richness at EPI sites

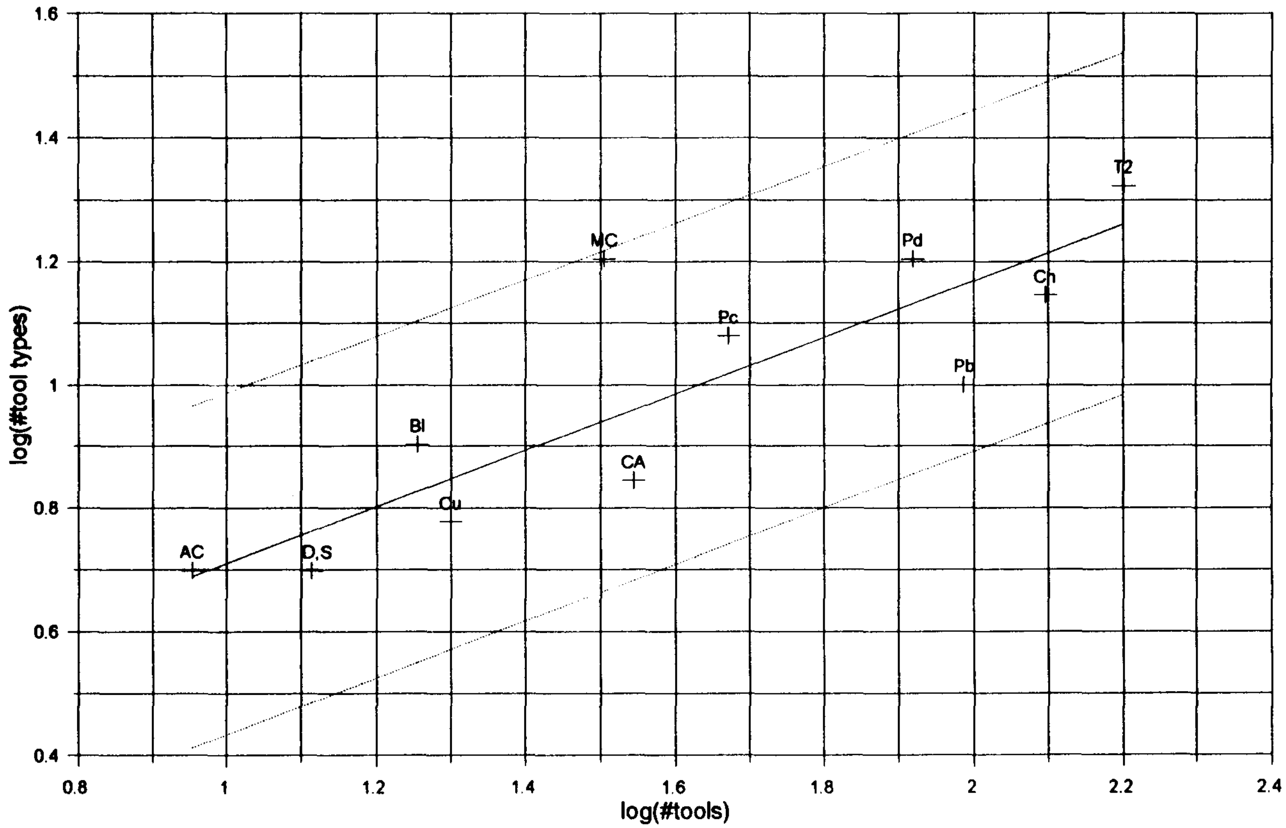


Table 21: Statistical Summary of Intersite Assemblage Analyses								
Figure #	measuring	typology	scale	r=	r^2=	p=	df=	n=
37	richness	Ellis & Deller	site	0.860	0.740	0.001	11	12
38	richness	Shott	site	0.595	0.354	0.020	13	14
39	richness	Shott	cluster	0.714	0.510	0.001	30	31
40	richness	Shott	Gainey clusters	0.326	0.106	0.660	3	4
41	richness	Shott	Parkhill clusters	0.796	0.634	0.001	22	23
42	richness	EDM	site	0.823	0.677	0.001	13	14
43	richness	EDM	cluster	0.630	0.397	0.001	30	31
44	richness	EDM	Parkhill clusters	0.574	0.298	0.004	22	23
45	richness	EDM	Gainey clusters	0.967	0.934	0.010	3	4
46	evenness	Shott	site	0.170	0.029	0.560	13	14
47	evenness	EDM	cluster	0.156	0.027	0.406	30	31
48	heterogeneity	Shott	site	0.101	0.010	0.806	13	14
49	heterogeneity	EDM	cluster	0.001	0.000	0.997	30	31

above, and plotted. Correspondence between assemblage size and richness is observed, using the Shott and EDM typologies and at the site and site cluster scales of analysis, but with correlations ranging from moderate to weak.

With the Shott typology, correlation between assemblage size and richness is moderate at the site and cluster scales (Table 21: Figure 38: $r=0.595$, $r^2=0.354$, $p=0.020$, df=13, 28.6% fall outside 2sd; Figure 39; $r=0.714$, $r^2=0.510$, $p=0.001$, df=30, 9.7% fall outside 2sd). Dividing the data into Gainey and Parkhill subsets as the cluster scale shows a weaker correlation for Gainey (Table 21: Figure 40: $r=0.326$, $r^2=0.106$, $p=0.660$, df=3) than for Parkhill (Figure 41: $r=0.796$, $r^2=0.634$, $p=0.001$, df=22, 8.7% outside 2sd) complex sites. The disparity in correlations between the two groups contradicts Shott, who finds a strong link in both (1997:207-209). The dearth of Gainey complex data available for this analysis likely results in part of the aberration.

Using the EDM typology, moderate correlations are also observed at site (Table 21, Figure 42: $r=0.823$, $r^2=0.677$, $p=0.001$, df=13, 7.1% outside 2sd) and cluster scales (Figure 43: $r=0.630$, $r^2=0.397$, $p=0.001$, df=30, 12.9% outside 2sd). Analysis of the Parkhill subset at the cluster scale (Figure 44 $r=0.574$, $r^2=0.298$, $p=0.004$, df=22, 13.0% outside 2sd) shows a weak correlation. The strong association in the Gainey complex (Figure 45: $r=0.967$, $r^2=0.934$, $p=0.01$, df=3, 50%

Figure 38: Shott typology, Site Scale
Tool Assemblage size vs. Richness

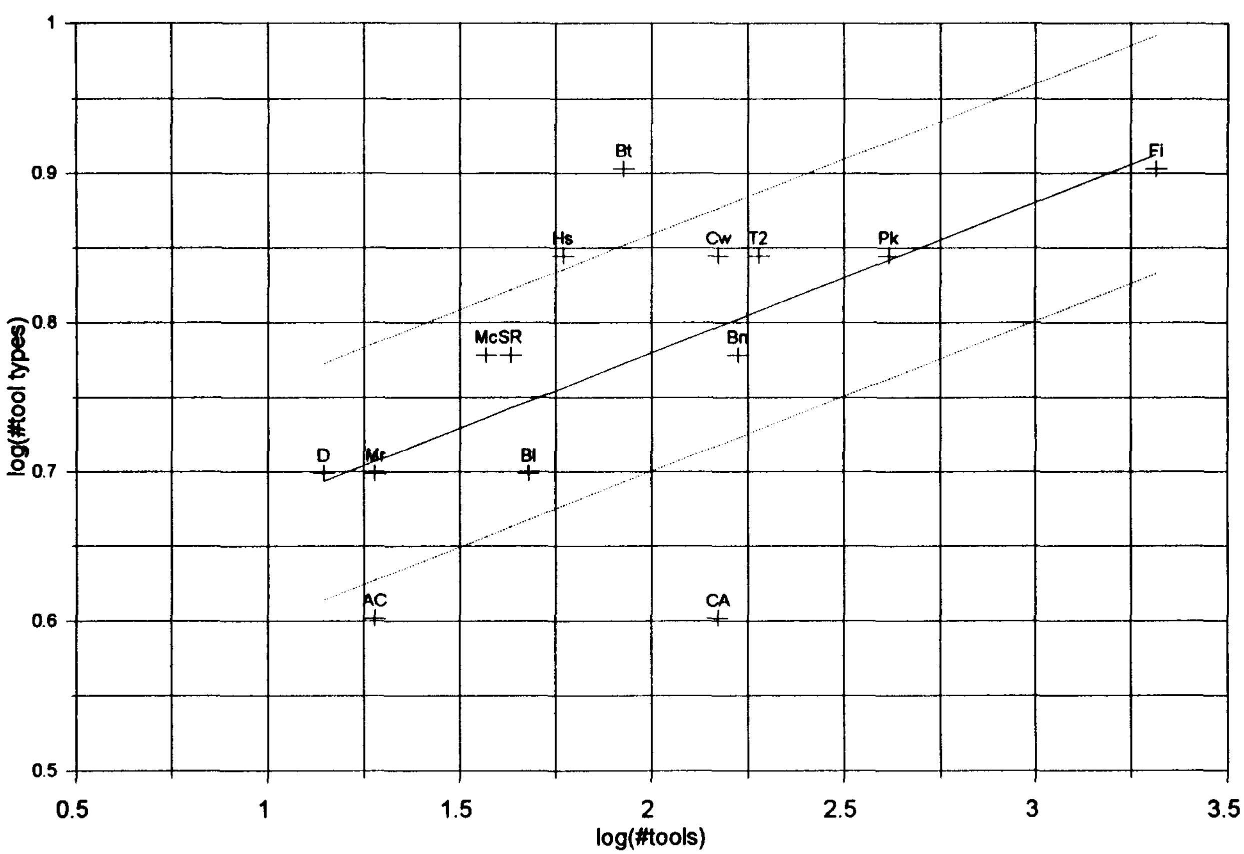


Figure 39 Shott Typology Cluster Scale
Tool Assemblage Size vs. Richness

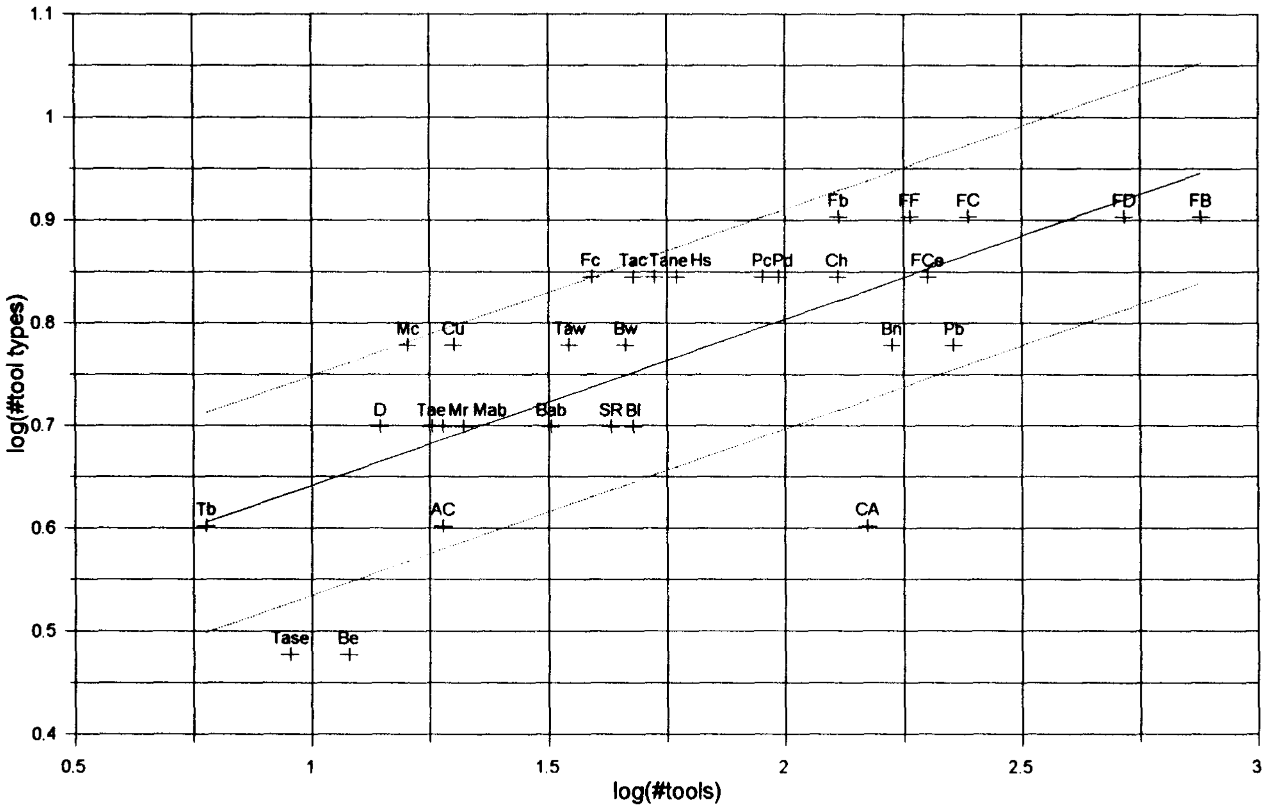
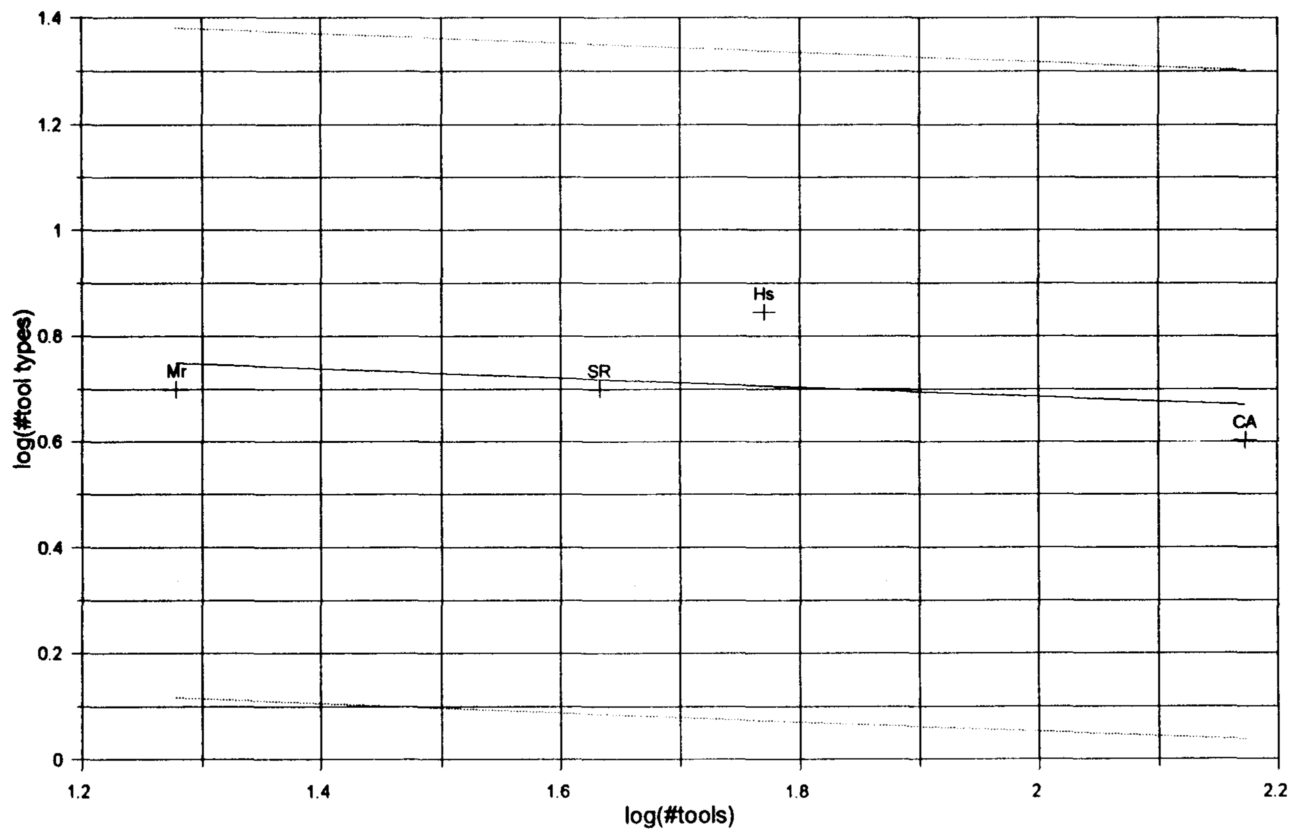


Figure 40 Shott type Gainey Clusters

Tool assemblage size vs. richness



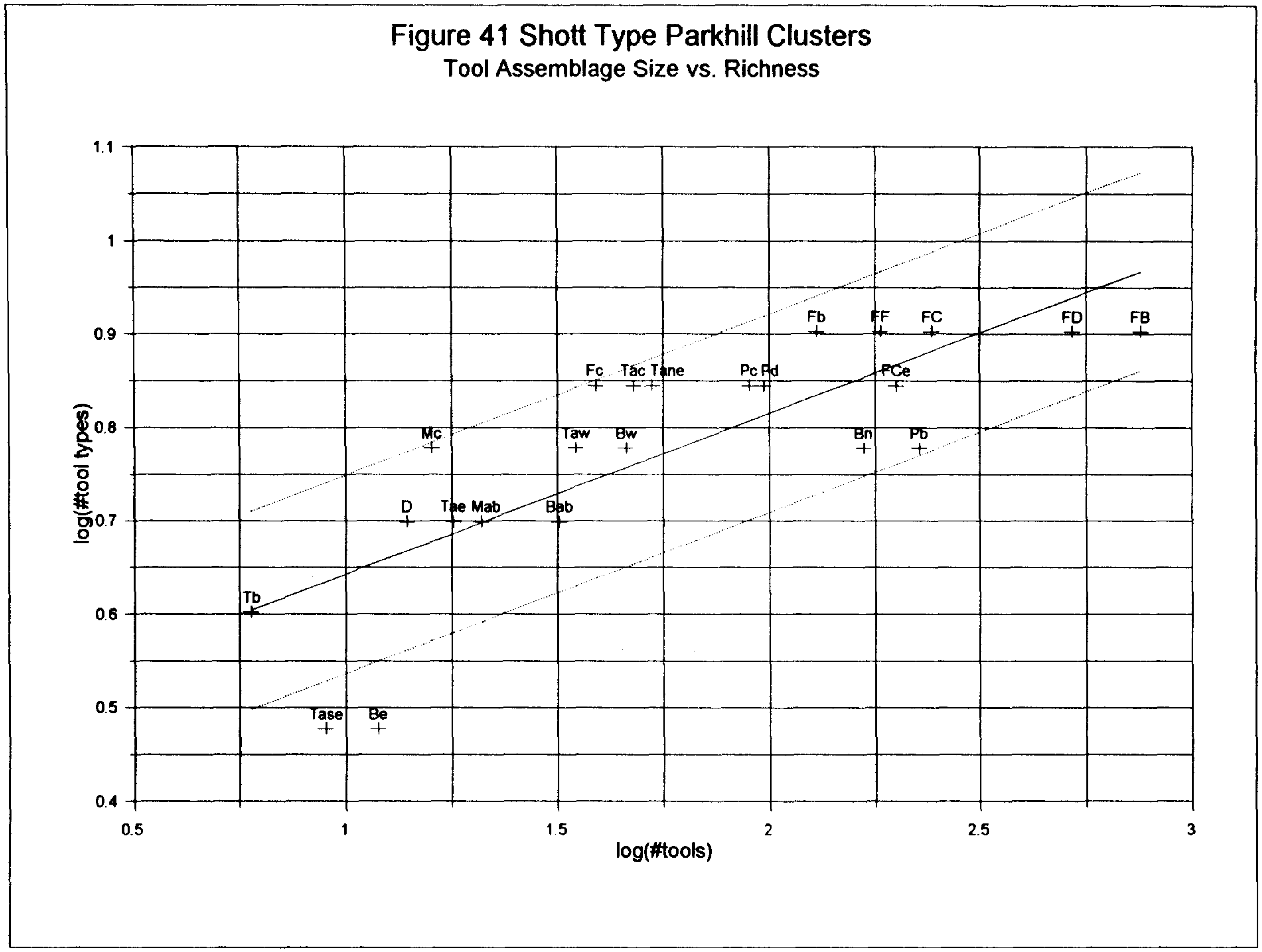


Figure 41 Shott Type Parkhill Clusters
Tool Assemblage Size vs. Richness
log(#tool types)
log(#tools)
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.5
1
1.5
2
2.5
3
Fb
FF
FC
FD
FB
Fc
Tac
Tane
Pc
Pd
FCe
Mc
Taw
Bw
Bn
Pb
D
Tae
Mab
Bab
Tb
Tase
Be

Figure 42: EDM Typology, Site Scale

Tool Assemblage Size vs. Richness

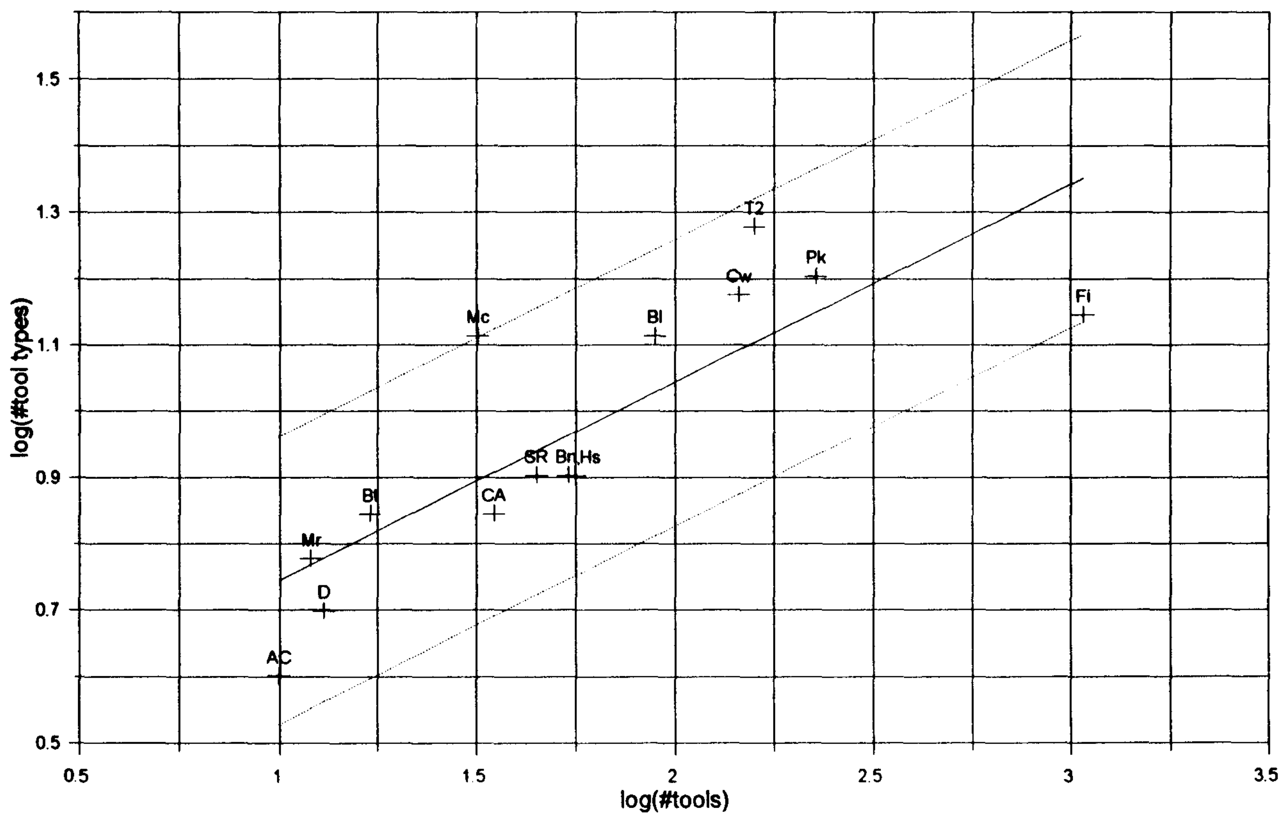


Figure 43: EDM Typology, Cluster Scale
Tool Assemblage Size vs. Richness

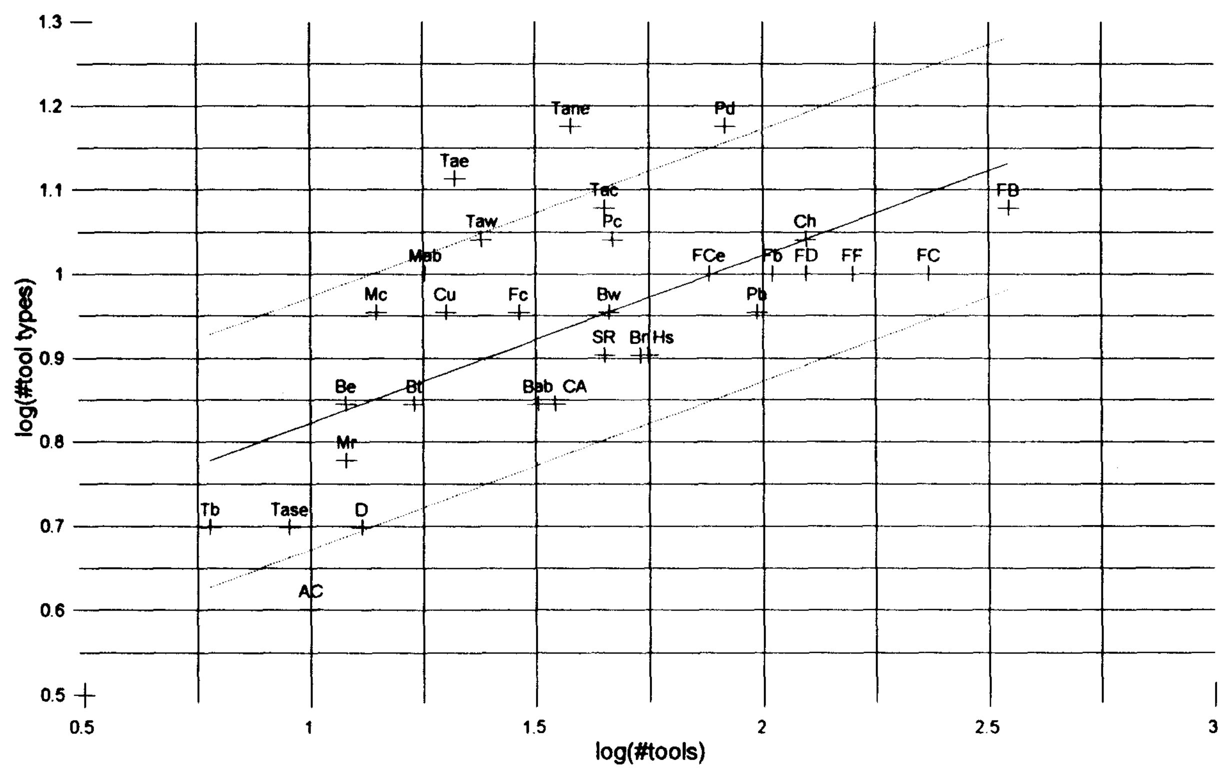


Figure 44: EDM Type Parkhill Clusters

Tool Assemblage Size vs. Richness

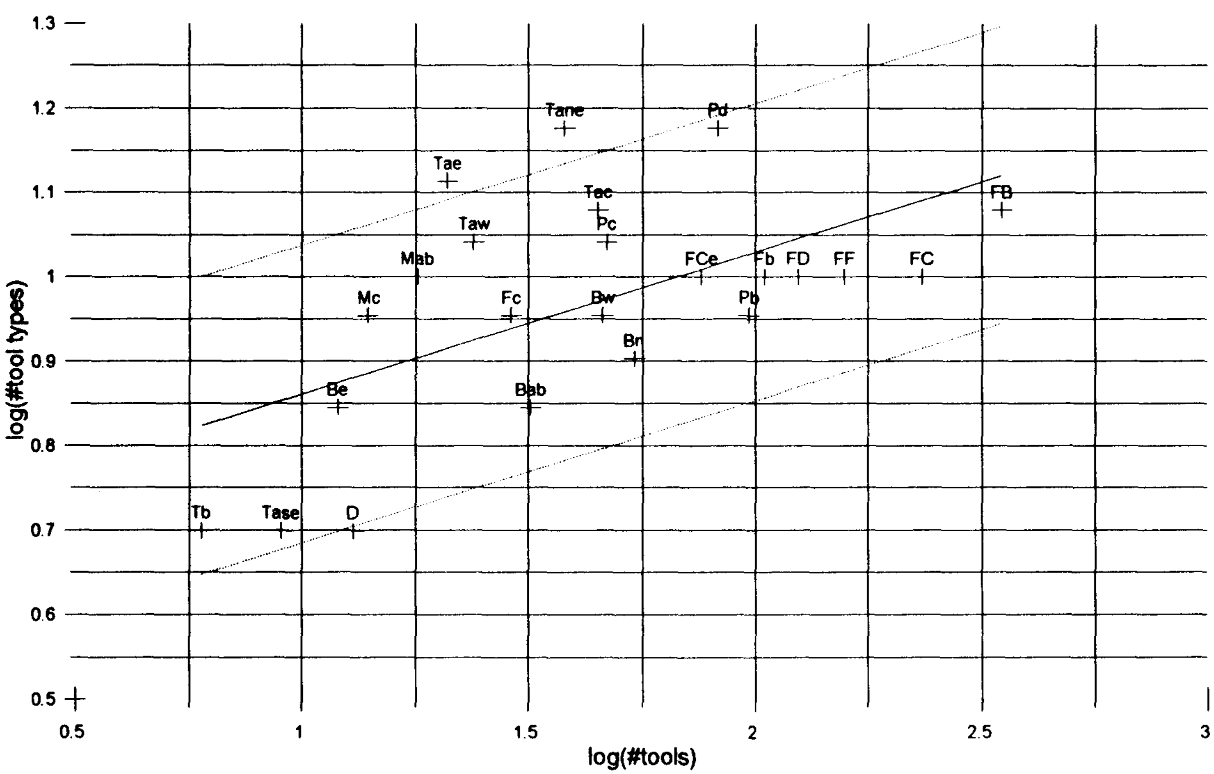
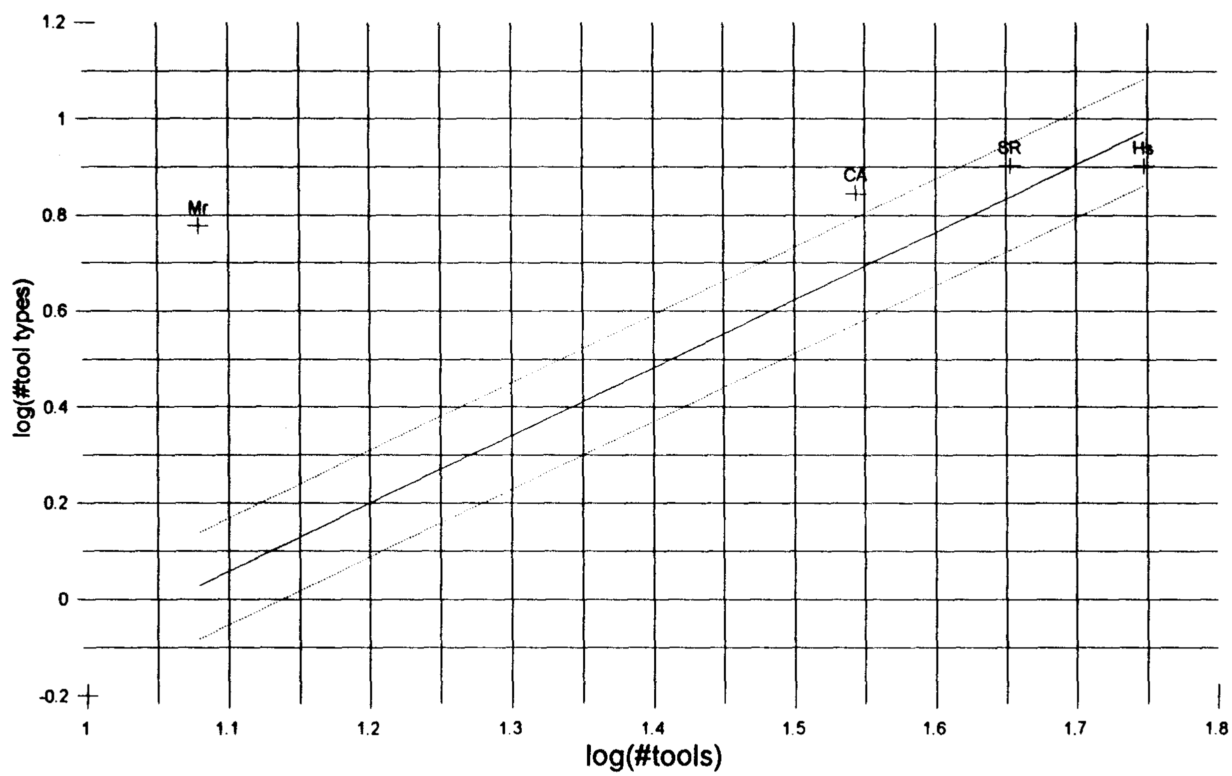


Figure 45 EDM Typology Gainey Clusters
Tool Assemblage Size vs. Richness



outside 2sd) likely arises from the small sample size.

These results identify some correlation between assemblage size and richness. The large number of sites or clusters falling outside of two standard deviations (from 7.1% to 28.6%, excluding the EDM Gainey complex where 50% of clusters fall outside, also likely due to sample size), however, indicates that other elements play a large role in the relationship between site richness and tool assemblage size. Although some correlations are strong, the overall pattern using Shott and EDM typologies at both the site and cluster scales of analysis, correlations are weaker than described in Shott (1997:207-209), a finding similar to one Meltzer reaches (1988: 35-36). Given that behavioural variation can provide adequate reasons for differences between artifact assemblages and sample sizes, and that regression of small samples overemphasizes correlations (Kaufmann 1998:75), it is suggested that behaviour, not sample size, should be the root of an explanation for the differences between sites (Plog and Hegmon 1997:718).

No correlation is observed between assemblage size and evenness, based on these data, using either the Shott typology at the site data scale (Table 21: Figure 46: $r=-0.170$, $r^2=0.029$, $p=0.560$, $df=13$), or the EDM typology at the cluster level (Figure 47: $r=0.156$, $r^2=0.027$, $p=0.406$, $df=30$). These results contradict Shott , as he finds a high negative correlation between these two variables in Gainey complex sites, and to a lower degree in Parkhill complex sites (1997:209). Shott's interpretation of his results is that with Gainey complex assemblages, size is an important dimension of variation. With his Parkhill complex data, "size dependence is merely one factor among those that govern composition in these assemblages" (1997:209). In other words, sample size does not adequately explain the variation in the Parkhill assemblages used in Shott's analysis. In the analyses here, sample size does not adequately explain variation in tool frequencies at EPI assemblages studied in this data set. Using a different measure, Meltzer reaches a similar conclusion (1988:36).

The relationship between the logarithm of tool assemblage size and heterogeneity shows no evident pattern between the two variables, either at high or low data resolution, using the Shott (Table 21: Figure 48: $r=0.101$, $r^2=0.010$, $p=0.806$, $df=13$) and EDM (Figure 49: $r=0.001$, $r^2=0.000$, p=0.997, df=30)) typology. The lack of significant correlation between these variables also contradicts the results of Shott (1997:207-209), who describes a strong correlation between heterogeneity and site size for the Gainey complex and a weaker relationship with Parkhill complex data. Again, the inference from these results is that sample size fails to adequately account for variation in tool distributions among the EPI assemblages examined in this analysis.

In summary, richness is loosely related to tool assemblage size, verifying a common sense argument that the bigger the collection, the more variety one is likely to observe within it. The overall moderate to low r- and r^{2}- regression values, and high proportion of sites or clusters lying outside of two standard deviations (7.1-28.6%), means that there are a significant number of exceptions to this correlation, and the degree of variation which can be attributed to sample size is low. Correlations between tool assemblage size and evenness or heterogeneity are not persuasive in this analysis using either the EDM or Shott typologies. Shott argues that these are strongly associated in Gainey, and less so in Parkhill assemblages. He attributes the latter weakness to assemblage size. This conclusion is not surprising, as 13 out of the 22 Parkhill complex assemblages in his analysis consist of small surface collections. However, Shott's results are not borne out by the analysis carried out here, where assemblages of markedly different sizes show similar measures of evenness (Figure 46: see also Meltzer 1988:38) or heterogeneity (Figure 48). The lack of correlation between evenness, heterogeneity and assemblage size (contrary to Shott 1997), in both the EDM and Shott typologies, suggests that Shott's subsequent correspondence analysis (1997:218-226) and conclusions be reexamined.

In addition, as has been observed in previous criticisms of such analyses, the measure of richness, evenness, or heterogeneity within a tool assemblage does nothing to describe the actual composition of a tool assemblage. It is possible for several very different tool assemblages, showing the same patterns of dominance by different tool types, to yield the same richness and heterogeneity values (Figure 50). These would appear identical or very similar, although logic would dictate that, being dominated by very different types or classes of tools, the sites would appear to have very different natures (Nagle 1989:306).

Figure 46: Shott Typology, Site Scale

Tool Assemblage Size vs. Evenness

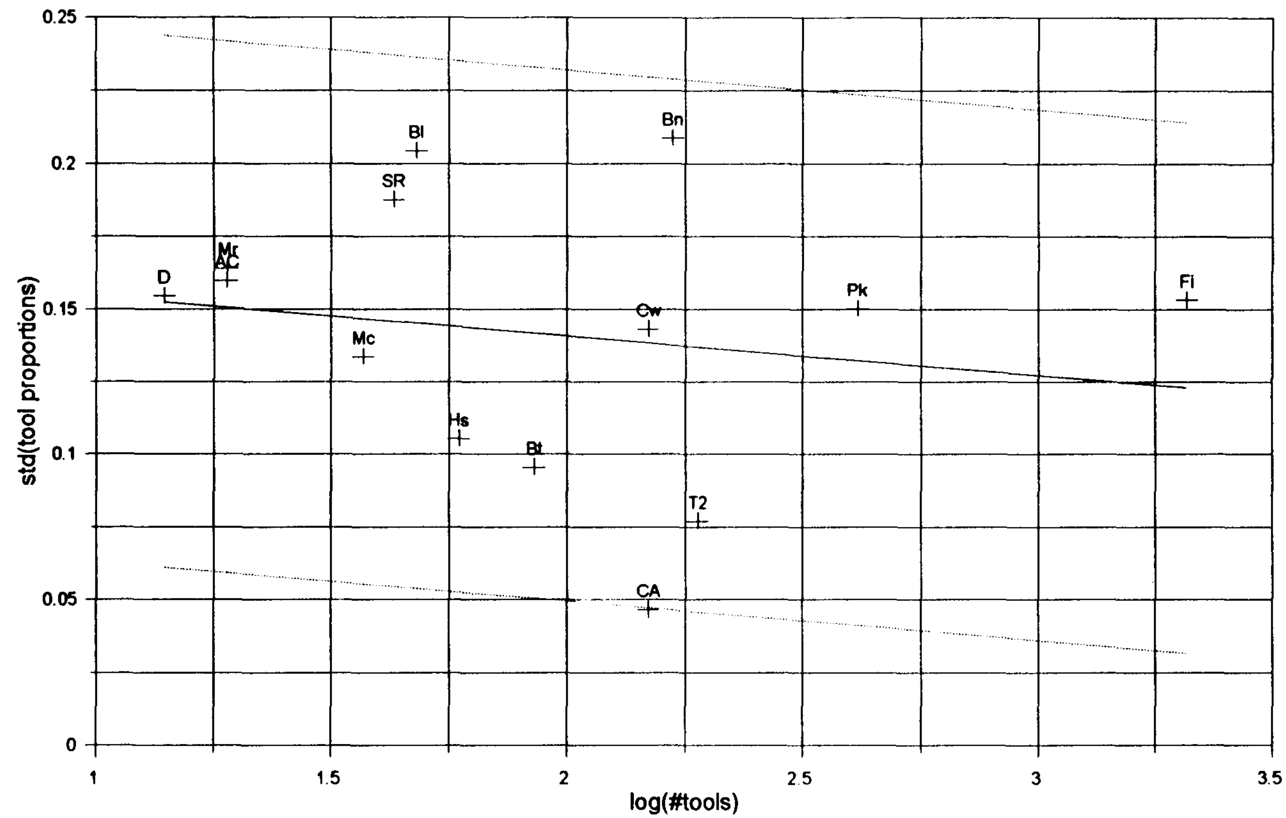


Figure 47: EDM Typology, Cluster Scale
Tool Assemblage Size vs. Evenness

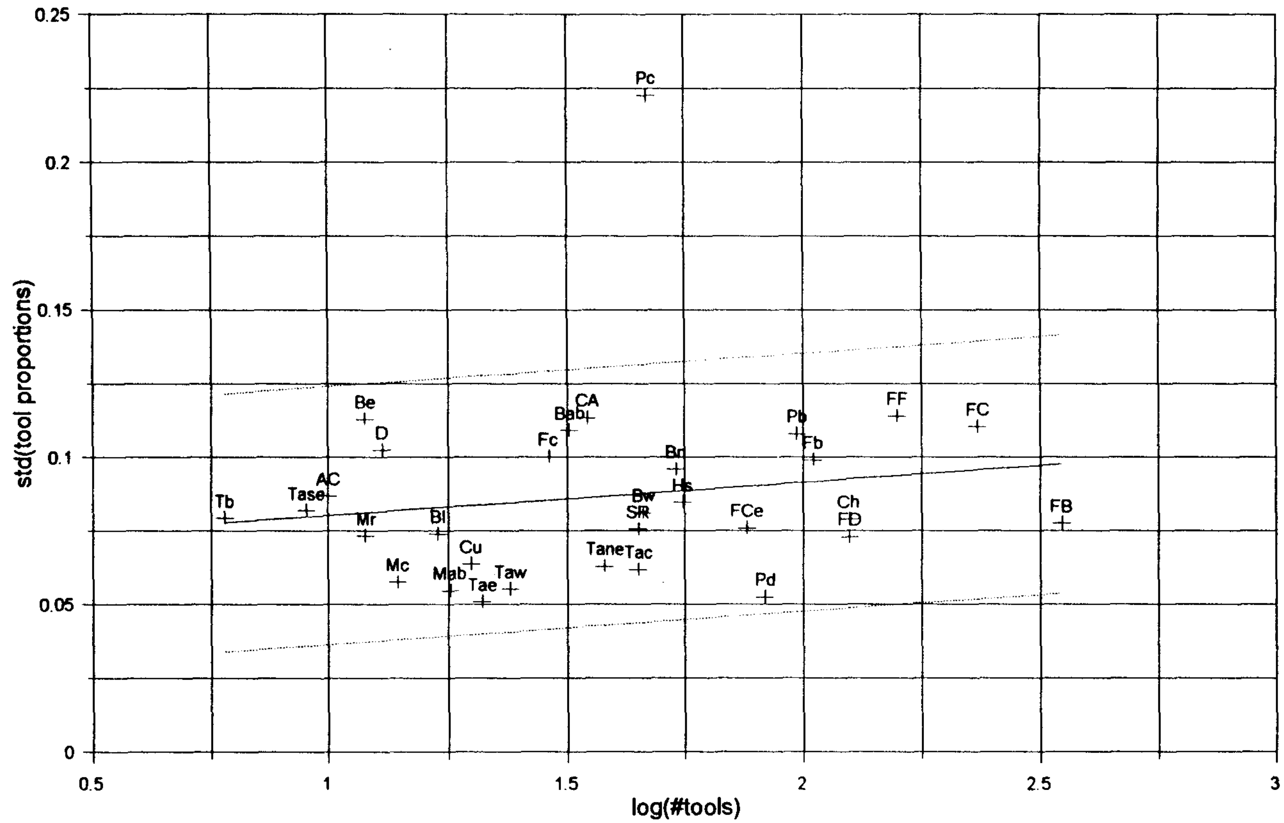
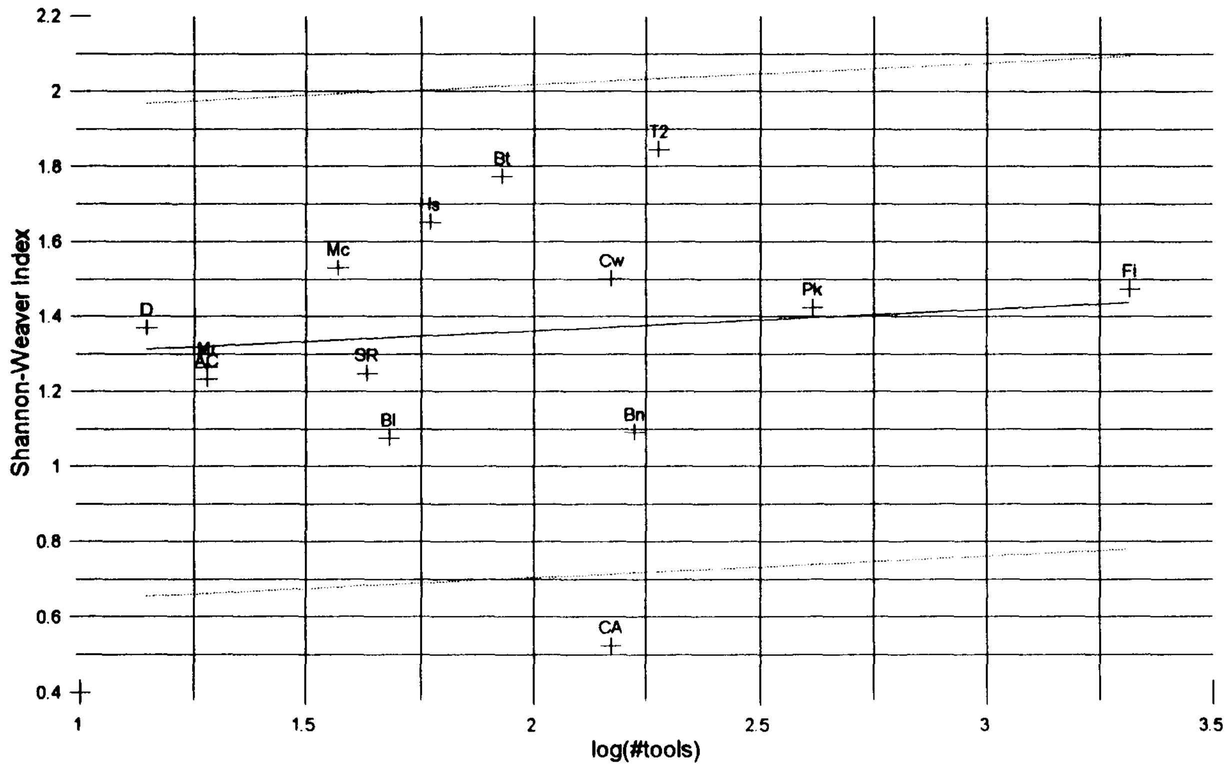


Figure 48: Shott Typology, Site Scale

Tool Assemblage Size vs. Heterogeneity



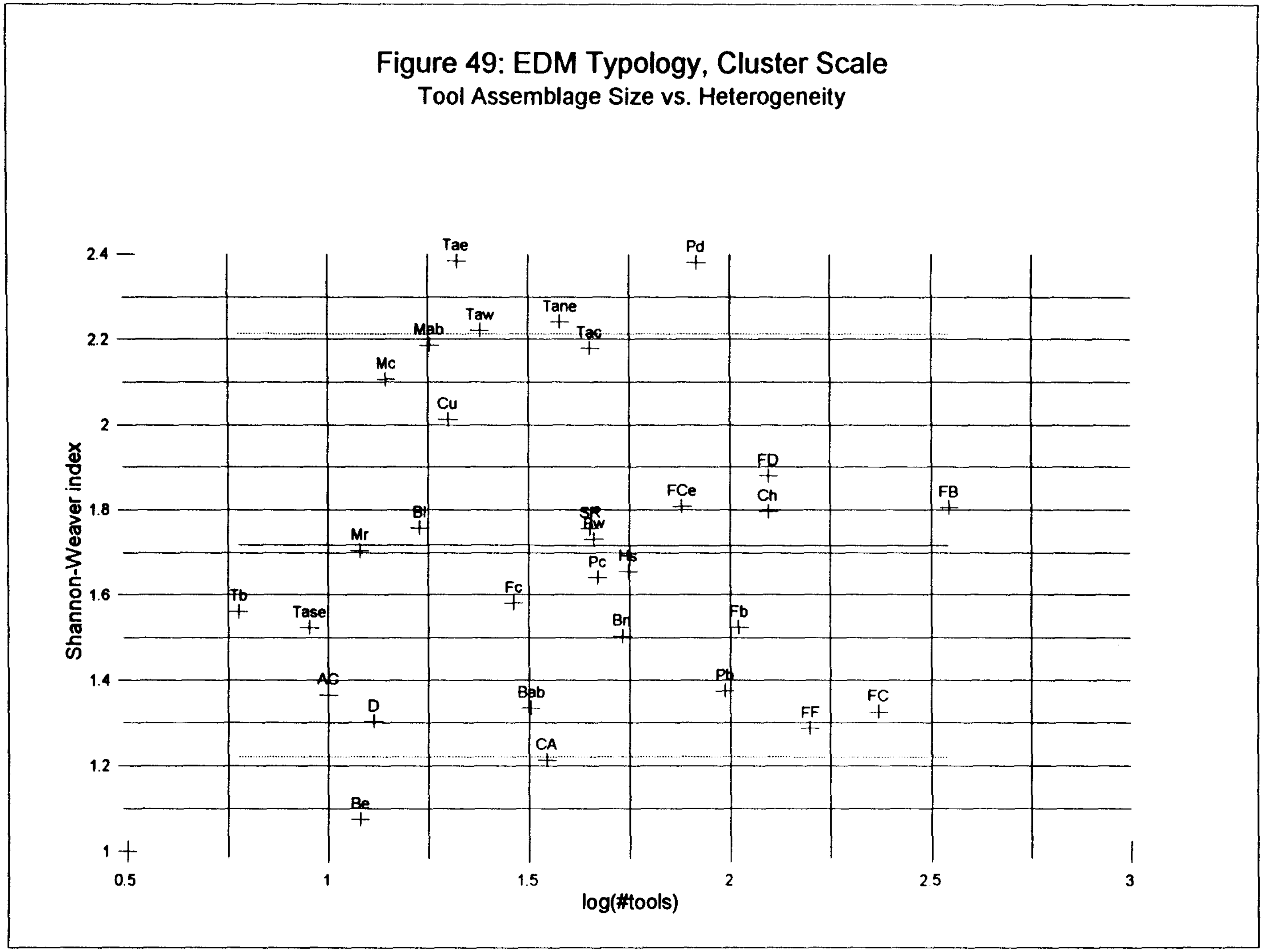
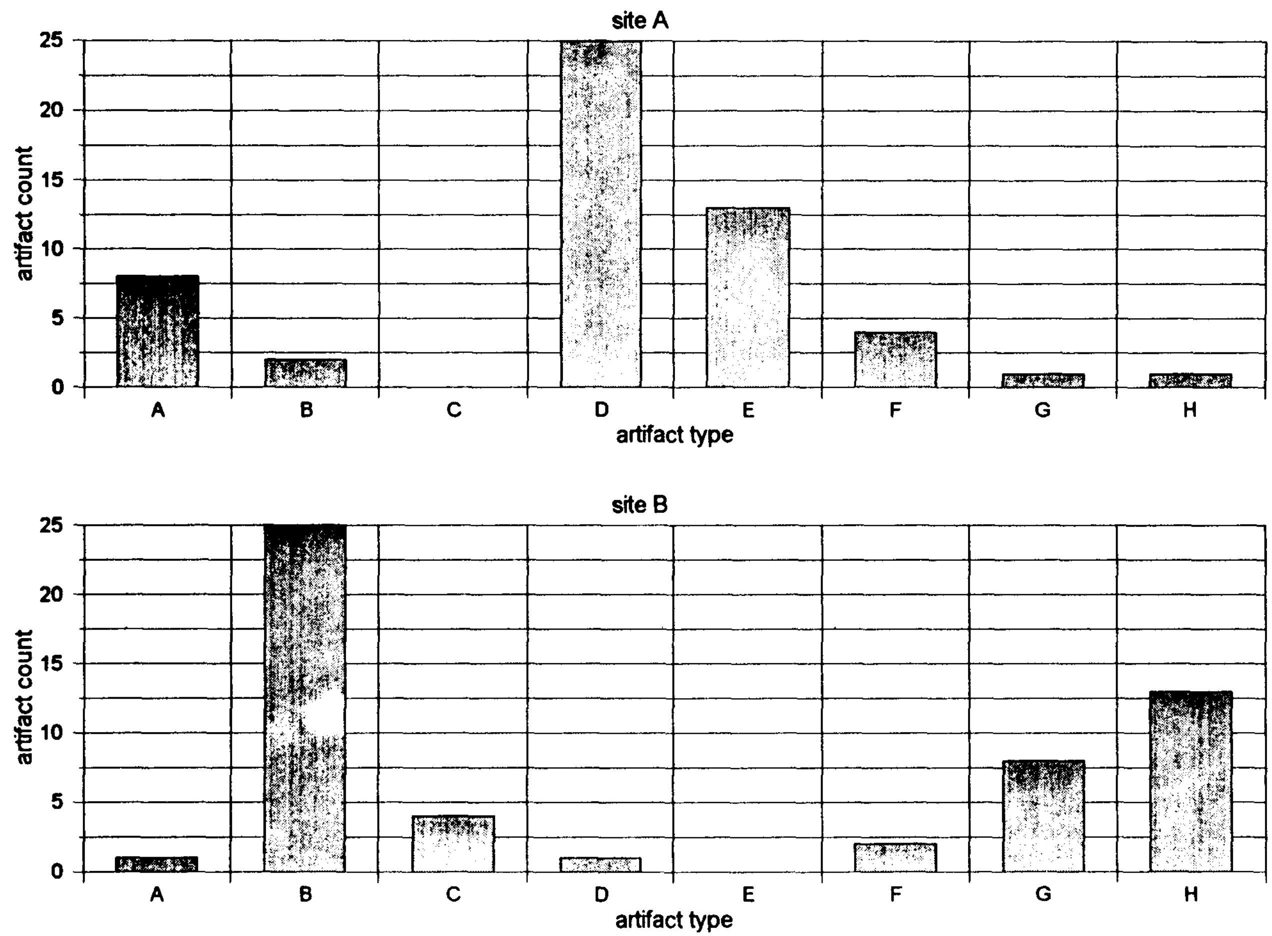


Figure 49: EDM Typology, Cluster Scale
Tool Assemblage Size vs. Heterogeneity
Shannon-Weaver index
log(#tools)
2.4
2.2
2
1.8
1.6
1.4
1.2
1
0.5
1
1.5
2
2.5
3
Tae
Pd
Tane
Taw
Mab
Tac
Mc
Cu
FD
FCe
Ch
FB
Bl
SR
Bw
Mr
Pc
Hs
Tb
Fc
Tase
Br
Fb
AC
Pb
Bab
D
FC
FF
CA
Be

Figure 50: Duplicate Site Model



Assemblage Heterogeneity and Tool Groups

To address this toolkit composition issue, two indices were devised for subsequent analysis. The biface: uniface ratio measures the relation of bifaces to unifaces at a site, while the second is a measure of similar ratios between formal and expedient tools. These sets overlap to some degree, but permit some contrast.

Logging the biface:uniface ratio, positive index values indicate domination by bifaces, negative values a majority of unifaces, and zero an equal number in each category. The terms biface and uniface are used to represent tools that are bifacially or unifacially worked, although some unifaces can show marginal bifacial edge retouch (Table 19). Two artifact types identified by Shott are not attributed to either category, as neither channel flakes nor bipolar cores are recognized as tools in their own right, excepting subsequently modified channel flake points.

By logging the formal:expedient tool ratio, a positive index value indicates a majority of formal tools, a negative value one dominated by expedient tools, and a zero value a balance. The definition of formal and expedient tools is more subjective. In this paper, formal tools are typified by a standard design requiring planning, and so show a higher degree of modification and a notable level of standardization in final tool morphology, are often hafted, and display evidence or intent of prolonged use. These likely correspond closely with the "designed" tool described by Shott (1997:220-222). Expedient tools typically show a less modification and standardization, are not hafted, require little planning, use opportunistic flakes, and show a low degree of reuse. These probably conform to what Shott describes as "opportunistic" tools (1997:222-23). These classifications are arbitrary, and some tool forms probably show some overlap between these two constructed categories. However, it is felt that the overall system of definition is internally consistent and functional (Table 19).

Indices were used instead of the ratios because the range in the latter is very high. The cost of using indices is that when an entire site assemblage belongs to one category, the ratio value is zero or indeterminate, and a logarithm of the value cannot be calculated. Due to this, several sites or clusters (Banting east, Culloden Acres, McLeod AB cluster, and Thedford II A-southeast cluster) were not part of one or more of the analyses. These particular assemblages are inherently outliers, and their absence does not greatly affect the analysis, nor do they cluster around H'_6 (the Shannon-Weaver index value). Because the sample size was reduced, most analyses were carried out at the cluster scale to maximize the available data sample.

No relation was noted between when the tool assemblage size and evenness were mapped against either the formal:expedient or biface:uniface indices. Evenness at all sites was within a tight range, with the exception of the Parkhill C cluster, using EDM typing. The Shott typology showed a wider scatter over evenness scale, but no marked correlation or notable clustering. More potential was noted for correlations between tool assemblage heterogeneity and either the biface:uniface or formal:expedient tool indices. With the nature of the heterogeneity scale, it is possible to predict several scenarios for assemblage types, whether at site or cluster scale. Specialized tool assemblages are predicted to have a low heterogeneity value, biased towards either biface or uniface tools (for example, a gearing up or armament cluster, or processing location) (Judge 1973:205-7). Generalized sites likely show a higher heterogeneity value, and owing to their general nature, tool assemblages might be expected to show a broader range of activities, and therefore less extreme biases in biface:uniface or formal:expedient indices.

Graphically, for assemblages with higher Shannon-Weaver values, the biface:uniface or formal:expedient indices would cluster around a zero value, with moderate biases towards unifaces or bifaces. In assemblages with a lower degree of entropy, a wider range of biface:uniface and formal:expedient values would appear more likely, given that lower heterogeneity marks a less even distribution of tool types, reflecting tool kit specialization. Clusters of tool assemblages with similar degrees of heterogeneity and tool category indices might infer similar site types.

Plots based on the Shott typology are inconclusive. A display of heterogeneity *vs.* the formal:expedient index displays three clusters (Figure 51). Low heterogeneity assemblages cluster around zero, and higher H'_6 values appear in two separate clusters, each biased towards either formal or expedient tools. This unanticipated contradictory pattern may arise from the

Figure 51 Shott typology Cluster Scale

Heterogeneity x formal:expedient index

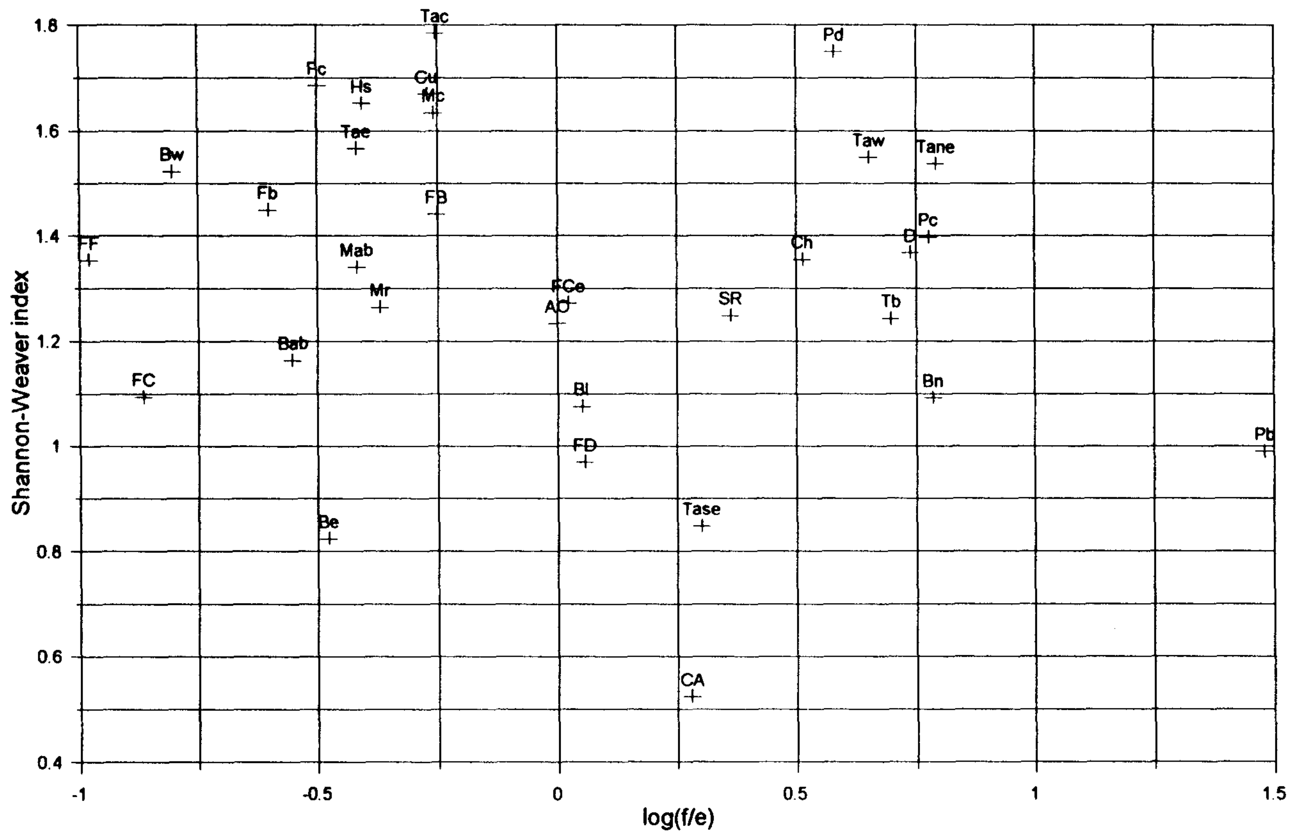
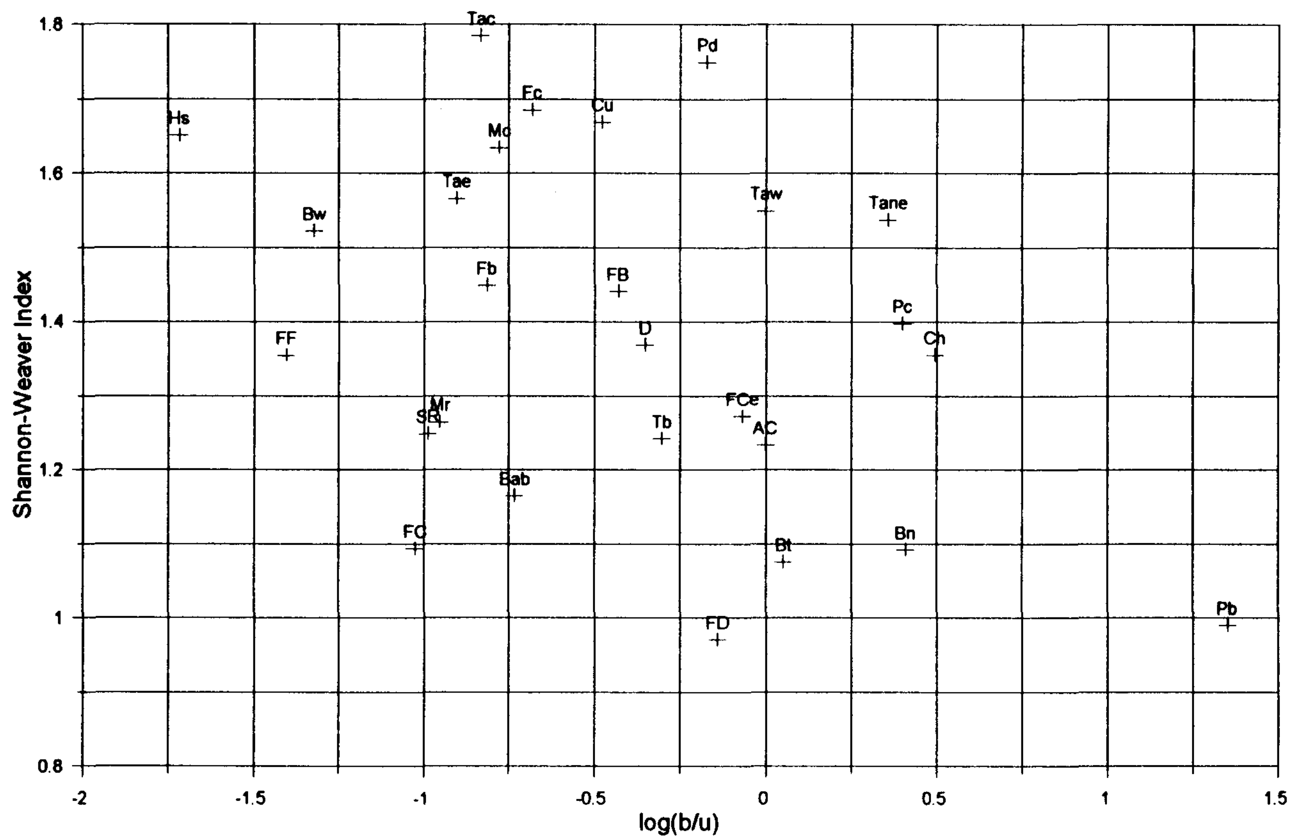


Figure 52

Shannon-Weaver x biface:uniface index



small number of tool types recognized in the Shott typology, resulting in an exaggeration of formal or informal tool bias. The plot of heterogeneity by the biface:uniface index (Figure 52) forms a diffuse scatter, again not predicted. In general, the use of a generalized typology may dampen heterogeneity and the biface: uniface index, and exaggerate the formal:expedient index . In short, it likely affects the degree to which a site is dominated by one tool category or another by restricting the precision of tool type classification (Meltzer 1988:35). In turn, this will affect measures derived from the typology, such as the indices used here.

The EDM typology more closely fits the predicted pattern, with some exceptions. With an increase in heterogeneity, the range of the biface:uniface and formal:expedient indices is lowered, and the reverse is also true (Figures 53, 54). The exceptions, Thedford II-A northeast and heated Crowfield assemblages, may arise because heterogeneity across one group or the other (e.g. biface:uniface or formal:expedient) is high enough to offset a tool category distribution bias (with a high heterogeneity level and a fairly strong bias towards biface or uniface). The tool assemblage from both clusters fit this scenario as they show very flat distributions across all types, with the exception of two large frequency spikes in the biface category (Appendix D).

Another pattern in the data is the offset of both biface:uniface and formal:expedient index distributions, centered around an axis of less than zero, indicating a majority of sites dominated by uniface and expedient tools, respectfully. This pattern contrasts with the lithic debris data described in section 5.3.3. Examining the clusters on the graph, the strengths and weakness of this analysis become evident. It does draw attention to sites and site clusters which, although they may range significantly in size, show similar degrees of heterogeneity and proportions of the broad categories discussed in this part of the analysis. It is evident that the larger categories of artifacts do match closely, and that the distribution across all artifact types are likewise similar. However, a fluted point does not equal a backed biface, nor is a hafted end scraper equivalent to a preform. Closer inspection of tool assemblages is necessary to determine whether the similarities go beyond those intimated here, an examination beyond the scope of this paper.

Figure 53: EDM Typology, Cluster Scale

Heterogeneity x Formal:Expedient Index

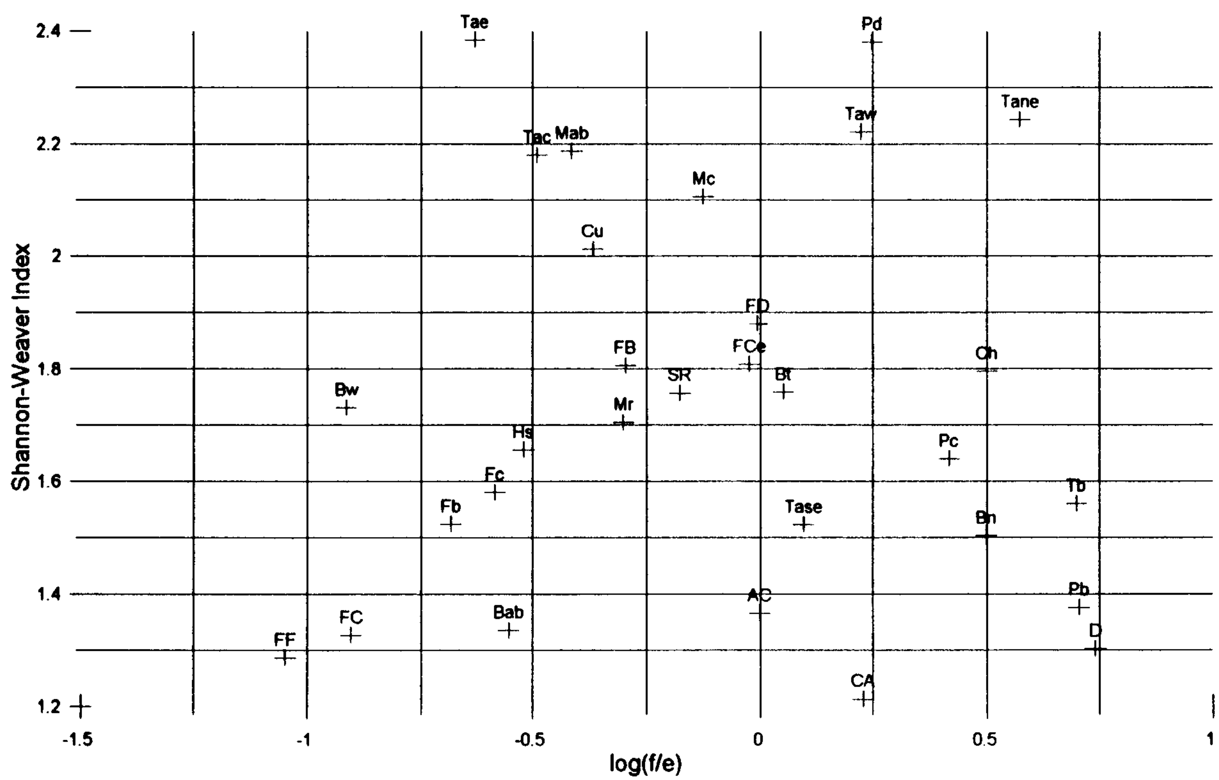
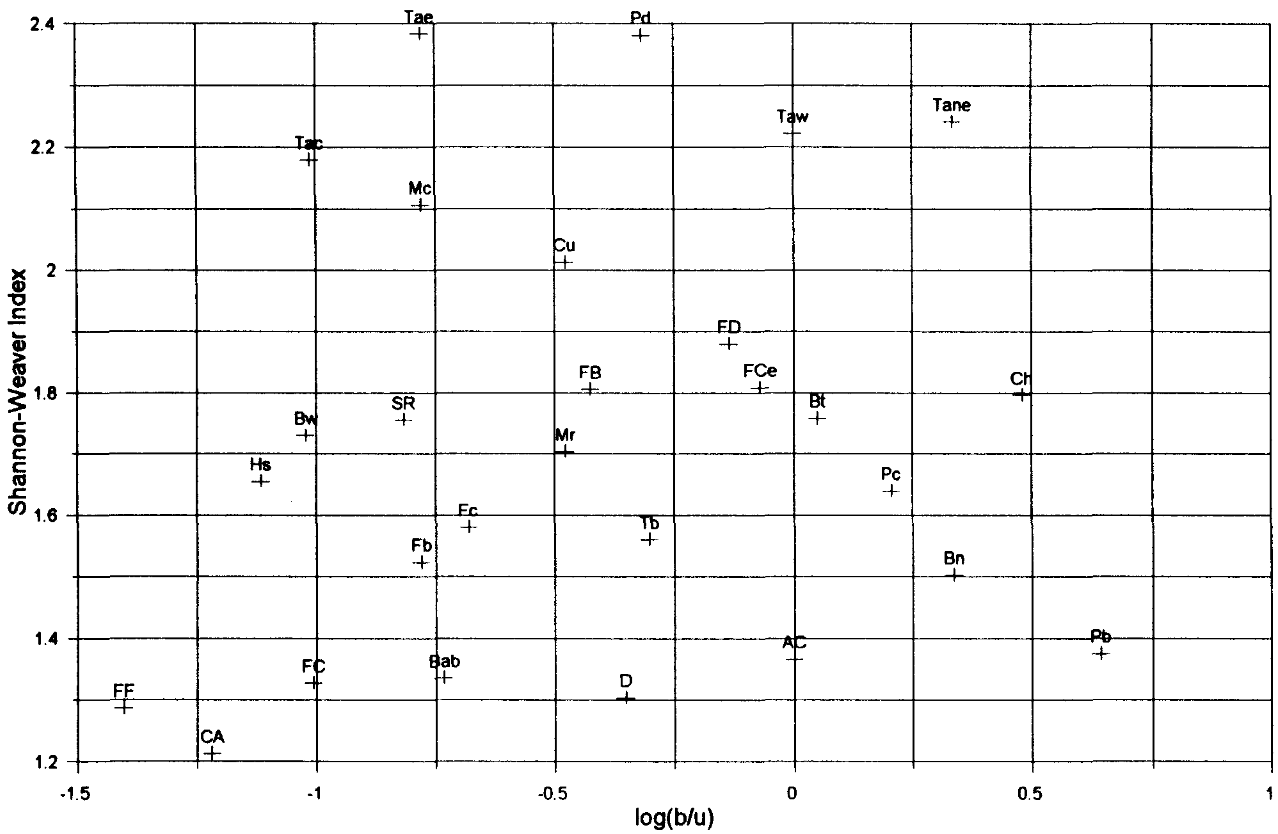


Figure 54: EDM Typology, Cluster Scale

Heterogeneity vs. Biface:Uniface Index



Toolkit analysis summary

The above analysis has confirmed the observations by Shott (1997) and Meltzer (1988) that richness is correlated with assemblage size (see also Grayson and Cole 1998:930-931), and supports Meltzer's finding that evenness is not linked to assemblage size (1988:36), contradicting Shott on the relationships between assemblage size and evenness or heterogeneity. This result may arise because the data sets used by Shott (1997) and this paper are not identical, and the analysis differs with respect to site versus cluster scales of data organization and analysis.

Specifically, the non-tool types used in Shott's typology (biface cores, channel flakes) may serve to accentuate patterns. For example, the presumed association of channel flakes with fluted bifaces likely exaggerates the dominance of the two within the analysis. An analysis measuring both tools and the products of tool manufacture as one index value may prove untenable, as this combines two large artifact categories: lithic debitage and tools. In addition, given the small number of types used by Shott, it is notable once again that regression analysis overemphasizes any correlations between variables in such cases (Kaufman 1998:75). Finally, correlation does not equal causal relationship, calling into question the argument by Shott that sample size can adequately account for assemblage distributions (1997:227). The results using the EDM typology question the degree to which Shott's results are effective outside of the typology and data set used in that analysis (1997). This evidence supports the critique (Plog and Hegmon 1998:717-8) of the premise that sample size is the only explanation for variation in tool assemblage composition.

The heterogeneity versus biface:uniface and formal:expedient indices analyses address a failing noted in other richness/evenness studies of archaeological assemblages: some measure of assemblage content. The EDM typology appears to provide a representation of EPI tool assemblages more suited to these analyses than that used by Shott (1997). In addition, the results using this analysis and typology also appear to limit the scope of Shott's conclusions regarding the correlates of evenness and heterogeneity. Sites occur which have very similar heterogeneity values but very different tool assemblage sizes, such as the cluster of Fisher B (n=255), Fisher D (n=125), Fisher C-east (n=76), Bolton (n=17), Sandy Ridge (n=45), and Murphy (n=12) (Figure 54). It remains to be seen how the EDM typology, or use of this revised data set, would fare in a comparative analysis as conducted by Shott.

By using a relatively detailed typology with the Shannon-Weaver Index, in combination with some index between two major categories of artifacts, one is able to statistically contrast a large set of sites and site data. This procedure facilitates simple and rapid graphic descriptions of sites which, although they may vary widely in tool assemblage size, show similar degrees of heterogeneity and another element, such as biface:uniface or formal:expedient indices. It is also suited to identifying clusters of tool assemblages which might indicate similar patterns of artifact distributions, and so may represent sites with similar functions. The limitation of this analysis is that the measure of similarity remains quite coarse, requiring further manual and statistical processing to ascertain closeness of 'fit' between sites. It does provide a potential starting point for such analysis, however. Finally, this analysis model does provide some facility for measuring whether a site falls within a predicted pattern, such as whether apparently highly specialized tool assemblages only occur at low heterogeneity levels.

The initial interpretation of the McLeod site assemblage, with a high degree of richness, is confirmed here, consistently falling outside of two standard deviations on regressions (as well as from 28.6 to 43.5% of other sites). The site's high heterogeneity (H'_6 for grids AB and C are greater than 2.1) places the McLeod site clusters among larger EPI site clusters in the study group, including Thedford II (A northeast, A west, A east, A centre), Parkhill D, and Crowfield unheated (Figure 49). The low evenness value also confirms that the McLeod tool assemblage clusters are distributed evenly across all tool types present. The McLeod site groups with some of the other clusters it is linked with in the heterogeneity graph, including Thedford II A east, A west, and Crowfield unheated (Figure 47). Both McLeod site cluster tool assemblages show a slight bias towards expedient tools, and a stronger bias towards uniface tools. All of these data confirm that the McLeod site is a small, very rich, and evenly distributed tool assemblage.

5.3.3 Lithic Debris and Tool Ratios

The role of sample size, and thus sampling error, has been introduced above. Following the lead of Thomas (1989), it has been argued by Shott (1997) that strong correlations between sample size and measures of richness, evenness, and diversity indicate sampling error plays a strong role in assemblage variation between sites. The role of sampling error, it is proposed, is so strong as to discount other potential explanations for such variation, such as behaviour (*e.g.* site activities). The analyses above, with the data-set described, identified some correlation between assemblage size and richness, although weaker than noted by Shott (1997), and with substantial proportions of the sample falling outside of two standard deviations in the regression analysis. No correlation was noted between assemblage size and evenness or heterogeneity.

However, for the purpose of argument, if one accepts that variation in the composition of tool assemblages is primarily the result of sampling error, it cannot be assumed that the correlation is (or is not) by default a causal relationship. One manner in which to test the nature of the association is to examine behavioural indicators other than tool assemblages, such as the lithic debris resulting from tool manufacture, resharpening, and use at sites.

It is argued that lithic debris can be more indicative of actual site activities than the tool forms discarded at the same site (Collins 1975:19). The following analysis examines lithic debris in comparison with the toolkits present at a sample of EPI sites. The first section explores the relations between the proportions of uniface tools present at a site and the representation of uniface debris present, and the variance in levels of biface and general lithic debris at a site in relation to the proportion of bifaces in the tool assemblage. If it can be shown that these correlate, even in small site or cluster assemblages, then this would be ***prima facie*** evidence that assemblage diversity is driven primarily by behavioural differences, and less by sample size.

The data requirements for this analysis are the same as those detailed in 5.3.2. Additional criteria are that sites in this analysis include full accounting for lithic debitage (measuring at least the number of flakes recovered from a site or cluster), and data was sought with debitage catalogued as the product of biface and uniface reduction pathways. Limited seamless conversion was conducted. The number of sites and clusters with data in the latter detailed form was smaller, a subset of that used in the more general data-set (Table 17). Debitage data were unavailable for some clusters in the lower Great Lakes area used in the heterogeneity analysis above. To increase the number of samples, and incorporate those sites discussed by Deller and Ellis (1996) the data-set includes several additional sites from northeastern North America, including Vail, Potts, Adkins, and Leavitt (Figure 2). Data was analyzed at the cluster level only, in order to minimize the loss of resolution resulting from aggregate data.

The EDM tool typology for this analysis was modified, to accommodate the data available, and to compensate for some characteristics of the toolkit. Notably, pièces esquillées were not classified as unifaces or bifaces, and so were not included in the tool count totals. It is arguable that pièces esquillées are bifaces (being bifacially worked), but it does not appear that they are reduced in a manner similar to that used in the production of any other bifaces, and there is no identifiable "pièces esquillées singular reduction flake" associated with the production or use of this artifact. Deller and Ellis (1996:30) classify pièces esquillées as unifaces, but they also do not fit the uniface reduction or resharpening pathway modeled for uniface tools. The only sites where this change plays a significant role are those in which pièces esquillées are a significant component of the toolkit: Vail; Potts, and Adkins, the three sites most distant from the lower Great Lakes. The remainder of the sites yield pièces esquillées in only trace quantities, if at all. The absence of these is typical of Parkhill complex sites in the lower Great Lakes EPI horizon.

In order to judge the impact of not including pièces esquillées, the data-set was plotted treating them as bifaces, unifaces, and as neither (but including them in the tool count totals). There was no major change in the overall data pattern. Because they are outside the norm in terms of uniface and biface tool types, their inclusion in one group or the other skews the data. As their removal does not greatly affect the data analysis, it is regrettable but functional, and at minimal data expense. The other tool kit classification change in this analysis is the exclusion of unidentifiable tool fragments from the counts, permitting inclusion of data from the Leavitt site (the report on which does not provide tool fragment counts) in the analysis. The exclusion of these data systematically increases the ratio of debris to tools, but consistently among sites.

Several other actions were used to normalize the data set. When possible, the yields of lithic debris were corrected for recovery using 6mm hardware cloth, to provide a standard as used across most of the sites in this analysis (Parkhill, McLeod, Banting, Fisher, Thedford II, Leavitt, Bolton, Culloden Acres, Alder Creek, Barnes, Vail). Numerous sites were excavated either partially or completely using 3mm hardware cloth. For some of these, data identifying what yields would be using only 6mm hardware cloth was provided (Thedford II, Parkhill, Bolton, McLeod), and this equivalent data was used when available. Other sites were excavated either partially or completely using 3mm hardware cloth (Sandy Ridge, Halstead, Murphy, Adkins, Culloden Acres), or water-screening and/or finer mesh for recovery (Vail, Adkins, Potts), but for which no 6mm equivalent recovery data was provided. In the cases of Vail and Potts, intensive recovery was limited to sampling and feature excavation. To minimize the resulting impact on the data sample, tools and debris recovered from features were not included in the analysis.

Culloden Acres area A was excavated by 3mm hardware cloth in 25% of the units. There is no equivalency data, but these units yielded 75% of the lithic debitage (Ellis per comm 1998). Sandy Ridge, Halstead, Murphy and Adkins were all excavated entirely by 3 mm hardware cloth. Lacking 6mm equivalence data, or a way to accurately estimate or convert it to what the 6 mm recovery results would be, the data from Culloden Acres is a significant example. Recovery in 6 mm mesh misses a significant portion of lithic debris, so the sites for which only 3mm recovery data is available will probably skew towards high counts of lithic debris in relation to tool frequency (Ball & Bobrowsky 1987).

It is unfortunate that some of the data available are not used, but due to the wide variety of excavation techniques, an attempt to normalize the data is necessary to provide a standardized frame of reference among a large number of sites.

Uniface Tools and Uniface Lithic Debris

The proportions of uniface tools and lithic debris were calculated in relation to the total number of identified tools and flakes respectively (Table 22). Flake percentages were calculated using the total of identifiable flakes as detailed in Chapter 4 (excluding flat flakes and shatter), except where noted. The corresponding data plot (Figure 55) confirms a linear relationship between the proportions of uniface tools and uniface lithic debris at a site, regardless of sample size. Regression analysis, using logs of the number of uniface tools by the number of uniface flakes (Figure 56), supports this ($r=0.806$, $r^2=0.650$, $p=0.001$, $df=22$). On this basis it is clear that the tools recovered at a site do measure behaviour occurring there, and the effect of assemblage size is relatively minor. It is also evident that uniface flakes under represent the proportion of uniface tools at a site, typically by an order of 20%. Even when essentially only uniface tools are recovered from an EPI site, uniface flakes represent 80% or less of the total of biface and uniface flakes. This pattern is anticipated, arguing that activities related to more extensively retouched bifaces produce a larger number of waste flakes than from uniface related activities,

Table 22: Intersite Data: Biface and Uniface Tool and Debris Percentages

site	biface flakes		uniface flakes		other flakes	total flakes	biface tools		uniface tools		total tools
	f	%	f	%	f	f	f	%	f	%	f
AC	94	51.37	1	0.55	88	183	5	50.00	5	50.00	10
Ad	79	28.83	31	11.31	164	274	3	3.33	87	96.67	90
Bt	131	53.47	5	2.04	109	245	9	50.00	9	50.00	18
CA	6	1.55	182	46.91	200	388	1	2.94	33	97.06	34
Hs	41	23.03	65	36.52	75	178	1	1.89	52	98.11	53
Lv	913	17.13	340	6.38	4076	5329	22	30.14	51	69.86	73
Mab	5	9.62	22	42.31	25	52	0	0.00	18	100.00	18
Mc	24	58.54	5	12.20	12	41	2	14.29	12	85.71	14
Mr	55	34.59	5	3.14	99	159	1	10.00	9	90.00	10
Pb	1234	56.09	34	1.55	932	2200	79	81.44	18	18.56	97
Pc	523	38.37	113	8.29	727	1363	29	61.70	18	38.30	47
Pd	254	24.93	80	7.85	685	1019	27	32.53	56	67.47	83
Pta	220	35.83	99	16.12	295	614	2	4.65	41	95.35	43
Ptb	654	34.51	525	27.70	716	1895	2	2.78	70	97.22	72
SR	22	10.05	102	46.58	95	219	4	9.30	39	90.70	43
Va	158	4.48	92	2.61	146	3528	7	7.69	84	92.31	91
Vb	72	30.90	88	37.77	73	233	6	7.89	70	92.11	76
Vc	183	43.06	115	27.06	127	425	25	18.12	113	81.88	138
Vd	103	31.21	84	25.45	143	330	11	9.48	105	90.52	116
Ve	499	30.28	436	26.46	713	1648	26	8.31	287	91.69	313
Vf	64	37.21	54	31.40	54	172	3	8.57	32	91.43	35
Vg	29	1.21	30	1.25	47	2403	1	2.86	34	97.14	35
Vh	72	43.90	24	14.63	68	164	5	13.51	32	86.49	37

Figure 55

Uniface Tool vs. Flake Percentages

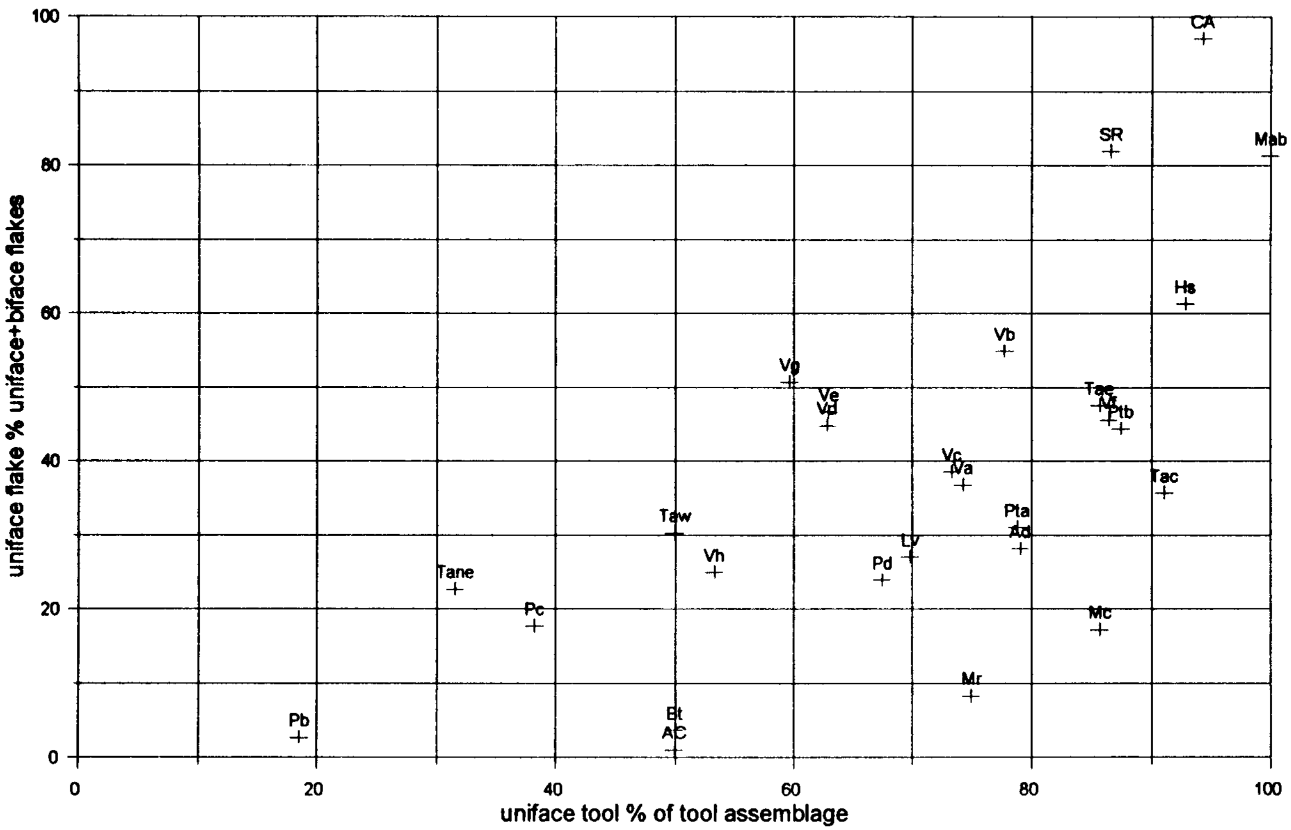
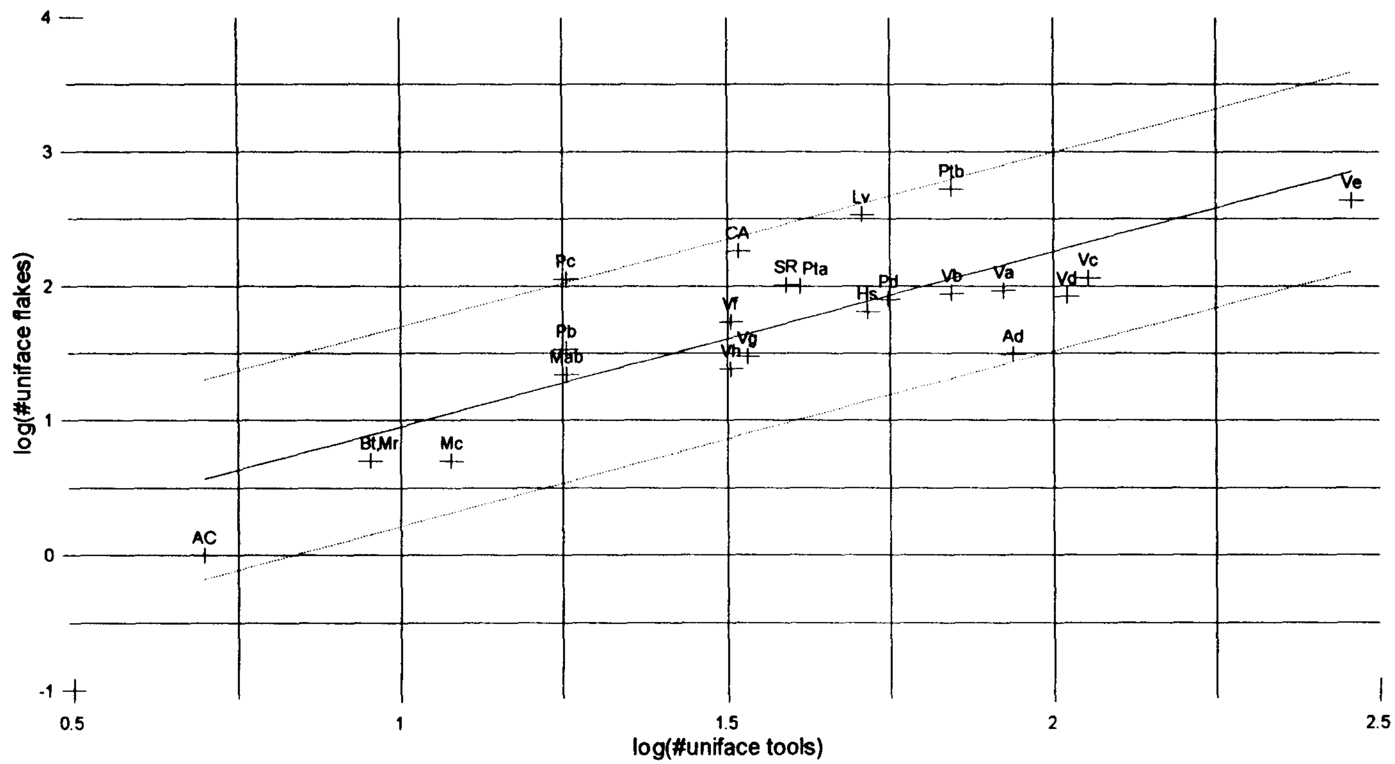


Figure 56

Uniface Tool vs. Flake log(frequency)



which typically involve much smaller degrees of retouch. In addition, debitage resulting from uniface resharpening is typically very small, with poor recovery rates in 6mm mesh. As a result, most of the plotted sites yielding the highest proportion of uniface flakes were excavated with 3mm mesh, data for which could not be normalized (Culloden Acres, Sandy Ridge, Halstead). Only grid AB of the McLeod site, which yielded exclusively uniface tools, has a uniface flake representation of higher than 80% (normalized to recovery in 6mm mesh).

Biface Tools and Biface Lithic Debris

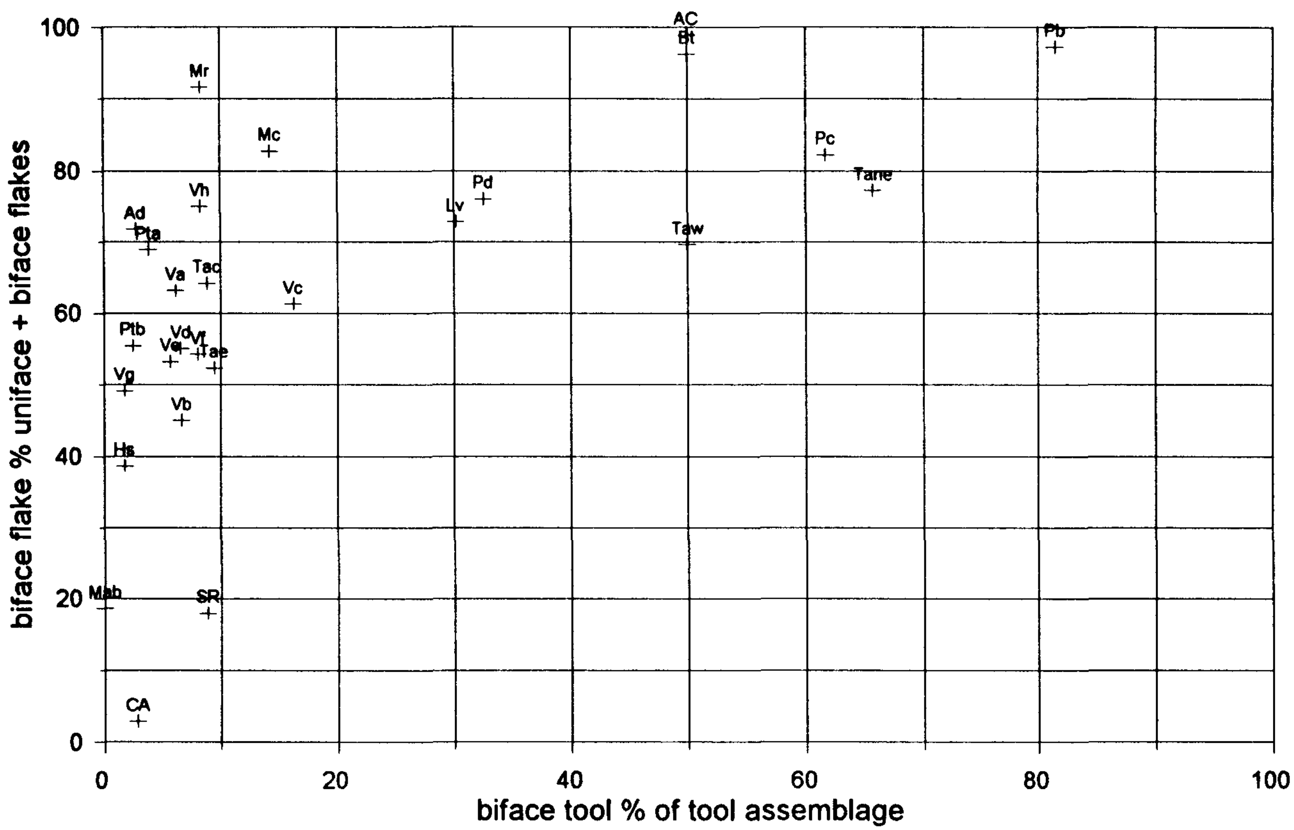
To establish the corollary to this, that biface flakes are over represented in lithic debris, a corresponding graph (Figure 57) was plotted for the proportion of biface tools and debris (Table 22). With a plot of logged values for the numbers of bifaces and biface flakes in assemblages (Figure 58), a correlation exists, although not as strong as with the uniface analysis ($r=0.737$, $r2=0.543$, $p=0.001$, $df=23$). The results support the hypothesis, with biface flakes occurring in frequencies typically 20-30% higher than the proportion of biface tools. The only cases arising when the quantity of biface flakes are lower than 40% at a site is either where no biface tools were recovered (McLeod grid AB), or where the proportion of biface tools is very low and the only data available are from 3mm recovery (Culloden Acres, Sandy Ridge, and Halstead).

Tools and All Lithic Debris

The final relation between lithic debris and tools examined is between the proportion of bifaces and unifaces in the tool assemblage and the quantity of all lithic debris in the entire lithic assemblage (Table 23). The corresponding graph (Figure 59) reveals that bifacial tools are associated with high quantities of lithic debris. Excluding one outlier (Thedford II A northeast), all assemblages with 20% or more bifaces in the toolkit (<80% uniface tools) comprise 92.5% or more lithic debris. Only those sites with a toolkit of less than 20% bifacial tools (>80% uniface tools) have a lithic debris component of less than 90%. Toolkits which consist of less than 20% biface tools, for which lithic debris makes up more than 90% of the assemblage, are either quarry sites (Potts A and B, Fisher C, F, b, and c, Banting east and AB), or are assemblages

Figure 57

Biface:Uniface Debris vs. Tool Ratios



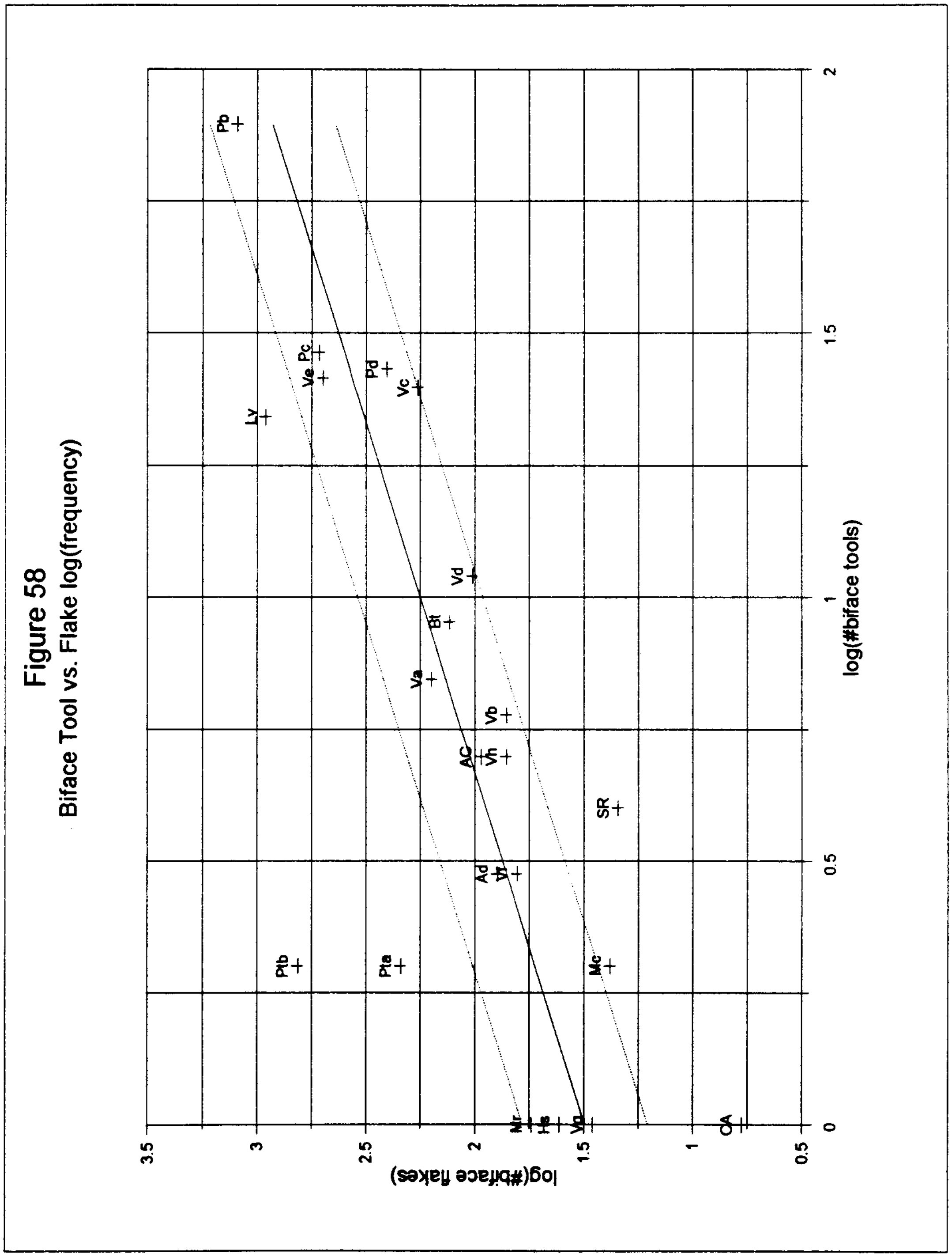
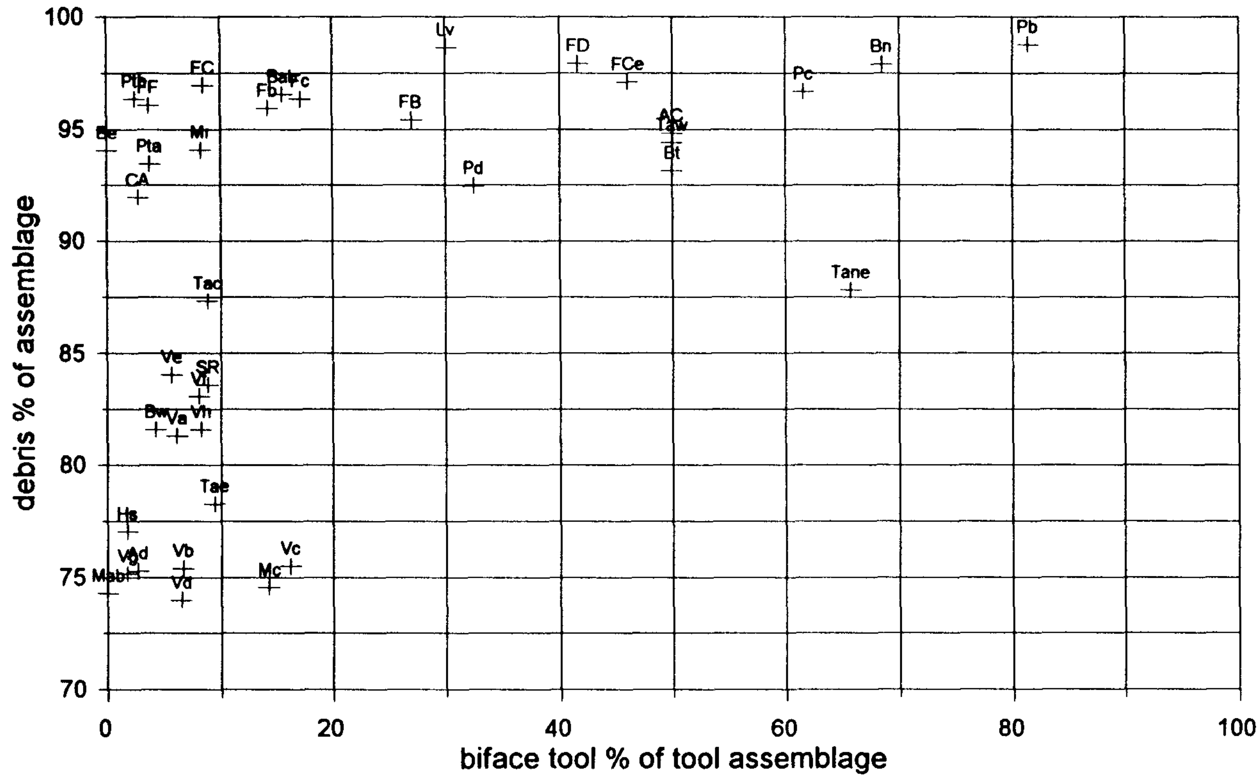


Figure 58

Biface Tool vs. Flake log(frequency)

Figure 59: Biface
Tool Frequency vs. Debris-Tool Ratios



recovered largely or entirely through 3mm mesh (Culloden Acres, Murphy).

Examining the exception, the A northeast cluster is the only one associated with a tool cache at Thedford II (Deller and Ellis 1992a:104). The cache of 13 bifaces "discarded"here, with no associated local lithic reduction, and so these tools are "removed" from their affiliated debris. This scenario lies outside everyday site activities (in that it involves strictly the deposition of tools produced elsewhere), and it seems a plausible explanation for the cluster's outlier status.

To examine the pattern more closely, the data were divided into two groups. Quarry sites occur when lithic raw material is reduced to portable preforms and blanks or block cores (Lothrop 1988:118-9). These are predicted to occur either within ***ca.*** 30 km of the lithic bedrock source utilized, or are described as such in reports (Table 23). Non-quarry sites are where this activity does not occur. The two graphs identify three clusters. The first (Figure 60) confirms the existence of a single cluster of quarry sites with a very high proportion of lithic debris, regardless of the proportion of bifaces in the tool kit. The one exception (Banting west) suggests that, as one might expect, not all sites within 30 km of the lithic source are by default quarries.

The remaining data plot of non-quarry sites (Figure 61) displays two discrete clusters. The first consists of assemblages with high proportions of lithic debris (>87.5%) and a tool kit with a biface component of 20% or more. The other cluster comprises assemblages which show a lower proportion of lithic debris (<87.5%), with toolkits represented by less than 20% biface tools. In fact, with two exceptions (McLeod grid C, and Vail locus C), the latter group is marked by biface frequencies of less than 10%. With one more exception (Thedford II - A centre), the lithic debris component of this cluster is less than 85%. The two remaining biface-poor sites with a lithic debris component of greater than 85% (Culloden Acres, Murphy), were partially or fully excavated using 3mm mesh, and cannot be adjusted for a 6mm hardware cloth yield.

Table 23: Intersite Data: Biface Tool and Debitage Percentages			
Site	biface % of tools	debris % of assemblage	quarry workshop
Alder Creek	50.00	94.82	no
Adkins	2.73	75.27	no
Banting AB	15.63	96.56	yes
Banting E	0.00	94.06	yes
Barnes	68.52	97.92	no
Bolton	50.00	93.16	no
Banting W	4.35	81.59	yes
Culloden Acres	2.86	91.94	no
Fisher B	27.07	95.43	yes
Fisher C	8.55	96.97	yes
Fisher Ce	46.05	97.09	yes
Fisher D	41.60	97.93	yes
Fisher F	3.80	96.05	yes
Fisher b	14.29	95.94	yes
Fisher c	17.24	96.34	yes
Halstead	1.79	77.06	no
Leavitt	30.14	98.65	no
McLeod AB	0.00	74.29	no
McLeod C	14.29	74.55	no
Murphy	8.33	94.08	no
Parkhill B	81.44	98.79	no
Parkhill C	61.70	96.67	no
Parkhill D	32.53	92.47	no
Potts a	3.85	93.46	yes
Potts b	2.50	96.34	yes
Sandy Ridge	8.89	83.59	no
Thedford II A-C	8.89	87.34	no
Thedford II A-E	9.52	78.26	no
Thedford II A-NE	65.79	87.80	no
Thedford II A-W	50.00	94.41	no
Vail a	6.19	81.31	no
Vail b	6.67	75.40	no
Vail c	16.23	75.49	no
Vail d	6.59	73.99	no
Vail e	5.70	84.04	no
Vail f	8.11	83.09	no
Vail g	1.75	75.18	no
Vail h	8.33	81.59	no

Lithic Debris Summary

The above analysis of debris data and its relation to the associated tool assemblages confirms that uniface related activities are consistently under represented by uniface lithic debris, while biface related activities are over represented by debitage. The presence of biface tools

Figure 60: "Quarry" Sites; Biface
Tool Frequency vs. debris tool ratios

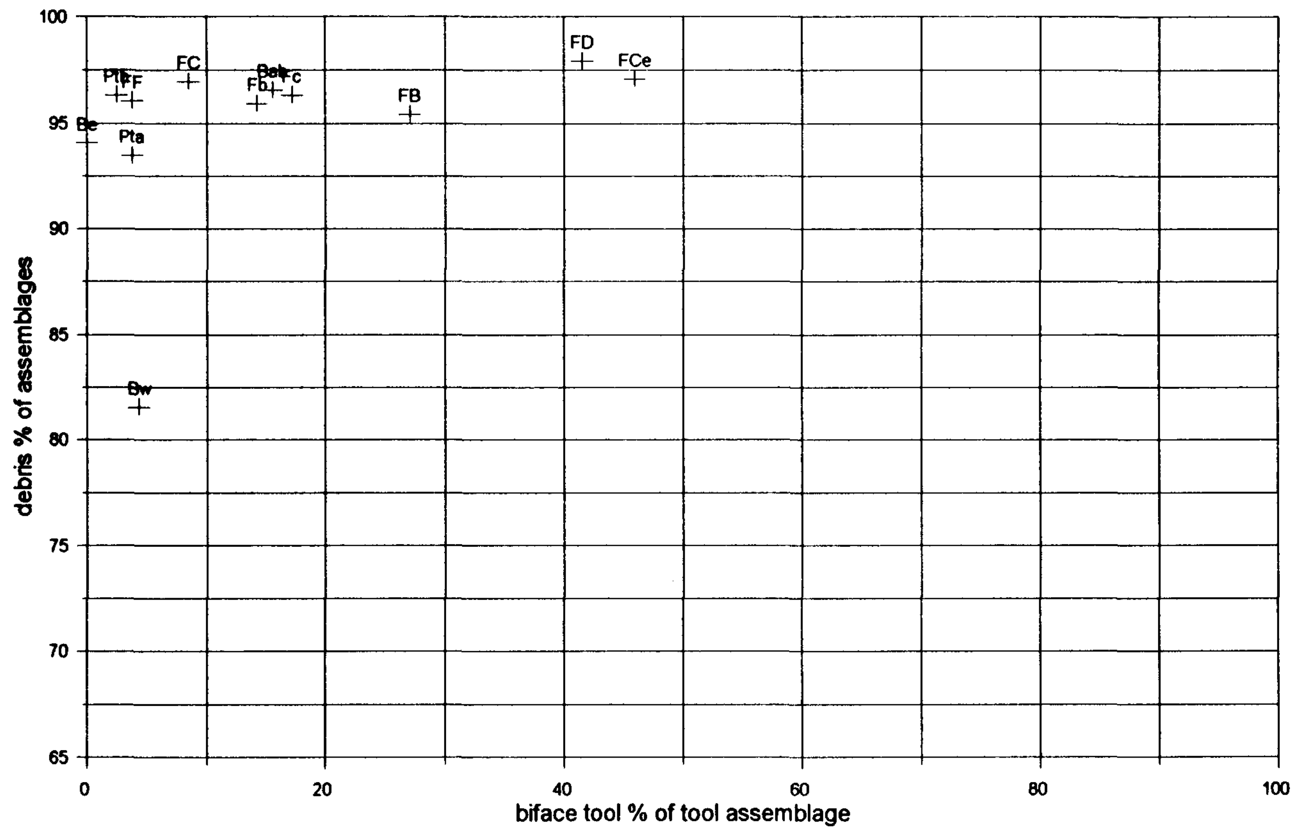
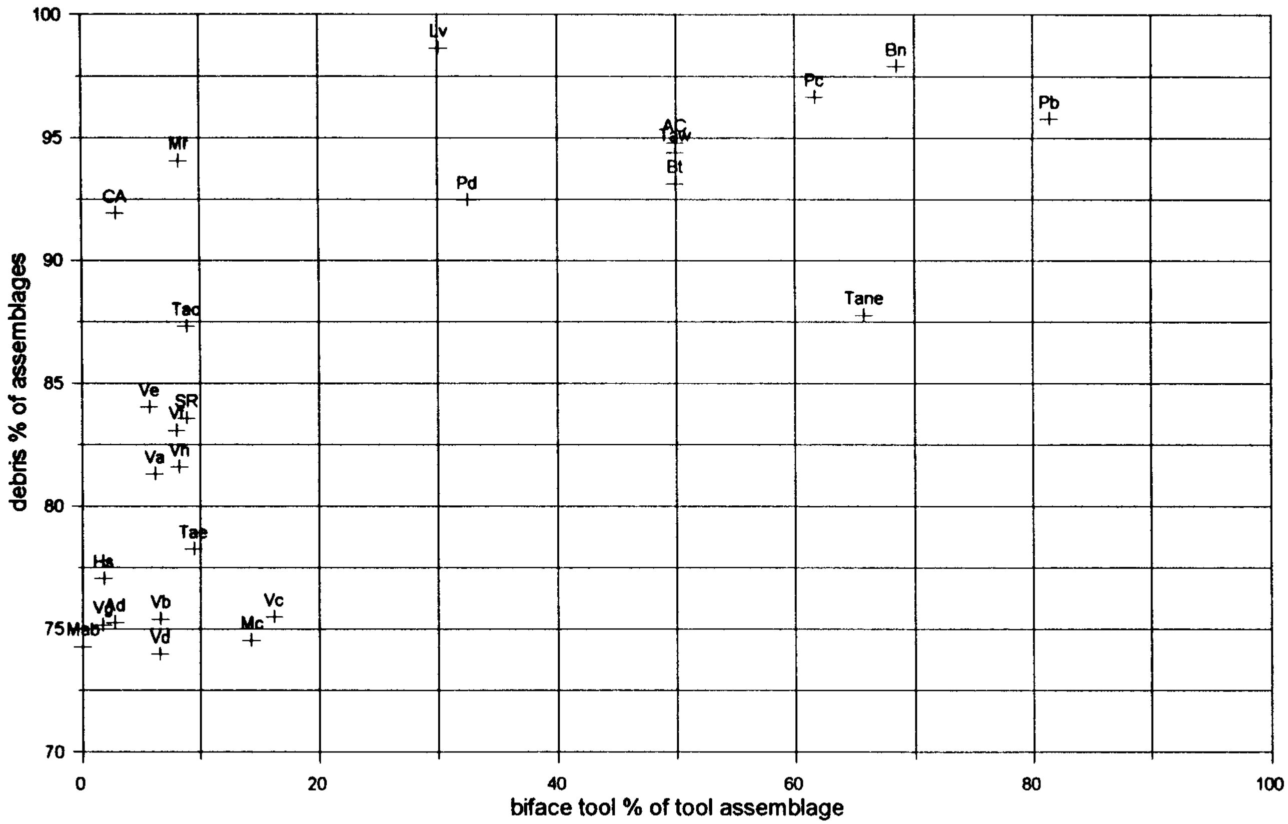


Figure 61: "non-Quarry" Sites; Biface
Tool Frequency vs. Debris-Tool Ratios



also significantly increases the volume of lithic debris in general, inferring that not only does the volume of bifacial flakes increase, but so too does the category of unattributable or flat flakes. This result was anticipated, as thinner biface flakes are more likely to collapse in removal than thicker uniface flakes (Deller and Ellis 1992a:87-89). The relation between the proportion of bifaces in a tool assemblage and the quantity of all lithic debris forms three distinctive lithic assemblage profile site clusters. These are described as uniface dominated sites; predominantly biface, and quarry sites. As members of these site types range widely in terms of size, it again seems likely that site function is closely related to the characteristics of both the tool kit and the lithic debris, contrary to the conclusions reached by Shott (1997), and that this exploration of debris offers a predictive model.

The McLeod site clusters show distinct similarities and differences in these analyses. Examining the relation between uniface tools and flakes at the site confirms the difference in lithic debris distributions between grid AB and Grid C, despite similar proportions of uniface tools (Figure 55). Predictably, this is also the case in the equivalent biface tool and flake analysis (Figure 57). Other than the general clusters identifying biface focused and uniface focused sites, the two McLeod grids do not cluster systematically with each other, nor with any other sites, nor are they outside of the normal scatter of other site clusters. The relationship between tools and debris at the site is undistinguished.

5.4 INTERPRETATION SUMMARY

Aside from the initial interpretations of the McLeod site, the analyses conducted in this chapter have examined the relationships between assemblage size, richness, evenness, and heterogeneity, and beyond this to the relation between the tools and lithic debris present at sites. A correlation between assemblage size and richness has been confirmed, although it is less strong than argued elsewhere (Shott 1997). In addition, no correlation has been identified between assemblage size and either evenness or heterogeneity. These findings contradict the conclusions reported by Shott (1997:207-213). As a result, the argument that sample size is the primary cause of variation among tool assemblages is not supported. Following an alternate explanation, that variation in tool assemblages is attributable to different patterns of behaviour at sites, lithic debris was examined to determine whether a correlation existed between lithic tool and debris assemblages. A positive relationship was observed, with strong correlations noted between biface tools and lithic debris, and a similarly strong association between uniface tool and lithic debitage. These results also argue against a strong role for sample size in accommodating variation in artifact assemblages, and support the proposal that such variation is primarily attributable to behaviour.

In the context of the above analyses, the McLeod site, as a small, Parkhill complex occupation in southwestern Ontario, is a pair of generalized activity clusters with three ephemeral scatters. The contemporaneity of any of these is not established, and so may reflect periodic use of the area by single non-task specialized groups or, alternately, one concurrent occupation by two such social units. There is some distinction between the two areas, as one (grid C) appears to reflect more bifacial activity than the other (grid AB), but they remain similar in their tool make-up, size, and intensity and range of activities as represented by the tool kit.

In relation to other Parkhill complex sites in particular, and other northeastern EPI sites in general, the McLeod clusters and site as a whole would be described as fitting within a uniface-focused cluster of sites, although biface activity does occur here. McLeod is unique in the high degree of heterogeneity, a high richness and an even tool distribution across tool types, characterized by the tool assemblage at such a small site. This result supports the argument that the McLeod site is a generalized occupation, comparable to most of the Thedford II clusters, Crowfield unheated, and Parkhill D, distinguished from these only by its small size, possibly related to the short duration or low intensity of the McLeod site occupation. The relationship between the toolkit and lithic debris McLeod is comparable to other EPI occupations, within the Parkhill complex and the EPI horizon as a whole.

6.0 Summary and Conclusions

As discussed in section 1.6, this research project had several goals. The first examined whether a regional pollen synthesis could be conducted, to determine the dominant vegetation in southern Ontario during the Early Paleo-Indian (EPI) occupation of this region, and to compare these results with additional paleoenvironmental data. The second studied lithic debitage and tool assemblages in a sample of EPI sites, determining whether variation in these assemblages reflected behaviour specific to sites, or was a function of site (assemblage) size and thereby sampling error. Finally, the place of the McLeod site within this cultural context was explored. The discussion below summarizes the conclusions of the McLeod site research project.

6.1 PALEOECOLOGY

The focus of research in the paleoecology chapter was the collection, analysis, and interpretation of fossil pollen data from 130 pollen sites and cores in southern Ontario and adjacent areas. Pollen distribution among three plant types and one vegetation group associated with the early post-glacial environment (*Picea*, *Pinus*, *Betula*, and non-arboreal pollen or NAP) were studied. Directional plant transgression and succession were identified, trending generally from south to north, with a secondary eastward component. Tundra conditions, indicated by the presence of ice-wedges and *Betula*, were established in the study area prior to 12 000 bp. The colonization of southern Ontario (*ca*. 11 000 bp) by the first EPI complex in the region took place within an open, 'spruce parkland' (defined in this paper), indicated by high percentages of *Picea* and NAP in the pollen profiles. A drop in the proportion of NAP in profiles, indicating closure of the spruce parkland into spruce dominated forest, began in southwestern Ontario near the end of the Gainey occupation. By the start of the Parkhill complex (*ca*. 10 800 bp), NAP percentages were dropping in southwestern Ontario, a northward trend, indicating that the parkland was beginning to close into forest in the region, while the remainder of southcentral and southeastern Ontario remained open spruce parkland. At this time, the closing and closed forest was dominated by spruce, being supplanted by pine at the southwestern margin by the mid-point of the Parkhill occupation. At the start of the Crowfield complex (*ca.* 10 600 bp) the closed, spruce-dominant forest spread northward, with pine succession paralleling to the south. However, by the end of the EPI horizon in southern Ontario, substantial portions of southcentral and southeastern Ontario remained in open spruce parkland.

Additional paleoclimatic data, fossil *Coleoptera* and oxygen isotopes, suggest that the plant colonization of southern Ontario lagged behind the climate change which had already taken place, likely due to limited seed dispersion rates and the soil fertility constraints. These data support the argument that the regional climate was warmer than indicated by the vegetation alone, although certain microenvironments (*e.g.* adjacent to proglacial lakes) remained cold.

With these results, it is likely that the region was occupied by a floral assemblage with no modern analog, and paleofaunal data are interpreted with this perspective. Modern associations of specific vegetation and fauna (*e.g.* arctic fox) did not reflect the same climatic conditions in the early post-glacial as they do today. Describing the EPI environment on the basis of faunal distributions is a problematic alternative, as no modern analogs exist. Traditional interpretations of EPI subsistence strategies are also suspect, given the unique post-glacial paleoecology.

6.2 McLEOD EXCAVATIONS

Excavations at the McLeod site took place in 1975 and 1990, with the site monitored and surveyed with surface collection during the intervening years. Research at the McLeod site identified five EPI clusters. These are attributed to the Parkhill complex based on the recovery of diagnostic Barnes projectile points, and additional tools and material associated primarily or exclusively with this complex. Based on the size range of the Barnes projectile points, it is possible that these represent a later stage of the Parkhill occupation in southern Ontario.

Utilizing a standard lithic typology, both the lithic tool kit and debitage were biased towards unifacial activities, although evidence of bifacial activity was present in both forms. The tool assemblage is very rich and relatively evenly distributed, showing a high measure of heterogeneity, suggesting that the site represents a broad range of activities, rather than specialization on a limited range of tasks. It resembles more a base than logistical camp, although a very small one, implying one of low-intensity and/or short duration.

The site consists of two larger clusters and three ephemeral scatters. It is not possible to ascertain the contemporaneity of these, and so they may represent concurrent or sequential occupations, or some combination of the two. The larger clusters probably represent small, short-term base camps. The three small scatters reflect either activity locations concurrent with, and peripheral to, either of the larger clusters, or find spots not directly related to the larger clusters. In the latter case, the scale of the scatters infers transient events or locations.

6.3 INTERSITE COMPARISON

The results of the McLeod site assemblage analysis were used to complete a sample set of data from EPI sites throughout the lower Great Lakes region, with some additional data from sites in the adjacent northeast. This information was used in studying the relationship between tool assemblages, to determine whether variation in the assemblages at the site and cluster scale of analysis primarily reflects behaviour (***e.g.*** activities at a site, or site function), or results from sample error due to sample size (a function of assemblage, and site, size). Two typologies were used, to compare the results of the analysis using general and detailed tool taxonomies, in addition to the comparison of data at fine and coarse degrees of resolution, at the cluster and site scales respectively.

These analyses show a correlation between site size and tool assemblage diversity, and stronger when using the generalized tool typology. While good correlations between tool assemblage size and assemblage evenness and heterogeneity are described by Shott (1997), using a general tool typology, such associates were not observed using either typologies at fine or coarse data resolution in this analysis. Sample size does not play a significant role in accommodating variation among the tool assemblages from the sites under examination. The results on which this conclusion is based do not vary between the different complexes, although this result may be due to a predominance of Parkhill complex sites in the sample.

Additional analysis was carried out using lithic debitage data from a similar site sample, to determine the association (if any) with tool assemblages. Significant correlations were observed: site assemblages dominated by bifacial tools have correspondingly high proportions of lithic debitage related to bifacial reduction activities, and likewise for unifacial tools and flaking debris. Bifacial lithic reduction activities are over represented in lithic debitage, occurring from 20% to 30% higher than percentages of biface tools in the same assemblage, while uniface tools are conversely under represented by uniface reduction debris in similar proportions. As predicted by this pattern, sites dominated by biface tools have the highest tool:debitage ratio, while mainly uniface tool sites show the lowest ratios between tools and debitage. Plotting proportions of biface tools in the tool kit versus the percentage of debitage in the entire lithic assemblage, three clusters were identified: biface focused sites; uniface focused sites, and 'quarry' sites. Quarry sites, identified as such in reports, or inferred by being <30km from bedrock chert sources, yield a high proportion of lithic debitage, but show less dominance by biface tools in the assemblage. They have large amounts of debris because unlike the other site classes, primary stages of manufacture (core reduction and tool blank production) are represented.

The comparative intersite analyses carried out in this paper conclude that site activities are indicated by the tool assemblage recovered, supported by evidence from tool and lithic debitage assemblages. Sample size plays a lesser role than suggested by Shott. In addition, biface activities are over represented in lithic debitage, and uniface activities are under represented. Three generic categories of sites were identified. Sites with high proportions of bifaces among tools have very high tool:debitage ratios, while sites with high percentages of uniface tools display low tools to debitage ratios. Sites which have higher proportions of uniface tools and high tool:debitage ratios are quarry sites. Some overlap is observed in this patterning with the data sample used, but the predictive nature of this model provides fodder for further testing.

6.4 McLEOD SITE SYNTHESIS

The McLeod site fits into the above patterns as a uniface dominated site, but not to the exclusion of either biface tools or debitage. It falls within the Parkhill complex of the EPI horizon in southern Ontario. As discussed, it may represent a later stage of the Parkhill complex, based on the small size of the Barnes projectile points recovered at the site. It would, therefore, be later than the surrounding Parkhill complex sites, including Thedford II and Parkhill.

The probable vegetation backdrop for this occupation is one of spruce-parkland closing into forest. Fossil *Coleoptera* recovered from the pollen site close to the McLeod site indicate a temperate microenvironment, inferring the locale is not impacted by the cold pro-glacial Main Lake Algonquin/Ardtrea nearby. Unlike most of the surrounding EPI sites, it is not oriented towards a strand-line focus ***per se***, the nearest of which is ***ca***. 1km distant. The small site may be focused on Ptsebe Creek, at the time an estuary of Main Lake Algonquin/Ardtrea terminating at or just downstream from McLeod, and whatever resources or utility this might yield. It does not appear to be a likely contender for caribou interception, herding or otherwise.

The richness of the site tool assemblage likewise represents a diverse range of activities, and implies a generalized site function, also reflected in the lithic debitage. The richness is unusual for such a small site, which can be interpreted as meaning that this is a unique site among the EPI phase in southern Ontario, or that this is a type of site which is not yet established within the sample of sites excavated. The conclusion drawn here is that this is not an inherently unusual site, but instead that it represents a very small base camp, either occupied once by two small groups concurrently, or twice, each by a single small group, sequentially. Whether there remains a subset of small EPI base camps to be identified by future research is unknown, but testable.

It is argued by Ellis and Deller (n.d.:81-82) that small sites may represent basic or single activity sets, and that larger sites represent palimpsest of these smaller 'basic activity units'. It is somewhat difficult to reconcile this with the diversity of activities represented at the McLeod site, the measure of which is reduced by the combination of the two main grid areas (AB with C). The overlap in toolkits between these two aggregations means that the tool assemblages are proportionally even more diverse when considered separately, but that some activities are common between them.

This appears to work in the opposite direction of the argument above by Ellis and Deller (n.d.), unless the McLeod site comprises a palimpsest of truly minimalist basic activity units. Culloden Acres Area A, for example, is suggested as a short-term occupation (n.d.:79) basic activity unit (n.d.:81), similar to McLeod site with a predominance of uniface tools, including trianguloid end scrapers, retouched/ denticulated flakes, gravers and a pièces esquillées. However, Culloden A has yielded nearly twice as many tools and fragments as the McLeod site (65 ***vs***. 36), and approximately four times as many debitage artifacts (388 ***vs***. 95), while the McLeod site comprises more than twice as many tool types (16 at McLeod, ***vs***. 7 at Culloden Acres Area A). The McLeod site tool assemblage character contrasts sharply with other small sites in a similar fashion.

It is this difference between the McLeod site and other reported small sites that seems most significant. Other small EPI sites at which excavations have been carried out (***e.g.*** Culloden Acres A, Bolton, Halstead, Murphy, Sandy Ridge) have less rich tool assemblages, reflecting more limited ranges of activities, whether described as locations or small base camps. It is the author's opinion that the McLeod site is unique, but that similar small, multi-functional sites do exist, remaining to be identified through additional survey of new sites, or through excavation of known small sites. It remains to be seen whether the McLeod site retains its unique character or is joined in the sample of known or excavated EPI sites by ones of a similar nature.

REFERENCES

Anderson, T.W. "Late Quaternary Pollen Stratigraphy of the Ottawa Valley-Lake Ontario Region and its Application in Dating the Champlain Sea." The Late Quaternary Development of the Champlain Sea Basin. Ed. Nelson R. Gadd. Vol. 35. Special Paper. Ottawa: Geological Association of Canada, 1988. 207-224.

Anderson, T.W. "Postglacial Vegetative Changes in the Lake Huron-Lake Simcoe District, Ontario with Special Reference to Glacial Lake Algonquin." Ph.D. University of Waterloo, 1971.

Anderson, T.W. "Terrestrial Environment and Age of the Champlain Sea based on Pollen Stratigraphy of the Ottawa Valley-Lake Ontario Region." Quaternary Geology of the Ottawa Region, Ontario and Quebec. Ed. R.J. Fulton. Vol. 86-23. Paper. Ottawa: Geological Survey of Canada, 1987. 31-47.

Anonymous. "Code of Stratigraphic Nomenclature - American Commission on Stratigraphic Nomenclature." Bulletin of the American Association of Petroleum Geologists 45.5 (1961): 645-665.

Ashworth, Allan C. "A Late Wisconsinan *Coleopterous* Assemblage from Southern Ontario and its Environmental Significance." Canadian Journal of Earth Science 14 (1977): 1625-1634.

Bailey, Robert E., and Phyllis J. Ahearn. "A Late- and Post-glacial Pollen Record from Chippewa Bog, Papeer Co., MI: Further Examination of White Pine and Beech Immigration into the Central Great Lakes Region." Geobotany II. Ed. Robert C. Romans. New York: Plenum, 1981. 53-74.

Ball, B.F., and P.T. Bobrowsky. "Cost Effectiveness and Time Management Evaluation of Intensive Recovery Techniques." Canadian Journal of Archaeology .11 (1987): 75-97.

Bennett, K.D. "Holocene History of Forest Trees in Southern Ontario." Canadian Journal of Botany 65 (1987): 1792-1801.

Bennett, K.D. "Holocene History of Forest Trees on the Bruce Peninsula, Southern Ontario." Canadian Journal of Botany 70 (1992): 6-18.

Binford, Lewis R. "Willow Smoke and Dogs' Tails: Hunter-Gatherer Settlement Systems and Archaeological Site Formation." American Antiquity 45 (1980): 4-20.

Bird, Ralph D. Ecology of the Aspen Parkland of Western Canada in Relation to Land Use. Contribution No. 27. Vol. 1066. Ottawa: Research Branch, Canada Department of Agriculture, 1961.

Bobrowski, P.T., and B.F. Ball. "The Theory and Mechanics of Ecological Diversity in Archaeology." Quantifying Diversity in Archaeology. Eds. R. Leonard and G. Jones. Cambridge, England: Cambridge University Press, 1989. 4-12.

Boyko, M. "The Fossil Pollen Record of European and Indian Man in Southern Ontario." Arch Notes 73.1 (1973): 11-12.

Burden, E., and J.H. McAndrews. "A Vegetational and Geological History of Methodist Point Park Preserve." Trans. . Toronto: Ontario Ministry of Natural Resources, 1973.

Calkin, Parker E., and John H. McAndrews. "Geology and Paleontology of two late Wisconsin sites in western New York State." Geological Survey of America, Part I 91 (1980): 295-306.

Campbell, Daniel R., Hamish C. Duthie, and Barry G. Warner. "Post-glacial Development of a Kettle-hole Peatland in Southern Ontario." Ecoscience 4.3 (1997): 404-418.

Campbell, Ian D. "Bison Extirpation May Have Caused Aspen Expansion in Western Canada." Ecology 17.4 (1994): 360-362.

Chapman, L.J., and D.F. Putnam. The Physiography of Southern Ontario. Ontario Geological Survey Special Volume. Third ed. Vol. 2, 1984.

Cleland, C.E. The Prehistoric Animal Ecology and Ethnozoology of the Upper Great Lakes Region. University of Michigan, Museum of Anthropology, Anthropological Papers. Vol. 29, 1966.

Collins, M. "Lithic Technology as a Means of Processual Influence." Lithic Technology: Making and Using Stone Tools. Ed. E. Swanson. The Hague: Mouton, 1975. 15-34.

Cooper, A.J. "Quaternary Geology of the Grand Bend-Parkhill Area, Southern Ontario." Trans. Ontario Geological Survey, 1979.

Cotter, James F.P., and G.H. Crowl. "The Paleolimnology of Rose Lake, Potter Co., Pennsylvania: A Comparison of Palynologic and Paleo-pigment Studies." Geobotany II. Ed. Robert C. Romans. New York: Plenum, 1981. 91-116.

Curran, Mary Lou. "Paleoindians in the Northeast: The Problem of Dating Fluted Point Sites." The Review of Archaeology 17.1 (1996): 2-11.

Custer, Jay F., and R. Michael Stewart. "Environment, Analogy, and Early Paleoindian Economies in Northeastern North America." Early Paleoindian Economies of Eastern North America. Eds. Kenneth B. Tankersley and Barry L. Isaac. Vol. 5. Greenwich: JAI Press, 1990. 303-322.

Davis, M.B. "Holocene Vegetational History of the Eastern United States." Late Quaternary Environments of the United Sates: The Holocene. Ed. H.E. Wright-Jr. Vol. 2. Minneapolis: University of Minnesota Press, 1983. 166-181.

Davis, M.B., K.D. Woods, and S.L. Webb
R.P. Futyma "Dispersal versus Climate: Expansion of *Fagus* and *Tsuga* into the Upper Great Lakes Region." Vegetatio 67 (1986): 93-103.

Davis, S.A. "Two Concentrations of Palaeo-Indian Occupation in the Far Northeast." Revista de Arqueological Americana .3 (1991): 31-56.

Deller, D.B. "Interpretation of Chert Type Variation in Paleoindian Industries, Southwestern Ontario." Eastern Paleoindian Lithic Resource Use. Eds. C.J. Ellis and J.C. Lothrop. Boulder: Westview Press, 1989. 191-220.

Deller, D.B. "Paleo-Indian Location on Late Pleistocene Strandlines, Middlesex County, Ontario." Ontario Archaeology .26 (1976): 3-19.

Deller, D. Brian. "Palaeo-Indian Reconnaissance in the Counties of Lambton and Middlesex, Ontario." Ontario Archaeology 32 (1979): 3-20.

Deller, D. Brian. "The Paleo-Indian Occupation of Southwestern Ontario: Distribution, Technology, and Social Organization." Ph.D. McGill University, 1988.

Deller, D.B., and C.J. Ellis. "Archaeological Investigations at Thedford II, Crowfield and other Paleo-Indian Sites in Southwestern Ontario." (1982).

Deller, D. Brian, and C.J. Ellis. "Crowfield: A Preliminary Report on a Probable Paleo-Indian Cremation in Southwestern Ontario." Archaeology of Eastern North America 12 (1984): 41-71.

Deller, D. Brian, and C.J. Ellis. "The Bolton Site (AfHj-89): A Crowfield Phase Early Paleo-Indian Site in Southwestern Ontario." Ontario Archaeology 61 (1996): 1-36.

Deller, D. Brian, and C. J. Ellis. "Early Palaeo-Indian complexes in southwestern Ontario." Late Pleistocene and Early Holocene Paleoecology and Archeology of the Eastern Great Lakes Region. Ed. N.G. Miller and D.W. Steadman R.S. Laub. Vol. 33. Bulletin of the Buffalo Society of Natural Sciences. Buffalo: Buffalo Society of Natural Sciences, 1988. 251-263.

Deller, D. Brian, and C.J. Ellis. "A Late Paleoindian Ceremonial Tool Cache from the Caradoc Site (AfHj-104) in Southwestern Ontario." Annual Archaeological Report for Ontario, New Series 9 (1999 in press).

Deller, D.B., and C.J. Ellis. Thedford II: A Paleo-Indian Site in the Ausable River Watershed of Southwestern Ontario. Memoirs. Vol. 24. Ann Arbor: Museum of Anthropology, University of Michigan, 1992a.

Deller, D.B., and C.J. Ellis. "The Early Paleo-Indian Parkhill Phase in Southwestern Ontario." Man in the Northeast 44 (1992b):15-41.

Dent, Richard J., and Barbara E Kauffman. "Aboriginal Subsistence and Site Ecology as Interpreted from Microfloral and Faunal Remains." Shawnee-Minisink: A Stratified Paleoindian-Archaic Site in the Upper Delaware Valley of Pennsylvania. Ed. McNett, Jr. and W. Charles. Studies in Archaeology. Orlando: Academic Press, 1985. 55-82.

Dibb, Gordon. "Late Palaeo-Indian Settlement Patterns Along the Margins of the Simcoe Lowlands in Southcentral Ontario." M.A. Trent University, 1985.

Dincauze, Dena. Fluted Points in Eastern Forests. in From Clovis to Kostenki. Ed. Proster, Y.N. and O. Soffer. Plennum, London.

Dunnell, Robert C. "Diversity in Archaeology: A Group of Measures in Search of Application?" Quantifying Diversity in Archaeology. Eds. R.D. Leonard and D.T. Jones. Cambridge: Cambridge University Press, 1989. 142-149.

Edwards, T.W.D., and J.H. McAndrews. "Paleohydrology of a Canadian Shield lake inferred from ^{18}O in sediment cellulose." Canadian Journal of Earth Sciences .26 (1989): 1850-1859.

Eisenberg, Leonard. Paleo-Indian Settlement Patterns in the Hudson and Delaware River Drainages. Occasional Publications in Northeastern Anthropology. Eds. Howard R. Sargent and Evelyn A. Sargent. Vol. 4. Rindge, NH: Department of Anthropology, Franklin Pierce College, 1978.

Eley, B.E., and P.H. von Bitter. Cherts of Southern Ontario. Toronto: Royal Ontario Museum, 1989.

Ellis, C.J. "Analysis of Lithic Debitage from Fluted Point Sites in Ontario." M.A. McMaster, 1979.

Ellis, C.J. "Paleo-Indian Lithic Technological Structure and Organization in the Lower Great Lakes Area: A First Approximation." Ph.D. Simon Fraser University, 1984.

Ellis, C.J. "The Explanation of Northeastern Paleoindian Lithic Procurement Patterns." Eastern Paleoindian Lithic Resource Use. Eds. C.J. Ellis and J.C. Lothrop. Boulder: Westview Press, 1989. 139-164.

Ellis, C.J. "Miniature Early Paleo-Indian Stone Artifacts from the Parkhill Site, Ontario." North American Archaeologist 15.3 (1994): 253-267.

Ellis, C.J., An Early Paleo-Indian Site near Parkhill, Ontario, in prep.

Ellis, C.J., and D. Brian Deller. "Culloden Acres (AfHj-90) and the Small Early Paleo-Indian Site Record of Southwestern Ontario." (n.d.): ca. 150.

Ellis, C. J., and D. Brian Deller. "Post-Glacial Lake Nipissing waterworn assemblages from the southeastern Huron Basin area." Ontario Archaeology .45 (1986): 39-60.

Ellis, C. J., and D. Brian Deller. "Some Distinctive Paleo-Indian Tool Types from the Lower Great Lakes Region." Midcontinental Journal of Archaeology 18.2 (1988): 111-158.

Ellis, C. J., and Brian Deller. "Variability in the Archaeological Record of Northeastern Paleoindians: A View from Southern Ontario." Archaeology of Eastern North America 25 (1997): 1-30.

Ellis, C. J., A. C. Goodyear, D. F. Morse and K. B. Tankersley "Archaeology of the Pleistocene-Holocene Transition in Eastern North America." Quaternary International 49/50 (1998): 151-166.

Eschman, Donald F., and Paul F. Karrow. "Huron Basin Glacial Lakes: A Review." Quaternary Evolution of the Great Lakes. Eds. P.F. Karrow and P.E. Calkin. Vol. Special Paper 30: Geological Association of Canada, 1985. 79-93.

Fedje, Daryl W., James M. White, Michael C. Wilson, D. Erle Nelson, John S. Vogel, and John R. Southon "Vermillion Lakes Site: Adaptations and Environments in the Canadian Rockies during the latest Pleistocene and early Holocene." American Antiquity 60.1 (1995): 81-108.

Fitzgerald, W.D. "Postglacial History of the Minesing Basin, Ontario." Quaternary Evolution of the Great Lakes. Eds. P.F. Karrow and P.E. Calkin. Vol. Special Paper 30: Geological Association of Canada, 1985. 133-146.

Frison, George C. "A Functional Analysis of Certain Chipped Stone Tools." American Antiquity 33.2 (1968): 149-155.

Frison, George C, and Bruce A. Bradley. Folsom Tools and Technology at the Hanson Site, Wyoming. Albuquerque: University of New Mexico Press, 1980.

Fritz, P., A.V. Morgan, U. Eicher, and J.H. McAndrews "Stable Isotope, Fossil *Coleoptera* and Pollen Stratigraphy in Late Quaternary Sediments from Ontario and New York State." Paleogeography, Paleoclimatology, Paleoecology 58 (1987): 183-202.

Fuller, Janice L. "Holocene Forest Dynamics in Southern Ontario, Canada: Fine Resolution Pollen Data." Canadian Journal of Botany 75 (1997): 1714-1727.

Funk, R.E., and D.W. Steadman. Archaeological and Paleoenvironmental Investigation in the Dutchess Quarry Caves, Orange County, New York. Buffalo: Persimmon Press, 1994.

Funk, R.E., and B. Wellman. "The Coritaipe Site: A Small Isolated Paleo-Indian Camp in the Upper Mohawk Valley." Archaeology of Eastern North America 12 (1984): 72-80.

Gaudreau, Denise C. "The Distribution of Late Quaternary Forest Regions in the Northeast: Pollen Data, Physiography, and the Prehistoric Record." Holocene Human Ecology in Northeastern North America. Ed. George P. Nicholas. Interdisciplinary Contributions to Archaeology. New York: Plenum Press, 1988. 215-256.

Gerrard, R.H. "Beyond Crossmends: Stratigraphic Analysis and the Content of Historical Artefact Assemblages in Urban Sites." Practices of Archaeological Stratigraphy. Eds. E. Harris, M. Brown and G. Brown. London, England: Academic Press, 1993. 229-249.

Gilliam, J.A., R.O. Kapp, and R.D. Bogue. "A post-Wisconsin pollen sequence from Vestaburg Bog, Montcalm County, Michigan." Papers of the Michigan Academy of Science, Arts, and Letters .52 (1967): 3-17.

Gold, Mici. "Vegetation and Vegetation History of Arrowhead Provincial Park and their Interpretation for a Recreational Public." M.M. University of Toronto, 1977.

Gordon, D.L. "Prehistoric Occupations at Temagami" Temagami: A Debate on Wilderness. Eds. Matt Bray and Ashley Thomson. Toronto: Dundurn Press, 1990. 153-183.

Gordon, D.L., and J.H. McAndrews. "Field testing a model of paleohydrology for prehistoric site prediction at Lake Temagami, northeastern Ontario." Annual Archaeological Report, Ontario (new series) .3 (1992): 80-86.

Gramly, Richard. The Adkins Site: A Palaeo-Indian Habitation and Associated Stone Structure. Monographs in Archaeology. Ed. Richard Gramly. Buffalo: Persimmon Press, 1988.

Gramly, Richard Michael. "Kill Sites, Killing Ground and Fluted Points at the Vail Site." Archaeology of Eastern North America 12 (1984): 110-121.

Gramly, Richard Michael. The Vail Site: a Palaeo-Indian Encampment in Maine. Bulletin of the Buffalo Society of Natural Sciences. Vol. 30. Buffalo, New York, 1982.

Gramly, Richard, and Robert Funk. "What is Known and Not Known about the Human Occupation of the Northeastern United States Until About 10,000 B.P." Archaeology of Eastern North America 18:5-32 (1990).

Gramly, Richard Michael, and Jonathon Lothrop. "Archaeological Investigations at the Potts Site, Oswego County, New York, 1982 and 1983." Archaeology of Eastern North America 12 (1984): 122-157.

Grayson, Donald K., and Stephen C. Cole. "Stone Tool Assemblage Richness during the Middle and Early Upper Paleolithic in France." Journal of Archaeological Science 25:927-938 (1998).

Haynes, C. Vance, D.J. Donahue, J.T. Jull, and T.H. Zabel "Application of Accelerator Dating to Fluted Point Paleo-Indian Sites." Archaeology of Eastern North America 12 (1984): 184-191.

Holling, C.S. Resilience and Stability of Ecological Systems. Laxenburg, Austria: Schloss Laxenburg, 1973.

Hyland, D.C., J.M. Tersak, J.M. Adovasio, and M.I. Siegel "Identification of the Species of Origin of Residual Blood on Lithic Material." American Antiquity 55.1 (1990): 104-112.

Jackson, Lawrence J. "Caribou Range and Early Paleo-Indian Settlement Disposition in Southern Ontario, Canada." Caribou and Reindeer Hunters of the Northern Hemisphere. Eds. Lawrence J. Jackson and Paul T. Thacker. Worldwide Archaeology Series. Aldershot: Avebury, 1997. 132-164.

Jackson, Lawrence J. "Fossil Cervids and Fluted Point Hunters: A Review for Southern Ontario." Ontario Archaeology 48 (1988): 27-41.

Jackson, Lawrence J. "Interior Paleoindian Settlement Strategies: A First Approximation for the Lower Great Lakes." Early Paleoindian Economies of Eastern North America. Eds. Kenneth B. Tankersley and Barry L. Isaac. Vol. 5. Greenwich: JAI Press, 1990. 95-142.

Jackson, Lawrence L. "Gainey Phase Occupation in the Southern Rice Lake Region,, Canada." Ph.D. Southern Methodist University, 1994.

Jackson, Lawrence J. "Some Late Palaeo-Indian Sites in the Rice Lake Region, South-Central Ontario." The Ottawa Archaeologist 22.2 (1995): 2-7.

Jackson, Lawrence J. "Murphy: An Early Palaeo-Indian Gainey Phase Site in Southwestern Ontario." Ontario Archaeology 62 (1996): 10-38.

Jackson, Lawrence J., C. J. Ellis, A. V. Morgan and J. H. McAndrews. Geomorphology, Geochronology and Eastern Great Lakes Palaeo-Indians: Crossing the Space/Time Barriers. Paper presented at the annual meeting of the SAA, Minneapolis, 1995.

Jackson, Lawrence, and Heather McKillop. "Approaches to Palaeo-Indian Economy: An Ontario and Great Lakes Perspective." Mid-Continental Journal of Archaeology 16.1 (1991): 34-68.

Jacobson, George L., and Eric C. Grimm. "Synchrony of Rapid Change in Late-Glacial Vegetation South of the Laurentide Ice Sheet." Late Pleistocene and Early Holocene Paleoecology and Archaeology of the Eastern Great Lakes Region. Eds. R.S. Laub, N.G. Miller and D.W. Steadman. Vol. 33. Bulletin of the Buffalo Society of Natural Sciences. Buffalo: Buffalo Society of Natural Sciences, 1988. 31-38.

Janusas, Scarlett Emilie. A Petrological Analysis of Kettle Point Chert. Mercury Series Paper. Vol. 128. Ottawa: Archaeological Survey of Canada, National Museum of Man, 1984.

Judge, W. James. Paleoindian Occupation of the Central Rio Grande Valley in New Mexico. Albuquerque: University of New Mexico Press, 1973.

Julig, Patrick J., and J.H. McAndrews. "Les Cultures Paleoindiennes dan la Region de Grands Lacs en Amerique du nord: Contextes Paleoclimatique, Geomorphologiques et Stratigraphiques." L'Anthropologie (Paris) 97.4 (1993): 623-650.

Justice, Noel D. Stone Age Spear and Arrow Points of the Midcontinental and Eastern United States: A Modern Survey and Reference. Bloomington: Indiana University Press, 1987.

Karrow, P.F. Quaternary Geology of the Hamilton-Cambridge Area, Southern Ontario. Ontario Geological Survey. Vol. 255. Toronto, 1987.

Karrow, P.F. "Quaternary Stratigraphy and History, Great Lakes-St. Lawrence Region." Quaternary Stratigraphy of Canada: Canadian Contribution to IGCP Project 24. Ed. R.J. Fulton. Vol. 84-10. Geological Survey of Canada Paper, 1984. 137-153.

Karrow, P.F., T.W. Anderson, A.H. Clarke, L.D. Delorme, and M.R. Sreenivasa "Stratigraphy, Paleontology, and Age of Lake Algonquin Sediments in Southwestern Ontario, Canada." Quaternary Research 5 (1975): 49-87.

Karrow, P.F., and B.G. Warner. "The Geological and Biological Environment for Human Occupation in Southern Ontario." The Archaeology of Southern Ontario to A.D. 1650. Eds. C.J. Ellis and Neal Ferris. Vol. 5. Occasional Publications of the London Chapter, OAS. London: London Chapter, OAS, 1990. 5-35.

Karrow, P.F., and B.G. Warner. "Ice, Lakes and Plants, 13,000 to 10,000 B.P.: The Erie-Ontario Lobe in Ontario." Late Pleistocene and Early Holocene Paleoecology and Archaeology of the Eastern Great Lakes Region. Eds. R.S. Laub, N.G. Miller and D.W. Steadman. Vol. 33. Bulletin of the Buffalo Society of Natural Sciences, 1988. 39-52.

Kaszycki, C.A. "History of Glacial Lake Algonquin in the Haliburton Region, South-Central Ontario." Quaternary Evolution of the Great Lakes. Eds. P.F. Karrow and P.E. Calkin. Vol. 30. Special Paper. St. John's: Geological Association of Canada, 1985. 109-123.

Kaufman, Daniel. "Measuring Archaeological Diversity: An Application of the Jackknife Technique." American Antiquity 63.1 (1998): 73-85.

Kelly, Robert L., and Lawrence C. Todd. "Coming into the Country: Early Paleoindian Hunting and Mobility." American Antiquity 53.2 (1988): 231-244.

Kerfoot, W.C. "Net accumulation rates and the history of cladoceran communities." Ecology .55 (1974): 51-61.

Levine, Mary Ann. "The Tyranny Continues: Ethnographic Analogy and Eastern Paleo-Indians." Caribou and Reindeer Hunters of the Northern Hemisphere. Eds. Lawrence J. Jackson and Paul T. Thacker. Worldwide Archaeology Series. Aldershot: Avebury, 1997. 221-244.

Lewis, C.F.M., and T.W. Anderson. "Oscillations of Levels and Cool Phases of the Laurentian Great Lakes caused by Inflows from Glacial Lakes Agassiz and Barlow-Ojibway." Journal of Paleolimnology 2 (1989): 99-146.

Liu, Kam-Biu. "Holocene Paleoecology of the Boreal Forest and Great Lakes-St. Lawrence Forest in Northern Ontario." Ecological Monographs 60.2 (1990): 179-212.

Liu, Kam-Biu. "The Palynology of Varved Sediments: An Example from Loon Lake, Ontario." M.Sc. University of Toronto, 1978.

Liu, Kam-Biu. "Postglacial Vegetational History of Northern Ontario: A Palynological Study." Ph.D. University of Toronto, 1982.

Lothrop, J.C. The Organization of Paleo-Indian Lithic Technology at the Potts Site. Department of Anthropology, State University of New York, Binghampton. Ann Arbor: University Microfilms, 1988.

Lotter, Andre F. "Absolute Dating of the Late-Glacial Period in Switzerland Using Annually Laminated Sediments." Quaternary Research 35 (1991): 321-330.

Manny, B.A., R.G. Wetzel, and R.E. Bailey. "Paleolimnological sedimentation of organic carbon, nitrogen, phosphorous, fossil pigments, pollen, and diatoms in a hypereutrophic, hardwater lake: a case history of eutrophication." Polskie Archiwum Hydrobiologii .25 (1978): 243-267.

McAndrews, J.H. "Late Quaternary Climate of Ontario: Temperature Trends from the Fossil Pollen Record." Quaternary Paleoclimate. Ed. W.C. Mahaney. Norwich: Geoabstracts, 1981. 319-333.

McAndrews, J.H. "Late Quaternary Vegetation History of Rice Lake, Ontario, and the McIntyre Archaeological Site. in " The McIntyre Site: Archaeology, Subsistence and Environment. Ed. R.B. Johnston. Vol. Paper 126. National Museum of Man, Mercury Series. Ottawa: Archaeological Survey of Canada, 1984. 161-189.

McAndrews, J.H. "Paleoecology of the Palaeo-Indian Deavitt Site." in Late Palaeo-Indian Settlement Along the Margins of the Simcoe Lowlands in Southcentral Ontario. by G. Dibb, Department of Anthropology MA. Thesis, Trent University, Peterborough, Ontario. 1985. 240-254.

McAndrews, J.H. "Pollen Analysis of the 1973 Ice Core from Devon Island Glacier, Canada." Quaternary Research 22 (1973): 68-76.

Alice Telka, ed. McAndrews, J.H., and I.D. Campbell. 6 ka Mean July Temperature in Eastern Canada from Bartlein and Webb's (1985) Pollen Transfer Functions: Comments and Illustrations: Royal Society of Canada, 1993. 22-25.

McAndrews, J.H., and L.J. Jackson. "Age and Environment of Late Pleistocene Mastodont and Mammoth in Southern Ontario." Late Pleistocene and Early Holocene Paleoecology and Archeology of the Eastern Great Lakes Region. Ed. N.G. Miller and D.W. Steadman R.S. Laub. Vol. 33. Bulletin of the Buffalo Society of Natural Sciences. Buffalo: Buffalo Society of Natural Sciences, 1988. 161-172.

Meltzer, David J. "Late Pleistocene Human Adaptations in Eastern North America." Journal of World Prehistory 2.1 (1988): 1-52.

Meltzer, David J. "On Stone Procurement and Settlement Mobility in Eastern Fluted Point Groups." North American Archaeologist 6.1 (1984-5): 1-24.

Miller, N.G. "The Late Quaternary Hiscock Site, Genesee County, New York." Late Pleistocene and Early Holocene Paleoecology and Archaeology of the Eastern Great Lakes Region. Eds. R.S. Laub, N.G. Miller and D.W. Steadman. Vol. 33. Bulletin of the Buffalo Society of Natural Sciences, 1988. 161-172.

Miller, N.G. Late-glacial and postglacial vegetation change in southwestern New York State. Vol. Bulletin 420. Albany, New York: New York State Museum and Science Service, The State Education Department, 1973.

Moeller, Roger W. 6LF21: A Paleo-Indian Site in Western Connecticut. Vol. Occasional Paper #2. Washington, Connecticut: American Indian Archaeological Institute, 1980.

Morgan, A.V. "Late Pleistocene and Early Holocene Coleoptera in the Lower Great Lakes." Late Pleistocene and Early Holocene Paleoecology and Archaeology of the Eastern Great Lakes Region. Eds. R.S. Laub, N.G. Miller and D.W. Steadman. Vol. 33. Bulletin of the Buffalo Society of Natural Sciences. Buffalo: Buffalo Society of Natural Sciences, 1988. 195-206.

Morgan, A.V. "Late Wisconsin Ice-wedge Polygons near Kitchener, Ontario, Canada." Canadian Journal of Earth Sciences 9.9 (1972): 607-617.

Morgan, A.V., J.H. McAndrews, and C.J. Ellis. "Geological History and Paleoenvironment." An Early Paleo-Indian Site near Parkhill, Ontario. Ed. C.J. Ellis, in prep.

Morgan, A. V., Randall F. Miller, and Anne Morgan. Paleoenvironmental Reconstruction of Southwestern Ontario Between 11,000 and 10,000 B.P. using Fossil Insects as Indicators. Proceedings of the 3rd International Paleontological Convention 1982. 381-386.

Morgan, Alan V., and Anne Morgan. "Faunal Assemblages and Distribution Shifts of *Coleoptera* During the Late Pleistocene in Canada and the Northern United States." The Canadian Entomologist 112 (1980): 1105-1128.

Morris, T.F., J.H. McAndrews, and K. Seymour. "Glacial Lake Arkona-Whittlesley transition near Leamington, Ontario: geology, plant and muskox fossils." Canadian Journal of Earth Sciences 30 (1994): 2436-2447.

Mott, R.J., and M. Camfield. Palynological Studies in the Ottawa Area. Geological Survey of Canada. Paper 69-38. Ottawa, 1969.

Mott, R.J., and L.D. Farley-Gill. "A Late-Quaternary Pollen Profile from Woodstock, Ontario." Canadian Journal of Earth Science 15 (1978): 1101-1111.

Mott, R.J., and L.D. Farley-Gill. Two Late Quaternary Pollen Profiles in Gatineau Park, Quebec Geological Survey of Canada Paper 69-38. Ottawa, 1981.

Muller, J. "A Late Archaic "Smallpoint" Component at the Welke-Tonkonoh Site, Ontario (AfHj-5)." Honours B.A. Thesis, Department of Anthropology, University of Waterloo, Waterloo, Ontario, 1988.

Muller, J. "The McLeod Site: a small Paleo-Indian occupation in southwestern Ontario (conducted under licence # 90-051)." Ontario Archaeological Licence Report on file . Toronto: Ministry of Citizenship, Culture and Recreation, 1996.

Muller, J. "Preliminary Report on the McLeod Site: a small Paleo-Indian occupation in southwestern Ontario (conducted under licence # 90-051)." Trans. Toronto: Ontario Heritage Foundation, 1995.

Muller, J. Tool Typologies and Site Function in the Paleo-Indian Horizon: A comparative examination. Paper presented at the 31st annual meeting of the CAA, Victoria, B.C., 1998.

Nagle, Christopher L. "Comments." Current Anthropology 30.3 (1989): 305-306.

Ogden-III, J.G. "Correlation of contemporary and Late Pleistocene pollen records in the reconstruction of postglacial environments in northeastern North America." Mitt. Internat. Verein. Limnol .17 (1969): :64-77.

Ogden-III, J.G. "Radiocarbon and Pollen Evidence for a Sudden Change in Climate in the Great Lakes Region Approximately 10,000 Years Ago." Quaternary Paleoecology. Eds. E.J. Cushing and H.E. Wright. New Haven: Yale University Press, 1967. 117-127.

Overpeck, J.T. "A pollen study of a late Quaternary peat bog, south-central Adirondack Mountains, New York." Geological Society of America Bulletin .96 (1985): 145-154.

Parkins, W. "Onondaga Chert: Geological and Palynological Studies as Applied to Archaeology." M.Sc. Brock University, 1977.

Pavlish, L.A., and P.J. Sheppard. "Thermoluminescent Determination of Paleoindian Heat Treatment in Ontario, Canada." American Antiquity 48.4 (1983): 793-799.

Payne, J.A. "The Western Basin Paleo-Indian and Archaic Sequences." B.A. University of Toledo, 1982.

Penney, R.A. "A Pollen Record from Pike Lake, Wellington County, Ontario." M.Sc. University of Toronto, 1979.

Pennington, Winnifred. "Lags in Adjustment of Vegetation to Climate Caused by the Pace of Soil Development: Evidence from Britain." Vegetatio 67 (1986): 105-118.

Pilny, J.J., A.V. Morgan, and A. Morgan. "Paleoclimatic implications of a Late Wisconsinan insect assemblage from Rostock, southwestern Ontario." Canadian Journal of Earth Sciences .24 (1987): 617-630.

Plog, Stephen, and Michelle Hegmon. "An Anthropological Perspective on the Sample Size-Richness Relation: A response to Leonard." American Antiquity 62.4 (1997): 717-718.

Prevec, R. "The Udora Site (BbGt-4) Faunal Report." Report on file. Department of New World Archaeology, ROM, Toronto, 1987.

Richard, Pierre. "Histoire Postglaciaire de la Vegetation au sud du Lac Abitibi, Ontario et Quebec." Geographie physique et Quaternaire 34 (1980): 77-94.

Richard, P.J.H. "Histoire post-wisconsinienne de la végétation du Québec méridional par l'analyse pollinique." Service de la recherche, Direction générale des forêts, Ministère des Terres et Forêts du Québec. Publications et rapports divers 1,2 (1977): 312,142.

Richard, P.J.H. "Histoire tardiglaciaire et postglaciaire de la végétation au mont Shefford, Québec." Géographie physique et Quaternaire .32 (1978): 81-93.

Roberts, Arthur C.B. Preceramic Occupations Along the North Shore of Lake Ontario. Mercury Series Paper. Vol. 132. Ottawa: Archaeological Survey of Canada, National Museum of Man, 1985.

Roosa, William B. "Some Michigan Fluted Point Types and Sites." Michigan Archaeologist 9 (1965): 44-48.

Roosa, W.B. "Testing of the McLeod Site, 1975. Report on Field work carried out under Licence #75-A-0030." Ontario Archaeological Licence Report on File, Ministry of Culture and Communications, Toronto, 1975.

Roosa, William B. "Great Lakes Paleoindian: The Parkhill Site, Ontario." Amerinds and their Paleoenvironments in Northeastern North America. Eds. Walter S. Newman and Bert Salwen. Vol. 288. Annals of the New York Academy of Sciences. New York: New York Academy of Sciences, 1977a. 349-354.

Roosa, William B. "Fluted Points from the Parkhill Ontario Site." For the Director: Research Essays in Honor of James B. Griffin. Ed. C. Cleland. Vol. 61. Ann Arbor: University of Michigan Museum of Anthropology, Anthropological Papers, 1977b. 87-122.

Rowe, J.S. Forest Regions of Canada. Canadian Forestry Service Publication. Ed. Department of the Environment. Ottawa: Information Canada, 1972.

Savoie, L., and P.J.H. Richard. "Paléophytogéographie de l'épisode de Saint-Narcisse dans la région de Sainte-Agathe, Québec." Géographie physique et Quaternaire .33 (1979): 175-188.

Schwert, Donald P., T. W. Anderson, Anne Morgan, A. V. Morgan, P. F. Karrow. "Changes in Late Quaternary Vegetation and Insect Communities in Southwestern Ontario." Quaternary Research 23 (1985): 205-226.

Shane, L.C.K. "Changing palynological methods and their role in three successive interpretations of the late glacial environments at Bucyrus Bog, Ohio, USA." Boreas .18 (1989): 297-309.

Shane, L.C.K. "Late glacial vegetational and climatic history of the Allegheny Plateau and the Till Plains of Ohio and Indiana, U.S.A." Boreas .16 (1987): 1-20.

Shane, L.C.K. "Palynology and radiocarbon chronology of Battaglia Bog, Portage County, Ohio." Ohio Journal of Science .75 (1975): 96-102.

Shane, L.C.K., and K.H. Anderson. "Intensity, gradients and reversals in late glacial environmental change in East-Central North America." Quaternary Science Reviews .12 (1993): 307-320.

Shott, Michael J. The Leavitt Site: A Parkhill Phase Paleo-Indian Occupation in Central Michigan. Memoirs. Vol. 25. Ann Arbor: Museum of Anthropology, University of MICHIGAN, 1993.

Shott, Michael J. "Activity and Formation as Sources of Variation in Great Lakes Paleoindian Assemblages." Midcontinental Journal of Archaeology 22.2 (1997): 197-236.

Simons, Donald B. "The Gainey and Butler Sites as Focal Points for Caribou and People." Caribou and Reindeer Hunters of the Northern Hemisphere. Eds. Lawrence J. Jackson and Paul T. Thacker. Worldwide Archaeology Series. Glasgow, Scotland: Avebury Press, 1997. 105-131.

Simons, Donald B., Michael J. Shott, and Henry T. Wright. "The Gainey Site: Variability in a Great Lakes Paleo-Indian Assemblage." Archaeology of Eastern North America 12 (1984): 266-279.

Spear, R.W., and N.G. Miller. "A radiocarbon dated pollen diagram from the Allegheny Plateau of New York State." Journal of the Arnold Arboretum .57 (1976): 369-403.

Spiess, Arthur, Deborah Wilson, and James Bradley. "Paleoindian Occupation in the New England-Maritimes Region: Beyond Cultural Ecology." Archaeology of Eastern North America 26 (1998): 201-264.

Spiess, Arthur E., Mary Lou Curran, and John R. Grimes. "Caribou (*Rangifer Tarandus L.*) Bones from New England PaleoIndian Sites." North American Archaeologist 6.2 (1984-5): 145-159.

Sreenivasa, B.A. "Paleoecological Studies of Sunfish Lake and its Environs." Ph.D. University of Waterloo, 1973.

Stewart, A. "Inter-Area Assemblage Patterning and Site Formation." in The Fisher Site: Archaeological, Geological and Paleobotanical Studies at an Early Paleo-Indian Site in Southern Ontario. Ed .P. L. Storck. Vol. 30. Memoirs of the Museum of Anthropology, University of Michigan. Ann Arbor: University of Michigan, Royal Ontario Museum, Ontario Heritage Foundation, 1997. 163-188.

Storck, Peter L., editor A Report on the Banting and Hussey Sites: Two Palaeo-Indian Campsites in Simcoe County, Southern Ontario. Vol. No. 93. Ottawa: National Museum of Canada, 1979.

Storck, Peter L. "Palaeo-Indian Settlement Patterns Associated with the Strandline of Glacial Lake Algonquin in Southcentral Ontario." Canadian Journal of Archaeology .6 (1982): 1-31.

Storck, Peter L. "Glacial Lake Algonquin and Early Paleo-Indian Settlement Patterns in Southcentral Ontario." Archaeology of Eastern North America 12 (1984): 286-298.

Storck, Peter L. "The Late Wisconsin Ice Margin and Early Paleo-Indian Occupation in the Mid-Continent Region." Midcontinental Journal of Archaeology 13.2 (1988): 259-272.

Storck, Peter L. editor, The Fisher Site: Archaeological, Geological and Paleobotanical Studies at an Early Paleo-Indian Site in Southern Ontario, Canada. Memoirs. Vol. 30. Ann Arbor: Museum of Anthropology, University of MICHIGAN, 1997.

Storck, Peter L., and Arthur E. Spiess. "The Significance of New Faunal Identifications Attributed to an Early Paleoindian (Gainey Complex) Occupation at the Udora Site, Ontario, Canada." American Antiquity 59 (1994): 121-142.

Storck, Peter L., and John Tomenchuk. "An Early Paleoindian Cache of Informal Tools at the Udora Site, Ontario." Early Paleoindian Economies of Eastern North America. Eds. Kenneth B. Tankersley and Barry L. Isaac. Vol. 5. Greenwich: JAI Press, 1990. 45-93.

Szeicz, J.M., and G.M. MacDonald. "Postglacial Vegetation History of Oak Savanna in Southern Ontario." Canadian Journal of Botany 69 (1991): 1507-1519.

Terasmae, J. "A Discussion of Deglaciation and the Boreal Forest History in the Northern Great Lakes Region." Proceedings of the Entomological Society of Ontario 99 (1968): 31-43.

Terasmae, J. "Radiocarbon Dating and Palynology of Glacial Lake Nipissing Deposits at Wasaga Beach, Ontario." Journal of Great Lakes Research 5.3-4 (1979): 292-300.

Terasmae, J. "Some Problems of Late Wisconsin History and Geochronology in Southeastern Ontario." Canadian Journal of Earth Sciences 17 (1980): 361-381.

Terasmae, J., and T.W. Anderson. "Hypsithermal Range Extension of White Pine (*Pinus strobus* L.) in Quebec, Canada." Canadian Journal of Earth Sciences 7 (1970): 406-413.

Terasmae, J., and H.L. Matthews. "Late Wisconsin White Spruce (*Picea glauca* (Moench) Voss) at Brampton, Ontario." Canadian Journal of Earth Science 17 (1980): 1087-1095.

Thomas, D.H. "Diversity in Hunter-Gatherer Cultural Geography." Quantifying Diversity in Archaeology. Eds. R.D. Leonard and G.T. Jones. Cambridge: Cambridge University Press, 1989. 85-91.

Timmins, Peter. "Alder Creek: A Paleo-Indian Crowfield Phase Manifestation in the Region of Waterloo, Ontario." Midcontinental Journal of Archaeology 19.2 (1994): 170-197.

Tomenchuk, John, and Peter L. Storck. "Two Newly Recognized Paleoindian Tool Types: Single- and Double-Scribe Compass Gravers and Coring Gravers." American Antiquity 62.3 (1997): 508-522.

Turner, J.V., P. Fritz, P.F. Karrow, and B.G. Warner "Isotopic and Geochemical Composition of Marl Lake Waters and Implications for Radiocarbon dating of Marl Lake Sediments." Canadian Journal of Earth Sciences 20 (1983): 599-615.

Vincent, Jean-Serge. "A Palynological Study for the Little Clay Belt, Northwestern Quebec." Le Naturaliste canadien 100 (1973): 50-70.

von Bitter, P.H., and Betty E. Eley. "Fossil Hill Formation Chert at the Fisher Site: Geological Source and Significance." The Fisher Site: Archaeological, Geological and Paleobotanical Studies at an Early Paleo-Indian Site in Southern Ontario. Vol. 30. Memoirs of the Museum of Anthropology, University of Michigan. Ann Arbor: University of Michigan, Royal Ontario Museum, Ontario Heritage Foundation, 1997. 223-235.

Voss, Jerome A. "The Barnes Site: Functional and Stylistic Variability in a small Paleo-Indian Assemblage." Mid-Continental Journal of Archaeology 2.2 (1977): 253-305.

Walker, P.C., and R.T. Hartman. "The forest sequence of the Hartstown Bog area in western Pennsylvania." Ecology .41 (1960): 461-474.

Warner, B.G., Richard J. Hebda, and Brenda J. Hann. "Postglacial Paleoecological History of a Cedar Swamp, Manitoulin Island, Ontario, Canada." Palaeogeography, Palaeoclimatology, Palaeoecology 45 (1984): 301-345.

Warner, B.G., Helen J. Kubiw, and P.F. Karrow. "Origin of a Postglacial Kettle-fill Sequence near Georgetown, Ontario." Canadian Journal of Earth Science 28 (1991): 1965-1974.

Williams, A.S. Late-glacial -- postglacial vegetational history of the Pretty Lake region, northeastern Indiana. U.S. U.S. Geological Survey Professional Paper 686-B, U. Washington, D.C.: U.S. Government Printing Office, 1974.

Wilmsen, E.N. "Lithics Analysis and Cultural Inference: A Palaeo-Indian Case." University of Arizona Press, Tucson. 1970.

Winn, C.E. "Vegetational History and Geochronology of Several Sites in South Southwestern Ontario with Discussion on Mastodon Extinction in Southern Ontario." M.Sc. Brock University, 1977.

Winn, R.F. "Postglacial Paleoecology and Effect of European Settlement on the Environment of Lake Hunger and Lake Lisgar, Southwestern Ontario." M.Sc. Brock University, 1975.

Wright, H.E. "Aspects of the Early Postglacial Forest Succession in the Great Lakes Region" Ecology 45 (1964): 439-448.

Wright, Henry T., and William B. Roosa. "The Barnes Site: A Fluted Point Assemblage from the Great Lakes Region." American Antiquity 31.6 (1966): 850-860.

Yu, Zicheng. "Late Quaternary Paleoecology of the Southern Niagara Escarpment, Ontario, Canada: A Multiple Proxy Investigation of Vegetation and Climate History." Ph.D. University of Toronto, 1997.

Yu, Zicheng, and J.H. McAndrews. "Holocene Water Levels at Rice Lake, Ontario, Canada: Sediment, Pollen, and Plant-macrofossil evidence." The Holocene 4.2 (1994): 141-152.

Yu, Zicheng, J.H. McAndrews, and D. Siddiqi. "Influences of Holocene Climate and Water Levels on Vegetation Dynamics of a Lakeside Wetland." Canadian Journal of Botany 75 (1996): 1602-1615.

Plates

Plate 1
Biface Artifacts

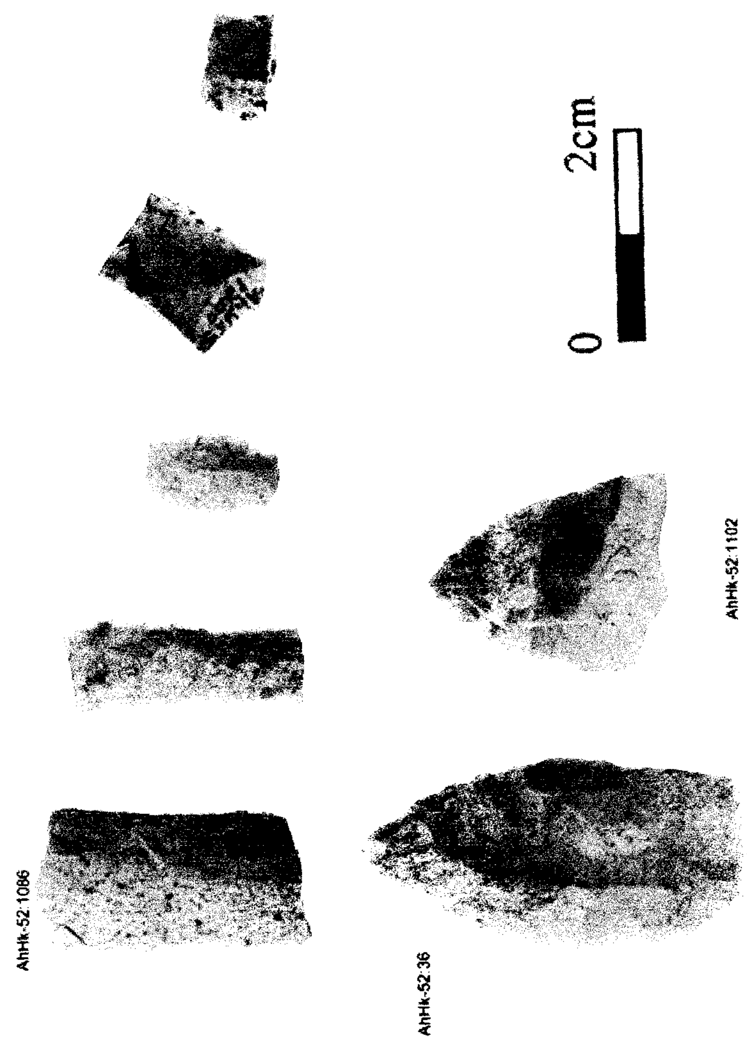


Plate 2
End Scrapers

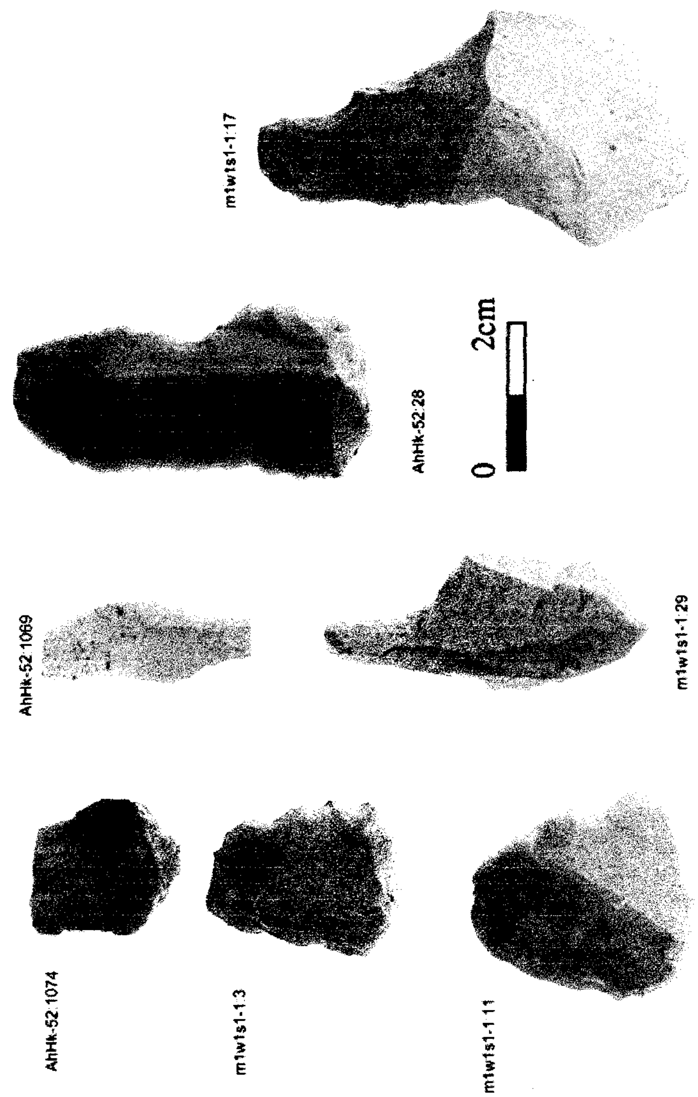
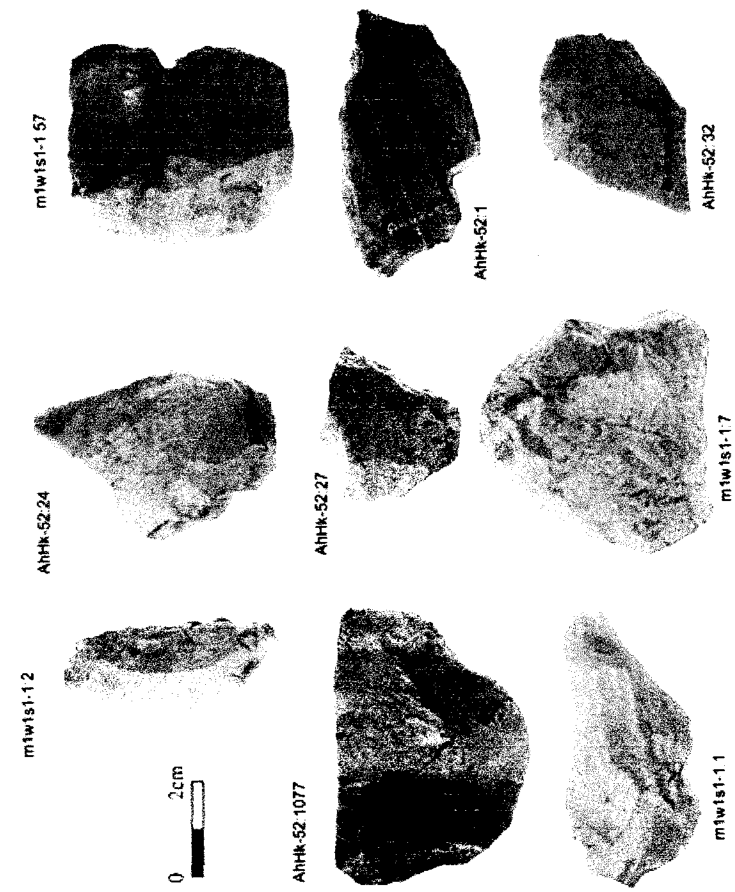


Plate 3
Side Scrapers



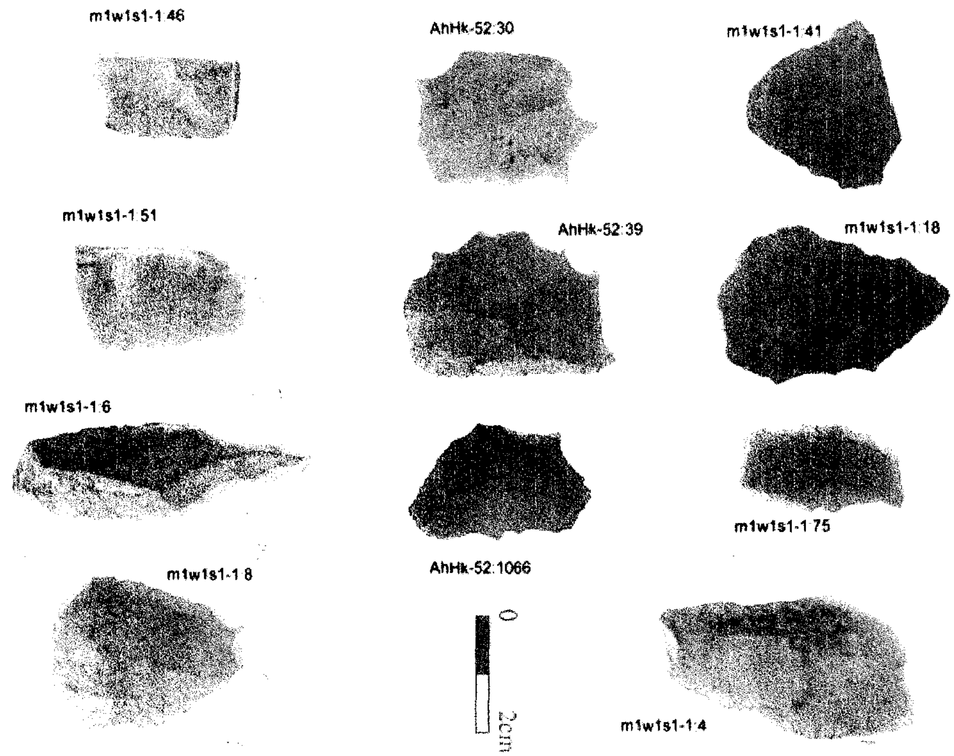


Plate 4
Miscellaneous Unifaces

Appendices

Appendix A

Pollen Site Data

Pollen Site Name	#	lat	long	grd	picea=	picea-	pinus+	pinus=	pinus-	betula+	nap-	ref
Atkins Lake	1	44.75	75.85	1		9300	11100	6800			9500	Terasmae 1980
Axe Lake	2	45.37	79.50	5	8800	8700		6300		6000	8500	Yu unpublished
Ballycroy Bog	3	43.95	79.87	1		10900	10900	10200	8600	10900	11500	Anderson 1971
Barry Lake	4	44.30	77.92	3	9800	9700	9900	8400	6050	10300	10000	McAndrews 1984
Baseball Bog	5	47.22	79.77	5	9600	9300	9400	6000		9600	9600	McAndrews unpub
Battaglia Bog core 1	6	41.13	81.32	3	15100	10100	11050					Shane 1975, Shane 1987
Bear Bog	7	47.17	80.15	5	8600	7700	10000			10000	10000	Gordon & McAndrews 1992
Belmont Bog	8	42.25	77.92	3	12300	11300	11100	10300	7400	7500	11300	Spear & Miller 1976
Bondi Site	9	42.08	82.63	7	13100							Morris et al 1994
Boyd Pond	10	44.33	75.08	3	10700	10300	9800			10400	10400	Anderson 1987
Brampton Esker Bog	11	43.72	79.80	6	12300					12000	12000	Terasmae & Matthews 1980
Brandreth Bog/Lake	12	43.92	74.68	5	10200	9800	10400	7400	6300	10200	10200	Overpeck 1985
Cataraqui River Marsh	13	45.27	76.47	3	10200							Terasmae 1980
Chippewa Bog	14	43.12	83.25	5	9600	9300	9500	9200	8300	9500		Bailey & Ahearn 1981
Colles Lake	15	43.12	80.55	5		12900	12900	10330	9800	12900	13000	Winn 1977
Cookstown Bog	16	44.22	79.62	3		10000	10400			10600	10000	Karrow et al 1975, Anderson 1971, Julig & McAndrews 1993
Copetown Bog	17	43.25	80.08	3		9300	9300	8900	8500	7900		Karrow 1987
Cornell Bog	18	42.90	80.65	3		9400	9400					Winn 1977
Cranberry Lake	19	44.10	78.10	3		10200		9100	7800	9900	9800	McAndrews unpub
Crates Lake	20	49.18	81.27	3					4700		8100	Liu 1982
Crawford Lake	21	43.47	79.95	7		9700	9600	8500	6900	9400	9800	Yu unpublished PhD
Creditview Wetland	22	43.60	79.60	3		10400	10200			10400	11000	McAndrews unpub
Crieff Kettle Bog	23	43.42	80.18	3		10800	11100	9500		12400	12000	Karrow 1987
Crystal Lake	24	41.55	80.37	6	11800	11100	12400	9600	6600	13000		Walker & Hartman 1960
Daber Lake	25	45.75	77.28	5							10900	Anderson 1987
Decoy Lake	26	43.23	80.37	7	11000	10200	10200	8600	2000	11700	10000	Szeicz & MacDonald 1991
Dows Lake Bog Site 3	27	45.40	75.70	1				9400		9000		Mott & Camfield 1969
East Twin Lake Ohio Etl2	28	41.18	81.33	5		10400	10300	9900	9000	7400	10100	Shane 1989, Shane & Anderson 1993
Edward Lake	29	44.37	80.25	3	12000	10550	10900	9000	6900	10900	10900	McAndrews 1981, Julig & McAndrews 1993
Fawn Lake	30	45.42	79.37	5	10000	9900	10100	8800			9800	Yu unpublished

Pollen Site Name	#	lat	long	grd	picea=	picea-	pinus+	pinus=	pinus-	betula+	nap-	ref
Fawn Lake	30	45.42	79.37	5	10000	9900	10100	8800			9800	Yu unpublished
Fischer-Hallman Site	31	43.43	80.55	7	11900					10500		Karrow & Warner 1988
Forest Pond	32	43.37	80.92	3		10300	11300	10300	8000	10300	10300	Winn 1977
Found Lake	33	45.80	78.63	5				8800	1200	10400	9100	Boyko & McAndrews 1973
Frains Lake	34	42.33	83.63	5	11900	10900	11900	11300	10000		14000	Kerfoot 1974
Gage Street	35	43.45	80.52	3		11000	11200	8500		11300		Schwert et al 1985
Georgetown Site	36	43.67	79.95	7	10600	8700	9200			8700	10500	Warner et al 1991
Graham Lake	37	45.18	77.35	3			9200	8200			9300	Fuller 1997
Greenbush Swamp Man 3	38	46.93	81.93	3		10500	11400	10900		11300	10300	Warner et al 1984
Hams Lake	39	43.23	80.42	3	11300	10400	10800	10000	7700	108000	10400	Bennet 1987, McAndrews & Campbell 1993, Julig & McAndrews 1993
Harrowsmith Bog	40	44.42	76.70	3	10300	10100		10400		10500		Terasmae 1968
Heart Lake ON	41	43.73	79.80	3					7800			Warner et al 1991
High Lake	42	44.52	76.60	3				9100	6900			Fuller 1997
Hiscock Site	43	43.08	78.08	7			8700			8700		Miller 1988
Hope Bay	44	44.92	81.12	3		8800	9900				8800	Lewis & Anderson 1989
Houghton Bog A+B	45	42.53	78.67	3	11900	11000	11000	10900	10800	11100	11000	Miller 1973
Inglesby Lake	46	44.48	77.05	1	10300	9800		10500		9300		Fritz et al 1987
Jack Lake	47	47.32	81.77	5	10400	10000				10900	10900	Liu 1990
Kincardine Bog	48	44.13	81.65	7	11300	8800	10800	8500	7120	9800	11400	Karrow et al 1975, Anderson 1971
Lac Bastien	49	46.40	78.92	5	9500	8900	9500	6500		9500	9500	Bennet 1992?, 1987
Lac Castor	50	46.60	72.98	5			8700	6500			9400	Richard unpub
Lac Clo	51	48.50	79.35	3					8300		8400	Richard 1980
Lac Geai	52	45.98	73.98	5			8800	6900	6100		9500	Richard unpub
Lac Louis	53	47.28	79.12	3	8400	8300	8500	7500			8300	Vincent 1973
Lac Yelle	54	48.50	79.63	3		9000				9000		Richard 1980
Lac a Sam	55	46.65	72.97	5			8400	6700	3000			Richard unpub
Lac a St-Germain	56	45.93	74.37	5			9400	8000	5500	10500	10400	Savoie & Richard 1979
Lac aux Quenoilles	57	46.17	74.38	3			9100	8000	6600	11000	10400	Savoie & Richard 1979
Lake Erie 1244	58	41.87	82.77	6			11300					Lewis & Anderson 1989
Lake Erie 68-6	59	41.92	82.75	3	11500	10700	11700	9000	6000	5900	10200	Lewis & Anderson 1989

Pollen Site Name	#	lat	long	grd	picea=	picea-	pinus+	pinus=	pinus-	betula+	nap-	ref
Lake Hunger	60	42.97	80.47	3	15200	11200	11200	9800	7400	10700	12480	Winn 1977, Winn 1975
Lake Medad	61	43.42	79.92	5				10300	9600			Karrow 1987
Lake QC	62	46.82	80.70	5	10000	8800	9000	7900		10400		McAndrews & Campbell 1993
Lake Six	63	48.40	81.32	3		7000				7600	6500	Liu 1990, 1982
Lake Sixteen	64	45.60	84.32	5	10400	9900						Futyma unpub
Lambs Pond	65	44.57	75.80	5	10500	10300				11000	10600	Anderson 1987
Little Lake	66	43.42	80.27	3			9000		7700			Turner et al 1983
Little Round Lake	67	44.77	76.83	1		11000						Terasmae 1980
Lockport Gulf Section	68	43.17	78.72	7	11000		8600					Miller & Morgan 1982
Loon Lake	69	46.73	81.60	7					2900			Liu 1978
Louise Lake	70	44.28	80.97	3	12300	10200	12100	10600	6600	11700		Anderson 1971
Maplehurst Lake	71	43.22	80.65	3	12000	10700	10500	10000	7300	10800	10500	Mott & Farley-Gill 1978
Marl Lake	72	44.67	79.83	3						4600		Terasmae 1979
Mary Lake	73	44.73	81.00	5		9020		8200	7145		9800	Bennet 1992
Mayflower Lake	74	45.38	79.22	5		8800		6300	2100		7400	Gold 1977
McCarston's Lake	75	45.05	80.08	3					7200			McAndrews unpub
McCormick Point Wetland	76	43.42	80.27	3		10700	11200	10700	7300	10200	9200	Campbell et al 1997
McIntyre Site Marsh 3	77	44.17	78.23	3		10000	10300	9800		9700	10000	McAndrews 1984
McLaughlan Lake	78	45.35	76.55	3	10100	9900			10100	10000	10100	Anderson 1988
Mer Bleue Peat Bog	79	45.40	75.50	3						7700		Mott & Camfield 1969
Minesing Swamp	80	44.45	80.85	3		6200						Fitzgerald 1985
Mont Shefford	81	45.35	72.58	3	11300	10500		13000	11400	11400	11300	Richard 1977, Richard 1978
Nichols Brook Site 2	82	43.53	78.47	7	12300	9500	11700	9500		11300	12000	Fritz et al 1987, Calkin & McAndrews 1980
Nina Lake	83	46.60	81.50	5	9500	9400		9800	9600	9800	9800	Liu 1990, 1982
North Bay Bog	84	46.48	79.47	5	9600	8400	9600	8000		9700		Terasmae 1968
Northfield Bog	85	45.13	74.93	5		9430						Anderson 1987
Nutt Lake	86	45.22	79.45	3			9500	8210		9500	9500	Bennet 1987
Parkhill Creek	87	43.18	81.75	7			10600			10800	10500	McAndrews unpub
Paynter Site	88	44.10	78.33	3		10000				10000	9000	Yu, McAndrews & Siddiqi 1996
Peatsah Site	89	43.32	79.78	7	12100	10700	10700				10700	Roberts 1985, Julig & McAndrews 1993
Perch Lake	90	46.03	77.33	3		9800				10000	9700	Terasmae 1980

Pollen Site Name	#	lat	long	grd	picea=	picea-	pinus+	pinus=	pinus-	betula+	nap-	ref
Pike Lake	91	43.95	80.82	1		9900	10200	9200	8000	9000		Penney 1979
Pink Lake	92	45.47	75.82	5	10300	10200		8000	6100	10600	10200	Mott & Farley-Gill 1981
Pond Mills I	93	42.95	81.20	5		10200	10200	10000	8600	10200	10200	Winn 1977
Pond Mills Pond	94	42.92	81.25	5		8000	8000	7700	7500	8000	8000	McAndrews 1981
Porqui Pond	95	44.17	79.77	3		10300		7000			9000	McAndrews unpub
Pretty Lake core A	96	41.58	85.25	5		11900	10700	10400	9800		10900	Ogden 1969, Williams 1974
Protection Bog	97	42.62	78.47	3	11300	10200	11000	9000	8300	10800	10700	Miller 1973
Pyle Site 1980D	98	40.67	84.88	5	13600	12800	10200	10100	9600	10300		Shane 1987, Shane & Anderson 1993
Ramsay Lake	99	45.60	76.10	5	10300	10100	9700	9700	9300	10900	10300	Mott & Farley-Gill 1981
Rice Lake McIntyre	100	44.20	78.23	3		10000	10000				8200	McAndrews 1984
Rice Lake core B	101	44.12	78.32	3				8900	5900	8600		Yu & McAndrews 1994
Rice Lake core E	102	44.10	78.32	1		8200	8400	7500		8400	8200	Yu & McAndrews 1994
Roblin Lake	103	44.12	77.43	1	10600	9400		9400	7620			Terasmae 1980
Rose Lake US	104	41.92	77.92	3		12500			12500		12500	Cotter & Crowl 1981
Rose Swamp	105	44.18	79.48	1		10200	10300	10000	6500	9300	11000	McAndrews 1985, Julig & McAndrews 1993
Ross Lake	106	44.32	77.45	3		11350			8200		11000	Terasmae 1980
Rostock Mammoth Site	107	43.50	81.00	3	10800	10400	10600	10500				Pilney & Morgan 1987
Ryerse Lake	108	46.13	85.17	5					7700			Futyma unpub
Saint-Calixte	109	45.95	73.87	5			9200	8000	6000		9200	Richard unpub
Second Lake Core 4	110	44.83	79.98	1		11400		9000	5500	10400	10700	Burden & McAndrews 1973
Shouldice Lake	111	45.15	81.42	5		10200				10200	9900	McAndrews unpub
Sunfish Lake	112	43.47	80.63	3		10600	11200	10000	7900	10500	13200	Sreenivasa 1973
Three Pines Bog	113	47.00	80.12	5						5700		Gordon 1990
Tonawa Lake	114	44.85	77.17	5		10100		9300		11100	10300	McAndrews & Campbell 1993
Torren's Bog core TB-4	115	40.35	82.47	5	11500	10900	11100	10700	10200	11000		Ogden & Hay 1967
Townline Lake	116	44.55	81.07	3	12800	11400	12800	9100	7300	12800	11400	Anderson 1971
Twiss Marl Pond	117	43.45	79.95	7	10900	9700	10300	9100		10100	11000	Yu unpublished PhD
Upper Mallot Lake	118	47.32	84.27	5	9500	8600		6200		9200	9300	McAndrews & Campbell 1993
Val St. Gilles	119	49.02	79.08	6	2900			6000		6000		Terasmae & Anderson 1970
Van Nostrand Lake	120	44.00	79.38	1		11000	11200	10000	6300	11000	11500	McAndrews 1973
Vestaburg Bog core 1	121	43.42	84.88	3	11000	10100			7800	10600	10200	Gillaim, Kapp & Bogue 1967

Pollen Site Name	#	lat	long	grd	picea=	picea-	pinus+	pinus=	pinus-	betula+	nap-	ref
Victoria Road Bog	122	44.62	78.95	5						10100	9700	Terasmae 1968
Wales Site	123	44.20	80.95	7								Fitzgerald 1985
Walker Pond I	124	42.93	81.18	3		12200	14100	12200	9900	13500	11200	Terasmae unpub
Walker Pond II	125	42.95	81.23	3		12200	12900	12200	11500	12200	11500	Winn 1977
Weslemkoon Lake Core 1	126	45.03	77.43	7	9300	9200	9300	9000			9400	Edwards & McAndrews 1989
Weslemkoon Lake Core 2	127	45.03	77.43	7						7200		Edwards & McAndrews 1989
Winter Gulf Site Section 1	128	42.55	78.93	7	12500							Calkin & McAndres 1980
Wintergreen Lake	129	42.42	85.38	1	11300	10700	11000	10400	9200		11000	Manny, Wetzel & Bailey 1978
Wylde Lake Bog	130	43.90	80.40	3		10800	10800			10600	10800	Anderson 1971

Appendix B

McLeod Site EPI Tool and Debris

Catalog and Metrics

Debitage Metrics

#	Gd	N	W	E	N-ing	W-ing	E-ing	Unt	Qd	Lvl	dbs	mat	typ	Grd	Mass	L	W	T	Pngl	P-L	P-W	P.lip	DS	DSO	Blb	BO	Ts	CL	CP	DT	LEO
34	a									0		col	2	1	6.08	26.49	24.27	7.92	120	9.32	2.92	32	1	1	2	0	45	0	0	2	90
35	a									0		col	1	1	5.57	24.42	31.03	5.73													
106	a									0		col	43	1	0.39	22.64	9.60	1.41					6	5						2	0
	a	540		455						0		col	3	1	0.07	10.63	7.80	1.03	85	3.60	0.89	32	1	7	2	1		13	2	1	35
	a	540		455						0		col	6	1	0.02	4.47	3.37	0.45													
	a	540		455						0		col	6	1	0.03	5.72	3.69	0.96													
	a	540		455						0		col	6	1	0.15	12.02	7.60	1.78													
	a	540		455						0		col	6	1	0.16	10.07	9.24	2.21													
35	a	540		455	542.25		457.67			0		col	50	1	0.42	18.58	9.59	2.78	85	3.72	0.79	32	3	1	0	0	25	4	1	2	0
108	a	540		455						0		col	50	1	0.06	8.40	7.01	1.60	85	1.31	0.70	32	2	1	1	0	50			2	20
126	a	540		455						0		col	50	1	0.09	10.05	7.65	1.74	85	2.33	1.16	32	2	1	2	0		9	1	1	75
126	a	540		455						0		col	50	1	0.12	8.52	5.35	3.47					2	1	1	0	80	4	2	1	0
	a	545		470						0		col	3	1	0.09	10.40	9.00	1.24	90	3.89	1.15	32	2	1	1	0		0	0	1	0
119	a	545		470						1		col	50	1	0.06	6.80	8.39	1.50					2	1	1	0		7	1	1	45
	a	560		450						0		col	6	1	0.33	13.35	10.50	3.01													
	a	560		450						0		col	6	2	0.15	9.87	8.11	1.57													
113	a	560		450						0		col	50	1	0.23	10.71	10.01	2.36					3	7	2	2		5	1	1	125
113	a	560		450						0		col	50	1	0.06	6.44	8.11	1.08	95	2.60	0.81	32	2	0	1	1		9	1	1	100
120	a	560		450						0		col	50	1	0.06	8.18	5.99	1.41					1	1	2	0	40	6	1	1	1
120	a	560		450						0		col	50	1	0.08	9.65	5.55	1.73	85	1.81	0.75	32	2	1	2	0	20	5	1	1	0
120	a	560		450						0		col	50	2	0.05	7.46	6.05	0.85	85	0.94	0.76	32			1	0		3	1	1	0
	a	560		460						0		col	6	1	0.04	4.22	4.06	0.89													
	a	560		460						0		col	6	1	0.09	9.91	7.75	1.02													
58	a	560		460	562.67		462.92			0		col	43	1	0.17	6.72	11.32	1.99					3	5						2	0
79	a	560		460	563.67		464.33			0		col	6	1	0.06	8.12	6.36	1.24													
	a	580		460						0		col	6	1	0.03	8.82	5.49	1.01													
85	a	580		470	583.08		474.50			0		col	50	1	0.03	4.67	5.93	0.98	90			32	3	1	0	0		3	1	1	0
34	a	585		440	586.67		443.50			0		col	43	1	0.24	12.93	8.15	2.01	65	5.30	1.95	14	4	5	1	0				2	0
	a	585		445						0		col	3	1	0.16	9.82	7.84	1.78	90	5.30	1.65	32	1	1	2	0				2	0
	a	585		445						0		col	6	1	0.03	6.44	3.92	0.75													
112	a	585		445						0		col	6	1	0.09	10.30	8.03	1.13													
112	a	585		445						0		col	50	2	0.04	6.75	5.08	1.50					2	1	1	0	10			2	45

#	Gd	N	W	E	N-ing	W-ing	E-ing	Unt	Qd	Lvl	dbs	mat	typ	Grd	Mass	L	W	T	Pngl	P-L	P-W	P.lip	DS	DSO	Blb	BO	Ts	CL	CP	DT	LEO
121	a	585		455						0		col	6	1	0.04	8.80	4.84	1.22													
121	a	585		455						0		col	42	1	0.17	11.32	8.98	2.10	70	3.18	1.12	4	2	1	2	0		4	1	1	0
121	a	585		455						0		col	50	1	0.10		10.79	1.46	80				2	1	2	0				2	20
121	a	585		455						0		col	50	1	0.18		8.87	1.97	80	3.10	1.19	32	2	1	2	0				2	85
	a	585		460						0		col	3	3	0.13	9.93	6.72	2.93	90	6.72	2.93	32	2	1	1	0	05	0	0	1	-20
	a	585		460						0		col	6	1	0.02	4.53	3.62	0.95													
	a	585		460						0		col	50	1	0.01	4.35	4.00	0.57	80	1.19	0.52	32			1	0		0	0	2	0
128	a	585		485						0		col	50	1	0.05	6.74	7.73	1.30	90	1.72	0.91	32	2	1	2	0				2	50
	a	595		485						0		col	6	2	0.11	9.37	7.65	1.44													
43	a	595		485						0		col	3	1	0.89	18.34	17.22	2.24	90	9.06	1.63	32	5	7	1	0		4	3	2	90
127	a	595		485						0		col	6	1	0.04	7.58	5.72	0.85													
	a	620		460						0		col	6	1	0.13	11.44	8.90	1.21													
	a	620		460						0		col	6	2	0.05	7.77	6.52	1.09													
88	a	620		460	623.50		464.17			0		col	50	1	0.03	5.33	6.87	1.40	95			32	3	3	1	0		7	1	1	55
122	a	620		460						0		col	50	1	0.04	7.32	5.45	0.96	80	1.43	0.72	32	1	1	1	0		6	1	1	
	ab											col	42	1	0.01	8.47	4.85	1.04	55	2.08	1.08	4	0	0	1	1		0	0	1	
	ab									0		col	50	1																	
14	ab									0		col	50	1	0.09	19.23	12.11	2.96	90	3.22	1.39	24	3	3	2	0	45	6	1	1	0
123	b	380		445						0		col	50	1	0.24	10.47	10.81	2.44	80				2	1	2	0		7	1	1	0
124	b	405		450						0		col	50	1	0.03	5.59	7.15	1.09	80	2.01	0.62	32	1	1	2	0		5	1	1	70
26	cd									0		col	2	3	2.76	25.57	24.39	5.21	90	18.12	4.98	32	2	1	1	0	25	0	0	2	0
31	cd									0		col	6	1	0.56	21.44	16.03	1.75					2	7							
45	cd									0		col	40	1	0.84	27.49	11.64	2.10	60	2.36	1.10	34	2	3	2	0		6	1	1	75
48	cd									0		col	50	1	0.66	14.21	15.13	3.77	75				5	3	2	0	25	0	0	2	45
50	cd									0		col	42	1	0.15	8.74	9.42	1.81	50	3.90	0.70	6	3	1	1	0				2	0
51	cd									0		col	50	2	0.18	12.57	7.85	2.06	90	3.52	1.40	32	5	1	2	0	50	8	1	2	0
	cs	449	242					f		0		col	6	2	0.15	10.20	8.90	0.90													
	cs	452	245		453.50	243.80		e		0		col	43	2	1.04	23.00	15.99	3.41					2	2			55	0	0	2	20
	cw	470	227					f		0		col	3	2	0.10	9.00	8.90	1.20	95	2.50	0.80	32	1		1	0		13	2	1	35
	cw	473	227					g		0		bp	40	1	0.43	16.34	15.38	2.29										9	1	1	0
	cw	473	230					e		0		col	50	1	0.32	16.70	9.30	2.20	85	1.80	0.50	4	2	1	3	1		3	2	2	30
	cw	473	230					e		0		col	50	1	0.31	16.80	8.80	2.00	50	4.30	1.20	4	4	1	3	0	60	3	1	2	0

#	Gd	N	W	E	N-ing	W-ing	E-ing	Unt	Qd	Lvl	dbs	mat	typ	Grd	Mass	L	W	T	Pngl	P-L	P-W	P.lip	DS	DSO	Blb	BO	Ts	CL	CP	DT	LEO
	cw	473	230					f2	nw	9		col	3	2	0.07	7.68	8.05	2.14	80	6.81	2.00	4	1		1	0		0	0		0
	cw	473	230					f2	nw	9		col	44	1	0.02	5.92	4.48	0.63	70	1.49	0.47	12	2	1	2	1		3	1	1	15
	cw	473	233					b		2		col	42	1	0.06	10.37	7.34	1.09	85	2.20	0.87	14	4	2	1	0		15	0	2	35
	cw	473	233					e	se	0		col	6	1	0.03																
	cw	473	233					f	nw	3		col	42	1	0.04	6.90	7.40	5.00	35	2.90	0.70	10	3	5	1	0		3	2	1	30
	cw	473	233					f2	nw	9		col	4	1	0.03	3.90	4.50	0.80	50	1.60	0.50	4	2	5	1	0		9	2	1	35
	cw	473	233					f2	nw	9		col	4	2	1.12	7.80	7.80	0.14	85	0.35	0.09	4			1	0		13	2	2	0
	cw	473	233					f2	nw	9		col	6	1	0.05	8.80	6.50	1.20										4	1	2	
	cw	473	233					f2	nw	9		col	6	1	0.08	6.30	7.40	1.30												2	0
	cw	473	233					f2	nw	9		col	6	1	0.08	7.40	7.40	1.20					2								
	cw	473	233					f2	nw	9		col	6	1	0.09	8.70	7.70	1.30					3	2	3	1		9	1	2	
	cw	473	233					f2	nw	9		col	6	1	0.14	14.30	9.40	1.20					1		1	0		8	1	1	
	cw	473	233					f2	nw	9		col	6	2	0.07	7.40	8.30	1.10					2								
	cw	473	233					f2	nw	9		col	40	1	0.11	10.06	7.40	1.10	75	2.90	0.40	6	2	1	2	0		14	1	2	0
	cw	473	233					f2	nw	9		col	40	2	0.10	9.30	8.90	1.00	80	1.50	0.50	2	2	5	2	0		5	1	1	0
	cw	473	233					f2	nw	9		col	42	1	0.09	6.80	6.00	1.60	80	3.50	1.20	34	1	1	2	0		13	2	2	0
	cw	473	233					f2	nw	9		col	44	0	0.03	6.80	5.90	0.06	70	2.40	0.50	10	2	1	1	0		15		2	10
	cw	473	233					f2	nw	9		col	44	1	0.06	8.10	8.00	1.00	75	2.40	0.30	10	2	1	1	0		13	2	2	30
	cw	473	233					f2	nw	9		col	44	1	0.07	7.80	8.90	1.00	50	1.80	0.50	6	2	2	1	0		6	1	2	20
	cw	473	233					f2	nw	9		col	44	1	0.03	3.40	4.70	0.09	65	1.80	0.50	8	2	1	1	0		8	3	2	0
	cw	473	233					f2	nw	9		col	45	1	0.03	4.50	5.50	1.20	65	3.70	0.80	13	1		3	0		8	1	1	0
	cw	473	233					f2	se	9		col	6	1	0.04	3.80	5.50	0.40													
	cw	473	233					f2	se	9		col	6	1	0.07	5.50	8.10	0.80												2	
	cw	473	233					f2	se	9		col	6	1	0.04	5.70	4.50	0.50					2	1				9	1	1	
	cw	473	233					f2	se	9		col	40	1	0.76	20.00	14.60	2.40	50	3.20	1.05	6	3	3	2	0	55	7	2	1	0
	cw	473	233					f2	se	9		col	45	1	0.05	3.50	6.60	1.60	40	6.30	1.40	34	3	3	1	0				2	-45
	cw	473	233		474.20	230.90		f	sw	2	28	col	4	1	0.80	7.35	5.90	1.30					2	1			45	13	3	2	20
	cw	473	233		474.20	230.90		f	sw	2	28	col	50	1	0.25	19.00	9.00	1.90	80	2.60	1.20	6	3	3	2	0		12	3	1	0
086	cw	476	227		476.40	225.00		i		0	1	col	43	1	1.26	25.51	14.05	2.81					7	5				0	0	2	0

Uniface Tool Provenience

Site	#	Grid	North	West	East	Northing	Westing	Easting	Unit	Quad	C1	C2	Level	DBS	T-code	Description
Ah	1	C											0		16	concave side-scraper w/distal chiseled graver, lateral retouch/chatter: Deller pickup
m1	1	B				395.17		457.75			2.60	5.30	0		11	unhafted concave S-S, grip blunting,top-diag struck,S of C1=400N490E C2=400N460E, Roosa '75, in feet
m1	2	B				379.50		455.42			0.20	1.00	0		10	convex sidescraper, platform chatter, south of C1=400N490E C2=400N460E, Roosa '75, in feet
m1	3	A				562.67		459.00			8.80	4.10	0		2	triangular endscraper, mended flake, hafting/notching mods, east of C1=590N450E C2=585N450E, in feet
m1	4	B	385		440	385.42		444.50			7.80	1.30	0		26	backed knife, S of C12=400N490E,C2=400N460E, in feet
m1	6	A				557.42		481.67			4.20	8.70	0		20	hafted perforator,retouch along sides,S of C1=560N485E,C2=560N490E,Roosa '75, in feet
m1	7	A	555		470	556.08		467.83			2.40	3.00	0		7	large convex narrow endscraper w/much convex/concave edge retouch, C1=555N470E, C2=555N465E, in feet
m1	8	A				587.75		464.33			4.50	4.60	0		24	triangular end scraper recycled into graver, E of C1=590N450E,C2=585N450E, Roosa'75, in feet
m1	9	A				553.25		444.50			6.40	2.20	0		0	poss. prox. frag endscraper, almost alt. edge bevelling, SW of C1=560N470E,C2=585N450E, in feet
m1	11	A	560		490	562.67		494.25			4.80	5.00	0		2	triangular endscraper, lateral hafting/mods,E of C1=585N490E,C2=560N490E, Roosa'75, in feet
m1	12	A				590.58		446.17			3.90	6.80	0		0	uniface tool fragment, W of C1=590N450E,C2=585N450E,Roosa'75, in feet
m1	13	AB											0		0	proximal pt. of snapped tool frag, some inverse retouch. S-S? AB prov.
m1	15	A				551.67		459.92			1.90	5.70	0		1	ut edge w/back edge collapsing @ cortex/platform, E of C1=590N450E,C2=585N450E, in feet
m1	17	A				653.50		467.50			4.60	3.60	0		7	retouched flake endscraper, side-struck, N of C1=600N460E,C2=600N470E,Roosa'75, in feet
m1	18	A				527.42		445.33			0.90	4.10	0		32	denticulate on type 40 flake, S of C1=560N470E,C2=560N475E, in feet
Ah	24	C											0		22	concave convergent side scraper w/distal chiseled graver, Deller collection
Ah	27	C											0		22	broken concave convergent side scraper, Deller collection
Ah	28	C											0		21	end of blade end-scraper, significant lateral work: top-corner blank, Deller collection
m1	29	A	560		470	560.67		472.33			2.40	4.90	0		19	narrow endscraper, C1=SW,C2=NW corner, in feet
Ah	30	C											0		24	compass graver, Deller collection
Ah	32	C											0		16	unhafted side-scraper utilized/retouched flake, Deller collection
Ah	39	C											0		32	denticulate, Deller collection
m1	40	A	585		450	587.50		452.00			3.20	3.20	0		1	convex edge utilized flake w/backing/snapping, C1=SW,C2=NW corner, in feet
m1	41	B				365.22		475.30			5.10	8.00	0		32	denticulate, S of C1=4000N480E,C2=400N460E, in feet
m1	46	A	560		485	562.83		489.50			2.20	2.90	2	1.69	13	backed/snapped uniface, snap retouch, poss lateral 1/2 of e-scrap w/spur?C1=NE,C2=SEcorner, in feet
m1	51	A	540		445	544.50		447.42			2.60	1.50	0		13	backed and snapped uniface, retouch on snap, C1=NE,C2=NW corners, in feet
m1	57	A				549.17		435.75			6.30	1.00	0		25	single convex S-S w/bend-break retouch, N of C1=600N460E,C2=600N440E, in feet
m1	75	A	595		485	598.08		485.92			3.21	2.13	3	1.46	32	retouched convex back (ut unk) w/flat denticulate edge,distal snap,C1=SW,C2=NW corner, in feet
Ah	1066	CW	464	233					I				0		24	single spur graver on Bayport, another likely spur broken, not measured
Ah	1069	CW	473	233					I	SE			0	0.00	19	narrow end scraper, no lateral retouch
Ah	1074	CN	521	230		522.00	229.00		H		1.42	2.23	0	7.00	2	triangular end scraper w/partially snapped bit, lateral retouch C1=SW,C2=SE corners of 3m prov. unit
Ah	1077	CW	473	233		474.40	231.60		E		1.92	2.13	0		10	large convex sidescraper w/notch, backed, C1=SW,C2=SE corners of 3m prov.unit
Ah	1086	CW	476	227					I		2.08	1.04	0		1	ut edge on channel flake
Ah	1200	CW	479	230					E				0		0	small tool frag, with small amount of potential usewear/retouch along one lateral edge

Uniface Tool Metrics

Site	#	mat	flk	grd	ht	ctx	mss	L	W	T	pngl	p-l	p-w	p-lip	d-s	dso	blb	b-o	crv	loc	d-t	leo	rt-loc	char	edge	e-L	blt-W	edgeD	e-T	btngl	engl	nch	loc	spr
Ah	1	Col	2	2	0	0	19.87	57.25	29.32	12.93	75	21.55	12.98	1	10	5	2	1	14	1	1	60	17	1	5	52.05	2.51	2.94	6.67	85	85			
m1	1	Col	9	1	0		11.98	58.73	27.94	7.56					6	7							33	1	2	28.73		7.05	6.21		55			
m1	2	Col	3	1	0		5.34	45.93	18.78	5.44					5	2	1	0	14	1	1	0	17	1	1	33.87	20.01	3.66	3.23	60	65			
m1	3	Col	9	1	0		4.81	26.94	21.30	6.81	65	9.24	3.49	4	10	7	1	0			2	30	5	1	1	21.12	20.13	4.28	6.32	90	90	5	4	
m1	4	Col	9	2	0		11.84	47.35	25.13	12.65																32.48		6.23	4.72		70			
m1	6	Col	3	1	0		7.10	52.30	17.38	9.49	100	6.68	5.08	4	10	7	0	0	12	3	2	0	53	1	3	68.43		3.55	4.97		50			
m1	7	Col	3	2	0		27.84	52.73	49.85	12.96					10	7	2	0	13	1			61	2	7	89.63	14.57	8.09	11.02	80	70			
m1	8	Col	3	2	0		4.59	33.16	27.38	5.19					10	7			8	2		45	53	1	1	72.68		0.95	2.47		75			1
m1	9	Col	10	2	0	0	6.88	33.26	29.73	8.48	95	5.06	3.18	32	3	7	2	0	0	0	2	40	51	2	4	34.16		4.28	4.29		60			
m1	11	Col	2	2	0	0	7.20	30.87	29.64	7.15	90	5.87	1.79	32	10	7	3	0	6	1		50	53	1	3	80.40	30.07	3.40	6.43	80	75	2	4	
m1	12	Col	3	2	0		2.89	26.44	22.68	5.01	85	4.56	1.61	32	3	2	2	0	10	1	2	75	41	1	4	16.71		1.77	1.44		80			
m1	13	Col	3	2	0		11.83	40.58	34.27	11.08	80	10.91	4.49	32	3	7	2	0	0	0		85	55	1	4	26.01		4.22	3.82		65			
m1	15	Col	6	2	0		4.82	31.10	26.58	6.52					6	7	2	0	7	1	2	45	53	2	4	34.68		1.99	4.49		70			
m1	17	Col	3	1	0		6.77	58.59	32.65	5.38	90	3.93	1.49	32	3	7	2	0	13	2	1	25	5	1	1	25.72	25.35	6.43	1.31		55			
m1	18	Col	3	2	0		3.70	40.92	28.13	4.19	115	10.49	2.48	32	2	7	2	1	15	1	1		17	1	3	35.56	22.00	7.12	1.57	80	85			
Ah	24	Col	3	1	0		15.71	51.55	33.15	10.85	80	11.38	4.70	32	4	5	3	0	14	1	1	130	53	1	6	48.92	2.65	3.28	6.59	80	100			
Ah	27	Col	3	1	0		8.42	29.36	26.60	9.09	85	9.06	2.44	32	4	1			0	0	2	65	41	1	2	14.91		4.70	3.55		70			
Ah	28	Col	3	1	0	0	12.84	48.47	24.23	12.95	85	9.44	3.74	1	10	7	2	1	13	1		0	1	1	7	89.98	26.72	14.25	6.15	85	85	2	4	
m1	29	Col	3	1	0		5.35	43.59	18.97	6.78	130	8.15	1.97	32	4	2	2	0	15	1			53	1	1	5.53	5.21	2.81	4.89	85	80			
Ah	30	Col	6	2	0		3.96	31.96	23.22	4.94					2	1			0	0		0	1	1	3	58.19	12.11	1.58	3.18		70			7
Ah	32	Col	3	1	0		11.16	29.74	40.29	10.73	80	10.20	2.70	32	3	7	1	1	6	1	2	0	33	1	1	22.41	22.41	1.87	1.39		50			
Ah	39	Col	2	2	0	0	6.85	38.04	25.51	7.84	75	6.41	2.66	32	2	7	2	1	13	2	2	95	21	1	3	32.50	32.78	0.98	1.82		65			6
m1	40	Col	2	2	0	0	15.23	47.73	27.94	11.41	85	9.48	3.28	1	6	7	0	0	0	0	1	65	33	1	1	9.55		1.78	5.91		95			
m1	41	BP	40	1	0	0	3.77	27.78	29.19	5.24	85	4.27	2.16	12	4	2	2	0	0	0	2	65	26	1	4	14.94	14.94	3.40	1.70	80	80			4
m1	46	Col	6	1	1	0	3.69	26.49	14.37	8.54									15	1			5	1	1						80			1
m1	51	Col	6	1	0	0	6.21	30.30	18.83	10.15					1							0	1	2	5	16.04		5.55	40.17		70			
m1	57	Col	2	2	0	0	30.51	47.01	41.17	13.73	120	27.47	9.26	32	3	7	0	0	15	1		0	49	1	1	58.70		16.76	10.34		70			
m1	75	Col	6	1	0		3.04	28.82	15.82	5.73					1	1	2	0	0	0		0	49	1	5	13.96	13.76	2.80	4.72	65	75			
Ah	1066	BP	40	1	0	0	2.41	29.81	20.60	4.05	70	7.05	3.96	6	4	2	2	0	10	1	2	50	5	1	3	12.99	11.92	2.83	2.56		65			1
Ah	1069	Col	50	1	0		1.28	28.40	11.40	3.80	75	6.50	1.60	32	6	2	2	0	15	0		0	53	1	7	18.00		2.60	2.50		75			
Ah	1074	Col	50	1	0		2.34	20.00	19.70	5.20					2	1	1	0	8	1	2	30	5	1	1	16.60	18.85	2.90	2.90	95	85			
Ah	1077	Col	2	2	0	2	25.89	58.20	40.10	9.20					4	7	2	1	9	3	1	50	41	1	3	58.30	23.49	2.60	1.40		70			
Ah	1086	Col	43	2	0		1.26	25.50	14.20	2.80					6	5			0		2	0	33	1	4	15.60		2.50	1.60		45			
Ah	1200	Col	4	0	0		0.61	14.30	11.00	3.70	50	9.90	4.70	32	1	5	1	0	15	0	2	0	17	2	4	5.41		0.49	0.61		60			

Biface Tools

site reg. #:	AhHk-5	Mat:	Col	Fishtail:	
Art. #:	36	F-type:	9	F-L-obv1:	31.47
Grid:	C	Grade:	1	F-W-obv1:	8.16
North:		Heat:	1	F-L-obv2:	16.50
West:		Cortex:		F-W-obv2:	4.16
East:		Mass:	4.67	F-L-rev1:	23.97
Plot-North:		L:	37.38	F-W-rev1:	9.43
Plot-West:		W:	18.88	F-L-rev2:	
Plot-East:		T:	6.62	F-W-rev2:	
Unit:		Basal width:			
Quad:		Basal concavity:			
C1:		Face angle:			
C2:		Band-orient:			
Level:	0	Flutes/face:	1		
DBS:		Barnes finish:	Y		

Description: near complete (ears missing), small fluted point: Barnes

site reg. #:	AhHk-5	Mat:	Col	Fishtail:	
Art. #:	1102	F-type:	9	F-L-obv1:	
Grid:	CN	Grade:	1	F-W-obv1:	
North:		Heat:	0	F-L-obv2:	
West:		Cortex:		F-W-obv2:	
East:		Mass:	2.10	F-L-rev1:	
Plot-North:	531	L:		F-W-rev1:	
Plot-West:	231	W:	18.48	F-L-rev2:	
Plot-East:		T:	5.60	F-W-rev2:	
Unit:		Basal width:			
Quad:		Basal concavity:			
C1:	11.6	Face angle:			
C2:	13.3	Band-orient:	86		
Level:	0	Flutes/face:	1		
DBS:		Barnes finish:			

Description: small fluted point tip (above shoulder): Barnes. C1=SW,C2=SE corners of 3m prov. unit.

Appendix C

McLeod Site EPI Tool and Debris Measurement/Coding

Provenience detail

grid: A, B, C, Cn(orth), Ce(ast), Cs(outh), Cw(est)

North: northing
West: westing
East: easting
Unit: sub square letter
level: 0=plough zone, 1=subsoil layer 1, 2=subsoil layer 2, etc. 9=feature, other = depth below surface

Lithic detail

material: col (Collingwood), bp (Bayport)
grade: 0=no matrix, 5=all matrix
heat: 0=none, 1=colour, 2=potlid dorsal, 4=potlid ventral
cortex: 0=primary origin, 1=secondary
mass: g
length: mm
width: mm
thickness: mm
flake type:
1=primary, 2=secondary, 3=tertiary, 6=flat-flake, 7=shatter, 8= pebble, 9=core, 10=blank

biface	4=generic	uniface	5= generic
	40=normal		50=normal
	41=end		51=ventral
	42=finishing		
	43=channel		
	44=retouch		
	45=errors		

platform angle: nearest 5 degrees
length: mm
width: mm
lip: 1=cortical, 2=ground, 4=faceted, 8=isolated, 16=reduced, 32=flat
D-S: # of dorsal scars
DSO: dorsal scar orientation:
1=unidirectional parallel
2=bidirectional parallel
3=unidirectional converge
4=bidirectional converge
5=transverse
6=flat
7=random
bulb: 1=flat/diffuse, 2=moderate, 3=pronounced
bulb-other: 0=smooth, 1=undulations
transverse section core facet angle: 5 degrees
curvature: 0-15
curvature placement: 0=none, 1=distal, 2=symmetrical, 3=proximal
distal termination: 1=feathered, 2=hinge/step
lateral edge orientation: 0=parallel, - = contracting angle (nearest 5 degrees)
+ = expanding angle (nearest 5 degrees)

banding orientation: nearest 5 degrees, with respect to axis of percussion

RETOUCHED/UTILIZED FLAKE TYPOLOGY

retouched surface:
1=dorsal/normal, 2=ventral/inverse, 4=distal, 8=proximal, 16=left, 32=right
retouch character: 1=continuous, 2=discontinuous
retouched edge: 1=convex, 2=concave, 4=flat
retouched edge length: mm
retouched edge depth (bit depth): mm
retouch edge thickness (bit thickness): mm
retouched edge angle (range): 5 degrees

Biface and Uniface flake identification criteria:

Biface flakes:
40=normal - Normal Biface Thinning flakes: ground, faceted, lipped acute platforms, rarely isolated, lateral edges expanding, curvature slight to pronounced, symmetrical to distal, smooth ventral surface, dorsal surface with parallel to convergent scars with overlap at distal end
41=end - End Biface Thinning flakes: acute, faceted, ground, isolated platforms, parallel lateral edges, large, no curvature, transverse dorsal scars, transverse banding, step termination
42=finishing - Biface Finishing flakes: very small, ground, faceted, acute platforms large inrelation to flake, parallel lateral edges, biconvex cross-section, smooth ventral surface, 1-2 small parallel scars on dorsal
43=channel - Channel flakes: long, thin, lenticular cross section, small transverse dorsal scars, transverse banding, no curvature, platform heavily ground, faceted, isolated
44=retouch - Biface Thinning flakes in Retouch:like biface thinning flakes, but smaller with smaller, roughly parallel sided dorsal scars
45=errors - Biface Reduction flake Errors: large ground, faceted, acute platforms, contracting lateral edges

Uniface flakes:
50=normal - Normal Uniface Retouch flakes: flat, right-angles, round to random, unground platform, large bulb of percussion, pronounced distal curvature, dorsal surface with small hinged scars
51=ventral - Ventral Uniface Retouch flakes: right-angled, faceted, "scalar" platform, pronounced bulb of percussion and ripples, hinge termination, no curvature, dorsal surface with few scars

(from Deller and Ellis 1992a: 79-87)

UNIFACIAL TOOL CODES

0	Tool Fragment (not otherwise identifiable)
1	Discontinuous Retouch/Utilized Flake
2	Triangular End Scraper
3	Asymmetrical/Offset Bit End Scraper
4	Combination Narrow-Wide End Scraper
5	Proximal End and Side Scraper
6	End and Convex Side Scraper
7	Other End Scraper
8	End and Concave Side Scraper
9	Fluted End Scraper
10	Convex Side Scraper
11	Concave Side Scraper
12	Double Edged Side Scraper
13	Bend-Break/Snapped Tool
14	Backed Uniface
15	Piercer/Spur
16	Generic Side Scraper
17	Beak
18	Blocky Scraper
19	Narrow/Beaked End Scraper
20	Hafted Perforator
21	end-of-blade End Scraper
22	Concave Convergent Side Scraper
23	Side Scraper/Chiseled Graver
24	Graver
25	Single Side Scraper with bend-break retouch
26	Backed Uniface Knife
27	Compass Graver
32	Notch/Borer/Denticulate

Appendix D

Intersite Heterogeneity Data

Notes:
Data from late Paleo-Indian sites not used in the analysis are included, collected as part of the project. It is provided because it was compiled here, and can be used for comparative purposes.

Artifact types suffixed by ~ are part of the Shott tool classification typology
Artifact types suffixed by * are part of the EDM tool classification typology

	Adkins		Alder Creek		Banting W		Banting E		Banting AB		Banting-ttl	
Artifact Type	edm	shott	edm	shott	edm	shott	edm	shott	edm	shott	edm	shott
fluted points *	2		2		2						2	
fluted bifaces ~		3		2		2						4
shouldered fluted points *												
large bevelled bifaces *												
backed bifaces *												
miniature tools *												
channel flake ~				9						1		1
drills *									2		2	
leaf-shaped bifaces *												
pieces esquilles *	20				2						2	
preforms *	1		3						1		1	
other bifaces ~/*				3					2	5	2	7
bipolar cores ~						2				1		3
trianguloid end scrapers *					2						2	
large || side end scrapers *												
offset end scrapers *												
narrow end scrapers *	3								2		2	
generic end scrapers ~/*	18	21			2	4	3	3		2	5	9
proximal end & side scrapers *												
concave side scrapers *					1				1		2	
concave convergent ss					1						1	
generic side scrapers ~/*	10	10			10	12			5	6	15	19
uniface knives												
backed & snapped unifaces *												
bend-break tools												
denticulates/ retouched flakes *			3		17		1				18	
utilized/retouched flakes ~		56		5		17		8		15		25
beaks *												
hafted perforators *												
micro-piercers *					9		1				10	
chisel gravers *												
compass gravers												
generic gravers ~						9		1		7		17
notch/borer/ denticulates *												
other unifaces *	56		2				7		19		26	
hammerstone												
total tools	110	90	10	19	46	46	12	12	32	37	90	85

	Barnes		Bolton		Crowfield un		Crowfield ht		Crowfield ttl		Culloden A	
Artifact Type	edm	shott	edm	shott	edm	shott	edm	shott	edm	shott	edm	shott
fluted points *	27		5		1		29		30			
fluted bifaces ~		28		8		1		29		30		
shouldered fluted points *												
large bevelled bifaces *							2		2			
backed bifaces *			1				14		14			
miniature tools *												
channel flake ~		111		31				5		5		
drills *												
leaf-shaped bifaces *	1						3		3			
pieces esquilles *											1	
preforms *	1		2		1				1			
other bifaces ~/*	8	13	1	1	3	4	46	65	49	69	1	
bipolar cores ~												
trianguloid end scrapers *	4										21	
large ∥ side end scrapers *												
offset end scrapers *												
narrow end scrapers *							1		1			
generic end scrapers ~/*	1	8			2	2		1	2	3		21
proximal end & side scrapers *												
concave side scrapers *							6		6			
concave convergent ss												
generic side scrapers ~/*	3	3			2	3	12	18	14	21	1	1
uniface knives					1				1			
backed & snapped unifaces *												
bend-break tools												
denticulates/ retouched flakes *			4		5				5		8	
utilized/retouched flakes ~		5		4		6		10		16		8
beaks *							1		1			
hafted perforators *												
micro-piercers *			3		4		1		5		2	
chisel gravers *												
compass gravers												
generic gravers ~				4		4		1		5		2
notch/borer/ denticulates *			1									
other unifaces *	9				1		10		11		1	
hammerstone												
total tools	54	168	17	48	20	20	125	129	145	149	35	32

	Dixon		Fisher-B		Fisher-C		Fisher-Ce		Fisher-D		Fisher-F	
Artifact Type	edm	shott	edm	shott	edm	shott	edm	shott	edm	shott	edm	shott
fluted points *	2		66		2		26		41		3	
fluted bifaces ~		2		66		2		26		41		3
shouldered fluted points *												
large bevelled bifaces *	1											
backed bifaces *	1											
miniature tools *			1									
channel flake ~		1		408		6		124		396		22
drills *											1	
leaf-shaped bifaces *												
pieces esquilles *			1		1				1			
preforms *			28		18		8		11		2	
other bifaces ~/*		2		28		18	1	9		11		3
bipolar cores ~				3		5		0		3		4
trianguloid end scrapers *	7		3		1				1			
large || side end scrapers *			1				1				1	
offset end scrapers *												
narrow end scrapers *			19		5		1		9		6	
generic end scrapers ~/*		7	8	31	2	8	2	4	4	14	2	9
proximal end & side scrapers *												
concave side scrapers *			5		10		2		5		5	
concave convergent ss												
generic side scrapers ~/*	2	2	44	49	15	25	7	9	9	14	27	32
uniface knives												
backed & snapped unifaces *												
bend-break tools												
denticulates/ retouched flakes *			46		40		13		18		13	
utilized/retouched flakes ~				142		173		21		33		105
beaks *												
hafted perforators *												
micro-piercers *												
chisel gravers *												
compass gravers												
generic gravers ~				31		7		7		11		6
notch/borer/ denticulates *												
other unifaces *			129		140		15		26		98	
hammerstone			1									
total tools	13	14	351	758	234	244	76	200	125	523	158	184

	Fisher-b		Fisher-c		Fisher-ttl-exc		Fisher-all		Halstead		Holcombe	
Artifact Type	edm	shott	edm	shott	edm	shott	edm	shott	edm	shott	edm	shott
fluted points *	8		2		148		157		1		184	
fluted bifaces ~		8		2		148		157		1		184
shouldered fluted points *												
large bevelled bifaces *												
backed bifaces *												
miniature tools *	1				2		2					
channel flake ~		24		10		990		1012		5		
drills *					1		1	1				
leaf-shaped bifaces *												
pieces esquilles *					3		3		3			
preforms *	5		2		74		80				120	
other bifaces ~/*	1	6	1	3	3	78	3	83				120
bipolar cores ~		1				16		17		1		5
trianguloid end scrapers *					5		6		12		8	
large || side end scrapers *					3		4					
offset end scrapers *												
narrow end scrapers *	3		1		44		48					
generic end scrapers ~/*	4	7	1	2	23	75	31	89	2	14	17	25
proximal end & side scrapers *												
concave side scrapers *	1		1		29		31				9	
concave convergent ss												
generic side scrapers ~/*	6	7	3	4	111	140	119	150	8	8		9
uniface knives												
backed & snapped unifaces *												
bend-break tools									2			
denticulates/ retouched flakes *	21		2		153		166		5		1	
utilized/retouched flakes ~		71		14		559		610		13		26
beaks *												
hafted perforators *												
micro-piercers *												
chisel gravers *												
compass gravers												
generic gravers ~		6		4		72		81		17		3
notch/borer/ denticulates *												
other unifaces *	55		16		479		529		23		26	
hammerstone					1		1		1			
total tools	105	130	29	39	1078	2078	1181	2200	56	59	365	372

	Leavitt		McLeod AB		McLeod C		McLeod ttl		Murphy		Parkhill B	
Artifact Type	edm	shott	edm	shott	edm	shott	edm	shott	edm	shott	edm	shott
fluted points *					2		2				57	
fluted bifaces ~		8				2		2				68
shouldered fluted points *												
large bevelled bifaces *												
backed bifaces *												
miniature tools *											4	
channel flake ~				3		2		5		9		133
drills *												
leaf-shaped bifaces *												
pieces esquilles *									2			
preforms *									1		9	
other bifaces ~/*		14		0		0		0		1	9	22
bipolar cores ~				0		0		0				0
trianguloid end scrapers *			2		1		3		2			
large || side end scrapers *											1	
offset end scrapers *												
narrow end scrapers *			1		1		2					
generic end scrapers ~/*		24	2	5	1	3	3	8		2		1
proximal end & side scrapers *												
concave side scrapers *			1				1					
concave convergent ss					2		2					
generic side scrapers ~/*		15	1	10	3	6	4	16		1	2	2
uniface knives			1				1		1			
backed & snapped unifaces *												
bend-break tools			3				3					
denticulates/ retouched flakes *			3		1		4		3			
utilized/retouched flakes ~			2	2	1	1	3	3		6		0
beaks *											1	
hafted perforators *			1				1				1	
micro-piercers *												
chisel gravers *												
compass gravers					1		1					
generic gravers ~				1		2		3				1
notch/borer/ denticulates *												
other unifaces *		12	1		1		2		3		13	
hammerstone												
total tools		73	18	21	14	16	32	37	12	19	97	227

	Parkhill C		Parkhill D		Parkhill ttl excv		Parkhill ttl		Potts A		Potts B	
Artifact Type	edm	shott	edm	shott	edm	shott	edm	shott	edm	shott	edm	shott
fluted points *	20		13		90		107				2	
fluted bifaces ~		26		19		113		132				2
shouldered fluted points *												
large bevelled bifaces *	2		1		3		3					
backed bifaces *			1		1		2					
miniature tools *			2		6		6					
channel flake ~		41		15		189		195		5		29
drills *												
leaf-shaped bifaces *												
pieces esquilles *									9		8	
preforms *	3		4		16		19					
other bifaces ~/*	4	9	6	14	19	45	21	26	2	2		
bipolar cores ~		0		0		0		0				
trianguloid end scrapers *	2		18		20		26		9		14	
large || side end scrapers *	1		6		8		9					
offset end scrapers *												
narrow end scrapers *	2		2		4		7		1		1	
generic end scrapers ~/*	2	7	6	32	8	40	12	54		10		15
proximal end & side scrapers *												
concave side scrapers *												
concave convergent ss												
generic side scrapers ~/*	3	3	6	6	11	11	18	18	2	2	9	9
uniface knives												
backed & snapped unifaces *												
bend-break tools												
denticulates/ retouched flakes *			2		2		3					
utilized/retouched flakes ~		0		5		5		9		29		46
beaks *	1		2		4		4					
hafted perforators *					1		2					
micro-piercers *												
chisel gravers *												
compass gravers												
generic gravers ~		4		6		11		15				
notch/borer/ denticulates *			3		3		6					
other unifaces *	7		11		31		37		29		46	
hammerstone												
total tools	47	90	83	97	227	414	282	449	52	48	80	101

	Potts all		T-II-Ane		T-II-Ae		T-II-Aw		T-II-Ac		T-II-Ase	
Artifact Type	edm	shott	edm	shott	edm	shott	edm	shott	edm	shott	edm	shott
fluted points *	2		9				3					
fluted bifaces ~		2		19		2		8		1		0
shouldered fluted points *												
large bevelled bifaces *			1				1		2			
backed bifaces *							1					
miniature tools *			1									
channel flake ~		34		17		0		13		9		
drills *												
leaf-shaped bifaces *												
pieces esquilles *	17		1		1							
preforms *			10		1		2					
other bifaces ~/*	2	2	4	6	1		5	3	2	4		
bipolar cores ~				0		0		0		0		0
trianguloid end scrapers *	23		3				1		2		2	
large || side end scrapers *												
offset end scrapers *					1				1			
narrow end scrapers *	2		1		1		2					
generic end scrapers ~/*		25	2	6	1	3	4	7	3	9	1	6
proximal end & side scrapers *			1						4		3	
concave side scrapers *												
concave convergent ss												
generic side scrapers ~/*	11	11		1	4	4	3	3	8	5	2	2
uniface knives												
backed & snapped unifaces *					2		1		1			
bend-break tools			1		1							
denticulates/ retouched flakes *					1		1		4		1	
utilized/retouched flakes ~		75		3		5		1		7		1
beaks *												
hafted perforators *												
micro-piercers *			1		4				13			
chisel gravers *												
compass gravers												
generic gravers ~				1		4				13		
notch/borer/ denticulates *			2		1				2			
other unifaces *	75		1		2				3			
hammerstone												
total tools	132	149	38	53	21	18	24	35	45	48	9	9

	T-II-B		T-II-unk		T-II-ttl		Sandy Ridge		Stelco 1		Vail A	
Artifact Type	edm	shott	edm	shott	edm	shott	edm	shott	edm	shott	edm	shott
fluted points *					12				1		6	
fluted bifaces ~		1				32		2		1		6
shouldered fluted points *												
large bevelled bifaces *			1		5							
backed bifaces *					1							
miniature tools *					1							
channel flake ~				2		41						6
drills *											1	
leaf-shaped bifaces *												
pieces esquilles *					1		2				22	
preforms *	2				15							
other bifaces ~/*		1		1	12	15	4	2				1
bipolar cores ~		0		0		0				1		
trianguloid end scrapers *	1		1		10		13				36	
large || side end scrapers *							1					
offset end scrapers *	1		3		6							
narrow end scrapers *	1				5							
generic end scrapers ~/*		3	4	10	18	48	12	26	3	3		36
proximal end & side scrapers *					8							
concave side scrapers *											8	
concave convergent ss												
generic side scrapers ~/*			1	1	15	15	4	4	2	2		8
uniface knives												
backed & snapped unifaces *			2		6							
bend-break tools			1		3							
denticulates/ retouched flakes *			2		3		1		7			
utilized/retouched flakes ~		1		5	6	21		2		13		40
beaks *												
hafted perforators *												
micro-piercers *					18							
chisel gravers *												
compass gravers												
generic gravers ~						18		7				
notch/borer/ denticulates *	1		1		7							
other unifaces *			1		7		8		6		40	
hammerstone												
total tools	6	6	17	19	159	190	45	43	19	20	113	97

	Vail B		Vail C		Vail D		Vail E		Vail F		Vail G	
Artifact Type	edm	shott	edm	shott	edm	shott	edm	shott	edm	shott	edm	shott
fluted points *	6		7		8		18		3		1	
fluted bifaces ~		6		7		8		18		3		1
shouldered fluted points *												
large bevelled bifaces *												
backed bifaces *												
miniature tools *												
channel flake ~		5		11		10		42				
drills *			18		3		8					
leaf-shaped bifaces *												
pieces esquilles *	14		16		51		143		2		22	
preforms *												
other bifaces ~/*				18		3		8				
bipolar cores ~												
trianguloid end scrapers *	42		37		42		107		17		6	
large || side end scrapers *												
offset end scrapers *												
narrow end scrapers *			11		2		29		1			
generic end scrapers ~/*		42		48		44		136		18		6
proximal end & side scrapers *												
concave side scrapers *												
concave convergent ss												
generic side scrapers ~/*	8	8	8	8	7	7	23	23			6	6
uniface knives												
backed & snapped unifaces *												
bend-break tools												
denticulates/ retouched flakes *												
utilized/retouched flakes ~		20		57		54		128		14		22
beaks *												
hafted perforators *												
micro-piercers *												
chisel gravers *												
compass gravers												
generic gravers ~												
notch/borer/ denticulates *												
other unifaces *	20		57		54		128		14		22	
hammerstone												
total tools	90	81	154	149	167	126	456	355	37	35	57	35

	Vail H		Vail all	
Artifact Type	edm	shott	edm	shott
fluted points *	4		55	
fluted bifaces ~		4		55
shouldered fluted points *				
large bevelled bifaces *				
backed bifaces *				
miniature tools *				
channel flake ~		2		76
drills *	1		31	
leaf-shaped bifaces *				
pieces esquilles *	23		295	
preforms *				
other bifaces ~/*		1		31
bipolar cores ~				
trianguloid end scrapers *	13		301	
large || side end scrapers *				
offset end scrapers *				
narrow end scrapers *	1		44	
generic end scrapers ~/*		14		345
proximal end & side scrapers *				
concave side scrapers *				
concave convergent ss				
generic side scrapers ~/*	3	3	65	65
uniface knives				
backed & snapped unifaces *				
bend-break tools				
denticulates/ retouched flakes *				
utilized/retouched flakes ~		15		353
beaks *				
hafted perforators *				
micro-piercers *				
chisel gravers *				
compass gravers				
generic gravers ~				
notch/borer/ denticulates *				
other unifaces *	15		353	
hammerstone				
total tools	60	39	1144	925